Step on to PAEDIATRICS

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Medical knowledge is constantly changing. Standard safety precautions must be followed, but as new research and clinical experience broaden our knowledge, changes in treatment and drug therapy may become necessary or appropriate. Readers are advised to check the most current product information provided by the manufacturer of each drug to be administered to verify the recommended dose, the method and duration of administration, and contraindications. It is the responsibility of the practitioners, relying on experience and practical knowledge from dealing the patients, to determine dosages and the best treatment for each individual patient. None of the authors assumes any liability for any injury and or damage to persons or property arising from this publication.

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TOMORROW IS TOO LATE

We are guilty of many errors and many faults.
But our worst crime is abandoning the children,
Neglecting the fountain of life,
Many of the things we need can wait,
The child cannot.
Right now is the time his bones are being formed,
His blood is being made and his sense are being developed
To him we cannot answer 'tomorrow' .
His name is 'today'.

Gabriela Mistral
Nobel Laureate (Chile, 1889 - 1957)

Dedicated to our

- Parents
- Teachers
- Families
- Children

Foreword

I am very happy to see the book "Step on to Paediatrics" published in March 2010. I congratulate both the authors and the contributors for accomplishing such a comprehensive work.

It was my long felt desire and perhaps of the undergraduate medical students, to get such a book on paediatrics, so as to strengthen themselves with core information on common child health problems of the country. And this is important, as after graduation these students will be the first-hand health care providers for the vast majority of sick children of the country.

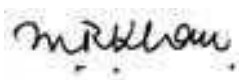
The beauty of this book is the comprehensive problem based discussions on common child health problems. Moreover, the essential elements in diagnosis and treatment are also highlighted considering the socioeconomic status of the people.

Each and every chapter of the book is enriched with a good number of photographs and sketches. Problems that are discussed in this book are so close to real life situation that readers will never feel bored and will not be overburdened with theoretical details. Important information are presented in boxes and tables. The book is also written in a clear and lucid language.

This book will be very helpful to enrich the medical students as well as the graduates and to minimize the existing gap in their knowledge in Paediatrics. Although the book is written mainly for the medical undergraduates, the post graduates students and senior nurses will also be benefitted.

I hope, this book will act as medical student's armour during their formative and summative assessment.

May this book be a handy companion to all those who love and work for children.



National Professor M R Khan
Dhaka, March 2010

PREFACE TO FORTH EDITION

It is indeed a great privilege for us to introduce to you the 4th edition of 'Step on to Paediatrics' which is a substantial revision and reorganization, based on recent updates in medical advancement, latest text books and the suggestions kindly provided by our beloved students and teachers of Paediatrics. In this edition, we have tried to incorporate a **brief pathogenesis of all the diseases to have a better understanding of pathology, to rationalize the investigations as well as treatment.** In addition, new topics such as, child with polyuria, haematuria, burn injury, foreign body aspiration, SDG goals etc. are included. The different aspects of the diseases are made easier to understand with the aid of a bunch of new X-Rays, sketches and patient photographs. The key points of the diseases are highlighted in boxes and tables as always.

We would like to appreciate all the contributors, who worked very hard to accomplish this herculean task. We are indebted to our beloved students, colleagues, teachers and faculties of Paediatrics of all Medical Colleges & Institutions of Bangladesh for their overall supports and thoughtful feedbacks on how to improve the quality of this book. We, would like to mention the names of Prof Md Ruhol Amin, Ex-Prof of Paediatrics, Dhaka Shishu hospital, Prof M Karim Khan, Prof of Paediatrics, CBMCB, Mymensingh, Prof Ranjit R Roy, Prof of Paediatric Nephrology, BSMMU for their continuous inquiry & suggestions. We must appreciate the contribution of the respected contributors, colleagues of department of Paediatrics, BIRDEM for their constant supports. It will be unfare, if we do not acknowledge Prof Ashraful Hoque, Prof Abdul Hanif Tablu, Pediatric surgeons of DHMC, Prof Kamal Ahmed, Dr Masud, Assistant Prof of Ped Surgery, BIRDEM for supplying with different academic pictures.

Our sincere appreciation will always remain to Sheikh Mahtab Ahmad, who despite his many limitations, made the edition as furnished as possible.

We hope that the 4th edition of Step on to Paediatrics will create interest of our beloved students on Paediatrics and this will facilitate their learning on child health & wellbeing as well as their sickness.

Md Abid Hossain Mollah
Nazmun Nahar
Dhaka, April 2018

Preface to revised third edition

It is indeed a great pleasure for us to present the revised version of the third edition. In this revision, we have tried to provide recent data pertaining to childhood morbidity & mortality, recent EPI schdule of Bangladesh and updates on case management from the latest edition of text books and journals. Moreover, we also changed some clinical photographs given previously with the better ones and added few new pictures and sketches.

We cannot thank enough our respected teachers, colleagues and beloved students for their continued belief in our endeavour. In the revision process, we would like offer our special thanks to Dr Abu Sayeed Chowdhury, Dr Nazmun Nahar Shampa, Registrars of Paediatrics, Dhaka Medical College Hospital who through their very keen ovservation compiled all the necessary updates for this revision. We would also like to acknowledge the support from Dr Amit Shome and Dr Sumon Shahriar Morshed, Assistant Registrars of Paediatrics, Dhaka Medical College Hospital.

Finally, we would like to thank our family members for their relentless moral support, positive understanding and unprecedented patience which paved the smooth completion of this revision.

Md Abid Hossain Mollah
Nazmun Nahar
Dhaka, January 2016

Preface to the third edition

The publication of the 3rd edition of Step on to Paediatrics is the assembly of evidence based updates of common childhood problems of Bangladesh. This edition represents a substantial revision,reorganization and expansion of already existing and few new chapters. The changes are made in accordance with the criticism, suggestions and wishes expressed by our teachers, students and several other readers. We tried to prepare this edition more reader friendly, easily understandable with lucid and easy language. Most of the texts are enhanced with a large number of photographs and X-Rays, taken mostly from our patients. A fair number of sketches, illustrations and algorithm are arranged in such a way that students clearly understand the pathophysiological basis of the disease and can explain the clinical features & consequences, rationalize investigations, interpret laboratory reports and optimize principles of management. The cardinal points are highlighted in coloured boxes & tables so the readers will have a scope of quick review before examination. At the end of each chapter, there are substantial number of self-assessment questions for the readers.

We would like to appreciate all the contributors who have been an outstanding and insightful partner to the editors and accomplished this complex production smoothly and efficiently.

We are indebted to our beloved students, teachers, colleagues and faculties of Paediatrics of all Medical Colleges of Bangladesh as well as colleagues of BSMMU, BICH, BIRDEM, ICMH, ICH for their overall supports and providing thoughtful feedbacks on how to improve the quality of the book! However, we must remember Dr Sadeka Chowdhury Moni, Assistant Professor of Neonatology, BSMMU and Dr Abu Sayeed Chowdhury, Registrar of Paediatrics, DMCH who went through all the trouble to check the details of the manuscript several times.

Our sincere appreciation will always remain to Sheikh Mahtab Ahmad, who despite his many limitations, made the publication as furnished as possible.

We are privileged to have compiled this 3rd edition and are enthusiastic about all that it offers to our readers. We hope that they will find this edition a uniquely valuable educational resource and any suggestions or comments are always welcome.

Finally, we would like to acknowledge the patience and moral supports given by our family members.

Md Abid Hossain Mollah
Nazmun Nahar
Dhaka, April 2015

Preface to the second edition

We are really amazed to see the overwhelming acceptance of Steps on to Paediatrics by both the undergraduate and post graduate medical students, residents, paediatricians and teachers, and this is the real inspiration to edit the book. We do express our gratitude to them for their support.

The new edition attempts to provide the essential information that the students, doctors always think imperative to address the common childhood illnesses. In addition to a substantial expansion and reorganization of the chapters, the 2nd edition also has additions of new problems like birth injuries, vomiting including blood vomiting, common surgical problems of children, croup, myopathy, Turner syndrome and basics of fluid, electrolytes and acid base homeostasis. All the discussions are enriched with many tables, algorithms, photographs and sketches so that the readers can have better understanding of the clinico-pathological basis of the problem, can rationalize and interpret investigations and can optimize the treatment. The cardinal features of the diseases are highlighted in coloured boxes and at the end of each chapter, there are questions for self-assessment of the students.

We do humbly acknowledge the support and encouragement by the faculty of Paediatrics of all medical colleges of Bangladesh, BSMMU, BICH, BIRDEM and ICMH. We do particularly express our thanks to Prof. Tahmina Begum, Prof. M Karim Khan, Dr. Narayan Saha, Dr. Bikash Majumder, Dr. Chandan Kumar Saha, Dr. A K M Amirul Morshed Khasru, Dr. Md Saiful Islam, Dr. Zohirul Alam Chowdhury, Dr. Kazi Selim Anwar, Dr. Mesbah Uddin Ahmed, Dr. Md Golam Sadik Mamun, Dr. A S M Hasibul Hasan, Dr. Sanjoy Kumar Das, Dr. Abu Sadat M Saleh, Dr. Janifa Akter for their valuable contributions.

To accomplish this edition, we also have had informal assistance from the faculty members, students and doctors of the department of Paediatrics, Dhaka Medical College & Hospital. Our sincere appreciation always remains for them.

We, gratefully acknowledge the publications and books from where information has been taken. At the end of each chapter, reference list has been cited. However, if any have been left out through oversight, we offer our sincere apologies.

The untiring efforts of the friends of Ahsania e solutions is especially appreciated to make the publication as perfect as possible.

Last and certainly not the least, we especially wish to thank our families for their patience and moral support without which this edition would not have been possible.

We hope that the 2nd edition will stimulate the students and serve their purpose.

Md Abid Hossain Mollah
Nazmun Nahar
Dhaka, August ‘2012

Preface to the first edition

Truly, not much careful attention was exercised on child health/paediatrics while planning the curriculum of our current undergraduate medical science. More undesirably, paediatrics is being pondered by the medical curriculum board merely as a branch of medicine since long, in strict sense. Contrarily, it demands huge importance & due attention, since more than one-third (37%) of our total population comprises of children and their health care associated responsibilities would often be conveyed to shoulder of our fresh medical graduates, passing out every year successfully.

In fact, the very question posed by several undergraduate students frequently– "Which book on Paediatrics should we go through?", remains the true inspiration for writing up this book on Paediatrics, just to contribute a modest effort to strengthen students' knowledge on child health so that they can contribute to child care successfully. In this book, we have tried to highlight the most common child health problems, if not all, matching with the undergraduate paediatric curriculum so that students can face formative and summative assessments, successfully.

Discussions are made essentially on symptoms rather than a formal review of disease entities as symptoms provide a major clue to the underlying disease particularly in Paediatrics. Starting with the cardinal manifestations, common differential diagnosis are listed out specifically followed by their aetio-pathogenesis, clinico-epidemiological features, establishing the diagnosis and detailed treatment plan. In order to ensure better understanding of individual clinical problem a good number of patient's photographs & essential sketches have also been incorporated. Moreover, at the end of each chapter, a number of short answer questions (SAQ) and multiple choice questions (MCQ) are given pertaining to that chapter for self evaluation of the students. These will certainly build up their knowledge and understanding and help them to avoid dependency on note books.

Alike others, several formal and informal assistance were sought in editing various chapters of this book from many faculties and house staffs of the department of Paediatrics at the Dhaka and Mymensingh Medical Colleges and we do express our gratefulness for their contribution.

The untiring efforts of Sheikh Mahtab Ahmed and Atikur Rahman is specially appreciated for secretarial assistance and desk top publishing.

Finally, special thanks go to our family members for their long-standing patience, positive understanding and active moral support in completing this book successfully without which this effort would have been futile.

We would, however, look forward optimistically to see if it serves the need of our undergraduate students and thus be beneficial to our budding doctors significantly.

Md Abid Hossain Mollah
Nazmun Nahar
Dhaka, March 2010

Contents

Chapter 01

The Child

Children are the future asset and hope of a nation. They are the foundation of a stable nation.

Who is a child?

The United Nations Convention on the Rights of the Child defines – "A child means every human being below the age of eighteen years unless under the law applicable to the child, majority is attained earlier."

According to Child Act 2010 Government of Bangladesh – "any person under age 18 is to be regarded as a child".

Characteristics of a child

A child is not a mini adult. His/her body physiology, homeostasis, immune response, illness /disease pattern, his/her basic or nutritional needs etc. are different from that of an adult. He/she grows up everyday towards maturity passing through different stages of life.

Stages of a child's life

- **Intrauterine period**
  - Embryo: Fertilization to 8 weeks
  - Foetus: 9 weeks to birth
- **Perinatal period**
  - 28th weeks of gestation to the 7th day after birth
- Neonates: Birth to 4 weeks of age
- Infancy: Birth to 1 year of age
  - Early infancy: Birth to 6 months
  - Late infancy: 6 to 12 months
- Toddler: 1 to 3 years of age
- Childhood: 3 to10 years of age
- Adolescence: 10 to19 years of age

Stages of a child's life

WHAT IS PAEDIATRICS?

Paediatrics (also spelled pediatrics or pædiatrics) is the branch of medical science that deals with the medical care of infants, children, and adolescents. The word "paediatrics" means "healer of children"; and is derived from two Greek words: (pais = child) and (iatros = doctor or healer). The sole discipline is concerned with all aspects of well being of infants, children, and adolescents, including their health, their physical, mental and psychological growth & development. A paediatrician is a child's physician who provides not only medical care for children who are acutely or chronically ill but also provides preventive health services for healthy children.

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the stages in a child's life?
2. Who is a child?
3. What is infancy?
4. Who are adolescents?
5. What is Paediatrics?
6. What are the roles of a Paediatrician?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Toddlers are children whose age is in between–

___ a) 1 month to 1 year ___ b) birth to 6 month ___ c) 1 to 3 years

___ d) 3 to 10 years ___ e) birth to 2 years

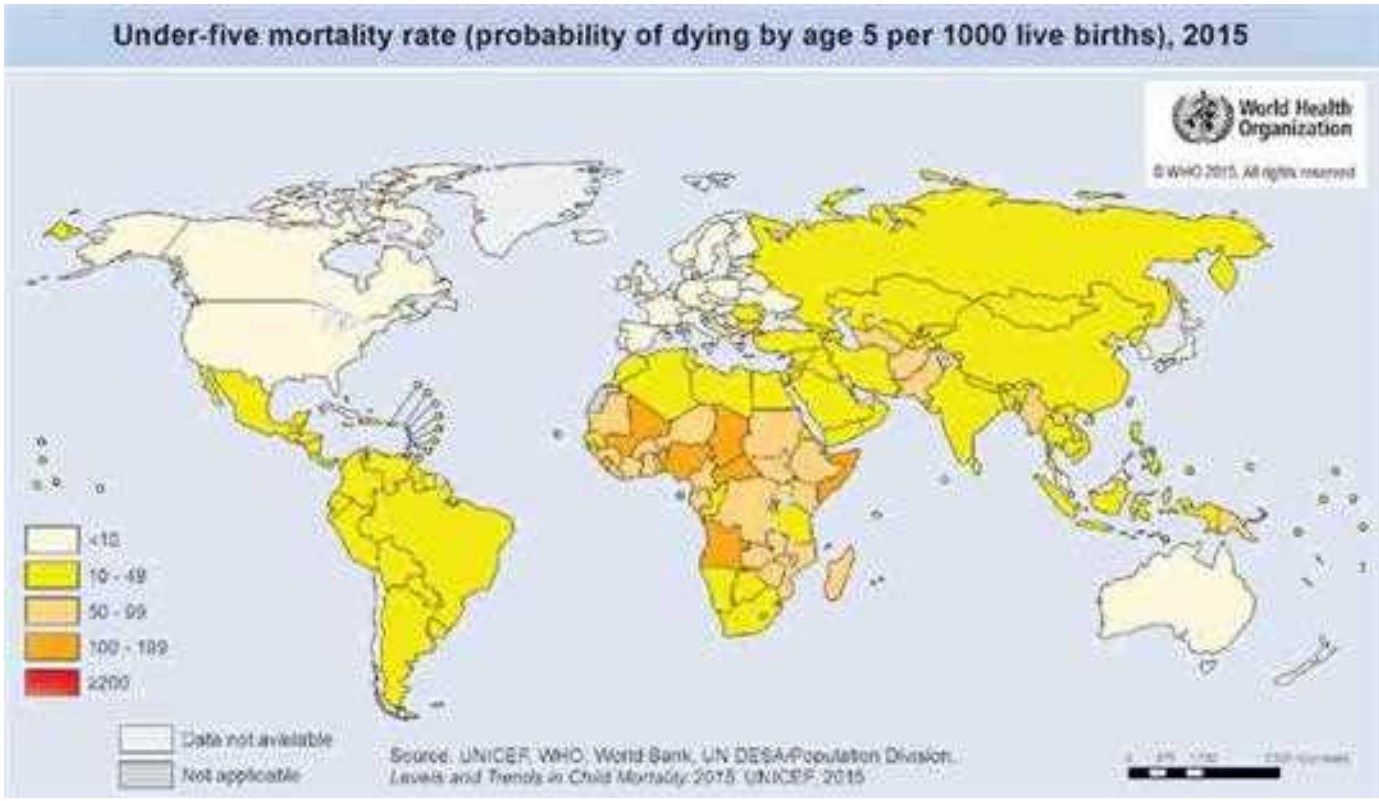
Chapter 02

Child Health Scenario

GLOBAL SCENARIO

Every year about 6.3 million children below 5 years die throughout the world. The major causes of these deaths remain acute respiratory infections (mostly pneumonia), diarrhoea, malaria, malnutrition and high perinatal deaths. Most of these deaths occur in countries of South-East Asia, Africa and Latin America.

WHERE MOST UNDER 5 DEATHS OCCUR



Source:

BANGLADESH SCENARIO

In Bangladesh, the major illnesses contributing to under 5 mortality are–

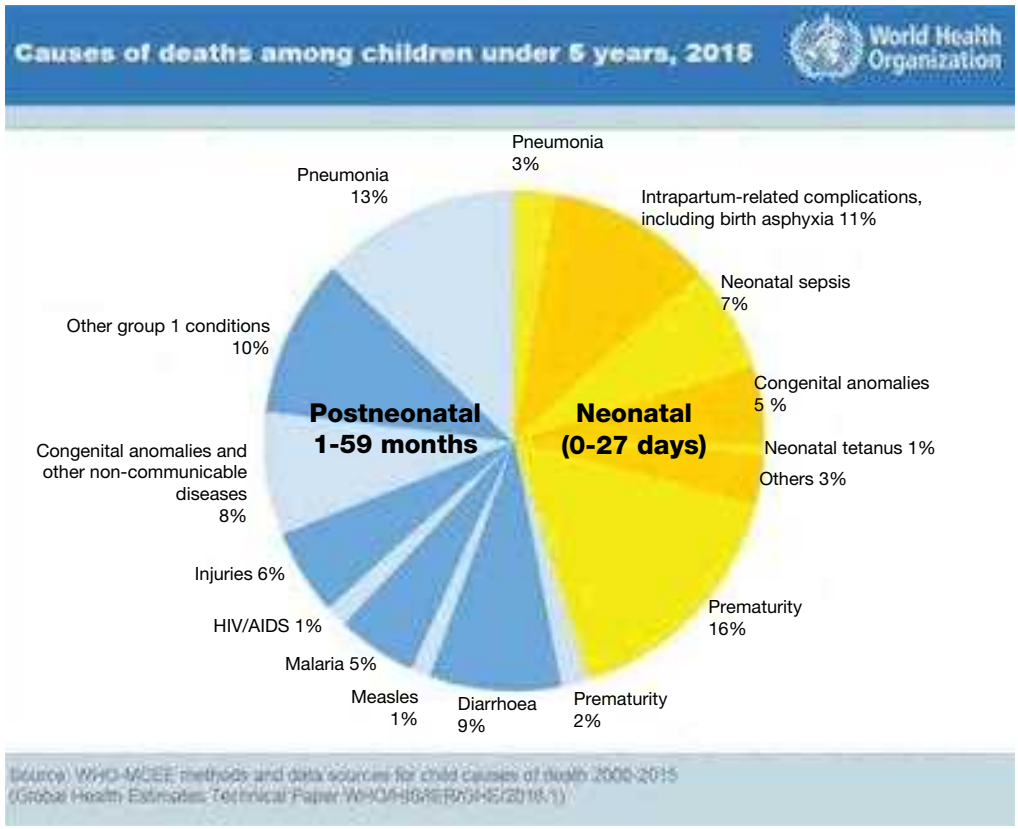
- Neonatal illnesses e.g.
  - perinatal asphyxia
  - low birth weight and its complications
  - sepsis
  - congenital malformations etc.
- Diarrhoea
- Pneumonia
- Malnutrition
- Accidents & Emergencies e.g. drowning

Only **Neonatal deaths** account for about two-thirds of all infant deaths.

The major causes of under 5 child deaths in Bangladesh

The current under 5, infant and neonatal mortality rates in our country being 46, 38, 28 per thousand live births respectively which remain still very high in comparison to developed world (BDHS '2014, p35) and the major challenge in the health sector is unacceptably high neonatal deaths.

To curb these unfortunate child deaths, The UN General Assembly set **Millennium Development Goal 4 (MDG 4)** in 2000.



MDG 4: Reduce child mortality

Goal

Reduce mortality rate by ¾ among under five children between the years of 1990 to 2015.

Indicators

- Under-five mortality rate
- Infant mortality rate
- Proportion of 1 year-old children immunized against measles

Target versus Achievements

Bangladesh perspectives

Indicators	Base year (1990)	Status (2011)	Current status (2015)
Under-five mortality rate (Deaths/1000 live birth)	151	53	46 *
Infant mortality rate (Deaths/1000 live birth)	94	43	38 *
Proportion of 1 year-old children immunized against Measles (%)	54	84	87 **

** BDHS '2014, p35*

***EPI Coverage evaluation Survey September '2015*

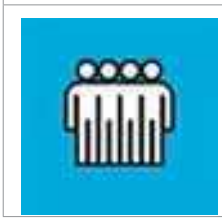
To prevent these deaths and to reach MDG 4 in time, Government has set many vertical child health programmes. These were–

- Integrated Management of Childhood Illness (IMCI)
- Expanded Programme on Immunization (EPI)
- Measles Rubella (MR) vaccination campaign
- Helping Babies Breathe (HBB)
- Emergency Triage Assessment & Treatment (ETAT) for neonates
- Infant and Young Child Feeding (IYCF)
- Vitamin A plus campaign & anthelmintic administration
- National Immunization Day (NID)

MDG

The Millennium Development Goals (MDGs) are eight international development goals that all 193 United Nations member states and at least 23 international organizations have agreed to achieve by the year 2015.

The MDGs are–

	◆ Goal 1: Eradicate extreme poverty and hunger
	◆ Goal 2: Achieve universal primary education
	◆ Goal 3: Promote gender equality and empower women
	◆ Goal 4: Reduce child mortality
	◆ Goal 5: Improve maternal health
	◆ Goal 6: Combat HIV/AIDS, malaria and other diseases
	◆ Goal 7: Ensure environmental sustainability
	◆ Goal 8: Develop a global partnership for development

Bangladesh has already achieved MDG 4 by 2015. Government of Bangladesh now adopted and supporting the UN declared Sustainable Development Goals (SDGs).

SDG, THE GLOBAL GOALS FOR SUSTAINABLE DEVELOPMENT

These are universal call to action to end poverty, to protect the planet and to ensure that all people enjoy peace & prosperity. The SDG comprises a set of 17 "Global Goals" with 169 proposed **Targets** and 304 **Indicators**. These goals replaced the MDGs. The programme is spearheaded by the UN and the 193 Member States of UN, as well as global civil society has adopted SDG on the 25th September 2015. Each goal has specific targets to be achieved over the next 15 years (by 2030).

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7. SDGs goal.

SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the current U-5, infant & NMR in Bangladesh?
2. What percentage of U-5 mortality is contributed by neonatal death?
3. What are the health related Millennium Development Goals?
4. What is MDG 4 ? What are the expected goal and Indicators of MDG 4?
5. What is the major challenge in Bangladesh to achieve MDG 4 by 2015?
6. How many goals are in sustainable development goals?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. The major illnesses contributing to high under 5 mortality in Bangladesh are–

___ a) pneumonia ___ b) diarrhoea ___ c) malnutrition
___ d) thalassaemia __ e) neonatal illness

2. The indicators of MDG 4 are–

___ a) neonatal mortality rate ___ b) infant mortality rate ___ c) maternal mortality rate
___ d) under 5 mortality rate ___ e) EPI coverage

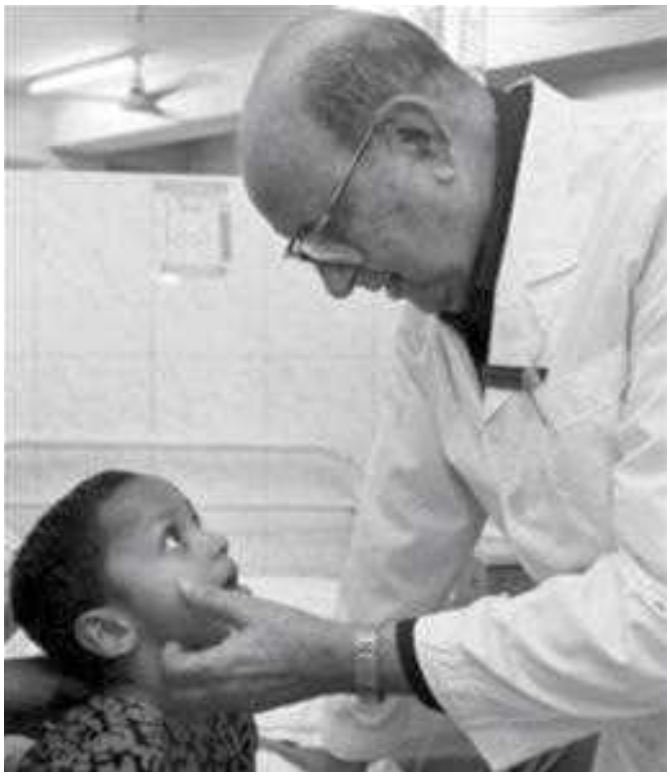
Chapter 03

Examination of A Child: Crucial to Remember

Examining a child is an art, not similar to that of an adult. It may not follow the usual sequence that we usually practice while examining an adult. However, examining a child requires much passion, attention and gentle handling.

EXAMINING A CHILD

- The consulting room must have a range of toys for all ages, and the child should be allowed to play & explore the room



National Professor Dr M R Khan is examining a child while interacting

- Build rapport with the child and the mother to make them feel confident on your full attention and active support
- Examine the child at his/her comfort. Young children should be examined sitting on their parents lap, as any attempt to get the child to lie down may result in crying
- Offer the child to play with something while examining. Sometimes a small toy clipped on to stethoscope may be distracting enough to examine the child adequately
- Talk to the child while examining. It creates a sense of bonding with each other
- Examination is better to be done by regions rather than by systems. It is better to auscultate heart and lungs before the child is disturbed and starts crying
- Those parts of examination, which are unpleasant or may be painful, should be left until last
- While talking to the mother, watch the child attentively
  - Does the child look unwell/sick?
  - Is he/she interested in the surroundings and exploring them or apathetic?
  - Are there any obvious physical abnormalities?
  - Is breathing difficult or noisy?
  - Is the child look well nourished or wasted?
  - Watch the child running around to look for any obvious abnormality in the gait
  - Anthropometry must be done in every child

Child examination area may be decorated with popular pictures or cartoons

Chapter 04

Growth and Development

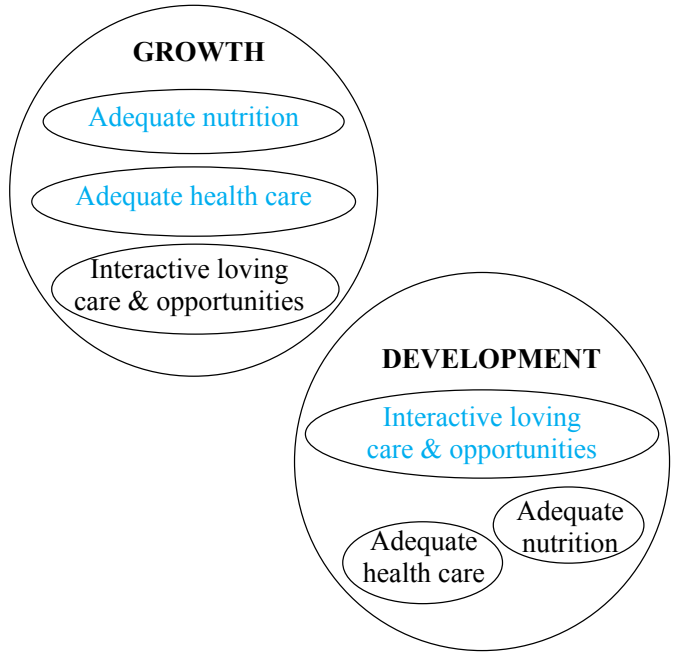
Growth and development are the universal concern of all parents and the doctors are frequently asked about this issu.

Growth refers to physical maturation and signifies an increase in size of the body parts and various organs. It occurs as a result of tissue hyperplasia, hypertrophy and differentiation.

Development refers to acquisition & maturation of skills, behaviour and values on the part of the growing child. It mostly depends on the maturation of nervous system. Through development, a child builds up a store of knowledge about his or her environment, learns motor skills, communications, behaviour etc.

A complete child is one who has both optimum physical growth and age appropriate mental development.

KEY NEEDS OF A CHILD



Courtesy: Dr M Q Hassan, ECD Project, 2005

Factors influence growth & development

- Genetic influence e.g. Tall parents have taller children or vice versa
- Nutrition e.g. optimum nutrition will ensure optimum growth
- Low birth weight e.g. LBW babies may grow at a slower rate
- Influence of hormones e.g. thyroxin, growth hormone, insulin
- Chronic illnesses e.g. TB, heart diseases, kidney diseases and other systemic illnesses
- Chromosomal abnormalities e.g. Down syndrome, Turner syndrome etc.
- Emotional deprivation e.g. children brought up in broken families may not grow and develop normally
- Others e.g. social, cultural and environmental factors

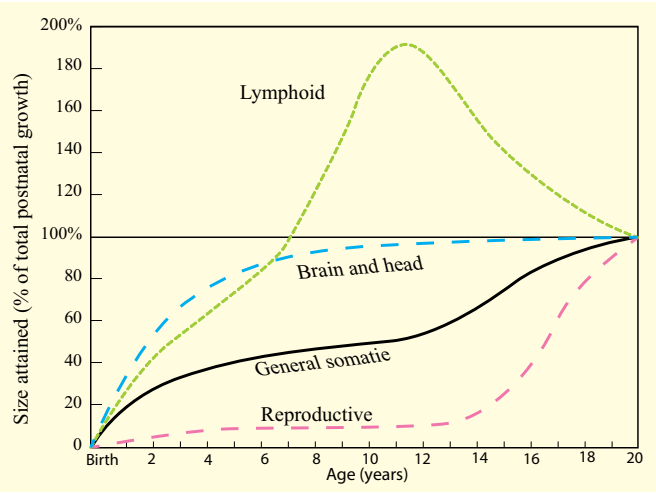
Growth velocity

It is the rate of growth of any organ/system over a period of time. It is maximum during first year of life and gradually decreases as the age advances.

The age of maximum growth attainment of the major systems e.g. somatic, neuronal, lymphoid, reproductive of the body are also different. Maximum attainment of–

Brain growth by	3 years
Lymphoid growth by	7-8 years
Reproductive (Gonad) growth by	14 years
Somatic growth by	18 years

Postnatal growth curves for general somatie, brain, lymphoid and reproduction systems (Tanner, 1962)



Normal growth velocity during childhood

Age	Growth velocity
1st year	25 cm/year
2nd year	12 cm/year
3-4 years	7 cm/year
5-6 years	6 cm/year
7 year till pubertal onset	5 cm/year

Ref: Agarwal et al. 2007, AAFP '2008

Growth spurt

It is the rapid and intense increase in the rate of growth e.g. height & weight that occars during adolescent stage of human life cycle. Growth spurt occurs around 2 years later in boys than that of girls.

ASSESSMENT OF GROWTH

It includes assessment of

- Physical growth i.e.anthropometry
- Reproductive growth i.e. assessment of testis volume and others secondary sex characters

ANTHROPOMETRY

The measurement of–

- Length/Height
- Weight
- Mid upper arm circumference (MUAC)
- Occipito-frontal circumference (OFC)
- Body Mass Index (BMI)
- Skin fold thickness

MEASURING LENGTH/HEIGHT

A. Recumbent or Supine length

For children who are–

- Less than 2 years of age
- Unable to stand or finds difficulties in standing

Procedure

Instrument: Infantometer, a firm measuring board with 125 cm/50 inches marking with one head and one foot board.

Courtesy: Dr Maliha Alam

Infantometer

- Two persons are required to measure the supine length
- Place the measuring board on a firm surface
- Lay the child on his back, on the board. One person should ensure that the head is held in contact with the headboard

Courtesy: Dr Maliha Alam

Measuring length of a child using Infantometer

- Other person should hold the ankles to ensure the child to be positioned completely aligned & flat against the board. Firm pressure may also need to be applied to keep the child's legs in position
- Record the length to the last complete millimeter

NB. The supine length is about 1 cm greater than standing height in children <5 years.

B. Standing height

Instrument: Stadiometer or a 6 feet measuring scale attached to a vertical surface or wall.

Procedure

- Child's body must be positioned with its–
  - Feet together
  - Feet flat on the ground
  - Heels touching the back plate of the stadiometer
  - Legs must be straight
  - Buttocks against the backboard
  - Scapula, wherever possible, against the backboard
  - Arms loosely at their sides
- The child's head must be positioned according to **Frankfort plane**
- Ensure the child is in the correct position
- The headboard placed carefully on the child's head
- Then place the child's head in such a way that the lower margins of the orbits will remain in the same plane with the tragi **(Frankfort plane)**. The Frankfort plane will remain parallel to ground surface
- Reading is taken from the scale at eye level to the last complete millimeter

Courtesy: Dr Rumi Myedull Hossain

Measuring height using stadiometer

Frankfort plane

NB. Child's height doubles the value of its birth length i.e.100 cm by 4th year and 3 times (150 cm) by 14th year.

Measurement of Body Weight

Instruments: Weighing scale

- Beam balance
- Bathroom scale (spring/digital)
- Hanging scale

Procedure

- The child should be weighed nude
- He/she should not touch any object during weighing
- The child should be off shoes or sandals

Beam balance

Bathroom scale

Courtesy: Dr Maliha Alam

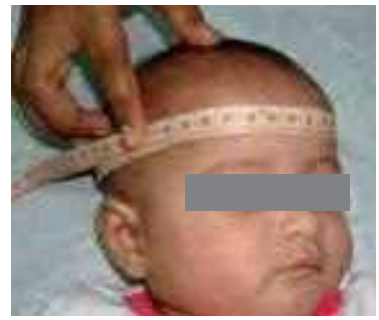
Hanging scale

NB. Child's weight doubles the value of its birth by 6th months and 3 times by 1st year and 4 times by 2nd year.

Measurement of Occipito-Frontal Circumference (OFC)

Instrument: Non-stretchable measuring tape

It is generally measured in infants and children less than 3 years of age by a flexible, non-stretchable measuring tape.



Measuring OFC by tape

Procedure

The tape is applied firmly just above the glabellas and superior orbital ridges anteriorly, then passed around head at same level on each side and posteriorly at the level of external occipital protuberance.

Average OFC of a child

At Birth (cm)	At 3 months (cm)	At 6 months (cm)	At 1 year (cm)	At 2 years (cm)
35	41	44	47	49

MEASUREMENT OF MID UPPER ARM CIRCUMFERENCE (MUAC)

Instrument: Shakir's tape

It is measured in children between ages 6 months to 5 years for mass screening of nutritional status.

Source: Internet

Procedure

It is measured at a point approximately midway between the acromion process and ulnar olecranon. The tape should touch the skin without compressing the tissue. It is traditionally recorded on left side while the arm hanging normally.

Source: Internet

Measuring MUAC by Shakir's tape

Measurement of tissue mass

- **Measurement of body mass index, BMI** (Calculation: Weight (kg) /Height (m2)
- **Measurement of triceps & sub-scapular skin fold thickness by Harpenden Calipers**

Source: Internet

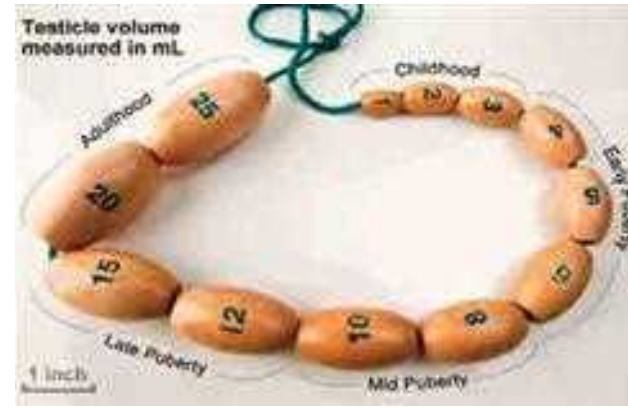
Harpenden Calipers

Source: Internet

Measuring skinfold thickness by Harpenden Calipers

ASSESSMENT OF REPRODUCTIVE GROWTH

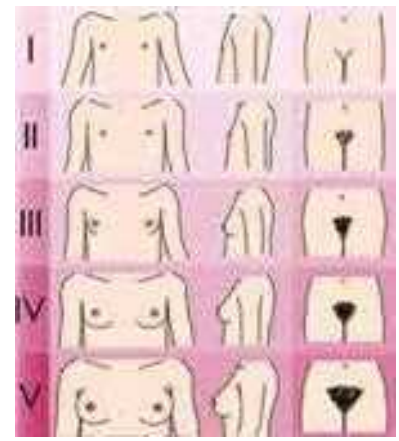
i) Assess of testicular volume by **orchidometer**.



Orchidometer showing variable size of balls with numbers corresponding to normal testicular volume at different ages

ii) Assessment of growth & development of different sex organs e.g, penis, breast, pubic and axillary hair, etc. at bedside, using the following **Tanner staging chart**.

Age specific growth & development of different sex organs of any child can be evaluated using this chart.



Female

Male

DEVELOPMENT

It is already mentioned that development depends on the **maturation of brain** which means increase in–

- Number of neurons as well as
- Number of synapses

At birth the number of neurons are 100 billions and the number of synapses are 50 trillions. Thereafter, through repetitive stimuli of different kinds and interactions from environment, the number of synapses increases and by 3 years, this number reaches its maximum to 1000 trillions.

However, the number of neurons do not change and remain almost similar to that, at the time of birth.

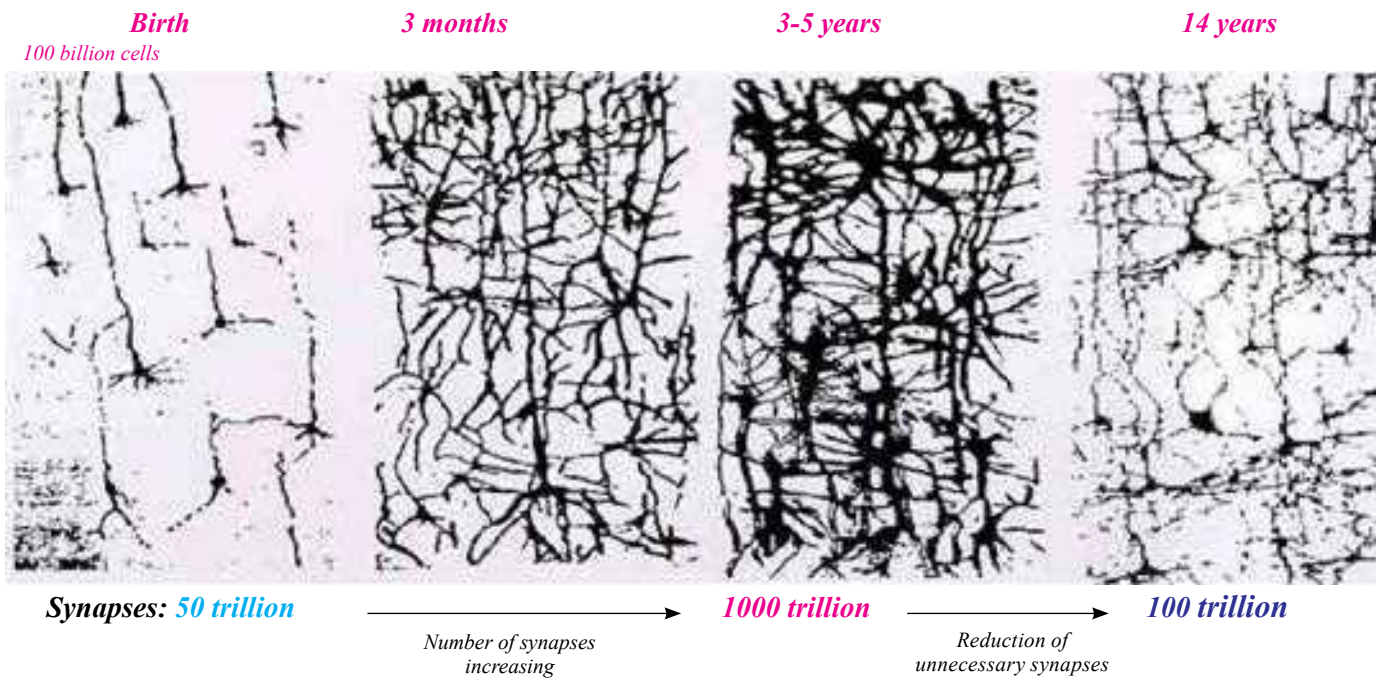
With time, the developing brain gets rid of unnecessary connections and at adulthood 100 trillions synapses persist and those are considered essential.

Therefore, appropriate care as well as proper stimuli during the first 3 years of life is very crucial as this will help to preserve the appropriate care & stimuli specific synapses and ultimately, the better neuro-developmental outcome of children and vice versa.

EARLY CHILDHOOD DEVELOPMENT (ECD)

The period from conception to 5 years of age is called early childhood. This period is the key determinant for subsequent growth, development and ultimate productivity. The development that a child acquires during this period is known as Early Childhood Development.

The **quality of care** given during this period, determines the persistence of relevant synapses and eventually what the child will become in future.



Principles of Development

- It is a continuous process
- It is cephalocaudal in direction
- Sequence of development is same but the rate is different
- Mass activities are replaced by specific responses
- Primitive reflexes are lost before the appearance of corresponding voluntary movement

Ways of developmental assessment

- Comparing the skills/performance (representing different domains of development) of any child with a **standard Age-specific Chart** of Milestones of Development at bedside.
- Using different scales *e.g.*
  - Baily Scale
  - Denver Scale
  - Weschsler Intelligence Scale for Children
  - Rapid Neurodevelopmental assessment (RNDA)

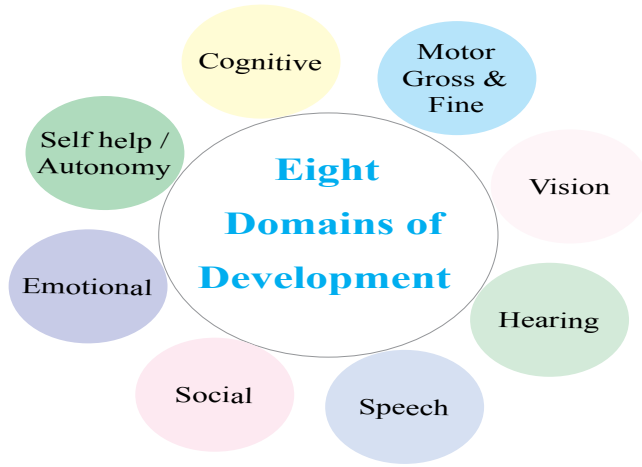
Milestones of development

These are the abilities that a child will achieve within a predictable age range. The age specific milestones of development of a normal child is given in the next pages to compare the developmental achievement of any child.

Domains of Development

While assessing development, one has to pay attention to the aquisition of skills specific to the following **8 domains.** But for practical purposes, these domains are grossly sub-divided into 4 functional areas. These are–

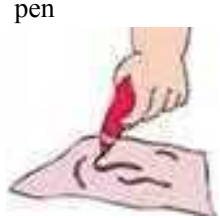
- Gross motor
- Fine motor & Vision
- Speech, language & hearing
- Social, emotional, behaviour, self help/autonomy



AGE SPECIFIC NORMAL MILESTONES OF DEVELOPMENT

Age group	Gross motor	Fine motor & Vision	Speech, language & hearing	Social, emotional, behaviour, self help/ autonomy
6 weeks	◆ When pulled from supine to sitting there is partial head lag ◆ Primitive reflexes persist 	◆ Follows moving object or face by turning the head 	◆ Scared to loud noises 	◆ Child smiles in response to mother's smile 
3 months	◆ Neck control is achieved ◆ Primitive reflexes are gone 	◆ Reaches out for toys 	◆ Vocalizes alone or when spoken to coos and laughs 	◆ Recognize mother ◆ Becomes excited by toys 
6 - 8 months	◆ Sits without support ◆ At 6 months with round back ◆ At 8 months with straight back 	◆ Transfer objects from one hand to other ◆ Palmar grasp is attained 	◆ Turns to soft sounds out of sight 	◆ Tries to feed him or herself ◆ 

AGE SPECIFIC NORMAL MILESTONES OF DEVELOPMENT

Age group	Gross motor	Fine motor & Vision	Speech, language & hearing	Social, emotional, behavior, self help/ autonomy
9 - 10 months	◆ Crawls ◆ Stands holding furniture 	◆ Pincer grip 	◆ Says bi syllable words e.g. Baba, Dada, Mama. ◆ Says one word with meaning 	◆ Plays peek a boo ◆ Waves bye bye 
12 months	◆ Walking unsteadily ◆ broad ◆ gaits ◆ hands ◆ apart 	◆ Throws objects ◆ Turns pages of a book	◆ Says 2-3 words with meaning other than 'dada'/'mama' ◆ Responds to own name by turning when called from behind 	◆ Drinks from cup 
15 - 18 months	◆ Walks alone ◆ steadily 	◆ Scribbles with pen 	◆ Says 12-15 words 	◆ Asks for things by pointing 
18 - 20 months	◆ Walks backwards	◆ Builds a tower of 3 cubes 	◆ Points to 3 body parts on request ◆ Begins to join 2 words together 	◆ Holds spoon and gets food to mouth 

Adapted from Module on Early Childhood Development for Undergraduate Medical Students, Teachers Guide
Courtesy: ***Late Professor SM Shahnawaz Bin Tabib***

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. Define growth and development.
2. Name important factors influencing growth and development.
3. What parameters are measured to assess growth?
4. What is Frankfort line? Name the instrument used to measure length & height.
5. What are the domains of development? How do we assess development?
6. Write down the milestones of development of a 12 months old child.
7. Define ECD. Write down the name of scales used to assess development.
8. Write in short the basics of development.
9. Write short note: Growth chart.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Normal developmental milestone of a child include–

   __ a) smiles at 6 weeks __b) holds head at 3-4 months __c) sits unsupported at 5 months

   __ d) crawls at 7 months __e) speaks 2-3 words at 12 months

2. Motor development of a 1 year old child include–

   __ a) running __ b) stands independently __ c) walks backward

   __ d) walking unsteadily, broad gait __ e) transfer of objects from one hand to other

3. The following are the five motor actions –

   __ a) pincer grip __ b) scribbles with pen __ c) walks backward

   __ d) turns page of a book __ e) sitting with support

4. Assessment of development includes assessment of –

   __ a) OFC __ b) motor function __ c) speech __ d) vision __ e) BMI

Chapter 05

Infant and Young Child Feeding (IYCF)

Appropriate feeding programme is essential to provide optimum nutrition and to ensure optimum growth and development of infant and young children as well as their survival. The feeding programme which include both breast feeding and complementary feeding are collectively known as **Infant and Young Child Feeding (IYCF).**

Components

IYCF has 3 components.

- Promotion of early initiation of breast feeding (within first hour of birth)
- Ensuring exclusive breast feeding for first 6 months (180 days) of life
- Proper complementary feeding from 6 months of age (completion of 180 days) with continuation of breast feeding up to 2 years of age

BREAST FEEDING

Breast feeding (BF) promotion is a key child survival strategy as breast milk contains all the energy and nutrients that a baby needs for optimum growth & development and protection against infections.

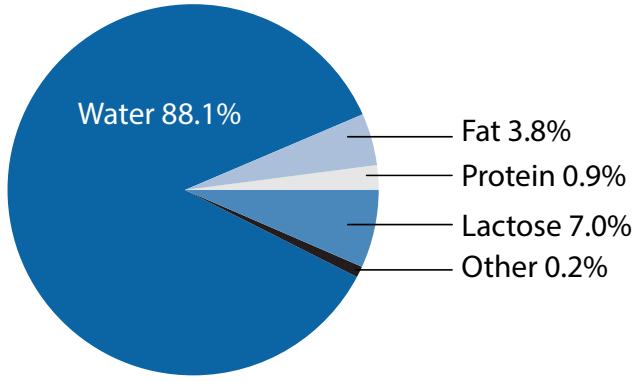
It is estimated that about 1 million newborn deaths could be averted globally, if breast feeding would have been initiated within first hour of birth. There is also published evidence that under five mortality rate could be reduced by 13% through exclusive breast-feeding up to 6 months. Further 6% deaths could be prevented by timely starting of proper complementary feeding with continuation of breast feeding up to 2 years of age.

Ample evidences exist which unequivocally proves that exclusively breast-fed babies have less diarrhoea, less respiratory and other infections than formula-fed babies.

Breast Milk

Milk produced by the mammary glands of a healthy human female to feed a baby. It is the primary source of nutrition for newborns and infants for first 6 months of life. Breast milk is of two types e.g. foremilk (high in water and lactose) and hindmilk (high in fat and calories). It contains water, fat, carbohydrates, protein, vitamins and minerals, amino acids, enzymes

Mother's Milk Composition

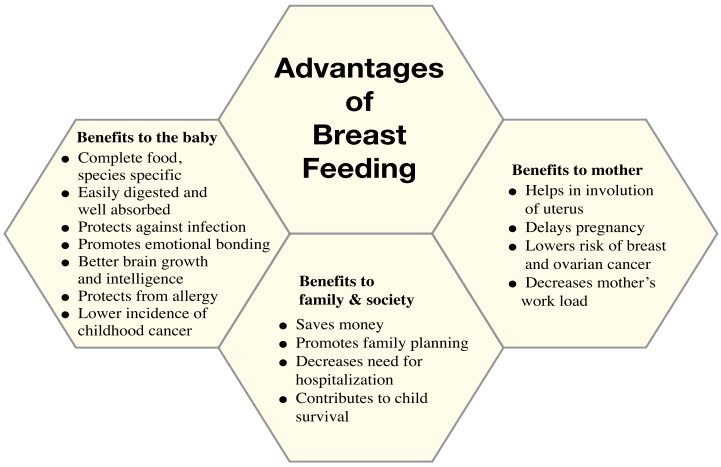


Colostrum

It is a sticky white or yellow fluid secreted by the breast during second half of pregnancy and for a few days after birth before breast milk comes in.

Colostrum: Anti-infective Components

- Immunoglobulins e.g. Secretory IgA, IgG, IgM
- Cellular elements e.g. White blood cells
- Lysozyme, Lactoferrin and transferrin
- Complement system e.g, opsonic & chemotactic activities of C3 and C4
- Oligosaccharides (prevent bacteria from attaching to mucosal surfaces)
- Bifidus factor (help special bacteria to grow in the intestine and prevent growth of other harmful bacteria)



Exclusive Breast Feeding (EBF)

It means–

- An infant receives only breast milk from his or her mother or a wet nurse or expressed breast milk
- No other liquids or solids are given not even a drop of water
- The exceptions are ORS, drops or syrups containing vitamins, minerals supplements or medicines

Positioning and Attachment

For successful breast feeding, proper positioning and good attachment of the baby with the mother & her breast are most important. The criteriae for these are given in the table–

Proper positioning	Good attachment
	

Proper positioning	Good attachment
• The body is fully supported • Body close to the mother • Straight head and body • Facing breast, nose opposite to the nipple	❑ The baby's chin is touching the breast ❑ The baby's mouth is open widely ❑ The baby's lower lip is turned outwards ❑ More areola is seen above than below

Signs of Effective Suckling

- The baby takes slow, deep suckles followed by a visible or audible swallow
- Sometimes the baby pauses for a few seconds, allowing the ducts to fill up with milk again
- The baby's cheeks remain rounded during the feed
- When satisfied, baby usually releases the breast spontaneously

Signs of Ineffective Sucking

- A baby may suck quickly all the time, without swallowing
- The cheeks may be 'drawn in' indicating that milk is not flowing well

Prelacteal Feeding and the Hazards

Prelacteal Feeding

It is the feeding of liquids or foods other than breast milk given prior to the establishment of breast feeding. In our society, honey, plain water, mustard oil, sugar water, etc. are commonly given to the newborn as prelacteal food.

Hazards of Prelacteal Feeding

- Deprives the child of colostrum
- Increases the risk of illnesses such as diarrhoea, other infections and allergies
- Satisfies a baby's hunger, making him or her less interested in breast feeding. As a result there is less stimulation of breast milk production and this ultimately leads to lactation failure
- If feeding bottle is used, it may interfere with baby's learning to suck at the breast

How to ensure successful Breast Feeding?

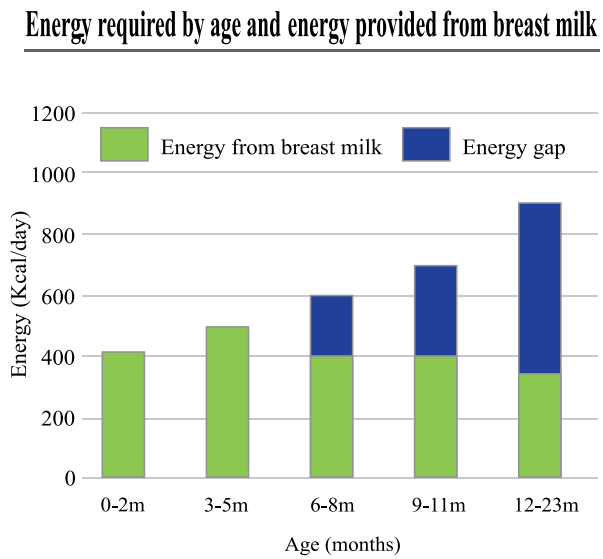
- Build confidence of the mother about her ability to breast-feed
- Ensure privacy of mother
- Explain mother about the benefits of breast feeding and hazards of artificial feeding
- Allow extra-nutritious food and special care to the mother
- Demonstrate good position and attachment to the mother during breast feeding
- Motivate other family members to support breast feeding

BMS e.g. infant formula and other commercially available baby foods should not be allowed to give to children.

COMPLEMENTARY FEEDING (CF)

It means giving the baby other foods in addition to breast milk. These other foods are called complementary foods, as they ideally complement breast milk. Appropriate CF means provision of right foods at right time in right amount, prepared and delivered hygienically to ensure optimum growth of the baby. It should be started after completion of 6 months (180 days) of age.

Through this process, a baby gradually accustomed to eat family foods.



Importance of Complementary Feeding

As babies grow and become more active, an age is reached when breast milk alone is inadequate to meet the child's nutritional needs.

To meet that **extra need** or to fill the **energy gap**, and to ensure optimum growth & development between the total energy and nutritional needs of the child and the energy & nutrients provided by the breast milk, complementary foods are added in the daily feeding schedule.

Ideal complementary food chart *Courtesy: ICMH, UPHCP, Bangladesh*

Properties of Complementary Foods

- Good complementary foods should be a combination of–
  - **Energy rich** e.g. • Rice • Ruti • Oil • Noodles • Potato
  - **Body building** e.g. • Fish • Meat • Egg • Pulses
  - **Protective** e.g. • Vegetables • Fruits and Micronutrients
- It should not be spicy or salty, easy to eat and liked by the child
- It should be easy to prepare from locally available and affordable foods

Principles of Complementary Feeding

- Start single food at a time e.g. • Mashed ripe banana with gradually increasing quantity • Fresh fruit juice
- Start 2nd weaning food e.g. • Khichuri made from Rice • Pulses and Vegetables after about a week introduce fish, meat, egg (begin with yolk) one after another
- Complete the whole weaning process by 9 months to 1 year
- Gradually, accustom to family foods

Do not force the child to eat.

Do not continue to feed a meal for more than 20-30 minutes.

COMPLIMENTARY FEEDING SCHEDULE

6-8 COMPLETED MONTHS

½ of 250 ml bowl/cup- 2 times/day
(total 200 kcal/day)
1-2 snacks may be offered

9-11 COMPLETED MONTHS

½ of 250 ml bowl/cup- 3 times/day
(total 300 kcal/day)
1-2 snacks may be offered

12-24 COMPLETED MONTHS

250 ml bowl/cup – 3 times/day
(total 550 kcal/day)
1-2 snacks may be offered

Sources: i) Modules on IYCF, Ministry of Health, GOB, 2012, ii) Clinical guidelines on IYCF, GOB 2014, iii) WHO.

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What do you mean by exclusive breast feeding & complementary feeding?
2. What are the anti-infective properties of breast milk?
3. Write down the properties of good complementary feeding?
4 What should be the frequency of complementary feeding at 6 months & 12 months of age?
5. Write down the importance of complementary feeding.
6. What are the hazards of prelacteal feeding?
7. What is colostrum? What are the advantages of colostrum?
8. Mention 4 points suggesting good positioning and attachment.
9. Write short note: Weaning.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Signs of good attachment during breast feeding are–
   ___ a) mouth wide open ___ b) lower lip turned inward ___ c) more areola below than above the mouth
   ___ d) facing breast, nose opposite to nipple ___ e) chin touching breast.
2. The energy yielding foods are–
   ___ a) meat ___ b) fish ___ c) fruits ___ d) oil ___ e) sugar
3. The body building foods are–
   ___ a) rice ___ b) meat ___ c) fruits ___ d) egg ___ e) potatoes
4. Amount of complementary foods for children between 6-12 months include–
   ___ a) full 250 ml cup once daily ___ b) half 250 ml cup twice daily ___ c) full 250 ml cup twice daily
   ___ d) full 250 ml cup thrice daily ___ e) half 250 ml cup once & 1-2 snacks daily

Chapter 06

Integrated Management of Childhood Illness [IMCI]

Most of the global child deaths occur in the world's poorest countries of sub-Saharan Africa and South Asia and the major causes are pneumonia, diarrhoea, neonatal illnesses, malnutrition and accidents particularly drowning. In addition malaria and HIV infections contribute in many areas of the world.

To combat this challenge, WHO and UNICEF developed Integrated Management of Childhood Illness (IMCI) in mid 1990s.

What is IMCI

It is an evidence based syndromic approach that identifies and categorizes the major illnesses responsible for under 5 deaths and what actions to be taken. The approach is designed to **classify the severity of the illnesses** rather than making a diagnosis. In addition to curative care, the strategy also addresses aspects of nutrition, immunization and other elements of disease prevention and health promotion.

Rationale

Evidences revealed that most sick children present with signs and symptoms of more than one diseases and this overlap of signs & symptoms signifies the possibility of more than a single illness. Hence an integrated approach is needed that can go beyond a single disease and can address the overall health of the sick child.

Components

IMCI has 3 components–

- Improvement in case management skills of healthcare providers
- Improvement in overall health system required for effective management of childhood illnesses
- Improvement in family and community health care practices

Case Management

Management of sick children through IMCI strategy is executed–

- At Outdoors of health centers & Referral hospitals **(Facility based IMCI)**
- In the Community **(Community based IMCI)**

FACILITY BASED IMCI

(Case Management at Outdoor)

Here the following things are done–

- **Assessment** of the sick children (0 day upto 2 months & 2 months upto 5 years) using a limited number of selected clinical signs
- **Classification** of the illnesses based on severity of clinical signs & symptoms
- **Identification of treatment** according to classification e.g. whether to treat at the outdoor or to refer to a higher centre with a pre referral treatment

I. Assessment of the sick child

Zero day upto 2 months

Features of very severe disease

- Not feeding well/unable to feed*
- Convulsion*
- Grunting
- Fast breathing (≥ 60/min)
- Severe chest indrawing*
- Fever (99.5° F or feels hot) or low body temperature (<95° F or feels cold)*
- Movement only, when stimulated or no movement at all*

Local bacterial infection

- Umbilical infection (Periumbilical redness or draining pus)
- Skin pustules

Jaundice

- Age of appearance (e.g. within 24 hours) and extent of jaundice (e.g. yellow palms and soles)

Diarrhoea

- General condition e.g. movement, restless/irritable, sunken eyes, skin pinch

- **Feeding problem or Low weight (< –3SD)**

Position & attachment, frequency of breast feeding, feeding during sickness, other foods & fluid or have oral ulcers or thrush

- **Immunization status**

Other problems

2 months upto 5 years

General danger signs

- Had convulsion during the present illness or convulsion now
- Lethargic or unconscious
- Not able to drink or breastfeed
- Vomits everything

Four main symptoms

- **Cough or difficult breathing** e.g. respiratory rate, chest indrawing, stridor, wheeze
- **Diarrhoea** e.g. duration, presence of blood, signs of dehydration e.g. general condition, sunken eyes, skin pinch, child's reaction when offered to drink
- **Fever** e.g. duration, H/O travelling to malaria endemic area, stiff neck, features of measles/mouth or eye complications
- **Ear problem** e.g. ear pain, discharge of pus, duration of illness, tender swelling behind the ear

- **Nutritional status**: Malnutrition e.g. visible severe wasting, bipedal oedema, weight for age & anaemia (palmar pallor)

- **Immunization status**

- **Vitamins** e.g. A, multivitamin/mineral supplementation
- **Deworming status**

- **Feeding assessment** e.g. breast feeding, complementary feeding, feeding during illness

Other problems

Presence of any general danger sign or features of very severe disease indicates that the child is very sick and in need for immediate referral to hospital.

II. Classification & Identification of Treatment

After assessment, sick children are classified, based on the presence or absence of general danger sign and presence of any specific sign or combination of signs. The **classification**(s) are colour coded which indicate the severity of the illnesses and call for specific actions as in the box.

Urgent referral with pre-referral treatment
Treatment at local health facility & follow up
Home treatment and follow up

Example: **A child (2 months upto 5 years) with cough and or difficult breathing. Assessment, classification and identification of treatment** (IMCI, WHO '2014 adopted)

Signs	Classify as	Identify treatment
◆ Any general danger sign ◆ Severe chest indrawing (deep & easily visible) ◆ Stridor in clam child	Severe Pneumonia or Very Severe Disease	◆ Give first dose of an appropriate antibiotic ◆ Treat the child to prevent low blood sugar ◆ Refer urgently to hospital
◆ Chest indrawing ◆ Fast breathing	Pneumonia	◆ Give oral Amoxycillin for 5 days ◆ If wheezing (even if it disappears after rapidly acting bronchodilator) give an inhaled bronchodilator/oral Salbutamol for 5 days ◆ Soothe the throat and relieve the cough with a safe remedy ◆ If coughing more than 2 weeks or recurrent wheeze, refer for assessment for TB or asthma ◆ Advise mother when to return immediately ◆ Follow up in 3 days
◆ No signs of pneumonia or very severe disease	Cough or Cold	◆ If wheezing (even if it disappears after rapidly acting bronchodilator) give an inhaled bronchodilator/oral Salbutamol for 5 days ◆ Soothe the throat and relieve the cough with a safe remedy ◆ If coughing more than 2 weeks or recurrent wheeze, refer for assessment for TB or asthma ◆ Advise mother when to return immediately ◆ Follow up in 5 days, if not improving

CASE MANAGEMENT AT HIGHER CENTRE

(Referral Health Facility)

- **Emergency Triage Assessment and Treatment (ETAT)**: Grouping the sick child on the basis of emergency signs & priority signs and ensure life saving management without delay
- Comprehensive clinical assessment and investigations to reach the diagnosis
- Appropriate treatment and follow up

TRIAGE : A process of rapid screening of sick children, when they first arrive at hospital and grouping them as follows–

- **Sick children with** EMERGENCY SIGNS

- Stridor
- Severe respiratory distress
- Central cyanosis
- Grunting
- Signs of shock
- Coma
- Convulsion
- Severe dehydration

If any one of the above emergency signs are found, appropriate emergency treatment should be given immediately.

- If the sick child has no emergency signs seen, PRIORITY SIGNS should be looked for

Sick children with priority signs

- Visible severe wasting
- Oedema of both feet
- Severe palmar pallor
- Any sick young infant (< 2 months old)
- Lethargy, drowsiness
- Continually irritable and restless
- Major burns
- Any respiratory distress
- Child with urgent referral note from another facility

If any of these signs are found, appropriate treatment should be given immediately.

- Those with neither emergency nor priority signs, will get **routine treatment**

CARDINAL FEATURES OF CERTAIN SEVERE DISEASES

Cardical features	Suggestive disease/conditions
Convulsion	◆ Meningitis ◆ Encephalitis ◆ Hypoglycaemia ◆ Hypocalcaemia
Stopped feeding well	◆ Septicaemia ◆ Meningitis ◆ Pneumonia ◆ Other serious illness
Fast breathing and severe chest indrawing	◆ Pneumonia ◆ Bronchiolitis ◆ Acute asthma ◆ Heart failure
Grunting	◆ Respiratory failure ◆ Septicaemia
Less movement	◆ Septicaemia ◆ Severe dehydration ◆ Hypocalcaemia
Lethargy/ unconsciousness	◆ Birth asphyxia ◆ HIE ◆ Intracranial haemorrhage ◆ Septicaemia, Meningitis ◆ Severe dehydration

COMMUNITY BASED (C-IMCI)

Evidence has shown that up to 80% of deaths of under five children occur at home with little or no contact with health care providers. So there is a big gap between the care seekers and care providers. To minimize this gap, interventions are also planned at the community (Community IMCI). The main objectives of C-IMCI is to improve behaviour and care practices of families and communities.

The important strategies of C-IMCI are–

1. Promotion of growth & development

- Exclusive breast feeding for first six months of age
- From six months, give children good quality complementary foods while continue to breast feed for two years or longer (IYCF)
- Micronutrients supplementation e.g. vitamin A, iron and zinc
- Promoting mental and social development by responding to a child's needs for care and by providing a stimulating environment e.g. playing, talking etc.

2. Disease prevention

- Disposal of all faeces safely, hand washing after defaecation, before preparing meals and before feeding children
- Protect children in malaria endemic areas, by promoting them to sleep under insecticide-treated bed nets
- Provide appropriate care for HIV affected people and to take action to prevent further HIV infections

3. Appropriate care at home

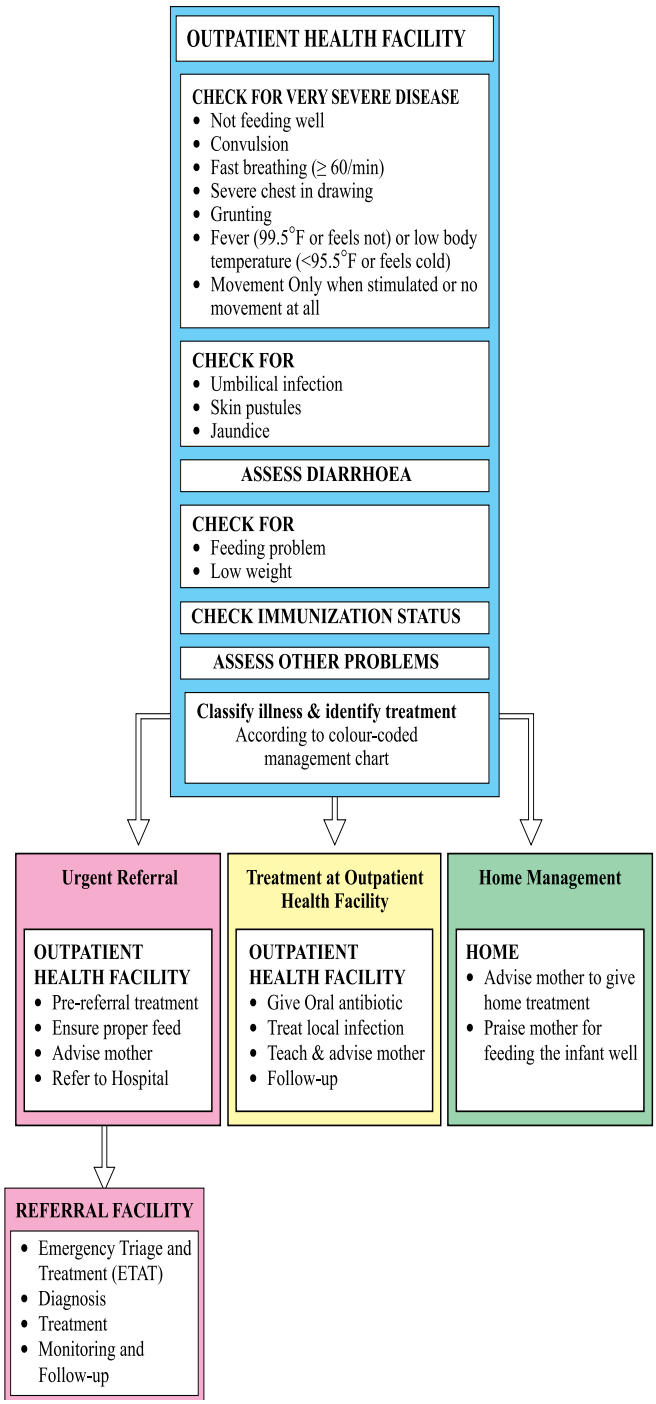
- Continue to feed and offer more fluids including breast milk to children when they are sick
- Give sick children appropriate home treatment for infections
- Protect children from injury and accident and provide treatment when necessary
- Prevent child abuse and negligence, and take action when it does occur
- Involve fathers in the care of their children and in the reproductive health of the family

4. Care-seeking outside home

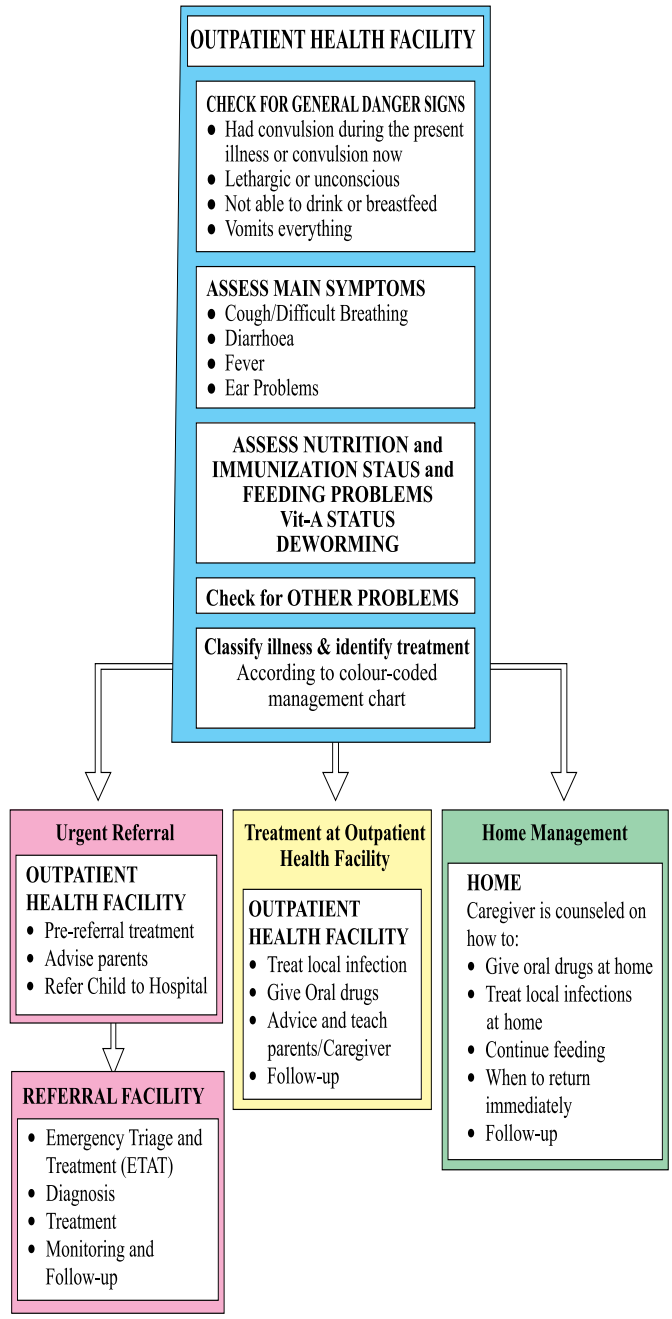
- Recognize when sick children need treatment outside home and seek care from appropriate providers
- Take children for complete immunization before their first birthday
- Follow the health provider's advice on treatment, follow-up and referral
- Ensure that every pregnant woman has adequate antenatal care (ANC) and seeks care at the time of delivery & afterwards

SUMMARY OF STEPWISE CASE MANAGEMENT

IMCI case management at a glance for children from 0 day up to 2 months



IMCI case management at a glance for children from age 2 months up to 5 years



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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What is IMCI? What childhood diseases are assessed in this strategy?
2. What are the different components of IMCI?
3. What are the main symptoms and other issues to be addressed in a sick child between 2 months to 5 years. according to IMCI?
4. What are the causes of lethargy?
5. Write down the main objectives of Community IMCI.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. The general danger signs of a sick child are–
   ___ a) convulsion ___ b) not able to drink ___ c) wheeze ___ d) lethargy ___ e) stridor
2. Indications of vitamin A supplementation according to IMCI are–
   ___ a) dysentery ___ b) persistent diarrhoea ___ c) measles ___ d) anaemia ___ e) very severe disease
3. The following signs are suggestive of very severe disease in young infants–
   ___ a) fast breathing ___ b) jaundice ___ c) not able to suck
   ___ d) umbilical infection ___ e) convulsion
4. The 4 main symptoms of sick children (2 months upto 5 years) are–
   ___ a) convulsion ___ b) ear problem ___ c) vomits everything
   ___ d) lethargy ___ e) jaundice
5. The emergency signs of a sick child include–
   ___ a) stridor ___ b) grunting ___ c) bipedal oedema
   ___ d) visible severe wasting ___ e) shock
6. Clinical signs indicating pneumonia of a 2 years old child include –
   ___ a) stridor ___ b) convulsion ___ c) fast breathing
   ___ d) chest indrawing ___ e) runny nose

Chapter 07

Childhood Immunization and Vaccine Preventable Diseases

IMMUNIZATION: THE BASICS

Vaccine

An Antigen used to stimulate the production of antibodies and to provide immunity against one or several diseases.

Immunization

It is the process of inducing immunity artificially by administering antigenic substances or preformed antibody. It is of 2 types–

Active	It is the process of inducing antibody production or to activate immunologically competent cells through stimulation of body's immune system by vaccines
Passive	It is the process of providing temporary protection through administration of exogenously produced antibody

Expanded programme on immunization (EPI)

It means increasing the number of vaccines in the vaccination schedule, so as to provide a wider coverage against infectious diseases among the population.

Cold chain

It is a system to keep the vaccines cool so as to maintain their potency and efficacy at every stage from the time of manufacturing until their use.

Adverse Events Following Immunization (AEFI)

It is a medical incident that takes place after immunization, causes concern and is believed to be caused by immunization.

Contraindications

- Acute illnesses
- Previous severe reaction to immunization
- Immune deficiency states/disorders
- Progressive or uncontrolled CNS diseases etc.

Major milestones of EPI in Bangladesh

- EPI launched on the 7 April 1979
- TT 5 doses for women of child bearing age was started in 1993
- Hepatitis B vaccine introduced in 2003
- AD (auto disable) syringes introduced in 2004
- Pentavalent (DTP+Hib+HepB) vaccine introduced in 2009
- MR vaccine and measles 2nd dose introduced in 2012
- WHO certified 11 countries of SEAR region including Bangladesh as polio free, on 27 March 2014
- Pneumococcal conjugate vaccine introduced in 2015
- IPV introduced in 2015

National immunization coverage (July 2016 revision)

Full vaccination coverage <1 year of age	82.3%
BCG	99.5%
Penta 3	90.1%
Polio 3	95%
PCV3	95%
Measles	87.5%

- 92% babies are protected from neonatal tetanus
- Human Papilloma virus (HPV) vaccine demonstration launched on 16 April 2016 in 4 Upazila and 1 Zone under Gazipur district targeting school going girls of grade 5 and out of school girls of the age 10 years
- Plan to introduce vaccines against Rota virus and vaccine against HPV to the adolescent girls by 2018

Source: EPI fact sheet, Bangladesh, WHO.SEARO/FGL/IVD. 31 August 2016

EPI SCHEDULE IN BANGLADESH

At Birth	BCG, OPV 0
At 6 weeks of age	* Penta 1, OPV 1, ** PCV 1, ***Fractioned IPV 1
At 10 weeks of age	* Penta 2, OPV 2, ** PCV 2
At 14 weeks of age	* Penta 3, OPV 3, ***Fractioned IPV 2, ** PCV 3
At 9 completed months	**** MR
At 15 completed months	**** MR

** Penta includes DPT + Hlb + HepB vaccines, ** PCV means Pneumococcal Conjugate Vaccine, *** IPV means Inactivated Polio Vaccine, **** MR means Measles & Rubella*

EPI schedule, Reviewed in 2017 *Courtesy: Dr Tajul Islam A Bari*

Apart from the above mentioned vaccines, other vaccines available in the private sector are chicken pox, hepatitis A (HAV), typhoid, meningococcal conjugate vaccine, cholera vaccine etc.

Another objective of EPI is to prevent deaths of mothers as well as their newborn babies from tetanus. This is ensured through vaccination of women during their reproductive age by Tetanus Toxoids (TT) and the schedule is as follows–

Doses	Age & Interval of vaccinations	Duration of protection
TT 1	At 15 years	Nil
TT 2	At least 1 month (4 weeks) after TT 1	3 years
TT 3	At least 6 months after TT 2	5 years
TT 4	At least 12 months after TT 3	10 years
TT 5	At least 12 months after TT 4	Life long

N.B. If 5 doses of TT are completed, no TT is required during pregnancy.

Congenital Rubella Syndrome (CRS) & Measles-Rubella (MR) vaccination campaign '2013-14

The major morbidities of CRS are–

- Deafness
- Cataract
- Patent ductus arteriosus

MR campaign '2013-14

To prevent the morbidity and mortality from rubella and measles, a nation-wide MR vaccination campaign was held during 2013-14 in 2 rounds to cover all children from 9 months upto 15 years. The objectives of this programme was to increase the vaccination coverage of >95% against measles and rubella by 2016.

VACCINE PREVENTABLE DISEASES

In this chapter we will discuss the following common vaccine preventable diseases e.g. TB, measles, mumps, chickenpox, tetanus, pertussis and diphtheria. The other vaccine preventable diseases e.g. pneumonia, typhoid, poliomyelitis, meningitis, diarrhoea and hepatitis A & B are also discussed in other sections.

TUBERCULOSIS

Organism

Mycobacterium tuberculosis hominis and occasionally *M. bovis*.

Source: Internet

Transmission

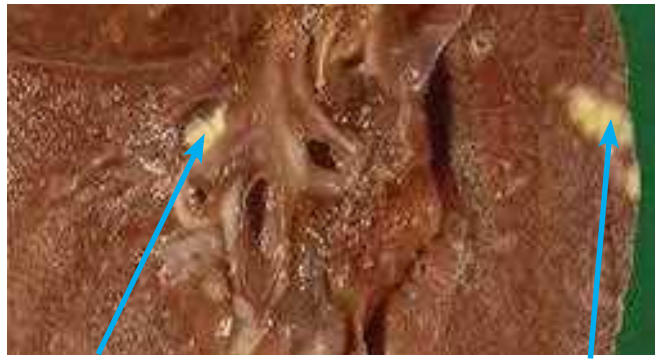
- Inhalation of airborne droplets from open adult pulmonary TB patients (sputum smear positive for AFB)
- Ingestion of infected cow's milk (rare)

Incubation Period: 2-12 weeks

PATHOGENESIS

The infectious droplets (containing TB bacilli) enter the **terminal bronchioles** of lungs parenchyma through inhalation where, they multiply and cause subpleural granulomatous lesion to the adjacent lungs tissue **(Ghon focus).**

The bacilli are then drained through lymphatics to the hilar lymph nodes and cause their enlargement **(Hilar lymphadenopathy)**. The Ghon focus and hilar lymphadenopathy form the **Primary complex (Ghon complex).**



Granuloma in a hilar LN *Ghon complex* *Sub-pleural granuloma*

Primary Complex: Other sites

- Intestine with mesenteric lymph nodes
- Skin with regional lymph nodes
- Tonsil with cervical lymph nodes

Outcome of Primary Complex

- Healing and calcification.
- Hypersensitivity reactions, e.g. erythema nodosum, phlyctenular conjunctivitis
- Destruction to lungs parenchyma e.g. progressive pulmonary TB
- Invasion of pleura (pleural effusion) either directly or from a subpleural pulmonary focus or caseated lymph node
- Pressure effects by the enlarged hilar & mediastinal lymph nodes–

  (i) Over the bronchus e.g.
  - if complete obstruction: collapse
  - if partial obstruction: ball-valve effect and obstructive emphysema

  (ii) Destruction of bronchial wall and entry of caseous materials inside the bronchus e.g. endobronchial TB

  (iii) Over other adjacent vital structures
- Haematogenous dissemination to–
  - Lungs (milliary TB)
  - Meninges & Brain (meningitis, tuberculoma)
  - Other organs (end organ tuberculosis) and their progressive destruction e.g. kidney & genitourinary tract, bones, adrenals, liver, skin, fallopian tube etc
  - Involvement of pericardium (pericarditis & pericardial effusion), either directly or through lymphatic drainage from subcarinal lymph nodes
  - Involvement of peritoneum (ascites) either from lympho-haematogenous dissemination and also directly from mesenteric lymph nodes
  - Ingestion of infected caseous materials (intestinal TB)

Types of Tuberculosis

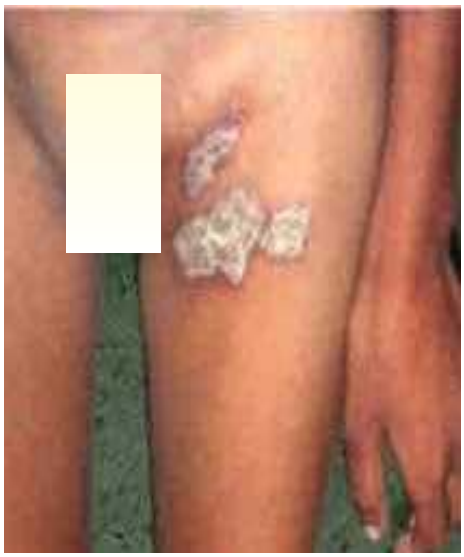
1. **Pulmonary TB (**Commonest form)

   Destruction of lungs parenchyma by–
   - Direct invasion of bacilli
   - Haematogenous invasion of bacilli
   - Pressure effects from the adjacent extra-pulmonary TB lesions

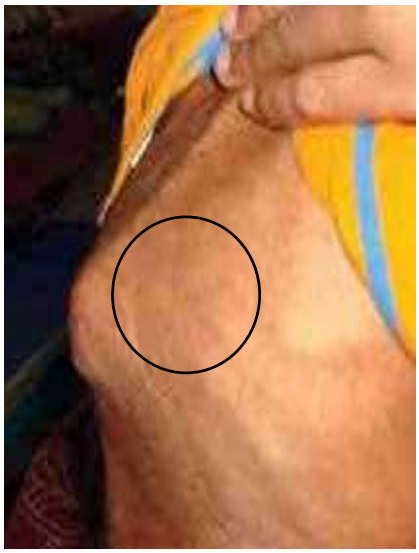
2. **Extra-pulmonary TB**

Photographs of different types of extra-pulmonary TB

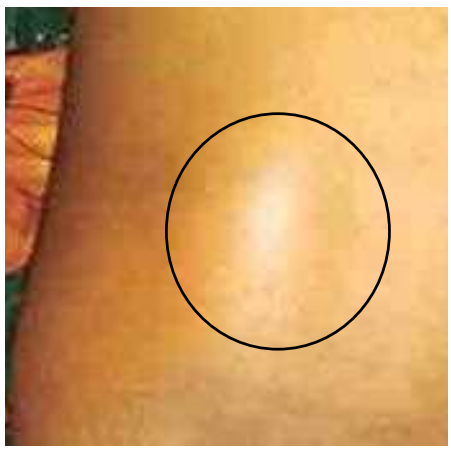
Tubercular lymphadenitis



Lupus vulgaris (skin TB)

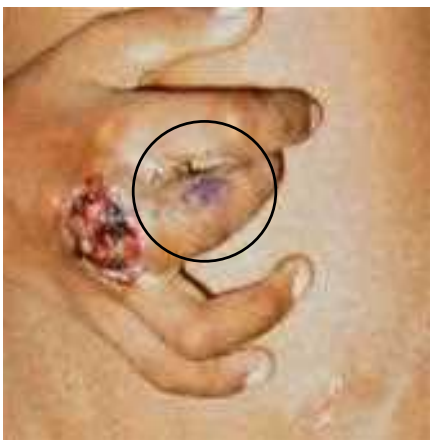


Gibbus in spinal TB



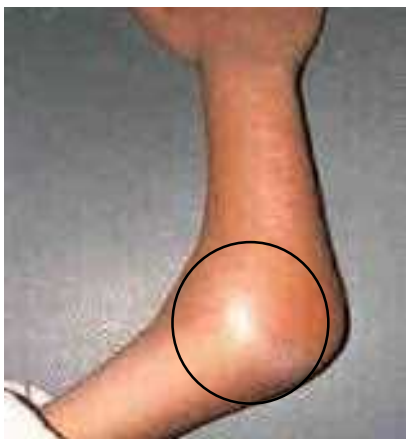
Cold abscess, paravertebral

Courtesy: Dr Iffat Ara Shamshad



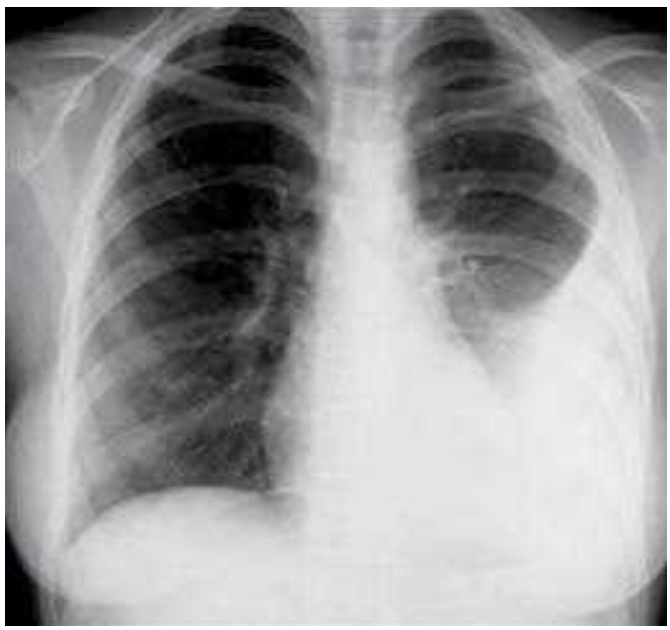
TB dactylitis with skin TB

Courtesy: Prof Sayeeda Anwar

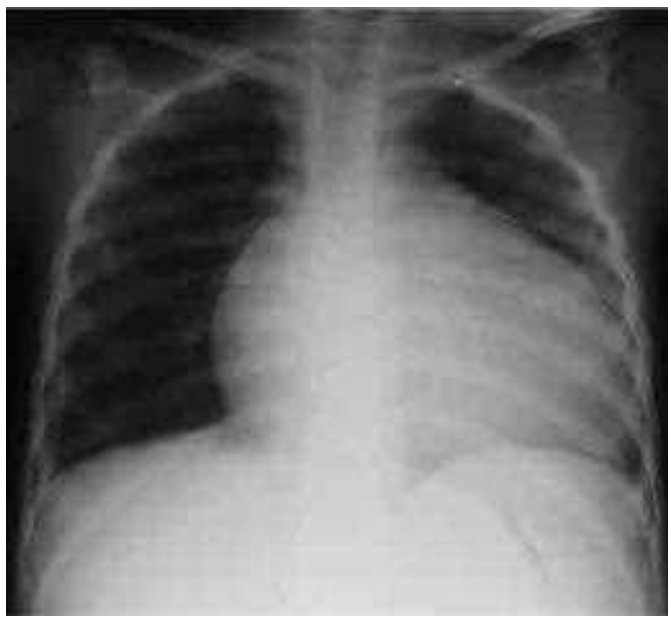


TB of elbow and wrist joint

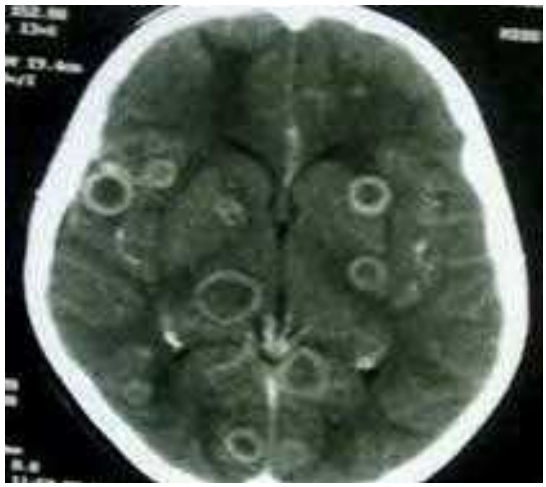
Source: Internet



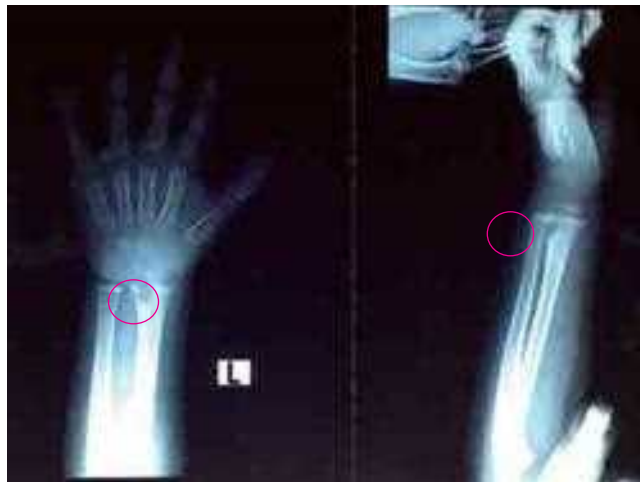
Pleural effusion



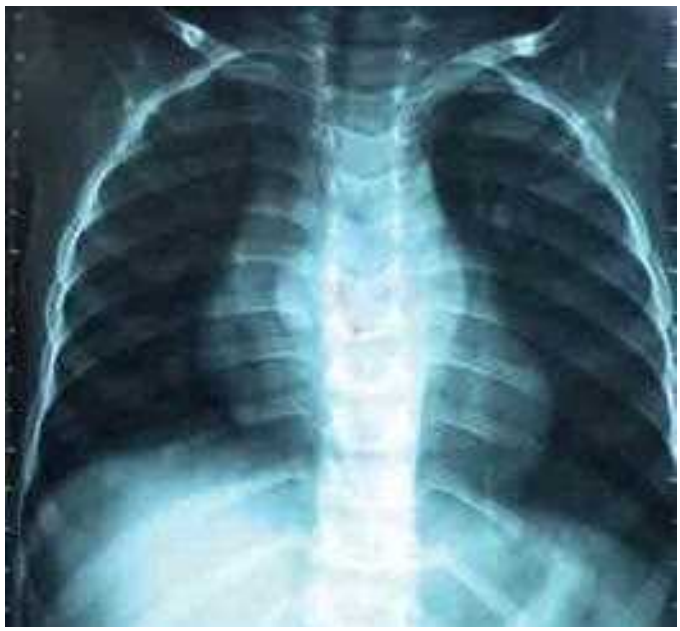
Pericardial effusion



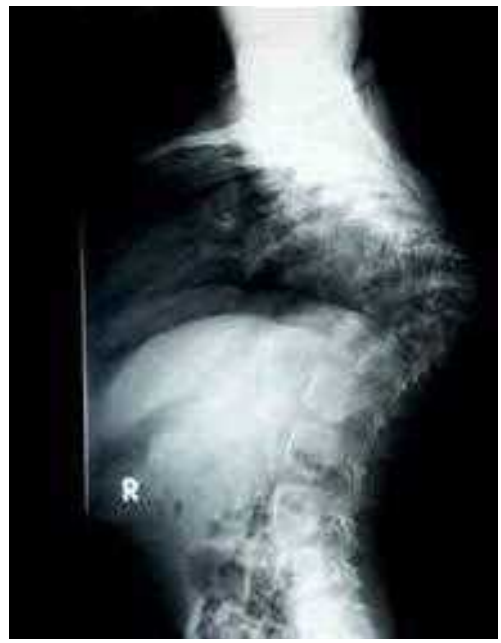
Tuberculoma of brain



X-Ray wrist joint showing erosion of lower end of radius



Paravertebral abscess & destruction of vertebral bodies



Pott's disease

CLINICAL MANIFESTATIONS

Symptom Criteriae suggestive of Pulmonary TB

- Persistent non-remitting cough for >2 weeks not responding to conventional antibiotics *(Amoxicillin, Co-trimoxazle or Cephalosporins)* and/or bronchodilators

and/or

- Persistent documented fever (38º C/100º F) > 2 weeks after common case such as typhoid, malaria or pneumonia have been excluded

and/or

- Documented weight loss or not gaining weight during the past 3 months (especially if not responding to de-worming with food and/or micronutrient supplementation) or severe malnutrition

and/or

- Fatigue and reduced playfulness

National Guideline for Tuberculosis in Children. 2nd edition; March 2016

NB: If any one of the above symptom criteria in a child <15 years, in close contact with a known bacteriologically confirmed TB or clinically confirmed TB should be regarded as presumptive TB case and be referred.

Symptoms & Signs Suggestive of Extra-pulmonary TB

Symptoms and signs	Extra pulmonary TB
◆ A painless enlarged mass of matted lymph nodes (>2×2 cm^2), usually in the neck, not fixed to the underlying tissue, may present with sinus, not responding to a course of antibiotics	TB lymphadenitis (commonly cervical)
◆ Cough and shortness of breath	Pleural TB, Pericardial TB
◆ Reduced playfulness, irritability, weight loss, headache, vomiting without diarrhoea, drowsiness, lethargy, convulsions, unconsciousness and meningitis of acute or sub acute onset not responding to antibiotic	TB meningitis
◆ Abdominal pain, altered bowel habit, mass or ascites	Abdominal TB
◆ Gibbus (acute angulation of the spine resulting from collapse of vertebral body)	TB spine
◆ Chronic pain and swelling of joint(s), usually single	TB arthritis

DIAGNOSIS

The key to diagnosis of TB is a High index of suspicion. Bacteriological confirmation is usually not possible in children.

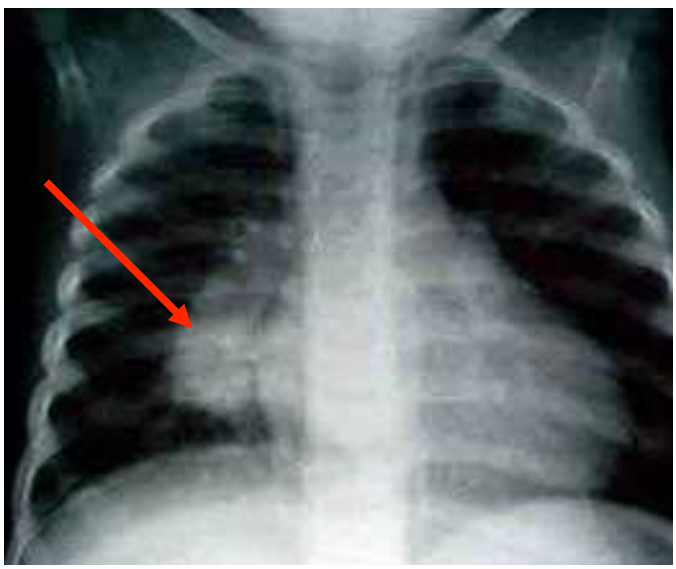
The presence of **3 or more of the features** given in the box strongly suggest a diagnosis of TB–

Symptom criteriae suggestive of TB

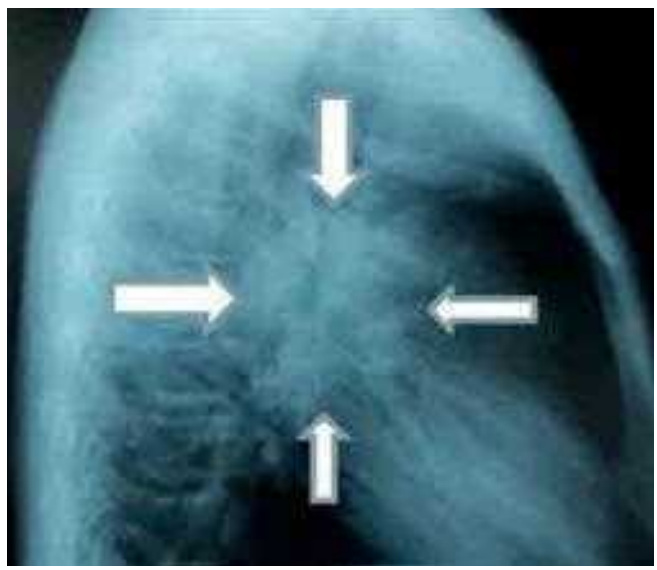
- ◆ History of recent close contact (within the past 12 months)
- ◆ Physical signs highly suggestive of TB
  - ❑ A positive Mantoux test
  - ❑ Chest X-Ray suggestive of TB
  - ❑ Special laboratory study e.g. CSF, histopathology, gene X-pert test

Investigations

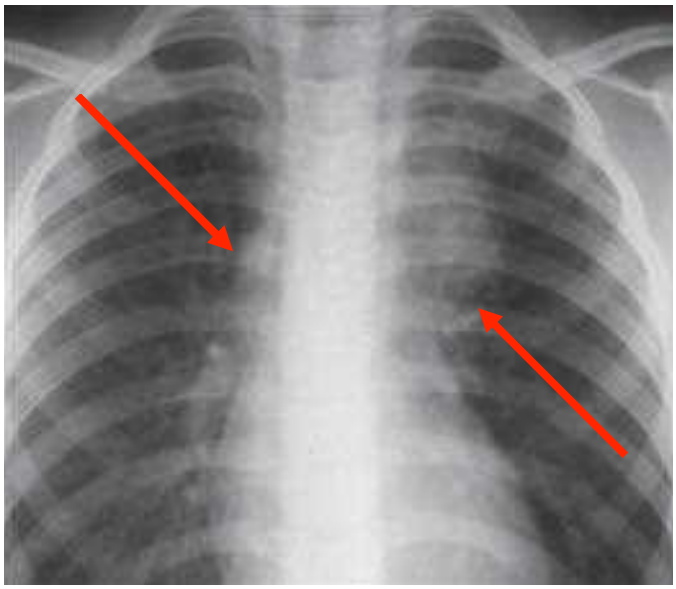
- ◆ Complete blood counts: Hb (reduced), lymphocytosis, ESR (high)
- ◆ X-Ray chest: Findings suggesting pulmonary TB (shown in X-Rays below), given below
  - ❑ Lymphadenopathy, hilar or mediastinal
  - ❑ Persistent opacity in lungs, not improving by antibiotic
  - ❑ Features of pressure effects e.g. collapse
  - ❑ Miliary mottlings
  - ❑ Unilateral pleural effusion



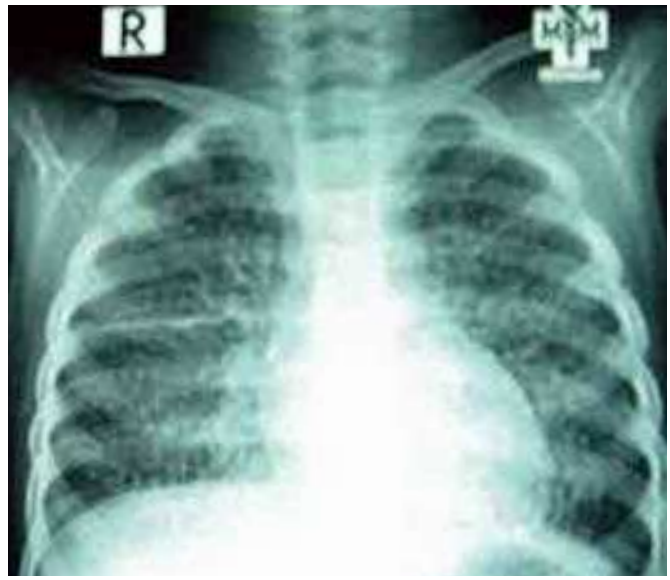
Right hilar lymphadenopathy AP view



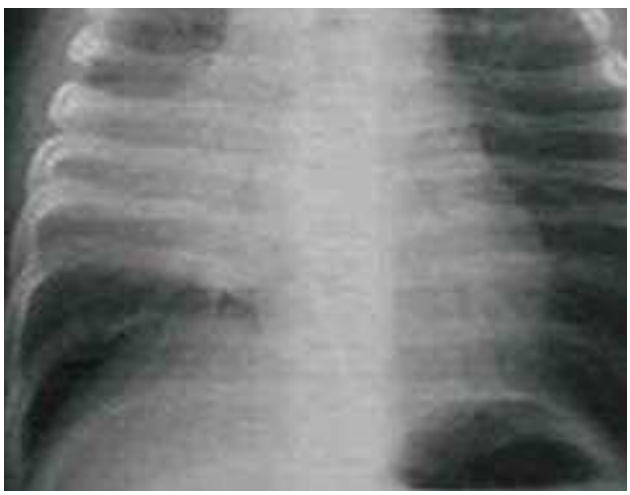
Right hilar lymphadenopathy, Lateral view



Paratracheal lymphadenopathy



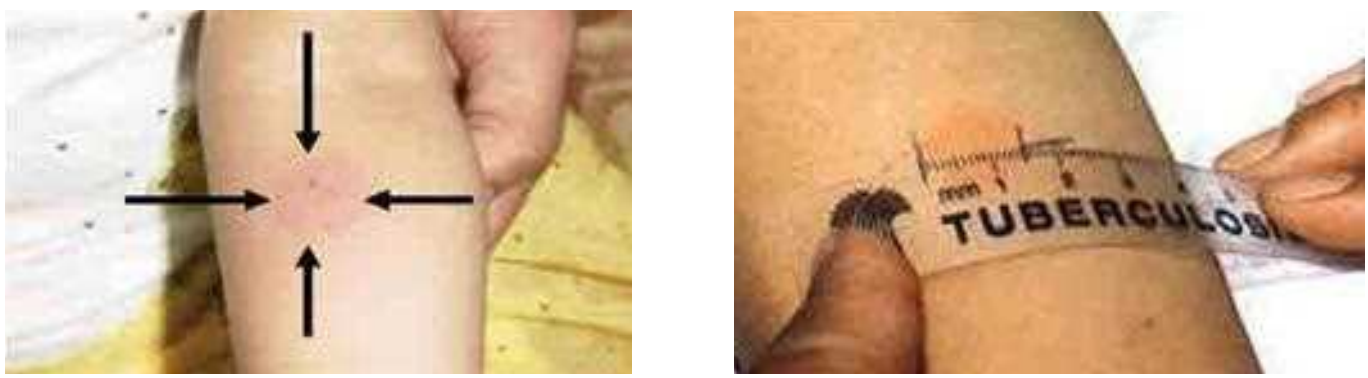
Patchy opacity



Middle lobe consolidation

Miliary mottling

- Mantoux Test (MT): Done by intradermal injection of 0.1 ml of tuberculin reagent containing 5 tuberculin unit of PPD in the skin of flexor aspect of forearm and the reaction is observed & measured after 72 hours at the site of injection
- Test is regarded as Positive, if induration is–
  - >10 mm diameter
  - >5 mm diameter, when the patients have associated severe malnutrition, HIV infection and immunosuppression



Mantoux test: Reaction and measurement

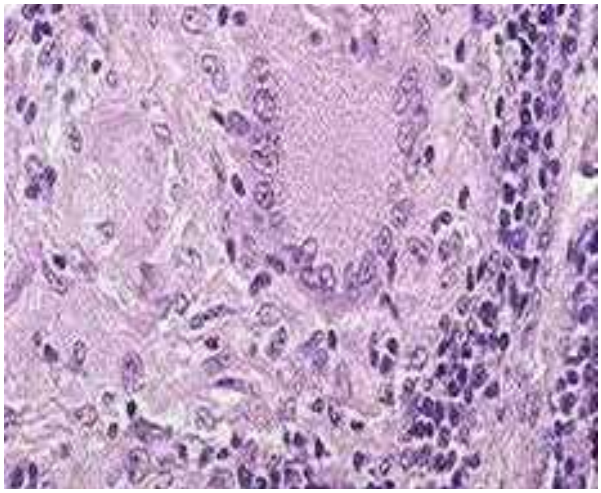
Causes of False Negative and Situations when, MT is considered false positive or false negative

False negative

- Severe malnutrition
- Severe tubercular infections
  - TB meningitis
  - Milliary TB
- Viral infections
  - Measles in last 3 months
  - Whooping cough
  - HIV infection
- Malignancy
  - Leukaemia
  - Lymphoma
- Immunosuppressive drugs
  - Steroid
  - Anti-cancer drugs
- Faulty technique: Subcutaneous rather than intradermal injection

False positive: Prior BCG vaccination

- Lymph node biopsy & histopathology: Central caseation surrounded by epithelioid and multinucleated giant cells
- Bacteriological confirmation: By smear microscopy on samples e.g. to demonstrate AFB (Z–N staining)
  - Sputum
  - Gastric lavage
  - CSF
  - Pleural and
  - Ascitic fluids for AFB



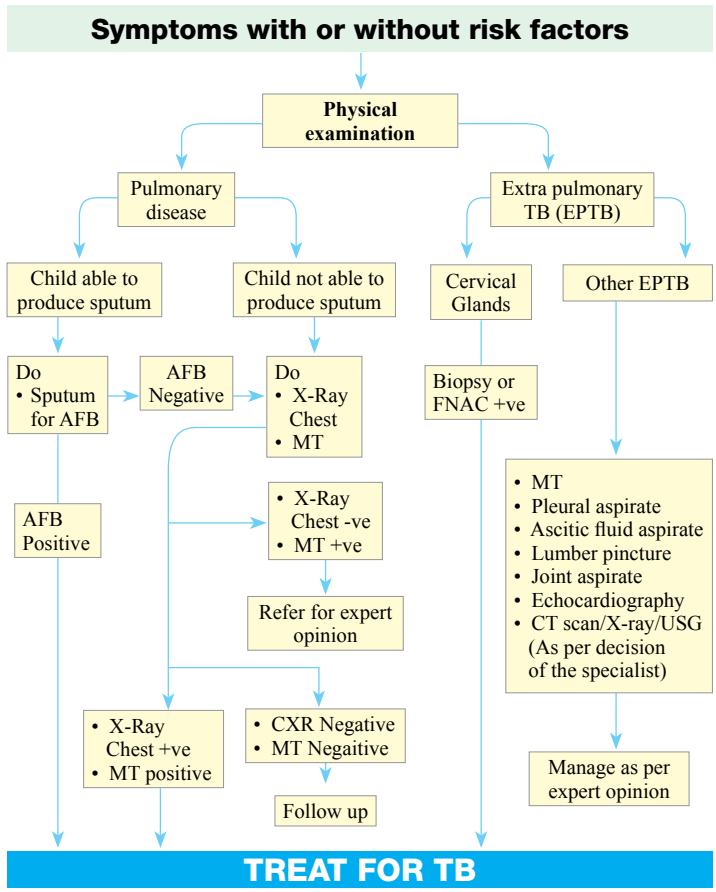
Lymph node biopsy showing giant cells and caseation

Source: Internet

- Gene X-pert is a cartiaidge-based automated diagnostic test to indentify MTB DNA and to detect resistance to Rifampicin by PCR from body fluids within 2 hours
- Microbial culture in Löwenstein–Jensen medium
- Other investigations
  - Nucleic acid amplification (PCR)
  - Interferon-Gamma Release Assays (IGRA)
  - Adenosine deaminase (ADA)

Sites of Extra-pulmonary TB and relevant investigations to reach diagnosis

Sites	Investigations
TB lymph nodes	Biopsy or FNAC
Miliary TB	X-Ray chest
Disseminated TB e.g. TBM	CXR, CSF study (Routine & Gene X-pert) and CT scan of brain, where available
Tuberculoma of brain	CT scan / MRI of brain
TB Pleural effusion	CXR, pleural fluid analysis (Routine &Gene X-pert), pleural biopsy & histopathology
Abdominal TB	Abdominal ultrasound, ascitic fluid study (Routine & Gene X-pert)
TB arthritis or Osteoarticular TB	X-Ray of affected joints, joint fluid study or synovial biopsy
Pericardial TB	CXR, echocardiography, pericardial tap, pericardial biopsy & histopathology
TB, all forms	MT and CXR



Specialty of childhood TB

The epidemiology, clinical presentation, investigations as well as treatment of TB are almost similar in both children & adults. However, there are certain specialities of childhood TB and these are given in the table below–

	Aspects	Childhood TB
1	Risk factors	◆ Close contact with sputum positive adult cases ◆ Children under 5 years of age ◆ Severe malnutrition ◆ Immunosuppressive states e.g. measles, whooping cough etc. ◆ Overcrowding
2	Bacilli load	◆ Pauci bacillary (<10000/ml)
3	Source of infection & Infectivity	◆ Smear positive adult cases ◆ Generally non-infectious
4	Site of primary focus	◆ Most commonly sub pleural lungs parenchyma
5	Haematogenous dissemination	◆ Common
6	Fate of primary complex	◆ Mostly heal and calcify
7	Clinical symptoms	◆ Nonspecific in most cases e.g. loss of appetite, losing weight, not playful ◆ Fever may be absent ◆ Persistent non remitting cough for > 2 weeks, usually nonproductive and no haemoptysis
8	Magnitude of extra-pulmonary TB	◆ More common than adults ◆ TB lymphadenopathy: Most common ◆ More vulnerable to develop severe form of TB e.g. TBM /disseminated TB ◆ Genitourinary TB: Less or rare
9	Rapidity of developing TB following exposure	◆ Develops TB rapidly in weeks to months and usually occurs within 1st year of exposure to *M. tuberculosis*
10	Yield of recommended investigations	◆ Poor. Sputum is difficult to obtain. Gastric lavage & nasopharyngeal aspirates often used to detect TB bacilli, but yield is poor ◆ X-Ray chest: Hilar lymphadenopathy is characteristic. Cavitation is rare ◆ AFB positivity rate: <20% ◆ Mantoux test: Less informative as it has more chance of false negativity ◆ Gene X pert: Limited role yet to diagnose childhood TB
11	Treatment in intensive phase	◆ With 3 drugs (3 FDC) due to paucibacillary load except in TB meningitis, lung cavities, extensive alveolar consolidation, osteo articular TB where 4 drugs are used ◆ Pyridoxine is not routinely recommended except in severe PEM, HIV, chronic liver disease and renal failure
12	Chance of developing resistance against anti-TB drugs	◆ Less because of paucibacillary load

TREATMENT

- Counsel parents about the disease, it's complications and importance of continuing anti-TB drugs
- Give Anti-TB drugs in 2 phases–
  - Intensive phase
  - Continuation phase

TB cases	Regimen	
	Intensive phase	Continuation phase
• Smear negative PTB (without extensive involvement) • TB lymph node (intrathoracic/ extrathoracic)	2 (HRZ)	4 (HR)
• Smear positive PTB • Smear-negative PTB with extensive involvement • Severe EPTB (except TBM and Osteoarticular TB) • Previously treated cases** • All forms of TB in HIV+ve cases (except TBM and Osteoarticular)	2 (HRZE)	4 (HR)
• TB meningitis/CNS TB* • Osteoarticular TB*	2 (HRZE)	10 (HR)
• MDR TB • XDR TB	Specially designed standardized treatment (2nd line anti-TB drugs)	
*For TB meningitis and osteoarticular TB, treatment may be extended up to 12 months or more, based on clinical judgment.		
H – Isoniazid 10 (7-15) [maximum 300 mg] R – Rifampicin 15 (10-20) [maximum 600 mg] Z – Pyrazinamide 35 (30-40) [maximum 2000 mg] E – Ethambutol 20 (15-25) [maximum 1200 mg]		

Currently available **3 FDC** contains–	Currently available **2 FDC** contains–
H – Isoniazid 50 mg R – Rifampicin 75 mg Z – Pyrazinamide 150 mg	H – Isoniazid 50 mg R – Rifampicin 75 mg

Indications of corticosteroid in TB

- CNS TB including TB meningitis
- TB pericarditis as it reduces the risk of restrictive pericarditis

Weight band table for 'NEW'/Upcoming FDCs for TB

Weight Bands (Kg)	Number of Tables		
	Intensive Phase		Countinuation Phase
	RHZ (mg)	E (mg)	RH (mg)
	75/50/150 per tablet	100 per tablet	75/50 per tablet
4-7	1	1	1
8-11	2	2	2
12-15	3	3	3
16-24	4	4	4
25+	**Use adult dosages and preparations**		

Drug Resistant TB (DR-TB)

DR-TB is confirmed through laboratory tests when the isolates of *Mycobacterium tuberculosis* grow in vitro in the presence of one or more antitubercular drugs.

Classification

Five categories have been identified–

- Mono-resistance: Resistance to one anti-TB drug
- Poly-resistance: Resistance to >1, 1st-line anti-TB drugs
- Multi-drug resistance (MDR-TB): Bacilli resistant to INH and RIF (in vitro), with or without resistance to any other drugs
- Extensively drug-resistance (XDR-TB): Bacilli resistant to multiple first-line anti-TB drugs as well as to any one of the fluoroquinolones and to at least one of three injectable second-line drugs e.g. Amikacin, Capreomycin or Kanamycin
- Total drug-resistance (TDR-TB): Bacilli resistant to all first and second line anti-TB drugs

Treatment regimen for MDR-TB

- **Intensive phase** (8 months)
  Treatment with Kanamycin, Pyrazinamide, Levofloxacin, Ethionamide, Cycloserine
- **Continuation phase** (12 months)
  Treatment with Levofloxacin, Ethionamide, Cycloserine, Pyrazinamide

MEASLES

Organism: *Rubeola virus,* an RNA virus

Transmission: Inhalation of air borne droplets

Incubation Period: 7-18 days

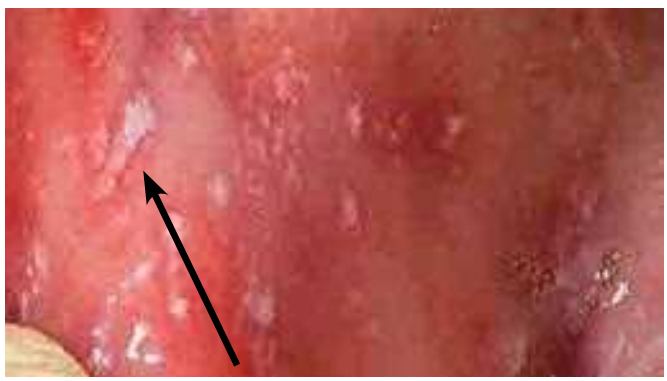
PATHOGENESIS

After entry into the host, virus replicates in the upper respiratory epithelium and then spreads to local lymphoid tissue, where replication continues. From the lymphoid tissue, measles virus disseminte through blood (viraemia) to many tissues *e.g. conjunctiva, respiratory tract, urinary tract, small blood vessels, lymphatic system and CNS* where, they cause organ-specific lesions *e.g. conjunctivitis, pneumonia etc*. In addition, the virus causes transient but profound immune suppression, make the child susceptible to secondary bacterial infections. The characteristic maculo-papular rash of measles are due to hypersensitivity reaction to measles infected cells in the skin.

CLINICAL MANIFESTATIONS

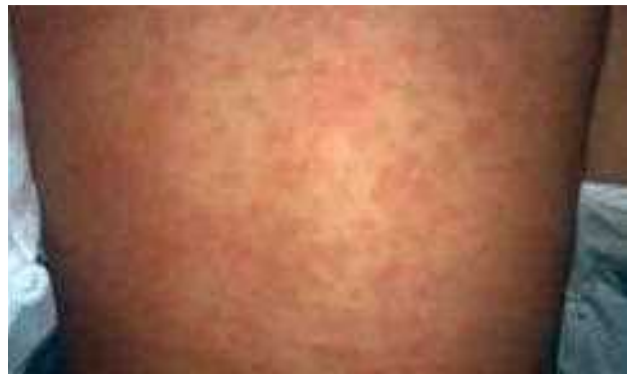
Clinical course pass through following stages–

Prodromal stage (duration 3 to 4 days)	◆ Fever ◆ Cough ◆ Red eyes ◆ Runny nose (coryza) ◆ Appearance of **Koplik's spot (s**mall white papules found on buccal mucosa against upper molar teeth)
Exanthematous stage (duration 6 to 7 days)	◆ Orderly appearance of maculo-papular rash starting on the 4th day of fever at it's peak ◆ Rash starts behind the ear, reaches extremities centrifugally in the next 3-4 days
Conval-escence phase	◆ Symptoms begin to subside.The rash fades in the same progression as it evolved, often leaving a fine desquamation of skin. ◆ Cough may persist for 2 weeks

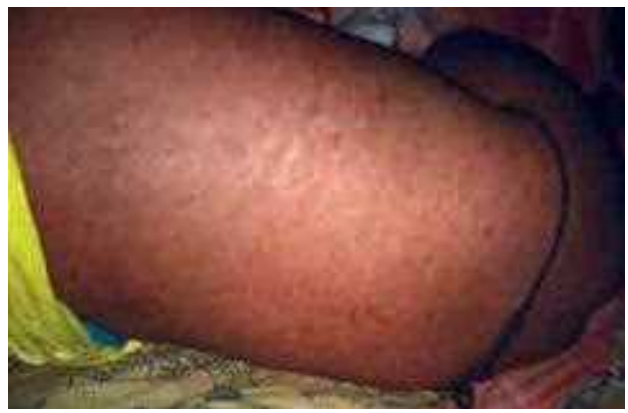


Koplik's spot

Runny nose,typical maculo-papular rash



Maculo-papular rash



Branny desquamation (early stage)

Branny desquamation (late stage)

Complications

- Immune deficiency & Secondary bacterial infections e.g. otitis media, pneumonia, flaring of dormant TB, diarrhoea etc.
- Depletion of vitamin A and Xerophthalmia e.g. night blindness, corneal xerosis, corneal ulceration etc.
- Severe malnutrition
- Neurological complications e.g. encephalitis, subacute sclerosing panencephalitis (SSPE)
- Others e.g. stomatitis, acute renal failure, noma

Diagnosis

Mainly **Clinical** with–

- H/O contact with a measles case, 7-14 days before the onset of illness
- Presence of characteristic prodromal features and orderly distributed maculo-papular rashes
- Investigations has little value. CBC may show leukopenia with absolute lymphopenia

Treatment

Counsel parents about the disease, its complications, treatment and prognosis.

Treatment mainly **Supportive**–

- Give Paracetamol (15mg/Kg/dose) 6 hourly to relieve from fever
- Advice parents to increase fluid intake by the child to ensure good hydration as well as good renal perfusion
- Give high potency vit. A capsule to prevent it's deficiency and the related complications e.g. xerophalmia

6 mo–1 year Two Doses	Age >1 year Two Doses	Xerophthalmia/ Malnutrition Three doses
Dose: 100,000 IU • 1st dose on admission • 2nd dose on the following day	Dose: 200,000 IU • 1st dose on admission • 2nd dose on the following day	Dose: 200,000 IU • 1st dose on admission • 2nd dose on the following day • 3rd dose at 2 weeks of 1st dose

- Foods, energy dense • Oily foods • More proteins
- Regular Assessment & Care of eyes. If any complication, give antibiotic eye ointments, artificial tears, and consult opthalmologist, if required
- Cough remedy • Warm water • Tulsi leaf juice • Lemon juice etc. can be given to soothe the throat
- Identify and treat any complication • Pneumonia
- Antibiotics, when secondary bacterial infection is suspected or identified
- Ribavirin may be given to an infected immuno-compromized child

Prevention

- Vaccinate children with Measles,MR/MMR vaccine
- Isolation of cases for 4 days after appearance of rash, as they are infectious to other healthy contacts (from 4 days before to 4 days after appearance of rash)

MUMPS

Organism: *Mumps virus,* an RNA virus

Transmission: Inhalation of air borne droplets

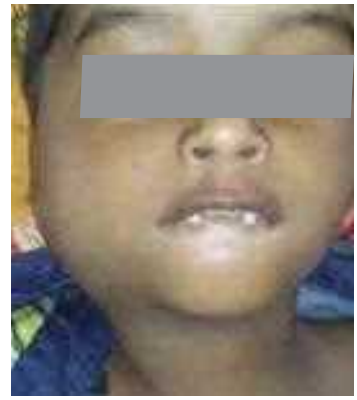
Incubation Period: 2-4 weeks

Pathogenesis

After entry, mumps virus replicates in the nasopharynx, spread to regional lymph nodes and finally the organisms spread through blood (viraemia) to different target tissues such as • Salivary Glands • Pancreas testes • Ovaries • Thyroid • Meninges • Heart • Liver • Kidneys and • Joints.

Clinical Manifestations

- **Prodromal stage**: 1-2 days and is characterized by anorexia, fever, myalgia, malaise, headache, vomiting, sore throat and earache on chewing & swallowing
- At the end of prodromal stage, there is painful swelling of the parotid gland (obliterating mandibular angle). Swelling is unilateral initially but later on become bilateral in about two-third of cases. The opening of Stensen duct may be red and oedematous. In a few cases, submandibular salivary glands are involved with or without parotid swelling



Swelling of left parotid gland

Complications

- Orchitis or epididymo-orchitis. Sometimes, testicular atrophy, but sterility is rare. Oophoritis in females
- Aseptic meningitis/Meningoencephalitis
- Myocarditis
- Polyneuritis
- Transient myelitis
- Hearing loss
- Others
  - Pancreatitis
  - Thyroiditis
  - Arthritis
  - Carditis
  - Arthralgia
  - Nephritis

Diagnosis

Mainly **Clinical** with–

- H/O contact with an affected patient and the
- Characteristic clinical features

Investigations

- Complete blood counts (CBC), PBF: Non-specific
- S. amylase: Elevated in both mumps parotitis and pancreatitis
- S lipase: Elevated only in pancreatitis but not in parotitis

Treatment

- Counsel the parents about the disease, it's complication
- Allow usual diet with intake of plenty of fluid
- Prescribe Paracetamol for fever and pain
- Encourage maintenance of oral hygiene e.g. warm saline mouth wash, regular tooth brushing
- For orchitis: Steroid helps in reducing pain and oedema, but it does not alter the clinical course of the disease or prevent future complications. Prednisolone (40 mg/day) may be used

Prevention

- MMR vaccination (2 doses): 1st dose at 12-15 months of age and the 2nd dose by 4-6 years of age
- Isolation of cases from school and child care centers for 9-10 days from the onset of parotid swelling

CHICKENPOX

Organism: *Varicella zoster virus,* a DNA virus

Transmission: Inhalation of air borne droplets

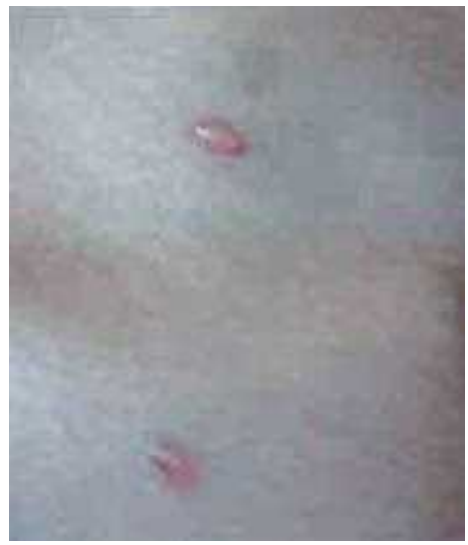
Incubation period: 10-21 days

Pathogenesis

After entry, virus colonizes in the upper respiratory tract and over the next 2-4 days, it replicates in regional lymph nodes. After about 4-6 days, virus spreads to the RE cells in the spleen, liver (primary viraemia). A secondary viraemia occurs after about a week,when the viruses are disseminated to skin (producing typical skin lesions) and other parts of body.

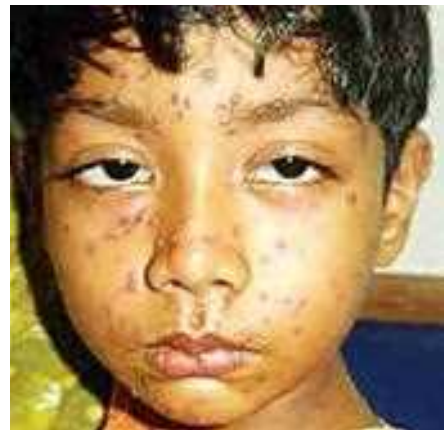
Clinical Manifestations

- **Prodromal phase**: Fever, malaise, anorexia, headache and occasionally mild abdominal pain
- Characteristic **Rash,** appears after 24 hours of prodromal symptoms
  - Each lesion starts as a red macule and passes through stages of papule, vesicle, pustule and crust. The appearance of the rash is described as a pearl or dewdrop on a rose petal



Characteristic rash of chickenpox as pearl or dewdrop on rose petal

  - New lesions continue to erupt for next 3-5 days
  - Lesions usually crust by 6 days (range 2-12 days), and completely heal by 16 days (range 7-34 days)
  - While the initial lesions are crusting, new crops form on the trunk and then the extremities; the simultaneous presence of skin lesions in various stages of evolution is characteristic of Varicella



Simultaneous presence of various stages of lesions

  - Apart from skin lesions, lesions may also involve the mucosa of oropharynx, eyelids, conjunctiva etc. but corneal involvement is rare

Complications

- Brain e.g. encephalitis particularly cerebellitis and cerebellar ataxia
- Skin e.g. secondary bacterial infection
- Lungs e.g. pneumonia
- Hepatobiliary e.g. hepatitis, pancreatitis
- Haematologic e.g. thrombocytopenic purpura
- Kidney e.g. nephritis, nephrotic syndrome
- Joints e.g. arthritis
- Heart e.g. myocarditis

DIAGNOSIS

Mainly **Clinical** with–

- H/O contact with an affected patient
- Characteristic skin lesions

TREATMENT

A. Supportive

- Offer normal foods (no restriction), more fluids intake
- Give Paracetamol (15 mg/kg) 6 hourly for fever
- Management of pruritus–
  - Cool compression and regular bathing
  - Oral antihistamines, e.g. Diphenhydramine and Hydroxyzine
  - Topical Diphenhydramine ointment

Topical calamine lotion may cause excessive drying of the skin, causing the child to scratch.

B. Specific

- Oral Acyclovir (20 mg/kg/dose) 5-6 hourly for 5 days
- Varicella zoster immunoglobulin (VZIG)– Recommended for immunocompromized children and newborns exposed to maternal varicella (described in page 67)

PREVENTION

- Vaccination with varicella vaccine: Usually single dose, given after 12 months of age
- Isolation of the affected children from school until the 6th day of rash

TETANUS

Organism: *Clostridium tetani* (gram positive spore forming anaerobic bacilli).

Transmission

- Through contamination of wounds by bacilli
- Newborn: Contamination of umbilical cord by clostridial spores

Incubation period: 4-14 days

PATHOGENESIS

The clinico-pathological events of tetanus are related to Toxins (Tetanospasmin). Toxins bind at the neuromuscular junctions and enter the spinal cord by retrograde axonal transport, where it prevents release of GABA. Toxins thus block normal inhibition of antagonistic muscles and as a consequence affected muscles show sustained contraction and fail to relax.

CLINICAL MANIFESTATIONS

Often **mild pain** at wound site, followed by **hypertonicity and sudden muscle spasm** lasting for seconds to minutes, occur either spontaneously or following any external stimuli like slight sound or touch. The patient remains fully conscious (as toxin does not affect cortical function) in fearful anticipation of the next tetanic seizure.

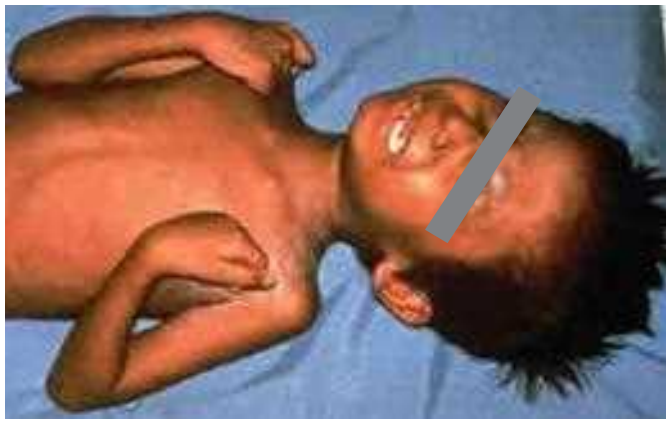
Muscle spasms are manifested by–

- **Opisthotonus,** characterized by flexion of upper limbs, clenched fists and extension of legs

Courtesy: Dr. Manisha Banerjee

Opisthotonus with flexed upper limbs aclenched fists

- **Trismus**, due to spasm of masseter muscles, **lock jaw**



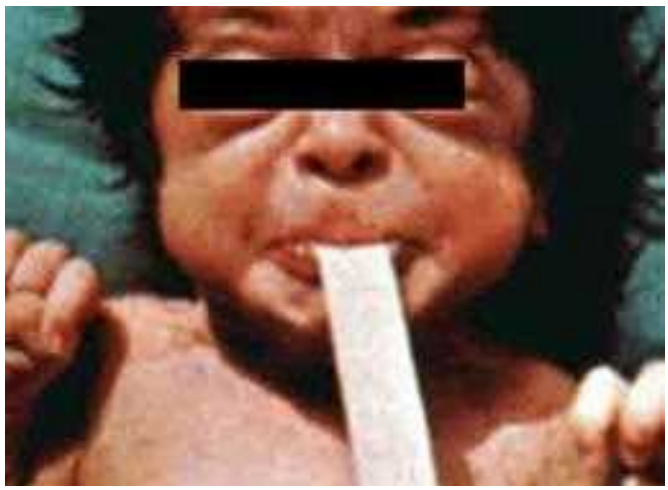
Trismus

- **Risus sardonicus** results from spasam of laryngeal and respiratory muscles
- **Board like rigidity** of abdominal muscles

Risus sardonicus

- Sometimes, **Apnoea** may occur

Newborns with tetanus: They present between 3 days to 3 weeks with irritability and inability to feed. They may have lock jaw and stiffness of neck, generalized hyperreflexia, rigidity and spasm of muscles of the abdomen and back



Source: Internet

Neonate with lock jaw

DIAGNOSIS

- Mainly **Clinical** with–
  - H/O non-immunization against tetanus
  - Presence of hypertonicity, hyper-reflexia and stimulus sensitive episodic generalized muscle spasm
- **Investigations** (little value). However, Gram staining of pus from the wound may reveal the organism

TREATMENT

Counsel parents about the disease, its complications and outcome.

A. Supportive

- Manage the child in a calm & quiet room
- Explore, clean and debride the wound thoroughly
- Infuse IV fluid to ensure adequate hydration & nutrition
- Monitor the case closely to note any respiratory distress due to muscle spasm
- Give Inj. Diazepam (0.1-0.2 mg/kg), IV, 4-6 hourly to control spasm and rigidity. After control of spasms, the dose is titrated to a dose at which patient remain spasm free and continued for 2-6 weeks and thereafter tapered gradually to stop
- Consider tracheostomy and/or endotracheal intubation, if necessary

B. Specific

- **Human TIG**: Give a single dose *(Children: 3000-6000 & Infants: 500 IU)* IM to neutralize the unbound toxin
- Inj Benzyl Penicillin (100 000 U/kg/day) IV, 4 to 6 hourly for 10-14 days

If penicillin is not available–

- Metronidazole (30 mg/kg/day) Oral or IV 6 hourly for 14 days or

If patient is allergic to Penicillin–

- Give Erythromycin and Tetracycline in adequate doses

PREVENTION

Vaccination with–

- Pentavalent vaccines (DPT+Hib+HBV) as in EPI schedule
- Tetanus toxoids to woman during their reproductive age (as mentioned earlier) or during pregnancy

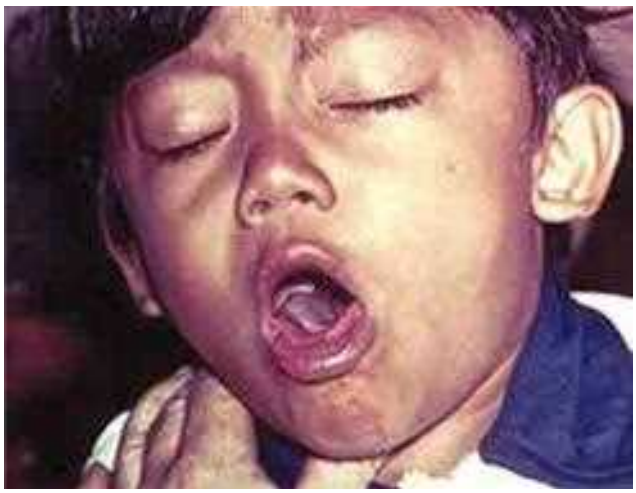
PERTUSSIS

Organism:

Bordetella pertussis (gram-negative cocco-bacilli)

Transmission: Inhalation of air borne droplets

Incubation period: 3-14 days



Source: Internet

PATHOGENESIS

Clinico-pathological events of whooping cough are related to toxin. After entry, bacteria attach & multiply over the ciliated columnar epithelium of respiratory tract and release toxin. This then causes inflammation and damages respiratory epithelium (tracheobronchitis) and give rise to paroxysmal cough and other clinical features.

CLINICAL MANIFESTATIONS

- Intense coughing. The manifestations occur in 3 stages–

Stages of the disease	Clinical manifestations
Catarrhal stage (1–2 weeks)	Mild cough & coryza with low-grade fever, sneezing, lacrimation and conjunctival suffusion
Paroxysmal stage (2–6 weeks)	Paroxysmal uninterrupted coughing lasting up to several minutes ending with loud whoop. **Infants** <6 months do not have the characteristic whoop but may have apnoeic spells and get exhausted. Post tussive vomiting is also common
Convale-scent stage (≥2 weeks)	Patients still have cough and may last for few weeks

Complications

- Bronchopneumonia
- Pulmonary collapse
- Otitis media
- Pulmonary hypertension
- Apnoea and sudden death
- Subconjunctival haemorrhage
- CNS complications e.g. encephalopathy, seizure
- Hernia
- Rectal prolapse

DIAGNOSIS

- Mainly **Clinical** with H/O–
  - Non-immunization with Pentavalent vaccines
  - Long duration paroxysmal cough with whoop

Investigations

- CBC: Leukocytosis & leukaemoid reaction (15,000-50,000 x $10^3/\mu L$) with absolute lymphocytosis
- Nasal wash or Nasopharyngeal swabs for culture or PCR to identify *B. pertussis*
- X-Ray chest: Reveals thickened bronchi and shaggy heart border

TREATMENT

Counsel the parents about the disease, its complications treatment and outcome.

A. Supportive

- Isolate the patient
- Minimize stimuli that trigger paroxysms is the best way to control cough
- Give Oxygen, if respiratory distress
- Maintain adequate hydration & nutrition by–
  - Frequent small feeding with adequate fluid intake
  - IV Infusion, when oral intake is difficult
- Provide ICU support for infants whose repeated paroxysms lead to life-threatening events

B. Specific: Antibiotic

- Azithromycin (10 mg/kg/day); Once daily for 5 days

  or
- Erythromycin (40-50 mg/kg/day) 6 hourly for 14 days (Not recommended for babies <1 month as it causes pyloric stenosis. Azithromycin is recommended here)
- Clarithromycin (15 mg/kg/day) in 2 divided doses for 7 days (Not recommended for babies < 1 month)

- Ampicillin (100mg/kg/day), 6 hourly for erithromycin-intolerant patients

or

- Trimethoprim-sulfamethoxazole (TMP 8 mg/kg/day plus SMZ 40 mg/kg/day), 12 hourly for 14 days (Not recommended for babies <2 month of age)

NB:

- Corticosteroid reduce disease severity but may mask signs of bacterial superinfection
- Cough suppressants have little value
- Nebulization may precipitate paroxysms

Prognosis

Variable. However, poor among infants and who are complicated with encephalopathy.

PREVENTION

- Vaccination (as in EPI schedule) with–
  - Pentavalent vaccines (DPT+Hib+HBV)
  - Isolation of the case

DIPHTHERIA

Organism

Corynebacterium diphtheriae (gram-positive aerobic, non-capsulated, non-spore forming, mostly nonmotile, pleomorphic, bacilli.

Transmission

Direct contact with infected respiratory secretions through airborne droplets from–

- Symptomatic individuals
- Infected skin lesions
- Fomites

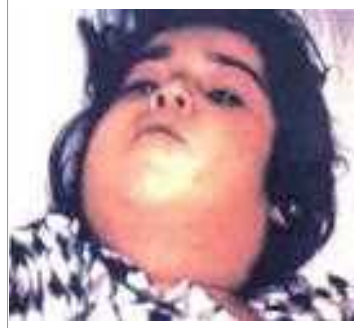
Incubation period: 2-5 days.

PATHOGENESIS

C. diphtheriae causes toxin mediated skin and mucosal damage of pharynx, tonsil, larynx and sometimes nose & vulva. Toxin inhibits protein synthesis and causes local tissue necrosis. Within first few days of infection, a **pseudomembrane** is formed in the pharynx and that interferes with respiration. The dissemination of diphtheria toxin can also lead to systemic disease, causing complications such as necrosis of kidney tubules, thrombocytopenia, cardiomyopathy and demyelination of nerves.

CLINICAL MANIFESTATIONS

- Fever is present in about 50% cases
- Cough is usually absent
- Other manifestations are related to the sites of involvement, given in a table–

Sites of involvement	Clinical Manifestations
Pharynx & Larynx	◆ Sore throat, dysphagia, hoarseness ◆ Respiratory obstruction, stridor, dyspnoea ◆ Toxic look, bull neck appearance ◆ Pseudomembrane in fauces and beyond, which is grayish brown in colour with areas of green or black necrosis surrounded by minimal erythema ◆ Sometimes, bleeding in an attempt to remove this pseudomembrane
 *Bull neck*  *Pseudomembrane*	
Nose Vagina Skin	◆ Ulceration, membrane formation and serosanguinous discharge

Complications

- Upper airway obstruction: Respiratory distress, stridor, cyanosis
- Myocarditis: Undue tachycardia, arrhythmia, heart failure
- Polyneuritis: Features of lower motor neuron paralysis, palatal palsy, 3rd cranial nerve palsy, sensory disturbances
- Adrenal failure: Circulatory collapse
- Pneumonia

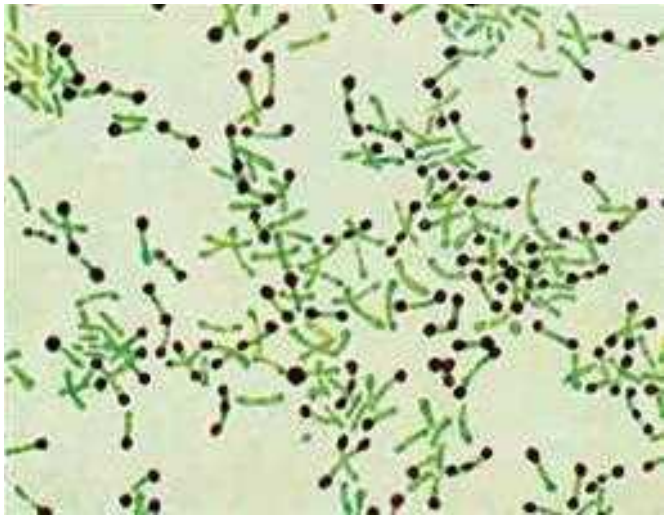
DIAGNOSIS

Based on–

- Clinical features, particularly the presence of **pseudomembrane,** the pathognomonic feature and
- Relevant investigations

Investigations

- Swabs (taken from nose, pseudomembrane, tonsillar crypts, any ulcerations or discolourations) send for–
  - Gram stain: Gram positive bacilli, straight or slightly curved and often enlarged (clubbing) at one or both ends as Chinese letters or V shaped
  - Albert staining (KLB) shows metachromatic granules which give the bacillus beaded appearance
  - Cultures in Tellurite agar media to yield growth of bacteria
- Toxigenicity: Elek test
- CBC: WBC usually normal, but haemolytic anaemia and thrombocytopenia are frequent



Source: Internet

Club shaped bacilli

TREATMENT

Counsel the parents about the disease, its complications and outcome.

A. Supportive

- Isolate the patient to limit spreading to the contacts
- Isolation may be discontinued when 2 successive nose and throat cultures at 24 hours apart are negative after completion of treatment
- Provide bed rest, usually for ≥2 weeks until the risk for symptomatic cardiac damage has passed
- Provide IV fluid, oxygen and nutrition by NG feeding, if necessary
- Monitor the child closely in the hospital for 10–14 days particularly to note any respiratory distress due to laryngeal pseudomembrane or features of complications
- Communicate with ENT specialist for emergency Tracheostomy, if any feature of respiratory obstruction

B. Specific

- **Anti Diphtheria Serum (ADS)**:10,000-150,000U, depending on the severity of disease. Single dose should be given within 48 hours of onset of disease
- **Antibiotics**
  - Penicillin G (100,000-150,000 units/kg/day), 6 hourly, IV or IM for 14 days
  - For penicillin alergic patients, Erythromycin (40-50 mg/kg/day), 6 hourly by mouth for 14 days
- **Treat the carriers with**
  - Erythromycin (40 mg/kg/day) or Penicillin V (50 mg/kg/day) for 10 days or Benzathine Penicillin (6-12 lac units) IM
  - Isolate them, till 2 successive nose and throat cultures at 24 hours apart are negative after completion of treatment
- **Care of exposed susceptibles**
  - Do thorough clinical examination
  - If symptomatic, treat with antibiotics, as before
  - If asymptomatic(immunized): DT, if a booster has not been received within 5 years
  - If non-immunized, treat with erythromycin for 10 days or Benzathine penicillin, IM single dose + DT

PREVENTION

- Vaccination (as in EPI schedule) with–
  - Pentavalent vaccines (DPT+Hib+HBV)
  - Isolation of the case from the contacts

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. Name the disease being prevented by vaccines in National EPI schedule of Bangladesh.
2. Write down the current EPI schedule of Bangladesh. What is AEFI?
3. Write down the contraindication of immunization.
4. Write down the classic manifestation of tetanus.
5. Write down the complication of measles.
7. What is primary complex?
8. How will you diagnose PTB in children as per national guideline?
9. Write down the fates of primary complex.
10. Define MDR & XDR tuberculosis.
11. Describe the paroxysmal stage of pertussis.
12. Describe the typical patch in pharynx in diphtheria.
13. A 5 years old girl presents with low grade fever for 2 months, swelling in neck for 1 month. She has evening rise of temperature and loss of weight for last 1 month.
    a) What is the most probable diagnosis?
    b) How will you investigate & treat the case?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Complications of mumps include–
   ___ a) meningoencephalitis ___ b) myocarditis ___ c) oophoritis
   ___ d) laryngitis ___ e) sterility
2. Vaccines included in the national EPI schedule of Bangladesh are–
   ___ a) MMR ___ b) Hib ___ c) hepatitis B ___ d) typhoid ___ e) Rota virus
3. Mantoux test may be false negative in–
   ___ a) rheumatic fever ___ b) leukaemia ___ c) kwashiorkor
   ___ d) hypothyroidism ___ e) measles
4. The complications of diphtheria include –
   ___ a) laryngeal obstruction ___ b) renal failure ___ c) polyneuritis ___ d) myocarditis ___ e) meningitis
5. Treatment of neonatal tetanus include–
   ___ a) Benzathine penicillin ___ b) Diazepam ___ c) Tetanus toxoid ___ d) Human TIG

___ e) Metronidazole

6. Causes of maculopapular rash are

___ a) measles ___ b) chicken pox ___ c) drugs

___ d) rubella ___ e) meningococcal septicaemia

7. Following are the complications of measles–

___ a) bronchopneumonia ___ b) renal failure ___ c) acute otitis media

___ d) intestinal obstruction ___ e) subacute sclerosing panencephalitis

8. The following condition are characterized by patches in the throat

___ a) Streptococcal tonsillitis ___ b) diphtheria ___ c) agranulocytosis

___ d) eosinophilia ___ e) Herpes simplex infection

9. Indications of steroid in TB are–

___ a) meningitis ___ b) intestinal TB ___ c) TB pericarditis

___ d) TB lymphadenopathy ___ e) TB arthritis

10. The pathognomonic radiologic feature of pulmonary TB is

___ a) patchy opacities ___ b) consolidation ___ c) pleural effusion

___ d) cardiomegaly ___ e) hilar lymphadenopathy

11. Hypersensitivity phenomenon of tuberculosis are–

___ a) arthritis ___ b) erythema nodosum ___ c) phlyctenular conjunctivitis

___ d) hilar lymphadenopathy ___ e) lupus vulgaris

12. Duration of treatment of TBM is–

___ a) 6 months ___ b) 7 months ___ c) 8 months ___ d) 10 months ___ e) 12 months

13. Number of anti TB drugs used in TBM are

___ a) 3 ___ b) 4 ___ c) 2 ___ d) 5 ___ e) 6

14. Histological landmark of TB lymphadenitis is the presence of–

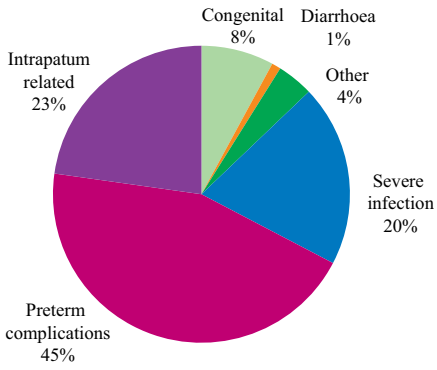
___ a) caseation necrosis ___ b) blast cells ___ c) small round cells

___ d) TB bacilli ___ e) Reed Sternberg cells

Chapter 08

Newborn and Common Neonatal Problems

Neonates are the most vulnerable group to suffer and die. The current neonatal mortality rate (NMR) in Bangladesh is around 28 per 1,000 live births (BDHS' 2014). Of the different causes, perinatal asphyxia, preterm complications and severe infections contribute to around 88% of all neonatal deaths. The other causes of neonatal deaths are congenital malformations, birth injuries, diarrhoea etc. To understand the specific neonatal problem, it is imperative to know the characteristics of healthy term newborn, delivered within 37 to 42 weeks of gestation.



Source: Child Health Epidemiology Reference Group (CHERG)'2010

Characteristics of a healthy term newborn

- Birth weight: 2500 to <4000 grams
- Length: Around 50 cm
- Occipito-frontal circumference (OFC): Approx 35 cm
- Colour: Pink, but mild peripheral (acral) cyanosis soon after birth may be present and is considered normal
- Breathing: Spontaneous, regular and rate is in between 30-60 breaths per minute
- Heart rate: 100-160 beats per minute
- Axillary temperature: 97.5° to 99° F
- Muscle tone: Normal and the baby will be in a flexed position
- Ability to suck: Present soon after birth
- Urine: Most babies pass urine within 24 hours, but some may take 48 hours to pass urine
- Meconium: Most of the babies pass meconium within 24 hours of birth
- Sleep: Around 18 hours a day
- Congenital anomaly: Absent
- Primitive reflexes: Good & stable

Normal newborn with mild peripheral cyanosis

Primitive Reflexes

These are brain stem mediated involuntary movements present since birth in normal term neonates. After persisting for a variable period, these start to disappear with CNS maturation and finally replaced by corresponding voluntary response.

Reflexes	Time of appearance	Time of disappearance
Moro reflex	Birth	3–4 months
Rooting reflex	Birth	3–4 months
Palmar grasp	Birth	2–4 months
Planter grasp	Birth	8–12 months
Sucking reflex	Birth	6–9 months
Stepping reflex	Birth	5–6 weeks
Tonic neck reflex	At 2 months	6–7 months
Landau reflex	At 3 months	12–24 months
Parachuute reflex	At 6–9 months & persists thereafter	

Palmar grasp

Planter grasp

Sucking reflex

Stepping reflex

Courtesy: Dr Farzana Sharmeen

Newborn Care

The pre-requisite for offering optimum care to a sick newborn, is the complete examination of the baby to understand the clinical status. To do so, the doctor should wash his hands properly following the standard techniques as shown below.

Rooting reflex

Moro reflex

NEWBORN CARE

Care at the time of birth

- Following a Clean & Safe delivery
  - Resuscitate the baby in a warm environment to initiate spontaneous respiration
- Cut the umbilical cord aseptically by 1-3 minutes and tie properly
  - Tie about 2 cm from the abdominal skin with umbilical clamp and cut with a sharp sterile instrument above the clamp

- Prevent & manage hypothermia
  - Dry & wrap the baby properly, including head. Use 2 dry and warm clothes. Dry the baby thoroughly with one, and cover the baby with the other
  - If possible, do it under radiant warmer or in a warm environment

- Assess cardio-respiratory status of the baby

  Check baby's respiratory pattern e.g. resp rate, chest indrawing, colour, respiratory drive, heart rate etc.
  - If apnoea,
    - Tactile stimulation
    - Bag & mask ventilation
    - Prepare to refer for further supports
  - If respiratory distress
    - Clean nose, throat and oral cavity
    - Give O_2 using head box or face mask
  - If any life-threatening anomaly or situation
    - Offer emergency support & prepare to refer
  - If preterm & LBW
    - Provide special care (discussed later)
  - If the baby is well with good cardio-respiratory status
    - Keep the baby with mother & support breast feeding
    - Counsel parents on how to keep the baby healthy

Do

- Always communicate with the parents about the status of the baby e.g. any problem

Don'ts

- Bathing immediately after birth
- Oil massage to the baby
- Clean the vernix

Care Following Birth

- Initiate **breast feeding** (colostrum) immediately after birth & no later than 1 hour of birth. Do not offer anything else other than colostrum
- Give Inj. Vitamin K_1 (IM)
  - 1 mg (BW >1000 gm); 0.5 mg (BW<1000 gm)
- Keep the baby warm by wrapping with warm clothes, including head
- Don't allow bathing until 3rd day of life
- Allow Skin-to-skin contact, KMC
- Apply **7.1% chlorhexidine** to cord once. Thereafter, keep it bare, clean and dry

  Washing cord with spirit or use of antiseptic cream is not recommended, as it delays cord shedding.
- Check for passage of urine and mecomium
- Clean eyes with cotton soaked with clean water
- Immunize the baby with BCG,OPV-0 & Hep B vaccine

Daily Fluid Requirement of a newborn

As the babies have larger body surface area and relatively thinner skin than adults, they loose fluid easily. Therefore, their fluid requirement is higher than that of an adult. The fluid demand increases during the 1st week of life as follows–

Day of life	Amount of fluid (ml/kg/day)
1	60
2	80
3	100
4	120
5	140
6 and onward	150

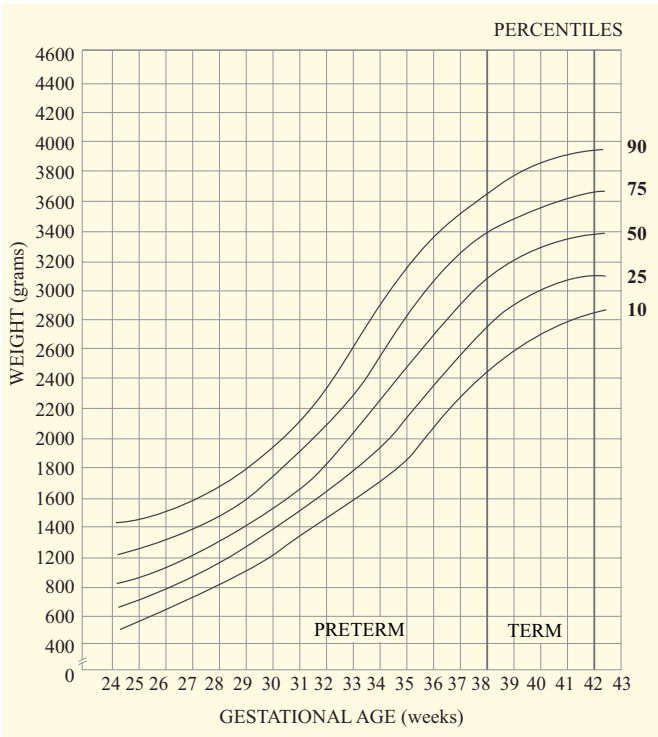
NB

- Daily requirement of fluid for normal term newborns starts with 60 ml/kg and for low birth weight babies it can be started with 80 ml/kg/day
- Daily increment of fluid requirement in normal weighing baby is 20 ml/kg/day and in a LBW baby, it is 15 ml/kg/day. In LBW babies, daily fluid volume can be raised up to 200 ml/kg/day by 14 days
- Babies receiving phototherapy will need extra 10-15 ml/kg of fluid daily
- These are general guidelines but the demand should be individualized according to other associated conditions

COMMON NEONATAL PROBLEMS

LOW BIRTH WEIGHT (LBW) BABY

Babies with a birth weight (BW) of < 2500 grams irrespective of gestational age is defined as LBW. When BW falls below 10th centile for any gestational age, the baby is designated as **small for that gestational age** (SGA) as shown in the **Lubchenco chart** given below. But if the BW is <2500gm (LBW) and falls on a point above 10th centile for a particular gestational age, then this LBW is **appropriate for that gestational age** and is mostly due to prematurity.



Lubchenco chart

Therefore, LBW of a newborn may be related to–

Prematurity–Appropriate for Gestational age (AGA)	Intrauterine growth retardation–Inappropriate/ Small for gestational age (SGA)

Spectrum of LBW

Spectrum	Birth weight
Low Birth weight	< 2500 gm
Very LBW	<1500 gm
Extremely LBW	<1000 gm
Incredible LBW	<750 gm

Level of Maturity of Newborn related to gestational age

Late preterm	34 to upto 37 weeks	239-259 days
Preterm	< 37 weeks of gestation	≤259 days
Term	37 to 42 weeks of gestation	260-294 days
Post term	> 42 weeks of gestation	≥295 days

Causes of Prematurity	Causes of IUGR/SGA
❑ Unknown mostly ❑ Poor socio-economic status ❑ Low maternal age ❑ Maternal diseases e.g. ante-partum haemorrhage, cervical incompetence, maternal genital infections, bicornuate uterus, multiple pregnancy ❑ Foetal malformations	◆ Inadequate placental growth ◆ Multiple gestations ◆ Maternal diseases e.g. hypertension, cardiac or pulmonary disease, malnutrition, chronic illness or severe anaemia ◆ Smoking or smokeless tobacco ingestion by mother ◆ Toxaemias of pregnancy, diabetic vasculopathy ◆ Diseases of foetus e.g. TORCHES infection, chromosomal disorders

Preterm baby with shiny and thin skin

Alert, wasted IUGR baby

Clinical differences between Preterm and Small for date babies

Parameters	Preterm	Small for date/IUGR
Alertness	Less alert	Alert
Movement	Usually less	Comparatively more
Skin	Thin, shiny	May have cracks or peeling of epidermis
Ear lobule	Soft	Like that of normal baby
Breast buds	Less developed	Well developed
Sole crease	Less or none	More
Labia majora	Widely separated	Normal
Limbs	Limp	Semi flexed
Abdomen	Distended with visible coils of intestine	Usually like that of a fully term baby

Problems of Preterm LBW babies

EARLY	◆ Hypothermia (Temperature <95° F) ◆ Hypoglycaemia (RBS < 2.5 mmol/L) ◆ Respiratory distress syndrome (RDS) ◆ Apnoea (caessation of respiration for ≥20 sec) ◆ More chance of acquiring infections ◆ Haemorrhage e.g. minor to fatal intraventricular, GI, pulmonary haemorrhage ◆ Feeding difficulty e.g. inability to suck or to tolerate feed as manifested by vomiting, abdominal distension etc. ◆ Problems of gut e.g. necrotizing enterocolitis (NEC), gastro oesophageal reflux disease (GERD) ◆ Exaggeration of physiological Jaundice ◆ Anaemia of prematurity ◆ Patent ductus arteriosus (PDA)
LATE	◆ Metabolic bone diseases e.g. rickets or osteopenia of prematurity ◆ Retinopathy of prematurity (ROP) ◆ Delayed growth and development ◆ Cerebral palsy and other neurological deficit

MANAGEMENT

In adjunct to all care given for normal newborn, LBW babies need some special care; These are–

A. Keeping the baby warm

- Wrap with adequate clothing (including cap & socks)
- Skin to skin contact **(Kangaroo Mother Care)**
- Bedding with mother
- Keep the room warm (Temp ≥ 25° C) with room heater
- Use radiant warmer, if available

Courtesy: Dr Mahfiza Shirin

Kangaroo Mother Care

B. Maintainance of good nutrition

Ideal feeding method for a LBW baby is determined by their gestational age, birth weight and oral feeding skills.

- ◆ Babies who are very premature (GA ≤ 28 weeks) are often homodynamically unstable and have poor sucking efforts as well as poor propulsive gut motility should be–
  - Put on IV fluid (e.g. 10% DA, 5% DA in 0.225% Nacl)
  - When gut motility as well as the general condition is considered stable, **minimal enteral feeding** (0.5-1ml/feed) may be given 4-6 hourly through orogastric or NG tube to stimulate the immature gut function **(Gut priming)**. If the baby tolerates, then feeding to be continued, 3-4 hourly interval with gradual increament in amount
  - Babies who are kept NPO for prolonged period should receive daily K^+, Ca^{++}, amino acid supplementation and usually started after 48 hours of age
  - Babies >34 weeks who have mature sucking ability and good coordination between sucking/swallowing and breathing should be put to mother's breast
  - Babies between 28-34 weeks who have impaired or no co-ordination between sucking/swallowing and breathing may be fed by orogastric/nasogastric tube, with occasional spoon feeding of expressed breast milk

Preterm LBW neonate under radiant warmer

- Babies should be kept NPO and put on IV fluid, if any of the signs of feed intolerance are seen e.g.

  - Vomiting
  - Abdominal distension
  - Pre-feed aspirate, if >50% of previous feed volume

C. Give Vitamin K_1 1mg IM/IV within 4 hours of birth

D. Protect against Infection

- Wash hands properly before touching the baby. Handle the baby as minimum as possible
- Don't give prelacteal feed
- Keep the umbilical stump bare, clean and dry
- Avoid overcrowding around the baby

E. Assess the following parameters regularly in hospital

- Overall activity
- Body temperature
- Sign of fluid overload/ dehydration
- Appearance and extent of jaundice
- Respiratory distress, apnoea
- Heart: arrythmia, murmur
- Weight of the baby
- Mottlings on skin
- Abdominal distension
- Evidence of sepsis
  - Lethargy
  - Stopped feeding well
  - Respiratory distress
  - Rash
  - Bulged fontanelle Convulsion, etc.
- Passage of urine and stool

F. Laboratory assessment, may be needed depending on specific clinical situation e.g. blood glucose, CBC, CRP, procalcitonin etc.

G. When to plan for Discharge?

- Able to maintain body temperature
- Neither apnoea nor bradycardia for 5 days
- Able to take and tolerate full feeding from breast or cup-spoon without respiratory discomfort
- Parents confident enough to take care of the baby at home
- Has crossed birth weight and shows a steady weight gain for 3 consecutive days

H. Provide vitamins & micronutrient supplements

Name	When to start	Duration
Tab Folic acid one-fourth tablet on every alternate day	Baby on full enteral feed, usually by 2 weeks of age	6 months
Multivitamin drop including vit D 6 drops once daily	Baby on full enteral feed, usually by 2 weeks of age	6 months
Iron (2 x birth weight in kg) drops once daily (4-6 mg/kg/day)	At 6 weeks of age	6 months

Follow up

All preterm LBW babies should be followed up. During each follow up visit the following parameters should be addressed–

- Growth monitoring e.g. weight, length, OFC
- **Evidence of micro-nutrient deficiency** e.g. anaemia, rickets, osteopenia of prematurity
- Screening for Retinopathy of prematurity (to be done between 20-30 days of postnatal age)
- Hearing assessment
- Assessment for milestones of development
- Looking for any physical or neuronal deficit

POST MATURITY/POST TERM

Babies, born at gestational age exceeding 42 weeks are called post-mature.There is high incidence of perinatal deaths among these babies.

PATHOGENESIS

The major pathological event behind high mortality & morbidity among the post-mature babies are **utero-placental insufficiency.** This may gives rise to–

- Oligohydramnios
- Foetal hypoxia & distress, acidosis
- In-utero passage of meconium & aspiration during or after birth (Meconium aspiration syndrome)
- Primary pulmonary hypertension (PPHN)

CLINICAL MANIFESTATIONS

- Growth retardation
- Increased alertness
- Abundant scalp hair
- Parchment like or desquamating skin

- Creases on the baby's palms and soles
- Minimal fat
- Overgrown nails
- Features of placental insufficiency (loose skin especially around the thigh and buttock)

Complications

- Meconium aspiration syndrome
- Polycythaemia
- Congenital anomalies
- Perinatal asphyxia
- Persistent pulmonary hypertension
- Hypoglycaemia, Hypocalcaemia

Treatment

- Counsel parents about the consequences of the baby
- Manage accordingly, if any problem identified

PERINATAL ASPHYXIA (PNA)

Perinatal asphyxia (PNA) is a clinical condition resulting from impairment of gas exchange in the foetus leading to hypoxia, hypercarbia and acidosis. This ultimately culminates into failure to establish and sustain spontaneous respiration immediately after birth.

Gas exchange: Foetal to Neonatal transition

Normally**,** in **utero**, the placenta provides O_2 to the foetus and removes CO_2 from the foetus. After **birth**, lungs of the newborn take over this responsibility and to do it efficiently, the following 3 changes occurs after birth–

- Replacement of alveolar fluid by air with the onset of breathing
- Rise of pressure in systemic circulation by constriction of umbilical vessels
- Fall of pressure in pulmonary vascular bed

Majority of newborn babies pass through these changes smoothly without any intervention. However, some babies cannot pass this transition without help. As a result,they may face acute hypoxic insult and this incapacitating them to breathe spontaneously.

Stimuli to initiate respiration at birth

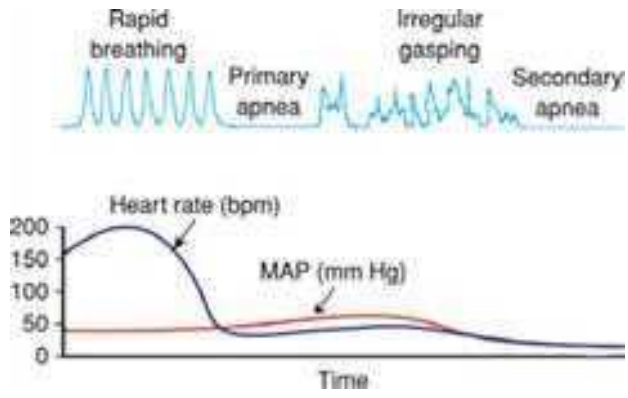
- Decreased PaO_2, rise of $PaCO_2$ & fall of blood pH
- Redistribution of cardiac output
- Decreased body temperature
- Various tactile and sensory stimuli

Risk factors

- Maternal illnesses
  - Hypertension,
  - Prolonged/ Obstructed labour,
  - Eclampsia,
  - Diabetes,
  - Hypotension,
  - Anaemia,
  - Uterine rupture and
  - Systemic disease
- Placental pathology
  - Abruptio placentae
- Umbilical cord accidents
  - Prolapse
  - Cord around the neck
  - Knot
  - Compression
- Foetal illnesses
  - Anaemia
  - Infection
  - Severe cardiac malformations/ Circulatory insufficiency
- Neonatal illnesses
  - Congenital malformation of lungs or heart
  - Persistent pulmonary hypertension,
  - Cardiomyopathy

Pathogenesis & Consequences

When a foetus faces acute hypoxia in utero (*antepartum or intrapartum)*, then certain cardio-respiratory and biochemical sequence of events occur. Initially, breathing effort increases but continuing hypoxia makes the foetus unconscious and finally, the respiratory center stops functioning. The foetus thus enters into the stage of **primary apnoea** which, if remains unattended, agonal gasps ensue, culminating in **terminal apnoea.**



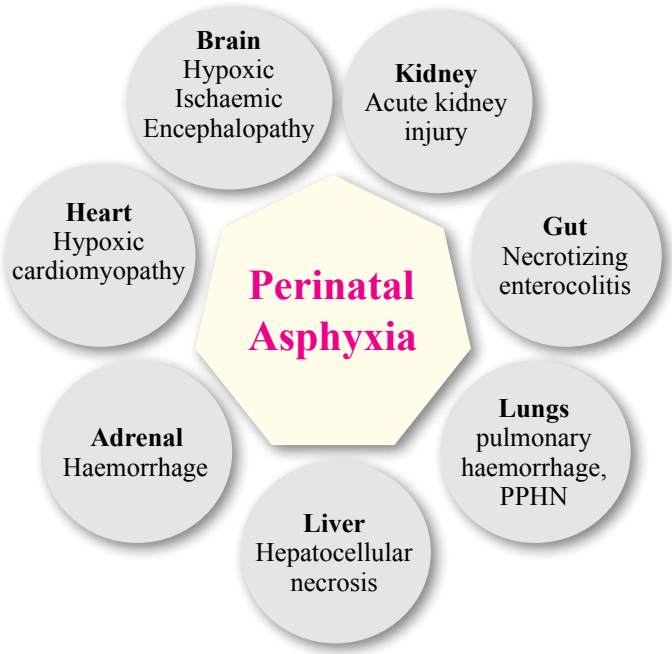
Concomitant to these respiratory events, other changes also occur in–

- Heart: Heart rate drops down after a brief initial rise. Cardiac output is redistributed with preference for maintaining perfusion of heart, brain and adrenals.

Accumulation of CO_2 and Lactic acids (bi-product of anaerobic metabolism) leads to increasing acidosis which further deteriorates cardiac functions and finally heart stop.

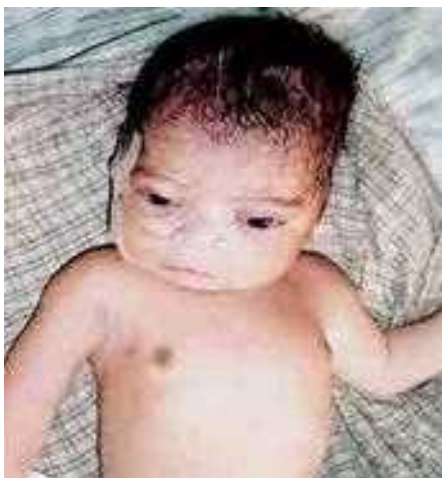
Therefore, a baby who fails to breathe spontaneously immediately after birth may be either in primary apnoea, gasping respiration or in terminal apnoea and **Resuscitation** is the only way to save these babies.

The most serious consequence of PNA is **Hypoxic Ischaemic Encephalopathy (HIE)**. However, other organs may also be affected, particularly–



CLINICAL MANIFESTATIONS

- The asphyxiated baby presents with–
  - No respiration, no cry
  - Absent or weak respiratory efforts
  - Gasping respiration with long pauses in between respirations
  - Convulsions (HIE)
  - Pale colour (asphyxia pallida)
  - Bradycardia (<100 beats/min)
  - Less tissue perfusion (capillary refill time > 3 sec)
  - Muscular hypotonia
  - Features of acute kidney injury e.g oliguria



An asphyxiated baby (vacant stare)

HYPOXIC ISCHAEMIC ENCEPHALOPATHY (HIE)

This is an abnormal neuro-behavioral state that accompanies severe perinatal asphyxia. It is due to both hypoxia as well as due to impaired cerebral blood flow (ischaemia) in an asphyxiated baby. The severity of this neurologic syndrome is related to the extent of brain injury and is classified into 3 stages–

HIE I	Hyperalert, irritable with dilated pupils and strong moro reflex. Muscle tone normal. Symptoms usually persist for <24 hours
HIE II	Convulsion, lethargy, weak moro reflex, mild hypotonia and constricted pupils
HIE III	Comatose, flaccid muscles, absent primitive reflexes , diminished or absent spontaneous movement and unequal pupils

Ref: Sarnat '1976

MANAGEMENT

A. Effective resuscitation at birth, the cornerstone of management

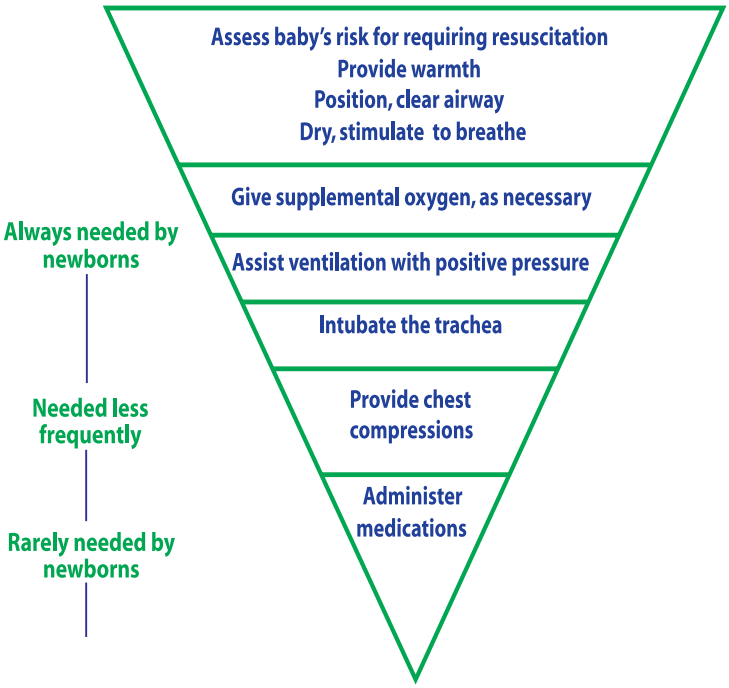
B. Post-Resuscitation care

Resuscitation: Preparation

- Person: At least one person trained in newborn resuscitation
- Warm environment: By closing windows, minimizing draughts, pre-warming towels, head covering for the baby, heater/radiant warmer
- Resuscitation surface: Arrange flat & firm surface
- Resuscitation equipments:
  - Self-inflating bag with correct sized mask
  - Oxygen source
  - Pulse-oxymeter with probe
  - Intubation equipments: Laryngoscopes with straight blades, endotracheal tubes
  - Drugs: Adrenaline *(1:10,000)*, Naloxone, 10% D/A, 0.9% NaCl
  - Others:
    - Stethoscope
    - Umbilical venous catheter

A. Resuscitation at birth

It is a set of interventions, required at the time of birth to support establishing breathing and circulation. The interventions support to achieve normal transition rather than imposing an alternate process.



Steps of Resuscitation at a glance

The key points are:

- **Keep the baby warm by**
  - Immediate drying and wrapping the baby including head with a dry warm towel
  - Providing a room heater, if available
- **Open and maintain airway** by
  - Keeping the baby in neutral airway position (neither over-extension nor hyperflexion of neck)
  - Chin lift & jaw-thrust
  - Placing a roll of towel (2 cm) under baby's shoulders
  - Clearing the airway by gentle suction
- **Support breathing** by
  - Stimulating the baby e.g. rubbing the back gently, slapping or flicking the soles of the feet
  - Positive pressure ventilation using bag and mask with or without Endotracheal tube
- **Maintain oxygenation and circulation** by
  - Chest compression and coordinated positive pressure ventilation
  - Mechanical ventilation

B. Post-Resuscitation management

- **Maintain body temperature** (mentioned earlier)
- **Support respiration** by–
  - Supplemental O_2 by nasal canula (2 L/min), head box (5-6 L/min)
  - Mechanical ventilation
- **Maintain adequate hydration, electrolyte, calcium and glucose homeostasis** by
  - Infusion of appropriate I/V fluid with 10-20% restriction of total daily allowance
- Regular **monitoring** of
  - Respiratory status: • Respiratory rate • Cyanosis • Rhythm & pattern
  - Circulatory status: • Heart rate • BP • CRT
  - Renal functional status: • Urine volume • S creatinine
  - Capillary blood glucose status
  - Arterial blood gas (ABG) analysis, when needed
- **Treatment of specific situations**
  - If shock *(CRT>3 sec, low volume pulse, low BP):*
    Infuse Normal Saline bolus, 10 ml/kg over 30 min
    Give Dopamine/Dobutamine, 5-10 µgm/kg/min
  - If convulsion: Control as per protocol (Page 67)
  - If sepsis: Parenteral broad-spectrum antibiotics

Prognosis

- Overall mortality: 10-30%. Among the survivours, 15-45% may develop the following neuro developmental sequelae
  - Cerebral palsy ❑ Cranial nerve palsy
  - Epilepsy/Seizure disorders ❑ Intellectual disability
  - Deafness,Visual problems ❑ Microcephaly

The Steps of Resuscitation (WHO 2005)

Neonatal resuscitation

- Dry baby with clean cloth and place where the baby will be warm.

Look for
- Breathing or crying
- Good muscle tone
- Colour pink

YES → Routine care

NO

A (30 SECONDS)
- Position the head of the baby in the neutral position to open the airway.
- Clear airway, if necessary.
- Stimulate, reposition.
- Give oxygen, as necessary.

Breathing and pink → Routine care and observe closely

Not breathing, cyanosed

- Use a correctly fitting mask and give the baby 5 slow ventilations with bag.

Breathing → Observe closely

If not breathing

B (30 SECONDS)
- Check position and mask fit.
- Adjust position, if necessary.
- Provide ventilation with bag and mask.
- If chest not moving well.
- Suction airway.

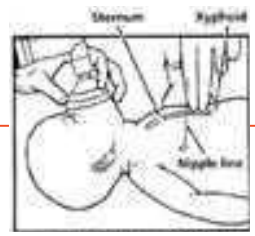
CALL FOR HELP!

- Check the heart rate (HR) (cord pulsation or by listening with stethoscope).

If HR <60/min → Compress the chest

If HR>60/min

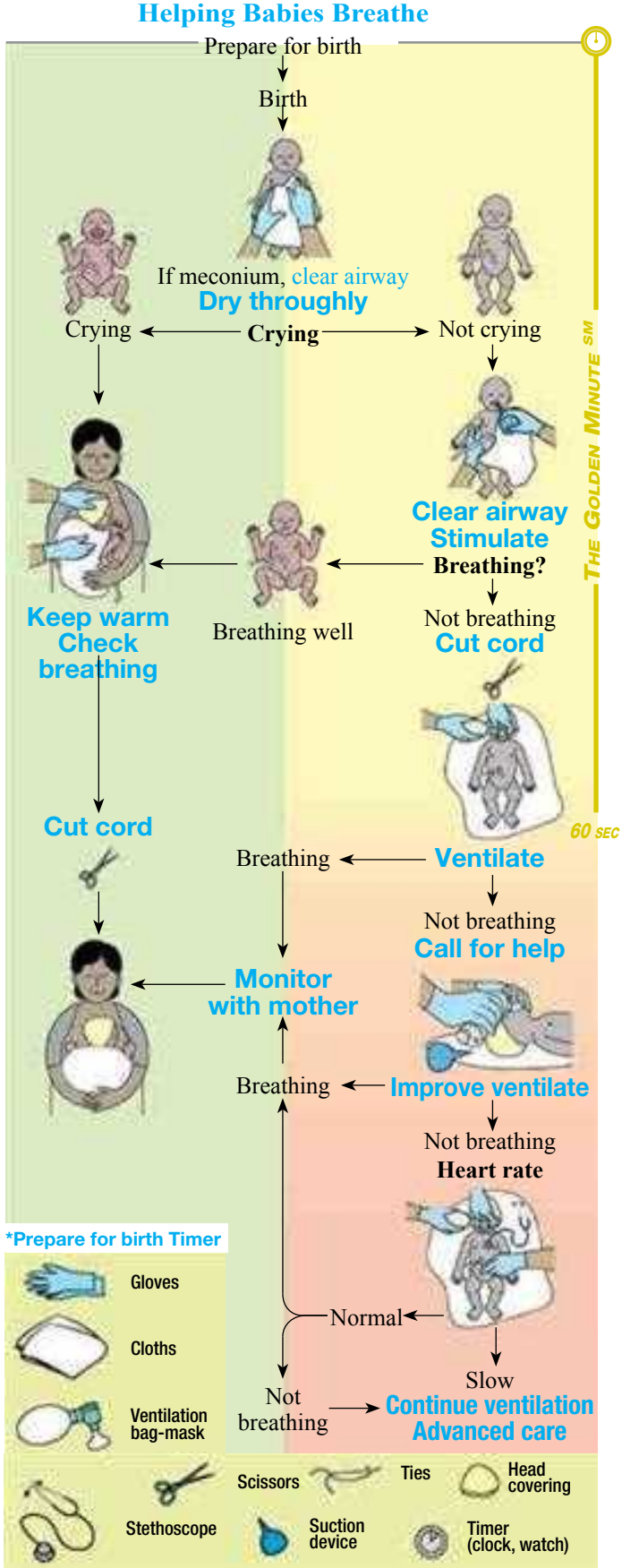
C
- Continue to bag at a rate of about 40 breaths per minute.
- Make sure the chest is moving adequately.
- Use oxygen if available.
- Every 1-2 minutes stop and see if the pulse or breathing has improved.
- Stop compressions once the HR >100/min.
- Stop bagging when respiratory rate >30/min.
- Continue oxygen until pink and active.



If after 20 minutes of resuscitation the baby is not breathing and pulse is absent stop all efforts and counsel parents that the baby has expired.

ACTION PLAN

Helping Babies Breathe



Adapted from: American Academy of Pediatrics. Helping Babies Breathe, Learner Workbook; 2010

RESPIRATORY DISTRESS IN NEWBORN

Whenever, a neonate presents with respiratory distress, the following conditions should be considered–

- Respiratory distress syndrome (RDS)
- Perinatal asphyxia
- Transient tachypnoea of newborn (TTN)
- Meconium aspiration syndrome
- Congenital pneumonia
- Spontaneous pneumothorax
- Diaphragmatic hernia, eventration of diaphragm
- Persistent pulmonary hypertension
- Congenital heart diseases/heart failure
- Pulmonary hypoplasia or cong. anomaly of resp tract

In this section RDS and TTN will be discussed.

RESPIRATORY DISTRESS SYNDROME (RDS): HYALINE MEMBRANE DISEASE

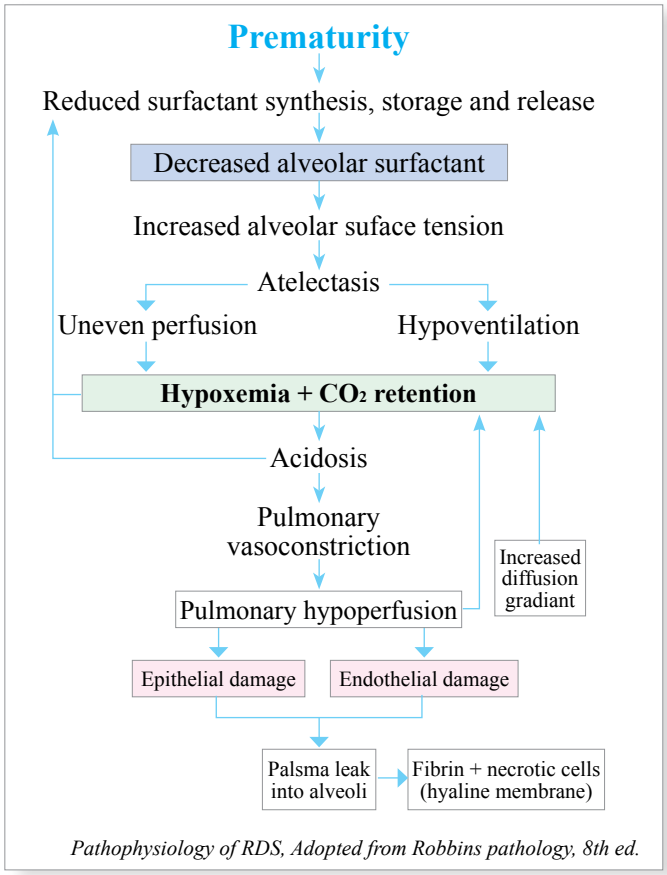
RDS (also known as hyaline membrane disease) is defined as respiratory difficulty starting shortly after birth, commonly among preterm infants, and is due to deficiency of **Surfactant**.

RISK FACTORS

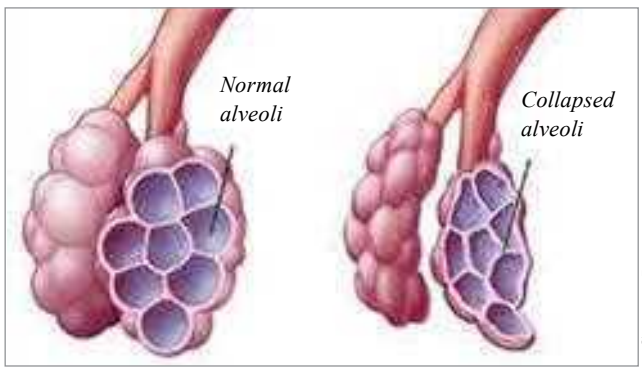
- Prematurity
- Infant of diabetic mother
- Early cord clumping
- Hypothermia
- Caesarean section
- Birth depression
- Others e.g. boys>girls, 2nd twin, genetic predisposition

PATHOGENESIS

Normally, surfactant (released by type 2 pneumocytes, appears in foetus by 23-24 weeks of gestation, but adequate amounts are not secreted until 30-32 weeks of gestation) reduces surface tension in the alveoli so that they can inflate. In RDS, surfactant deficiency results in collapse of alveoli. This causes, reduced air entry in alveoli, impairment in gas exchange, hypoxia & hypercarbia, acidosis and finally respiratory distress and respiratory failure.



Pathophysiology of RDS, Adopted from Robbins pathology, 8th ed.



Source: Internet

CLINICAL MANIFESTATIONS

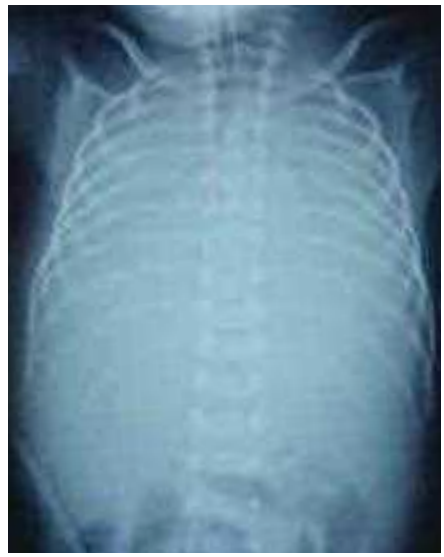
- Respiratory distress within 1st hour of birth in a preterm baby as manifested by–
  - Fast breathing (>60 breaths/min)
  - Flaring of alae nasi
  - Sternal & intercostal retraction, chest indrawing
  - Grunting
- Cyanosis
- Manifestations of reduced air entry into lungs e.g. paucity of chest movement, feeble breath sounds
- Falling Oxygen saturation (SPO_2< 90%)

DIAGNOSIS

Diagnosis is based on clinical presentation and supports from relevant investigations

Investigations

- X-Ray Chest, shows–
  - Ground glass appearance
  - Air bronchogram
  - Complete white out lungs e.g. loss of demarcation/ visualization of heart borders
  - Pneumothorax & pneumome-diastinum (in case of associated air leak)



Ground glass appearance with air bronchogram

- Blood
  - CBC, PBF: Non specific
  - CRP: Raised, if associated infection
  - Arterial blood gas (ABG): Altered e.g. acidosis
  - Serum electrolytes: May have dyselectrolytaemia

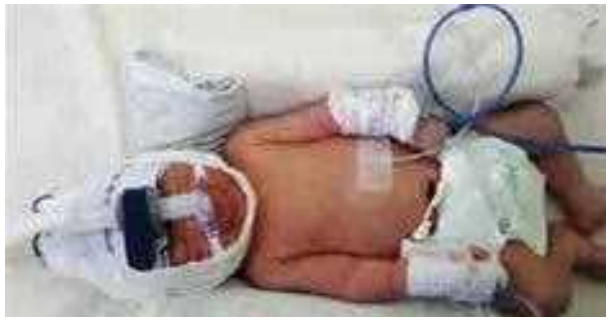
MANAGEMENT

A. Supportive

- Keep the baby warm e.g. keeping under radiant warmer, covering the baby with warm clothes
- Keep the baby NPO and put on appropriate IV fluid 10% DA upto 1st 24 hours then 5-10% Dextrose in 0.225% NaCl
- Respiratory support e.g. Clearing airway, giving O_2 (3-4 L/min) through head box

O_2 supplementation through Head box

- If baby does not improve and develop severe breathing difficulty with falling SPO_2, then keep the baby on **nCPAP** and if required on **mechanical ventilator**



Respiratory support with CPAP

Courtesy: Dr. Farzana Sharmeen

Newborn in mechanical ventilation

- Regular bedside monitoring of–
  - Respiratory status e.g. cyanosis, respiratory rate, rhythm & pattern, air entry, SPO_2
  - Circulatory status e.g. CRT, heart rate, BP
  - Body temperature
  - Capillary glucose status
- Arterial blood gas (ABG) analysis, when indicated
- If sepsis, IV Antibiotics *e.g. Ampicillin plus Gentamicin*

B. Specific

- Administer **Surfactant** (Dose: 4 ml/kg. Divide into 4 aliquots) and introduce through ET tube. During this process, keep the baby either on CPAP or on ventilator

TRANSIENT TACHYPNOEA OF NEWBORN (TTN): WET LUNGS

Transient tachypnoea of newborn (TTN) is a relatively mild, self-limited pulmonary disorder, usually noted among babies who are born at/near term.

AETIOLOGY: Unknown.

PATHOPHYSIOLOGY

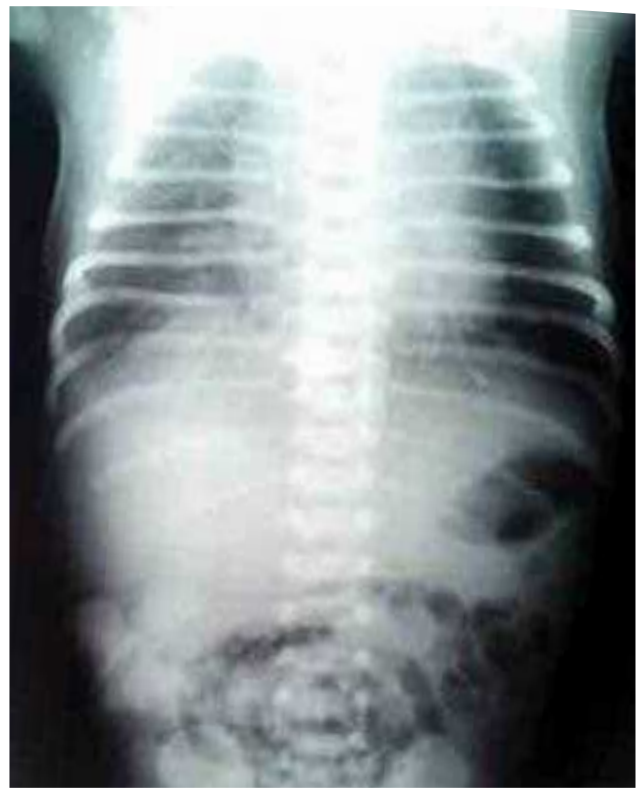
TTN results from **delayed absorption** of fluid from foetal alveoli which leads to alveolar hypoventilation with a variable severity of respiratory distress and the related consequences.

CLINICAL MANIFESTATIONS

- Mild to moderate respiratory distress as manifested by–
  - Tachypnoea
  - Chest retractions
  - Cyanosis
  - Flaring of alae nasi
  - Grunting (occasional)

Investigations

- X-Ray chest: Shows prominent vascular markings, fluid in the interlobar fissure, over-aeration, flat diaphragm
- CBC, CRP: Non-specific



TREATMENT

- Mainly supportive *e.g.*
  - Keep the baby warm
  - O_2 inhalation, 2 L/min (by nasal canula), 5-6 L/min, by head box
  - NPO and infusion of appropriate IV fluid
  - Antibiotics–usually not required

Prognosis

Good with uneventful recovery by 24-48 hours.

NEONATAL SEPSIS (NS)

Sepsis is one of the leading cause of neonatal morbidity and mortality. It is defined as presence of microorganisms, their proliferation with production of toxins in the blood. Based on the time of acquisition of infection, neonatal sepsis is divided as–

- **Early onset sepsis (EONS):** Sepsis that is acquired before or during birth and manifested within first 72 hours of birth
- **Late onset sepsis (LONS):** Sepsis that is acquired after delivery (in the nursery or in the community), manifested usually after 72 hours of birth

AETIOLOGY

Common Organisms

EONS	LONS
❑ Group B Streptococcus ❑ *Escherichia coli* ❑ *H. Influenzae* ❑ Klebsiella sp ❑ *Listeria monocytogenes*	◆ *Staphylococcus aureus* ◆ Coagulase-Ve Staph. ◆ *Klebsiella pneumoniae* ◆ *Pseudomonas aeruginosa* ◆ Acinetobacter ◆ Candida sp. ◆ Enterobacter ◆ Serratia

RISK FACTORS

- Prematurity (< 37 weeks)
- Low birth weight (<2500 grams)
- Febrile illness of mother with evidence of bacterial infection within 2 weeks of delivery
- Foul smelling and/or meconium stained liquor
- Rupture of amniotic membrane >18 hours
- Single unclean or > 3 sterile vaginal examination(s) during labour
- Prolonged labour (sum of duration of 1st & 2nd stage of labour > 24 hours)
- Perinatal asphyxia (APGAR score <4 at 1 minute)
- Mechanical ventilation
- Invasive procedures
- Poor hygiene, poor cord care
- Bottle-feeding, prelacteal feeds

CLINICAL MANIFESTATIONS

I. **Nonspecific,** in most cases

- Not feeding well/refusal to suck
- Less alert/less active
- Hypo or hyperthermia
- Lethargy, poor muscle tone, less movement
- Poor cry
- Movement, only when stimulated or no movement at all
- Primitive Reflexes– Diminished or Absent

Lethargic baby

II. Specific, and related to the involvement of specific body systems.

Systems	Clinical features
◆ Central nervous system	Irritability, full fontanelle, seizure, vacant stare, high pitched cry, neck retraction, hypotonia.
◆ Respiratory system	Grunting, apnoea, irregular breathing, fast breathing, severe chest indrawing or cyanosis.
◆ Cardio-vascular system	Bradycardia or tachycardia, features of shock e.g. hypotension, poor perfusion (prolonged capillary refilling time > 3 sec).
◆ Skin changes	Periumbilical redness or foul smelling umbilical discharge, multiple pustules, mottling, sclerema
◆ Haemato-logical	Anaemia, jaundice, bleeding e.g. petechiae, purpura.
◆ Kidneys	AKI, manifested as oliguria or anuria.
◆ GIT	Vomiting, abdominal distension, hepato-splenomegaly, jaundice.

DIAGNOSIS

Based on clinical suspicion, suggestive C/F and supportive findings from relevant investigations.

Investigations

- CBC with PBF
  - TC & DC of WBC: Increase or decrease
  - Hb: May be decreased
  - Platelets: May be decreased
  - PBF: Shows toxic granules or band form of neutrophil
- Blood
  - Sepsis Screening

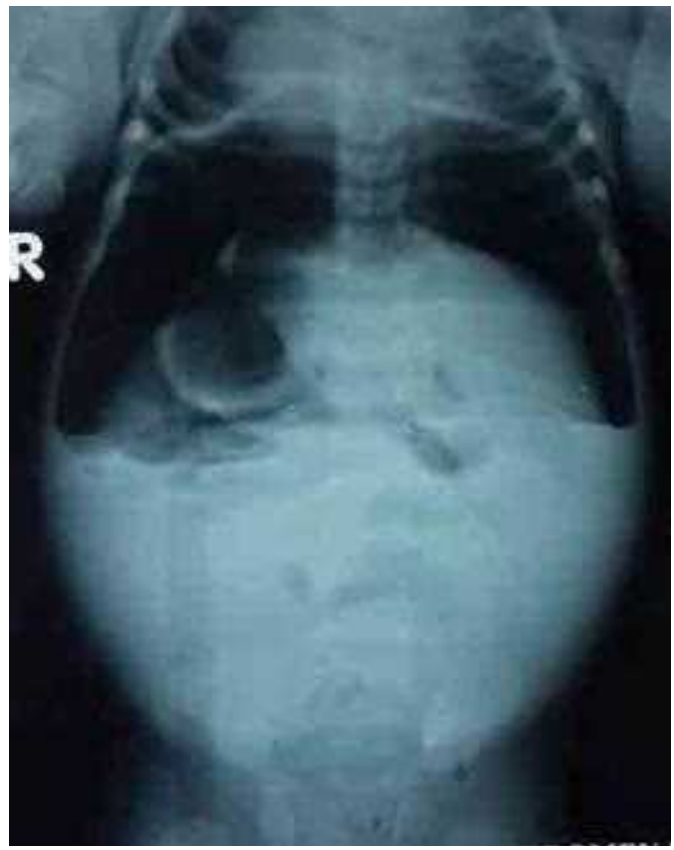
Sepsis screening	Total leucocyte count	< 5,000/cmm
	Absolute neutrophil count	<2500/cmm for term <1000/cmm for preterm
	Immature to total neutrophil (I:T) ratio	> 0.2
	C reactive protein (CRP)	Positive
	Micro-ESR	>15 mm in 1st hour
	Haptoglobin	Positive (>1mg/dl)

  - Procalcitonin: Raised
  - Culture & sensitivity: May reveal the organism
  - CSF study: Evidence of meningitis–
    - Hazy CSF • Plenty of WBC • Low glucose
    - Raised CSF pressure • Raised protein etc.

CSF PROFILE OF HEALTHY TERM NEONATES

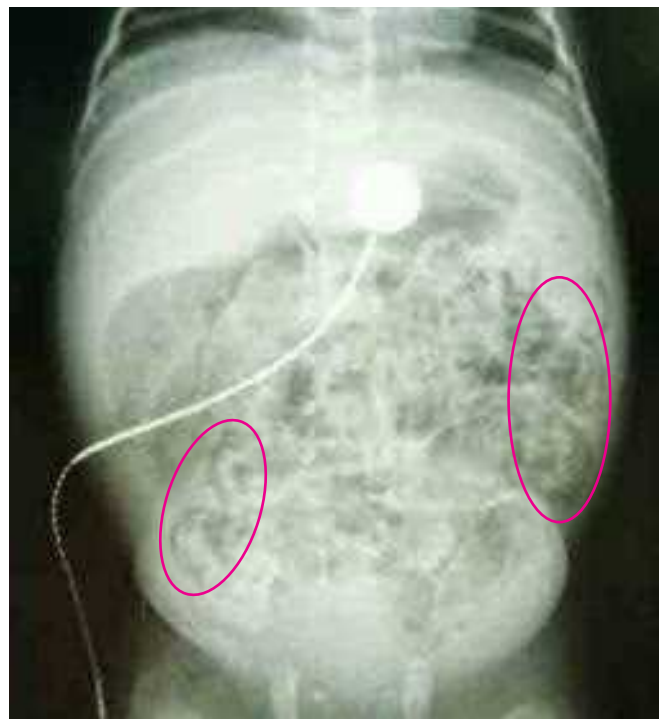
Parameters	Result
Appearance	Clear
Cell count (WBC)	0-30 /mm^3; PMN 60%
Protein (mg/dl)	90 (Range:20-170)
Glucose (mg/dl)	52 (Range: 34-119)

- Urine study (R/M/E, C/S): Evidence of UTI e.g. presence of pus cells, RBC, albuminuria, growth of bacteria and antibiotic sensitivity
- X-Ray Chest: To look for any evidence of pneumonia
- X-Ray abdomen: Evidence of NEC e.g.
  - Pneumatosis intestinalis
  - Gas in portal vein
  - Pneumoperitonium (subdiaphragmatic gas), as occurs in perforation of gut



Pneumoperitoneum (Drooping Lily sign)

- Ultrasonogram of brain or others as individualized



Courtesy: Prof. Shahida Akhter, Dr, Baki, BIRDEM

Pneumatosis intestinalis

TREATMENT

- Hospitalize the baby

A. Specific: Select the recommended antibiotics

1st line	Ampicillin + Gentamicin
2nd line	Ceftazidime + Amikacin
3rd line (Reserve)	Meropenem, Ciprofloxacin, Vancomycin, Cefepime, Clarithromycin, Netilmicin, Imipenem, Piperacillin + Tazobactum, Colistin
In suspected meningitis	Cefotaxime + Amikacin or Meropenem + Amikacin

N.B. Antibiotics are given parenterally and may be changed according to culture & sensitivity report. Empirical use of reserve antibiotics should be avoided.

Duration of Antibiotic Therapy

Diagnosis	Duration
Risk factor positive i.e. (clinically well, culture negative, screen negative)	2-3 days
Risk factor positive, screen positive (clinically well, culture negative)	5-7 days
Clinically sepsis (screen negative)	7 days
Clinically sepsis, screen positive (culture negative)	7-10 days
Blood culture positive but no meningitis	14 days
Meningitis (with or without positive blood/CSF culture)	21 days

B. Supportive

- **Hypothermia**: Wrapping the baby with warm towel, keeping under radiant warmer or in incubator
- **Hypoglycaemia**: Intravenous, 10% DA @ 2 ml/kg stat
- **Nutrition**: Breast feeding
  - If sucking is not satisfactory, then naso-gastric/ oro-gastric feeding with expressed breast milk
  - If baby can not tolerate oral/naso-gastric feeding, infuse appropriate IV fluid with restriction of 20% from the normal daily allowance
- Other supportive options e.g.
  - IV immunoglobulin (contains IgG & also IgM, IgA)
  - Granulocyte-colony stimulating factor (G-CSF)
  - Exchange transfusion

C. Follow up (during hospital staying)

- Vital signs e.g. heart rate, respiratory rate, BP and temperature
- Primitive reflexes e.g. sucking, rooting, moro and others
- Skin condition e.g. texture, colour, tissue perfusion, any mottling etc.
- Anterior fontanelle e.g. any bulging or fullness
- Abdomen e.g. any distention, presence of bowel sound, passage of urine and stool
- Any untoward events e.g. convulsion, apnoea, cyanosis etc.

Interventions addressing newborn complications and sickness '2014

- 7.1% Chlorhexidine application as part of routine ENC for umbilical cord care to reduce infection
- Antenatal corticosteroid (ACS) e.g. Betamethasone (not available in Bangladesh)/Dexamethasone injection during threatened preterm labour by skilled providers to promote lungs maturation
- Kangaroo Mother Care (KMC) for thermal protection of preterm/low birth weight newborns
- Management of newborn sepsis using simplified treatment protocol (oral Amoxycillin, IM Gentamicin) in lower level facilities

NEONATAL JAUNDICE

About 60% of term and 80% of preterm neonates develop jaundice during first week of life. Although most of the neonatal jaundice are physiological but it always demands

Newborn with jaundice extending to palms & soles

special attention because of the serious toxic effect of bilirubin to the brain [bilirubin induced neuronal deficit (BIND) or commonly known as kernicterus.

AETIOLOGY

Jaundice appears within 1st 24 hours of life	
◆ Rh incompatibility ◆ ABO incompatibility ◆ Congenital spherocytosis	◆ Minor blood group incompatibility ◆ G-6-PD deficiency
Jaundice appears within 3-10 days of life	
◆ Physiological jaundice ◆ Jaundice of prematurity ◆ Sepsis	◆ Crigler-Najjar syndrome ◆ Galactosaemia

Jaundice persists beyond 2 weeks of life

- ◆ Unconjugated
  - ❑ Breast milk jaundice
  - ❑ Hypothyroidism
  - ❑ Pyloric stenosis
  - ❑ Galactosaemia
- ◆ Conjugated
  - ❑ Intra-hepatic cholestasis e.g. sepsis, idiopathic neonatal hepatitis and other metabolic disorders
  - ❑ Extra hepatic cholestasis e.g. biliary atresia, choledocal cyst

Physiological Jaundice

- ◆ Appears on 2nd-3rd day of life
- ◆ Reaches it's peak by 5th-6th day
- ◆ Declines by 7th-8th day of age (term) & 10th-11th day (preterm)

Non-physiological (Pathological) Jaundice

- ◆ Appears on the 1st day of life
- ◆ Lasts longer than 14 days in term & 21 days in preterm babies
- ◆ Rate of rise of S. bilirubin of > 0.5 mg/dl/hour or ≥ 10 mg/dl/day
- ◆ Jaundice with signs of sepsis/sickness
- ◆ Jaundice extended upto palms and soles
- ◆ Jaundice with pale stool & yellow urine

HAEMOLYTIC DISEASE OF NEWBORN

- Rh incompatibility
- ABO incompatibility

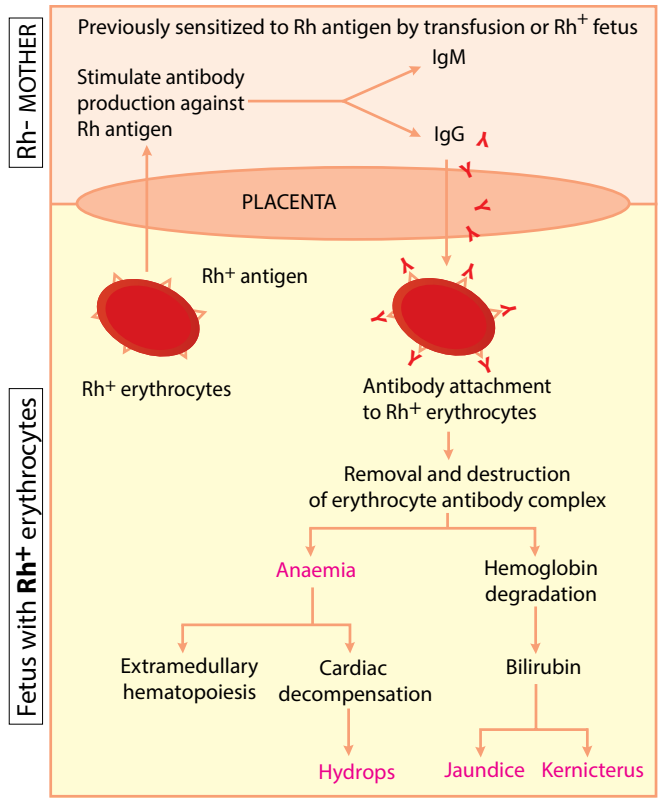
Rh incompatibility

In this condition, blood group of–

◆ Mother	Rh negative
◆ Foetus/Newborn	Rh positive

PATHOGENESIS

The major effect of Rh-incompatibility is immune mediated haemolysis due to sensitization of mother's immune system by the **D** antigens of foetal RBC.



Pathogenesis of immune haemolysis in RH incompatibility
Adopted from Robbin's & Cotran's pathology '2010

During last trimester of pregnancy or during child birth, Rh (D) positive foetal RBC reach maternal circulation. This undue exposure of mother's immune system to D antigen **(life-long memory)** evokes an immunological response with production of anti-D immunoglobulin(Ig) in maternal circulation. Initial exposure produces **IgM** (cannot cross placenta), so in 1st pregnancy, Rh incompatibility induced haemolysis & consequences are uncommon.

However, exposure during subsequent pregnancies provoke a brisk immunological response with huge production of **IgG** anti-D in maternal circulation. These IgG, then cross placenta freely and enter into foetal circulation where they coat foetal RBC and cause haemolysis.

The newborn thus suffers from–

- ❑ **Severe anaemia**
- ❑ **Severe jaundice** and occasionally
- ❑ **Hydrops foetalis** *(generalized oedema from anaemic heart failure and low serum albumin)*

ABO incompatibility

In this condition, the blood groups of–

Mother:

O positive and that of foetus is either A or B positive

Antibody profiles of different blood group antigens

	Blood Group	Natural Antibodies
Mother	O	Anti A – IgM Anti B – IgM
Baby	A	Anti B – IgM
	B	Anti A – IgM
	AB	None

PATHOGENESIS

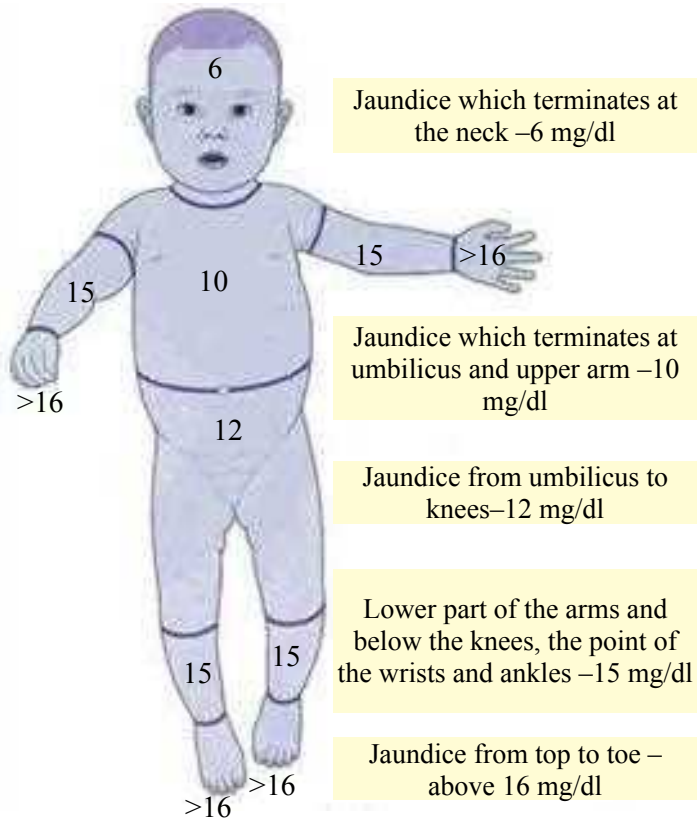
For unknown reason(s), certain O positive mother possess IgG anti-A and anti-B antibodies in their circulation instead of IgM type and these IgG antibodies crossing placenta, enter in foetal circulation and causes haemolysis, jaundice and anaemia though with less severity than Rh incompatibility.

DIAGNOSIS

By both clinical and laboratory evaluation.

Clinical Evaluation

- History: Relevant points are–
  - Age of appearance of jaundice
  - Order of pregnancy
  - H/O jaundice in previous child
  - H/O death of any baby due to jaundice
  - Blood group & Rh typing of both baby and mother
  - H/O any intra-uterine deaths, abortion in Rh –ve mother in her previous pregnancy
  - Physical examination: To look specially for–
    - Extent of jaundice: Upto palms & soles
    - Severity of anaemia: Mild, moderate or severe
    - Hepato-splenomegaly: Present or not
    - Evidence of sepsis e.g. lethargy, poor feeding etc.
    - Presence of any concealed haemorrhage
    - Profile of primitive reflexes
    - Presence of any abnormal neurological behaviour e.g.convulsion, rigidity



***Kramer's** rule for approximate levels of S. bilirubin*

Investigations

- Serum bilirubin (total, direct, indirect): Indirect bilirubin level is increased in physiological jaundice & haemolytic disease of newborn but direct bilirubin is increased in sepsis, neonatal hepatitis, biliary atresia etc.
- Blood group and Rh typing of both baby and mother
- Haemoglobin: Reduced due to haemolysis
- CBC & CRP: Altered when associated sepsis
- Peripheral blood film: To see evidence of haemolysis e.g. fragmented RBC, nucleated RBC, toxic granules (present in sepsis) etc.
- Reticulocyte count: Increased from compensatory erythropoiesis, in response to anaemia from haemolysis
- Coombs tests (direct & indirect): May be positive in Rh and ABO incompatibility
- Other investigations done in severe jaundice when exchange transfusion is decided e.g. S. albumin, calcium, electrolytes, creatinine

TREATMENT

Most of the neonatal jaundice are physiological and usually do not require any treatment except–

- Counseling to parents
- Advising for exclusive breast feeding
- Follow up

But if S bilirubin is raised at a level when treatment is indicated, then the baby should be referred urgently for further evaluation & treatment. The treatment options are–

- **Phototherapy**
- **Exchange transfusion (ET)**

The treatment options are chosen, considering baby's–

- Total Serum bilirubin (TSB) level
- Gestational age
- Age of appearance of jaundice and
- Presence of any risk factors of kernicterus

Baby under phototherapy

Phototherapy

- Most effective with blue light (wave length 329-333nm)

Mechanism of phototherapy

After absorbing light from skin surface, bilirubin undergoes 3 chemical changes–

- Photo-isomerisation and changing to a less toxic isomer that readily excretes in bile
- Structural isomerization and changing to lumirubin and readily excreted in bile and urine
- Photo-oxidation and changing to a more polar substance and excreted in urine

What is the mechanism of action?

- After it's absorption through baby's skin, this light causes 3 chemical changes in bilirubin

- Photoisomerisation
- Photooxidation
- Structural isomerisation (lumirubins)

When to start?

- When the TSB level reaches in the Phototherapy zone in the bilirubin chart (See annexure)

When to stop?

- When level has fallen below 3 mg/dl lower than the phototherapy threshold for that particular postnatal age

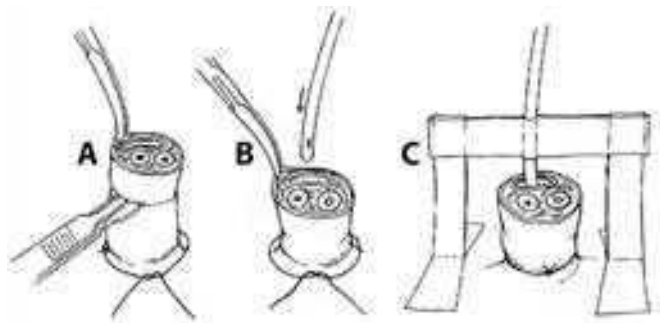
How to take care to the baby during phototherapy?

- Cover the eyes, using eye patches
- Cover the genitalia, with a small nappy
- Encourage & ensure frequent breast feeding
- Monitor urinary frequency of around 6-8 times/day
- Monitor body temperature 4 hourly
- Record body weight, every 24 hours

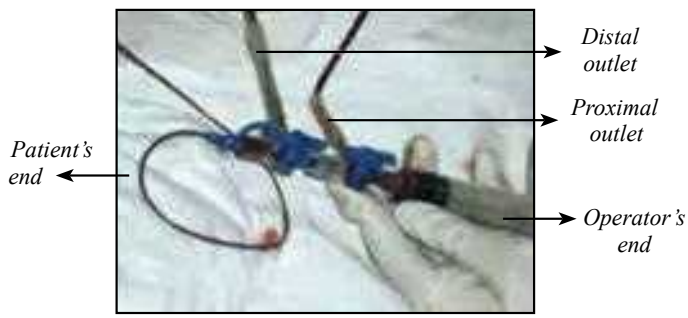
Exchange Transfusion (ET)

Indications, if–

- Phototherapy failed to reduce TSB to a safer level



Steps in umbilical vein catheterization



Exchange transfusion

- Risk of kernicterus exceeds the hazards of ET
- Initial S bilirubin level is in the range of ET (See annexure page 345 to 350)

NEONATAL CONVULSION/SEIZURE

Another common neonatal problem. It is the manifestation of many underlying neurologic and metabolic disorders.

A neonate having convulsion (stiff limbs & body)

AETIOLOGY

CNS	◆ Perinatal asphyxia (HIE) ◆ Meningitis, TORCHES infection ◆ Haemorrhages, e.g. Subarachnoid, intraventricular, intracerebral ◆ Structural abnormalities e.g. A-V malformation
Metabolic	◆ Hypoglycaemia ◆ Hypocalcaemia ◆ Hypomagnesaemia ◆ Hyponatraemia ◆ Hypernatraemia ◆ Vit B6 deficiency/dependency ◆ Inborn error of metabolism
Others	◆ Tetanus

Types of seizures & their characteristic presentation

Subtle seizure Commonest type but difficult to recognize	Abnormal gaze, blinking of eyes, abnormal posture, cycling, apnoeic spells, stiffness of limbs, chewing, tongue thrusting, lip smacking etc.
Clonic seizure	Characterized by rhythmic movements of muscle groups
Tonic seizure	Characterized by sustained flexion or extension of muscle groups
Myoclonic seizure	Characterized by jerky movements of upper or lower limbs

Jitteriness (tremor) and its characteristics

- Is suppressed by flexing the limb
- Have no associated ocular movements or autonomic phenomena
- Have stimulus sensitivity

DIAGNOSIS

Based on C/F & supports from relevant investigations.

Investigations

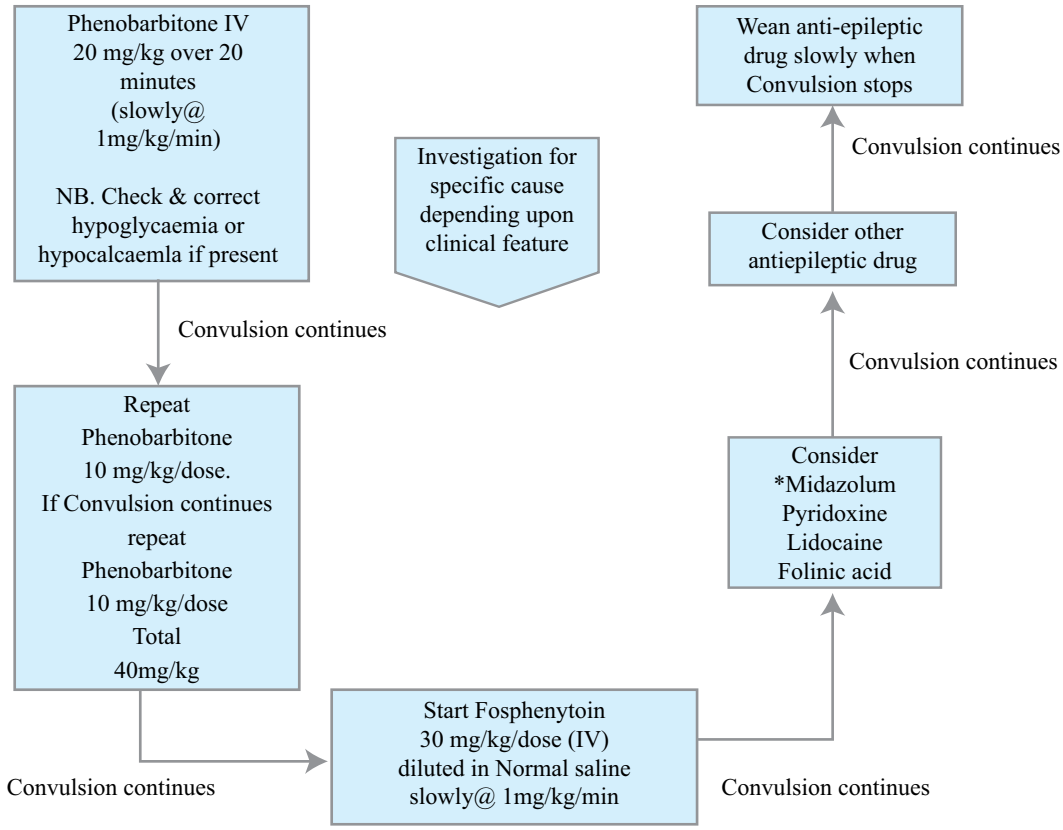
These are directed to identify the underlying causes.

Investigations
◆ CBC, PBF and CRP
◆ Serum electrolytes, glucose, calcium, magnesium
◆ CSF study, to assess evidence of meningitis
◆ Cranial ultrasonogram to look for IVH
◆ CT scan or MRI of brain to look for cong. anomaly
◆ TORCHES screening when patient has hepatosplenomegaly, thrombocytopenia, growth failure, SGA and chorioretinitis
◆ Electro-encephalogram (EEG), to charaterize seizure type
◆ Metabolic screening e.g. blood & urine ketones, ammonia, lactate, anion gap, urine reducing substance

TREATMENT

- Maintain airway, breathing and circulation (see page 241)
- Control convulsions (see algorithm, page 66)
- Keep the baby nothing per oral and open an IV line for infusion, anticonvulsants and other drugs e.g. Calcium, Glucose, Mmagnesium etc.
- Correction of metabolic abnormalities
  - Hypoglycaemia: 2 ml/kg of 10% DA
  - Hypocalcaemia: 1-2 ml/kg of 10% Ca gluconate (mixed with equal amount of distilled water) very slowly under cardiac monitoring
  - Hypomagnesaemia: 0.2 ml/kg of 50% $MgSO_4$ I/M
  - Pyridoxine: 50-100 mg, IV/IM. Single dose
- O_2 inhalation: 1-2 L/min through nasal cannula
- Identify & treat any underlying cause of convulsion

ALGORITHM FOR CONTROL OF NEONATAL CONVULSION



**Midazolam: Initial bolus 0.2 mg/kg then 0.05 – 2 mg/kg/hour in drip. Increase every 15 minute upto 2 mg/kg/hour if no response*

MANAGEMENT OF BABIES DELIVERED FROM MOTHERS WITH SPECIFIC ANTENATAL DISEASES

Maternal diseases during pregnancy	Management to be given to baby
Mother with Diabetes mellitus	Check babies blood glucose within 1 hour of birth, by heel prick ◆ If the infant found to be clinically well and normoglycaemic ❑ Start and continue breast feeding ❑ Monitor blood glucose 4-6 hourly at least for 24 hours ◆ If the infant is asymptomatic but hypoglycaemic (blood glucose <50 mg/dl) ❑ Put an I/V line and start glucose infusion@ 6 mg/kg/minute ❑ Allow breast feeding & monitor blood glucose 4 hourly ◆ If the baby is symptomatic and hypoglycaemic ❑ Give a bolus of 10% glucose solution (2 ml/kg) ❑ Continue infusion of glucose @ 6-8 mg/kg/min and increase the infusion rate as needed to maintain a normal blood glucose ❑ The level should be monitored every 30-60 minutes until glucose level is stable
HBs Ag positive mother **Regardless of HBeAg or Anti-HBeAb status**	◆ Give Hepatitis B immune globulin (HBIG) 0.5 ml IM within 12 hours of delivery ◆ Additionally, Give Hepatitis B (HB) vaccine at birth at a separate site and then follow the usual EPI schedule ◆ Breast feeding to be continued

Mother with active Tuberculosis	Do X-Ray chest & assess gastric aspirate (3 days) for AFB/Gene X pert. If these do not yield evidence of TB– ◆ Give INH prophylaxis to the baby for 6 months (10 mg/kg/day, single dose; crush the appropriate fraction and dissolve in drinking water or multi-vitamin syrup) ◆ Withhold BCG until INH therapy is completed. Give BCG after 2 weeks of completing INH therapy ◆ Plan for MT at 3 and 6 months of age. If MT is positive at any time and if baby is symptomatic, evaluate comprehensively and treat with anti-TB drugs ◆ Breast feeding to be continued. Separation of mother and infant is only necessary if the mother is sick enough to require hospitalization or has MDR TB
Chickenpox of mother occurred within 5 days before & 2 days after birth	◆ Give Varicella Zoster immunoglobulin (VZIG) 125 units as soon as possible and no later than 96 hours. (If VZIG is not available, then IVIG should be used) ◆ If mother developed chickenpox 7 days prior to delivery, baby do not need VZIG as baby will get antibodies via the placenta ◆ If the baby develops chickenpox, give Acyclovir, 10-15 mg/kg 8 hourly for 5-7 days ◆ Breast feeding to be continued
Mother known to have HIV infected	◆ Thoroughly clean off amniotic fluid and blood from the baby just after delivery ◆ Initiate Zidovudine (ZDV) I/V 1.5 mg/kg/dose, four times daily for 6 weeks ◆ Exclusive breast feeding for 1st 6 months of life, introducing appropriate complementary foods thereafter and continue breast feeding for 1st 12 mo of age

BIRTH INJURIES

These are the injuries present on the infant's body or structure due to adverse influences, occurred at birth.

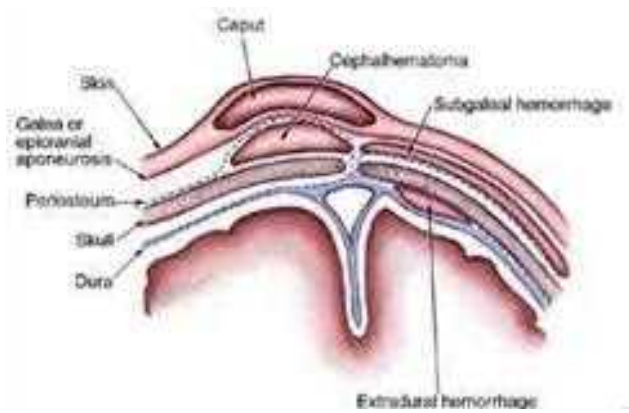
RISK FACTORS

- Rigid birth canal e.g. primiparous, small malformed pelvis, cephalopelvic disproportion
- Abnormal presentations e.g. breech, face or brow presentation, transverse lie
- Instrumental delivery e.g. vacuum or forceps assisted delivery
- Macrosomia
- Shoulder dystocia
- Prolonged labour
- Excessive traction during delivery

Among all birth injuries, trauma to the head are the commonest. These may result in haemorrhage in and around any layers of scalp. This diagram will help us to understand the sites of bleeding over head.

Common Birth Injuries

Injury sites	Injuries
Head & neck region	❑ Caput succedaneum, Cephalhaematoma Subaponeurotic/ Intracranial haemorrhage
Brachial plexus Facial (VII) nerve Phrenic nerve	❑ Erb's palsy, Klumpke's Palsy, ❑ Features of VII nerve palsy ❑ Features of phrenic nerve palsy
Clavicle, humerus, femur, skull	❑ Fructures at these sites
Eye injuries	❑ Subconjunctival, Retinal haemorrhage
Soft tissues	❑ Echymoses, abrasion, laceration etc.
Abdomen	❑ Injury to liver, spleen



COMMON BIRTH INJURIES AND THEIR CARDINAL FEATURES

Caput succedaneum

- Subcutaneous fluid collection in the soft tissues of the scalp that is presented during vertex delivery
- Has poorly defined margins and can extend over the midline and across suture lines
- The lesion usually resolves spontaneously without sequelae over the first few days after birth

Cephalhaematoma

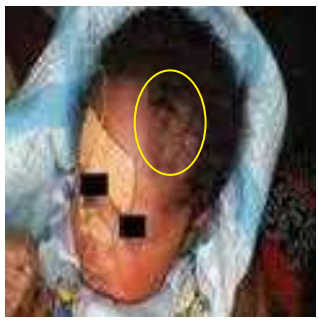
- Subperiosteal collection of blood which does not cross the suture line
- Presents as a soft, fluctuant mass usually over the parietal bone
- Usually resolved within 2 weeks– 3 months, depending on their size

Subgaleal Haemorrhage

- Haemorrhage between Galea aponeurotica of scalp and the periosteum. (Subaponeurotic haemorrhage)
- It appears as a fluctuant mass within few hours after birth and can extend from orbital ridges to the nape of the neck and laterally to the ears crossing the suture line
- There is massive loss of blood which may lead to anaemia, sometimes shock and jaundice from extravascular haemolysis

Left facial nerve injury

- It is usually due to pressure by the forceps blade on the facial nerve
- Appears within 1-2 days after delivery due to resultant oedema and haemorrhage around the nerve
- Spontaneous recovery usually occurs within 14 days



Source: Internet

Skull Fracture

- Usually depressed skull fractures resulting in a “ping-pong” deformity without discontinuity
- Rarely require surgical elevation

COMMON BIRTH INJURIES AND THEIR CARDINAL FEATURES

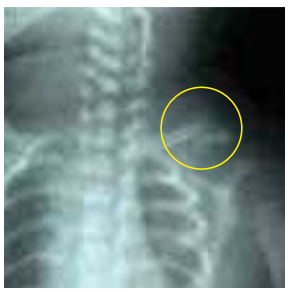
Brachial plexus injuries e.g. Duchenne-Erb's palsy, Klumpke's palsy.

- The characteristic position in Duchenne-Erb's palsy like that of **waiters tip hand.** This consists of–
  - Adduction at the shoulder
  - Internal rotation of the upper arm
  - Pronation of the forearm
  - Outward direction of the palm of the hand
- In addition, patient will have asymmetric Moro reflex, absent biceps jerk but hand grasp is usually present

MANAGEMENT

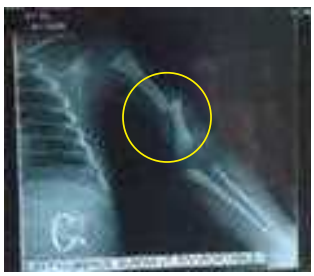
- Relaxation of the paralyzed muscles just opposite to the pathological position of the affected limb i.e. abduction at the shoulder, external rotation of the upper arm, supination of the forearm. This is done by, holding of the wrist to the pillow beside head
- Physiotherapy, mild electrical stimulation, neuroplasty

Source: Internet



Fracture clavicle

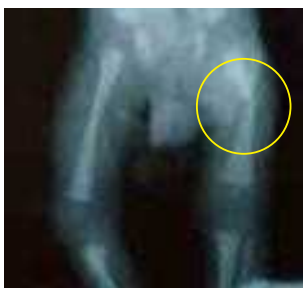
- Infant does not move the arm freely on the affected side
- Crepitus and bony irregularity may be palpated
- A remarkable degree of callus develops at the site within a week and may be the first evidence of the fracture
- Treatment consists of immobilization of the arm and shoulder on the affected side
- Prognosis is excellent



Fracture Humerus

- Spontaneous movement of the fractured limb is usually absent
- Moro reflex is absent in the affected limb
- Treatment consists of a triangular splint and a bandage or a cast

Source: Internet



Fracture Femur

- Spontaneous movement of the affected limb is absent
- Moro reflex is absent in the affected limb
- Treatment consists of traction-suspension of both lower extremities, even if the fracture is unilateral

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the major illnesses causing high neonatal deaths in Bangladesh?
2. Enumerate 5 common features of neonatal sepsis.
3. What investigations will you do for sepsis screening? Write down the treatment of a baby with septicaemia.
4. What are the important causes of jaundice during neonatal period?
5. A newborn is delivered at 34 weeks of gestation by LUCS for fetal distress and severe hypertension of the mother. The baby failed to take breath immediately after birth. a) What is the most likely diagnosis? b) Outline the steps of resuscitation.
6. A 32 weeker newborn, weighing 1500 gm is admitted in neonatal ward with respiratory distress. a) What are the problems of this baby? b) Write down the important complications that this baby may develop. c) Outline your plan of management.
7. A 3 days old baby presents with convulsions. a) Write 5 important causes of convulsions. b) Outline the management steps.

SHORT ANSWER QUESTIONS [SAQ]

1. Common causes of neonatal convulsion include–

   ___ a) jaundice of prematurity ___ b) meningitis ___ c) hypoglycaemia
   ___ d) RDS ___ e) hypocalcaemia
2. Direct hyperbilirubinaemia in newborn occurs due to–

   ___ a) blood group incompatibility ___ b) congenital biliary atresia
   ___ c) physiological jaundice ___ d) cystic fibrosis ___ e) breast milk jaundice
3. The cause of jaundice in a 3 days old baby are–

   ___ a) Rh incompatibility ___ b) congenital hypothyroidism ___ c) billiary atresia
   ___ d) physiological jaundice ___ e) septicaemia
4. Drugs commonly used to control neonatal convulsion include–

   ___ a) Phenobarbitone ___ b) Fosphenytoin ___ c) Diazepam
   ___ d) Lidocaine ___ e) Midazolam

CHAPTER 09

NUTRITIONAL DISORDERS

In a developing country like Bangladesh, many children suffer from various nutritional problems because of inadequacy of food & nutrients and ignorance. Common nutritional disorders of children in Bangladesh are–

- Protein energy malnutrition (PEM)
- Vitamin and other micronutrient deficiencies
- Nutritional anaemia e.g. iron deficiency anaemia
- Iodine deficiency disorders e.g. hypothyroidism

In this section, PEM and few vitamin deficiency disorders will be discussed. Another nutritional disorder, obesity is also highlighted in this chapter.

PROTEIN ENERGY MALNUTRITION (PEM)

It is a pathological condition occurring most frequently in infant & young children due to long-continued deficient intake of protein and calories. It is an important cause of under 5 deaths in Bangladesh. The current (BDHS'2014) nutritional status of under 5 children in Bangladesh are–

Stunting (41%), Wasting (14%) and Underweight (36%). These figures are on the decline compared to previous years.

AETIOLOGY & RISK FACTORS

Risk Factors

- Scarcity of food due to poverty
- Lactation failure
- Poor complementary feeding practices (from ignorance) either early or late starting of complementary feeding, faulty preparation of foods
  - Low calorie food
  - Food deficient in protein
  - Fat and minerals
- Closely spaced pregnancies
- Lack of tender love & care
- Helminthiasis
- Mental or physical handicap or other concomitant diseases

Classification

PEM is classified in different ways by different authorities.

1. Welcome classification

Weight-for-age (% of median*)	Without oedema	With oedema
60-80	Under nourished	Kwashiorkor
<60	Marasmus	Marasmic-kwashiorkor

2. Gomez classification

Weight-for-age (% of median*)	Status of nutrition
90-110	Normal
75-89	1st degree – Mild malnutrition
60-74	2nd degree – Moderate malnutrition
<60	3rd degree – Severe malnutrition

** Median is the 50th percentile value of CDC chart.*

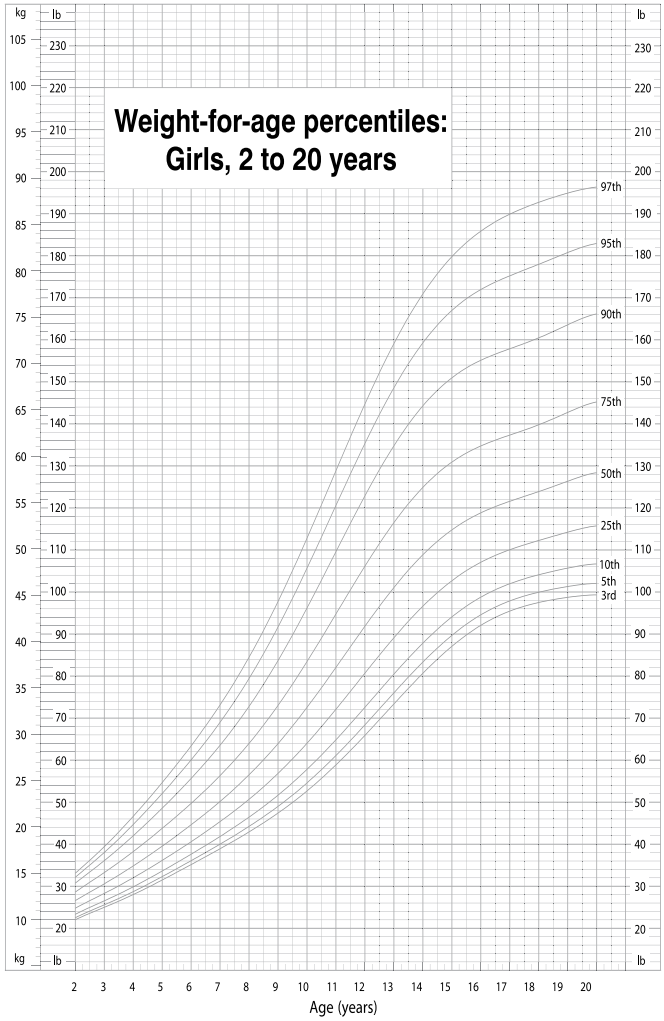


Chart 1

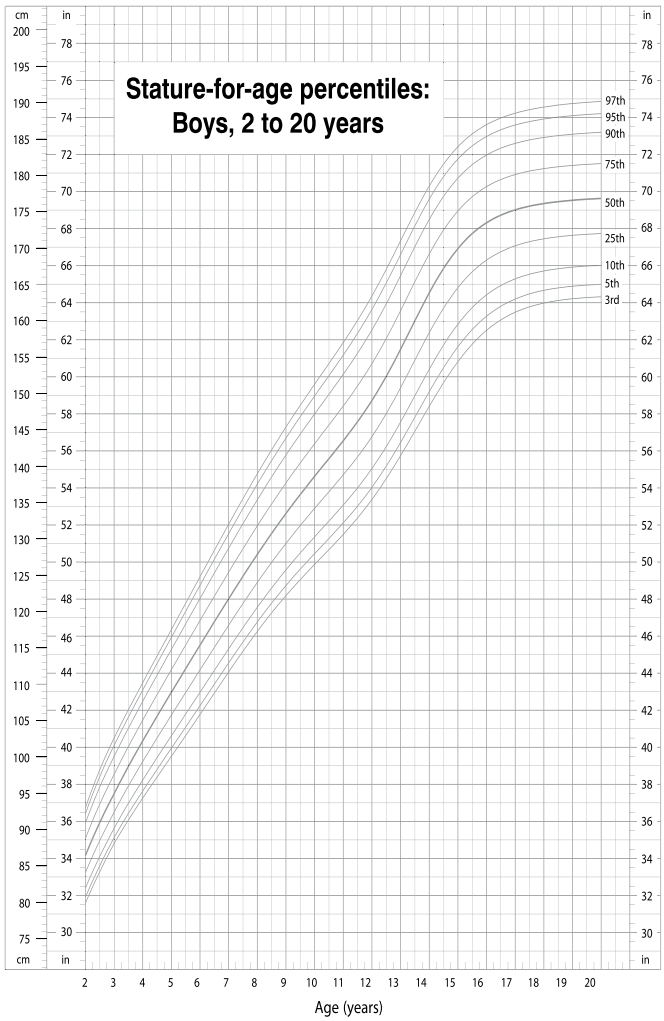


Chart 2

How to Calculate Z Score

$$\text{SD or Z score} = \frac{\text{Observed value} - \text{Expected value (median)}}{\text{One standard deviation (1SD)}}$$

$$1\ \text{SD} = \frac{\text{Median value} - 5\ \text{percentile value}}{1.8}$$

Example: If we consider a 5 years old boy with 90 cm height, from chart 2

his, 50th percentile value of height = 109 cm (median)

5th percentile value of height = 101 cm

$$\text{So, 1 SD} = \frac{\text{median value} - 5_{th}\ \text{percentile value}}{1.8} = \frac{109\text{-}101}{1.8} = 4.4$$

$$\text{SD or Z score} = \frac{\text{Observed value} - \text{Expected value (median)}}{1\ \text{SD}} = \frac{90\text{-}109}{4.4} = \text{(- 4.3)}$$

ACUTE MALNUTRITION

Whenever, a child presents with any one or both of the features given below such as-

a) MUAC <125 mm and/or

b) Weight for Length/height <–2 SD) of acute malnutrition, his nutritional status should be classified as follows–

- Moderate Acute Malnutrition (MAM) and
- Severe Acute Malnutrition (SAM)

Parameters	Normal	MAM	SAM
MUAC mm	≥ 125	115 to 124	< 115
WHZ SD	≥ – 2 SD	– 3 to < – 2 SD	< – 3 SD
Bipedal oedema	Absent	Absent	Present

MAM: Moderate Acute Malnutrition; SAM: Severe Acute Malnutrition
WHZ: Weight for Height Z score; MUAC: Mild upper arm circumference

Children with severe acute malnutrition may additionally have bipedal oedema

MODERATE ACUTE MALNUTRITION (MAM)

MANAGEMENT

To stop progression from MAM towards SAM and help to bring the nutritional status back to normal for age and sex.

Management comprises–

- Counseling the parents/caregivers on healthy feeding practices and food fortification at home by encouraging consumption of–
  - Home-made food with a good proportion from animal sources e.g. fish, egg, milk etc.
  - Extra meal to provide additional >25kcal/kg/day above the normal energy requirement of a well-nourished children
  - Fortified staple food with micronutrient power
- De-worming should be done at least 6 monthly
- Treatment of any associated infections
- Promotion of food & other hygiene to prevent further infection

SEVERE ACUTE MALNUTRITION (SAM)

SAM is characterized by the presence of severe wasting e.g. low weight for height (WHZ<–3 SD, MUAC<115 mm) and or bipedal oedema. Here, no distinction is made between marasmus, kwashiorkor or marasmic-kwashiorkor as their management approach is similar.

REVISED DIAGNOSTIC CRITERIA FOR SAM

A. Children between 6-60 months (WHO'2009)

Indicators	Measure	Cut-off
Severe wasting[2]	Weight-for-height[1]	<–3 SD
Severe wasting[2]	Mid-upper arm circumference (MUAC)	<115 mm
Bilateral oedema[3]	Clinical sign	Present

1 = Based on WHO standard; 2,3 = independent indicators of SAM

B. Children <6 months

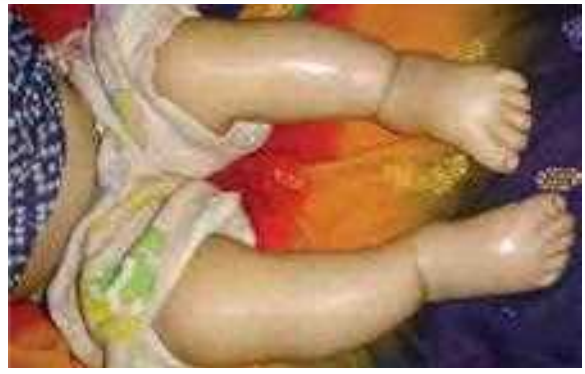
(Bangladesh Guideline '2012)

- Weight for height Z score (WHZ) <–3SD
- Visible wasting
- Bipedal oedema

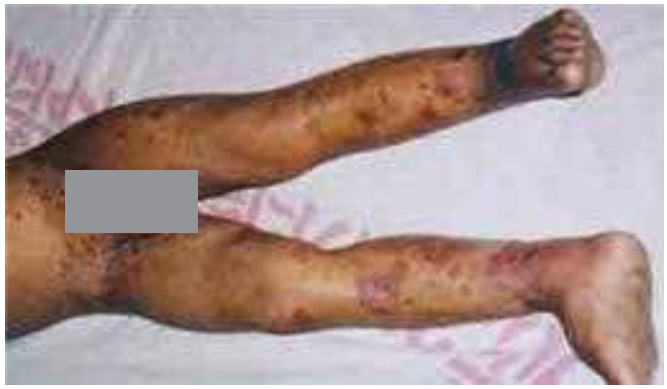
CLINICAL FEATURES OF SAM

(Kwashiorkor & Marasmus)

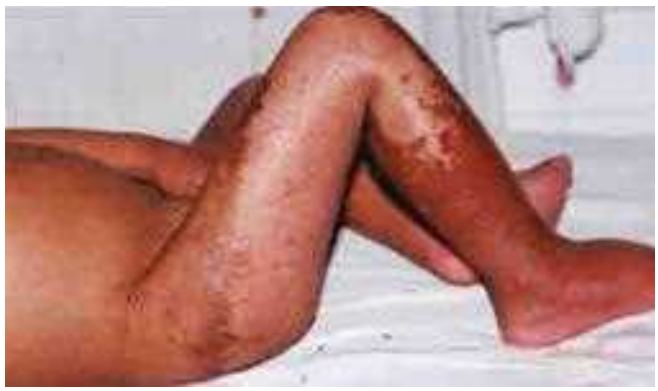
- Skin changes (nutritional dermatoses)
  - Flaky paint dermatosis
  - Crazy pavement dermatosis
  - Reticular pigmentation
  - Mosaic dermatosis
  - De-pigmentation
  - Indolent sores & ulcers
  - Superimposed infection



Shiny skin due to oedema (Seen in kwashiorkor)



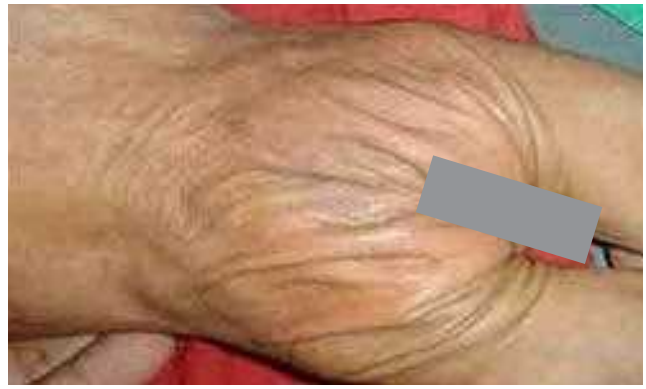
Crazy pavement dermatosis with sores (Seen in kwashiorkor)



Flaky paint dermatosis with hypo and hyper pigmentations (Seen in kwashiorkor)

Flaky paint dermatosis with hypo and hyper pigmentations (seen in kwashiorkor)

Severe wasting of periorbital and other facial muscles



Baggy pant appearance (seen in marusmus)

SALIENT FEATURES: MARASMUS & KWASHIORKOR

Clinical features	Marasmus	Kwashiorkor
◆ Face	Well alert wizened face	Rounded and oedematous
◆ Visible severe wasting	Obvious	Less obvious
◆ Oedema	Absent	Present
◆ Skin changes	Less frequent	Present
◆ Hair change	Absent	Present
◆ Mental change	Sometimes	Usually present
◆ Appetite	Good	Poor
◆ Hepatomegaly	Absent	Present

Complications

- Infection, both overt & hidden e.g. TB
- Dehydration & dyselectrolytaemia
- Hypoglycaemia
- Hypothermia
- Anaemia
- Congestive cardiac failure
- Bleeding
- Xerophthalmia & blindness
- Sudden infant death syndrome

DIAGNOSIS

Virtually clinical. However, investigations should be done to assess the biochemical status and to screen infection. These are–

Investigations	Results
❑ Complete blood counts with PBF	Low Hb, leukocytosis, PBF shows microcytic hypochromic or dimorphic blood picture
❑ Blood biochemistry	RBS (low), S. total protein, albumin (hypoalbuminaemia), electrolytes (hypokalaemia)
❑ Infection screening	Urine for R/M/E, C/S, blood C/S
❑ X-Ray chest	For evidence of pneumonia and pulmonary TB

MANAGEMENT

WHO has prescribed 10 steps for the management of SAM. These 10 steps are accomplished in 2 phases–

1. Stabilization phase

This phase is meant for making the patient stable. During this phase–

- Life-threatening problems are identified & treated
- Specific nutrient deficiencies are corrected
- Metabolic abnormalities are reversed
- Feeding is started

2. Rehabilitation phase

This phase is signaled by return of appetite and disappearance of most/all of the oedema. It usually takes about a week of meticulous management in stabilizing phase. During this phase–

- Intensive feeding is started but slowly to recover the lost weight
- Breast feeding is re-initiated and/or encouraged
- Emotional and physical stimulations are increased
- The mother or care givers are trained how to continue care at home, and
- Preparations are made for discharge of the child

Time-frame for Management of SAM

Steps	Stabilization Phase Days 1-7	Rehabilitation Phase Weeks 2-6
Hypoglycaemia	→	
Hypothermia	→	
Dehydration	→	
Electrolytes	→	→
Infection	→	
Micronutrients	No Iron	Iron →
Cautious feeding	→	
Catch up growth		→
Sensory simulation	→	→
Prepare for discharge & Follow up		→

GENERAL PRINCIPLES OF 10 STEPS

Step 1: Treat/Prevent Hypoglycaemia

Assume all severely malnourished children are hypoglycaemic and often accompanied by hypothermia. Features of hypoglycaemia are–

- Lethargy, limpness, convulsions and loss of consciousness. If blood sugar is found low (<3 mmol/L)
  - ❑ Give 50 ml of 10% glucose orally/NG tube or 5 ml/kg of 10% glucose IV
  - ❑ Start & continue 2 hourly feed day and night

Step 2: Treat/Prevent Hypothermia

(Axillary <35° C or 95° F, Rectal < 95.9° F or 35.5° C)

- Warm the child
  - ❑ Clothe the child including the head, cover with a warm blanket and increase the ambient temperature with safe heat source or
  - ❑ Put the child on mother's bare chest for skin to skin contact and cover them (Kangaroo mother care)
- Ensure that the child is covered all the time, especially at night and keep away from cold air
- Avoid prolonged exposure for examination & procedure

Step 3: Treat/Prevent Dehydration

As it is difficult to assess dehydration in a malnourished child, assume that such a child with acute diarrhoea has dehydration. Dehydration may be overestimated in Marasmic child & underestimated in a Kwashiorkor child.

The rehydration process is as follows–

- Slow Oral correction with **ReSoMal** (a fluid low in Na^+ & high in K^+)
- Give ReSoMal 5 ml/kg orally or by NG tube every 30 min for first **2** hours. Then ReSoMal 5-10 ml/kg/hour, alternately with F-75 for next 4-10 hours until the child is rehydrated
- Do not rehydrate intravenously except in shock and do so with care. Otherwise it may lead to fluid overload and heart failure
- If child is breastfed, encourage mother to continue breastfeeding along with the measured foods

Step 4: Correct Electrolyte Imbalance

- Normally, Na-K pump maintains an appropriate balance of Na and K between ICF & ECF (plasma)
- In SAM, this pump become weak and as a result, Na^+ from ECF enters inside the cells where it's concentration rises and K^+ leaks out of the cells and is lost in urine or stools
- Therefore, the net effects in SAM are–

  i) Excess intracellur Na^+ despite but low plasma Na^+.

  ii) Low K^+ levels in both plasma and cells. In addition child with SAM also have low Mg level in their body. Therefore, until stabilization, supplement them with–
  - K^+: 3-4 mmol/kg/day (each 5 ml contains 7.6 mmol)
  - Mg++: 0.3 ml of (Inj. 50% $MgSO_4$) & 0.4-0.6 mmol/kg IM single shot. (Mg^{++} promotes entry of K^+ into the cells and to be retained there)
  - Prepare food without salt

Step 5: Treat/Prevent Infection

- With broad spectrum antibiotics–
  - Oral Amoxicillin (15 mg/kg) 8 hourly for 5 days or Cotrimoxazole (Trimethoprim–5 mg/kg) 12 hourly for 5 days
- In severely ill patients–
  - IV/IM Ampicillin (50 mg/kg) 6 hourly &
  - IV/IM Gentamicin (7.5 mg/kg) once daily for 7 days
- Change the antibiotic to Ceftriaxone (50-100 mg/kg/day) with or without Inj. Gentamicin (7.5 mg/kg) once daily when–
  - No improvement e.g. lethargy, persistance of fever by 48 hours or
  - Deteriorates after 24 hours or
  - Presents with septic shock or meningitis

Step 6: Correct Micronutrient deficiencies

Considering all malnourished children have micronutrient deficiency and give the following:

- Vitamin A: On day 1 of treatment–

Age	Dose
0-5 months	50,000 IU (2 drops from High potency vitamin A capsule) 
6-12 months	100,000 IU (4 drops)
>12 months	200,000 IU (whole of a High potency vitamin A capsule)

- Give the following for 2 weeks–
- Multivitamin without Iron: Usually 1-2 tsf/day
  - Folic acid: 5mg (1 tab) on day1, then 1 mg/day
  - Zinc (10 mg/tsf): 2 mg/kg/day
  - Copper: 0.3 mg/kg/day (if available)
  - Elemental iron: 3 mg/kg/day started in the rehabilitation phase (usually after 2 wks of starting treatment)

Step 7: Start Feeding Cautiously

Considering the child's fragile physiologic state and reduced capacity to handle large feeds, feeding should be started as soon as possible in the following manner.

NG tube feeding

- Small amount & frequent (2-3 hourly) oral or NG tube feeding
- IV nutrition should never be given
- Low calorie diet (F-75) should be given
- Total fluid intake should be ≤ 130 ml/kg/day but 100 ml/kg/day if oedema is present. Along with measured feeding, breast feeding should be continued and encouraged

Step 8: Achieve Catch-up Growth

- About 1 week after admission when appetite has returned and most of the oedema has lost, a gradual transition F-75 to F-100 should be done

	F-75	F-100
Amount of calories	75 kcal/100 ml	100 kcal/100 ml
Amount of protein	0.9 g /100 ml	2.9 g/100 ml

- Weight gain should be monitored to assess response–
  - Poor: <5 gm/kg/day
  - Moderate: 5-10 gm/kg/day
  - Good: >10 gm/kg/day

Step 9: Provide Sensory Stimulation and Emotional Support

- Give tender loving care e.g. smiling, laughing, patting, touching etc.

- Establish a cheerful, stimulating environment
- Organize structured play therapy
- Involve parents or caregiver for this support and teach them how to continue at home

Step 10: Prepare for Discharge and Follow-up after Recovery

Discharge, if the following criteriae are present–

Child	Mother /Caregiver
❑ WHZ ≥ – 2 SD ❑ Oedema has resolved ❑ Gaining weight at a normal OR increased rate ❑ Child eating an adequate amount of nutritious food that the mother can prepare at home ❑ All infections and complications have been treated ❑ Child is provided with micronutrients ❑ Immunization is updated	◆ Knows how to prepare appropriate foods and to feed to the child ◆ Knows how to make appropriate toys and to play with the child ◆ Knows how to give home treatment of common ailments and can recognize danger signs

Treatment of Associated Conditions

1. Vitamin A deficiency

- If the child presents with photophobia/xerophthalmia, vitamin A supplemente with on days 1, 2 and 14 at doses mentioned earlier
- If associated with **corneal clouding or ulceration**

  - ❑ Cover eyes with eye pads soaked in saline solution and bandage
  - ❑ Antibiotic eye drop (Chloramphenicol or Tetracycline): 1 drop in each eye 2-3 hourly for 7-10 days
  - ❑ Instill artificial tear to both the eyes
  - ❑ Atropine eye drops (1%): 1 drop three times daily for 3-5 days

Steroid eye ointment/drop should never be used.

In case of young children it may be necessary to restrain their arm movement.

2. Dermatosis

- If presents with hypo or hyperpigmentation, desquamation, ulceration, exudative lesions (resembling severe burns), and weeping skin lesions (in and around the buttocks)
  - ❑ Keep the perineum dry
  - ❑ Apply 1% **Potassium permanganate** solution soaked gauze over the affected areas and keep for 10 minutes twice daily
- For fungal infections–
  - ❑ Skin lesions: Clotrimazole cream twice daily for 2 weeks
  - ❑ Oral candidiasis: Drop Nystatin 1 ml (contains 1 lac units) four times daily for 7 days

3. Helminthiasis

(Treatment should be delayed until the rehabilitation phase).

- A single dose of any one of the following anti-helmintics should be given–
  - ❑ Oral Albendazole 200 mg for children 12-23 months, 400 mg for children ≥24 months or
  - ❑ Oral Pyrantel Pamoate 11 mg/kg (any age) single dose or
  - ❑ Oral Mebendazole 100 mg twice daily for 3 days (not recommended below 24 months)

4. Treating Diarrhoea and Dysentery

- Giardiasis: Oral Metronidazole (7.5 mg/kg) 8-hourly for 7 days

- Dysentery–
  - Oral Ciprofloxicillin (10 mg/kg/dose) 12 hourly for 3 days or
  - Oral Pivmecillinum (15 mg/kg/dose) 6 hourly for 5 days

5. Tuberculosis

- Suspected cases should be evaluated by Mantoux test, Chest X-Ray and by gastric lavage for AFB/ Gene-Xpert
- If test is positive or there is a strong suspicion of TB, start anti TB drugs as per National Guideline

Vitamin Deficiency Disorders

Children often suffer from different vitamin deficiency disorders either as an isolated problem or along with severe malnutrition.

Deficient Vitamins	Diseases
A	Xerophthalmia
D	Rickets
K	Bleeding/Coagulopathy
B1 (Thiamine)	Beriberi
B2 (Riboflavin)	Angular stomatitis
B3 (Niacin)	Pellagra
B6 (Pyridoxine)	◆ Peripheral neropathy ◆ Convulsion in children
B12 (Cyanocobalamin)	◆ Megaloblastic anaemia ◆ Subacute combined degeneration of spinal cord
Folic acid	Megaloblastic anaemia
Vit C	Scurvy

Among all these deficiencies, vitamin A, C and D deficiency disorders will be discussed in this section.

VITAMIN A DEFICIENCY: XEROPHTHALMIA

Aetiology & Risk factors

- SAM
- Measles & others infection
- Helmentheasis
- Inadiquate intake

Pathogenesis

- Vitamin A is important for the normal function of both rods and cones in the retina. Its deficiency causes maladaptation of retina in darkness leading to night blindness
- Vitamin A is also essential for the integrity of epithelial tissue and mucous membrane

So lack of this vitamin causes different ocular and extra-ocular problems due to epithelial changes in various organs.

Clinical Manifestations

1. Ocular Manifestations (Xerophthalmia)

XN	Night-blindness	
XIA	Conjunctival Xerosis	
XIB	Bitot's spot	
X2	Corneal Xerosis	
X3A	Corneal ulceration/ keratomalacia involving <1/3 of corneal surface	 *Corneal ulceration*
X3B	Corneal ulceration/ keratomalacia involving ≥1/3 of corneal surface	
XS	Corneal scar	
XF	Xerophthalmic fundi (white retinal lesion)	

2. Extra-ocular Manifestations

◆ Skin changes	Dry scaly skin specially over the outer aspect of the limbs called follicular hyperkeratosis (phrynoderma)
◆ Susceptibility to infections	Increased
◆ Squamous metaplasia	Involving respiratory, urinary and vaginal epithelium
◆ Urinary problems	Pelvic keratinization, keratin debris and stone formation, pyuria, haematuria
◆ CNS problems	Raised intracranial pressure, rarely optic or other cranial nerve palsy, mental retardation, apathy
◆ Growth failure	

Treatment

- All the stages of xerophthalmia should be treated immediately with vitamin A

Dose recommendation

- ≥ 12 months : 200,000 IU/dose
- 6 < 12 months : 100,000 IU/dose
- < 6 months : 50,000 IU/dose

It should be given orally on 2 successive days and a third dose to be given at least 2 weeks later.

Treatment

- Corneal Ulcer (Discussed on page 78)

PREVENTION

- Exclusive breast feeding
- Routine vitamin A supplementation (every 6 months upto 5 years of age)
- Vitamin A supplementation in special situations e.g. diarrhoea and measles.
- Regular intake of Vitamin A rich foods:
  - Dark green leafy vegetables • Coloured fruits
  - Egg • Liver • Fat of fish, meat • Cod liver oil
  - Mola-dhela fish etc.

VITAMIN C DEFICIENCY: SCURVY

AETIOLOGY & RISK FACTORS

- Prolonged dietary deficiency
- Others
  - GI diseases e.g. Crohn's disease
  - Iron overload e.g. Thalassaemia
  - Type 1 DM

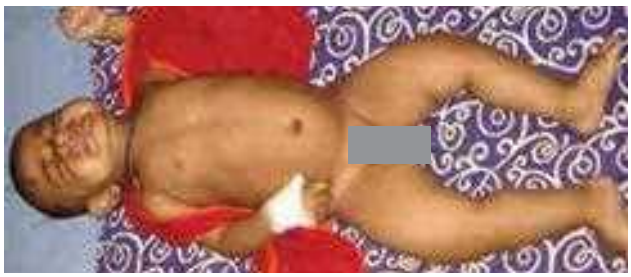
PATHOGENESIS

Vitamin C is essential for hydroxylation of lysine and proline for the formation of collagen. Its deficiency leads to faulty collagen synthesis in bones, cartilages and gum. In addition, the intercellular substance of capillaries become defective often leading to bleeding.

CLINICAL MANIFESTATIONS

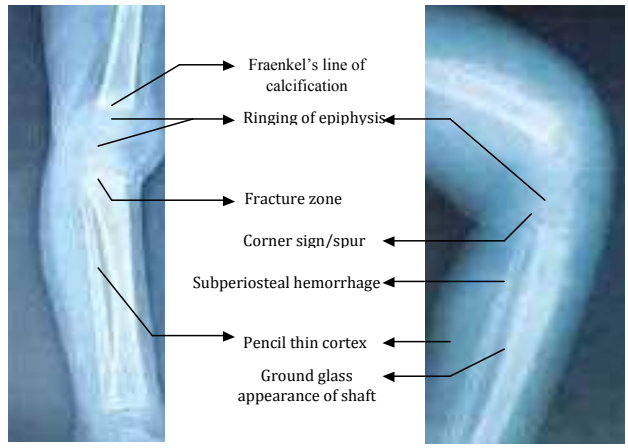
Age: Peak mostly found around 6-24 months of age, with–

- Irritability and loss of appetite
- Crying on handling e.g. during dressing, bathing etc.
- Generalized tenderness especially in legs resulting in pseudo-paralysis and legs assume typical frog position



Legs assume typical frog position (pseudoparesis)

- Bluish purple, spongy swelling of gum mucosa is seen when teeth are erupted
- Sharp painful scorbutic rosary is palpable at costochondral junction and depression of sternum
- Peri-follicular haemorrhage, Skin bleeding e.g. Petechial haemorrhage, Ecchymosis of extremities and Systemic bleeding e.g. Haematuria, Melaena, Orbital haemorrhage may be found
- Delay in wound healing



Typical X-Ray findings of scurvy

DIFFERENTIAL DIAGNOSES

Leukaemia, osteomyelitis, suppurative arthritis, Caffeys disease.

Investigations

- X-Ray of limbs including joints
- CBC, PBF, LDH to exclude other differential diagnoses

TREATMENT

- Oral Vitamin C 200 mg daily for several weeks. Ingestion of 3-4 ounces of tomato or orange juice are equally effective
- Response
  - Clinical recovery occurs within 24-48 hours
  - Radiological improvement takes a week or two
  - Disappearance of sub-periosteal haemorrhage takes months
- After scurvy has been cured, 35-50 mg of Vitamin C should be given daily as drug or in diet

PREVENTION

- Encourage intake of vitamin C rich diet, e.g. citrous fruits like guava, amloki, tomato, orange etc. and green leafy vegetables
- Promote exclusive breast feeding. Lactating mothers should have a daily intake of 100 mg Vitamin C
- Formula fed babies should be supplemented with Vitamin C

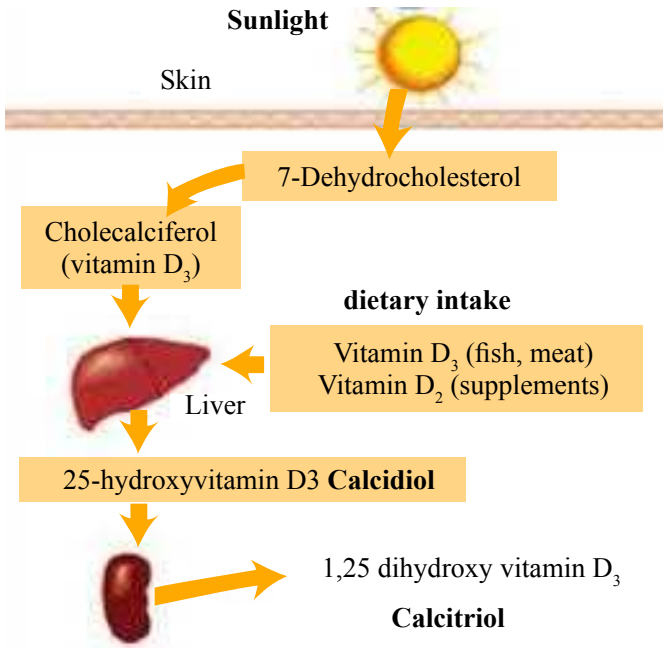
VITAMIN D

Sources

- Endogenous synthesis in skin (major source)
- Foods rich in vitamin D e.g. egg yolk, cod liver oil, butter, any fat rich diet, milk amd milk products

Functions and Metabolism

The principal function of Vitamin D is to maintain serum calcium (Ca) and phosphorus concentration in a range that supports cellular processes, neuromuscular function and bone mineralization. Vitamin D does these by–



Vitamin D Metabolism

- Increasing Ca^{++} absorption from gut (duodenum)
- Stimulation of Ca^{++} reabsorption from distal renal tubules
- Interacting with parathormone to regulate serum Ca^{++}

VITAMIN D DEFICIENCY: RICKETS

Rickets is a disease children caused by vitamin D deficiency characterized by imperfect miniralization (calcification) of growing bones. Softentening and destruction of the bones.

AETIOLOGY

- Prolonged non/under exposure to sunlight
- Prolonged consumption of foods deficient in vitamin D
- Others–
  - Renal disorders e.g. chronic kidney disease (CKD), renal tubular acidosis (RTA)
  - Genetic e.g. familial hypophosphataemic rickets, Fanconi syndrome, cystinosis
  - Malabsorption of vit D e.g. liver & intestinal disorders (Malabsorption syndrome)
- Vitamin D dependent rickets: Type I & II
- Drugs e.g. Phenobarbitone, Phenytoin
- Hypocalcaemic rickets

Of the various aetiological types, nutritional rickets and X–linked hypophosphataemic rickets are common.

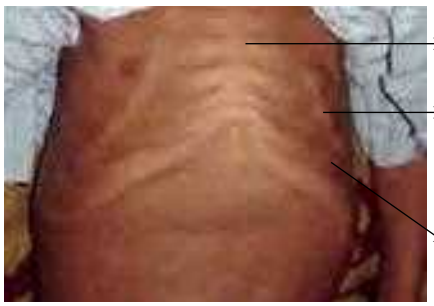
PATHOGENESIS

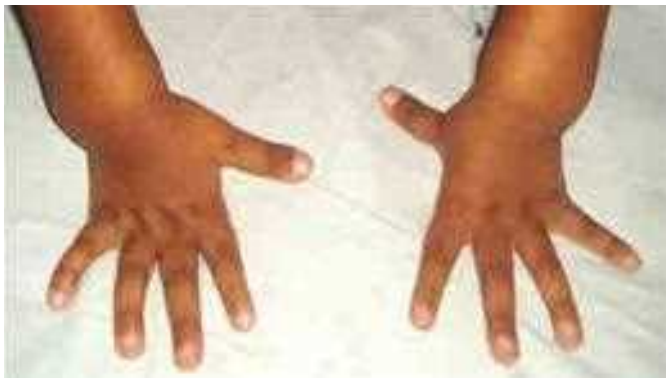
In rickets, due to deficiency of active vitamin D, there is inappropriate calcium-phosphate homeostasis, leading to defective mineralization of osteoid tissue. As a rule, bones become soft, and liable to different types of deformities and short stature

CLINICAL MANIFESTATIONS

Vary according to aetiology and age of presentation. Common manifestations include–

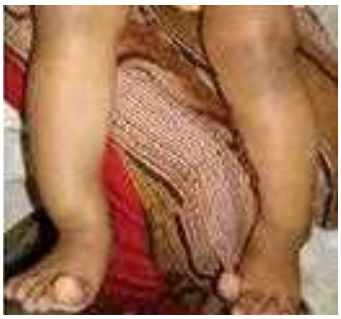
General features	◆ Short stature, listlessness, protruded abdomen, muscle weakness
Head	◆ Box like square head, hot-cross-bun appearance of skull, craniotabes (As the skull bone is soft, when pressure is applied they will collapse underneath it and upon releasing of pressure, the bones will snap back into place). Delayed closure of fontanels and sutures
Teeth	◆ Delayed dentition, dental caries and impaired enamel formation
Chest	◆ Pigeon chest deformity ◆ Painless rachitic rosary at costochondral junction ◆ Harrison sulcus
Spine	◆ Deformities like scoliosis, kyphosis, lordosis . These may lead to recurrent respiratory infections
Extremities	◆ Widening of wrist and ankle, vulgus and varus deformity, anterior bowing of leg, coxa vara, fractures and pain, gait deformity
Symptoms of hypocalcaemia	◆ Tetany, seizure, stridor due to laryngeal spasm





Widened wrist

Knock knee



Widened ankle & deformity of legs

In **familial hypophosphataemic rickets**, deformities of limbs are more prominent than other manifestations like deformity of the chest or head, which are more florid manifestation of nutritional rickets.

Bowing of legs

DIAGNOSIS

Based on typical features and laboratory supports.

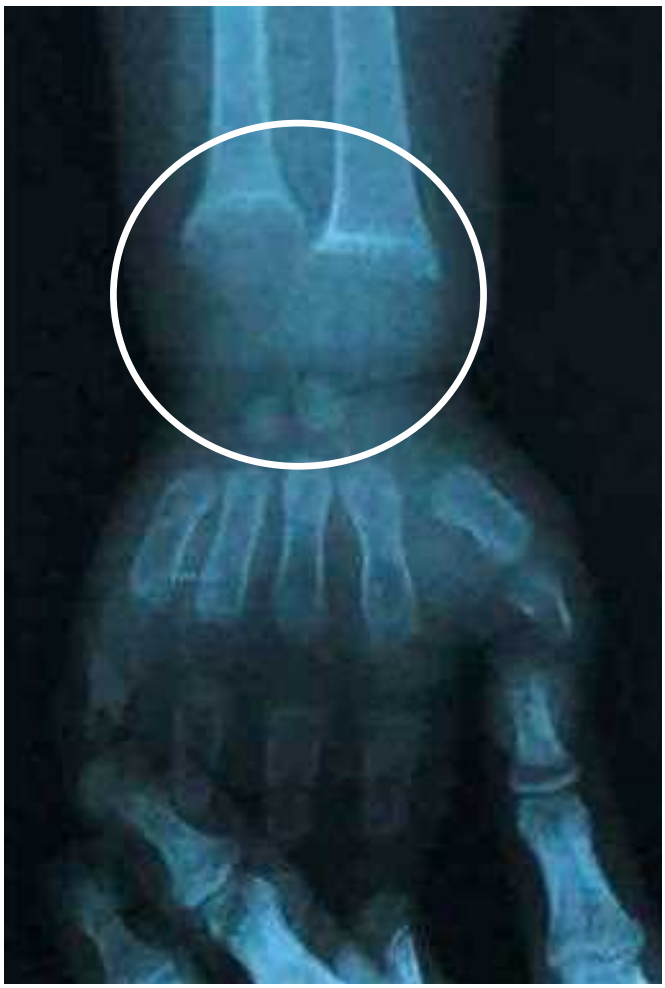
Investigations

- Blood & Urine biochemistry

S. Calcium	Normal usually, may be low
S. Inorganic Phosphorus (Pi)	Low (Hypophasphataemia) due to PTH-induced renal loss. Also low in RTA, Fanconi syndrome, X-linked hypophosphataemic rickets
Rachitic Index: S. Ca × S. Pi	◆ <30: Rickets likely ◆ >40: Rickets unlikely ◆ 30-40: Rickets doubtful
S. Alkaline phosphatase	High
S. Parathormone (PTH)	High
S. 25 (OH) D and 1,25 (OH)2D levels	Low in severe vit D deficiency but may be normal in other actiology
S. creatinine	High in CKD and RTA
S. electrolytes	Altered in CKD and RTA
Arterial blood gas (ABG)	Metabolic acidosis in RTA*, CKD**
Urine for glucose, amino acid	Glycosuria, aminoaciduria as seen in Fanconi Syndrome
24 hours urinary calcium level	Increased in Fanconi syndrome
Urinary calcium/ creatinine ratio	Increased in Fanconi syndrome (disorder of renal tubular function)
24 hours urinary phosphate level	Increased (Phosphaturia) in RTA, X-linked hypophosphataemic rickets, Fanconi Syndrome

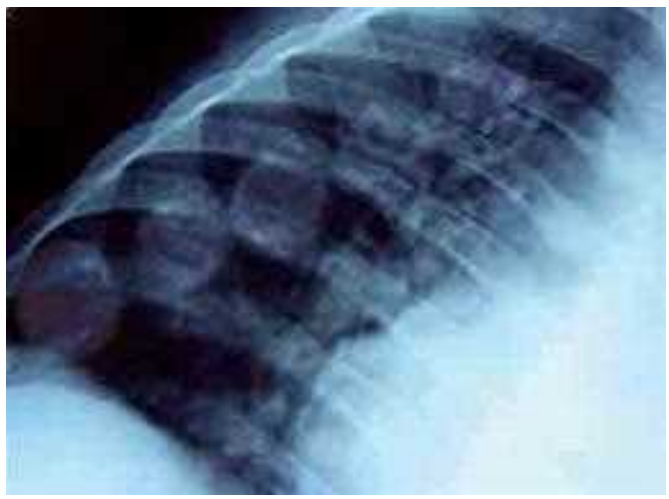
** Renal tubular acidosis, ** Chronic kidney diseases*

- **Radiology**
  - X-Ray upper and lower limbs including knee, ankle, elbow & wrist joints. It shows–
    - Widening, cupping and fraying of metaphysis
    - Wide gap between epiphysis and metaphysis
    - Density of shaft of bone is reduced (osteopenia)
    - Deformity of long bones may be present
    - Green stick fracture may be present



Typical X-Ray of rickets

- Chest X-Ray: X-Ray chest shows–
  - Chondral ends of ribs are expanded, cupped and indistinct
  - Rachitic rosary may be identified



CXR showing Rachitic rosary

TREATMENT

A. Nutritional Rickets

- Vitamin D supplementation as follows
  - Vitamin D3 (Cholecalciferol)
    - Stoss therapy: 300,000-600,000 IU is given orally or IM 2-4 doses over 1 day

      or
    - Gradual therapy: 2000-5000 IU/day over 4-6 weeks

Either strategy should be followed by daily maintenance vitamin D intake of–

- 400 IU/day (children <1 year of age) and 600 IU/day (for children >1 year of age)
- Stoss therapy may be repeated if required after radiological evaluation at 6-8 weeks of therapy

- Calcium supplementation (350-1000 mg/day)
- Adequate calcium rich diets
- 1,25 di (OH) cholecalciferol e.g. dicaltrol, rocaltrol (0.25 microgm) may be given orally or IV (dose: 0.05 microgm/kg/day) for few days when there is acute symptomatic hypocalcaemia along with IV Calcium

B. Familial hypophosphataemic rickets

- Phosphorus supplementation as Joulie solution (Dibasic sodium phosphate)–
  - 1-3 gm elemental phosphorus in 4-5 times a day for whole life
  - Oral Calcitriol (1,25 (OH) 2D3) supplementation: 30-70 ngm/kg/day in two divided doses

> Joulie solution contains 30.4 mg/ml elemental phosphate

Surgery

- Consultation with Orthopedic surgeon in severe deformity of limbs

PREVENTION

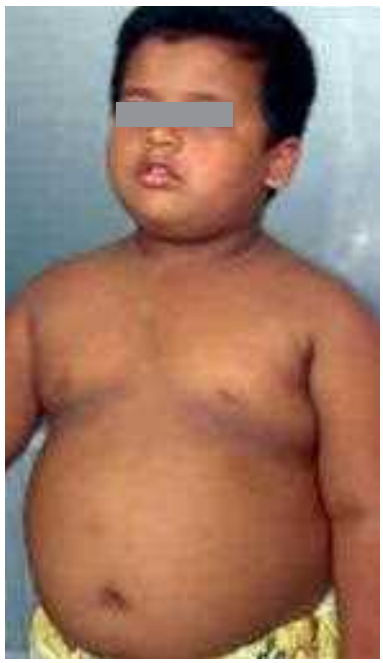
- Encourage
  - Exposure to adequate sunlight
  - Intake of diet rich in Vitamin D & Calcium
    - Egg • Yolk • Liver • Milk and milk products
    - Butter • Any fat rich diet
  - Regular intake of vitamin D
    Daily dose:
    - Child <1 year: 400 IU • >1 year: 600 IU/day

Profiles of different types of rickets

Sl	Types	Causes	Pathophysiology	Treatment
1	Calcium deficiency rickets	◆ Low intake of calcium ◆ Premature infants ◆ Malabsorption ◆ Anticonvulsants ◆ Renal tubular acidosis	Mineralization of bone matrix is defective	◆ Adequate calcium (350-1000 mg/d) should be taken ◆ Vitamin D supplementation is necessary if there is concurrent vitamin D deficiency
2	Vitamin D deficiency	◆ Insufficient Uv light ◆ No vitamin D supplementation ◆ Liver disease ◆ Renal disorders	Decreased absorption of calcium and phosphorus from intestine	
3	Phosphorus deficiency	◆ Premature infants ◆ Antacid excess intake	Mineralization of bone is defective	
4	Vitamin D resistant rickets (Familial hypophosphatemic rickets)	◆ X-linked dominant disorder ◆ AR or sporadic form ◆ Excess phosphaturia due to tubular dysfunction	Defects occur in the proximal tubular reabsorption of phosphorus and conversion of 25(OH) D to 1,25 $(OH)_2$ D3	
5	Vitamin D dependent rickets type I (VDDR type I)	◆ AR disorder	Absence of the renal enzyme 1α- hydroxylase and the conversion of 25 (OH) D2 to 1,25 $(OH)_2$ D3 is defective	Type I: physiological doses of alfacalcidiol or calcitriol (1-2 µg/d) and concomitant calcium with or without phosphate supplements
	Vitamin D dependent rickets type II (VDDR type II)	◆ AR disorder	There is end organ resistance to 1,25 $(OH)_2$ D3	Type II: long term administration of large amounts of IV or oral calcium
	Renal tubular acidosis		Appropriate correction of acidosis with bicarbonate and phosphate supplementation	
	Chronic kidney disease		Therapy consists of restricting phosphate intake and providing supplements of calcium and active vitamin D analogs	

CHILDHOOD OBESITY

Obesity is a burning problem among children now a days and it is dramatically on the rise. Childhood obesity leads to adult obesity. This is a chronic preventable disease.



Courtesy: Dr Shamima Sharmin Shova

Definition

Overweight: Having excess body weight for a particular height.

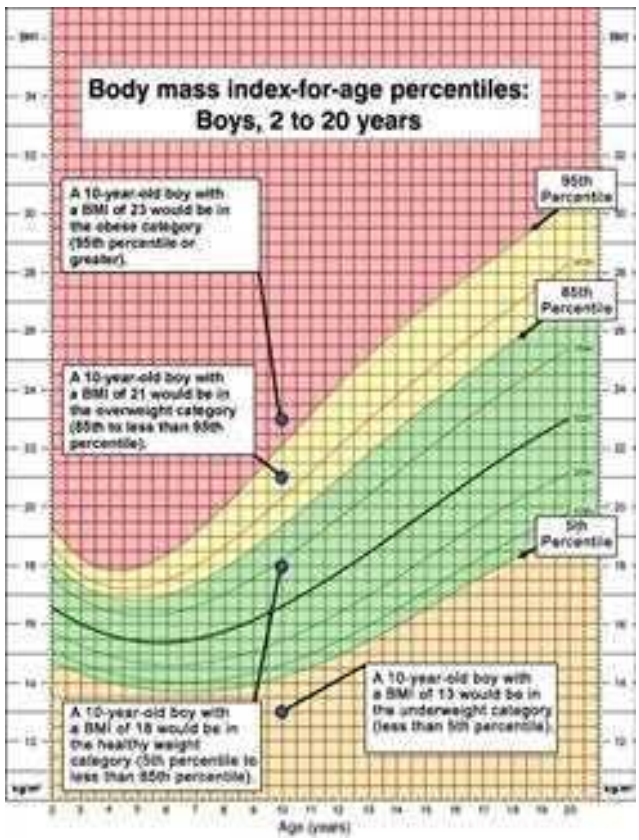
Obesity: Having excess body fat (Not simply overweight).

Ways to Measure Obesity

- Measuring Body Mass Index (BMI)

  Weight (kg)/Height (m2)

BMI percentile chart to assess obesity



Interpretation of BMI for percentile chart

Weight status category	Percentile range
Underweight	<5th
Healthy weight	5th -85th
Overweight	85th -95th
Obese	≥ 95th

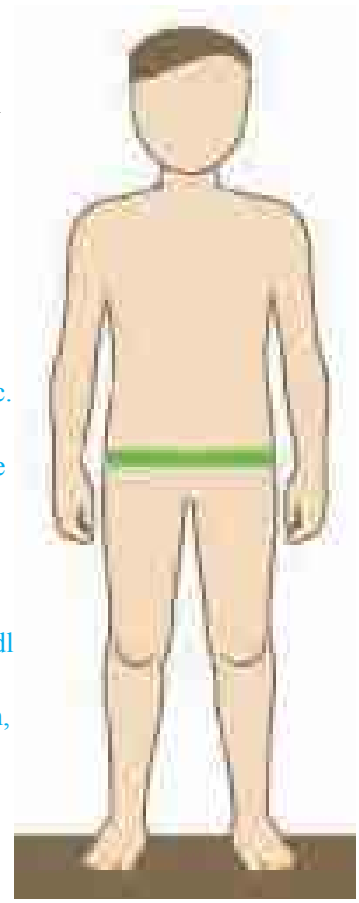
- Skin fold thickness or Caliper's test: Measured by thickness of skin over triceps or over the calf muscle or sub scapular skin fold
- Waist circumference measurement: Measured at a point midway between the 10th rib and the iliac crest.

Source: Internet

Measurement of skin fold thickness with Harpenden calipers

AETIOLOGY

- Mostly exogenous–
  - Eating too much high calorie food (fast food)
  - Too little exercise
- Other causes (< 5%)
  - Hormonal e.g. hypothyroidism, Cushing syndrome, hyperinsulinaemia etc.
  - CNS problems e.g. hypothalamic damage due to tumor, trauma or infection
  - Syndromes e.g. Down, Prader-Willi, Laurance–Moon-Biedl
  - Drugs e.g. corticosteroid, insulin, antithyroid, sodium valproate etc.

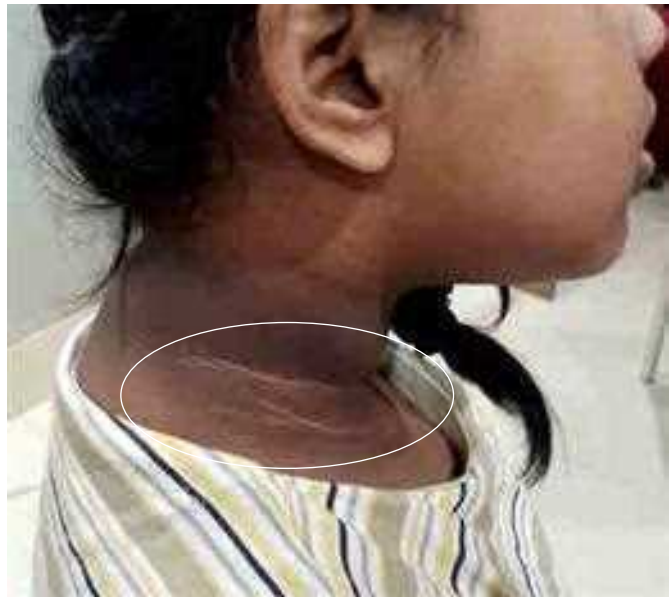


Source: Internet

Measurement of waist circumference

Complications

Psychological	Poor self esteem Eating disorder e.g. anorexia
Neurological	Pseudotumor cerebri
Pulmonary	Sleep apnoea Asthma Exercise intolerance
Skin	Infection Acanthosis nigricans
Gastrointestinal	Gall stone Steatohepatitis (inflammation of the liver with concurrent fat accumulation in liver) Fatty liver
Cardiovascular	Dyslipidaemia Hypertension Coagulopathy
Renal	Glomerulosclerosis
Musculoskeletal	Slipped capital femoral epiphysis Blount's disease Forearm fracture Flat feet
Endocrine	Type II diabetes Precocious puberty Polycystic ovary syndrome Hypogonadism



Acanthosis nigricans

TREATMENT

- Counsel about the nature and the complications of the disease
- Behavior modification to control appetite and change of food habit
- Reduce calorie intake e.g. intake diet low in carbohydrate & fat and eat more vegetables and fruits
- Increased physical activity e.g. walk to school, play with friends, regular physical exercise
- Treatment of cause, if any

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the 10 steps of management of severe acute malnutrition?
2. Define obesity.
3. What are the complications & sequele of obesity?
4. How can you control obesity?
5. A 2 year old boy weighing 5.5 kg presented with severe wasting and bipedal oedema.
   i) Write down the common complications of severe PEM.
   ii) How will you manage hypoglycaemia in present in this child?
6. Write down the difference between Marasmus and Kwashiorkor.
7. Write down the occular manifestation of Xerophthalmia.
8. Describe the radiological feature of rickets.
9. Classify PEM.
10. Write short note on: Kwashiorkor

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Common nutritional problems of Bangladesh are–
   ___ a) acrodermatitis enteropathica ___ b) obesity ___ c) iodine deficiency disorders
   ___ d) protein energy malnutrition ___ e) iron deficiency anaemia
2. The diagnostic criteria for severe acute malnutrition are–
   ___ a) MUAC < 115 mm ___ b) bipedal oedema ___ c) sparse hair
   ___ d) xerophthalmia ___ e) WHZ < –3SD

3. The following micronutrients are used in acute phase treatment of severe acute malnutrition–
___ a) Zinc ___ b) Iron ___ c) Copper
___ d) Vitamin E ___ e) Folic acid
4. Nutritional rickets is characterized by–
___ a) short stature ___ b) hepatosplenomegaly ___ c) hypotonia
___ d) arthritis ___ e) recurrent chest infection
5. Deficiency of vitamin B complex gives rise to–
___ a) pellagra ___ b) angular stomatitis ___ c) scurvy
___ d) convulsion ___ e) xerophthalmia
6. Beriberi occurs in the deficiency of–
___ a) Pyridoxine ___ b) Riboflavin ___ c) Niacin
___ d) Thiamine ___ e) Cyanocobalamine
7. The clinical and haematological pictures of iron deficiency anaemia are–
___ a) smooth tongue ___ b) white nails ___ c) increased TIBC
___ d) normocytic normochromic picture ___ e) decreased s ferritin level
8. The clinical features of iron deficiency anaemia are–
___ a) pica ___ b) white nails ___ c) smooth tongue
___ d) irritability ___ e) epistaxis
9. The classical radiological features of scurvy are–
___ a) ground glass appearance of shaft of long bones ___ b) ring shaped epiphyses
___ c) Fraenkel's white line ___ d) cupping and fraying of metaphysis
___ e) wide gap between epiphysis and metaphysis
10. A 2 years old boy presented with severe wasting. The recommended objective clinical parameters to define severe acute malnutrition are–
___ a) MUAC 115 mm ___ b) WHZ – 3SD ___ c) bipedal oedema
___ d) severe anaemia ___ e) skin changes
11. A 3 years old child having 110 mm mid upper arm circumference will be defined as–
___ a) well nourished ___ b) stunted ___ c) kwashiorkor
___ d) marusmus ___ e) severe acute malnutrition
12. The suggestive biochemical changes in nutritional rickets are–
___ a) Normal S. calcium ___ b) low S. inorganic phosphorus ___ c) elevated S. creatinine
___ d) low S. parathormone level ___ e) low S. Alkaline phosphatatase
13. Obesity is assessed by–
___ a) BMI ___ b) MUAC ___ c) Harpenden Cailper
___ d) upper and lower segment ratio ___ e) waist circumference measurement

Chapter 10

Cough and/or Difficult Breathing

Cough and/or difficult breathing are the commonest symptoms of respiratory illnesses. Whenever children present with these symptoms, the following conditions should be considered–

- Pneumonia
- Acute bronchiolitis
- Asthma
- Croup
- Pertussis
- Pulmonary TB
- Pneumothorax
- Foreign body
- aspiration
- Others e.g. cystic fibrosis, interstitial lungs diseases etc.

Apart from these, **heart failure** also presents with cough and difficult breathing.

Of the different illnesses, pneumonia, acute bronchiolitis and asthma are the major respiratory illnesses of the children and will be discussed in details. Other respiratory illnesses like acute laryngotracheobronchitis, laryngomalacia will also be highlighted in this chapter.

PNEUMONIA

Pneumonia is the infection of lung parenchyma. It alone contributes to >16 % of all under 5 deaths worldwide, including 30% neonatal deaths. Each year around 25,000 children die from pneumonia in Bangladesh.

Grossly, Pneumonia is grouped into–

- **Community acquired pneumonia (CAP)** i.e. pneumonia acquired from community/outside hospital
- **Nosocomial** i.e. pneumonia acquired from hospital
- **Pneumonia in special situations** e.g. aspiration pneumonia, pneumonia in immunocompromized host (opportunistic pneumonia)

Of the different types, CAP is the most common and is important from public health point of view.

Risk factors

- Severe malnutrition
- Infectious diseases e.g. measles, pertussis
- Immune deficiency disorders e.g. severe combined immune deficiency
- Congenital lesions e.g. congenital heart (VSD, ASD, PDA) & congenital lungs diseases
- Younger age e.g. neonates & infants
- Others e.g. indoor air pollution, over-crowding

Organisms

Newborn	*Gr. B Streptococci* Enteric gram negative
1-3 month	*C. trachomatis* *U. urealyticum* *Viruses*
1-12 month	*S. pneumoniae* *H. influenzae* *S. aureus* *M. catarrhalis* *Viruses*
1-5 years	*S. pneumoniae* *M. pneumoniae* *C. pneumoniae* *Viruses*
> 5 years	*S. pneumoniae* *M. pneumoniae* *C. pneumoniae*

Pathogenesis

After entering in the respiratory tract and alveoli, the invading organisms evoke a local inflammatory response.

This activates complement, coagulation cascades and release many chemical mediators e.g. leukotrienes, prostaglandins, histamines etc. which enhance capillary permeability & blood flow to the inflamed areas of lungs.

As a result, a protein-rich fibrino-suppurative inflammatory exudate containing leukocytes, RBC, antibodies accumulate in the alveolar spaces causing solidification of lungs tissue (**consolidation)**. The solidification may involve a larger portion of a lobe or of an entire lobe (lobar consolidation) or may have patchy lesions throughout one or both lungs (bronchopneumonia).

The net result is **reduction of functional areas in alveoli for gas exchange** and patients become hypoxic and present with respiratory distress.

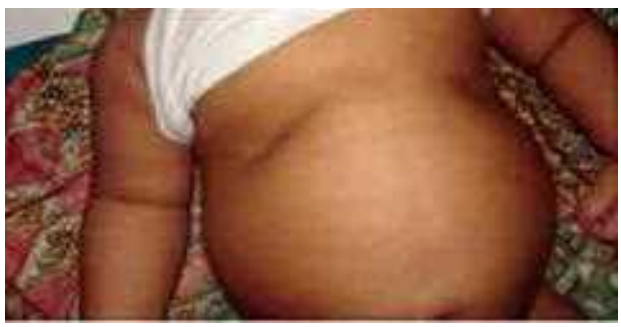
CLINICAL MANIFESTATIONS

A. Symptoms

- Fever (moderate to high grade)
- Cough
- Respiratory distress
- Chest pain (if associated pleurisy)
- Unable to feed and drink (when severe respiratory distress)

B. Physical examination

- Appearance: Dyspnoeic, toxic, irritated
- Increased body temperature
- Flaring of alae nasi
- Cyanosis, may be
- Head nodding, present in severe hypoxia
- Grunting may be present in severe cases



Chest indrawing

Chest examination: Other findings will vary according to the underlying pathologies as given in a table–

- Fast breathing
  - ≥ 60 breaths/min (0–2 months)
  - ≥ 50 breaths/min (2–upto12 months)
  - ≥ 40 breaths/min (1–5 years)
- Chest indrawing
- Tachycardia

Systemic (Chest) Examination

	Pneumonic consolidation	Pleural effusion	Pneumo-thorax
Movement of chest	Restricted on the affected side	Restricted on the affected side	Restricted on the affected side
Position of Trachea	Central	Shifted to the opposite side	Shifted to the opposite side
Position of Apex beat	In normal position	Shifted to opposite side	Shifted to opposite side
Vocal fremitus	Increased	Decreased/ absent	Decreased
Percussion note	Woody dull	Stony dull	Hyper-resonant
Breath sounds	Bronchial	Absent	Absent
Vocal resonance	Increased	Decreased/ absent	Decreased
Added sounds	Coarse crepitations	Absent, but crepitations may be present above the level of effusion	Absent

In **Bronchopneumonia,** the clinical features are similar to consolidation except that the characteristic dullness of consolidation is absent and breath sound is vesicular instead of bronchial with presence of coarse crepitations all over the lung fields.

DIAGNOSIS

Based on–

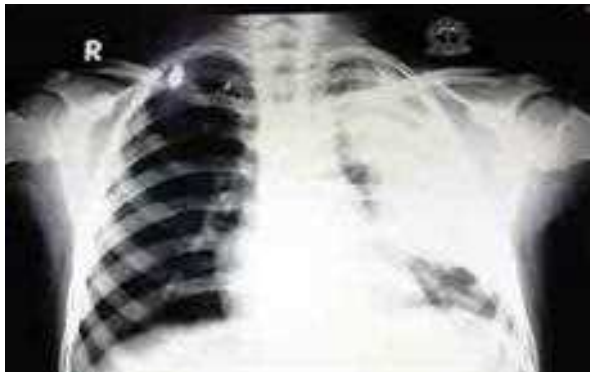
- Clinical manifestitions
- Relevant investigations

Investigations

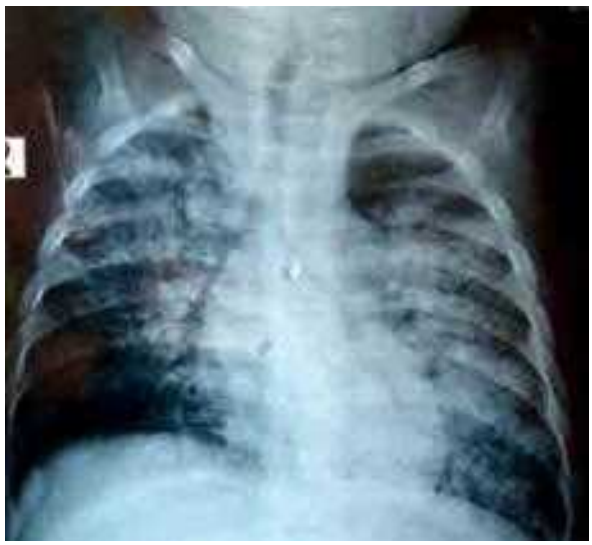
- X-Ray chest: The findings are–
  - Lobar consolidation: Homogeneous opacity in the lobe
  - Patchy consolidation: Small consolidations seen in different areas of lung fields
  - Pneumatocele: Thin walled cystic lesion, pathognomonic of *staphylococcal* pneumonia
  - Interstitial infiltrate: Hyper aeration & prominent

lungs markings caused by bronchial wall thickening found in viral and pneumonia from atypical organisms

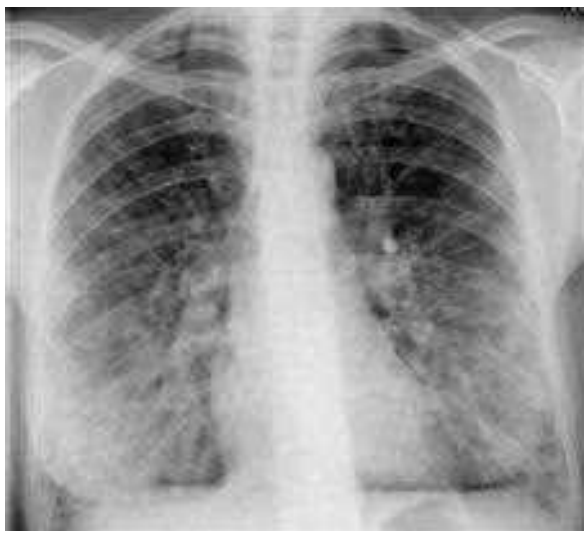
- Features of complications e.g. pleural effusion, empyema thoracis, lungs abscess etc.



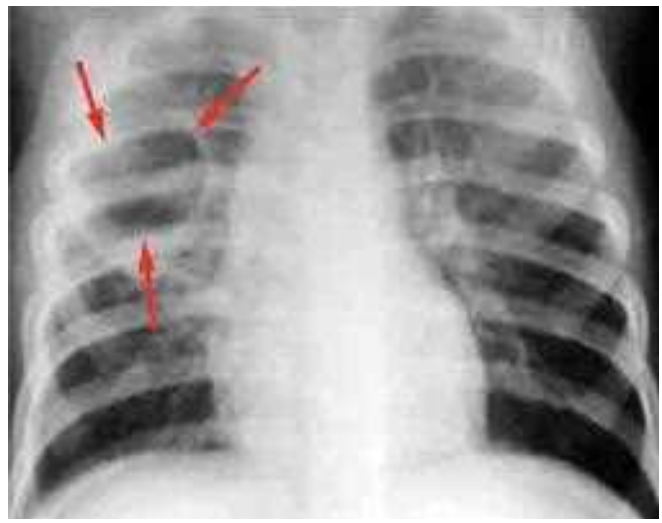
Large lobar consolidation in right lung



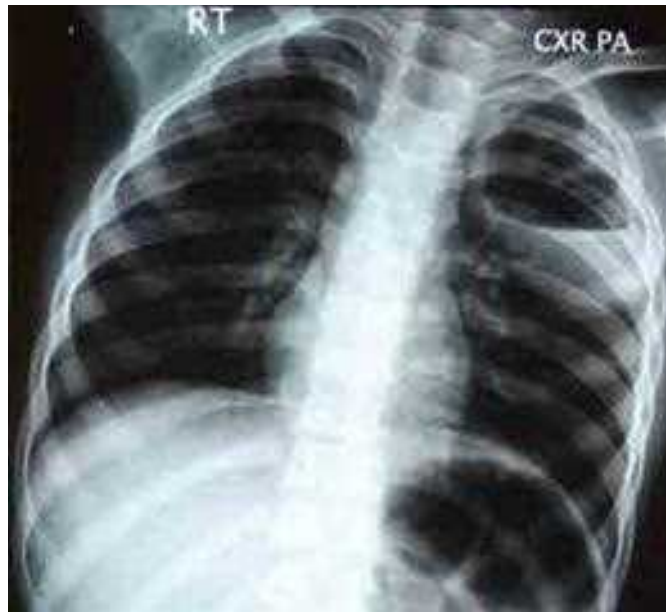
Patchy consolidations involving different areas of both lungs (Bronchopneumonia)



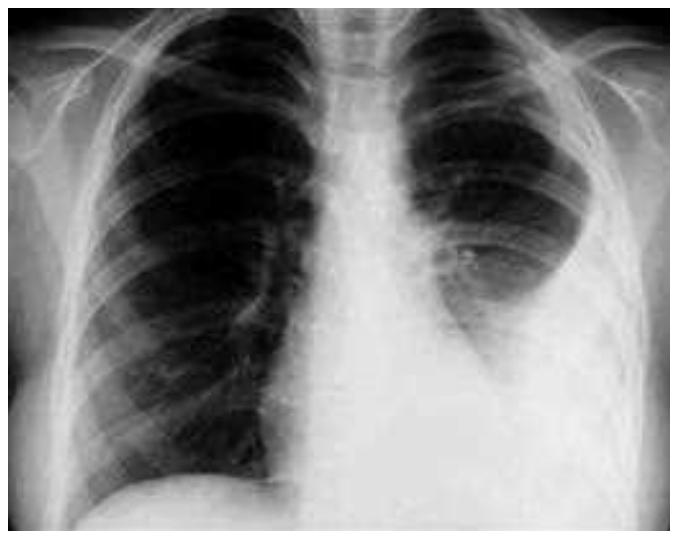
X-ray chest showing streaky densities & bilateral consolidation of lower lobes: Atypical pneumonia



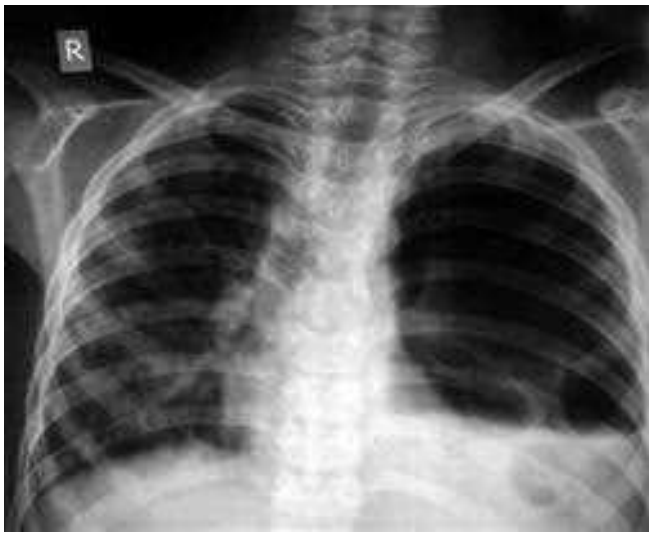
Thin walled cystic lesion in the middle of the right upper lobe (Pneumatocele)



A circumscribed area in left upper lobe with air fluid level: lung abscess



Left sided plural effusion with obliteration of left costo phrenic and cardiophrenic angles



Air fluid level in left hemithorax, obliteration of costophrenic and cardiophrenic angles & shifting of mediastinum to the right.

- CBC: Polymorphonuclear leukocytosis, ESR: (High)
- Blood C/S: May reveal the organism (<10% of cases)

Complications

- Lungs abscess, from tissue destruction and necrosis
- Pleurisy and pleural effusion
- Empyema resulting from spreading and accumulation of pus into the pleural cavity
- Haematogenous dissemination of bacteria to other organs and may cause meningitis, arthritis, infective endocarditis etc.
- Fibrosis of lungs from organization of the exudate

Classification of the Severity of Pneumonia & Recommended Treatment

(2 months – upto 5 years) WHO' 2013

Any child under 5 years of age who is brought with fever, cough and difficult breathing should be assessed after 3 doses of salbutamol nebulization in an interval of 20 minutes. The patients who responds to nebulization will be considered as wheezy child e.g. bronchiolitis, asthma but who do not respond should be classified as pneumonia in the following way–

Sign or symptom	Classification	Treatment
◆ Any general danger sign ◆ Severe chest indrawing (deep & easily visible) ◆ Stridor in clam child	**Severe Pneumonia**	◆ Give first dose of an appropriate antibiotic ◆ Treat the child to prevent low blood sugar ◆ Refer urgently to hospital
◆ Chest indrawing ◆ Fast breathing ❑ ≥ 60 breaths/min (age <2 months) ❑ ≥ 50 breaths/min (age 2–upto 12 months) ❑ ≥ 40 breaths/min (age 1-5 years)	**Pneumonia**	◆ Give oral Amoxycillin for 5 days ◆ If wheezing (even if it disappears after rapidly acting bronchodilator) give an inhaled/oral Salbutamol for 5 days ◆ Soothe the throat and relieve cough with a safe remedy ◆ If coughing >2 weeks or recurrent wheeze, Refer to assess for TB or asthma ◆ Advise mother, when to return immediately ◆ Follow up the child in 3 days

TREATMENT

Counsel parents, what is pneumonia, how it occurs,its complications, treatment and outcome.

A. Antibiotic therapy

a) For Children (2 months-5 years)

I. Severe pneumonia

- Inj. Ampicillin (50 mg/kg/dose) IM or IV 6 hourly + Inj. Gentamicin 7.5 mg/kg, IM/IV once daily for at least 5 days
- If no response by 48 hours and Staph. is suspected, change Ampicillin to Cloxacillin, 50 mg/kg/dose IM /IV 6 hourly and continue for 3 weeks. Continue Gentamicin 7.5 mg/kg IM/IV once daily for total 7 days.
- Use Ceftriaxone (80-100 mg/kg) IM or IV once daily 5-7 days, when failure of first line treatment

II. Pneumonia

- Amoxicillin (40 mg/kg/dose) orally every 12 hours for 3 days (5 days in High HIV prevalent areas)
- Routine follow up after 72 hours–
  - To assess the response to treatment
  - To look for complication (if any)

or

Earlier, if clinical status deteriorates and hospitalize

the child & investigate to exclude complications or any alternate diagnosis

NB: The antibiotics mentioned above are the WHO recommended empiric choice. But other antibiotics such as macrolides, amoxicillin-clavulonic acid, 2nd and 3rd generation cephalosporins can be used, depending on patient's clinical status.

b) Neonates and young infants (< 2 months)

In this age group, pneumonia of any severity should be hospitalized and managed with parenteral antibiotics, O_2 inhalation and other supports.

The antibiotics of choice are–

- Ampicillin & Gentamicin for 7-10 days
- If Staph suspected: add Cloxacillin
- Choose other antibiotics including macrolides, if indicated

B. Supportive treatment

1. Oxygen therapy

- Give Oxygen, if SpO_2 is < 90% by Pulse Oximeter
- If pulse oximeter is not available, continue O_2 until the signs of hypoxia e.g. inability to BF or RR ≥ 70/min are no longer present
- Curtail O_2 for a trial period each day to see SpO_2. If SpO_2 remains > 90% (at least 15 min in room air), then discontinue O_2
- Check nasal prongs 3 hrly to see, whether these are
  - blocked with mucus or not
  - in correct position and all the connections are secured

2. Other supports

- Manage Airway e.g. remove any thick secretions from nose or throat
- Give paracetamol for fever (≥ 39° C or ≥ 102.2° F)
- Give a rapid-acting bronchodilator for wheeze
  - Soothe the throat & relieve cough with a safe remedy • Warm water • Lemon tea
- Encourage breast feeding and oral fluids
- Start NG tube feeding, if child cannot drink
- Avoid overhydration, if the child is on IV fluid

PREVENTION

- Immunization: Against Pneumococcus, Hib, Measles
- Improving nutritional status: By breast feeding and energy dense complimentary feeding
- Hand washing before handling the young infants

Conditions presenting with wheeze

Whenever a child presents with wheeze, the following conditions should be considered–

- Bronchial asthma
- Acute bronchiolitis
- Gastro-oesophageal reflux disease (GERD)
- Cystic fibrosis
- Foreign body in lungs
- Tropical pulmonary eosinophilia

In the first 2 years of life, wheezing is mostly due to viral respiratory infections like acute bronchiolitis but afterwards, it is mostly due to asthma. In this section, we will discuss both these diseases.

ACUTE BRONCHIOLITIS

It is an acute viral infection of the **bronchioles** and is characterized by cough, respiratory distress and wheeze that used to start following an episode of viral upper respiratory catarrh.

A child with bronchiolitis

The disease occurs among children <2 years of age, mostly, between 2-6 months and usually occurs in epidemics, during winter and rainy season.

Clinically, it appears to be pneumonia but actually it is a different entity.

Organisms

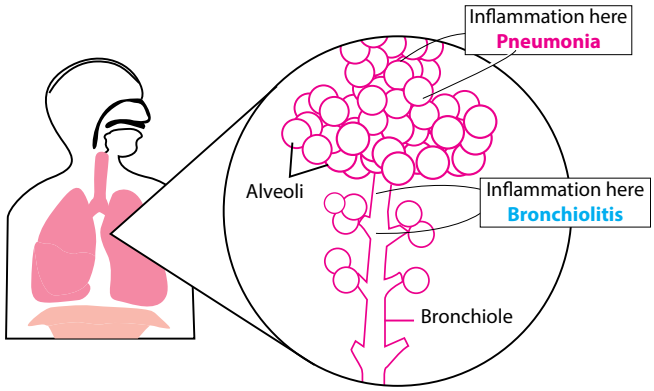
- Respiratory Syncytial Virus (RSV): Most common
- Others: Influenza, para influenza viruses, Human metapneumovirus and sometimes mycoplasma

RISK FACTORS

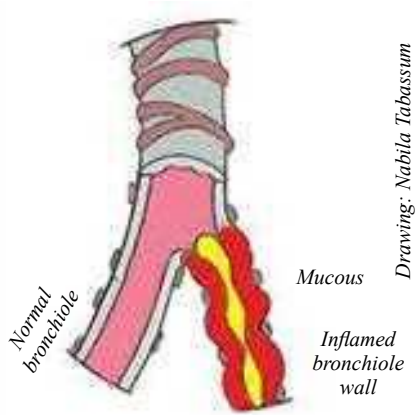
- Prematurity
- Non breast feeding
- Over crowding
- Passive smoking
- Indoor air pollution
- Low socio-economic status

PATHOGENESIS

Infection/inflammation of bronchioles gives rise to–



- Swelling of the walls of bronchioles
- Profuse secretion of mucous
- Narrowing of the lumen of bronchioles, and causes–
  - Increased resistance to air-flow, particularly during expiration
  - Air-trapping & alveolar hyperinflation and raised pressure



Drawing: Nabila Tabassum

Inflamed narrow bronchioles

in the alveoli. This gives rise to hypoventilation, compromised pulmonary circulation and the ultimate results are hypoxaemia, CO_2 retention and acid-base imbalance (resperatory acidosis). The net clinical effects are–

- Severe cough
- Respiratory distress
- Wheeze
- Hypoxia, hypercarbia and respiratory acidosis
- Segmental collapse (if complete obstruction of bronchioles by mucous plug)

CLINICAL MANIFESTATIONS

- Sudden onset of cough
- Respiratory distress
- Wheeze

Following an upper respiratory catarrh. In many cases, the affected children are otherwise playful and afebrile or have low grade fever, not looking so sick (happy wheezer).

Physical examination shows–

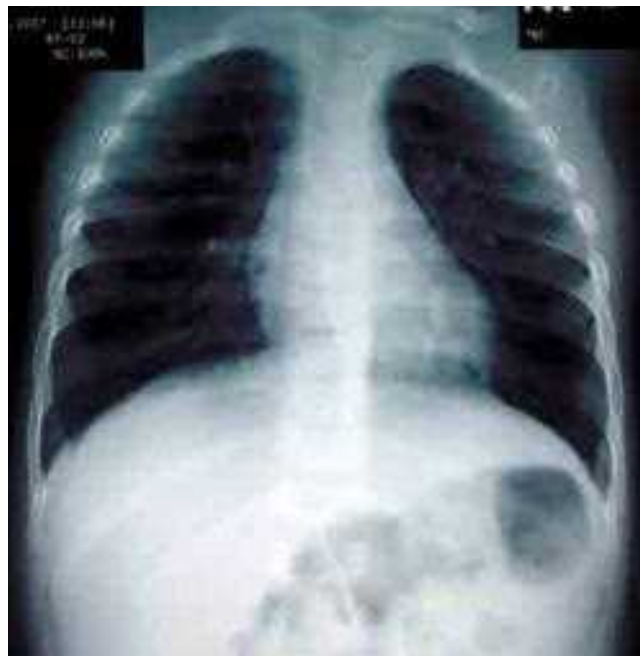
- Dyspnoeic
- Cyanosis (may be)
- Occasional grunting
- Inspection of chest
  - Fast breathing
  - Chest indrawing
  - Suprasternal recession
  - Hyper inflated/bloated chest
- Flaring of alae nasi
- Head nodding
- Palpation: No characteristic finding
- Percussion note: Hyper-resonant
- Auscultation: Breath sound is vesicular with prolong expiration and wide-spread rhonchi. Sometimes, fine crepitations may be present
- SpO_2: Low
- Others: Liver and Spleen may be palpable (visceroptosis)

DIAGNOSIS

Based on the characteristic clinical features & supportive findings from relevant investigations.

Investigations

- X-Ray chest: The characteristic findings are–
  - Hypertranslucency e.g. more blackish lung fields
  - Hyperinflation e.g. horizontal ribs, depression of domes of the diaphragm



X-ray chest of bronchiolitis, more black, depression of domes of diaphragm (hypertranslucency and hyperinflation)

- CBC, CRP: Unremarkable
- Others e.g. S electrolytes, ABG, when disease is severe

TREATMENT

- Counsel parents about the nature of the disease, treatment etc.Treatment is variable and is related to the disease severity

I. Mild cases

Hospitalization not required, only HOME CARE. These include, guiding parents to–

- Keep the baby's head in upright position
- Clean nose by cotton soaked with normal saline
- Continue usual feeding
- Bath/sponge the baby with luke warm water
- Advice: When come to hospital for routine follow up or when to return immediately

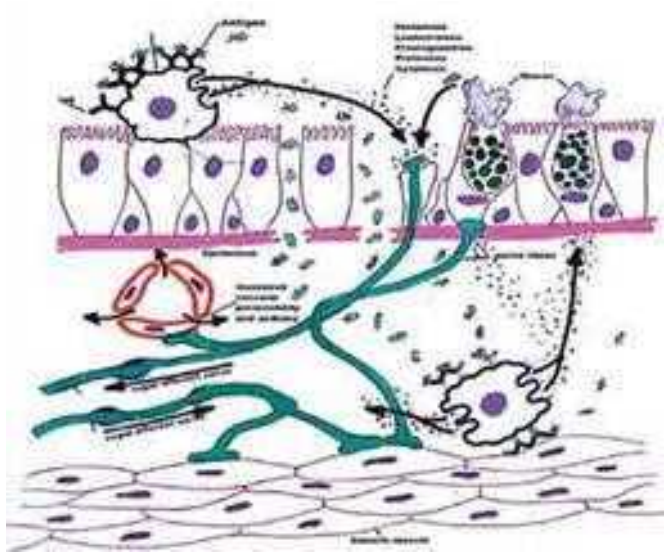
II. Severe cases

- Immediate hospitalization
- Humidified O_2 inhalation, 4-6 L/min through head box
- NPO and infusion of appropriate fluid. Restrict fluid of 20%, whenever, evidence of SIADH
- Although having inconsistent results with growing evidence of non-beneficiary role in recent studies, Nebulization with hypertonic saline *(e.g. 3%,7% NaCl)* may be done
- Monitoring, particularly SPO_2 by pulse oximeter
- Consider CPAP/Ventilator support, when severe respiratory distress, falling SPO_2 & altered ABG profile.
- Supportive management: As in home care
- Nebulization of Salbutamol/Budesonide, Theophylline, Ipratropium bromide are not recommended
- Although having no conclusive benefit, the other treatment options are–
  - Dexamethasone, IV may be tried only in severe cases
  - Antibiotics: No role, but given only when secondary bacterial infection is suspected

ASTHMA

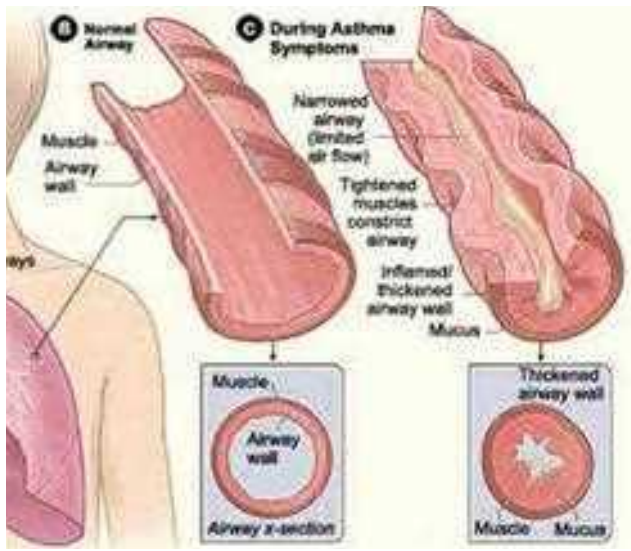
Asthma is one of the 3 major lower respiratory illnesses among children. It is a chronic inflammatory condition of respiratory tract characterized by an increased responsiveness of the trachea and bronchi to various stimuli and presenting with features of reversible airflow limitation.

PATHOGENESIS



Inflammation of airway remains the major pathology of asthma. After it's entry into the lumen of hyper-reactive airway, the asthma triggers (e.g. viral infection, irritants, smokes, dust, mites, NSAID, pollens cockroach etc.) initiate local inflammation and recruits many inflammatory cells especially mast cells and eosinophils. These cells liberate different inflammatory mediators (e.g. histamine, prostaglandin D_2, leukotriene C_4, D_4, E_4, etc) which stimulate various structures, present in the bronchial wall–

- **Goblet cells**, secret profuse mucous which causing plugging of the airway lumen
- **Vagus nerve**, causing bronchospasm & narrowing of bronchial lumen
- **Blood vessels**, causing vasodilatation with increasing permeability and make the mucosa oedematous

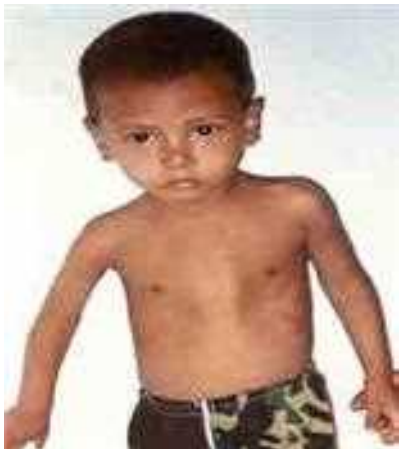


Narrowing of bronchial lumen

All these effects cause narrowing of air passages with increased airflow resistance and work of breathing particularly during expiration. As a result, there is air trapping with consequent hyperinflation and increasing pressure in the alveoli and hypoventilation.

Pulmonary circulation is also compromized which along with hypoventilation impair gas exchange through respiratory membrane and ultimately results in hypoxaemia and CO_2 retention.

In asthma, the inflammatory processes are **recurrent** and if not controlled adequately, then repeated airway inflammations, will facilitate development of **sub-basement fibrosis** & chest deformity and finally decreased lungs compliance.



CLINICAL MANIFESTATION

Symptoms

- Recurrent cough, nocturnal episodic cough
- Breathlessness or shortness of breath
- Chest tightness (expressed by older children)
- Wheeze (in advanced asthma or in acute exacerbation)

General examination

- Dyspnoeic
- Flaring of alae nasi
- Prominent accessory muscles of respiration
- Air hunger, cyanosis
- Altered sensorium (agitated to drowsy) in acute exacerbation

Examination of Chest

- Inspection: Tachypnoea, Hyperinflated chest, presence of suprasternal, subcostal & intercostal recessions
- Palpation: Reduced chest expansibility, Central trachea
- Percussion: Hyperresonant
- Auscultation: Vesicular breath sound with prolonged expiration, presence of rhonchi

DIAGNOSIS

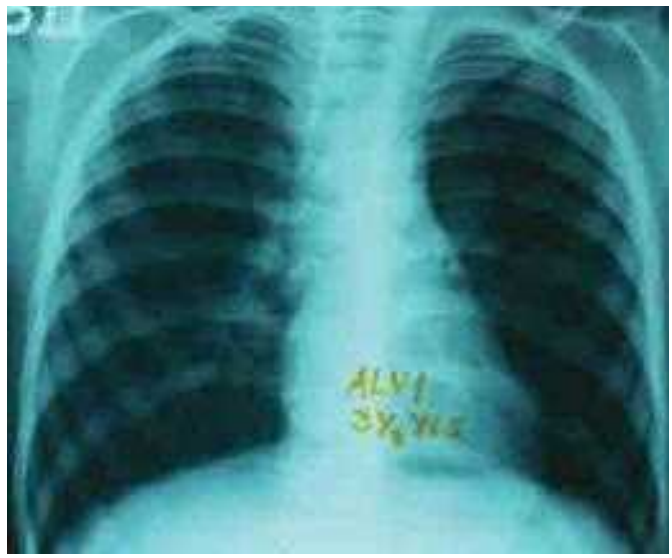
Basically clinical. Laboratory support has little role.

I. Clinical evidences

- Classical presentation e.g. recurrent cough, breathlessness, wheeze etc.
- Presence of co-existing atopic manifestations e.g. allergic rhinitis, allergic conjunctivitis, eczema
- History of asthma or atopy among the close relatives
- Dramatic relief of asthma symptoms by salbutamol and steroid

II. Laboratory supports

- X-Ray chest: Hyper-translucent (blackish lungs field) and hyper-inflated lungs (*low flat diaphragm & more horizontal ribs)* and tubular heart



- Blood: CBC (Eosinophilia), high IgE level
- Sputum examination: Eosinophilia
- PEFR diurnal variability: More than 20%
- Others: Bronchial reversibility test, spirometry etc. are relevant but less feasible for children

Classification and Types of asthma

Classification is based on frequency of recurrence of asthma symptoms either in day (Daytime symptoms) or at night (Night time symptoms) and is grouped into 3 types–

• Intermittent asthma • Persistent asthma • Special variant asthma	Any one of these types may be complicated by acute exacerbation

Types	Daytime symptoms	Night symptoms	Spirometry FEV_1
Intermittent	≤ 2 days / week	≤ 2 times/ month	FEV_1 at least 80% of predicted
Mild persistent	> 2 days / week	3-4 times/ month	FEV_1 at least 80% of predicted
Moderate persistent	Daily	1 time/week	FEV_1 at least 60-80% of predicted
Severe persistent	Continuous	Often every night	FEV_1 60% of predicted or less

Special Variant Asthma

When asthma symptoms appear on exposure to certain special situations and ingestion of some drugs and based on the background, asthma is grouped into–

- Seasonal asthma
- Exercise induced asthma
- Drug induced asthma
- Cough variant asthma
- Occupational asthma

Any of the above types may have an **acute exacerbation** and the patients may present with–

- Severe respiratory distress
- Widespread wheeze
- Inability to drink or talk
- Altered sensorium (agitated to drowsy)
- Central cyanosis
- Low oxygen saturation (<95%)
- Low FEV_1 (<60% in spirometry)

In extreme cases, patients may have **life threatening situations** like–

- Profound exhaustion
- Silent chest
- Bradycardia
- Hypotension etc.

Differences between Acute Bronchiolitis, Pneumonia and Asthma

Parameters	Bronchiolitis	Pneumonia	Asthma
Age	<2 years; peak 2-6 mo	Any age	Usually after 2 year
Runny nose	Present	Usually absent	May be present
Wheeze	Present	Usually absent	Present
Tempera-ture	Low grade	Moderate to high	Usually absent
Crackles	+	+++	Absent
Rhonchi	+++	+	+++
Response to broncho-dilator	Variable	No	Good
WBC count	Normal	Neutrophilic leukocytosis	Normal. may have eosino-philia
X-Ray chest	Hypertrans-lucency & Hyper-inflation	Consolida-tion or patchy opacities	Hyper-translucency, Hyperinfla-tion

Treatment

Counseling parents, about the natural course of the disease, it's treatment and importance of disease control

A. Intermittent Asthma

Objective of treatment: To relive the patients from respiratory distress by rapidly acting bronchodilators like salbutamol. Steroid may be require, when the patient is in acute exacerbation.

- Patients with intermittent asthma do not require any preventor drug
- Mild cases: Salbutamol either MDI or oral at home
- Moderate cases: MDI salbutamol plus a short course of oral prednisolone (1-2 mg/kg/day) for 3-5 days at home

- **Severe cases:** May be life threatening and should be treated in the hospital as below–

- Salbutamol nebulization (0.15-0.3 mg/kg/dose) every 20 minutes for 3 times or continuously. If nebulization is not available, then continuous inhalation of Salbutamol by MDI (inhaler) with spacer may be tried at home and on the way to hospital
- Propped up position/head up position
- Oxygen inhalation; 4-6 liter/min through head box
- Inj Hydrocortisone 3-4 mg/kg/dose, 4-6 hourly or Prednisolone 2 mg/kg/day for 3-5 days, or as necessary
- If condition does not improve, Nebulized Ipratropium bromide may be added
- If condition still shows no improvement, Inj. Aminophylline may be tried
- If still no improvement, Nebulization with Adrenaline, $MgSO_4$ may be given
- In refractory cases, Mechanical ventilation and PICU support will be required

B. Persistent Asthma (PA)

The main objective of management of persistent asthma (PA) is to prevent Recurrence of asthma symptoms, so as to bring the disease under long-term satisfactory control. To do that, children and their parents require–

- Counseling **(asthma education)**
- Regular use of preventor drugs
  - **Inhaled corticosteroids (ICS),** *The mainstay of management of PA* e.g. Beclomethasone, Fluticasone, Budesonide etc.
  - Leukotriene antagonists e.g. Montelukast
  - Cromones e.g. Sodium cromoglycate, Nedocromil sodium
  - Long acting $ß_2$ agonist (LABA) e.g. Salmeterol

Child using inhaler through spacer

- Regular Monitoring of lung functions: By peak flow meter
- Maintaining asthma diary
- Avoiding triggering factors as far as possible, and
- Treatment of acute exacerbations, if any

Child using peak flow meter

The dose of ICS is selected/adjusted as per the severity of the disease, Step Care Management. The steps may be graded up or down based on the status of control of asthma symptom, as shown below.

Sometimes, along with ICS, other drugs like Montelukast, LABA, SR-Theophylline etc. may be added.

A. STEP CARE MANAGEMENT OF ASTHMA FOR CHILDREN, AGE < 5 YEARS

Steps		Severity	Recommended treatment	Alternative options of treatment	
IV	STEP UP ↑ TREATMENT STEPS ↓ STEP DOWN	Severe persistent	Continue controller and refer for specialist assessment	Add Montelukast/Theophylline/LD OCS Add Intermittent ICS Increase dose & frequency of ICS	+ Step 1
III		Moderate persistent	Medium Dose ICS	Low Dose ICS + Daily Montelukast	+ Step 1
II		Mild persistent	Low Dose ICS	Montelukast/Episodic ICS	+ Step 1
I	Intermittent: Short acting ß2-agonist (Salbutamol), 100-200 µgm as and when required. 1-2 puffs up to 4-6 times daily. Additional 1-2 puffs prior to exercise, sports or exposure to triggers are advised.				

B. STEP CARE MANAGEMENT OF ASTHMA FOR CHILDREN, AGE 6 – 12 YEARS

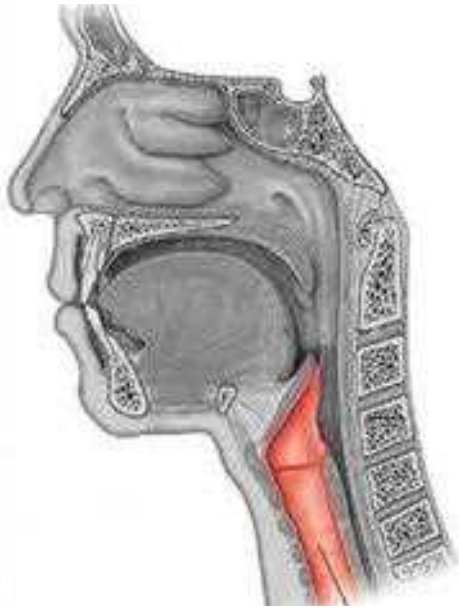
Steps		Severity	Recommended treatment	Alternative options		
V	STEP UP ↑ TREATMENT STEPS ↓ STEP DOWN	Severe persistent	Refer for add on treatment e.g. anti-IgE	Add low dose OCS	+ Step 1	Asthma education and environmental control
IV			MD/HD ICS+ LABA	Montelukast &/or SR Theophylline		
III		Moderate persistent	LD ICS+LABA	MD/HD ICS or LD ICS + Montelukast or LD ICS + SR theophylline		
II		Mild persistent	LD ICS	Montelukast	+ Step 1	
I	Intermittent: Short acting ß2-agonist (Salbutamol), 100-200 µgm as and when required. 1-2 puffs up to 4-6 times daily. Additional 1-2 puffs prior to exercise, sports or exposure to triggers are advised.					

LABA: Long acting β2-agonist, OCS: Oral corticosteroid, SR: Sustained Release
Dose of inhaled Beclomethasone–
LD: Low dose (100-200 µgm), MD: Medium Dose (200-400 µgm), HD: High Dose (>400 µgm)

Source: GINA 2015

CONDITIONS PRESENTING WITH STRIDOR

Stridor is a harsh noise produced during inspiration. This is due to narrowing of the air passage of the oropharynx, subglottis or trachea from any cause. In severe cases, stridor may also evident during expiration.



Upper respiratory tract

Source : internet

Whenever, a child presents with stridor along with cough and respiratory distress, the following diseases should be considered–

- Acute laryngotracheobronchitis (Croup)
- Acute epiglottitis
- Laryngomalacia & other pathologies in larynx
- Foreign body aspiration
- Retropharyngeal abscess
- Laryngeal diphtheria
- Bacterial tracheitis
- Angioneurotic oedema of the upper respiratory tract

In this section, we will discuss acute laryngotracheobronchitis (croup), laryngomalacia and acute epiglottitis.

ACUTE LARYNGOTRACHEOBRONCHITIS (CROUP)

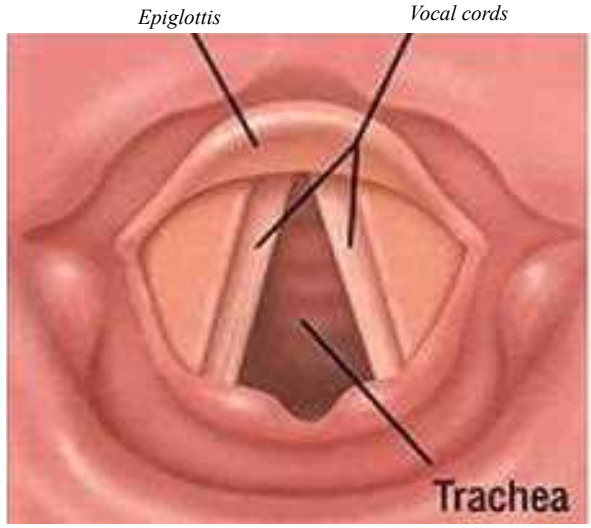
Croup is a viral infection of the upper airway. Children between 6 months and 3 years suffer more. It occurs, mostly during early winter or late fall.

AETIOLOGY

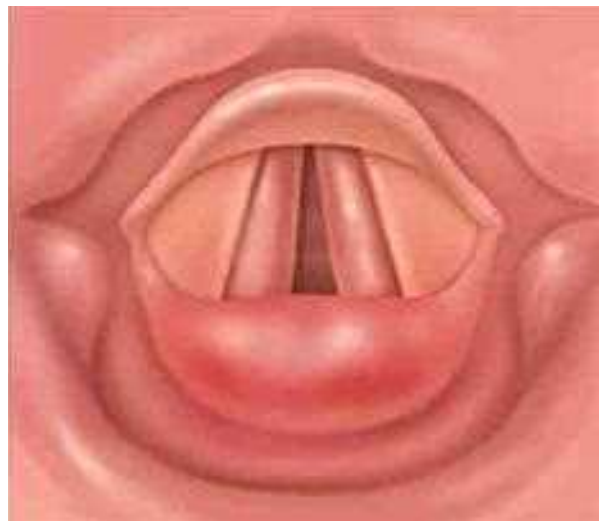
- Virus: Para influenza types 1 & 2 in most cases. Others are Influenza A & B, Adenovirus, RSV, Metapneumovirus
- Mycoplasma (rare)

PATHOGENESIS

In croup, tracheal wall becomes oedematous with profuse mucous secretion. This causes narrowing of the airway, resistance to air flow with development of harsh noise during inspiration (stridor).



Normal larynx



Source: Internet

Inflamed larynx

Depending on the extent of inflammation, the clinical severity may be mild, moderate and severe. Sometimes patients may develop respiratory failure.

CLINICAL MANIFESTATIONS

Sudden onset of–

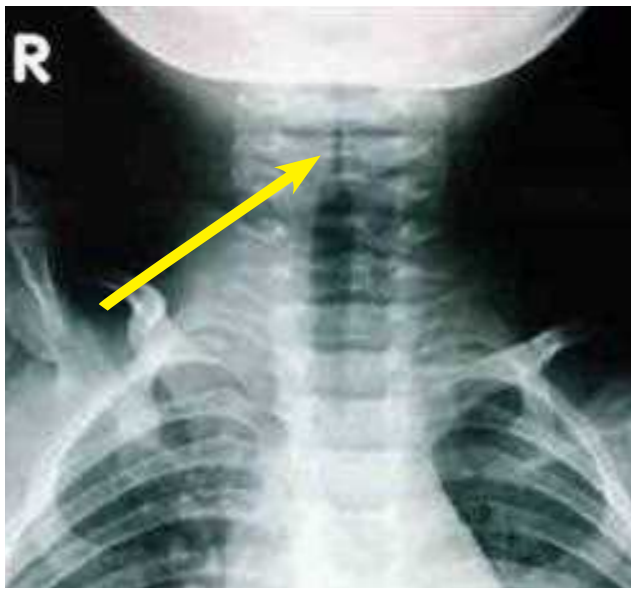
- Barking cough (characteristic)
- Inspiratory stridor
- Hoarseness of voice
- Respiratory distress
- Suprasternal recession
- Cyanosis (may be)
- Mild fever

DIAGNOSIS

Based on characteristic clinical features and supports from the relevant investigations.

Investigations

- X-Ray Neck: **Steeple sign** (Narrowing of air column) at trachea is characteristic
- CBC: Nothing characteristic



X-ray neck showing narrow air column

TREATMENT

Mainly, supportive

- Keep the child as comfortable as possible
- Allow the baby to remain in parent's lap
- Avoid unnecessary painful procedures, which may cause agitation and increased O_2 requirements
- O_2 inhalation by nasal cannula (2 L/min) or by face mask (3-5 L/min)
- Steroid: It reduces subglottic oedema and significant relief is obtained by 6 hours of administration. Single administration of any of the following is effective–
  - Dexamethasone: 0.6 mg/kg or
  - Prednisolone: 1 mg/kg or
  - Nebulized Budesonide: 2 mg
- Adrenaline (1:1000): 4-5 ml of undiluted adrenaline is given through nebulizer. Where possible, oxygen driven nebulization is preferable
- Antibiotic: Indicated, only when bacterial infection is suspected
- Inhalation of mist/humidified air: Ineffective
- Antitussive & decongestants: Ineffective
- Tracheostomy may be required in refractory cases

ACUTE EPIGLOTTITIS

An acute inflammation of epiglottitis.

Organism: *H. influenzae type b*

CLINICAL MANIFESTATIONS

Sudden development of–

- Respiratory distress and Stridor
- High fever
- Sore throat/Swallowing difficulty
- Excessive salivation (drooling)
- Toxic look, apprehensive
- Cyanosis may be present
- The disease progress very rapidly towards respiratory obstruction & within an hour, the affected child faces
  - Laboured breathing
- The affected child adopt **tripod** position (sitting upright & leaning forward with chin up and mouth open, bracing on the arms)
- Neck may found hyper-extended

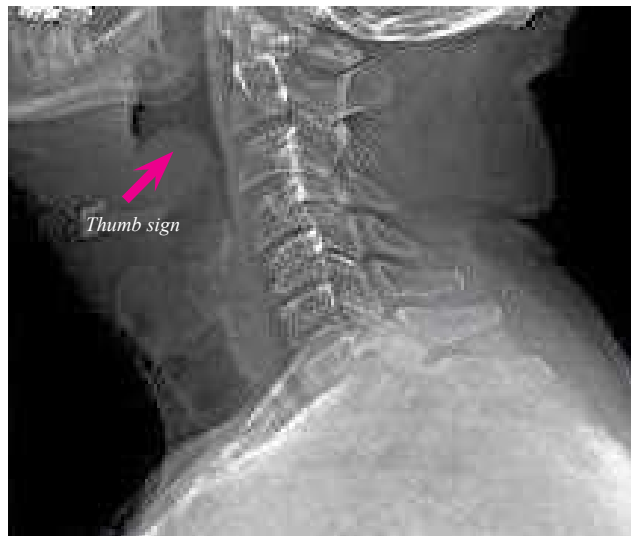
NB:Throat examination prohibited, as it causes sudden spasm at the level of epiglottis. If examination is obligatory, then it may be done cautiously with preparation for emergency resuscitation.

DIAGNOSIS

Based on the characteristic clinical features & supports from the relevant investigations

Investigations

- X-Ray neck (lateral view): **Thumb sign**
- CBC : Neutrophilic leukocytosis
- Laryngoscopy: Large **"cherry red"** swollen epiglottis



Source: Internet

X-ray neck showing 'thumb sign'

TREATMENT

- Propped up position
- Paracetamol, 15 mg/Kg/dose, 6 hourly for fever
- O_2 inhalation by nasal cannula (2 L/min) or by face mask (3-5 L/min)
- Antibiotics: Ceftriaxone @ 100mg/Kg, once daily for 7-10 days
- Monitoring of pulse, BP, respiratory rate, cyanosis, SPO_2, every 4-6 hourly
- Intubation & ventilator support may be required in progressive cases

Difference between epiglottitis and croup

Parameters	Epiglottitis	Croup
Aetiology	Bacterial	Viral
Fever	High grade	Low grade
Drooling	Present	Absent
X ray neck	Thumb sign	Steeple sign
Treatment	Antibiotic (Ceftriaxone)	Steroid & Adrenaline nebulization

LARYNGOMALACIA

Another common cause of stridor, particularly among the preterm, low birth weight babies.In this condition, manifestations, usually occur within first 2 weeks of life and remaining for a variable period.

PATHOGENESIS

In laryngomalacia, stridor occurs due to–

- Collapse of supraglottic structure during inspiration
- Floppy arytenoid cartilage of larynx or floppy epiglottis

CLINICAL MANIFESTATIONS

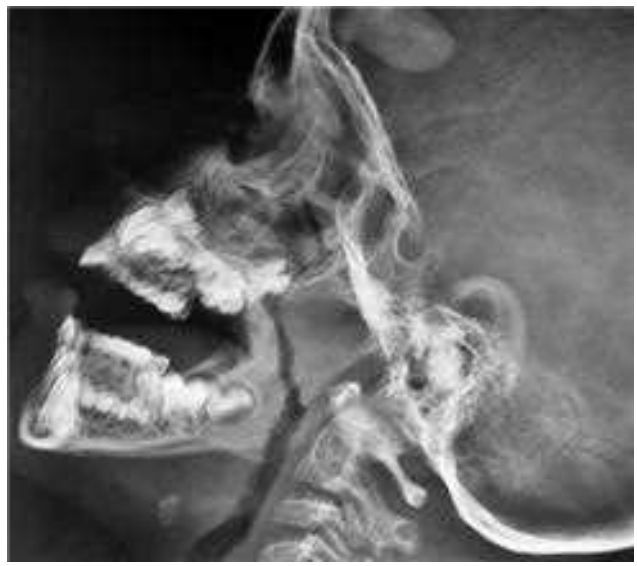
- Inspiratory stridor, aggravated by exertion e.g. crying,agitation,feeding and when lies on his back. It decreases while keeping the baby on prone or lateral position
- Sometimes, dyspnoea, chest retraction, feeding difficulties e.g.regurgitation, chocking on feeding may be present

DIAGNOSIS

Based on clinical features and relevant investigations *e.g. flexible laryngoscopy*

TREATMENT

- Counsel & assure parents that it will resolve spontaneously within 18/24 months of age and no need of treatment
- Demonstrate the mother, how to feed the child
- Surgery e.g. tracheostomy, endoscopic supraglottoplasty may be done in severe obstruction



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SELF ASSESSMENT

Short answer questions [SAQ]

1. What are the organisms responsible for pneumonia in under 5 year old children?
2. What antibiotic will you administer or prescribe to a 3 year old child suffering from severe pneumonia and how long?
3. Write down the five signs of severe acute exacerbation of asthma.
4. What is the doses of nebulized Salbutamol in acute exacerbation of bronchial asthma?
5. Write down the definition of chest indrawing, stridor and grunting.
6. What are the signs of respiratory distress in children?
7. Write down the difference between bronchiolitis & pneumonia.
8. A 2 year old girl presented with high fever , cough and respiratory distress for 2 days. On examination you noted fast breathing , chest indrawing and coarse crepitations in both lung fields.

   a) What is the probable diagnosis?

   b) Write down the relevant investigations and treatment of this child.
9. A 5 year old boy had history of recurrent wheeze . From early morning he developed severe respiratory distress and wheeze. How will you assess the case clinically? Please write down the steps of management.
10. Write short note on: a) Croup.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Conditions can give rise to stridor are–
   ___ a) acute laryngotracheobronchitis ___ b) acute bronchiolitis ___ c) diphtheria
   ___ d) pneumonia ___ e) acute epiglottitis
2. The cardinal physical findings of consolidation are–
   ___ a) shifting of trachea ___ b) prominent vocal resonance ___ c) coarse crepitations
   ___ d) dullness on percussion ___ e) vesicular breath sounds with prolonged expiration
3. The characteristic radiologic features of acute bronchiolitis are–
   ___ a) hypertransulency ___ b) horizontal ribs ___ c) cardiomegaly
   ___ d) shifting of trachea ___ e) depression of domes of diaphragm
4. The following drugs are recommended for treatment of acute severe asthma–
   ___ a) salbutamol ___ b) prednisolone ___ c) ipratropium bromide
   ___ d) fluticasone ___ e) beclomethasone
5. A 2 years old boy with cough and difficult breathing will be classified as pneumonia if the following are present–
   ___ a) grunting ___ b) chest indrawing ___ c) barking cough
   ___ d) stridor ___ e) respiratory rate 52/min
6. Vesicular breath sound with prolong expiration is noted in–
   ___ a) pneumonia ___ b) bronchiolitis ___ c) croup ___ d) asthma ___ e) pneumothorax
7. Common radiological features of acute bronchiolitis include–
   ___ a) cardiomegaly ___b) shifting of trachea ___c) hyper translucency
   ___d) overcrowding of ribs ___ e) low flat diaphragm
8. The most common organism responsible for pneumonia in between 1-12 months are–
   ___ a) *S. pneumoniae* ___ b) *H. influenzae* ___ c) *C. pneumoniae* ___ d) RSV ___ e) *S. aureus*
9. The cardinal features of croup are–
   ___ a) stridor ___ b) thumb sign ___ c) drooling ___ d) Steeple sign ___ e) high fever
10. The following drugs are used in persistent asthma–
    ___ a) Beclmathasone ___ b) Salbutamol ___ c) Salmetarol
    ___ d) Montelucast ___ e) Nedocromil Sodium

CHAPTER 11

DIARRHOEA

Diarrhoeal diseases are the leading cause of malnutrition and the second leading cause of deaths of children under 5 years of age. Each year about 10% under 5 children die from diarrhoea.

WHO, defined diarrhoea as the frequent passage of loose stools. During diarrhoea, 3 important clinico-pathological consequences occur. These are–

- **Increased loss of water and electrolytes** (e.g. Na^+, K^+ and HCO_3^-) in the liquid stools, leading to dehydration and dyselectrolytaemia
- **Loss of greater quantity of zinc** in the loose stool which delays recovery of patients from the disease and make the child vulnerable to suffer afterwards
- **Weight loss** due to decreased intake of food, decreased nutrient absorption and increased nutrient requirements

Types

- Acute watery diarrhoea
- Persistent diarrhoea
- Dysentery

ACUTE WATERY DIARRHOEA

When, diarrhoea persists for less than 14 days. Patient passes loose watery stool several times (≥ 3 times) daily that do not contain blood. Sometimes, patients may have associated vomiting and low-grade fever.

Organisms

- *Rota virus, V. cholerae 01, 0139*
- *Enterotoxigenic E.coli, Enteropathogenic E. coli, Enteroadherent E.coli, Campylobacter jejuni*
- *Cryptosporidium*

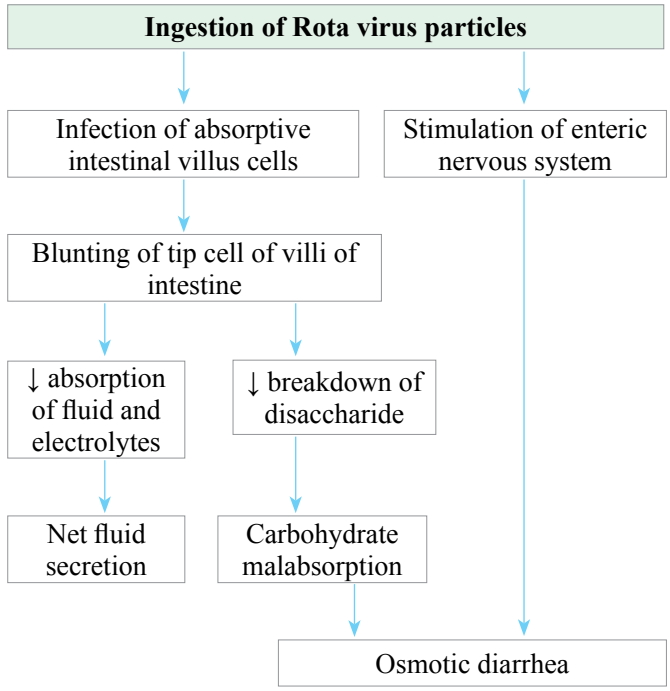
Of all these microbes, rota virus and V cholerae commonly affect the gut of the children and will be discussed in this chapter.

ROTA VIRUS

- Route of entry in the gut: Oral
- Incubation Period: 1-3 days

PATHOGENESIS

After entry, the virus infects, kills and destroy the mature absorptive enterocytes. The damaged cells as well as their affected villi are rapidly replaced by immature non-absorptive crypt-like cells having no brush border and no brush border enzymes e.g. disaccaridase (lactase).



As a result, there is–

- Less absorption of fluid & electrolytes *e.g.* Na^+, K^+, HCO^{3-} and their loss in stool which gives rise to (dehydration, dyselectrolytaemia)
- Decreased breakdown of disaccaride/lactose and their excretion in stool, which results in (Osmotic diarrhoea)

V CHOLERAE

- Route of entry in the gut: Oral
- Incubation period: Few hours to 5 days, usually 2-3 days

Mechanism of cholera

V. Cholerae accumulates in the gut & produce toxins
↓
Toxin A binds to G-Protein coupled receptor
↓
Persistent stimulation of Adenylyl cyclase
↓
Overproduction of cAMP
↓
Activates cAMP dependent protein kinase
↓
NaCl influx into Gut lumen along with water
↓
Increased purging of water & electrolytes

PATHOGENESIS (Toxin mediated)

After entry into the gut, *V. cholerae* produce toxins. These toxins bind to a regulatory sub unit of adenyl cyclase in enterocytes, causing increased cyclic AMP dependent protein kinase and an outpouring of NaCl and water in the lumen of small gut.

CLINICAL MANIFESTATIONS

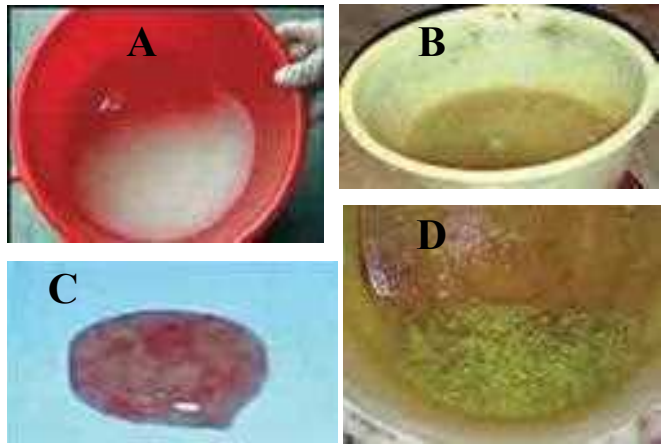
- Mild diarrhoea, in most cases. However, in 1-2% ofcases diarrhoea is severe (Severe cholera) where there is sudden onset of massive, frequent, watery stools, generally light gray in colour (so-called rice-water stools), containing mucous but no pus. Within 2-3 hours of onset, tremendous loss of fluid & electrolytes results in–
  - Life-threatening dehydration,
  - Hypochloremia, and hypokalaemia
  - Marked weakness and circulatory collapse

How to assess a child with diarrhoea ?

Whenever, a child is brought to you with diarrhoea, then assess the case with the following clinical parameters–

I. History of–

- Vomiting, as it is the first symptom of rota
- Duration of diarrhoea
- Frequency of passage of loose stool daily
- Stool characteristics e.g.consistency e.g. watery, mucoid, colour, odour, presence of blood etc.



Coutesy: Dr. Iqbal, Scientist, ICDDRB

Appearances of stool in diarrhoea caused by A. Cholera, B. ETEC, C. Shigella and D. Rota virus

- Fever, screaming with pale appearance
- Last urine output and amount
- Feeding and fluid intake
- Treatment already taken e.g. antibiotic or other drugs
- Diarrhoea/diarrhoeal deaths in the family or neighbourhood

II. Physical examination, particularly to assess for–

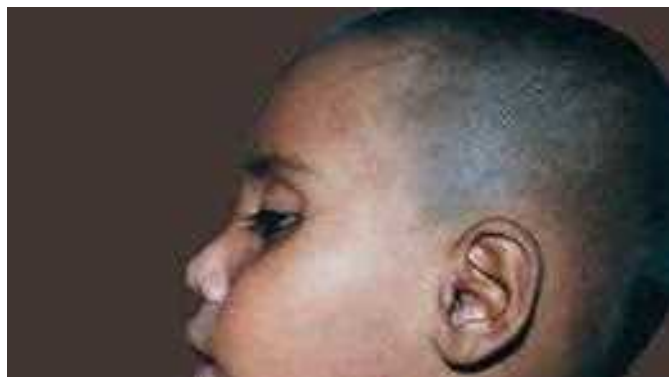
- Signs of dehydration
- Abdominal distension, from severe hypokalaemia
- Signs of severe malnutrition

Signs of Dehydration & the Classification

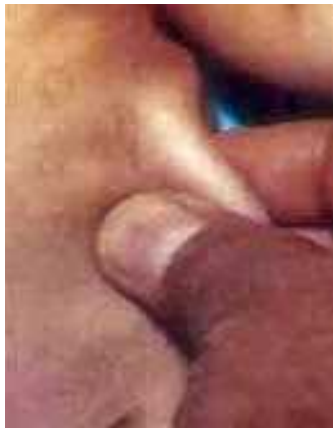
- If ≥ 2 of the following signs are present–

- Lethargy/unconscious
- Sunken eyes
- Unable to drink or drinks poorly
- Skin pinch goes back very slowly (≥ 2 sec)

Then the child will be categorized as **Severe dehydration** and will be managed as **Plan C**.



Unconsciousness & sunken eyes of a severely dehydrated child




Skin pinch goes back to normal very slowly

- If ≥ 2 of the following signs are present–

- Restless, irritable
- Drinks eagerly, thirsty
- Sunken eyes
- Skin pinch goes back slowly

The child will be categorized as **some dehydration** and will be managed as **plan B**.

If the child has not enough signs to classify some or severe dehydration, he/she will be classified as **No dehydration** and will be managed as **plan A.**

Irritable child

Sunken eye

INVESTIGATIONS

- Stool RME, : No RBC, Pus cells, macrophase
- Stool for *V. cholerae*:
- Stool C/S: To see the growth of any organism
- Blood for CBC, PBF: Low Hb, changes in WBC
- S Electrolytes: Low Na^+, K^+, Cl^-, $HCO3^-$
- Others e.g. S Creatinine, X-Ray abdomen (if indicated)

TREATMENT

The **essential elements of** treatment are–

- Rehydration
- Continued feeding
- Zinc supplementation
- Antibiotics, when diarrhoea is due to V cholerae or other bacteriae

A. Rehydration

Signs	Classification	Treatment
≥ 2 of the following signs– ❑ Lethargy/ unconsciousness ❑ Sunken eyes ❑ Unable to drink or drinks poorly ❑ Skin pinch goes back to normal very slowly (≥ 2 sec)	Severe dehydration	**Plan C** ◆ Choice of fluid: Cholera saline, Ringer's lactate ◆ If not available: Dextrose in Normal Saline or Normal Saline ❑ Never use: 5% Dextrose in Aqua (DA) ◆ Amount of fluid: 100 ml/kg ◆ Route of rehydration: Intravenous ◆ Duration of rehydration: 3 hours (<1 year), 6 hours (>1 year) ❑ During rehydration, foods other than breast milk should be withheld ◆ Do not use the IV route for rehydration, except in cases of shock. Rehydrate slowly, either orally or by nasogastric tube, using ReSoMal (5–10ml/kg per hour up to a maximum of 12 hours)

Monitoring

Reassess the child every 15-30 minutes until a strong radial pulse is present. When full amount of IV fluid has been given, reassess the child's hydration status fully and decide accordingly–

- If signs of severe dehydration still present: Repeat IV fluid as outlined in Plan C
- If signs of some dehydration: Discontinue IV fluid and give ORS for 4 hours as in Plan B
- If no signs of dehydration: Advise mother to give ORS after each loose stool as in Plan A

≥ 2 of the following signs– ❑ Restless, irritable ❑ Sunken eyes ❑ Drinks eagerly, thirsty ❑ Skin pinch goes back to normal slowly	Some dehydration	**Plan B** ◆ Choice of fluid: Oral rehydration solution (ORS) ◆ Amount of fluid: 75 ml/kg ◆ Route of rehydration: Oral ◆ Duration of rehydration: 4 hours ❑ During rehydration, foods other than breast milk should be withheld
Monitoring ◆ Reassess child's hydration status after 4 hours of oral rehydration and decide accordingly– ◆ If no signs of dehydration: Advise mother to give ORS after each loose stool as in Plan A ◆ If signs of some dehydration: Rehydrate with ORS for another 4 hours as in Plan B ◆ If signs of severe dehydration present: Rehydrate with IV fluid as in Plan C		
◆ Not enough signs to classify as some or severe dehydration	No dehydration	**Plan A** ◆ Choice of fluid: Oral rehydration solution ❑ Others e.g. chira pani, cooked rice water, yogurt **Amount of fluid after each stool** ◆ Less than 2 years: 50-100 ml ◆ 2 years and above: 100-200 ml Avoid: Very sweet tea, soft drinks & sweetened fruit drinks.

After rehydration, advice mother–

- ◆ To continue treatment at home
- ◆ To continue feeding at home
- ◆ Come for routine follow up in 5 days and
- ◆ When to return immediately

If the baby–

- ◆ Drinks poorly or unable to drink or breastfeed
- ◆ Becomes sicker
- ◆ Develops fever or
- ◆ Blood appears in stool

B. Zinc supplementation

Age	Dose	Duration
< 6 months	10 mg/day	10-14 days
≥ 6 months	20 mg/day	10-14 days

C. Feeding, to be continued

Age	Foods
<6 Months	◆ Breast feeding
>6 Months	◆ Breast feeding ◆ Freshly prepared energy dense complementary foods like • khichuri • mashed banana • fresh fruit juice etc.

Advice mother to encourage the child to eat at least 6 times a day with an extra meal daily for 2 weeks, after cessation of diarrhoea.

D. Antibiotics

- ◆ Rota diarrhoea: Antibiotic not indicated
- ◆ Cholera, any one of the following–
  - ❑ Tetracycline, 12.5 mg/kg 6 hourly for 3 days
  - ❑ Azithromycin, 10 mg/kg/day OD for 5 days
  - ❑ Ciprofloxacin, 20 mg/kg/day 12 hourly for 5 days
  - ❑ Cotrimoxazole, TMP 10 mg/kg/day 12 hrly for 3 days

PERSISTENT DIARRHOEA (PD)

Diarrhoea, that begins acutely (with or without blood) and lasts for 14 days or more, with no >2 intervening days without diarrhoea. In developing countries, 3-20% of all childhood diarrhoea become persistent and contribute to about ⅓ to ½ of all diarrhoea-related deaths.

Types

- **Non-severe PD**: PD, not associated with dehydration and can be managed at home with special diets, extra fluids
- **Severe PD**: PD, when associated with signs of dehydration and usually requires hospitalization

RISK FACTORS

A. Host factors

- Young age <12 month
- Low birth weight (LBW) baby
- Malnutrition
- Faulty feeding practice e.g. lack of breast feeding
- Recent introduction or feeding of cows milk
- Injudicious use of antibiotic & antimotility drugs
- Impaired immune function
- Systemic infections e.g. UTI, pneumonia, oral thrush
- History of previous PD

B. Environmental factors

- Living in highly contaminated environment and their ill effects on GI mocroecology
- if Enteroadherent E. coli, was the causative organism of recent acute diarrhea

Organisms

- *E. coli (enteroadherent)*
- *Klebsiella*
- *Campylobacter*
- *Aeromonas*
- *Cryptosporidium*
- *Giardia lamblia*

PATHOGENESIS

Not well understood. However, it is said that persistent inflammation & defective intestinal repair, results in abnormal mucosal morphology. This leads to poor absorption of luminal nutrients and increased permeability of the bowel to abnormal dietary or microbial antigens. The severity of these changes is greater in younger children due to their delayed intestinal mucosal maturation.

DIAGNOSIS

By clinical assessment and supports from investigations.

Clinical assessment

- Assessment of the case, keeping in mind the risk factors
- Check evidence of any
  - Dehydration
  - Non-intestinal infections e.g. pneumonia, sepsis, UTI, oral thrush etc.
  - Malnutrition, micro-nutrient deficiency

Investigations

- Stool RME, for Giardia, C/S, pH, reducing substance, neutral fat
- CBC, RBS, S electrolytes, S albumin
- Urine RME and C/S
- Duodenal fluid for aerobic & anaerobic culture

TREATMENT

I. Non-Severe PD (Treatment at home)

Objective: Improve diarrhoea by dietary manipulation. To do that, 2 diets are recommended for children > 6 months. Initially **Diet 1** is started and is evaluated after 7 days. If no improvement in relation to either stool frequency or weight gain, then Diet1 changed to **Diet 2** for another 7 days. Most cases are improved with this intervention. But if not, then the cases should be referred for further evaluation. The other options like pregestimil, TPN may be considered.

Diet 1:

Starch based, reduced milk (low lactose) diet This diet is composed of–

- Full fat dried milk/whole liquid milk: 85 ml
- Rice: 15 gm
- Vegetable oil: 3.5 gm
- Cane sugar: 3 gm
- Water : 200 ml

Diet 2:

Reduced starch based, No milk diet

This diet is composed of–

- Whole egg: 64 gm
- Vegetable oil: 4 gm
- Rice: 3 gm
- Glucose: 3 gm
- Water: 200 ml

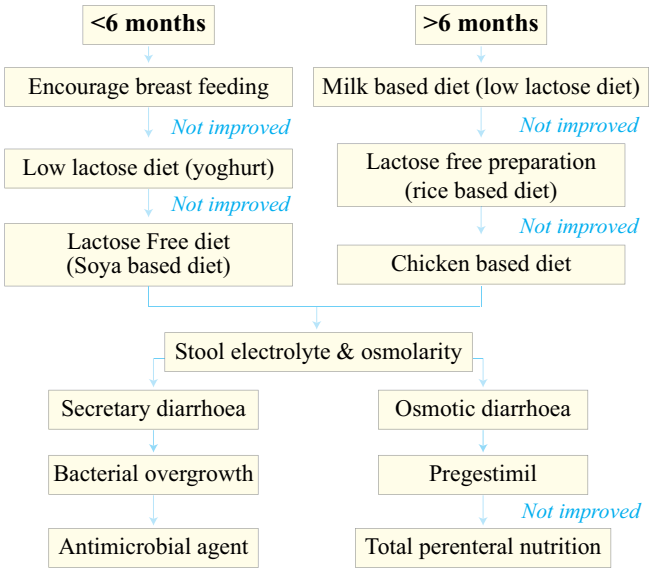
II. Severe PD (Treatment at Hospital)

It includes–

- Rehydration as outlined in acute diarrhoea
- Dietary manipulation and the recommended special diets (Diet 1 & Diet 2) are–
  - **Low lactose diet**: Made from full fat milk, rice, vegetable oil, cane sugar and water
  - **Lactose free diet**: Made from whole egg/cooked chicken, rice, vegetable oil, glucose and water
- Additional management includes–
  - Treatment of non-intestinal infection *if present. e.g. Pneumonia, Sepsis, UTI, Oral thrush, Otitis media,*
  - Treatment of intestinal infections *e.g. Amoebiasis/ giardiasis: Metronidazole, 35-50 mg/kg/day 8 hourly for 10 days*

- Supplementation of micronutrient & vitamins e.g. Folate, Zinc, Vitamin A, Iron, Copper, Magnesium

Dietary manipulation (According to age)



DYSENTERY

Dysentry is another type of diarrhoea, where patient passes frequent loose stools along with blood.

Organisms

- *Shigella spp, Salmonella spp*
- *Enteroinvasive E.Coli, Enterohaemorrhagic E.Coli*
- *Campylobacter spp.*

PATHOGENESIS

After entering in the gut, the organisms invade into the gut wall, causes ulceration & bleeding with manifestations of pain, cramp and bloody diarrhoea.

CLINICAL MANIFESTATIONS

- Loose stool, containing blood
- Fever, abdominal cramp, tenesmus
- Pallor

Complications

- Electrolyte imbalance e.g. hypokalaemia, metabolic acidosis, hyponatraemia
- Paralytic ileus
- Acute renal failure/ Haemolytic uraemic syndrome
- Growth failure/Malnutrition

Guillain–Barré Syndrome from *C. Jejuni*

In addition, dysentery can lead to–

- Rectal prolapse
- Convulsions

DIAGNOSIS

Based on theclinical features and supports from relevant investigations.

Investigations

Stool for R/M/E	To look for RBC, pus cells & macrophage
Stool for C/S	To grow the causative organism and their drug sensitivity pattern
Blood for CBC, PBF	To assess anaemia, neutrophilic leukocytosis
Serum Electrolytes	To check hypokalaemia, hyponatraemia, acidosis
Arterial blood gas (ABG)	Metabolic acidosis
S creatinine	To evaluate complications as it may be raised in acute renal failure/HUS

TREATMENT

- Antibiotics
  - Ciprofloxacin, 20 mg/kg/day 12 hourly for 5 days
  - Pivmecillinam, 40 mg/kg/day 6-8 hourly for 5 days
  - Nalidixic acid, 50 mg/kg/day 6 hourly for 5 days
- Diet: Usual family diet
- Rehydration: Plan A, B or C, if required
- Zinc supplementation as outlined before
- Others e.g. Paracetamol for fever, antispasmodic for cramp etc.

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. Define & classify diarrhoea. What parameters you look to assess dehydration?
2. What are the pathological consequences of diarrhoea?
3. What complication may develop if a severely dehydrated child is not adequately rehydrated?
3. i) Define Persistent diarrhoea & Severe persistent diarrhoea.
   ii) What amount of fluid you should give in first hour to a child weighing 15 kg suffering from severe dehydration?
   iii) What advice you will give to mother of child suffering from diarrhoea with no dehydration?
4. A 12 months old child (10 kg) admitted in a hospital with frequent loose motions & persistent vomiting for last three days.
   a) How will you assess his state of dehydration according to IMCI?
   b) How will you rehydrate the child if he is severely dehydrated?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. A child is said to suffer from severe dehydration if he has–
   ___ a) lethargy ___ b) sunken eyes ___ c) increased thirst
   ___ d) slow return of skin pinch ___ e) depressed anterior fontanelle
2. Organisms responsible for acute dysentery are–
   ___ a) C. jejuni ___ b) V. cholera ___ c) S. typhi ___ d) S. dysentery ___ e) E. coli
3. Electrolyte abnormalities commonly found in acute diarrhoea are–
   ___ a) hypocalcaemia ___ b) hypokalaemia ___ c) metabolic acidosis
   ___ d) hyponatraemia ___ e) hypomagnesaemia

4. In plan A for the management of acute watery diarrhoea with no dehydration the following fluid should be used–
   ___a) ORS ___b) soft drinks ___c) cooked rice water
   ___d) chira pani ___e) sweetened fruit juice
5. The IV fluids recommended for rehydration in severe dehydration are–
   ___ a) Cholera saline ___ b) Ringer's lactate ___ c) 5% dextrose in normal saline
   ___ d) Normal saline ___ e) Dextrose in aqua
6. A 2 years old boy weighing 10 Kg is brought to you with H/O loose motion for last 2 days. If the child is not managed properly, the following immediate complications may develop–
   ___ a) acute renal failure ___ b) hypovolaemic shock ___ c) pneumonia
   ___ d) jaundice ___ e) malnutrition
7. Complications that may arise from acute dysentery are–
   ___ a) rectal prolapse ___ b) haemolytic uraemic syndrome ___ c) hypokalaemia
   ___ d) shock ___ e) malnutrition
8. The pathophysiological consequences of acute diarrhoea are–
   ___ a) loss of Na^{+} ___ b) loss of Zn^{++} ___ c) loss of $HCO3^{-}$
   ___ d) loss of Mg^{++} ___ e) loss of Ca^{++}
9. Antibiotics effective against the organisms responsible for acute dysentery are–
   ___ a) Ciprofloxacin ___ b) Amoxicillin ___ c) Pivmecillinam
   ___ d) Erythromycin ___ e) Ampicillin
10. Causes of vomiting in a neonate–
   ___ a) congenital adrenal hyperplasia ___ b) oesophageal atresia ___ c) duodenal atresia
   ___ d) infantile HPS ___ e) congenital malrotation of gut

Chapter 12

Vomiting

Whenever, a child presents with vomiting, one should first consider the site of pathology is in gastrointestinal, hepatobiliary system, pancreas like–

- Acute gastritis/ Gastroenteritis
- Acute hepatitis
- Acute appendicitis
- Acute pancreatitis
- Food poisoning
- Intestinal obstruction
- Acute cholecystitis, etc.

Apart from GIT disorders, the following conditions also induce vomiting–

- Acute tonsilitis
- Renal diseases e.g. pyelonephritis, chronic kidney disease, acute kidney failure
- CNS diseases e.g. meningitis, brain tumor, hydrocephalus
- Endocrine disorders e.g. diabetic ketoacidosis, congenital adrenal hyperplasia
- Cyclic vomiting syndrome
- Inborn errors of metabolism

The causes of vomiting among **Neonates** are quiet different. These are mostly congenital and include–

- Gastro-esophageal reflux diseases
- Duodenal atresia
- Infantile hypertrophic pyloric stenosis
- Intestinal obstruction
- Congenital malrotation of gut
- Congenital adrenal hyperplasia
- Bottle feeding of breast milk substitute (BMS)

Patho-physiological consequences

a) Metabolic

- Fluid loss e.g. dehydration, shock
- HCl loss in vomitus e.g. alkalosis, hypochloraemia
- Na^+, K^+ loss in vomitus e.g. hyponatraemia, hypokalaemia

b) Nutritional

- Failure to thrive due to loss of calories and nutrients

c) Others

- Oesophagitis due to exposure of lower end of esophagus to gastric acid
- Pneumonia due to aspiration of vomitus
- Mallory-Weiss tear at the lesser curve of gastroesophageal junction due to forceful vomiting

Approach to a patients with vomiting

Relevant History

- Frequency of vomiting
- Amount of vomitus
- Colour & content e.g. blood in vomitus
- Associated loose motion or absolute constipation
- Abdominal pain and site of pain
- Urine output, e.g. colour, amount and when last urine passed
- Headache/vertigo/convulsion/vision
- Fever present or not
- Pain in ear or sore throat present or not

Physical Examination

- State of consciousness e.g. alert, drowsy
- State of hydration e.g. general condition, sunken eyes, skin pinch, thirst
- Haemodynamic status e.g. pulse, BP, pulse pressure, capillary refill time (CRT)
- Any features suggesting underlying pathology e.g.
  - Abdomen: Distension, tenderness & absent bowel sounds
  - Temperature: Raised/normal
  - Jaundice: Present/absent

- CNS: Neck rigidity, convulsion, pupils
- Throat: Tonsillitis/ulceration

D/D based on characteristics of vomitus

Materials	Site of pathology	Diagnoses
Undigested food particles	Oesophageal	Oesophageal stricture, achalasia
Digested food, milk curds	Distal to ampulla of Vater	Small bowel obstruction e.g. malrotation, Prolonged vomiting due to any cause
Bile: green/ yellow	Stomach (At pylorus)	Pyloric stenosis
Blood: red (fresh blood) or brown (old blood)	Lesion above ligament of Treitz: Stomach, oesophagus	Rupture oesophageal varices, Gastritis/ ulceration, bleeding diathesis
Clear large volume	Increased gastric secretions	Peritonitis, Zollinger-Ellison syndrome
Malodorous/ feculent	Distal or Colonic obstruction	Malrotation, appendicitis
Mucus	Respiratory mucus, gastric	URI, sinusitis, oesophagitis

Investigations

- Complete blood count, Peripheral blood film
- S. bilirubin, SGPT, alkaline phosphatase, creatinine
- S. electrolytes, arterial blood gas (ABG)
- Others e.g. Serum/urinary amylase, lipase, random blood sugar
- Urine RME, C/S, glucose, ketones
- X-Ray abdomen in erect posture
- USG of abdomen
- Contrast X-Ray of upper GI
- CT scan of abdomen/brain
- Metabolic screening e.g. blood pH, ammonia, lactate

THE RED FLAG SIGNS

- Altered sensorium (cause or effect)
- Toxic/septic/apprehensive look
- Bilious or bloody vomiting
- Presence of inconsolable cry or excessive irritability (meningitis, intussusception)
- Signs of severe dehydration
- Bent-over posture *(drawing of legs up to the chest)*, and avoidance of unnecessary movement typical of peritoneal irritation *(peritonitis, intussusception)*

TREATMENT

- Counseling
- Fluid (Saline) replacement according to degree of dehydration
- Antiemetic e.g. Domperidone, Ondansetrone (0.2 mg/kg, oral and 0.15 mg/kg parenteral; maximum 4 mg), Granisetron, Metoclopramide
- Treatment of the underlying cause

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SELF ASSESSMENT

SHORT ANSWER QUESTION [SAQ]

1. Write down 5 important causes of vomiting.
2. What investigations will you plan to send for a child with severe vomiting ?
3. Name 5 common anti-emetics.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Fluid recommended for rehydration in a child with vomiting includes–

   ___ a) 10% dextrose in aqua ___ b) 5% dextrose in 0.45% NaCl ___ c) ORS

   ___ d) 5% dextrose in 0.225% NaCl ___ e) water
2. The following condition commonly cause vomiting in neonates–

   ___ a) duodenal atresia ___ b) congenital adrenal hyerplasia ___ c) acute appendicitis

   ___ d) meningitis ___ e) brain tumor
3. The following are the red flag sign of vomiting–

   ___ a) blood in vomitus ___ b) bile with vomitus ___ c) shunken eyes

   ___ d) CRT < 2 sec ___ e) altered sensorium

Chapter 13

Abdominal Pain

Pain in abdomen is a frequent complaints of children. It may be acute or chronic and recurrent in nature.Causes of acute abdominal pain are mostly surgical and medical disorders contribute only about 10% of cases. On the other hand, **recurrent abdominal** pain (at least one episode of abdominal pain for consecutive 3 months severe enough to interfere with routine functioning) are mostly functional and organic disorders contribute only in a small proportion of cases.

The common differential diagnosis of acute and recurrent abdominal pain are given below–

Acute abdominal pain	Recurrent abdominal pain
❑ Acute appendicitis ❑ Intussusception ❑ Intestinal obstruction ❑ Renal calculus ❑ Acute pancreatitis ❑ Acute cholecystitis ❑ Pyelonephritis ❑ Basal pneumonia	◆ Helminthiasis ◆ Meckel's diverticulitis ◆ Cholelithiasis ◆ Chronic pancreatitis ◆ Inflammatory bowel disease ◆ Peptic ulcer ◆ Giardiasis

Cardinal features of conditions commonly causing recurrent abdominal pain

Diseases	Characteristics features	Investigations	Treatment
Helminthiasis (discussed in chapter 35)	◆ Abdominal pain, distension, bloating, gas, malabsorption, growth failure, intestinal obstruction	❑ Stool R/M/E– to see ova and egg ❑ CBC with PBF	◆ Albendazole Mebendazole ◆ Healthy measures e.g. personal hygiene, hand washing, use of sanitary latrine, etc.
Meckel's diverticulum	◆ Painless per rectal bleeding, brick colour/currant jelly stool ◆ Intestinal obstruction, vomiting	❑ Meckel scan with Tc99 pretechnetate isotope	◆ Surgery
Peptic ulcer disease	◆ Burning epigastric pain, worse on awaking or before meal ◆ Pain relieved with antacid, vomiting, haemorrhage	❑ Endoscopy of upper GIT ❑ Urea breath test ❑ Detection of Abti H. pyloi antibody in serum	◆ Proton pump inhibitor, H_2 blocker ◆ Treatment of *H. Pylori* with proton pump inhibitor, Clarithromycin, Amoxicillin for 2 weeks
Inflammatory bowel disease	◆ Abdominal pain, nausea, vomiting, diarrhoea, per rectal bleeding, tenesmus, urgency	❑ X-Ray of abdomen ❑ USG of abdomen ❑ Colonoscopy	◆ Prednisolone ◆ Sulfasalazine ◆ Azathioprine ◆ Monoclonal antibody ◆ Surgery

Cardinal features of conditions commonly causing acute abdominal pain

Diseases	Clinical features	Investigations	Treatment
Acute appendicitis	◆ Abdominal pain, vomiting ◆ McBurney's point tenderness ◆ Rebound tenderness, Rovsing sign ◆ Psoas sign (retrocaecal appendix) ◆ Obturator sign (pelvic appendix)	❑ CBC: Neutrophilic leukocytosis ❑ USG of abdomen: Wall thickness > 6 mm, a compress mass	◆ NPO, nasogastric (NG) Suction ◆ IV fluid ◆ Antibiotic ◆ Surgery
Intussusception	◆ Classical triad-colicky pain, palpable sausage shaped abdominal mass and bloody or red currant jelly stool (see page 308)	❑ USG: Classic doughnut or target appearance ❑ Barium enema: Filling defect/cupping in the head of barium, coilspring sign	◆ NPO, NG Suction ◆ IV fluid ◆ Antibiotic ◆ Hydrostatic reduction ◆ Surgery
Intestinal obstruction	◆ Proximal obstruction, frequent, bilious emesis, little or no abdominal distension. Intermittent pain, relieved by vomiting ◆ Distal obstruction-moderate or marked abdominal distension, vomiting	❑ X-Ray abdomen: Multiple air fluid level ❑ USG of abdomen	◆ NPO, NG Suction ◆ IV fluid ◆ Antibiotic ◆ Surgery
Acute pyelonephritis	◆ Abdominal pain, Vomiting ◆ High fever with chills & rigor ◆ Tenderness at renal angle ◆ In newborn: Poor feeding, irritability, jaundice, weight loss	❑ Urine R/M/E ❑ Urine C/S ❑ CBC, CRP, PBF ❑ USG of abdomen	◆ Broad-spectrum Antibiotics ◆ Antibiotics as sensitive to C/S
Acute pancreatitis	◆ Severe abdominal pain ◆ Persistent vomiting ◆ Fever, shock ◆ Cullen sign: Bluish discoloration around umbilicus ◆ Grey Turner sign: Bluish discoloration in flanks	❑ Serum amylase, lipase-high ❑ Leucocytosis-high ❑ RBS-high	◆ NPO, NG Suction ◆ IV fluid ◆ Antibiotic to prevent infected pancreatic necrosis ◆ Anti emetics

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SELF ASSESSMENT

SHORT ANSWER QUESTION [SAQ]

1. What are the common causes of acute abdominal pain?
2. How will you diagnose a child with acute appendicitis?
3. Write down the clinical features of acute pancreatitis
4. A 5 years old boy fever & acute abdominal pain for 1 day
   a) Write down 4 important differential diagnoses.
   b) How will you investigate & treat the boy?
5. A 7 years old girl presented with recurrent abdominal pain for 6 months
   What are the important differentials?

MULTIPLE CHOICE QUESTION [MCQ]

1. Common causes of recurrent abdominal pain–
   ___ a) renal calculus ___ b) peptic ulcer ___ c) helmentheasis
   ___ d) Meckel's diverticulitis ___e) pyelonephritis
2. In acute appendicitis–
   ___ a) McBurney's point tenderness ___ b) Obturator sign ___ c) sausage shape abdominal mass
   ___ d) Grey turner sign ___ e) Rovsing sign
3. Characteristic findings of Intussusception–
   ___ a) Red currant jelly stool ___ b) colicky abdominal pain ___ c) Rebound tenderness
   ___ d) CBC-leukocytosis ___ e) Barium enema-filling defect/cupping in the head of barium
4. Acute pancreatitis–
   ___ a) persistent vomiting ___ b) hypoglycaemia ___ c) high serum amylase
   ___ d) X-Ray abdomen-calcification ___ e) CT-Pseudocyst
5. Treatment of acute pancreatitis–
   ___ a) IV fluid ___ b) correction of electrolyte imbalance
   ___ c) antibiotics ___ d) surgery ___ e) oral pancreatic enzyme

Chapter 14

Constipation

Constipation is a growing problem among children in our society with changing food habits and limited physical activity.

Definition: Passage of hard stool with difficulty in every 3rd day.

Whenever any child with the problem is brought, the following causes should be considered.

Aetiology

Non organic (functional)	Organic
◆ Idiopathic ◆ Change in diet: not enough fibre rich fruits, vegetables or fluid in child's diet ◆ Stool withholding, because the child is afraid of painful defecation or doesn't want to take a break from play or uncomfortable using public toilets ◆ Change in routine e.g. travel, hot weather or stress ◆ Forceful potty training ◆ Family history ◆ Cow's milk allergy: consuming too much milk daily	❑ Anatomic e.g. anal stenosis, Anal fissure ❑ Abnormal musculature e.g. Down syndrome ❑ Intestinal nerve abnormality e.g. Hirschsprung disease ❑ Hormonal disorder e.g. hypothyroidism ❑ Drugs e.g. Phenytoin, anticholinergics, anti depressants ❑ Psychiatric disorder e.g. anorexia nervosa ❑ Acute febrile illness

Approach to a Patient with Constipation

History

- ◆ History of delayed passage of meconium e.g. Hirschsprung disease
- ◆ History of prolonged jaundice in the neonatal period e.g. congenital hypothyroidism
- ◆ Painful passage of stool e.g. anal fissure
- ◆ History of passage of stool in inappropriate places e.g. encopresis
- ◆ Dietary history e.g. low fiber diet, change of diet from breast milk to cow's milk
- ◆ Family history of constipation e.g. parental habit
- ◆ Forceful potty training

Physical Examination

- ◆ Appearance: If coarse facies, low hair line, protruded tongue (congenital hypothyroidism)
- ◆ Abdomen: If distended (Hirschsprung disease)
- ◆ Perianal region: Checking for presence of anal fissures
- ◆ Back: Checking for meningocele/myelomeningocele
- ◆ Digital rectal examination
  - ❑ Increased tone of anal sphincter (Hirschsprung disease)
  - ❑ Presence of explosive loose stool on withdrawal of examining finger (Hirschsprung disease)
- ◆ Muscle tone: Hypotonia (hypothyroidism, Down syndrome), hypertonic (meningocele/myelomeningocele)

Complications

◆ Anal fissure ◆ Rectal prolapse ◆ Encoparesis

Diagnosis

Based on classic clinical features and supports from relevant investigations.

Investigations	Results
Plain X-Ray of abdomen	To look for evidence of bowel obstruction e.g. presence of multiple air-fluid levels
Barium enema X-Ray of large gut	Presence of normally dilated proximal colon and a smaller calibre constricted distal colon as seen in Hirschsprung disease
Serum TSH, FT_4	High TSH & low FT_4 level indicate congenital hypothyroidism
Karyotyping	Presence of extra copy of chromosome on 21 as seen in Down syndrome

TREATMENT

A. Supportive

- Counseling regarding the consequences of constipation and the importance of regular bowel habbit
- Encourage intake of more fluid, intake of fiber rich diet e.g. vegetables, fruits
- Avoid excessive consumption of milk, cereals, meat, mashed foods
- Toilet training: Regular toilet sitting for 10 minutes twice a day after meal
- Promote physical activity
- Drugs
  - Osmotic laxative (lactulose)
  - Bulk forming laxatives (Ispaghula husk)
  - Stool softeners (liquid paraffin)
- Others
  - Glycerine supository
  - Enema simplex
  - Manual evacuation under G/A

B. Specific

Treatment of the underlying cause, if any.

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2. Mayo Clinic. Constipation in children– Symptoms & causes, Aug 2017.

SELF ASSESSMENT

SHORT ANSWER QUESTION [SAQ]

1. Define constipation. Write down the common causes of constipation.
2. What clinical findings will you search during examination of a child with constipation?
3. A 1 year old child presented with constipation since his early infancy.
   a) What are the important differentials?
   b) What history will you take to diagnose this patient?
   c) How to investigate the child?
   d) Write down the management plan.

MULTIPLE CHOICE QUESTION [MCQ]

1. Common organic causes of constipation–
   ___ a) hypothyroidism ___ b) Hirschsprung disease ___ c) low fiber diet
   ___ d) spinal cord defect ___ e) transition from breast milk to cow's milk
2. Patients with constipation may have–
   ___ a) recurrent abdominal pain ___ b) coarse facies ___ c) myelomeningocele
   ___ d) recurrent UTI ___ e) abdominal distension.
3. Treatment of constipation–
   ___ a) high fiber diet ___ b) GIT stimulant ___ c) Osmotic laxative
   ___ d) excessive consumption of milk ___ e) enema simplex

Chapter 15

Sore Throat & Difficulty in Swallowing

Soreness in throat is a common presentation of throat infection and is one of the major cause of health-care seeking in children.

The common causes of sore throat are–

- Viral pharyngitis
- Acute bacterial pharyngotonsillitis
- Diphtheria
- Infectious mononucleosis

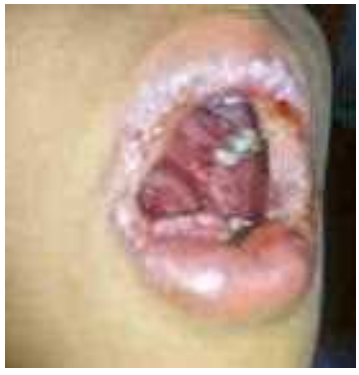
In this section, viral pharyngitis, acute bacterial pharyngotonsillitis will be discussed.

VIRAL PHARYNGITIS

Organisms: *Adenovirus, Coxsackie virus, EBV, Herpes simplex virus.*

Clinical Manifestations

- Sore throat
- Runny nose, red eye
- Hoarseness, cough
- Low grade fever
- Throat examination may reveal redness of fauces & tonsil, but no pus point



Treatment: Supportive

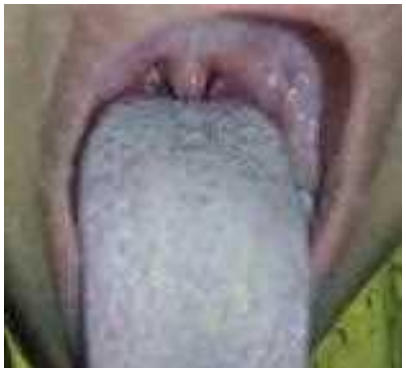
- Analgesic e.g. paracetamol
- Saline water gurgling
- Lemon tea to soothe the throat
- Feeding: as usual, soft less spicy

ACUTE BACTERIAL PHARYNGOTONSILLITIS

Organisms: Group A beta haemolytic Streptococci is the predominant organism. Other organisms are *Staph. aureus, gram-negative organism and Mycoplasma.*

Clinical Manifestations

- Sudden onset of high fever
- Severe pain in throat
- Difficulty in deglutition
- Refusal to feed
- Drooling of saliva



Inflamed tonsils with pus in the crypts

Cough is characteristically absent

In addition, headache, vomiting and abdominal pain may be present.

Physical examination

- Throat is seen red and congested
- Tonsils are enlarged and pus points in the crypts (white patch)
- Anterior cervical lymph nodes are enlarged and tender

Other causes of white patches over tonsil

- Faucial diphtheria
- Infectious mononucleosis
- Oral thrush
- Scarlet fever
- Moniliasis

- **Vincent angina:** Acute & painful infection of the tooth margins & gum caused by symbioic organism Bacillus fusiformis & Borrelia vincent

Complications

The following 2 complications may occur if the cases of acute streptococcal pharyngotonsillitis are not adequately treated–

- Acute rheumatic fever
- Acute glomerulonephritis

DIAGNOSIS

Based on clinical features & relevant investigations.

Investigations

Investigations	Results
CBC	Polymorphonuclear leukocytosis
ASO titre	Raised
Culture of throat swab	May be positive for *beta haemolytic streptococcus*

TREATMENT

A. Specific: Either of the following

- Penicillin
  - Phenoxymethyl penicillin 50 mg/kg/day, 6 hourly for 10 days or
  - Benzathine penicillin 600,000 unit deep IM (< 30 kg) and 1200,000 unit (> 30 kg) single dose
- Erythromycin 40-50 mg /kg/day in 4 divided doses (in cases of penicillin hypersensitivity) for 10 days
- Cefpodoxime proxetil 8 mg/kg/day twice daily for 5 days
- Azithromycin 10 mg/kg/day for 5 days

B. Supportive

- Analgesic/antipyretic
- Warm saline gurgling
- Feeding: As usual, better to choose with child's desire and conditions

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SELF ASSESSMENT

Short answer question [SAQ]

1. What are the complications of streptococcal tonsillitis?
2. How to differentiate streptococcal tonsillitis from diphtheria on examination of throat?

MULTIPLE CHOICE QUESTION [MCQ]

1. The causes of white patches on throat are–

___ a) acute follicular tonsillitis ___ b) diphtheria ___ c) viral pharyngitis
___ d) Vincent's angina ___ e) oral thrush

2. Organisms commonly cause acute tonsillitis are–

___ a) ß haemolytic Streptococcus ___ b) Staphylococcus aureus
___ c) Herpes simplex ___ d) Haemophilus influenza ___ e) Adeno virus

3. Common causes of sore throat in children are–

___ a) viral pharyngitis ___ b) acute tonsillitis ___ c) herpes gingivo-stomatitis
___ d) infectious mononucleosis ___ e) moniliasis

Chapter 16

Undue Exhaustion to Normal Activities

Undue exhaustion of a child to normal activities **(effort intolerance)**, shortness of breath and palpitation with failure to thrive are the usual presentations of underlying heart diseases.

However, apart from heart diseases, conditions causing chronic hypoxaemia e.g. thalassaemia major, chronic lung diseases, neuromuscular disorders may also give rise to undue exhaustion.

Heart diseases among children are mostly congenital, in contrast to adults who usually suffer from acquired heart diseases like coronary heart diseases, rheumatic valvular heart diseases etc.

In this chapter we will discuss the common congenital heart diseases, heart failure and infective endocarditis.

Classification

Broadly based on the presence or absence of cyanosis in the affected child.

Cyanotic CHD	Acyanotic CHD
◆ Tetralogy of Fallot (TOF) ◆ Transposition of great arteries (TGA) ◆ Total anomalous pulmonary venous drainage (TAPVD) ◆ Persistent truncus arteriosus ◆ Tricuspid atresia ◆ Ebstein anomaly	◆ With left to right shunts ❑ Ventricular septal defect (VSD) ❑ Atrial septal defect (ASD) ❑ Patent ductus arteriosus (PDA) ◆ Without shunt ❑ Coarctation of aorta ❑ Pulmonary stenosis ❑ Aortic stenosis

Congenital heart diseases (CHD)

Prevalence: 8 per 1000 live births.

Aetiology

- Unknown, mostly
- Chromosomal anomalies e.g. Down syndrome, Turner syndrome, Noonan syndrome
- Antenatal illnesses of mothers, e.g. diabetes mellitus, rubella infection, radiation, smoking, etc.

VENTRICULAR SEPTAL DEFECT (VSD)

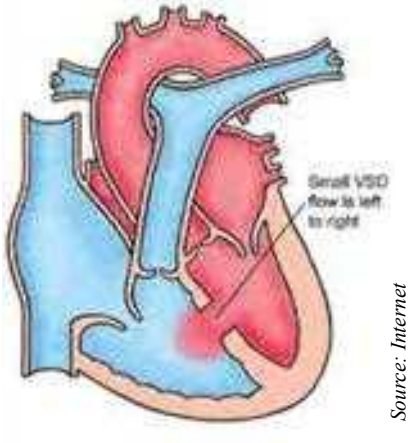
The commonest congenital heart disease. The defect occurs at any point on the interventricular septum, mostly in its **membranous** part (80%) and the remaining in the **muscular** part. It can occur as an isolated defect or along with other cardiac defect e.g. TOF.

VSD is classified according to it's size, as–

Small	< 5 mm
Moderate	5-10 mm
Large	> 10 mm VSD

Haemodynamics

During ventricular systole oxygenated blood shunts from the left ventricle to right ventricle (left to right shunt) through VSD and adds with the deoxygenated blood present there, coming from right atrium. This excess blood then pass to the pulmonary vascular bed through pulmonary trunk. The cycle continues again and again. With continued exposure of the pulmonary vascular bed to these high blood flow, patient develops pulmonary hypertension, pulmonary oedema and later pulmonary vascular obstructive disease, resulting in right to left shunt (Eisenmenger syndrome). This reversal of shunt direction results in appearance of cyanosis.



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Clinical Manifestation

Small defect

- Patients usually remain asymptomatic with normal growth and development
- Incidental detection of a pansystolic murmur at left 3rd and 4th intercostal spaces

Large defect

- Dyspnoea at rest or on exertion
- Poor feeding/interrupted feeding
- Poor weight gain (failure to thrive)
- Easy fatigability
- Profuse perspiration (diaphoresis) e.g. head sweating
- Recurrent respiratory tract infections
- Cyanosis is usually absent

General physical examination

- Appearance: Sick looking, often malnourished
- Respiratory rate: Increased
- Pulse rate: Increased, Volume: Good
- Blood pressure: Normal
- Jugular venous pressure: May be raised in CCF
- Pedal oedema: Absent but may be present in heart failure

Precordium

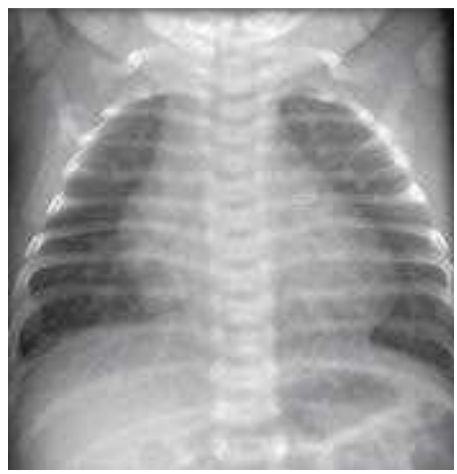
- Inspection: Hyperdynamic, may be bulged
- Palpation
  - Apex beat is shifted to left (due to cardiomegaly) and is thrusting
  - Left parasternal heave may be present
  - Thrill may be present in tricuspid area (related to grading of murmur)
  - P2 (pulmonary component of 2nd heart sound) may be palpable in pulmonary area when associated with pulmonary hypertension
- Auscultation
  - 1st and 2nd heart sounds are audible in all 4 areas
  - A harsh pansystolic murmur (grade 4/6) best heard at lower left sternal border at the 3rd, 4th & 5th intercostal spaces. The murmur may radiate to the right lower sternal border. Intensity varies based on the size of the VSD and pulmonary vascular resistance

Diagnosis

Based on the clinical features and relevant investigations.

Investigations

- Chest X-Ray
  - Cardiomegaly (cardiothoracic ratio > 60%)
  - Increased pulmonary vascular markings
  - CXR may be normal in small defects


Source: Internet

Cardiomegaly

- ECG
  - Normal in small defect
  - Left ventricular hypertrophy in large VSD
  - Biventricular hypertrophy when associated with pulmonary hypertension
  - P waves may be notched or peaked
- Echocardiogram with color Doppler is diagnostic. It shows location and size of the defect & direction of blood flow

TREATMENT

Counsel the parents about the disease, its complications and prognosis.

Medical

Small defects

Parents should be reassured of the relatively benign nature of the lesion, and the child should be encouraged to live a normal life, with no restrictions on physical activity. Spontaneous closure (30-50%) during 1st year of life

Moderate to Large defects

The goals of treatment are to–

- Ensure adequate growth of the patient
- Prevent development of Eisenmenger syndrome
- Prevent infective endocarditis
- To control congestive cardiac failure

A. Supportive

- Nutrition: High calorie diet (add fat and sugar) to ensure adequate weight gain
- Frusemide (1-3 mg/kg/day) in 2-3 divided doses
- Afterload reducing agents: ACE inhibitors
  - Enalapril (0.1-0.5 mg/kg/day) once or twice daily
  - Captopril (0.05-0.1 mg/kg/dose), 8 hourly
- Digoxin (5-10 µg/kg/day) may be indicated if diuresis and afterload reduction do not relieve symptoms of heart failure adequately

B. Surgical repair

Indications: Patients with–

- Cardiomegaly
- Poor growth
- Poor exercise tolerance or
- Other clinical abnormalities who have a significant shunt (>2:1)

Time of surgery: At age 3-6 months. In most centers, surgery is done before 1 year. As a result, Eisenmenger syndrome has been virtually eliminated. The surgical mortality rate is <2% *(Current Ped Dx & Rx 23rd Ed'2016)*

Contra-indication

- Severe pulmonary obstructive vascular disease, non responsive to pulmonary vasodilators

ATRIAL SEPTAL DEFECT (ASD)

Atrial septal defect is an abnormal communication between the atria due to a defect in the interatrial septum.

Types of ASD

Ostium secundum	60%
Ostium primum	30%
Sinus venosus	10%

Haemodynamics

In ASD there is shunting of oxygenated blood from the left to the right atrium where it is added to the usual venous return (volume overload). The blood then passes to the right ventricle and pumped to the lungs.

Source: Internet

As the pressure difference between the 2 atria is low; the amount of blood shunting through the defect is not as high as that of other high pressure gradient e.g. VSD. As a result, the pulmonary circulation & pulmonary artery pressure as well as pulmonary vascular resistance remains normal throughout the childhood although, it may begin to increase in adulthood and may eventually result in reversal of the shunt and clinical cyanosis.

CLINICAL MANIFESTATIONS

Vary with the size of defect.

- Small defect: Asymptomatic and is usually diagnosed during a routine health check-up
- Large defect: Symptomatic & patients present with–
  - Exercise intolerance
  - Easy fatigability
  - Increased perspiration
  - Poor weight gain (failure to thrive)
  - Recurrent respiratory tract infections

General Physical Examination

- Appearance: Usually normal
- Pulses: Normal
- Respiratory rate: Normal
- Weight & height: Age appropriate

Precordium

- Inspection: Heart usually hyperactive
- Palpation
  - Apex beat may be shifted to left
  - P2 may be palpable
  - Left parasternal heave may be present
- Auscultation
  - S1 is normal
  - S2 **is widely splitted and fixed** at pulmonary area
  - Added sound. An ejection systolic murmur (grade I-III), best heard at the upper left sternal edge (in pulmonary area). This is caused by increased flow accross the pulmonary valve, not due to flow accross ASD

DIAGNOSIS

Based on the clinical features and relevant investigations.

Investigations	Results
Chest X-Ray shows	Normal size heart or Cardiomegaly Dilated main pulmonary artery (Full Pulmonary conus) Increased pulmonary vascular markings due to increased pulmonary blood flow
ECG shows	Right-axis deviation RSR pattern in V1
Echo shows	Dilated right atrium & RV Anatomic location & size of ASD

Colour Flow Doppler: Confirm the diagnosis by demonstrating a left-to-right shunt accross the defect

TREATMENT

- Counsel parents about ASD, its treatment& prognosis.

A. Medical management is aimed to reduce volume overload and to prevent CCF by–

- Frusemide (1-2 mg/kg), Digoxin

B. Surgical closure of the defect. It is generally recommended for symptomatic children with a large defect and associated right heart dilatation

C. Device closure (nonoperative) during cardiac cathterization

Prognosis

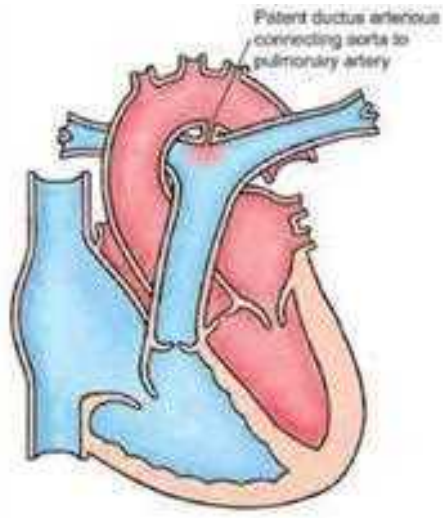
Good. Pulmonary hypertension, Reversal of shunt and Infective endocarditis are uncommon. Spontaneous closure occurs in ASD of <4 mm in diameter

PATENT (PERSISTENT) DUCTUS ARTERIOSUS (PDA)

PDA is the Persistence of the normal foetal vessel (ductus venosus) joining the Aorta to the Pulmonary artery. It accounts for 10% of all congenital heart diseases and found more among preterm infants weighing <1500 gram.

Haemodynamics

During ventricular systole, oxygenated blood flows from aorta to the pulmonary trunk through this patent ductus because of high pressure gradient. This blood is then added with the deoxygenated blood in pulmonary trunk, coming from right ventricle. As a result of this added volume, there is pulmonary congestion, pulmonary hypertension and ultimately pulmonary vascular obstructive disease and reversal of shunt ***(Eisenmengar syndrome).***



Source: Internet

CLINICAL MANIFESTATIONS

Vary with the size of defect.

- Small defect may be asymptomatic
- Moderate to large defect, generally results in–
  - Poor feeding
  - Poor weight gain (failure to thrive)
  - Intolerance to physical activities
  - Profuse sweating with crying and feeding
  - Recurrent respiratory tract infections

General Physical Examination

- Appearance: Normal or distressed. May be wasted
- Respiratory rate: Tachypnoea
- Pulses: High volume and collapsing with wide pulse pressure due to diastolic runoff through the ductus

Precordium

- Inspection: Hyperdynamic
- Palpation
  - Apex beat is shifted to left, heaving in character
  - A thrill may be palpable at left 2nd ICS
- Auscultation
  - S1: Normal
  - S2: Often obscured by the murmur
  - Added sound : Continuous machinery murmur present at left 2nd ICS near the sternum (maximal at mid clavicular line) is the classic finding

DIAGNOSIS

Based on the clinical features and relevant investigations.

Investigations	Results
Chest X-Ray	*If shunt small,* CXR appears Normal *If shunt is large* • Left atrial and LV enlargement • Prominence of aorta and main pulmonary artery • Increased pulmonary vascular markings
ECG	• Normal, *in small shunt* • LVH, *in large shunt* • Biventricular hypertrophy, *in pulmonary hypertension* • RVH *in pulmonary VODisease*
Echo-cardiogram	• Visualize the ductus and confirm the direction and degree of shunting

TREATMENT

Counsel the parents about the disease, treatment options and prognosis.

A. Medical

To facilitate closure of PDA by any of the following drugs when given within 72 hours of age.

- **Indomethacin**: IV slowly over 30 minutes in the following dosage–
  - 1st dose: 0.2-0.3 mg/kg
  - 2nd dose: 0.2 mg/kg (12-24 hours after 1st dose if PDA persists)
  - 3rd dose: 0.2 mg/kg (12-24 hours after 2nd dose if PDA persists)
- **Ibuprofen**: Given orally
  - Day 1: 10 mg/kg
  - Day 2:5 mg/kg
  - Day 3:5 mg/kg

B. Surgical repair: By one year age for patients with significant left-to-right shunt.

C. Device closure: Can safely be done for symptomatic PDA cases (Weight: 5 kg) with normal PA pressure.

Prognosis: Spontaneous closure may occur within 1 year of age. After 1 year, spontaneous closure is rare. Infective endocarditis is a potential complication.

TETRALOGY OF FALLOT (TOF)

[Etienne L A Fallot 1850-1911]

Commonest congenital cyanotic cardiac lesion, accounts for 10% of all congenital heart diseases.

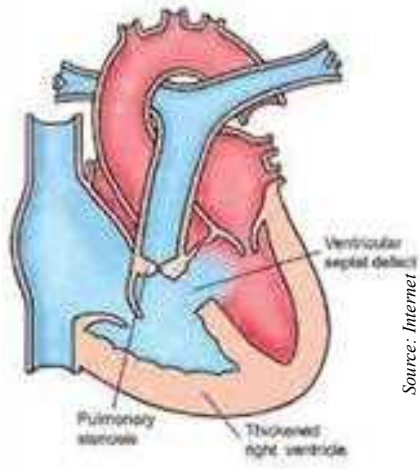
Pathology: Four components–

- Obstruction to right ventricular outflow tract (pulmonary infundibular stenosis)
- Ventricular septal defect (VSD)
- Over-riding of Aorta (over VSD)
- Right ventricular hypertrophy

When additionally ASD is present along with these defects, it is called Pentalogy of Fallot.

Haemodynamics

Owing to right ventricular outflow obstruction, during ventricular systole deoxygenated blood of right ventricle shunts through VSD to left ventricle, mix with oxygenated blood there and then this mixed blood passes through the aorta to different parts of the body.



Source: Internet

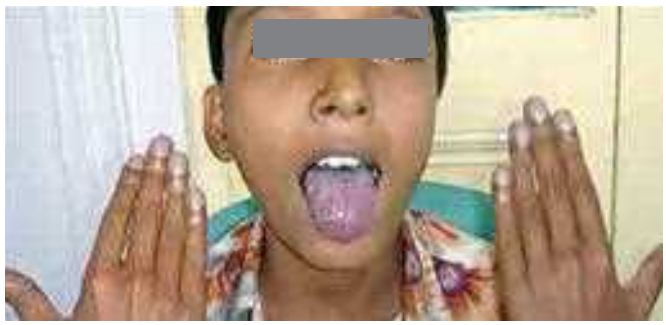
Therefore, the net pathological effects of these events are–

- Persistently less blood in pulmonary circulation (oligaemic lung fields)
- Persistently low O_2 saturation of blood in systemic circulation (chronic hypoxaemia & cyanosis)
- Polycythaemia due to chronic hypoxaemia
- Growth failure due to chronic hypoxaemia

CLINICAL MANIFESTATIONS

Clinical findings are variable and mainly depends on the degree of right ventricular outflow obstruction.

- Cyanosis
  - Patients with mild obstruction are minimally cyanotic or even acyanotic (pink TOF)
  - Those with maximal obstruction are deeply cyanosed since birth
  - Most have progressive cyanosis by 4 months of age



Clubbing and Blue tongue (central cyanosis)

- Paroxysmal hypercyanotic attacks (Hypoxic spells, blue spells, Tet spells)

This is the hallmark of severe TOF and usually occurs during first 2 years of life, most commonly by 4-6 months of age. The attacks are associated with further reduction of an already compromized pulmonary blood flow & more severe systemic hypoxia and metabolic acidosis. Spells occur most frequently in the morning on awakening or after episodes of vigorous cry.

Cyanotic spells precipitating factors are–

- Exertion
- Upseting due to any cause
- Sleeplessness
- Irritation to the baby
- Vigorous crying

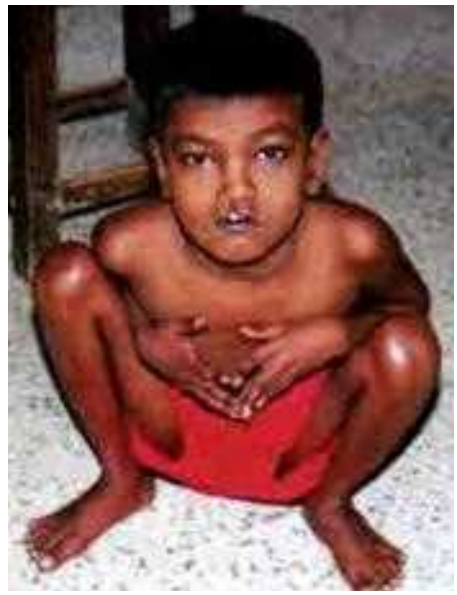
Cyanotic spells are characterized by–

- Sudden onset of dyspnoea. Sometimes gasping respiration and syncope
- Sudden deepening of cyanosis
- Alterations in consciousness, from irritability to syncope. Sometimes convulsions and hemiparesis
- Temporary disappearance or decrease in the intensity of the systolic murmur at pulmonary area
- Metabolic acidosis

Easy fatigability and dyspnoea on exertion.The affected child tires easily (easy fatigability) and begins panting with any form of exertion (dyspnoea on exertion).

Sometimes, because of sudden dyspnoea, the affected child adopts squatting position till dyspnoea improves and then the child resumes physical activity.

Squatting is of diagnostic significance and is highly typical of infants with TOF.



A TOF child in squatting position

Squatting causes increased resistance in **Peripheral Systemic blood vessels.** This raises left ventricular pressure above that of right ventricle which decreases right-to-left shunt across the VSD. Blood thus flows through the stenosed pulmonary infundibulum. This ultimately improves pulmonary circulation, better oxygenation and relieves the child from dyspnoea and episodes of cyanotic spells.

- Failure to thrive (not gaining weight and height)

General Physical Examination

- Appearance: Cyanosis (skin, lips, and mucous membranes inside the mouth and nose looks blue)
- Conjunctiva: Congested

Conjunctival congestion

- Fingers and toes: Clubbing
- Pulse and blood pressure: Normal
- Oedema: Absent
- Anthropometry: Stunting

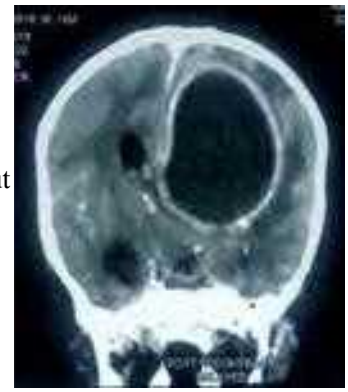
Clubbing of fingers

Precordium

- Inspection: May be bulged due to right ventricular hypertrophy **(RVH)**
- Palpation
  - Apex beat is tapping in character, not shifted
  - P2 is not palpable
  - Left parasternal heave may be present
  - A systolic thrill may be felt at left upper intercostals spaces
- Auscultation
  - S1 is normal
  - S 2 is loud & single
  - Added sound: A loud ejection systolic murmur is heard at pulmonary area (originating from the turbulence at right ventricular outflow tract obstruction)

Complications

- Hypercyanotic spells
- Severe polycythaemia
- Cerebral abscess as deoxygenated blood enters the systemic circulation and brain, bypassing lungs without clearing the germs by pulmonary scavenger cells
- Cerebral thrombo-embolism and stroke
- Infective endocarditis
- Delayed growth, development and puberty
- Others:
  - Hyperuricaemia & gout
  - Relative IDA
  - Bleeding disorders/coagulopathy



Cerebral abscess in a child with TOF

Heart failure is uncommon in classical TOF.

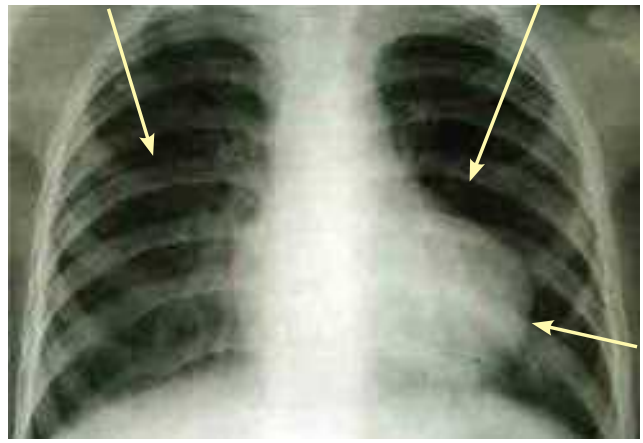
DIAGNOSIS

Based on the clinical features and relevant investigations.

Investigations

- Complete blood counts
  - Haemoglobin and haematocrit values are usually elevated which is proportional to the degree of cyanosis
  - TC & DC of WBC, Platelet counts: Normal
  - PBF shows microcytic hypochromic anaemia
- X-Ray chest
  - Heart
    - Size: Not enlarged
    - Shape: Boot shaped (coeur-en-sabot) due to concavity at pulmonary conus (because of low pressure of pulmonary artery) and upturning of cardiac apex (due to lifting up of cardiac apex by the hypertrophied right ventricle)

Oligaemic lungs field *Concavity at pulmonary area*



Boot shaped heart and oligaemic lungs fields

  - Lung fields: Look black due to decreased pulmonary vascularity (oligaemia)
- ECG: RVH and right axis deviation
- Echocardiography: Confirms the diagnosis

TREATMENT

- Counsel the parents about the disease, treatment options and prognosis

A. Medical

- Neonates with severe cyanosis is treated with IV infusion of Prostaglandin E_1 (0.05-0.1 µg/kg/min IV) to keep the ductus arteriosus open/patent and thereby to improve pulmonary circulation and is life saving
- Treatment of cyanotic spells (in hospital)

- Place the infant in a knee-chest position (older children usually squat spontaneously and do not develop cyanotic spells)
- Give O_2: 3-5 L/min through face mask/head box
- Establish a calm environment by isolating the patient

If the spell persists, give the following:

- **Intravenous fluids:** 10 ml/kg bolus normal saline followed by maintenance fluids
- **Morphine:** 0.1-0.2 mg/kg SC for keeping the child calm and for muscle relaxation
- **$NaHCO_3$:** 1 mEq/kg IV to correct acidosis
- **Propranolol:** 0.1 mg/kg IV which relaxes the infundibular muscle and thereby reduces spasm

If these measures do not control the spell, then arrange to trancfer the child to CCU.

- **Phenylephrine (alfa agonist):** To raise systemic BP as well as systemic vascular resistance. This will reduce right to left shunt and ultimately promote pulmonary blood flow.
  - **Phenylephrine:** 10-20 µg/kg bolus IM or SC. followed by 0.1-0.5 µg/kg/min IV infusion titrated according to heart rate and blood pressure

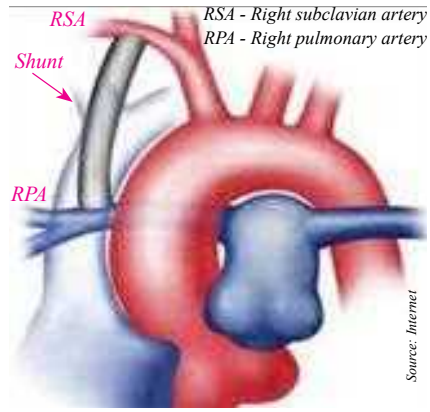
If the preceding steps do not relieve the spell or if the infant is rapidly deteriorating, intubation and ventilatory support should be given.

- Treatment at home
  - Propranolol: 0.25-1 mg/kg/day orally to be continued to prevent cyanotic spells
  - Fluid & Nutrition
    - Provide high calorie diets to ensure growth
    - Supplement Iron: 3-6 mg/kg/day elemental iron orally to promote maturation of RBC
    - Supplement Vitamins & minerals
- Counsel parents to pay special attention to fluid intake so as to prevent dehydration, haemoconcentration and thereby to reduce thromboembolism. Dehydration of any child with TOF should be referred immediately for prompt rehydration.

B. Surgical repair

- **Total correction:** The treatment of choice, can be done as early as 1 month of age (electively in between 4-6 months of age)
- **Palliative surgery (Blalock Taussig Shunt)**

This is done between Subclavian artery (systemic) and pulmonary artery (pulmonary circulation) to increase circulation to the lungs. This will improve tissue oxygenation, relieves cyanosis and allow the child to grow good enough to do complete surgical repair. This procedure is reserve for TOF with associated comorbidities e.g. other congenital anomalies or prematurity



BT shunt

Prophylaxis for infective endocarditis: Recommended.

Prognosis

The long-term outcome of treatment of TOF depends primarily on the size and anatomy of the pulmonary arteries.

CLINICO-PATHOLOGICAL DIFFERENCES BETWEEN TOF AND VSD

Traits	TOF	VSD
Direction of shunt	◆ Right to left	◆ Left to right
Nature of defect	◆ Multiple	◆ Single, mostly but may be associated with other defects
Status of pulmonary circulation	◆ Less entry of blood from right ventricle to pulmonary circulation ◆ Low pulmonary pressure	◆ More blood into pulmonary circulation ◆ High chance of developing pulmonary hypertension and pulmonary oedema in untreated cases
Cyanosis	◆ Present	◆ Absent
Complications	Mostly extra-pulmonary and are related to ◆ Hyperviscosity of blood, thromboembolism, stroke ◆ Direct entry of venous blood to systemic circulation bypassing lungs may lead to brain abscess ◆ Heart failure (uncommon)	◆ Pulmonary congestion and recurrent pneumonia ◆ Cardiac overload– CCF ◆ Turbulence and infective endocarditis
Chest X-Ray findings	◆ Boot shaped heart ◆ Depression at pulmonary conus ◆ Oligaemic lung fields	◆ Cardiomegaly ◆ Normal or prominent pulmonary conus ◆ Prominent pulmonary vascular markings

HEART FAILURE (HF)

It is a clinical situation where heart fails to pump blood to meet the circulatory or metabolic needs of the body.

AETIOLOGY

Cardiac causes	Congenital Heart diseases	VSD, TGA, TAPVD, PDA, Coarctation of Aorta (CoA)
	Acquired Heart diseases	❑ Valvular heart diseases e.g.mitral, aortic etc. ❑ Infective endocarditis ❑ Hypertensive heart diseases e.g. acute glomerulonephritis ❑ Viral myocarditis etc.
Non-cardiac causes	❑ Fluid overload ❑ Septicaemia ❑ Asphyxial cardiomyopathy	❑ Severe anaemia ❑ Beriberi (wet) ❑ Thyrotoxicosis

Ischaemic heart disease and cardiomyopathies are less common causes of heart failure in children.

PATHOGENESIS

When heart fails to pump out its blood, it dams either in pulmonary or in systemic circulations or both.

Features of pulmonary overload (LHF)	Features of systemic overload (RHF)
❑ Respiratory distress ❑ Cough with frothy sputum ❑ Tachypnoea ❑ Basal crepitations	◆ Upper abdominal pain ◆ Dependent oedema ◆ Tender hepatomegaly ◆ Raised JVP

CLINICAL MANIFESTATIONS

- ◆ Infants: Non specific e.g. irritability, excessive sweating, poor feeding & difficult feeding, respiratory distress
- ◆ Older children: Effort intolerance, dyspnoea on exertion, excessive sweating, cough, abdominal pain

A. General examination

- ◆ Tachypnoea
- ◆ Tachycardia
- ◆ Cold peripheries
- ◆ Weak thready pulse
- ◆ Low blood pressure
- ◆ Prolonged capillary refilling time
- ◆ Dependent oedema
- ◆ Raised JVP
- ◆ Cyanosis, may be

B. Chest examination

- ◆ Cardiomegaly
- ◆ Gallop rhythm
- ◆ Murmurs
- ◆ Wheeze
- ◆ Basal crepitation

C. Other features

- ◆ Tender hepatomegaly
- ◆ Positive hepatojugular reflux

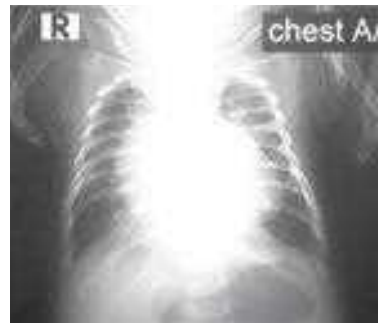
DIAGNOSIS

Based on clinical features & supports from the relevant investigations.

Investigations

- ◆ X-Ray Chest
  - ◆ Cardiomegaly (Increased cardiothoracic ratio, the ratio between the maximum diameters of chest & heart)

    Normal ratio
    - ❑ Newborn: 60%
    - ❑ Children: 55%
    - ❑ Adult: 50%



Cardiothoracic Ratio > 60%

Source: Internet

  - ❑ Pulmonary vascular congestion
- ◆ ECG: Not diagnostic but can say the primary heart defects
- ◆ Echocardiography: Demonstrate structural pathology
- ◆ CBC: Hb may be low if HF is related to severe anaemia

TREATMENT

- ◆ Counseling parents about the problem
- ◆ General measures
  - ❑ Decubitus: Upright position
  - ❑ O_2 inhalation: Humidified oxygen by head box/ mask/nasal prongs
  - ❑ Bed rest & restriction of physical activities
  - ❑ Maintenance of body temperature
  - ❑ Feeding: Breast feeding or nasogastric tube feeding of foods rich in calory and low in sodium
- ◆ Control of fluid overload by
  - ❑ Fluid restriction: By 25-30%
  - ❑ Salt restriction: Avoid table salt and salt rich foods
  - ❑ Diuretics e.g. Frusemide, Thiazide or K^+ sparing diuretics

- Augmentation of myocardial contractility by inotropic agents e.g.
  - Cardiac glycosides (Digoxin). Total digitalization dose: 0.02-0.04 mg/kg)
  - Sympathomimetic amines e.g. Dopamine, Dobutamine
  - Phosphodiesterase inhibitors e.g. Bipyridines, Amrinone and Milrinone
- Afterload reducing agents: ACE inhibitors e.g. Captopril, Enalapril is given to reduce the impedance to left ventricular ejection.
- Correction of underlying causes and precipitating factors

INFECTIVE ENDOCARDITIS (IE)

It is one of the most serious of all infections and is characterized by colonization or invasion of the heart valves or the endocardium by a microbial agent, leading to formation of bulky, friable vegetation laden with organism. The vegetations are composed of fibrin, inflammatory cells and micro organisms.

Clinical Types

Types	Natural history	Prognosis
Acute By virulent organism	Produce destructive infections usually to a previously normal heart valve	High mortality
Subacute By low virulent organism	Less destructive infection particularly on deformed valves	Low mortality, good recovery

Risk Factors

- Congenital heart disease; particularly those creating high velocity jet streams e.g. small VSD, PDA or TOF
- Valvular defects e.g. valvular stenosis
- Artificial valves and vascular grafts
- Normal heart with indwelling vascular catheter
- Immunodeficiency e.g. HIV, therapeutic immune suppression, DM, IV drug users

Organisms

- *Streptococci* viridans (30-40%)
- *Staphylococcus aureus (25-30%)*
- *Fungal agents (5%)*

Pathogenesis

Patients with high-velocity flow congenital heart lesions cause turbulence and this promotes formation of a sterile network of platelets and fibrin on the endocardial surface. Subsequently this is colonized by microorganisms and forms vegetations. These vegetations may sometimes become large enough to cause obstruction in blood circulation within heart or may break away as emboli and deposit in different organs. Sometimes, there may be manifestation of i**mmune mediated vasculitis.**

Clinical Manifestations

- History of–
  - Heart diseases, in majority of patients
  - Surgical procedure e.g. cardiac surgery, tooth extraction, tonsilectomy
  - Long continued fever with chills and night sweat
  - Non specific manifestations e.g. malaise, anorexia, weight loss, cough, shortness of breath, headache, myalgias, joint pain

A. General Features

- Appearance: Sick looking, pale
- Body temperature: Raised in 90% of patients
- Heart rate: Increased
- Respiratory rate: May be increased
- Oedema: May present, if associated CCF

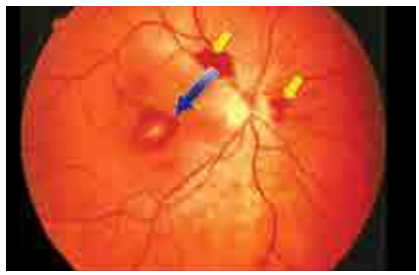
B. Cutaneous manifestations

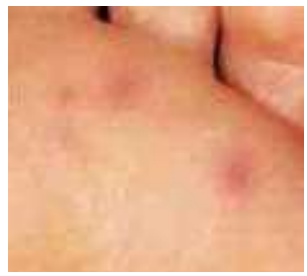
Petechiae	Found on the palpebral conjunctiva, buccal or palatal mucosa
Splinter haemorrhages	Dark red linear lesions in the nail beds
Osler's nodes	Small red to purple, tender nodules found in pulp of fingers, soles of the feet, thenar and hypothenar eminences
Janeway lesions	Nontender haemorrhagic maculae on the palms and soles
Clubbing	Fingers and toes
Roth's spots	Retinal haemorrhages with pale centers

Cutaneous lesions represent vasculitis produced by circulating antigen-antibody complexes.


Splinter haemorrhage


Osler's node


Roth spot


Janeway lesion

Source: Internet

C. Systemic Manifestations

CVS	◆ Change in a pre-existing murmur or development of a new murmur ◆ Tachycardia ◆ Features of congestive cardiac failure
CNS	◆ Embolic stroke ◆ Intracerebral haemorrhage and multiple microabscesses
Joints	◆ Arthritis
Renal	◆ Flank pain and haematuria due to renal emboli
Spleen	◆ Splenomegaly and left upper quadrant pain in splenic emboli

Complications

- Myocardial infarction, pericarditis, cardiac arrhythmia
- Cardiac valvular insufficiency
- Congestive heart failure
- Sinus of Valsalva aneurysm
- Aortic root or myocardial abscesses
- Arterial emboli, infarcts, mycotic aneurysms
- Arthritis, myositis
- Glomerulonephritis, acute renal failure
- Stroke syndromes
- Mesenteric or splenic abscess or infarct

Investigations

Investigations	Results
❑ Complete blood counts	Anaemia: present in 70-90% of patients and is usually normocytic and normochromic. Leukocytosis: noted in <50% of patients
❑ Acute phase reactants (ESR, CRP)	Raised
❑ Blood culture	◆ It should be done in all patients who have a pathologic heart murmur, a history of heart disease or previous endocarditis. ◆ 3 separate samplings (3 ml each) within 1-24 hours should be obtained from different peripheral sites ◆ Cultures should be grown aerobically and anaerobically for at least 1 week ◆ If no growth is observed by 48 hours of incubation, 2 more blood cultures should be obtained
❑ Echocardiography	Typical findings include vegetations, abscess and valvular insufficiency
❑ Urinalysis	May reveal proteinuria (50-60%) and/or microscopic haematuria (30-50%)
❑ Immune assays	Increased Ig, circulating immune complexes and rheumatoid factor
❑ Culture of other specimen	Scraping from cutaneous lesion, urine, synovial fluid, abscess, CSF (in presence of meningitis)

DIAGNOSIS

Based on Revised Duke Clinical Diagnostic Criteriae.

Revised Duke Clinical Diagnostic Criteriae for Infective Endocarditis

Major Criteriae	Minor Criteriae
❑ Positive blood cultures (2 separate cultures for a usual pathogen, 2 or more for less-typical pathogens), and ❑ Evidence of endocarditis on echocardiography ❑ Intracardiac mass on a valve or other site ❑ Regurgitant flow near a prosthesis ❑ Abscess, partial dehiscence of prosthetic valves or ❑ New valve regurgitant flow	◆ Predisposing heart conditions ◆ Fever ◆ Embolic-vascular signs e.g. arterial embolism, septic pulmonary embolism, mycotic aneurysm, intracranial haemorrhage, conjunctival petechiae, Janeway lesions ◆ Immune complex phenomena e.g. glomerulonephritis, arthritis, rheumatoid factor, Osler nodes, Roth spots ◆ A single, positive blood culture or serologic evidence of infection, and Echocardiographic signs not meeting the major criteria ◆ Presence of newly diagnosed clubbing ◆ Splenomegaly ◆ Splinter hemorrhages, and petechiae ◆ A high erythrocyte sedimentation rate ◆ A high C-reactive protein level ◆ The presence of central nonfeeding lines, peripheral lines, and presence of microscopic hematuria
Definite diagnosis: **2 major criteriae** or 1 major + 3 minor criteria or 5 minor criteria	
Possible diagnosis: 1 major + 1 minor criteria or 3 minor criteria	

Adapted from Kliegman RM, Stanton BF, Geme III JWS, Schor NF, Behrman RE. Editors. Nelson Textbook of Pediatrics, 20th Edition. New Delhi: Elsevier; 2016

TREATMENT

Antibiotics should be started immediately, once a diagnosis of IE is made. The dose, duration and route of administration of antibiotics should be decided jointly with cardiologist and microbiologist.

- Empiric therapy with Vancomycin plus Gentamicin for 4-6 weeks period is the most common regimen for patients without a prosthetic valve and when there is a high risk of S aureus, Enterococcus, or S viridans infection
- Therapy can be tailored with appropriate antibiotics, once the pathogen & sensitivities are defined

Organisms	Regimen, Dose and Route	Duration
Strep viridans and Strep bovis	C Penicillin G (200000u/kg/day) IV, 4-6 hourly or Ceftriaxone (100mg/kg/day) IV once daily	4 weeks
	or	
	Ceftriaxone + Gentamicin (3mg/kg/day, IV/IM, single or in 3 divided doses)	2 weeks
	or	
	Vancomycin (40 mg/kg/day) IV, 8-12 hourly for penicillin & ceftriaxone allergic patients	4 weeks
Staphylococcus (Oxacillin susceptible strain)	Nafcillin or oxacillin (200mg/kg/day, IV, 4-6 hourly ± Gentamicin	4 weeks
	Cefazoline (100mg/kg/day), IV 8 hourly Penicillin allergic ± Gentamicin	6 weeks
Staphylococcus (Oxacillin Resistant Strain)	Vancomycin	6 weeks

Prophylaxis

Only the high risk patients listed below require antibiotic prophylaxis before–

- Dental procedures involving manipulation of gingival tissue, periapical region of the teeth, or perforation of oral mucosa
- Procedures involving respiratory tract or infected skin or musculoskeletal tissue
- IE prophylaxis is not recommended for Genito-urinary or GI tract procedures, body piercing or tattooing

Highest risk group people for prophylaxis of IE

- Recipients of prosthetic valve or prosthetic material
- Patients with–
  - Previous endocarditis
  - Congenital heart diseases (CHD) e.g.
    - *Palliated cyanotic CHD*
    - *Completely repaired CHD with prosthesis/device during 1st 6 months postprocedure*
    - *CHD with residual defects bordered by the prosthetic material*
- Cardiac transplant with valvulopathy

Antibiotic prophylaxis options include the following

Situations	Drug	Route	Regimen: Single dose 30 to 60 min before procedure
Can take orally & not allergic to Penicillins or Ampicillin	Amoxicillin	Oral	50 mg/kg
Unable to take oral medication	Ampicillin or Cefazolin or Ceftriaxone	Parenteral	50 mg/kg IM or IV 50 mg/kg IM or IV
Can take orally but allergic to Penicillins or Ampicillin	Cephalexin*† or Clindamycin or Azithromycin or Clarithromycin	Oral	50 mg/kg 20 mg/kg 15 mg/kg
Allergic to Penicillins or Ampicillin and unable to take oral medication	Cefazolin or Ceftriaxone† or Clindamycin	Parenteral	50 mg/kg IM or IV 20 mg/kg IM or IV

** Or other first or second generation Cephalosporin in equivalent dose † Cephalosporin should not be used in a child with history of anaphylaxis, angioedema or urticaria with Penicillin or Ampicillin*

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the findings in hand of child suffering from infective endocarditis?
2. Classify congenital heart disease.
3. Write down the treatment of heart failure in children.
4. Write down the common presentations of Tetralogy of Fallot.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Cyanotic congenital heart diseases are–
   ___ a) ventricular septal defect ___ b) tetralogy of Fallot ___ c) coarctation of aorta
   ___ d) transposition of great arteries ___ e) patent ductus arteriosus
2. Common congenital heart disease having left to right shunt include–
   ___ a) VSD ___ b) ASD ___ c) Coarctation of aorta ___ d) PDA ___ e) Pulmonary stenosis
3. Causes of heart failure in children are–
   ___ a) COPD ___ b) VSD ___ c) AGN ___ d) myocarditis ___ e) TOF
4. Tetralogy of Fallot includes following components–
   ___ a) ventricular septal defect ___ b) aortic stenosis ___ c) overriding of aorta
   ___ d) pulmonary hypertension ___ e) right ventricular hypertrophy
5. The recognized complications of TOF are–
   ___a) polycythaemia ___ b) cerebral abscess ___ c) thromboembolism ___ d) heart failure ___ e) hyperuricaemia
6. Features of heart failure in infants and children are–
   ___ a) dyspnoea ___ b) gallop rhythm ___ c) cardiomegaly ___ d) enlarged tender liver
   ___ e) crepitations at lung bases
7. The characteristic chest X-Ray findings of TOF are–
   ___ a) cardiomegaly ___ b) concavity at pulmonary conus ___ c) oligaemic lungs field
   ___ d) upturned apex of heart ___ e) prominent pulmonary vascular markings
8. Organisms commonly responsible for infective endocarditis are–
   ___ a) *Staphylococcus aureus* ___ b) *Streptococcus viridans* ___ c) *Nisseriae gonorrhoea*
   ___ d) *Strept. pneumoniae* ___ e) *Haemophilus influenzae*
9. The major diagnostic criteria of infective endocarditis according to Dukes criteria are–
   ___ a) positive blood culture ___ b) Roth's spot ___ c) fever ___ d) Osler's nodes
   ___ e) evidence of endocarditis on echocardiography
10. Antibiotics recommended for treatment of infective endocarditis are–
    ___ a) Benzyl Penicillin ___ b) Ceftriaxone ___ c) Gentamicin___ d) Vancomycin ___ e) Amoxicillin
11. Clinical features of pulmonary overload are–
    ___ a) hepatomegaly ___ b) palpitation ___ c) raised JVP
    ___ d) crackles in lung base ___ e) cough with frothy sputum
12. Measures taken to avoid hypercyanotic spell in TOF are–
    ___ a) Propranolol ___ b) Iron supplementation___ c) Morphine___ d) good hydration ___ e) knee chest position
13. The following is the characteristic murmur in mitral stenosis–
    ___ a) pansystolic murmur at the mitral area ___ b) ejection systolic murmur
    ___ c) mid diastolic murmur ___ d) Austin flint murmur ___ e) early diastolic murmur
14. Patients with TOF usually present with–
    ___ a) pulmonary oedema___ b) brain abscess___ c) cardiomegaly ___ d) high PCV ___ e) low pulmonary vascular pressure

Chapter 17

Joint Pain and Swelling

Whenever a child presents with painful swollen joint, tenderness and limitation of movements, the following conditions should be considered–

- Acute rheumatic fever
- Juvenile idiopathic arthritis (JIA)
- Infection e.g. septic or tubercular arthritis
- Haemarthosis e.g. Haemophilia
- Reactive arthritis following enteropathic & urogenital infections
- Systemic lupus erythematosus (SLE)
- Trauma
- Acute leukaemia

Many a times, children complaint of pain in the limbs but not truely in the joints, usually occurs at night and get relieved by gentle massage. These are probably related to **overuse of limbs or growing pain or non specific limbs pain** and should not be confused with arthritis.

Sometimes, atients with Thalassaemia major may present with pain in joints and limbs.

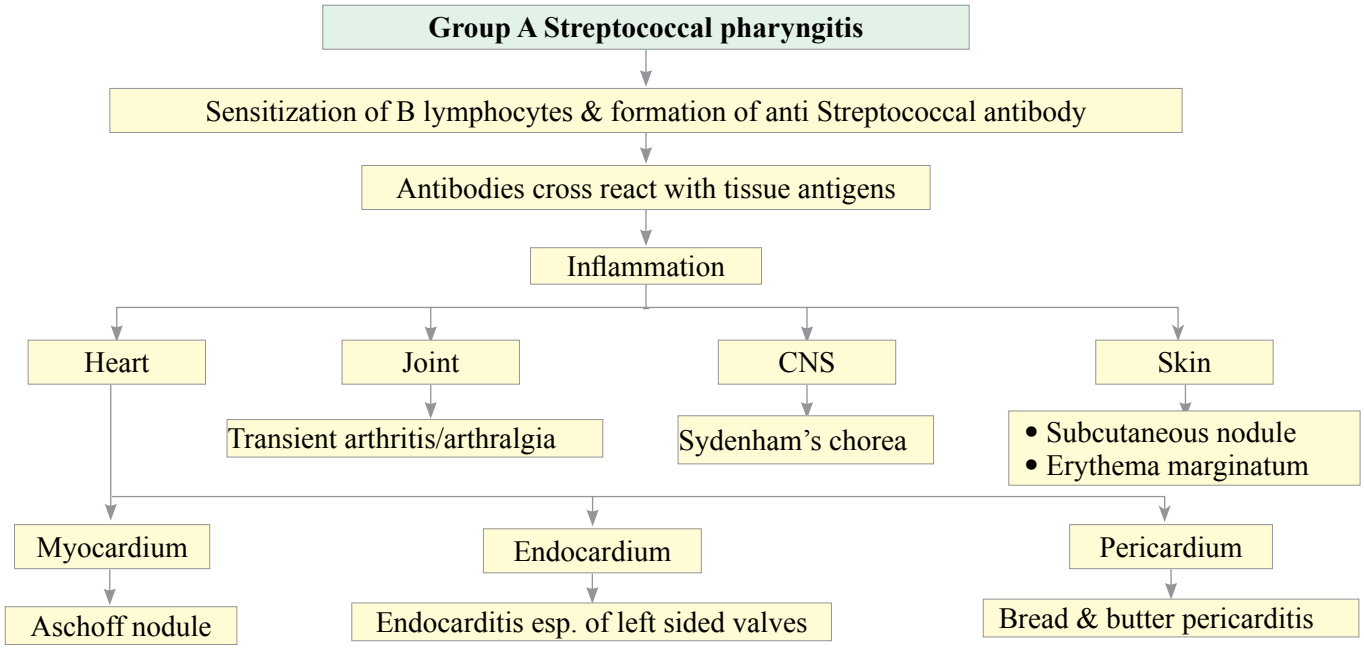
Acute rheumatic fever and Juvenile idiopathic arthritis are the 2 most common causes of arthritis in children and will be discussed in this chapter.

ACUTE RHEUMATIC FEVER (ARF)

It is a common problem in developing countries. The most important concern of ARF is that if the diagnosis is missed or if not treated properly, it may lead to development of rheumatic heart diseases e.g. mitral valvular diseases as well as neurological problem like rheumatic chorea.

Aetio-pathogenesis

Rheumatic fever develops 2-4 weeks after an acute episode of group A beta haemolytic streptococcal pharyngitis (at a time when clinical findings of pharyngitis are no longer present). However, in about one third of cases history of pharyngitis are absent. The disease is immune mediated and is related to immunogenic cross reactivity between streptococcal components (e.g. M protein, cell wall group A carbohydrate etc) and tissues of heart, joints and brain.



Pathophysiology of ARF (adopted from Robbin's & Cotran's pathology '2010)

CLINICAL MANIFESTATIONS

Age: Children between 5-15 years of age have high risk of streptococcal pharyngitis and acute rheumatic fever.

As there is no clinical or laboratory findings pathognomonic for acute rheumatic fever, **T. Duckett Jones** in 1944 proposed a guideline (revised in 1992) for diagnosis and to limit over diagnosis of acute rheumatic fever. The Jones Criteria, as revised by the American Heart Association (in 2015), is now used for diagnosis of the initial attack of acute rheumatic fever and recurrent attacks.

Major criteriae	Minor criteriae	Evidence of antecedent group A streptococcal (GAS) infection
❑ Migratory polyarthritis ❑ Pancarditis ❑ Sydenham's chorea ❑ Subcutaneous nodules ❑ Erythema marginatum	◆ Clinical features e.g. ❑ Arthralgia ❑ Fever ◆ Laboratory features, e.g. ❑ Elevated acute phase reactants e.g. ESR, CRP ❑ Prolonged P-R interval	◆ Microbiological: Positive throat swab culture or rapid streptococcal antigen test or ◆ Serological: Elevated or increasing streptococcal antibody titer– ASO
❑ **Low-Risk populations:** Incidence ≤2 per 100,000 school-age children per year or all-age rheumatic heart disease prevalence of ≤1 per thousand populations ❑ **Moderate/High Risk populations:** Those with higher incidence or prevalence rates		

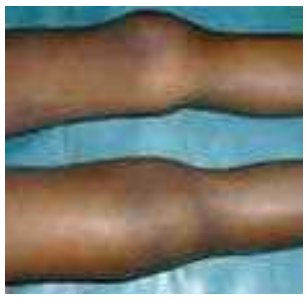
- ◆ Initial attack: 2 major manifestations or 1 major and 2 minor manifestations, plus evidence of recent GAS infection
- ◆ Recurrent attack: 2 major or 1 major and 2 minor or 3 minor manifestations (the latter only in the Moderate/High-Risk population), plus evidence of recent GAS infection

Exception: In the following 3 circumstances, the diagnosis of ARF can be made without strict adherence to the Jones criteria

- ◆ Chorea occurs as the only major manifestation
- ◆ Indolent carditis is the only manifestation and
- ◆ Recurrent rheumatic fever in high-risk populations

A. Migratory polyarthritis

- ❑ Occurs in about 75% of patients of ARF
- ❑ Typically **large joints** e.g. knees, ankles, wrists and elbows are involved with pain and limitation of movements
- ❑ Affected joints are swollen, red, hot and exquisitely tender. A severely inflamed joint can become normal within 1-3 days, even without treatment
- ❑ A dramatic response to oral aspirin is characteristic



Swollen knee joints

NB: Monoarthritis and involvement of spines, small joints of hands and feet and hip joints are uncommon in rheumatic fever. Rheumatic arthritis is typically not deforming.

B. Carditis *(pancarditis)*

- ❑ Occurs in 50-60% of cases
- ❑ It involves all the 3 layers of heart i.e. endocardium, myocardium or pericardium

Features of Pancarditis

- ◆ Endocarditis: Murmurs due to valvular involvement
- ◆ Myocarditis: Tachycardia, conduction defect, cardiomegaly
- ◆ Pericarditis: Pericardial rub & effusion

As per Revised Jones criteria'2015– **Subclinical carditis** (defined as carditis, identified by echocardiogram without clinical evidence i.e. murmur) is also accepted as major criteria.

Commonly, mitral valves are involved. Sometimes along with mitral valves, aortic valves may be involved. But isolated aortic or right-sided valvular involvement is uncommon.

Common murmurs are–

- ◆ High-pitched holosystolic murmur radiating to axilla because of mitral regurgitation
- ◆ Apical mid diastolic murmur due to relative mitral stenosis
- ◆ High pitched decrescendo diastolic murmur due to aortic insufficiency

Sometimes, carditis results in cardiomegaly and CCF with pulmonary and systemic congestion.

C. Sydenham's chorea

- Occurs in about 10-15% of patients
- Characteristic movements are–
  - Milkmaids grip
  - Spooning and pronation of hands when patient's arms are extended
  - Wormian /darting movements of the tongue upon protrusion
  - Deterioration of handwriting

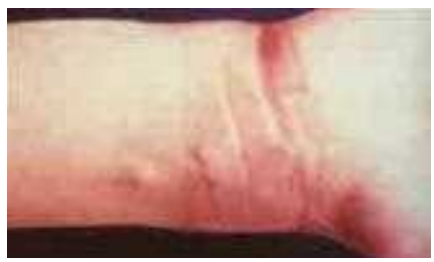
Source: Internet

Sydenhams chorea

- Associated features are • emotional lability • incoordination • poor school performance and • facial grimacing. These are exacerbated by stress and disappears with sleep

D. Subcutaneous nodules

These are firm non-tender nodules present along the extensor surfaces of tendons near bony prominences. There is a correlation between the presence of these nodules and rheumatic heart diseases

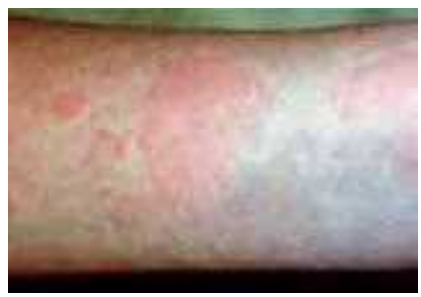


Source: Internet

Subcutaneous nodules

E. Erythema marginatum (Rare)

- Erythematous macular rash, which are serpiginous with pale centers and are non-pruritic
- Occurs primarily over the trunk & extremities but not on the face and accentuated by warming the skin



Source: Internet

Erythema marginatum

COMPLICATION

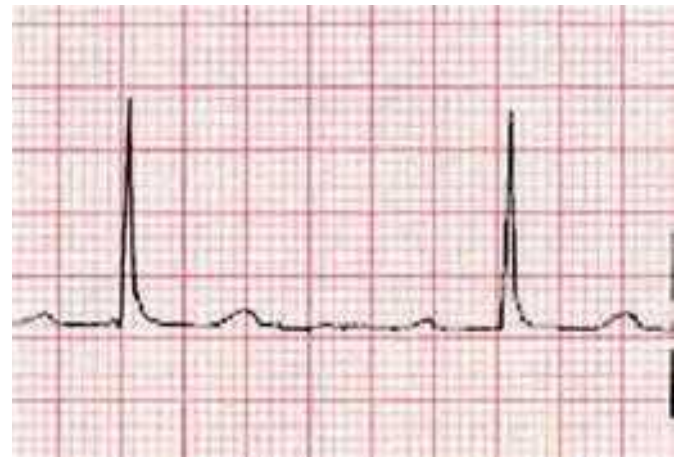
Rheumatic valvular diseases e.g. mitral (stenosis, regurgitation), aortic (stenosis, regurgitation) and involvement of other valves.

DIAGNOSIS

It is basically Criteriae-based with supports from the following relevant investigations.

Investigations

- Complete blood counts and PBF: Hb% (normal), TC, DC (leukocytosis), PBF: Normal
- Acute phase reactants (ESR, CRP): Raised
- Chest X-Ray: Normal or may have cardiomegaly in case of carditis
- ECG: Features of 1st degree heart block (prolonged P-R interval)



- Echocardiography: To detect evidence of carditis, including changes in valve rings
- Throat swab for C/S: May reveal group A ß haemolytic streptococci

TREATMENT

- Counsel parents about the disease, its complications & importance of strict adherence to Penicillin prophylaxis
- Supportive: Bed rest
  - Immobilization of affected joints
  - Close monitoring to note any features of carditis
- Antibiotics
  - A single IM injection of Benzathine Penicillin (6,00,000 unit for <30 kg and 12,00,000 unit for >30 kg) is the drug of choice or
  - Phenoxymethyl Penicillin (50 mg/kg/day PO 6 hourly) for 10 days or
  - Erythromycin (40 mg/kg/day PO 6 hourly) for 10 days

- Anti-inflammatory drugs: Aspirin and steroids and the recommendations are–

Category	Anti inflammatory Agents	Dose & duration
Patients with • Polyarthritis • Isolated carditis without cardiomegaly or CCF	Aspirin	▫ 50-75 mg/kg/day in 4 divided doses for 3-5 days followed by 50 mg/kg/day in 4 divided doses for 3 weeks & 25 mg/kg/day for another 2-4 weeks.
Patients with carditis and cardiomegaly or CCF	Prednisolone	▫ 2 mg/kg/day in 4 divided doses for 2-3 weeks followed by 1 mg/kg/day for 2-3 weeks and then tapering of the dose by 5 mg/24 hours every 2-3 days. ▫ When prednisone is tapered, aspirin should be started at 50 mg/kg/day in 4 divided doses for 6 wk to prevent rebound of inflammation.

N.B. Digoxin may be used in heart failure of acute rheumatic carditis if needed. But with caution as it may precipitate arrhythmia.

- **Treatment of Sydenham's chorea**
  - Phenobarbital (16-32 mg every 6-8 hour PO) is the drug of choice

If phenobarbital is ineffective, any of the following drugs should be initiated

- Haloperidol (0.01-0.03 mg/kg/24 hour PO in 2 divided doses)
- Chlorpromazine (0.5 mg/kg every 4-6 hourly PO)
- Anti-inflammatory agents are usually not indicated
- Duration of treatment: depends on the response. Dose is increased until desired response is achieved and then tapered gradually

Prevention

Both initial and subsequent attacks of ARF can be prevented through Penicillin prophylaxis.

- Prevention of initial attack (Primary prevention): Phenoxymethyl Penicillin or erythromycin orally for 10 days in any case of streptococcal sore throat
- Prevention of subsequent attacks (Secondary prevention): Penicillin or other drugs according to the following schedule–

Drug	Dose	Route
▫ Benzathine Penicillin	1.2 million units for patients> 30 kg, 600,000-900,000 units for patients < 30 kg every 3-4 weekly	IM
▫ Penicillin V	250 mg bd (weight > 30 kg) 125 mg bd (weight < 30 kg)	Oral
▫ Erythromycin	250 mg bd (weight > 30 kg) 125 mg bd (weight < 30 kg)	Oral
▫ Sulfadiazine/ Sulfisoxazole	0.5 gram once daily	Oral

Duration of penicillin prophylaxis

Category	Duration after last attack
▫ Rheumatic fever without carditis	5 years or until 21 years of age whichever is longer
▫ Rheumatic fever with carditis but no residual heart disease i.e. no valvular disease	10 years or until 21 years of age whichever is longer
▫ Rheumatic fever with carditis and residual heart disease i.e. persistent valvular disease	10 years or until 40 years of age, whichever is longer. Sometimes lifelong

JUVENILE IDIOPATHIC ARTHRITIS

(Synonyms: JRA, JCA) It is the most common chronic rheumatic illness of children.

AETIOLOGY

Unknown, but it is thought to be a multifactorial genetically predisposed auto-immune disorder, influenced by environmental factors and infection.

PATHOGENESIS

The net pathological effect in JIA is chronic synovial inflammation. Initially, the synovial membrane is infiltrated with many inflammatory cells e.g. lymphocytes, plasma cells and macrophages and

the membrane become swollen and congested (synovitis). Subsequently, the inflammatory process expands and give rise to villous hypertrophy & hyperplasia of synovium and secretion of synovial fluid in joints (effusion). Inflammatory granulation tissue (pannus) develops and that spreads under the articular cartilage, causes progressive erosion of the articular cartilage and the adjacent bones. Finally, there is fibrosis and ankylosis of the affected joints, limitation of movement and atrophy of periarticular muscles.

Diagnostic Criteriae

All three of the following must be met–

- Arthritis persisting for ≥ 6 weeks
- Onset of arthritis before 16 years of age
- Exclusion of other causes of arthritis

Arthritis is defined as–

- Swelling or effusion, or
- ≥ 2 of the following signs–
  - Limitation of range of motion
  - Tenderness or Pain on motion
  - Increased temperature

Swollen knee joints with periarticular wasting

Classification

Based on the number of joints affected during the first 6 months of the disease and the presence of extra-articular manifestations, 7 categories of JIA are seen among children.

1. Oligoarthritis (40-50%)

   Arthritis affects 1-4 joints during the 1st 6 months of disease. Two subcategories are recognized–

   - Persistent oligoarthritis: affecting ≤4 joints throughout the disease course
   - Extended oligoarthritis: affecting >4 joints after the 1st 6 months of disease

2. Polyarthritis, Rheumatoid factor negative (20-35%)

   Affects ≥5 joints during the 1st 6 months of disease. May be symmetric or asymmetric; Affects small and large joints; cervical spine; temporomandibular joint.

3. Polyarthritis, Rheumatoid factor positive (<10%)

   Affects ≥5 joints during the 1st 6 months of disease. Aggressive symmetric polyarthritis.

4. Systemic arthritis (5-15%)

   Along with joint manifestations, it has prominent extra-articular systemic manifestations e.g. non remittent fever, rash, lymphadenopathy, serositis and hepatosplenomegaly.

5. Enthesitis related arthritis (5-10%)

   Inflammation at ≥1 of the entheses (site of insertion of tendons, ligaments or fascia into bones). The common sites of inflammation are at insertion of planter fascia and at the insertions of tendo Achilles into calcaneum.

6. Psoriatic arthritis (5-10%)

   Arthritis & psoriasis, or arthritis and at least 2 of the following–

   - Dactylitis
   - Nail pitting and onycholysis
   - H/O Psoriasis in a 1st degree relative

Source: Internet

Pitting of nails

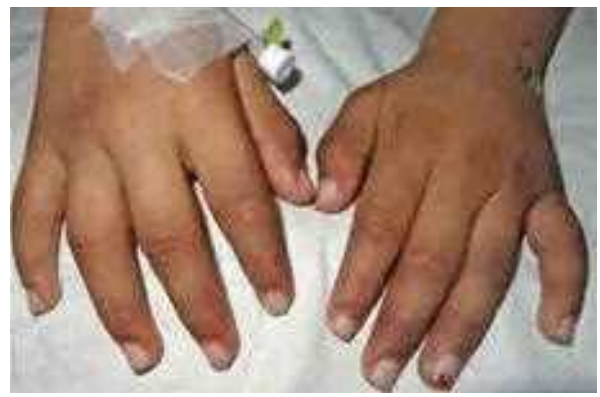
7. Undifferentiated

   Covers overall definitions of JIA but do not fulfill any specific category.

Clinical Manifestations

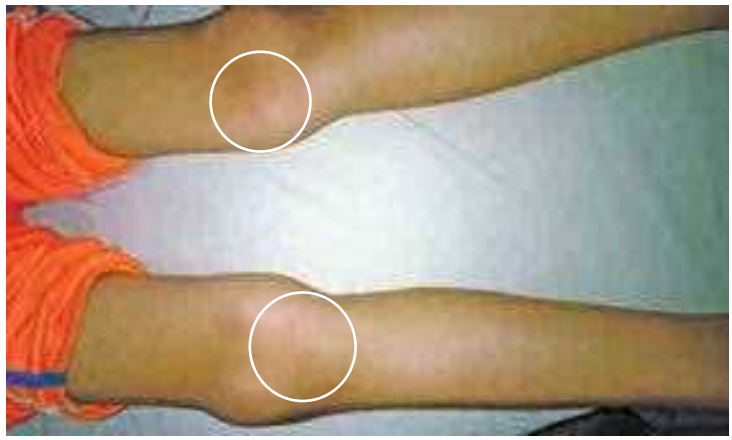
Although variable, the usual presentations are–

- Persistent pain & swelling of joints, both small and large
- Limping or refusal to walk or trying not to use the affected joints (guarding of joints)
- Involvent of PIP joints of hands gives rise to characteristic spindile shaped appearance



Proximal interphalangeal (PIP) joints with deformity (spindle shaped)

- Sometimes dysfunction noted in upper limbs, neck (torticollis)
- Joint stiffness following sleeping, rest or decreased activity (as morning stiffness)
- Presence of rheumatoid nodules on the extensor surface of elbow & over Achilles tendons
- Non-specific symptoms such as lethargy, high fever, poor appetite or irritability, sleep disturbances
- Presence of evanescent rash
- Occasionally, features of extra-articular manifestations e.g. pericarditis, serositis, organomegaly, uveitis may be present



Evanescent rash on the inner aspects of knee joints
Courtesy: Dr. Anindita Bose

CHARACTERISTICS OF ARTHRITIS IN ACUTE RHEUMATIC FEVER AND RHEUMATOID ARTHRITIS

Parameters	Acute Rheumatic fever	Rheumatoid arthritis
Types of joints involved	Large joints. Involvement of spines, small joints of hands and feet and hip joints are uncommon	Both large & small joints
Symmetry of involvement	Asymmetrical	Usually symmetrical
Onset of arthritis	Acute onset and lasts for shorter period	Insidious onset and arthritis remains for a longer duration
Characteristics of arthritis	Migratory polyarthritis with exquisite pain & tenderness. Monoarthritis unusual	Arthritis & joint symptoms are more marked early in the morning (morning stiffness) or after a period of rest
Response to aspirin	Dramatic	Not such
Chance of deformity	Typically non deforming disease	High
Preceding history	Sore throat 2-4 weeks prior to the onset of joint pain	Absent
Involvement of other organs	Heart (carditis/ valvular lesions), Basal ganglia (chorea)	Uveitis, lymphadenopathy, hepatosplenomegaly

DIAGNOSIS

Based on clinical features & supports from relevant investigations.

Investigations

- **Blood**

Investigations	Results
Complete blood counts	Hb (low), TC & DC (neutrophilic leukocytosis), platelets (thrombocytosis)
PBF	Non-specific
Acute phase reactants (ESR, CRP, ferritin)	Raised
Anti-Nuclear Antibody (ANA)	Positive in 40-50% of patients
Rheumatoid Factor (RF)	Only 5-10% patients are positive
Anti-cyclic citrullinated peptide (Anti-CCP) antibody	Highly specific serological marker for early diagnosis of Rheumatoid arthritis
Urinalysis	May reveal proteinuria (50-60%) and/or microscopic haematuria (30-50%)

- **Radiology & Imaging**

Investigations	Results
❑ X-Ray of affected joints	May show soft tissue swelling, periarticular osteoporosis, periostitis, subchondral bony erosion, loss of cartilage, narrowing of joint space, osteopenia
❑ Ultrasonography of affected joints	May identify joint effusion
❑ MRI of the affected joints	More sensitive than X-Ray to detect early changes

- Synovial fluid analysis & synovial biopsy
- Arthroscopy, arthrography
- Others
  - ❑ Slit lamp examination of the eyes to assess uveitis
  - ❑ Urine R/M/E to exclude SLE e.g. haematuria, proteinuria

Complications

- Joint contractures
- Anaemia
- Pericarditis
- Myocarditis
- Glomerulonephritis
- Chronic anterior uveitis
- Growth disturbance
- Amyloidosis

TREATMENT

Treatment of JIA is multidisciplinary involving paediatrician, rheumatologist, physiotherapist and ophthalmologist. Treatment options as well as duration of treatment vary among different subtypes & from patient to patient.

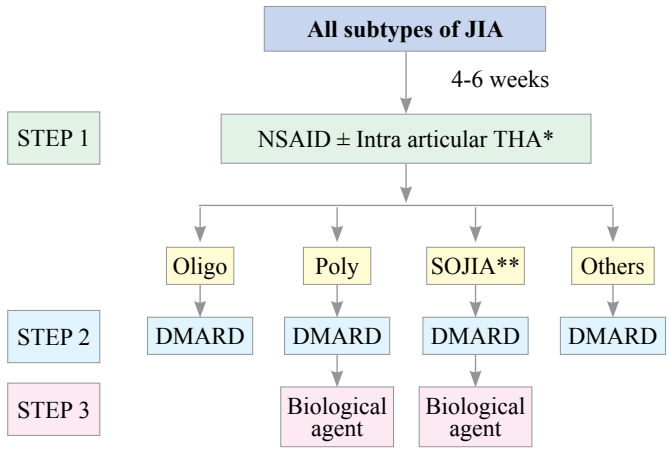
Treatment should be started with NSAID and unless adversity noted, the drug should be continued for at least 4 to 6 weeks to allow sufficient time to assess clinical response.

Sometimes, along with NSAID, other options are added depending on the response to drugs, types of arthritis, associated co-morbidities and also stages of the disease.

A. Drugs

- NSAIDs: Commonly used are–
  - ❑ Naproxen (15 mg/kg/day PO bid, max. 1 gm/day)
  - or
  - ❑ Ibuprofen (40 mg/kg/day PO tid, max. 2.4 gm/day)
  - or
  - ❑ Meloxicam (0.125 mg/kg/day PO once daily, max. 15 mg/day)
- Disease modifying anti-rheumatic drugs (DMARDs)– These drugs hinder the progression of disease and selected for any form of arthritis, responded not by NSAID. The drugs include–
  - ❑ Methotrexate, Oral or S/C (dose:10 mg/m^2/week)
  - ❑ Sulfasalazine ❑ Leflunamide
- Corticosteroid: Used as an adjunct when severe handicapping from pain or as bridging therapy–
  - ❑ Systemic steroid e.g. Prednisolone, Methyl prednisolone
  - ❑ Intra-articular steroid e.g. Triamcinolone hexacetonide
- Biological agents
  - ❑ Tocilizumab ❑ Etanercept ❑ Infliximab
  - ❑ Adalimumab ❑ Abatacept ❑ Rituximab
  - ❑ Anakinra

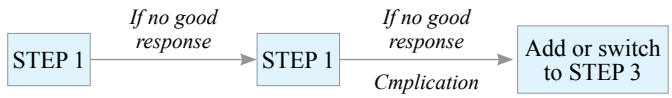
TREATMENT ALGORITHM FOR JIA AT A GLANCE



** THA - Triamcinolone hexacetodide, ** SOJIA - Systemic onset JIA*

All subtypes of JIA

Rule



B. Physiotherapy

It preserves range of motion of the joints and muscular strength, and protects joint integrity.

Follow up

- To see improvement in activities of daily life and early detection of complications e.g. joint contractures, muscle wasting etc.
- Periodic slit-lamp ophthalmologic examinations to monitor for asymptomatic uveitis

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]S

1. How will you diagnose a case of Rheumatic fever in children?
2. A 6 year old boy weighing 16 kg presented with fever and painful swelling of knee joint for 7 days. From yesterday, he developed breathlessness. He had history of similar joint pain 6 months ago. Examination of the precordium revealed a systolic murmur. i) What is the most likely diagnosis? ii) How will you investigate & treat this boy? iii) How will you plan to prevent further attacks?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. The major criteriae for diagnosis of acute rheumatic fever include–
   ___ a) arthralgia ___ b) fever ___ c) Sydenham's chorea
   ___ d) carditis ___ e) subcutaneous nodules
2. Recommended drugs for prevention of rheumatic fever recurrences are–
   ___ a) benzathine penicillin ___ b) phenoxymethyl penicillin ___ c) erythromycin
   ___ d) benzyl penicillin ___ e) sulfadiazine
3. The characteristic features of JIA are–
   ___ a) migratory polyarthritis ___ b) morning stiffness ___ c) high chance of joint deformity
   ___ d) symmetrical arthritis ___ e) dramatic response to aspirin
4. Disease modifying anti-rheumatic agents are–
   ___ a) naproxen ___ b) sulfasalazine ___ c) methotrexate
   ___ d) etanercept ___ e) indomethacin
5. Features of acute rheumatic carditis include–
   ___ a) tachycardia ___ b) arrhythmia ___ c) pleural effusion
   ___ d) mitral stenosis ___ e) changing murmur
6. Major objectives of Penicillin prophylaxis in rheumatic fever are, prevention of–
   ___ a) mitral valvular disease ___ b) joint deformity ___ c) infective endocarditis
   ___ d) mental retardation ___ e) nephropathy
7. The following drugs are DMARD–
   ___ a) Etanercept ___ b) Leflunamide ___ c) Methotrexate
   ___ d) Meloxicam ___ e) Rituximab

Chapter 18

Fever and Rash

When a child presents with fever and rash, the following conditions should be considered as the possible differential diagnoses–

- Measles
- Dengue syndrome
- Rubella
- Exanthem subitum (HSV 6 &7)
- Scarlet fever
- Kawasaki disease
- Fifth disease
- Chikungunya
- Chicken pox
- Meningococcal infection
- Typhus
- Idiopathic thrombocytopenic purpura (ITP)
- Henoch Schönlein purpura (HSP)

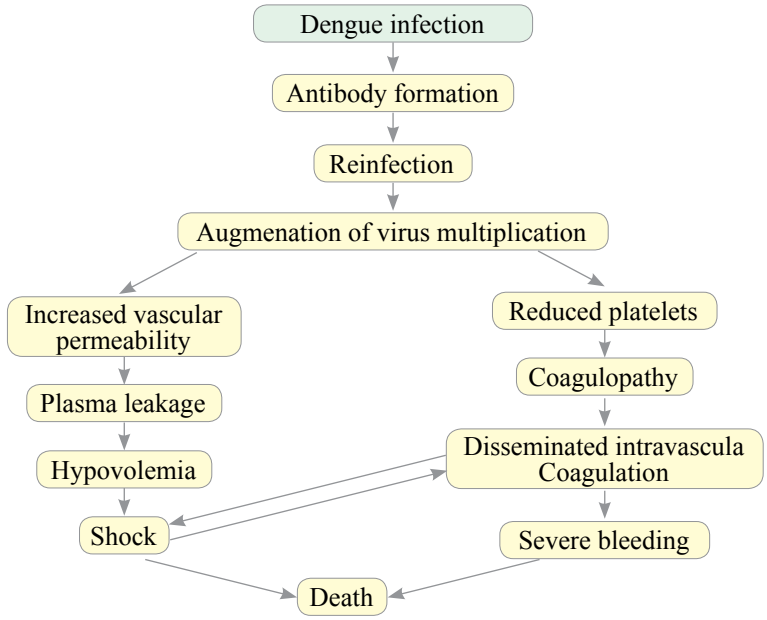
Of the different causes, dengue syndrome e.g. dengue fever, dengue haemorrhagic fever and dengue shock syndrome and Chikungunya are highlighted in this section.

DENGUE SYNDROME

Dengue is the most common and important arthropod-borne viral (arboviral) illness in humans. It is transmitted by mosquitoes of the genus Aedes, which are widely distributed in subtropical and tropical areas of the world. The incidence of dengue has increased dramatically in recent years and estimated that 40%-50% of the world's population at risk for the disease .

Organism: Dengue virus 4 serotypes– Den-1, Den-2, Den-3, Den-4

Pathogenesis



Spectrum of Dengue Syndrome

Dengue fever (DF)			Dengue hemorrhagic fever (DHF)			Dengue Shock syndrome
Suspected DF	Probable DF	Confirmed DF	Suspected DHF	Probable DHF	Confirmed DHF	
Fever + Nonspecific features + High index of suspicision	Suspected DF + High dengue IgM titre ≥1280	Probable DF + Isolation of dengue virus/ Antigen from the body	DF + Evidence of hemorrhagic manifestation + Evidence of plasma leakage	Suspected DHF + High dengue IgM titre ≥1280	Probable DHF + Isolation of dengue virus/ Antigen from the body	

A. Dengue fever (DF)

Case definition

Suspected dengue: Continued fever for 2-7 days, AND Two or more of the following features–

- Severe headache, rash
- Retro-orbital pain
- Severe myalgia/arthralgia/back pain
- Nausea, vomiting/abdominal pain
- Haemorrhagic manifestation
- Leukopenia
- Thrombocytopenia
- Raising Hct (5-10%)

AND

- High index of suspicion based on period, population and place

AND

- Absence of convincing evidence of any other febrile illness.

- **Probable dengue:** Suspected dengue with suppotive serology: Positive IgM, titre ≥ 1280
- **Confirmed dengue:** Probable dengue with one of the following–

Case definition

- Isolation of dengue virus
- Detection of dengue virus or Ag in tissue, serum or CSF by ELISA, Imunofluroscence, PCR

B. Dengue Haemorrhagic Fever (DHF)

- **Suspected DHF**
  - Features of dengue fever (DF) at the initial stage

AND

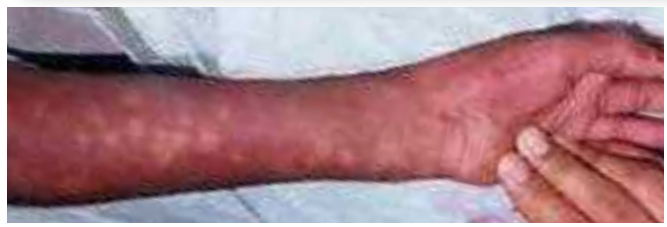
  - Evidence of ≥1 of the following **haemorrhagic** manifestations–

- Positive tourniquet test
- Petechiae, ecchymosis or purpura
- Bleeding from mucosa (mostly epistaxis & gum bleeding)
- Bleeding from injection sites
- Haematemesis, melaena, haematuria, per vaginal bleeding
- Thrombocytopenia (platelet count ≤100,000/cmm)

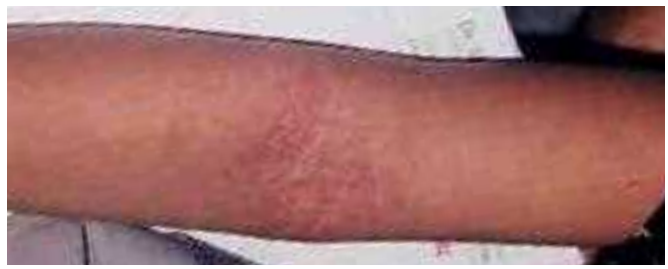
AND

- Evidence of plasma leakage due to increased capillary permeability, manifested by one or more of the following–

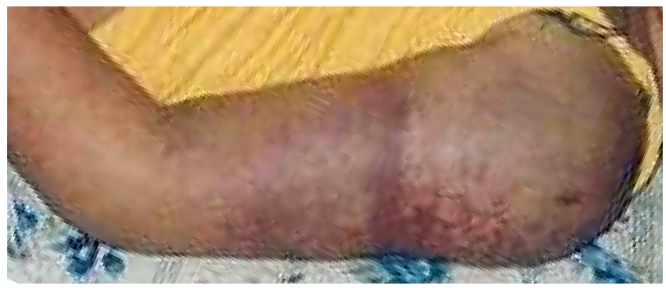
- ≥ 20% rise in haematocrit for age and sex
- ≥ 20% drop in haematocrit following treatment with fluids as compared to baseline
- Pleural effusion/ascites/hypoproteinemia



Typical rash in dengue fever



Positive tourniquet test



Bleeding at injection site

Ascites, evidence of plasma leakage

Subconjunctival haemorrhage

- **Probable DHF**

  Suspected dengue Haemorrhagic Fever (DHF) with serological evidence (dengue IgM titre ≥1280)

- **Confirmed DHF**

  Probable DHF with either virus isolation or detection of dengue antigen in tissue, serum or CSF

Dengue Shock Syndrome (DSS)

Case definition

When a case of DHF manifests with one or more of the features of **circulatory failure** given alongside.

- Restlessness
- Hypotension for age
- Narrow pulse pressure (< 20 mmHg)
- Rapid, weak pulse
- Cold clammy skin
- Profound shock

The major pathophysiologic abnormalities of DHF and DSS are–

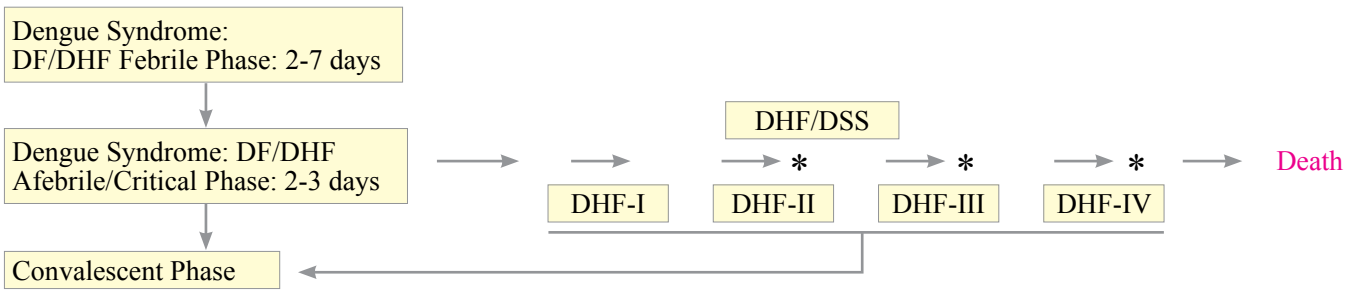
- Increased vascular permeability
- Abnormal haemostasis
- Thrombocytopenia

The cut-off point between dengue fever and dengue shock syndrome is the evidence of plasma leakage, which will invariably be present in the later but absent in the former.

Severity grading of Dengue Shock Syndrome

Dengue Syndrome	Grade	Clinical Features	Laboratory Features
DF		Features as per case definition	Leukopenia ± Thrombocytopenia (< 1,50,000/cmm) 5-10% change in haematocrit
DHF	I	Features of DF or H/O features of DF + Positive tourniquet test	Thrombocytopenia (<1,00,000/cmm) Haematocrit rise ≥ 20%
DHF	II	Features of DF or H/O features of DF + Spontaneous bleeding e.g. sub-conjunctival haemorrhage, bleeding from nose or gum, petechiae or purpura, tarry stool	Thrombocytopenia (<1,00,000/cmm) Haematocrit rise ≥ 20%
DHF (DSS)	III	Features of DF or H/O features of DF + Features of circulatory failure e.g. restlessness, weak thready pulse, hypotension, narrow pulse pressure, cold clammy skin, fluid leakage	Thrombocytopenia (<1,00,000/cmm) Haematocrit rise ≥ 20%
DHF (DSS)	IV	Features of DF or H/O features of DF + Profound shock with undetectable blood pressure and pulse	Thrombocytopenia (<1,00,000/cmm) Haematocrit rise ≥ 20%

Clinical Course at A Glance



* If appropriate treatment is not provided then there is high risk of death.

DIAGNOSIS

Based on clinical features and the support from relevant investigations

Investigations

No appreciable change is seen in the laboratory tests except NS1 within first 3 days of febrile phase. So no tests should be done before 3 days, if not otherwise indicated e.g. unusual haemorrhage

- CBC: Total leukocyte count (reduced), platelet count (reduced) and haematocrit (raised)
- Blood for NS1 (Non Structural protein of dengue): may be positive as early as day 1 of illness. It becomes negative on 4-5th day of illness
- Dengue antibodies (IgG & IgM): Positive after 6-7 days
- Chest X-Ray right lateral decubitus view or
- Ultrasonography of chest & abdomen: To detect pleural effusion or ascitis

- Serum albumin: May be reduced
- Prothrombin time: May be elevated
- Serum electrolytes: May be altered
- Others: MP to exclude malaria in malaria endemic zone

Serial leukocyte counts, haematocrit level and platelet count are very important for prognostic purpose. Leukocyte count has a very important prognostic guide in early phase of dengue infection. Leukopenia <5000 cells/cmm indicates that within the next 24 hours, the patient will have subsidence/defervescence of fever and he will be entering the critical phase.

TREATMENT

A. Dengue Fever

Supportive management at home–

- Rest
- Antipyretics: Only Paracetamol
- Fluid: More, including ORS
- Foods: Usual family diet

- Investigations:
  - CBC:Hb, WBC, platelet counts and haematocrit
- Referral knowledge to parents: If any of the following signs noted, then the child should be taken to hospital–

- Abdominal pain
- Passage of black tarry stool
- Bleeding in the skin/nose/gums
- Excessive sweating

B. DHF and DSS

Patients should be managed in the hospital.

Objectives of management are–

Assessment (Clinical & Laboratory)

Check & keep records of–

- Maintenance of–
  - Circulatory volume & haemodynamic status
  - Blood osmolality
  - Fluid & electrolytes balance

- Prevention & treatment of complications
  Haemodynamic status e.g. pulse, BP, pulse pressure, capillary refilling time every 4-6 hours
  - Evidence of bleeding
  - Evidence of pleural effusion or ascites
  - Intake-output chart
  - Platelet count and haematocrit, twice daily

TREATMENT

Meticulous fluid replacement. Recommended fluids are–

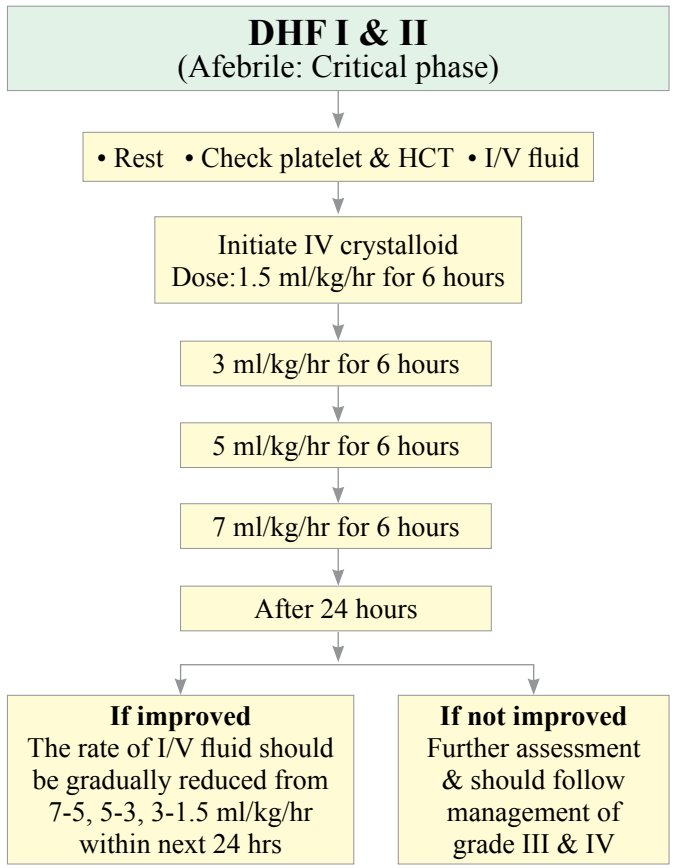
Crystalloids

- 5% dextrose in isotonic normal saline
- 5% dextrose in half strength normal saline
- 5% dextrose in Ringer's lactate solution

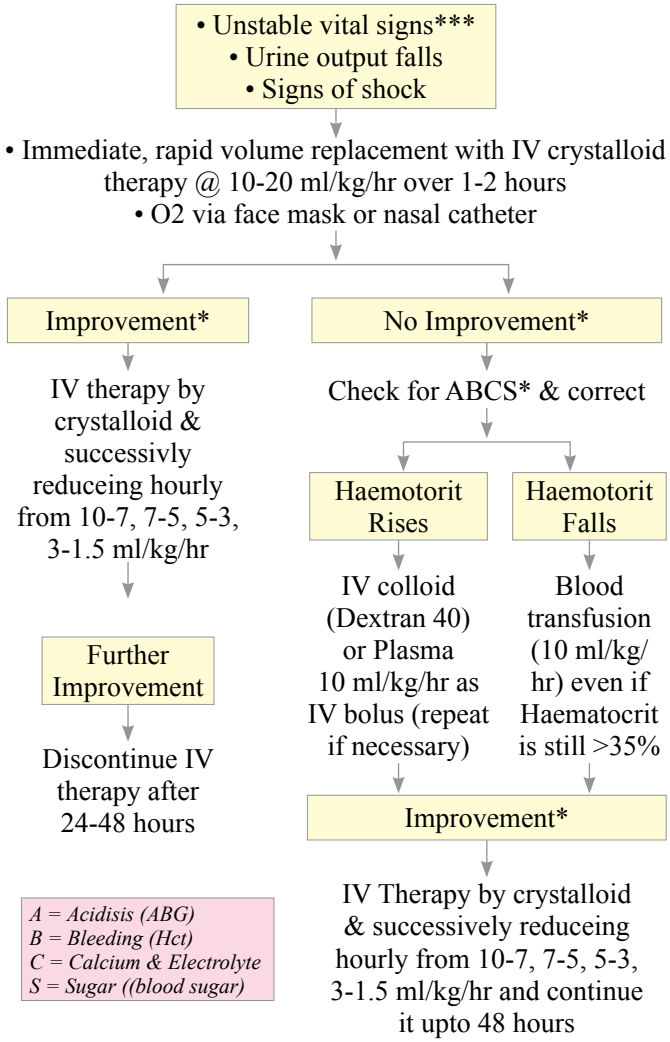
Colloids

- Dextran 40
- Plasma expander e.g. Haemaccel
- Plasma

FLUID (VOLUME) REPLACEMENT ALGORITHM



DHF III & IV



* Improvement
◆ Haematocrit falls
◆ Pulse rate and blood pressure stable
◆ Urine output rises
**** No improvement**
◆ Haematocrit/pulse rate rises
◆ Pulse pressure falls below 20 mm Hg
◆ Urine output falls
***** Unstable vital signs**
◆ Signs of shock
◆ Urine output falls

Signs of circulatory failure

- Restlessness
- Hypotension
- Rapid, weak, thready pulse
- Narrow pulse pressure (≤ 20 mmHg)
- Cold clammy skin
- Capillary refill time >2 seconds

Shock

- Undetectable pulse and blood pressure

DON'Ts in Dengue

- Give aspirin or NSAID
- Give antibiotic
- Give steroid
- Change the rate of infusion
- Give transfusion unless indicated
- Insert NG tube to determine concealed bleeding

When to stop fluid

- Signs of cessation of plasma leakage
- Stable BP, pulse & peripheral perfusion
- Fall of Haematocrit towards normal in the presence of good pulse volume
- No fever for 24-48 hours without antipyretics
- Restoration of bowel and abdominal function
- Improving urine output

Criterie for Discharging Patients

- Absence of fever for at least 24 hours
- Minimum 3 days after recovery from shock
- Presence of signs of recovery e.g.
  - Stable Vital signs
  - Normal temperature without Paracetamol
  - No evidence of bleeding
  - Return of appetite
  - Good urine output
  - Stable haematocrit
  - Platelet count ≥ 50,000/cmm

CHIKUNGUNYA FEVER (CF)

Chikungunya fever is a mosquito-transmitted viral illness, emerging as a global threat because of its highly debilitating nature and unprecedented magnitude of its spread.

Organism: Chikungunya virus (CHIKV), an RNA virus, first isolated in Tanzania in 1953

Transmission: By Aedes mosquito.

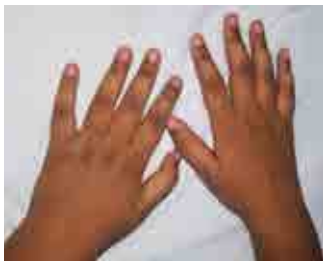
Incubation period: 2-12 days (usually 3-7 days)

PATHOGENESIS

Following entry, CHIKV replicates in the skin and then disseminates through blood to the different parts of body.

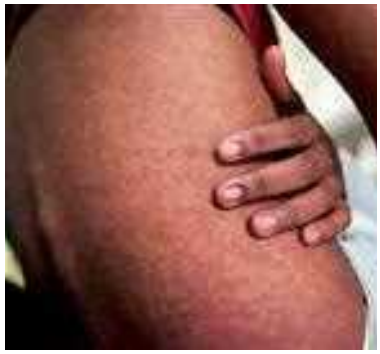
The virus primarily targets the fibroblasts of muscles, joints, where an immune mediated inflammatory reaction occurs.

In addition, the epithelium & endothelium of many organs, including liver, spleen and brain are also affected. This (incubation period) is followed by a sudden onset of clinical disease without prodromal manifestations. The acute phase of CHIKV infection typically resolves by 7-10 days.



Chikungunya arthrities

Skin rash



Skin rash

CLINICAL MANIFESTATION

Common	Infrequent	Rare in adult but common among children
❑ Fever ❑ Arthritis/ arthralgia ❑ Backache ❑ Headache ❑ Rash	◆ Stomatitis ◆ Oral ulcers ◆ Exfoliative dermatitis ◆ Photosensitivity ◆ Hyperpigmentation	❑ Photophobia ❑ Retro-orbital pain ❑ Vomiting ❑ Diarrhea ❑ Mental confusion ❑ Signs of meningeal irritation

Complications

- ◆ Bleeding
- ◆ Hypotension & shock

DIAGNOSIS

Based on C/F and laboratory supports

Investigations

- ◆ CBC (leukopenia), thrombocytopenia (rare), ESR/CRP (raised)
- ◆ SGPT (elevated)
- ◆ Specific investigations (at least one of the following in the acute phase)
  - ❑ Virus isolation by cell culture
  - ❑ Detection of viral RNA by real time (RT–PCR) within 5 days of onset of illness
  - ❑ Detection of virus specific IgM antibody in a single serum sample collected within 5-28 days of onset of fever
  - ❑ A 4-fold rise of IgG antibody in samples collected at least 3 weeks apart (1st sample after 7 days of fever)

Case definition

CF should be suspected when a person develops sudden onset of fever, joint manifestations and rash. The cases are categorized as–

- ◆ **Possible case:** Meeting only clinical criteria
- ◆ **Probable case:** Meeting both clinical and epidemiological criteriae
- ◆ **Confirmed case:** Meeting the laboratory criteria, irrespective of clinical presentation

How to identify CHIK infection ?

Clinical criteriae

- ◆ Acute onset of fever> 38°5 F
- ◆ Severe arthralgia/arthritis, not explained by other medical condition

Epidemiological criteria

- ◆ Residing or having visited epidemic areas
- ◆ Having reported transmission within 15 days prior to the onset of symptoms

DIFFERENTIAL DIAGNOSES

- ◆ Dengue fever (DF)
- ◆ Reactive arthritis
- ◆ Serum sickness
- ◆ Rickettsial disease

However, it most closely resembles DF. Therefore, any patient with suspected CHK fever should be managed as DF until excluded.

Clinico-pathological differences between Chikungunya Fever & Dengue Fever

Characteristics	Chikungunya	DF
❑ Fever (>39F)	+++	++
❑ Arthralgia/ arthritis	+++	+/–
❑ Rash	++ (within 48 hrs of fever)	+ (after 6 days of fever)
❑ Myalgia	+	++
❑ Haemorrhage	+/–	++
❑ Shock	–	+
❑ Lymphopenia	+++	++
❑ Thrombocytopenia	+	+++
❑ Haemoconcentration	–	+++

Management

- Mild & moderate cases: Home management
- Severe cases: Management in hospital

Home management

- Consume plenty of liquids e.g. plain water, ORS and fruit juice and homemade normal diet
- Take paracetamol, if joint pain. Avoid NSAID
- Rest at home and refrain from exertion
- Tepid sponging with warm water & Warm water bath
- Monitor, Urine output, pulse/BP or any bleeding spot

Criteriae for Hospitalization

- Unstable hemodynamic status (Low BP, raised CRT)
- Oliguria
- Patients age < 12 months
- Bleeding manifestations
- Altered sensorium
- Persistent joint pain/disabling arthritis, even after 3 days of treatment

Hospital management

- Rehydration with appropriate crystalloids after assessing dehydration
- Cold compressions over the joints to relieve from pain
- Antibiotics, if secondary infection is suspected
- Monitor–
  - Vital signs e.g. pulse, BP, respiration, temperature
  - Any evidence of bleeding
  - Features of carditis, meningoencephalitis
- Steroid has no role in acute stage

D/D of Fever and Rash (except DF, Chickenpox, CHIKungunya

Diseases & Aetiology	Characteristics of rash
Measles Rubeola virus	Macular-papular rash appears on the 4th day of fever. First on the forehead along hairline, behind ears & upper neck, gradually spread downwards to trunk, extremities, palm and sole, become confluent, gradually disappear over next 7 days leaving a fine desquamation
German measles Rubella virus	Small, irregular pink macules begin on face and neck on the 1st day of fever that coalesce and spread centrifugally towards trunk and extremities. It persists for 3 days and resolve without desquamation
Erythema infectiosum (5th disease) Human parvovirus B19	Three stages of rash; 1st stage: erythematous facial flushing (slapped cheek appearance). 2nd stage: diffuse macular erythema rapidly spreads to trunk and upper extremity sparing palm and sole. 3rd stage: central clearing of macular lesion (a lacy reticulated appearance). Rash wax and wane over 1-3 weeks, fades without desquamation
Roseola infantum (exanthema subitum or sixth disease) Human herpes virus 6	Faint pink or rose-colored, nonpruritic, 2-3mm morbilliform rash appears on trunk on the 4th day of fever, as fever resolves. Rash then spreads to face and extremities and disappears within 1-3 days without desquamation.
Meningococcemia (acute)	Variety of rashes but characteristically, non blanching petechial lesions distributed on the trunk, extremities and on mucous membranes that coalesces to become large and characterized by central necrosis.
Scarlet fever Beta-hemolytic Streptococcus	Diffuse, finely papular, erythematous rash, producing bright red discoloration appears on skin, after 2-3 days of fever and then spreads over trunk and extremities. Rash is accentuated over creases of elbows, axilla and groin. Skin appears goose pimple and feels rough. Rash fades after 3-4 days leaving desquamation.
Herpes zoster (shingles) Varicella- zoster virus	Vesicular lesions clustered within 1 or 2 adjacent dermatomes.
Erythema nodosum	Bright or dull red, painful, symmetric, oval, 1-6 cm sized, nodular, lesions most commonly on anterior surface of arms and pretibial area of legs. Old lesions appear brown or purple and do not ulcerate.
Erythema nodosum	Bright-red nodules scattered bilaterally but not symmetric; most frequently on lower legs lesions often tender and indurated.

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2. Center for disease control, dengue home page, Laboratory Guidance and Diagnostic Testing, website accessed on 28.12.14, http://www.cdc.gov/dengue/clinicalLab/laboratory.html.
3. Schwartz O, Albert ML. Biology and pathogenesis of Chikungunya virus, Nature Reviews Microbiology; Volume 8, July 2010 491– 500.
4. Directorate General of Health Services. Ministry of Health and Family Welfare. Dhaka, Bangladesh. Government of the People's Republic of Bangladesh. National Guideline on Clinical Management of Chikungunya fever, May 2017.

SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. Write down the case definition of dengue haemorrhagic fever.
2. i) What is the cut off point of dengue fever and dengue haemorrhagic fever ?
   ii) When patient should be taken to hospital in dengue haemorrhagic fever?
3. When plasma or blood should be given to a patient with dengue haemorrhagic fever?
4. What are the causes of fever with rash in children?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. The case definition of dengue shock syndrome (DSS) are–
   ___ a) hypertension ___ b) narrow pulse pressure ___ c) rapid weak pulse
   ___ d) ascites ___ e) subconjunctival haemorrhage
2. The recommended fluid for managing DSS are–
   ___ a) dextrose in normal saline ___ b) dextrose in acqua ___ c) colloid
   ___ d) plasma ___ e) normal saline
3. The evidence of plasma leakage in dengue fever are–
   ___ a) pleural effusion ___ b) ascites ___ c) capillary refill time < 2 seconds
   ___ d) narrow pulse pressure ___ e) decreased haematocrit
4. In dengue fever–
   a) retro-orbital pain is common b) relative bradycardia is found ___ c) Saddle back fever is unusual
   d) rash spread centrifugally e) Leukopenia is uncommon
5. The following are the signs of circulatory failure–
   ___ a) restlessness ___ b) convulsion ___ c) capillary refill time > 2 sec
   ___ d) narrow pulse pressure ___ e) petechiae
6. The dont's in dengue are–
   ___ a) use of steroid ___ b) use of NSAID ___ c) whole blood transfusion
   ___ d) antibiotics ___ e) use of DA

Chapter 19

Prolonged High Fever

Many a times, children are brought with history of fever for longer time e.g. for 2-3 weeks or even more with severe prostration despite getting the first line management. In such situation the following clinical conditions should be considered

- Enteric fever
- Malaria
- Kala-azar
- Malignancy e.g. leukaemia, lymphoma
- Connective tissue diseases e.g. JIA, SLE
- Infective endocarditis
- Typhus
- Liver abscess or any hidden abscess anywhere in the body

In this chapter, we will highlight enteric fever, malaria and Kala-azar. Lymphoma, leukaemia, JIA, infective endocarditis are discussed in other chapters.

ENTERIC FEVER

It is a common illness in this part of world. In this condition children usually suffers from fever for more than 7 days with significant sickness and prostration.

Organisms: *Salmonella typhi, S. paratyphi A, B, C*

Transmission: *Faecal-oral route*

Incubation period: 7-14 days

Pathogenesis

The organisms enter the body through ingestion of contaminated foods or drinks. The organisms, after passing through the intestinal mucosa enter the mesenteric lymphoid system and then into the blood via lymphatics. This is called **Primary Bacteraemia** and at this stage the patient remains asymptomatic. The organisms then disseminate throughout the body, colonize and multiply in the reticuloendothelial system. After replication, organisms again enter the blood causing **Secondary Bacteraemia**, which coincides with the onset of symptoms and marks the end of incubation period.

Clinical Manifestations

- **Fever:** Prolonged high-grade fever is the main symptom in almost all the cases. It rises gradually but the classical step-ladder pattern is rare
- **Abdominal symptoms:** Vomiting (39%), diarrhoea (36%), abdominal pain (21%) or constipation (7%). Diarrhea may occur in the earlier stages of the illness and may be followed by constipation
- **Coated tongue** (76% cases)
- **Truncal rash (rose spots):** In approximately 25% of cases, a macular or maculopapular rash (rose spots) may be visible around the 7th-10th day of the illness and lesions may appear in crops of 10-15 on the lower chest and abdomen and last 2-3 days.
- **Non-specific symptoms**: Anorexia (70%), generalized myalgia

In the **second week** of illness, patients become acutely ill, lethargic and abdominal symptoms increase in severity. Vomiting and **meningism** may be prominent in infants and young children in this stage.

Physical examination reveals–

- High body temperature
- Pallor
- Coated tongue
- Hepatomegaly
- Splenomegaly
- Jaundice
- Paralytic ileus
- Rose spots

Sometimes, patients may present with irritability, confusion, delirium, stupor **(encephalopathy)**.

Complications

Gastro-intestinal system	Intestinal haemorrhage, perforation, peritonitis, paralytic ileus, cholecystitis, hepatitis, hepatic abscess, splenic abscess
Central nervous system	Encephalopathy, cerebral oedema, subdural empyema, cerebral abscess, meningitis, ventriculitis
Cardio-vascular system	Endocarditis, myocarditis, pericarditis, arteritis, congestive heart failure
Respiratory system	Pneumonia, empyema, bronchopleural fistula
Bone and joint	Osteomyelitis, septic arthritis
Genito-urinary system	Urinary tract infection, renal abscess, pelvic infections, testicular abscess, prostatitis, epididymitis
Soft tissue infections	Psoas abscess, gluteal abscess, cutaneous vasculitis

Multidrug-resistant (MDR) Typhoid Fever

- When typhoid fever resistant to the 1st-line drugs e.g. Chloramphenicol, Ampicillin and Trimethoprim-Sulfamethoxazole

DIAGNOSIS

Based on clinical features and relevant investigations.

Investigations

- Blood culture: It is positive in 40-60% of cases and yield is highest during the 1st week of illness

Stool and urine cultures become positive after the 1st week.

In addition, other supportive investigations are–

- Complete blood counts
  - Haemoglobin is normal but may drop
  - Blood leukocyte counts are frequently low in relation to the fever and toxicity (leucopenia with relative lymphocytosis). Eosinopenia, is present in about 80% cases
  - In younger children leukocytosis is common and may reach 20,000-25,000/mm3
  - Platelet counts usually normal though thrombocytopenia may be present
- Widal test: It measures antibodies against O and H antigens of *S. typhi* and S. *paratyphi* and becomes positive after 5-7 days of fever. Because of many false-positive and false-negative results, diagnosis of typhoid fever by Widal alone is prone to error. Titers of TO-1:160 or TH -1:320 is considered significant if clinical features are consistent
- Bone marrow culture: It is a highly sensitive method for bacteriological confirmation of typhoid fever even in late stage of illness or with prior antibiotics

TREATMENT

- Counsel parents about the natural history of the disease, treatment and complications
- Supportive measures:
  - Antipyretic e.g. Paracetamol
  - Adequate hydration e.g. more fluid intake
  - Correction of fluid and electrolyte imbalance, if present
  - Adequate nutrition by soft, easily digestible nutritious diet
- Specific treatment: Appropriate antibiotics

  Duration: 10-14 days
  - Ceftriaxone 100 mg/kg/day, once daily
  - Cefotaxime 150 mg/kg, 8 hourly
  - Amoxicillin 100 mg/kg/day orally 6 hourly
  - Azithromycin 10 mg/kg stat on D1, followed by 5mg/kg for 7 days

Treatment of Complications

When a typhoid child complicated by shock or encephalopathy, **dexamethasone** should be added along with specific antibiotics.

- Dexamethasone (3 mg/kg initial dose, followed by 1 mg/kg every 6 hour for 48 hours)
- Surgery, when perforation of gut

Prognosis

- With early antibiotic therapy, prognosis is excellent and mortality rate is <1%
- Relapse occurs in 1-3 weeks later in 10-20% cases

MALARIA

Malaria is a major parasitic problem throughout the world as well as in Bangladesh. The disease kills a million of children worldwide each year and they are mostly due to *Plasmodium falciparum.*

In Bangladesh, approximately 33.6% of the total population are at risk of malaria. Majority of malaria cases are reported from the following 13 districts.

Malaria Risk	Districts
High endemic	Rangamati, Khagrachari, Bandarban
Moderate endemic	Cox's Bazar
Low endemic	Hobigonj, Kurigram, Moulavibazar, Mymensingh, Netrokona, Sherpur, Sylhet and Sunamgonj, Chittagong

Organism: *Plasmodium (P. falciparum, P. vivax, P. ovale* and *P. malariae)*

Vector: Female anopheles mosquito

Host: Human being

Incubation period: Ranges from 10-35 days (*P. falciparum, P. vivax, P. ovale:* 10-14 days and *P. malariae*: 25-35 days).

Transmission: Through–

- Bite of female anopheles mosquito
- Blood transfusion
- Rarely affect foetus through placenta

PATHOGENESIS

Symptoms of malaria results when erythrocytes of the hosts are invaded by merozoite (the intermediary stage of any of 4 species of plasmodium).

Apart from invasion of RBC and consequent high fever, the parasitized RBC (*P. falciparum*) also causes microvascular blockade and anoxic damage of different organs particularly brain (cerebral malaria), kidney (acute tubular necrosis), lungs (pulmonary oedema), gut (algid malaria) etc. In addition, the parasite can also give rise to severe anaemia and hypoglycaemia.

CLINICAL MANIFESTATIONS

Vary according to species, strain and host immunity.

Infant: Recurrent bouts of fever, irritability, poor feeding, vomiting, jaundice and splenomegaly.

Older Children: Fever may be cyclic (every 48 hours for all but *P. malariae* infection, in which it occurs every 72 hours) or irregular (most commonly in *P. falciparum* infection).

- The classical **cold stage** (feeling of chills & rigor), **hot stage** (dry flushed skin, rapid respiration and marked thirst) and **sweating stage** (temperature falls by crisis) may not always be present. Between attacks, patients may look quite well
- Sometimes patients with *P. falciparum* infection present with–
  - Change of behaviour, convulsion and unconsciousness (cerebral malaria)
  - Cold skin, profound weakness, and severe diarrhoea and sometimes circulatory collapse (algid malaria)
  - Intravascular haemolysis, haemoglobinuria and renal failure (black water fever)
  - Respiratory distress *due to acute pulmonary oedema or acute respiratory distress syndrome* (acidotic breathing)
  - Severe prostration, i.e. extreme generalized weakness so the patient cannot walk, stand or sit without assistance and in small child failure to feed
  - Severe vomiting
  - Bleeding tendency or spontaneous bleeding
  - Oliguria or acute renal failure (<17 ml/hour or <400 ml/24 hours)
  - Other features e.g. confusion or drowsiness, jaundice, severe anaemia (haematocrit <15%, Hb% <5 gm/dl)
- Apart from fever, patients may have headache, backache, myalgia and fatigue.
- Clinical examination may reveal hepatomegaly and/or splenomegaly

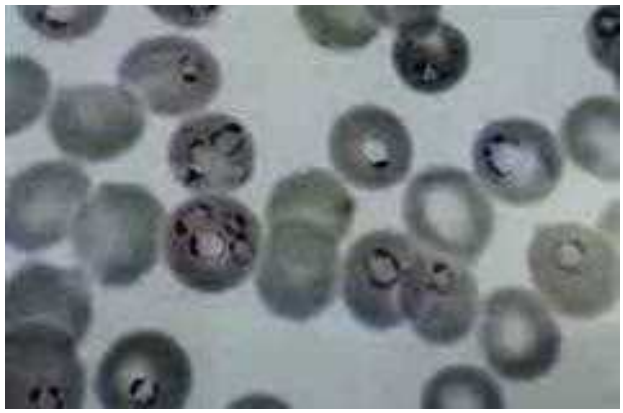
Rash is usually absent in malaria, which helps distinguishing it from viral infections.

DIAGNOSIS

Basically clinical. The possibility of malaria is high, if a febrile child comes from any high risk area for malaria and who has no convincing evidence of other febrile illnesses.

Investigations

- Blood slide examination (thick & thin film) for detection of plasmodia in blood smear



Courtesy: Dr Rasheda Samad

- ICT for malaria (Rapid Diagnostic Test RDT): Similar diagnostic accuracy like that of blood slide examination for *P. falciparum*

Courtesy: Dr Rasheda Samad

- Complete blood counts: Hb (low), TC, DC (leukocytosis), platelet count (low), reticulocyte count (high) and findings related to the severity of haemolysis

Classification (according to National Guideline'2010)

In an endemic area, malaria is classified as–

- Falciparum malaria (Uncomplicated or severe)
- Vivax malaria

I. Falciparum malaria (FM)

a. Uncomplicated malaria (UM)

Fever or history of fever within last 48 hours
and
Absence of convincing evidence of any other febrile illness
and
High index of suspicion based on time, place and person (endemic zone, susceptible population, transmission season)
and
Diagnosis is confirmed by presence of asexual form of *P. falciparum* in Blood Slide Examination (BSE)
or
Rapid Diagnostic Test (RDT) +ve for *P. falciparum*

b. Severe malaria (SM)

Fever or history of fever within last 48 hours
and
One or more of the clinical or laboratory features of severity (Cl fearures just discussed in previous page)

Laboratory findings of severe Falciparum malaria

- Hyperparasitaemia (> 5% or 250000/µL)
- Hypoglycaemia (<2.2 mmol/L or < 40 mg/dl)
- Severe normocytic anaemia (Hb <5 gm/dl, PCV <15%)
- Fluid and electrolyte disturbance (hyponatraemia)
- Haemoglobinuria
- Metabolic acidosis (plasma bicarbonate <15 mmol/L)
- Hyperlactataemia (>5 mmol/L)
- Renal impairment (serum creatinine > 265 µmol/L or > 3 mg/dl)
  and
- Presence of asexual form of *P. falciparum* in BSE or +ve RDT for *P. falciparum*

II. Vivax malaria (VM)

Fever or history of fever within last 48 hours
and
Absence of convincing evidence of any other febrile illness
and
High index of suspicion based on time, place and person
and
Diagnosis is confirmed by presence of asexual form of P. vivax in Blood Slide Examination (BSE) or Rapid Diagnostic Test (RDT) +ve for P. vivax

Malaria Chemoprophylaxis

Chemoprophylactic drugs should be started one week before travel to endemic zone, continued during the stay and for 4 weeks after returning.

Drugs used for chemoprophylaxis

- Chloroquine plus Proguanil or
- Mafloquine or
- Doxycycline

NB: Doxycycline should be given for 1 day before travel.

TREATMENT OF MALARIA

FALCIPARUM MALARIA

A. UNCOMPLICATED FALCIPARUM MALARIA (UM)

A. First line treatment

Drug	Day	No of dose	Time	5-<15 kg	15-<25 kg	25-<35 kg	>35 kg
Artemether + Lumefantrine combination (ACT)	D 1	1st	0 hour	1	2	3	4
		2nd	8 hour	1	2	3	4
	D 2	3rd	24 hour	1	2	3	4
		4th	36 hour	1	2	3	4
	D 3	5th	48 hour	1	2	3	4
		6th	60 hour	1	2	3	4

B. Alternative therapy

- Quinine (10 mg/kg 8 hourly) 7 days + Tetracycline (250 mg 6 hourly) 7 days

or

- Quinine 7 days + Doxycycline (100 mg/day) 7 days

or

- Quinine 7 days + Clindamycin (10 mg/kg twice daily) 7 days

or

- Other WHO recommended ACT e.g. Artesunate-Mefloquine, Artesunate-Amodiaquine
- Tetracycline and Doxycycline are contraindicated in children < 8 years old and pregnant & lactating mother

B. SEVERE FALCIPARUM MALARIA

- Refer urgently to the hospital with pre-referral treatment.

I. Pre-referral Treatment

IM Quinine (20 mg salt/kg stat IM– half dose in each thigh) or Artesunate rectal capsule 10 mg/kg

II. Hospital Treatment

- IV Artesunate (2.4 mg/kg stat followed by 2.4 mg/kg daily until the patient can tolerate oral medication)

or

- IM Artemether (3.2 mg/kg stat followed by 1.6 mg/kg until patient can tolerate oral anti malarial)

or

- IV Quinine hydrochloride (20 mg/kg salt in drip followed by 10 mg/kg 8 hourly. Should be given in Glucose containing fluid in drip over 4 hours

or

- IM Quinine to the anterior thigh (diluted 1:1 in sterile water for injection: the first 20 mg/kg dose is splitted; 10 mg/kg to each thigh)

III. Follow on Treatment

Once patient tolerates oral therapy, it is essential to continue and complete the treatment like that of uncomplicated falciparum malaria.

Total duration of treatment: 7 days.

IV. Gametocytocidal drug

At the end of treatment–

- Primaquine (0.75 mg/kg) Single dose should be given.

(Not recommended for <4 years of age and in pregnancy)

VIVAX MALARIA

I. Specific: Antimalarial

- Chloroquine,10 mg/kg on Day 1&2 and 5 mg/kg on Day3 Plus
- Primaquine, 0.3 mg/kg daily for 14 days

II. Supportive

- Give Paracetamol & tepid sponging for fever
- Maintain fluid and nutrition

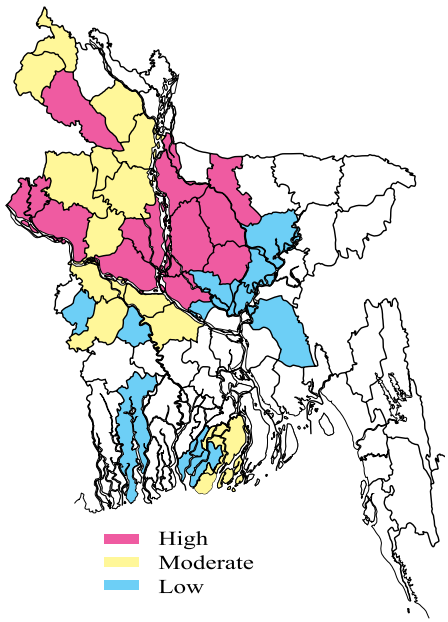
III. Treatment of Complications

- Correct
  - Fluid & electrolyte imbalance, acidosis, dehydration
- Transfuse packed cell in severe anaemia

KALA-AZAR (KA)

Kala-azar (Black sickness) or visceral leishmaniasis is a parasitic disease. The Government of Bangladesh declared the disease reportable since 1987.

Pabna, Sirajgonj, Rajshahi, Dinajpur, Natore, Naogaon, Thakurgaon, Mymensingh, Tangail, Jamalpur and Gazipur.



Kala-azar endemic districts in Bangladesh

AETIO-PATHOGENESIS

Agent: *Leishmania donovani* (India, Bangladesh)

Host: Humans

Vector: Sandfly (*Phlebotomus argentipes*)

Sandfly breed in the corners of soil floors of rooms, cattle sheds, damp places (rural areas). But in urban areas they breed in cracks and crevices of human dwellings, between bricks holes.

Transmission

- Bite of sandfly: Only females bite, mainly during nocturnal feeding
- Other possible ways of transmission are through–
  - Blood transfusion
  - Placenta
  - Inoculation from cultures in the laboratory

Peak seasonal incidence

Three months after the onset of rain (August to October).

Incubation period

Ranges from 10 days to 2 years, but usually 3-6 months.

PATHOGENESIS

After inoculation by sandflies, the promastigotes bind to skin macrophages and then the parasite-laden macrophages disseminate to all parts of the body but more so to spleen, liver, and bone marrow. The vascular spaces of spleen are dilated and engorged with blood as well as the reticular cells are markedly increased and packed with amastigotes. Similarly, in liver Kupffer cells are increased in size and number, giving rise to gross hepatosplenmegaly. Bone marrow turns hyperplastic, and parasitized macrophages replace its normal haemopoietic tissue. In kala-azar, there is marked suppression of the cell-mediated immunity.

The Net clinical effects are–

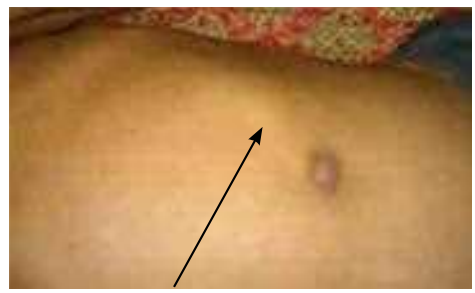
- Hepatosplenmegaly
- Lymphadenopathy
- Pancytopenia
- Fever
- Weight loss

CLINICAL MANIFESTATIONS

- Variable. The disease may be asymptomatic, oligosymptomatic (sub-acute) or symptomatic
- Fever *(in a case who reside/travel in an endemic areas)*
  - Commonly: Long standing intermittent with a characteristic double diurnal periodicity.
  - Sometimes
    - Gradual onset of low-grade fever with malaise or
    - Very acute high grade remittent associated with prostration and features of toxaemia
- Appetite is usually good with normal digestive functions
- Epistaxis and bleeding from gum may be present
- Gradual blackening of skin (Black sickness or Kala-azar)

Physical Examination

- Appearance: Sick, wasted, cachectic. Patients are usually mentally clear and alert



Gross splenomegaly in Kala-azar

- Pallor: Usually moderate to severe
- Jaundice: May be present
- Oedema: May be present
- Lymphadenopathy: Usually absent
- Skin: Dry, rough earthy grey colour
- Tongue: Clear
- Marked splenomegaly and hepatomegaly (spleen size > liver size). Spleen is soft and non-tender

In terminal stage, there may be severe anaemia, heart failure, jaundice, oedema, ascites, septicaemia and bleeding manifestations.

DIFFERENTIAL DIAGNOSES

Malaria, leukaemia, typhoid, tuberculosis and lymphoma.

Complications

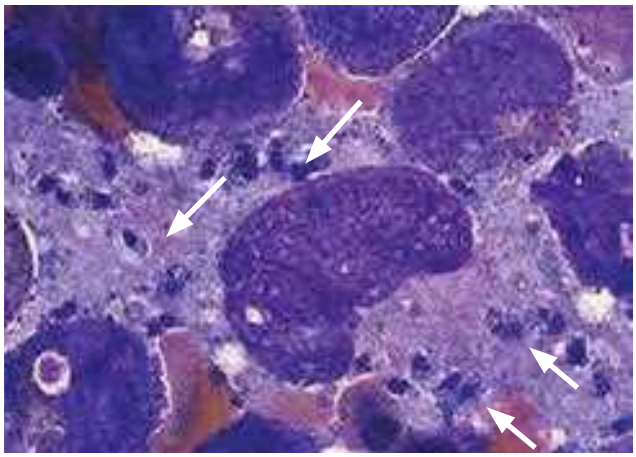
- Secondary bacterial infection e.g. pneumonia, bacillary dysentery, TB, measles
- Haemorrhage
- Cancrum oris
- Post Kala-azar Dermal Leishmaniasis (PKDL)

DIAGNOSIS

Based on clinical features & relevant investigations.

Investigations

- Complete blood counts: Hb (reduced to 5-8 gm/dl), TC (leukopenia), DC (relative increase of lymphocytes, moderate increase in monocytes, absence of eosinophils), platelets (thrombocytopenia), ESR (high)
- Serum albumin: (low), Serum globulin (hyperglobulinaemia, mostly IgG)
- Immunological tests for indirect evidence of Kala-azar
  - Direct agglutination test (DAT): Become positive (Titer ≥1:3200) as early as 2 weeks after infection and remain so for many years irrespective of treatment
  - Immuno Chromatographic Test (ICT): A simple, rapid test based on **rK39 antigen** derived from *L. chagasi.* It has the highest sensitivity & specificity for Kala-azar. Become positive within 2 weeks after infection and remain so for 2 years
  - Other tests: Aldehyde test, Complement Fixation Test (CFT), Immuno-Fluorescent Antibody Test (IFAT) etc. may be done
- Tests for direct evidence of parasites
  - Detection of LD bodies (amastigote form) in smears prepared from bone marrow, splenic aspirates or lymph node aspirates. Among these, splenic puncture has the highest rate of yielding LD bodies



Source: Internet

LD bodies in bone marrow

  - Detection of promastigotes in the culture of aspirates (Novy-Macneal-Nicolle media)
  - Detection of DNA of parasite by PCR

Case Definitions

KALA-AZAR (KA)

- History of fever for more than 2 weeks
- Residing/traveling in kala-azar endemic areas
- Any one of the following symptoms and signs
  - Splenomegaly
  - Weight loss
  - Anaemia
- And positive 'rk39 test

TREATMENT

Recommended drugs, dose and duration, based on National guidelines.

1st line Drugs

- Liposomal Amphotericin B (10 mg/kg) single dose in IV drip very slowly is the first choice

Alternative 1st line drugs

- Miltefosine: 2.5 mg/kg/day, orally in two divided doses after meal for 28 days
- Paromomycin (15 mg/kg/day, IM, OD~21 days
- Combination treatment
  - Miltefosine + Paromomycin, is the 1st choice
  - Alternative combinations are
    - Liposomal Amphotericin B + Miltefosine

      or
    - Liposomal Amphotericin B + Paramomycin

2nd line drugs

- Amphotericin B deoxycholate (1 mg/kg) Daily or on alternate day in IV infusion (5% Dextrose solution 500 ml) for total 15 doses
- Sodium Stibogluconate (20 mg/kg) IM once daily for 30 days

KALA-AZAR TREATMENT FAILURE

A case earlier diagnosed as Kala-azar
and
Took complete treatment within 1 year
and
Reappearance of symptoms of Kala-azar
and
Any positive lab evidence of parasite from bone marrow
or
splenic aspirate

POST KALA-AZAR DERMAL LEISHMANIASIS (PKDL)

DIAGNOSTIC CLUE

- H/o Residing/travelling in the endemic areas
- H/o treatment of Kala-azar any time in the past
- Suggestive skin lesion **with preservation of sensation**, which may be (macular, papular, nodular or mixed)
- Exclusion of other skin diseases e.g. leprosy, vitiligo, pityriasis, ring worm etc. The close DD of PKDL is leprosy, which is characterized by loss of sensation 'rk39' positive/Slit skin smear positive/PCR positive

Skin lesions of PKDL
Courtesy: Dr Shahriar, MMC

- In rare instances if rk39 is negative then PKDL should be diagnosed by slit skin smear

TREATMENT OF PKDL

1st line

Miltefosine

- 2.5 mg/kg body weight/day in two divided doses, not exceeding 50 mg/day for 12 weeks

2nd line

- **Sodium Stibogluconate:** 20 mg/kg body weight daily for 20 days per cycle IM
- **Amphotericin B Deoxycholate:** 1mg/kg daily or on alternate days IV (in 500 ml of 5% DA) for 15 doses per cycle

NB: Total 6 cycles (in an interval of 10 days between the cycles) are given with any one of the above mentioned drugs.

Supportive treatment

- Ensure adequate nutrition
- Control superadded infections
- Correct anaemia and if required blood transfusion

Follow up

- Regularly for 6-12 months to identify relapse of any case. A small minority may experience relapse during this period, irrespective of treatment regimen.

Relapse is indicated by–

- Enlargement of spleen
- Decline in blood counts
- Return of fever
- Weight loss

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. Write down the specific treatment of enteric fever.
2. Classify malaria and write down the treatment of severe malaria.
3. What is PKDL? Enumerate its clinical forms.
4. How Kala-azar is diagnosed?
5. What are the complications of enteric fever and when those usually develop?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Organs affected by *P. falciparum* are–
   ___ a) brain ___ b) kidney ___ c) lungs
   ___ d) gut ___ e) heart
2. Drugs recommended to treat cerebral malaria are–
   ___ a) Quinine ___ b) Artemether ___ c) Chloroquine
   ___ d) Tetracycline ___ e) Artesunate
3. The recognized complications of Kala-azar are–
   ___ a) hypersplenism ___ b) cancrum oris ___ c) PKDL
   ___ d) heart failure ___ e) secondary bacterial infections
4. The recommended drugs to treat Kala-azar are–
   ___ a) Stibogluconate ___ b) Miltefosine ___ c) Liposomal Amphotericin B
   ___ d) Ketoconazole ___ e) Paromomycin
5. In Kala-azar–
   ___ a) promastigote is the infective form ___ b) culture is not possible in artificial media
   ___ c) screening test can be done by rK39 ___ d) opportunistic infection can lead to fatality
   ___ e) anaemia is common
6. Enteric fever–
   ___ a) step-ladder pattern of fever is common ___ b) jaundice ___ c) hepatosplenomegaly
   ___ d) bleeding manifestation ___ e) perforation is common in children
7. Multidrug resistance enteric fever is resistance to–
   ___ a) Amoxicillin ___ b) Ciprofloxacin ___ c) Azithromycin

___ d) Chloramphenicol ___ e) Ceftriaxone

8. Appropriate antibiotics for uncomplicated enteric fever–
___ a) fully sensitive cases – Cefixime ___ b) MDR cases – Ceftriaxone
___ c) Quinolone resistance cases – Azithromycin ___ d) fully sensitive cases – Ceftriaxone
___ e) MDR cases – Ciprofloxacin
9. Complications of sever Falciparum Malaria–
___ a) circulatory collapse ___ b) hypersplenism ___ c) acute respiratory distress syndrome
___ d) severe prostration ___ e) secondary bacterial infection
10. Lab findings of severe falciparum malaria–
___ a) hyperglycaemia ___ b) hyperparasitaemia (>5%/microL) ___ c) metabolic alkalosis
___ d) hypernatraemia ___ e) haemoglobinuria
11. Relapse of Kala-azar is indicated by–
___ a) Enlargement of spleen ___ b) Enlargement of liver
___ c) Return of fever ___ d) Weight loss and ___ e) Decline in blood count
12. Complete blood count of a kala-azar patient shows
___ a) normal hemoglobin ___ b) lymphopenia ___ c) eosinophilia
___ d) thrombocytopenia ___ e) raised ESR
13. Immunological tests for Kala-azar–
___ a) Direct agglutination test ___ b) VDRL ___ c) anti-ds DNA
___ d) PCR ___ e) IFAT
14. Differential diagnosis of Kala-azar include–
___ a) malaria ___ a) typhoid ___ a) leukaemia
___ a) tuberculosis ___ a) HIV
15. Tests for direct evidence of parasites in Kala-azar include–
___ a) detection of LD bodies' in tissue smears
___ b) culture of aspirates ___ c) detection of DNA of parasite by PCR
___ d) Aldehyde test ___ e) Complement Fixation Test
16. Kala-azar can be transmitted by–
___ a) blood transfusion ___ b) placenta ___ c) inoculation from cultures in the laboratory
___ d) breast feeding ___ e) mosquito bite
17. Kala-azar endemic districts in Bangladesh are–
___ a) Pabna ___ b) Sirajgonj ___ c) Moulavibazar
___ d) Gazipur ___ e) Barisal

CHAPTER 20

JAUNDICE

Whenever a child presents with jaundice, one should consider pathologies in any of the following areas–

A. Hepato-cellular

- Viral hepatitis (HAV, HBV, HCV, HEV)
- Chronic liver disease (CLD) e.g. decompensated cirrhosis
- Autoimmune hepatitis
- Drug-induced hepatitis e.g. paracetamol rifampicin

B. Pre hepatic

- Genetic diseases e.g. Gilbert's syndrome, Crigler-Najjar syndrome
- Haemolytic anaemias e.g., thalassaemia, spherocytosis, autoimmune haemolytic anaemia

C. Post hepatic

- Biliary atresia
- Choledocal cyst
- Idiopathic neonatal hepatitis
- Bile duct strictures
- Stone in common bile duct

Jaundice during neonatal period has different aetiology, pathophysiology and their management is also different *(discussed in chapter 8)*

In this section acute viral hepatitis and chronic liver diseases (CLD) particularly cirrhosis of liver will be discussed.

Transmission

- Haematogenous: B,C,D, G virus
- Faeco-Oral route: A,E virus

ACUTE VIRAL HEPATITIS

Aetiology

Organisms: Six hepatotrophic viruses *(Hepatitis A, B, C, D, E, and G).* All are RNA viruses except B which is DNA virus. Hepatitis A & E viruses cause acute hepatitis only, whereas B, C, D causes CLD, though acute presentation may occur.

Clinical Manifestations

- **Asymptomatic**: Only rise in serum transaminases (SGPT, SGOT)
- **Anicteric:** Patients have no jaundice but suffer from anorexia, nausea, vomiting and influenza like symptoms.
- **Classical presentation**: Occurs in 3 phases:
  - Prodromal phase: This phase precedes the icteric phase by 1-2 weeks with non-specific symptoms like malaise, anorexia, nausea, vomiting, fever, headache, myalgia, arthralgia etc.

Yellow sclerae

- Icteric phase: This phase is characterized by yellow sclera, tender hepatomegaly with right hypochondriac or epigastric pain. Stool often turn pale and urine becomes high coloured
- Recovery phase: In this phase, constitutional symptoms disappear but mild hepatomegaly and biochemical abnormalities may persist

DIAGNOSIS

Based on clinical features & relevant investigations.

Investigations

Liver function tests	◆ S. Bilirubin ◆ SGPT ◆ Prothombin time (PT) ◆ Alkaline phosphatase	All markers are elevated
Viral markers	◆ Anti HAV IgM ◆ Anti HEV IgM ◆ Anti HCV ◆ HBsAg	Any one or more may be positive
USG of abdomen		To assess hepatic echogenecity & appearance of ascitis

TREATMENT

- Counsel parents about the natural history of the disease.
- Provide supportive treatment only and includes–
  - **Rest:** Outdoor activities should be restricted as much as possible but forced & prolonged bed rest is not essential
  - **Diet:** Normal. High calorie diet is desirable. Traditional low fat, high carbohydrate diet has no beneficial effect
  - Infuse IV fluid in patients with persistent vomiting or those who cannot tolerate oral feeding
  - Vitamin K_1: If PT is high (>15 sec or INR > 1.5) [Normal INR: 0.8-1.2]
  - Purgatives, gut sterilizers or lactulose: No therapeutic benefit in uncomplicated cases

PREVENTION

By vaccination with hepatitis B and A vaccines.

FULMINANT HEPATIC FAILURE (FHF)

A clinical condition, characterized by–

- Biochemical evidence of acute liver injury (usually of <8 weeks duration)
- No evidence of chronic liver disease
- Presence of hepatic-based coagulopathy, defined as a–
  - PT >15 sec or INR>1.5, not corrected by Vitamin K1 in the presence of clinical hepatic encephalopathy OR
  - PT >20 sec or INR >2 regardless of the presence of clinical hepatic encephalopathy

AGGRAVATING FACTORS

- GIT bleeding
- Hypovolaemia
- Hypokalaemia
- Hypoglycaemia
- Drugs e.g. sedatives, diuretics
- Uraemia
- Sepsis
- High protein diet
- Constipation
- Paracentesis

CLINICAL MANIFESTATIONS

Patients with FHF presents in 2 ways–

- Some patients presents with rapid development of deepening jaundice, bleeding *(commonly haematemesis & melaena)*, confusion, and progressive coma,
- Some patients remain asymptomatic at the onset. Then suddenly become severely ill during the 2nd week of the disease and jaundice, fever, anorexia, vomiting and abdominal pain are the common symptoms.

Clinical examination reveals–

- Tender hepatomegaly, which may be followed by progressive shrinking, often with worsening hepatic function
- Hyper-reflexia, and positive extensor planter responses are seen before the onset of encephalopathy

The features of encephalopathy are–

- Drowsiness
- Altered sleep pattern
- Agitation
- Disorientation, convulsion, coma

The features of coagulopathy are–

Bleeding

- TT Haematemesis & melaena
- TT Haematuria
- TT Intracranial

Stages of Hepatic encephalopathy

Stages	Symptoms	Signs	EEG
I	Periods of lethargy, euphoria; reversal of day-night sleeping; may be alert	Trouble drawing figures, performing mental tasks	Normal
II	Drowsiness, inappropriate behavior, agitation, wide mood swings, disorientation	Asterixis, fetor hepaticus, incontinence	Generalized slowing, q waves
III	Stupor but arousable, confused, incoherent speech	Asterixis, hyperreflxia, extensor reflxes, rigidity	Markedly abnormal, triphasic waves
IV	Coma ❑ Responds to noxious stimuli ❑ No response	Areflxia, no asterixis, flccidity	Markedly abnormal bilateral slowing, d waves, electro-cortical silence

DIAGNOSIS

Based on clinical features & relevant investigations.

Investigations

Investigations	Results
◆ S. bilirubin, SGPT, SGOT	Raised
◆ Prothrombin time	Prolonged (INR >2.0)
◆ Blood ammonia	Raised
◆ Blood glucose, albumin	Low
◆ CBC & PBF	May show anaemia, leukocytosis and thrombocytopenia
◆ Blood urea nitrogen	Often very low
◆ Serum electrolytes	Hypokalaemia, hyponatraemia
◆ Arterial blood Gas	Metabolic acidosis or respiratory alkalosis
◆ Serum Calcium, Magnesium, Phosphate	May be altered

TREATMENT

- Counsel parents about the nature of the disease and its prognosis
- Manage the patient in ICU on it demands Excellent CRITICAL CARE including careful management of–
  - ❑ hypoglycaemia
  - ❑ bleeding & coagulopathy
  - ❑ hyperammonemia
  - ❑ cerebral oedema
  - ❑ fluid balance

A. Supportive

- Open an IV line and give suitable IV fluid for nutritional support
- Restrict fluid: Give 75% of daily requirement
- Correct–
  - ❑ Hypovolaemia (with Normal saline)
  - ❑ Hypoglycaemia (Inj 10% DA-2 ml/kg)
- Treat coagulopathy with–
  - ❑ Inj. Vitamin K_1, 5-10 mg IV for 3 days
  - ❑ Fresh frozen plasma transfusion
  - ❑ Whole blood transfusion
  - ❑ Platelet transfusion (to maintain a platelet count >50,000/cmm)
- Give Inj.Ranitidine,1-3 mg/kg 8 hourly to prevent GI bleeding.
- Treat infection with non-hepatotoxic antibiotics (Ampicillin 200 mg/kg/day, 6 hourly and Gentamicin 5 mg/kg/day 8 hourly)
- Give parenteral supplement with calcium, magnesium and phosphorus, if any deficiency
- Identify & treat the precipitating factors
- Empty the bowel of nitrogen containing material, blood (100 ml contains 14-20 gm protein) etc. in the following ways–
  - ❑ Insert an NG tube and ensure NG suction
  - ❑ Give Lactulose orally or via NG tube (1-2 ml/kg) 2-4 hourly, until loose stool occurs. Then adjust the dose to produce several loose bowel movements per day
  - ❑ Lactulose enema (1-2 ml/kg) diluted with 1-3 volumes of water may be given
- Give oral Neomycin, Rifaximin or Metronidazole to reduce enteric bacteria responsible for ammonia production
- Give IV mannitol (2.5-5 ml/kg/dose) for raised ICP and cerebral oedema
- Haemodialysis, may be needed when complicated by AKI
- Mechanical ventilation, if respiratory failure

B. Specific: Liver transplantation.

CHRONIC LIVER DISEASE

Many a times, children present with distension of abdomen (ascites) and wasting who may either have associated jaundice or history of jaundice before. They are perhaps suffering from chronic liver disease particularly cirrhosis of liver, the end stage of many forms of liver injury. In children, 2 most common forms cirrhosis are:

- Post-necrotic and
- Biliary cirrhosis.

AETIOLOGY

- Idiopathic
- Chronic hepatitis e.g. HBV & HCV infection
- Metabolic e.g. Wilson's Disease, alpha -1 antitrypsin deficiency, haemochromatosis
- Autoimmune liver disease
- Biliary atresia

PATHOGENESIS

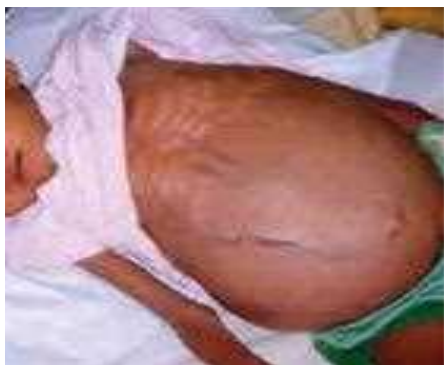
- Diffuse hepatocyte injury and regeneration
- Replacement of normal hepatic structure by regenerative nodules
- Increase in fibrous tissue (bridging fibrosis)
- Distortion of hepatic vasculature and that leads to–
  - increased resistance to blood flow
  - porto-systemic anastomosis
  - portal hypertension (PH) and its consequences

The net clinico-pathological consequences are–

- Hepatic dysfunction e.g. low albumin, coagulopathy, malabsorption of food
- Development of ascites
- Metabolic derangement
- Portal hypertention
- Development of varices and haemorrhage

CLINICAL MANIFESTATIONS

- Many children may be asymptomatic early in the course
- Non specific symptoms e.g.weakness, loss of appetite, malaise, nausea



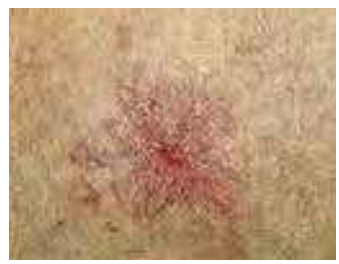
Wasted child with ascites and engorged abdominal vessels

- Gradual distension of abdomen due to ascites
- Dilated veins on the abdominal wall due to engorgement of venous collaterals sometimes, Caput medusae
- Generalized wasting of muscles (failure to thrive)
- In Biliary atresia, patients often present with jaundice, persistent pale stool, dark urine, pruritis, hepatomegaly and if not treated, may proceed to chronic liver disease (biliary cirrhosis)

In addition to the above presentations, these patients may have other features (stigmata) like–

General	Malaise, loss of appetite, nausea
GIT	Gastro intestinal haemorrhage in the form of haematemesis or melaena
Spleen	Splenomegaly
Liver	Hepatomegaly (firm) or small liver
Skin & nail changes	Skin: Palmar erythema, spider naevus, white spots on skin Nails: White nails, clubbing
Palm	Wasting of thenar and hypothenar muscles
Endocrine	Male: Gynaecomastia and soft, small testes (testicular atrophy) Female: Infertility and amenorrhoea
Encepha-lopathy	Altered sleep rhythm, irritability, altered consciousness, constructional apraxia, flapping tremor, exaggerated deep tendon reflexes, planter extensor, foetor hepaticus or deep coma

Palmar erythema



Spider naevus

Source: Internet

- The first indication of underlying CLD are splenomegaly, ascites GIT haemorrhage or hepatic encephalopathy

COMPLICATIONS

- Hepatic encephalopathy
- Progressive nutritional disturbances
- Portal hypertension
- Hormonal disturbances
- Hepatocellular carcinoma

DIAGNOSIS

Based on clinical features & relevant investigations.

Investigations

Liver function tests	• Serum bilirubin (may be increased) • SGPT (normal or increased) • Prothrombin time (prolonged) • Serum albumin (decreased) • Gamma globulins (increased)
Endoscopy of upper GIT	Different grades of oesophageal varices
Complete Blood count	Pancytopenia if hypersplenism
USG of hepatobiliary system	May demonstrate hepatic texture and nodules
Viral markers B, C, D	May be positive
Serum ceruloplasmin	Low in Wilson's disease
24 hours urinary copper level (Penicillamine challenge test)	High in Wilson's disease (> 1600 is diagnostic)
• ANA • Anti liver kidney microsomal antibody • Antineutrophilic cytoplasmic antibody	Positives in autoimmune hepatitis
Liver biopsy (Confirmatory)	Presence of regenerating nodules and surrounding fibrosis are hallmark of cirrhosis
S. electrolytes S. creatinine	Altered

TREATMENT

A. Supportive

- Counseling about nature & future of the disease
- Diet: Rich in medium chain triglyceride.
- Supplementation of fat soluble vitamin e.g. A, D, E, K
- Supplementation of Calcium and Zinc, if required
- Treatment of ascites
  - Fluid & salt restriction
  - Diuretics: Combination of Spironolactone & Frusemide
- Treatment of spontaneous bacterial peritonitis: I/V broad spectrum antibiotic
- Treatment of encephalopathy

B. Specific

- Chronic hepatitis B: Combination therapy with α-interferon & Lamivudine may be tried if there is clear cut indication like:
  - Disease duration is more than 6 months
  - Raised liver enzymes
  - Positive HBe antigen
  - Positive HBV DNA
- Liver histology showing positive core antigen
- Chronic hepatitis C: Combination therapy with INF-α and Ribavirine
- Autoimmune hepatitis: Single or combination therapy with Prednisolone and Azathioprine
- Wilson's disease: See page no 279
- Biliary atresia: **Modified Kasai porto-enterostomy**
- **Liver transplantation** may increase the chance of survival

Prognosis

- Patients with a rising bilirubin, a vitamin K–resistant coagulopathy or ascites, refractory to diuretic usually survive less than 1–2 years
- Without transplantation, affected patients may die from liver failure within 10–15 years
- With liver transplantation, the long-term survival rate is 70–90%

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the factors aggravating hepatic encephalopathy?
2. What are the features of hepatic encephalopathy?
3. Write down the treatment of hepatic encephalopathy.
4. What happens in cirrhosis of liver?
5. What is Chronic liver disease? What are the stigmata of chronic liver disease?
6. Write down the pathogenesis of cirrhosis of liver.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Viruses responsible for chronic hepatitis are–
   ___ a) hepatitis A ___ b) hepatitis B ___ c) hepatitis C
   ___ d) hepatitis D ___ e) hepatitis G
2. Features of hepatocellular failure are–
   ___ a) jaundice ___ b) haematemesis ___ c) palmar erythema
   ___ d) gynaecomastia ___ e) splenomegaly
3. Patients with biliary cirrhosis may have–
   ___ a) jaundice ___ b) dark urine ___ c) pruritus
   ___ d) hepatomegaly ___ e) xanthoma
4. Management of acute viral hepatitis includes–
   ___ a) rest ___ b) low calorie diet ___ c) vitamin K
   ___ d) vitamin C ___ e) purgative
5. The following biochemical changes are characteristic of Wilson's disease
   ___ a) low ceruloplasmin ___ b) high Cu level in blood ___ c) high Cu level in urine

___ d) low S. albumin level ___ e) high S. Alk. phosphatase level

6. Complications of chronic liver disease include–
   ___ a) Hepatic encephalopathy ___ b) Portal hypertension ___ c) Ammonia intoxication
   ___ d) Hormonal disturbances ___ e) Hepatocellular carcinoma
7. Liver function tests in a patient with CLD shows–
   ___ a) very high serum bilirubin ___ b) high SGPT ___ c) prolonged Prothrombin time
   ___ d) normal serum albumin ___ e) raised alkaline phosphatase
8. Treatment options for Wilson disease include
   ___ a) Penicillamine ___ b) Trientine ___ c) Lamivudine
   ___ d) Zinc ___ e) Azathioprine
9. Features of hepatic encephalopathy include–
   ___ a) variceal bleeding ___ b) Altered sleep pattern ___ c) intracranial bleeding
   ___ d) Agitation ___ e) convulsion
10. Treatment options for coagulopathy in a patient with fulminant hepatic failure include–
    ___ a) Vitamin K1 ___ b) Fresh frozen plasma ___ c) Factor VIII
    ___ d) Platelet transfusion ___ e) Cryoprecipitate

Chapter 21

Blood Vomiting

Whenever a child presents with blood vomiting, one should always consider Portal Hypertension **(PH)** leading to rupture of oesophageal varices as the possibility. The other causes of blood vomiting are–

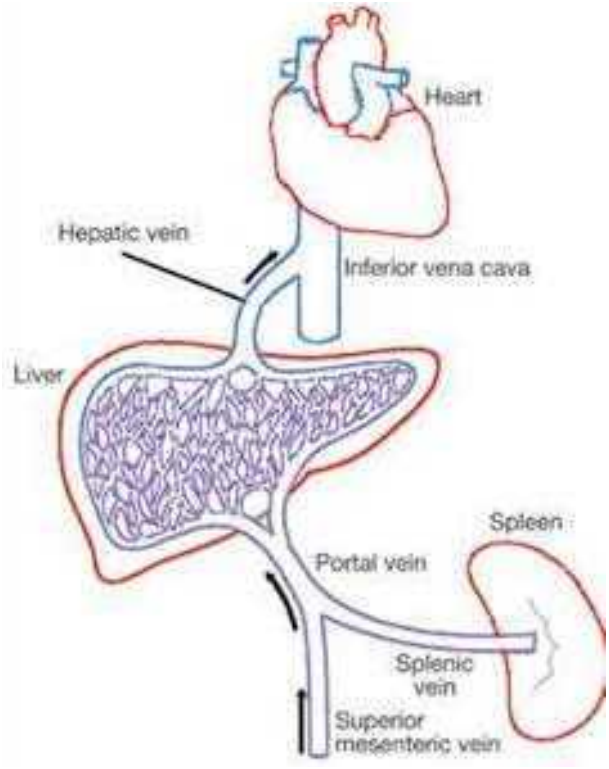
- Gastric erosion from any cause e.g. NSAID
- Mallory-Weiss syndrome
- Coagulopathy
- Severe thrombocytopenia from any cause

In this chapter, we will discuss PH.

PORTAL HYPERTENSION (PH)

Portal hypertension: Elevation of portal venous pressure >10-12 mm Hg. *(Normal pressure: ≈7 mm Hg)*

Aetio-pathogenesis



Aetiology

- Idiopathic
- **Pre-hepatic:** Portal vein thrombosis due to sepsis (e.g. umbilical sepsis, portal pyaemia), severe dehydration, prolonged or difficult umbilical vein catheterization
- **Hepatic:** Cirrhosis of liver, congenital hepatic fibrosis, veno-occlusive disease, schistosomiasis
- **Post-hepatic**
  - Budd-Chiari syndrome
  - Biliary tract disease: Extra-hepatic biliary atresia, choledochal cyst, cystic fibrosis

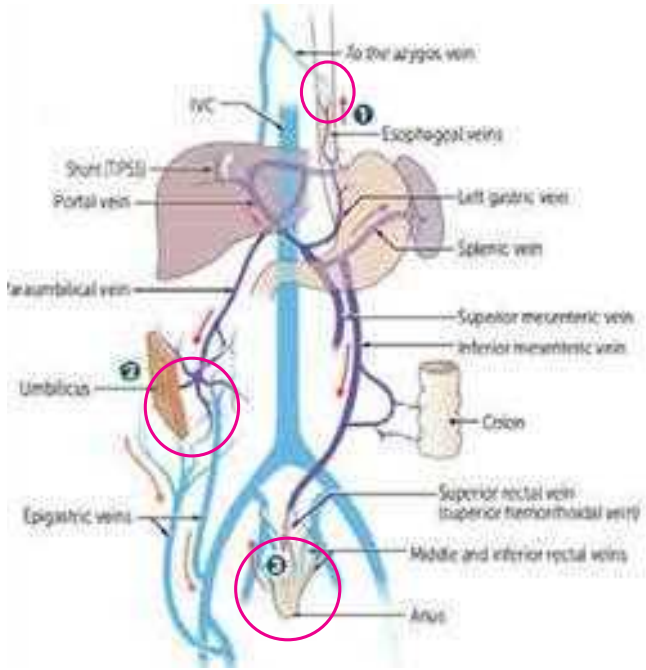
PH: Net clinico-pathological consequences

- Increased resistance to portal blood flow
- Pooling of blood with consequent increase of pressure in the tributaries of portal vein e.g. in spleen, gut
- Development of collaterals, diverting blood from portal into systemic veins **(porto-systemic shunting)** e.g. oesophageal varices, haemorrhoids etc.
- Sudden rupture of any of these colaterals & profuse haemorrhage

Common sites of porto-systemic anastomosis

Regions & Effects	Portal vein	Systemic vein
1. Lower end of oesophagus with development of oesophageal varices	Oesophageal branch of left gastric vein	Hemiazygous vein
2. Around the umbilicus e.g. Caput medusae	Paraumbilical vein	Superior epigastric vein
3. Rectum e.g. Haemorrhoid	Superior rectal vein	Middle & inferior rectal vein

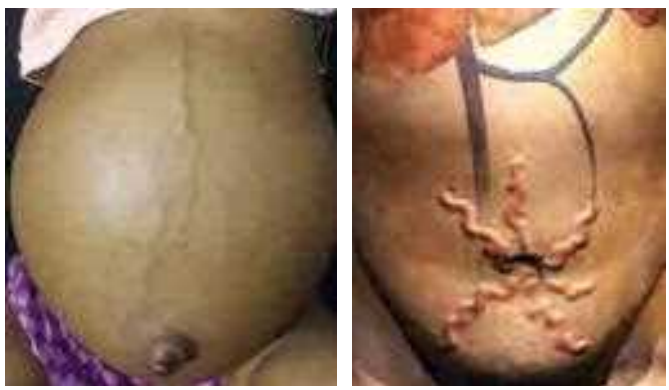
Blood flow in portal hypertension and porto-systemic shunts



Source : internet

Clinical Manifestations

- Recurrent bouts of blood vomiting & passage of black turry stool
- Sometimes, fresh per rectal bleeding may occcur from haemorrhoids
- Splenomegaly
- Prominent vessels around the umbilicus (Caput medusae)



Source : internet

Caput medusae

- Features of shock (if massive haemorrhage) e.g. cold clammy skin, increased perspiration, rapid thready pulse, hypotension, prolonged capillary refilling time etc.
- Other clinical features are characteristic and related to the aetiology of PH, as follows–

Pre-hepatic	◆ H/o previous liver disease: Absent ◆ H/o neonatal sepsis, UV catherization: Present ◆ Liver size: Normal ◆ Splenomegaly in an otherwise well child is characteristic of pre-hepatic PH ◆ Testis: Normal ◆ Ascites: Uncommon
Hepatic	◆ H/o previous liver disease: Present ◆ Ascites: Present ◆ Testis: Atrophy ◆ Stigmata of CLD (see previous chapter)
Post-hepatic	◆ Abdominal pain ◆ Tender hepatomegaly ◆ Ascites ◆ Jaundice ◆ Distended veins on the back & anterior abdomen ◆ Hepato-jugular reflux: Absent

Diagnosis

Based on classical clinical features and supportive laboratory evidences.

Investigations

A. To establish the diagnosis of portal hypertension

Non-invasive

- Barium swallow X-Ray of oesophagus: To look for evidence of oesophageal varices
- Ultrasonogram of abdomen: To assess portal venous pressure, hepatic texture, presence of ascites and to exclude other pathology
- Doppler assisted ultrasound scanning of liver, portal vein, IVC, hepatic vein to define their vascular anatomy.

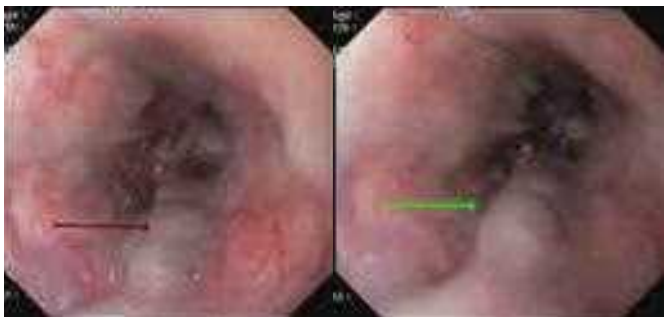
Invasive

- CBC: To assess any features of hypersplenism

Hypersplenism

- Splenomegaly
- A peripheral blood picture of anaemia, neutropenia, and thrombocytopenia (either singly or in combination)
- A cellular bone marrow, and
- Significant improvement in peripheral blood picture following splenectomy

- Upper GI Endoscopy: To detect & grade oesophageal varices



Courtesy: Prof ASM Bazlul Karim

Oesophageal varices

- Others e.g. Angiogram to detect any abnormality and direct measurement of portal pressure

B. To find-out the aetiology of PH

- Liver function tests e.g. S. albumin, S. bilirubin, SGPT, alkaline phosphatase, prothrombin time etc.
- Viral markers e.g. HBsAg, Anti-HCV
- S Ceruloplasmin: Low, in Wilson disease
- 24 hours urinary copper: High in Wilson disease

TREATMENT

A. Management of acute variceal bleeding

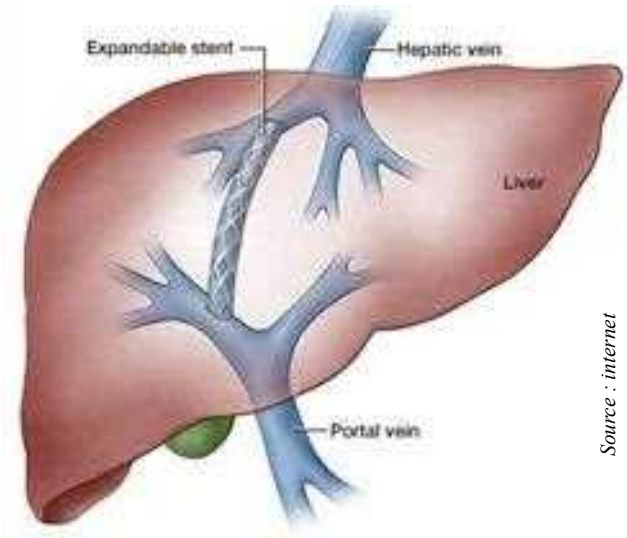
- Assess the vital parameters quickly e.g. pulse, BP, pulse pressure, capillary refill time, resp rate, temperature
- Resuscitate & stabilize the patient
  - Give blood or crystalloid fluid (e.g. DNS, NS) for volume replacement
  - Transfuse whole blood or blood products e.g. fresh frozen plasma (if PT >20 sec.) or platelet (if count < 50,000/cmm)
- Keep NG tube in situ to aspirate blood and to monitor extent of bleeding
- Give Inj. Vit K_1 5-10 mg IV
- Give Inj. Ranitidine (0.5-1 mg/kg/day) to prevent bleeding from gastric erosions
- Give parenteral antibiotics, if evidence of infection
- Consider Vasopressin, Terlipressin, Somatostatin or Octreotide (e.g. Sandostatin 1 µg/kg/hour) to reduce portal blood pressure by reducing portal blood flow

If bleeding not controlled with the given support–

- Endoscopic **sclerotherapy** (Na-marrhuate) or Band ligation of varices

If bleeding still continuing, then arrange–

- **Sengstaken– Blakemore Balloon temponade** placement to stop haemorrhage.
- Surgery e.g. Ttransjugular Intrahepatic Portosystemic Stent Shunt (TIPSS)



Source : internet

TIPSS

B. Prevention of further bleeding

- Peroiodic endoscopic variceal ligation/ sclerotherapy
- Pharmacotherapy by nonselective β-blockers e.g. propranolol, isosorbid mononitrate

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the common causes of haematemesis ?
2. What is portal hypertension ?
3. Write down the important causes of portal hypertension.
4. What are the important clinico-pathological consequences of portal hypertension?
5. What are the sites of portosystemic anastomosis?
6. Write down the investigations of portal hypertension.
7. Outline the treatment of acute variceal bleeding.

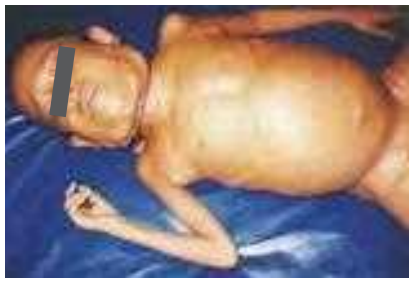
MULTIPLE CHOICE QUESTIONS [MCQ]

1. The common clinical presentations of portal hypertension are–
   ___ a) haematemesis ___ b) haematochezia ___ c) splenomegaly
   ___ d) fever ___ e) jaundice
2. Common causes of haematemesis in children
   ___ a) portal hypertension ___ b) drugs-NASAIDs ___ c) coagulopathy
   ___ d) malignancy ___ e) peptic ulcer disease
3. Non invasive investigation to diagnose portal hypertension
   ___ a) upper GIT endoscopy ___ b) USG of abdomen ___ c) liver function test
   ___ d) barium swallow x ray of oesophagus ___ e) angiography
4. Drugs used in portal hypertension
   ___ a) Propanolol ___ b) diuretics ___ c) Adrenaline
   ___ d) Vasopressin ___ e) Somatostatin
5. Surgical options in portal hypertension
   ___ a) splenectomy ___ b) band & ligation ___ c) TIPSS
   ___ d) sclerotherapy ___ e) liver transplantation

CHAPTER 22

LYMPH NODE ENLARGEMENT

Lymph node enlargement (lymphadenopathy) reflects diseases involving reticuloendothelial system.



Generalized lymphadenopathy

It is mostly due to infections e.g. viral, bacterial, parasitic or fungal. However, malignancies, autoimmunity, storage diseases etc. also contribute. It may be localized or generalized (when adenopathy involve >2 non-contagious sites). It is not a diagnosis but the manifestation of many underlying diseases.

Whenever a child presents with lymph node enlargement, the following diseases should considered–

- Tuberculosis
- Lymphoma
- Leukaemia
- Infectious mononucleosis
- HIV infection
- Systemic onset juvenile idiopathic arthritis
- Systemic lupus erythematosus (SLE)
- Cat scratch disease

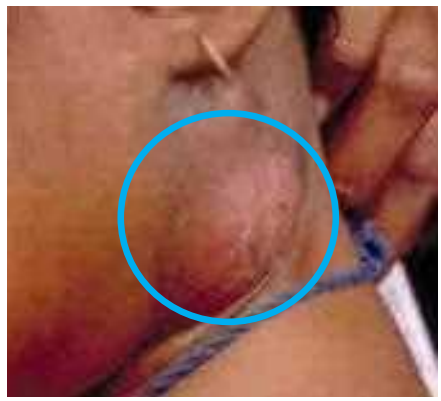
Among all causes, tuberculosis, lymphoma and infectious mononucleosis will be discussed in this section.

Lymph node (LN) examination: Points to note–

- Site of lymph node enlargement
- Number: Single or multiple
- Size of the largest one
- Local temperature: Normal or raised
- Tenderness: Present or absent
- Nature: Matted or discrete
- Consistency: Soft, cystic, rubbery, firm or hard
- Overlying skin colour: Normal or reddish
- Discharging sinus: Present or not
- Adjacent structures: Free or adherent
- Pressure symptoms e.g. Respiratory distress, dysphagia, facial puffiness etc.: Present or not

TUBERCULAR LYMPHADENOPATHY

Organisms: *M. tuberculosis,* atypical micobacteriae.



Scrofula

Lymph node enlargement (scrofula) is the most common manifestation of extra pulmonary tuberculosis. Cervical glands are affected most frequently, followed by submandibular, supraclavicular, axillary and inguinal nodes. Sometimes, more than one region are involved. Abdominal (mesenteric) lymph nodes are also involved e.g. tabes mesenterica.

Characteristics of the lymph nodes in TB

- Firm, not hard
- Usually painless and non-tender
- Matted, though initially mobile
- Often fixed to underlying or overlying tissue
- When caseation and liquefaction occurs, nodes become fluctuant and may discharge through the skin with the formation of a collar-stud abscess and sinus formation

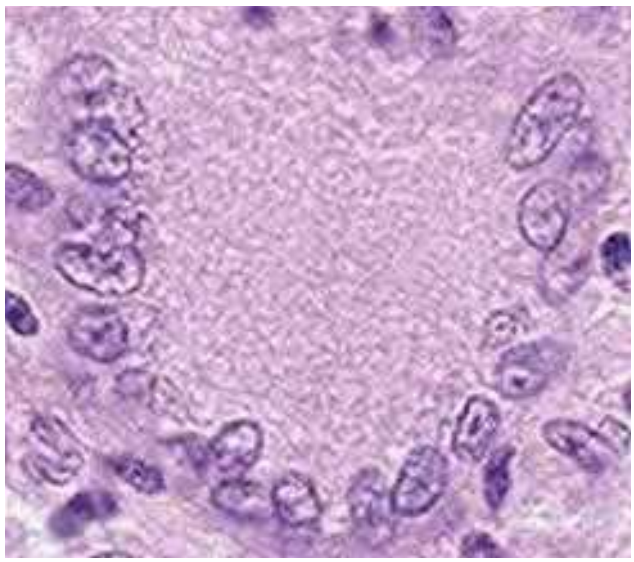
Systemic symptoms other than low grade fever are usually absent. However, sometimes, along with lymph node enlargement, growth failure, pallor, hepatosplenomegaly may be present.

DIAGNOSIS

Based on characteristic clinical and histology profile of lymphadenopathy and other supportive lab evidences.

Investigations

- Complete blood counts: Hb% (low). TC and DC of WBC will show lymphocytosis
- Tuberculin test: Usually positive
- Chest radiography: Mostly normal though paratracheal, hilar and other lymphadenopathy may be present. Hilar lymphadenopathy is characteristic
- Lymph node biopsy & histopathology: Central caseation necrosis surrounded by epithelioid and multinucleated giant cells



Source: Internet

Lymph node biopsy showing giant cells and caseation necrosis

Treatment

- Counsel the parents
- Anti-TB drugs (as per National TB Guideline for Children, 2nd ed.)
- Good nutritional support
- Follow up

LYMPHOMA

Lymphoma is the malignant proliferation of cells native to lymphoid tissue i.e. lymph nodes and extra-nodal sites like Waldeyer's ring, liver, spleen, thymus, Peyer's patches, vermiform appendix etc.

In lymphoma, lymphoid tissues anywhere in the body may be affected but cervical nodes are commonly affected and less frequently the mediastinal and sub-diaphragmatic nodes.

Lymphoma is always malignant; no benign category.

Types

- Hodgkin disease (HD)
- Non-Hodgkin lymphoma (NHL)

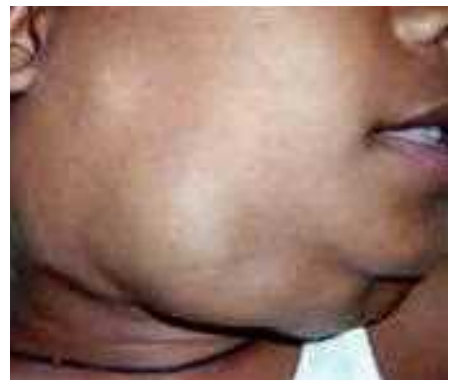
Pathology

The net clinico-pathological consequences are–

- Depression of cellular immunity and increased susceptibility to infections
- Pressure symptoms

Clinical Manifestations

- Painless nodular swellings in neck and other areas of body is the commonest presentation
- Constitutional symptoms:
  - Intermittent fever
  - Weight loss (>10%) during last 3 months
  - Drenching night sweats
  - Others e.g. fatigue, lethargy, anorexia, urticaria
- Pressure symptoms:
  - Respiratory distress (pressure over trachea & principal bronchi by mediastinal lymph nodes)
  - Facial oedema, chemosis, plethora, venous engorgement (pressure over superior vena cava i.e. superior vena caval syndrome)
  - Dysphagia (pressure over oesophagus)
  - Hoarseness of voice (pressure over recurrent laryngeal nerve)
  - Abdominal pain, discomfort & disturbances of bowel habits (pressure over bowel)
  - Paraplegia and root pain (pressure over spinal cord & nerve roots)
  - Cholestatic jaundice (pressure over biliary channels at porta hepatis)
  - Symptoms due to extra-nodal involvement:
    - Cough, dyspnoea (lungs)
    - Ascites (peritoneum)
    - Pleural effusion (pleura)



Cervical, submandibular and pre-auricular lymphadenopathy

- Pericardial effusion (pericardium)
- Features of leukaemia (bone marrow)
- Pruritus (skin)
- Neurological manifestations (cerebral involvement)
- Pain and swelling of jaw, testes

Characteristics of lymph nodes (LN) in Lymphoma

- Non-tender
- Firm to rubbery in consistency
- Discrete
- Not fixed to underlying or overlying structures

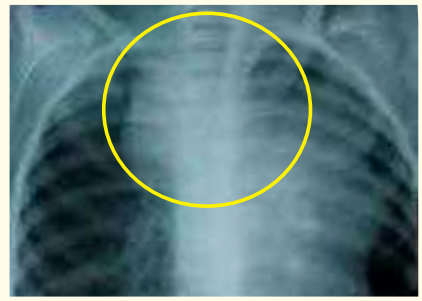
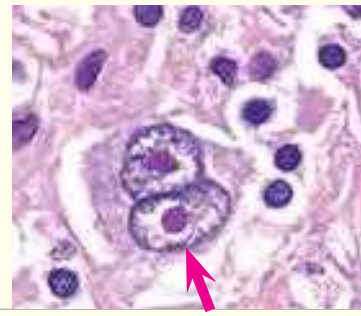
Difference between NHL and HD

Parameters	NHL	HD
Disease progression	Short history and rapid progression of disease	Not so
Lymph node involvement	At multiple peripheral sites	Localized to a single axial group
Involvement of Waldeyer ring and extra-nodal sites e.g. thymus, liver, CNS, testis bone marrow, spleen	Common	Uncommon
Spread	Non contiguous	Orderly spread
Mesenteric nodes involvement	Common	Rare

DIAGNOSIS

Based on characteristic C/F & supportive lab evidences.

Investigations

CBC, PBF, ESR	❑ Hb: Low ❑ WBC: Counts variable. May have neutrophilia/eosinophilia (HD). In advance stage, there may be lympho and other cytopenias. ❑ Platelets: Normal/Thrombocytosis ❑ PBF: Normocytic normochromic anaemia. ❑ ESR: Very high
Blood for LDH	Very high
X-Ray chest AP/ Lateral view	Mediastinal lymphadenopathy (widening) may be present. 
Lymph node biopsy for histopathology, immuno-phenotyping, cytogenetics molecular studies	Reed-Sternberg giant cell is the hallmark of classical HD (pic below) Small round cell in case of NHL Immunohistochemistry: Confirmatory for types of NHL.  *Source: Internet* *Complied by Zohora Jameela Khan*
CT scan of chest, abdomen, pelvis	To detect involvement of other lymph node groups as well as extra nodal sites.
MRI of spine & bones	To evaluate bone (vertebral) involvement.
PET scan	For disease staging, treatment response and bone involvement.
Bone marrow examination	To assess whether marrow infiltration occurs or not.
Bone scan	Indicated in bone pain or with high S alkaline phosphatase level.
Liver, renal function tests	May be altered, if dissemination occurs to these organs.
CSF & other body fluids (cytospin analysis)	To know cytochemical characteristics of the malignant cells.

TREATMENT

- Counseling parents about the disease, treatment and prognosis

HODGKIN DISEASE

- Treatment consists of combined Chemotherapy and low-dose involved field radiation therapy (LD-IFRT) is considered standard of care. The volume of radiation and

the duration of chemotherapy are determined by the following prognostic factors at presentation
- Presence of B symptoms
- Initial stage of disease
- Presence of bulky disease

Chemotherapy

Standard chemotherapy regimen are-

- ABVD: 6 cycles (repeat every 28 days) plus LD-IFRT or
- COPP/ABV hybrid course: 4 cycles (repeat every 28 days) plus LD-IFRT. These regimen has a cure rate up to 90%

ABVD	COPP
Doxorubicin (Adriamycin)	Cyclophosphamide
Bleomycin	Vincristine/Oncovine
Vinblastine	Procarbazine
Dacarbazine	Prednisolone

Radiotherapy (LD-IFRT)

Here, 15-25 Gy are used with modification based on patient's age, presence of bulky disease, normal tissue concerns and potential acute or long term effects.

Non-Hodgkin Lymphoma

Usual duration of treatment with chemotherapy is about 2 years according to **NHL BFM-90** (Berlin-Frankfurt-Munich) protocol (for T cell), LMB-96 (for B cell).

Commonly used drugs are–

- Cyclophosphamide
- Cytarabine
- Methotrexate
- Vincristine
- Etoposide
- L-asparaginase

INFECTIOUS MONONUCLEOSIS (GLANDULAR FEVER)

Organism: Epstein-Barr virus in 90% cases

Incubation period: 30-50 days

Transmission: Through saliva, sexual contact

Clinical Manifestations

- Fever, Sore throat
- Generalized lymphadenopathy (Epitrochlear lymphadenopathy is suggestive)
- Hepatosplenomegaly may be present
- Maculopapular rash usually appeared after intake of Amoxicilln
- **Petechiae at the junction of hard and soft palate** is characteristic

Complications

- **CNS:** Meningitis, encephalitis, cranial nerve palsy, GBS, ataxia, perceptual distortions of size, shapes (Alice in wonderland syndrome)
- **Respiratory:** Airway obstruction due to swelling of tonsil and oropharyngeal soft tissue, interstitial pneumonia
- **Haematological:** Haemorrhage due to thrombocytopaenia, auto immune haemolytic anaemia, aplastic anaemia
- **Others:** Splenic rupture, myocarditis

Diagnosis

Mainly clinical. Following investigations will be supportive.

Investigations	Results
Complete Blood Count	Lymphocytic leukocytosis
PBF	Normal with presence of **atypical lymphocytes.**
Heterophile antibody test	Positive. Heterophile because it agglutinate antigen from other species.
Paul-Bunnell-Davidson test	IgM antibody detected for sheep RBC agglutination. Positive after one week and persist for several months.
Monospot test (rapid slide agglutination test)	Horse RBC agglutination test. Remain positive for 2 years.

Treatment

Supportive only and includes

- Bed rest: Avoid contact sports for 6-8 weeks to decrease the risk of splenic rupture
- Antipyretic: Paracetamol
- Antiviral: Acyclovir
- Steroid: Prednisolone 1mg/kg for 7 days, then taper over another 7 days

Indications of steroid

- Airway obstruction
- Thrombocytopenia with haemorrhage
- Auto immune haemolytic anaemia
- Seizure
- Meningitis

Prognosis: Excellent.

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the causes of generalized lymphadenopathy?
2. What symptoms may develop due to pressure by enlarged lymph nodes in lymphoma?
3. What are the characteristics of lymph nodes in TB lymphadenopathy?
4. What relevant investigations will you consider in a patient with lymphoma?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. The characteristics of lymph nodes in lymphoma are–
   ___ a) rubbery consistency ___ b) discrete ___ c) matted
   ___ d) necrosis of the lymph nodes ___ e) fixed to underlying structures
2. Generalized lymphadenopathy is found in–
   ___ a) tuberculosis ___ b) systemic onset JIA ___ c) aplastic anaemia
   ___ d) kala-azar ___ e) acute lymphoblastic leukaemia.
3. Patient with lymphoma may present with extra nodal symptoms like–
   ___ a) pleural effusion ___ b) pericardial effusion ___ c) pruritus
   ___ d) neurological manifestations ___ e) swelling of jaw
4. Characteristic clinico-haematological features of infectious mononucleosis are–
   ___ a) maculopapular rash ___ b) epitrochlear lymphadenopathy ___ c) blast cells in PBF
   ___ d) atypical lymphocyte in PBF ___ e) petechiae at the junction of hard and soft palate
5. Drugs used to treat Hodgkin's Disease (HD) are–
   ___ a) Doxorubicin ___ b) Vincristine ___ c) Etoposide
   ___ d) Methotrexate ___ e) Dacarbazine

Chapter 23

Pallor or Anaemia

Pallor (anaemia) is a common problem among children. It is defined as the decreased concentration of haemoglobin for specific age and sex of the child.

Haemoglobin levels of healthy children at different ages

Age	Haemoglobin (g/dl)
1 to 3 days	18.5
1 month	13.9
6 months	12.6
6 months to 2 years	12.0
2 to 6 years	12.5
6 to 12 years	13.5
12 to 18 years Male/Female	14.5 14.0

Whenever a child present with pallor, one should consider the following causes–

- Iron deficiency anaemia
- Hereditary haemolytic anaemias e.g. thalassaemia syndrome, haemoglobinopathies
- Helminthiasis
- Malnutrition
- Chronic kidney diseases
- Chronic infection e.g. tuberculosis, malaria, kala-azar
- Diseases of the bone marrow e.g. leukaemia, aplastic anaemia
- Others e.g. chronic liver disease, SLE, JIA

In this chapter, iron deficiency anaemia (IDA) and hereditary haemolytic anaemia (HHA) will be discussed.

IRON DEFICIENCY ANAEMIA (IDA)

The most common cause of anaemia in children. It is associated with depressed motor and mental development of infants and children.

Iron Metabolism

Sources

Iron is widely present in animal and plant foods as–

- Heme iron: Present in meat, liver, fish and poultry. It is readily absorbed and absorption is not influenced by other dietary factors
- Non-heme iron: Present in beans, pulses, tubers, dried fruits and green vegetables e.g. banana, arum (kochu) etc.

Daily requirement: 10 mg of elemental iron

Absorption: At duodenum and jejunum in ferrous form

Stored form of iron: Ferritin, haemosiderin

Factors influence iron absorption

Factors enhance absorption	◆ Vitamin C ◆ Proteins
Factors inhibit absorption	◆ Phytates (found in unrefined cereals) ◆ Tannins (found in tea & legumes) ◆ Phosphates (found in eggs) ◆ Polyphenols (found in coffee and spinach)

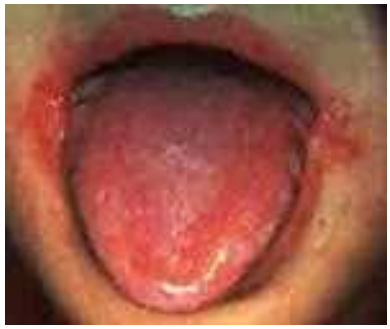
AETIOLOGY

- Preterm, LBW babies
- Babies born to mothers with unusual perinatal haemorrhage
- Lactation failure: Iron in breast milk is 2-3 times more efficiently absorbed than that in cow's milk
- Inappropriate weaning
  - Consumption of large amount of cow's milk (may give rise to chronic intestinal blood loss due to a heat labile protein present in whole cow's milk)
  - Regular consumption of foods deficient in iron e.g. rice gruel, suzi, barley etc.
- Increased demand: During the period of rapid growth of infants or adolescents
- Occult bleeding: From gut as in peptic ulcer, Meckel's diverticulitis, polyp, anal fissure, haemorrhoid, haemangioma or inflammatory bowel disease etc
- Worm infestation e.g. hook worms in particular
- Persistent or recurrent attacks of diarrhoea

CLINICAL MANIFESTATIONS

- General symptoms of anaemia e.g. fatigue, dizziness, less activities, irritability, profound anorexia etc.
- Pallor of palm, lips and conjunctiva
- The cardinal features of iron deficiency are–
- Features related to atrophic changes in epithelium of–
  - Mouth, lips e.g.cracking
  - Tongue e.g. atrophy of papillae, smooth, pale and shiny tongue
  - Angle of mouth e.g. redness, soreness and cracking
  - Pharynx & oesophagus e.g. dysphagia (Plummer-Vinson syndrome)
  - Nails e.g. flattening and thinning of nails, koilonychia

Severely pale conjunctiva



Cracked lips, angles of mouth, shiny tongue

Source: Internet

Koilonychia

- Features related to change of behaviour e.g. Pica (the compulsive ingestion of non-nutritive substances like clay, dirt, paint or others)
- Neurological & intellectual dysfunctions e.g. reduced attention span, alertness and reduced school performance
- Reduced immunity and frequent infections

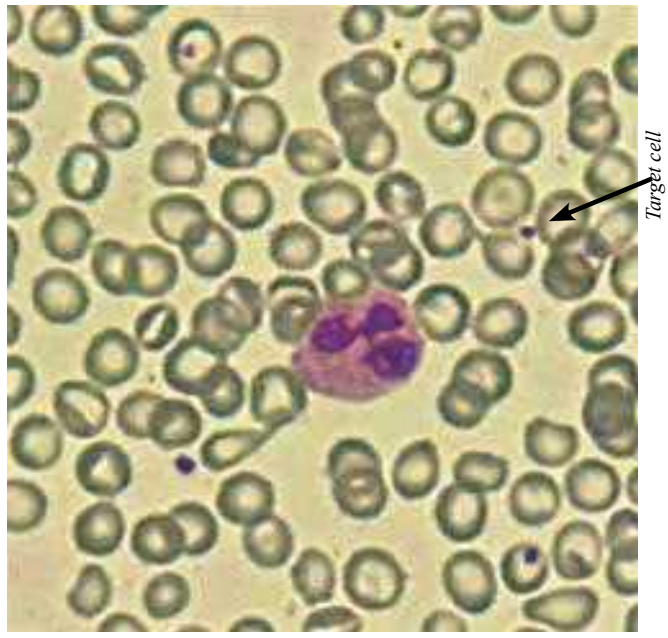
In addition, the affected child may have **breath-holding spells** (are brief periods, when young children stop breathing for upto 1 minute and often cause the chid to loose consciousness)

DIAGNOSIS

Based on C/F & supports from relevant investigations.

Investigations

- Complete blood counts: Hb% (reduced). TC and DC (normal), reticulocyte counts (low or normal). Platelet counts usually normal but occasionally may be high (thrombocytosis)



Microcytic and Hypochromic red cells with few target cells
Courtesy: Dr Akhil Ranjon Biswas

- Peripheral blood film: Shows microcytic hypochromic RBC with anisocytosis, poikilocytosis and occasional target cells
- RBC indices: MCV, MCH are reduced but RDW (red cell distribution width) is high
- Serum iron profile: S. iron and ferritin are low and Total Iron Binding Capacity (TIBC) is high
- Other investigations: May be directed towards detecting aetiology of iron deficiency e.g. stool R/M/E & for occult blood test (may be positive) & for helminth

The characteristic PBF features of IDA may mimic with that of–

- α / β thalassaemia trait
- Hemoglobin E trait/ disease
- Lead poisoning
- Anaemia of chronic disease e.g. JIA
- Sideroblastic anaemia

TREATMENT

The objectives are to–

- Restore haemoglobin level to normal
- Replenish the depleted iron stores and
- Treat the underlying causes
- Counsel the parents about the cause, consequences and importance of treatment and prevention of IDA
- Oral iron therapy: 3 mg of elemental iron/kg/day in 3 divided doses. It should be given about half an hour before meal to maximize absorption

NB: The choices are Ferrous sulphate, Ferrous fumarate and Iron polymaltose complex.

Duration of treatment: 6-8 weeks, after haemoglobin indices return to normal

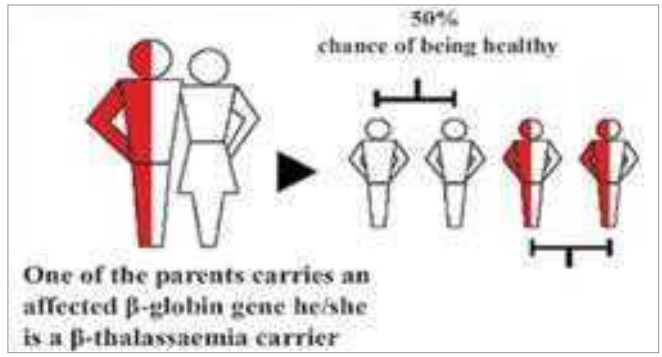
- Diet
  - Supplementation of diets rich in iron
  - Avoidance of foods deficient in iron
  - Avoidance of foods those interfere with iron absorption e.g. tea, coffee etc.
- Treatment of the underlying cause e.g. anthelmintics

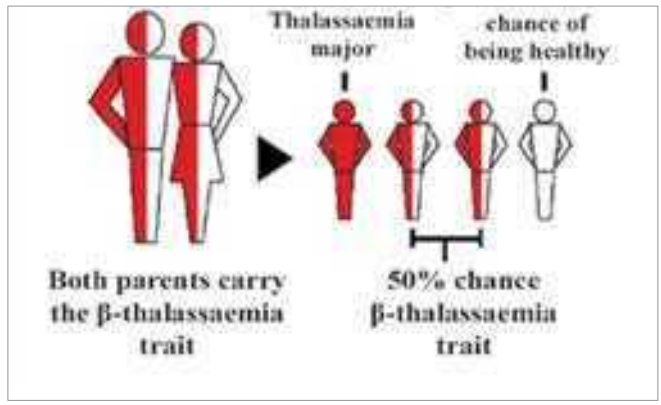
HEREDITARY HAEMOLYTIC ANAEMIAS (HHA)

These are a group of genetically determined disorders of RBC, characterized by excessive haemolysis. The defects/ deficiency attributed to RBC is present, either in–

- Membrane e.g. spherocytosis, eliptocytosis
- Enzymes e.g. deficiency of G6PD, pyruvate kinase
- Haemoglobin e.g.Thalassaemia syndromes, haemoglobinopathies

Of these, Thalassaemia syndromes and haemoglobin–opathies are the common haemolytic disorders, where the defective genes are inherited from the parents.





THALASSAEMIA SYNDROMES

These are inherited abnormalities in globin synthesis where, there is a **deficient production** of either α or β chains and the globin chains are **structurally normal**.

Based on the deficiency of either α or β chains, thalassaemias are of 2 types.

A. α thalassaemia (deficient production of **α** chain): It may be–

- Homozygous e.g. hydrops foetalis (α^0 or Hb Bart), or
- Heterozygous e.g. silent carrier (3α+), α thalassaemia trait (2α+) or Hb H (1α+).

B. β thalassaemia (deficient synthesis of **β** chains): It may be–

- β Thalassaemia major: They are transfusion dependent
- β Thalassaemia minor or trait: They carry the defective gene, completely asymptomatic and are identified incidentally
- β Thalassaemia intermedia: Their clinical phenotype is more than thalassaemia minor but milder than thalassaemia major. Their clinical behaviour is widely variable. Some of them, maintain Hb concentration of about 7-8 gram without transfusion but some may remain completely asymptomatic until adult life

HAEMOGLOBINOPATHIES

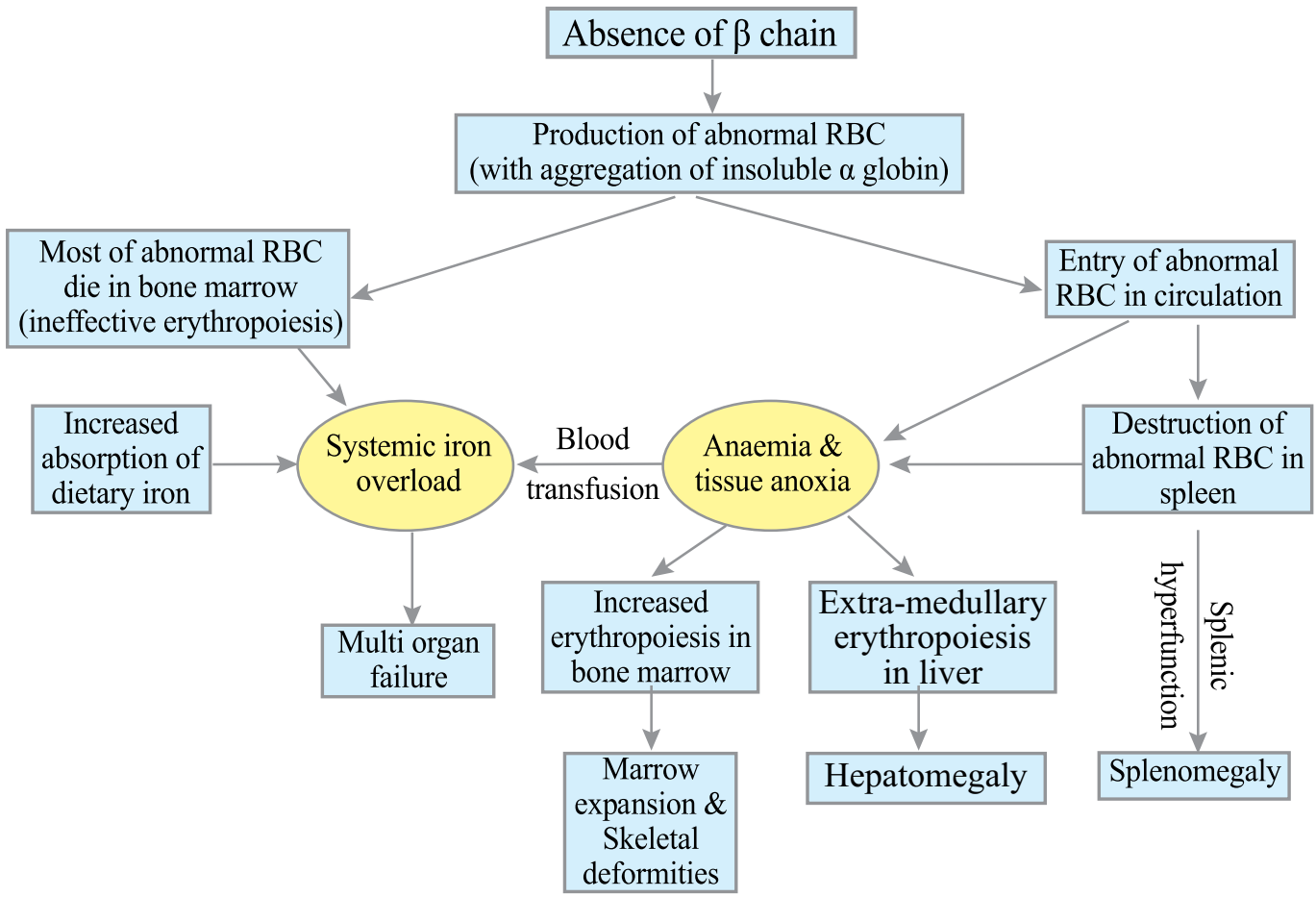
These are inherited disorder of haemoglobin where globin chains are **structurally abnormal**. The most important of these are HbE, HbS, HbC and HbD Punjab and all are the results of amino acid substitutions in globin chains. They may be either heterozygous or homozygous and their clinical presentations are variable.

Of the different types, HbE is most prevalent in South East Asia and is important because of it's combination with beta thalassaemia gene giving rise to HbE-beta/β thalassaemia and children having this combination suffer from severe anaemia like that of thalassaemia major and dependant on regular blood transfusion to survive.

Prevalence

Overall prevalence of β thalassaemia trait and Hb-E trait in Bangladesh are 4.1% & 6.1 % respectively.

BETA THALASSAEMIA MAJOR



Pathophysiology of β thalassaemia Major (Adopted from Robbin's & Cotran's pathology '2010)

PATHOGENESIS

In β thalassaemia major, due to absence or decreased β chain production, the unpaired α globin chains are accumulated as 'toxic inclusion bodies' in the developing erythroblasts and are causing their destruction within the bone marrow (ineffective erythropoiesis). The remaining defective RBC (carrying inclusion bodies), those escaping the destruction in the bone marrow, enter in the circulation and ultimately gets destroyed in the spleen (splenomegaly). This premature haemolysis causes 2 major clinico-pathological consequences–

- Severe anaemia
- Production of excess iron from haem fraction of haemoglobin of lysed RBC and their accumulation in the blood as well as in vital organs & causing their progressive dysfunction

To compensate severe anaemia, exaggerated erythropoiesis occurs both in the marrow spaces (medullary erythropoiesis) as well as in liver (extramedullary erythropoiesis). The marrow spaces thus expand due to erythroid hyperplasia which causes gradual thinning of cortical bone. The long bones in particular, become fragile and results in **pathological fractures**. Marrow expansion of the flat bones of skull and face (e.g. maxilla, zygoma) results in–

- Facial deformities
- Maxillary protrusion and mal-aligned jaw & teeth
- Prominence of Frontal and Parietal (bossing)

In addition, the untreated or partially treated children grow poorly (**growth failure**) and develop massive spleno–hepatomegaly.

CLINICAL MANIFESTATIONS

Affected child may be normal at birth but develop significant anaemia during their first year of life.

The common presentations are–

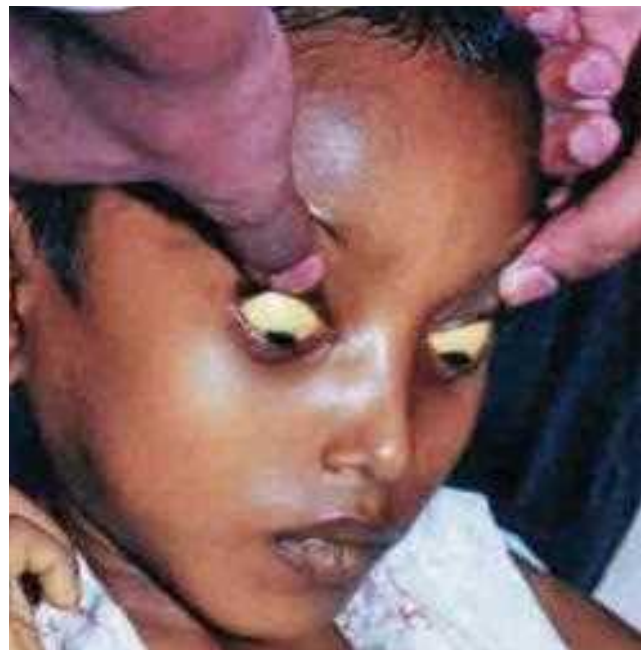
- Progressive pallor, lethargy and effort intolerance
- Failure to thrive and growth retardation
- Psychological depression
- Recurrent infections
- Problems in movement and abdominal discomfort because of massive spleno-hepatomegaly
- Sometimes, patient may present with features of complications like–
  - Respiratory distress due to anaemic heart failure
  - Gum bleeding, epistaxis etc. due to hypersplenism
  - Pathological fracture
- Sometimes, they may present with complications related to excess tissue deposition of iron–
  - Islets of Langerhans : Diabetes mellitus
  - Liver : Chronic liver disease
  - Heart: Cardiomyopathy, arrythmia, heart
  - Thyroid (hypothyroidism) Parathyroid (hypoparathyroidism), Gonads (hypogonadism, delayed puberty) etc.
  - Brain: Epilepsy, neuropsychiatric problem

Physical Examination

- Moderate to severe pallor

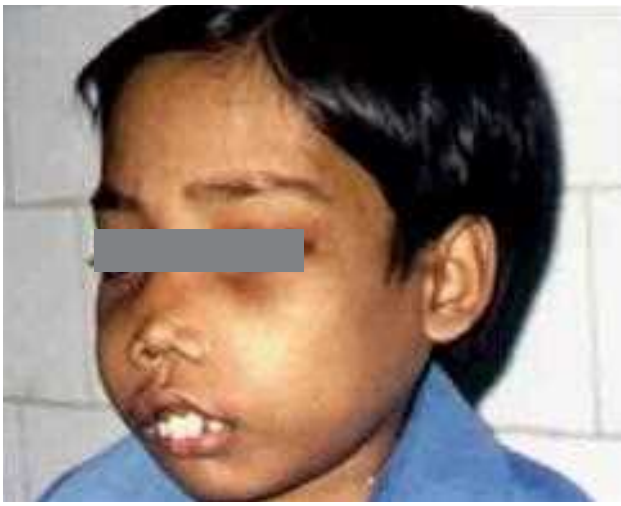
Pale palm

- Mild jaundice



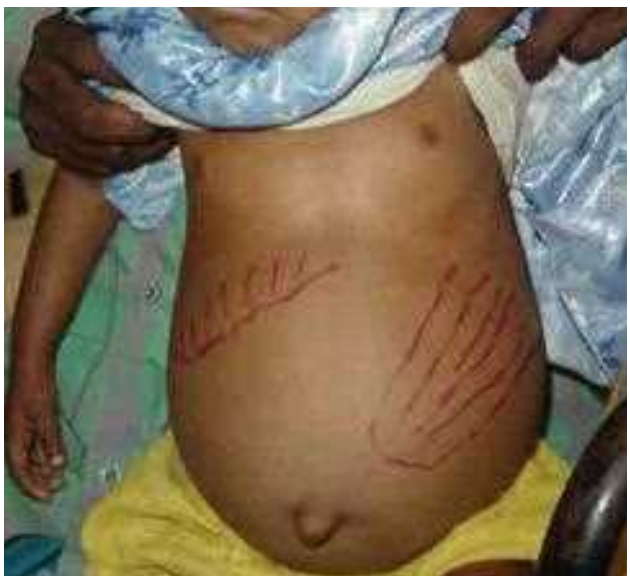
Jaundice

- Changes in facial profiles like frontal and parietal bossing, depressed nasal bridge, prominent zygoma, malaligned jaw and teeth (Thalassaemic facies)



Prominent zygoma, misaligned jaw and teeth

- Greenish brown complexion due to the effect of combined pallor, haemosiderosis and jaundice
- Growth failure (Stunting)
- Massive splenohepatomegaly.



Massive hepatosplenomegaly

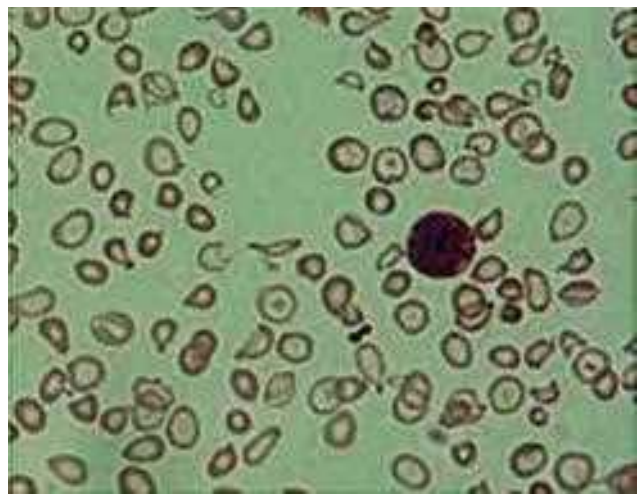
DIAGNOSIS

Based on C/F & supports from relevant investigations.

Investigations

A. Blood

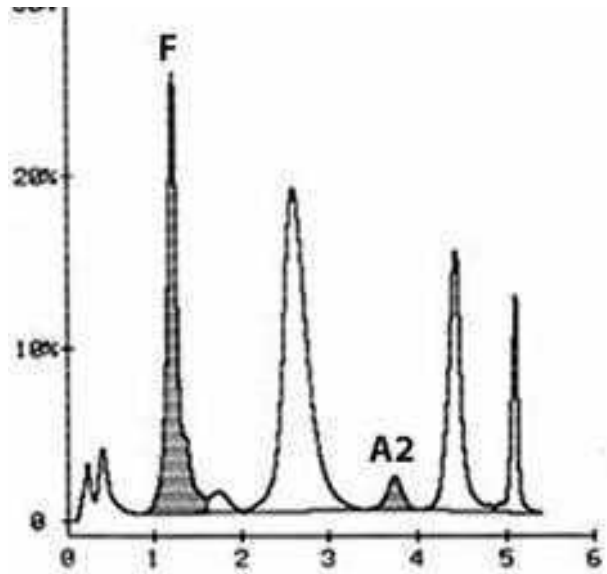
- Haemoglobin: Low, depending on the severity of the disease
- TC & DC: Normal, except when associated infection (leukocytosis) or hypersplenism (depleted)
- Platelet count: Usually normal except in hypersplenism (Thrombocytopenia)
- Reticulocyte count: Relative reticulocytopenia, commonly <8% (normal range 0.2-2%)
- Peripheral blood film: Shows microcytic hypochromic picture with marked anisocytosis & poikilocytosis. Appearance of abnormal cells like target cells, tear drop, pencil shaped cells, nucleated cells, schistocytes, fragmented cells



Courtesy: Dr. Akhil Ranjon Biswas

Hypochromia with plenty of tear drop calls, schistocytes, target cells and few nucleated RBC.

- RBC indices (MCV, MCH, MCHC): Low
- Serum iron and S ferritin: Increased
- S transferin saturation: Increased
- S Total iron binding capacity (TIBC): Decreased
- S unconjugated bilirubin: Usually increased
- Haemoglobin electrophoresis: Shows markedly reduced or absent HbA and raised HbF and HbA_2

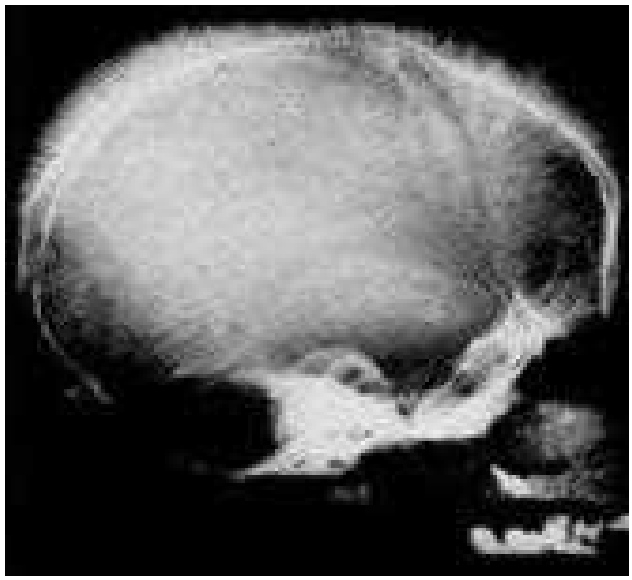


Summary of haematological changes in IDA & Thalassaemia major

Haematological parameter	Iron deficiency anaemia	Thalassaemia
Haemoglobin	Reduced	Markedly reduced
Platelet	Thrombocytosis	Normal or low
S. iron	Reduced	Raised
Ferritin	Reduced	Raised
TIBC	Raised	Reduced
RDW	Raised	Normal
MCHC	Reduced	Reduced
MCV	Reduced	Reduced

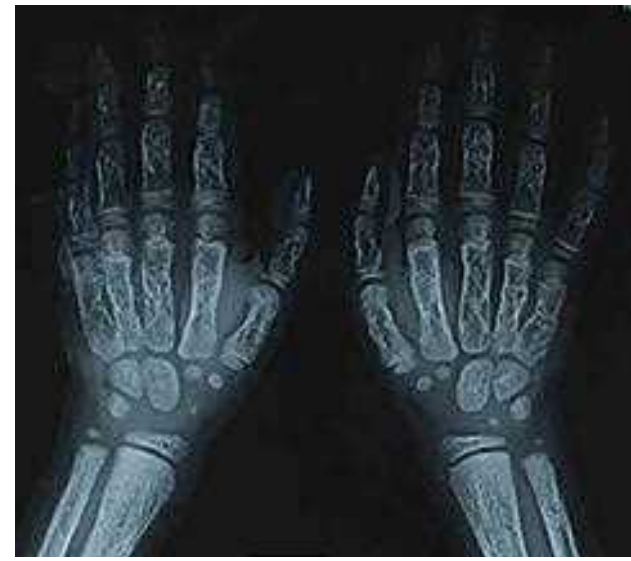
B. Radio-imaging

- X-Ray skull shows–
  - Increased diploic space
  - Hair on end appearance



Typical X-ray skull of thalassaemia Major

- X-Ray of long bones shows–
  - Lacy increased trabecular, mosaic patterns and
  - Osteopenia



X-ray hands showing mosaic pattern

Complications

- Growth retardation, Stunting
- Bony deformities: Deformed skull & facies
- Organ damage related to iron overload:
  - Heart (cardiomyopathy), liver (CLD) and endocrine system (hypothyroidism, diabetes mellitus, hypogonadism etc.)
- Recurrent infections/sepsis due to low immunity
- More chance of fractures as the bones are thin and brittle
- Spinal cord compression due to extramedullary haemopoiesis
- Massive splenomegaly causing worsening of anaemia & mechanical discomfort
- CCF from severe anaemia and cardiomyopathy
- Complications of blood transfusion *e.g,*
  - Allergic reaction
  - Acute haemolytic reaction
  - TRALI (Transfusion Related Acute Lung Injury)
  - TACO (Transfusion Associated Circulatory Overload)
  - Transmission of infectious agents e.g. HBV, HIV

TREATMENT

The affected children are transfusion dependent. In addition to regular blood transfusions, they require an integrated supports from Paediatrician, Haematologist, Psychologist and Transfusion specialists.

- Counseling parents–
  - Help them to understand the illness
  - Help the family to cope up with the illness and and encourage self-esteem
  - Genetic counseling and how to prevent the disease
- The major options of treatment are–
  - Conventional method
  - Bone marrow transplantation
  - Pharmacological methods to increase γ chain synthesis
  - Gene therapy

A. Conventional method: This includes–

I. Blood transfusion

To correct anaemia and to maintain satisfactory haemoglobin level, so as to–

- Ensure normal growth and to increase physical activity
- Minimize expansion of bone marrow

Childrens getting blood transfusion

Desferrioxamine infusion through pump

The adopted transfusion programme should maintain–

- Pre-transfusion Hb: > 9-10.5 gm/dl
- Post transfusion Hb: ~ 15 gm/dl
- Mean Hb: 12.5 gm/dl

However, a higher pre-transfusion Hb of 11-12 gm/dl is beneficial for thalassaemic child with cardiac disease.

The recommended **blood products** for transfusion are–

- Leuko-reduced packed RBC with a minimum haemoglobin content of 40 gm/dl
- Washed RBC
- Frozen or cryopreserved RBC
- Neocyte or young red cell

II. Iron chelation

Iron chelators are used to keep Iron in a safe zone, so as to prevent its deposition in vital organs. The iron chelators are–

- Desferrioxamine DFO, (Inj. Desferol 500 mg)
- Deferiprone (Cap Kelfer 500 mg)
- Deferasirox (Tab. Asunra 100, 400 mg)

Q. When to start iron chelation?

- Usually, after,10-20 transfusions OR
- When, S ferritin level >1000 ng/ml

Treatment is started with any of the iron chelators or with different chelators combinedly e.g. DFO at the time of transfusion and Deferiprone in between transfusions. Combined therapy is found more effective.

III. Diet & Nutrition

- The child can eat & drink almost everything that a normal child can. But better to avoid red meat, liver etc.
- Drinks like, tea, coffee decreases iron absorption, hence drinking these just after meal is beneficial
- Vitamin C, increases iron excretion by increasing the availability of chelatable iron. Dose: 2-3 mg/kg/day as supplements, to be taken at the time of DFO infusion so that iron is rapidly chelated and excreted through urine
- Vitamin E should be supplemented as an antioxidant to reduce iron induced oxidative damage of cells

N.B. Iron should not be Prescribed as supplement in Thalassaemia.

IV. Splenectomy

- Indications–
  - Transfusion requirement is > 200 ml of packed cells/kg/year
  - Massive splenomegaly is associated with–
    - mechanical discomfort
    - left upper quadrant pain
    - fear of rupture
    - early satiety

- **Prerequisites of splenectomy**
  - Age: More than 5 years (time needed for maturition of immune system)
  - Vaccination: Four weeks prior to surgery against *Strepcoccus pneumoniae, H. influenzae type b* and meningococcal meningitis
- **Care after splenectomy**
  - Oral Phenoxymethyl Penicillin (lifelong prophylaxis)
  - <2 years: 125 mg every 12 hours
  - >2 years: 250 mg every 12 hours
  - Prompt treatment of any infection

V. Treatment of complications e.g. Replacement of–

- Insulin (diabetes mellitus)
- Thyroxin (hypothyroidism) etc.

VI. Follow up

Monthly	• Complete Blood Count
Every 3 months	• S. ferritin, RBS, SGPT, albumin, creatinine
Every 6 months	• Cardiac evaluation e.g. echocardiography, ECG
Yearly	• Screening for infection: HBV, HCV, HIV • Screening for endocrinopathy: FT4, TSH, LH, Testosterone, Estradiol, GTT • Assessment of vision and hearing

- Other investigations to assess iron deposition in vital organs e.g.
  - MRI of heart, liver, endocrine glands
  - Measurment of hormones e.g. TSH, FT_4, GH, etc.

B. Bone marrow or stem cell transplantation from a HLA identical sibling donor

- The probability of haematological cure is >90%, when transplantation is done prior to the development of hepatomegaly or portal fibrosis

C. Pharmacological methods

- This is done to increase γ chain production so as to produce more HbF, through methylation of γ genes by drugs *like Hydroxyurea, Sodium phenyl butyrate and 5-azacytidine.* This helps to improve haemoglobin status of patients

D. Gene therapy

- Retroviral vector mediated gene transfer into the haemopoietic stem cells provide a potential cure of severe β Thalassaemia, but this modality is still in the experimental phase

THALASSAEMIA: PREVENTION

- **Carrier detection** among the general population through Lab assessment of blood CBC, PBF, MCV, MCHC & Haemoglobin electrophoresis. DNA analysis in confirmatory
- **Pre-marital counseling** among the population, specially among the carriers, how the disease is transmitted from one generation to the next and how to prevent
- **Antenatal detection**: When a carrier mother becomes pregnant, the status of the foetus whether having thalassaemia major, carrier or normal can be detected by chorionic villus sampling (CVS) and DNA analysis during 8-11th weeks of pregnancy

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the cardinal features of iron deficiency in IDA?
2. Write down the treatment of iron deficiency anaemia with duration.
3. What are the radiological findings of beta thalassaemia major?
4. What do you mean by the hyper-transfusion regimen of blood transfusion in thalassaemia?
5. What is the non-invasive way to assess iron-deposition in vital organs?
6. Write down 7 complications of thalassemia major.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Normal fractions of haemoglobin of a child include–
   ___ a) HbA ___ b) HbA2 ___ c) HbF ___ d) HbS ___ e) Hb Gower
2. The blood picture of beta thalassaemia major are–
   ___ a) microcytic hypochromic anaemia ___ b) target cells ___ c) nucleated RBC
   ___ d) normal reticulocyte count ___ e) high TIBC
3. The recommended iron chelators are–
   ___ a) Desferrioxamine ___ b) Deferiprone ___ c) Deferasirox
   ___ d) Hydroxyurea ___ e) 5-azacytidine
4. The pathological consequences of thalassaemia major are–
   ___ a) haemolysis ___ b) organ dysfunction ___ c) iron overload
   ___ d) iron deposition to vital organs ___ e) excessive medullary and extramedullary haemopoiesis
5. In iron deficiency anaemia serum iron profile shows–
   ___ a) low serum iron ___ b) low serum ferritin ___ c) high % saturation of iron
   ___ d) low total iron binding capacity ___ e) low marrow sideroblast
6. Pharmacotherapy in thalassaemia causes increased production of–
   ___ a) alpha chain ___ b) beta chain ___ c) gamma chain ___ d) delta chain ___ e) theta chain
7. The common clinico-haematological profile of iron deficiency anaemia include–
   ___ a) clubbing ___ b) Microcytic hypochromic anaemia

___ c) low serum total iron binding capacity ___ d) high serum ferritin level ___ e) low serum iron level

8. Iron deficiency anemia in children–
___ a) depressed motor & mental development ___ b) may have breath holding attacked
___ c) iron absorption is affected by vit C ___ d) macrocytosis found in blood film
___ e) 3-6 months treatment is required for improvement

9. Iron deficiency in childhood occur due to–
___ a) exclusive use of goats milk ___ b) heavy tea drinkers ___ c) in most cases of celiac disease
___ d) in adolescent girls during puberty ___ e) early weaning

10. Hypochromic microcytic anemia may be seen in–
___ a) iron deficiency anemia ___ b) beta thalassaemia ___ c) hereditary spherocytosis
___ d) vit B12 deficiency ___ e) glucose 6 phosphate deficiency

11. Drugs used to treat thalassaemia through γ chain production are–
___ a) Hydroxyurea ___ b) Sodium phenyl butyrate ___ c) Vitamin C
___ d) Deferasirox ___ e) Deferiprone

12. The haematological profile of thalassaemia includes–
___ a) low S. iron ___ b) high S. ferritin ___ c) high TIBC
___ d) high RDW ___ e) low MCV

13. Important follow-up investigations for a thalassemia patient include–
___ a) S. ferritin, ___ b) S. Testosterone ___ c) S. albumin
___ d) S. Estradiol ___ e) S. creatinine

14. Example of iron chelators include–
___ a) Desferrioxamine ___ b) Rituximab ___ c) Deferiprone
___ d) Cycloserine ___ e) Deferasirox

15. Complications of intramedullary erythropoiesis include–
___ a) Facial deformities ___ b) Dental mal-occlusions
___ c) Frontal bossing ___ d) Pathological fractures ___ e) Thinning of bony cortex

Chapter 24

Pallor, Bleeding and Fever

Whenever, children present with pallor, mucocutaneous bleeding and fever simultaneously i.e. features of RBC, platelets and WBC pathology, one should think that the problem is possibly in the bone marrow. In such situation, the following common bone marrow diseases should be considered–

- Leukaemia
- Aplastic anaemia
- Anyb one marrow infiltrating diseases

However, sometimes septicaemia/disseminated intravascular coagulation (DIC), hypersplenism also present with the above manifestations.

In this section acute leukaemia and aplastic anaemia will be highlighted.

LEUKAEMIA

Leukaemia, the commonest malignancy of children. It constitutes about 40% of the total childhood cancers. In addition to leukaemia, other childhood malignancies are–

- CNS tumor
- Lymphoma
- Neuroblastoma
- Hepatoblastoma
- Wilm's tumor
- Retinoblastoma
- Sarcoma e.g. rhabdomyosarcoma, osteosarcoma

Aetiology

- Unknown
- Genetic & chromosomal disorders
- Environmental factors e.g. radiation, viral infections, exposure to chemicals and cytotoxic drugs

Pathogenesis

Leukaemias are the primary malignancies of bone marrow, where haemopoietic stem cells undergone malignant proliferation. The malignant cells (blast cells) subsequently replace and occupy a major area of normal bone marrow, predominantly affecting the erythoid and megakaryocyte population. As a result, there is decreased production of RBC, mature WBC and platelets and the net clinical consequences of this malignant invasion are–

Paucity of RBC	Anaemia
Paucity of mature WBC	Immune suppression and infection
Paucity of platelets	Bleeding

Over a period of time, the leukaemic (malignant) cells gradually spill over into blood from bone marrow and from where, they may infiltrate into the extramedullary sites like, lymph nodes, liver, spleen, bone, brain, eyes, testes and other tissue throughout the body.

Types

Leukaemia may be acute or chronic and the common types are–

- Acute lymphoblastic leukaemia (75-80%)
- Acute myeloblastic leukaemia (12-15%)
- Chronic myelogenous leukaemia (5%)
- Others (7-8%)

Clinical Manifestations

- Non specific–
  - Profound loss of appetite, lethargy, irritability
  - Pain in different parts of body
- Specific–
  - Fever: May be prolonged or intermittent. It results from either leukaemia induced liberation of cytokines or secondary infections due to leukopenia/ immunosuppression
  - Progressive pallor

- Bleeding from gum, epistaxis, petechiae, purpura, ecchymosis etc.

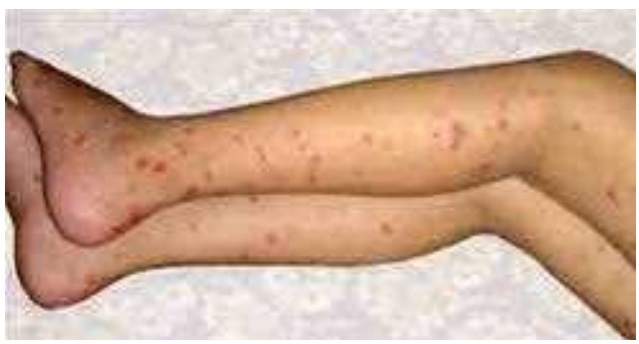
- Sometimes patients may have–
  - Convulsion and other neurological manifestations e.g. headache, vomiting, cranial nerve palsy etc. because of CNS/meningeal infiltration
  - Problems of vision because of infiltration to retina
  - Respiratory distress from the pressure effect of mediastinal mass on airway or from anaemic heart failure

Physical Examination

Physical findings at presentation are widely variable, ranging from normal to highly suggestive. The usual features are–

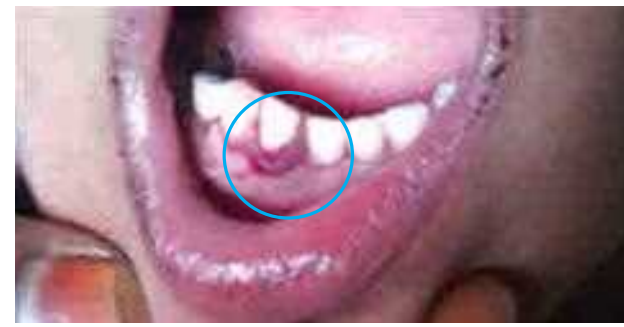
- Sick looking, irritable, febrile child

Pallor



Purpuric spots

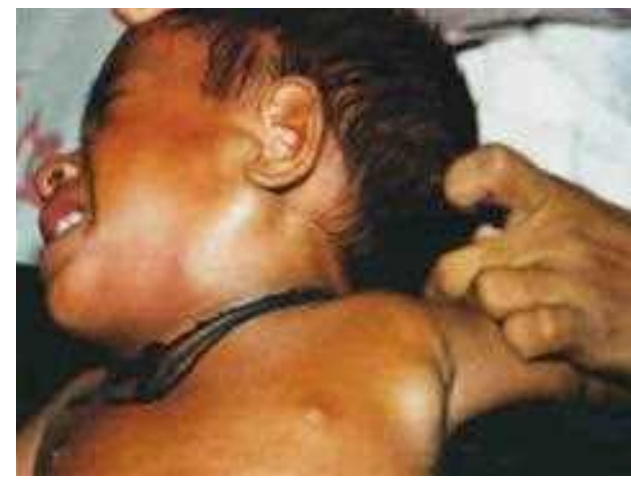
- Signs related to bone marrow dysfunction e.g.
  - raised body temperature (infection)
  - pallor (depleting haemoglobin)
  - petechiae, purpura, gum bleeding or epistaxis due to platelet depletion
- Hepatomegaly and splenomegaly
- Infections anywhere in the body
- Testicular swelling from infiltration of leukaemic cells



Gum bleeding

Infection at nose

- Lymphadenopathy: Either localized or generalized



Lymphadenopathy

- Bony tenderness over sternum, tibia

Bony tenderness

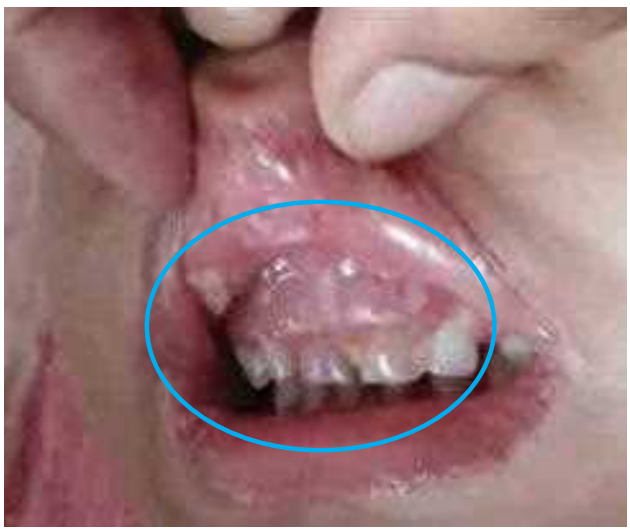
Acute Myeloid Leukaemia (AML)

The clinico-pathological behaviour of AML is more aggressive and has a high tendency to infiltrate into different organs. Here, bone pain & tenderness are more severe than ALL. In addition, patients may present with–

- Gingival hypertrophy, parotid swelling
- Proptosis
- Mediastinal mass with pressure symptoms (e.g. dyspnoea, superior vena caval syndrome) and

> Superior vena cava syndrome (SVCS), is a group of symptoms caused by obstruction of the superior vena cava. SVCS is characterized by–
>
> - Shortness of breath(most common symptom)
> - Headache
> - Facial swelling
> - Venous distention in the neck and distended veins in the upper chest and arms
> - Upper limb edema
> - Lightheadedness
> - Cough
> - Edema (swelling) of the neck, called the collar of Stokes

- Chloroma (solid collection of leukaemic cells outside the bone marrow)
- Hyperleukocytosis syndrome with life-threatening complications e.g. venous stasis & sludging of blast cells in small vessels cause hypoxia, haemorrhage and infarction, most notably in lungs and brain
- When leukaemic cells infiltrate in the skin (leukaemia cutis)



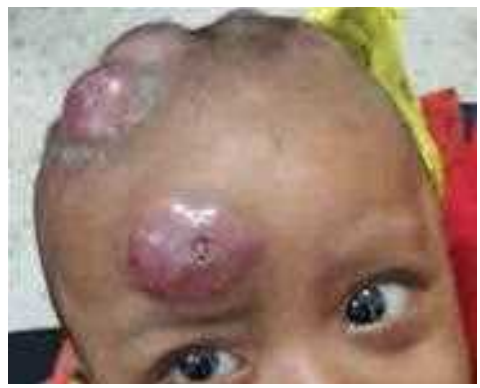
Gingival hypertrophy

Infiltration of leukaemic cells to eye

Aleukaemic/subleukaemic leukaemia

A type of leukaemia in which the total leukocyte count remains within normal limits or low and few abnormal forms appear in the peripheral blood. Diagnosis requires bone marrow study. About 30% of leukaemic patients may present in this way.

Chloroma



Leukaemia cutis in a 6 months old boy

> **Aleukemic leukemia**
>
> A type of leukemia in which the total leukocyte count remains within normal limits or is low and few abnormal formsappear in the peripheral blood. Diagnosis requires bone marrow biopsy. It occurs in 30% of all patients with leukemia,regardless of the specific type.

DIFFERENTIAL DIAGNOSES

- Aplastic anaemia
- ITP
- Kala-azar

DIAGNOSIS

Based on C/F & supports from relevant investigations.

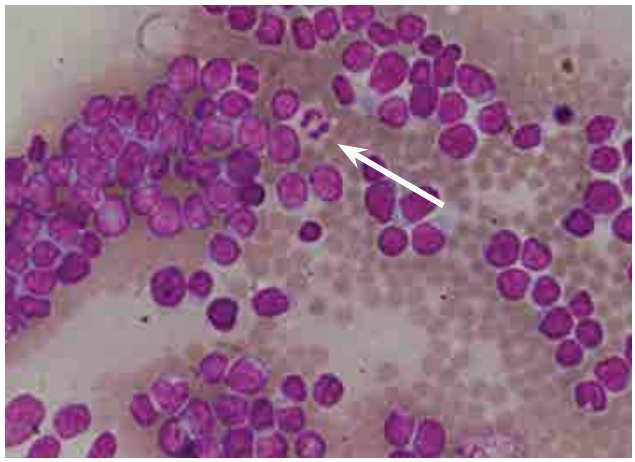
Investigations

- CBC with PBF
  - Haemoglobin level: Reduced
  - Total counts of WBC: Usually high, but may be normal or low (in aleukaemic leukaemia)
  - Differential counts of WBC: Depending on the type of leukaemia, cell lines may be changed. Characteristic feature is the presence of **blast cells**
  - Platelet count: Low
  - Peripheral blood film: RBC; Normal/low, WBC series shows **blast cells** & platelets reduced

Courtesy: Dr. Akhil Ranjon Biswas

PBF showing lymphoblast

- Bone marrow study
  - Cellularity: Hypercellular
  - M:E ratio: Increased
  - Granulopoiesis: Increased
  - Erythropoiesis: Reduced
  - Megakaryopoiesis: Reduced
  - **Blast cells of >25% is diagnostic**



Courtesy: Dr. Akhil Ranjon Biswas

Bone marrow showing lymphoblast

- CSF examination
  - Atypical/blast cells may be found in CNS leukaemia
- Other investigations
  - X-Ray chest :May show mediastinal widening/ anterior mediastinal mass, tracheal compression from lymphadeopathy or thymic infiltration specially inT cell leukaemia
  - X-Ray of long bones & spines: Demineralization, periosteal elevation, growth arrest lines, compression of vertebral bodies
  - Ultrasonogram of abdomen: May show kidney enlargement from leukaemic infiltration, intra-abdominal lymphadenopathy
  - S Uric acid, S LDH: Uusually elevated
  - S electrolytes, Ca, PO_4: May be altered
  - S creatinine: Raised, in uric acid nephropathy from rapid lysis of blast cells and metabolism of bases
  - Flow cytometry of marrow cells: To characterize the types of leukaemia

TREATMENT

Counsel parents about the disease, its management and prognosis.

A. Supportive

- Diet: Nutropenic diet (freshly prepared food, low microbial diet). Thin peeled fruits are restricted.
- To treat & prevent infections by–
  - Antibiotics: Broad spectrum covering both gram positive and gram negative organisms to treat any associated infection
  - Cotrimoxazole, 12 hourly twice a week throughout the treatment
  - Clotrimazole/Nystatin drop, orally, 2.5 ml 6 hourly throughout the treatment
  - Chlorhexidine mouth wash(mixed with water) 12 hourly throughout the treatment
  - Acriflavine hip bath (acriflavin mixed with warm water to clean the perinium), 12 hourly throughout the treatment
  - Maintenance of total hygiene in the living area
  - Barrier nursing
- Ranitidine IV/PO, 12 hourly when steroid is in regim
- To correct anaemia & thrombocytopenia: Transfusion of blood products or whole blood
- To treat fever: Oral paracetamol (not suppository)

- **Pre-chemo measures**

To reduce leukaemic cell induced aemoconcentration	IV fluid 2-2.5 L/m²/day for first 48 hours
To reduce risk of uric acid nephropathy	Allopurinol 100 mg/m²/ dose, 8 hrly (start 24 hours before chemo and continue for 14 days)
To reduce metabolic acidosis	Inj. Sodi-bicarb 25ml in 500 ml IV fluid
For emergency medical de-bulking of tumour cell load	Tab Prednisolone 60 mg/ m²/day, orally

B. Specific

- **Chemotherapy**: This is a protocol based **(UKALL2003 Regimen A)** multi-staged poly-chemotherapy schedule, currently used in Bangladesh.
- **Bone marrow transplantation**: The curative treatment of leukaemia

Multi-stage poly Chemotherapy sehedule (UKALL 2003)

Induction of Remission Phase: 1	Weeks: 1-5	Vincristine, IV on D2,9,16,23 and 30 L-asparaginase IM on D4, 6, 8, 10, 12, 14, 16, 18, 20 (9 doses) Triple IT (MTX +Cyt+Hct) on D 1, 8, 15, 22 and 29 Dexamethasone PO, D1-28, then taper within 7 days 6-Mercaptopurine PO once at night from D 29-35
Early Intensification Phase: 2	Weeks: 6-8	6-mercaptopurine PO, once daily Triple IT (TIT) weekly
Interim maintenance Phase: 3	Weeks: 9-16	6-mercaptopurine PO, once daily up to week 15 Methotrexate PO, on Week 9, 10, 12, 13, 14, 16 TIT on week 11 and week 15 Vincristine IV, on the 1st day of week 9 and week 13
Delayed Intensification Phase: 4	Weeks: 17-20	TIT on the 1st day of Week 17 Vincristine IV, on the 2nd day of week 17, 18, 19 Doxorubicin IV, on 2nd days of week 17, 18, 19 L-asperaginase IM, every alternate day from D2 of week 17 Dexamethasone PO, for 7 days on week 17 and week 19
Delayed Intensification **Part-2,** Phase: 4	Weeks: 21-23	TIT on the 1st day of week 21 and week 22 Cyclophosphamide IV, on the 1st day of week 21with mesna /uromitoxan rescue Cytarabine IV,from D 2-5 of week 21 and week 22 NB:Dexamethasone eye drops 6 hourly to be started 24 hours before Cytarabin to 48 hours after Cytarabine therapy to avoid chemical keratitis as Cytarabine excretes through tears 6-mercaptopurine PO, once daily from the 1st day of week 21 to the last day of week 22
Maintenance therapy **Cycle: 1-12**	Weeks: 24-166 (Boys) Weeks: 24-112 (Girls)	Vinristine IVmonthly TIT every 3 monthly 6-mercaptopurine PO daily Methotrexate PO, weekly Dexamethasone PO, D1-5 from the day of IV Vincristine

**MTX+Cyt+Hct (Methotrexate + Cytarabine + Hydrocortisone) – Triple IT*

Prognosis

Childrens with ALL are expected to have a long-term survival rate of >80%, at 5 years from the diagnosis.

Poor prognostic criteriae (High risk)

- Age <1 year or >10 years at diagnosis
- Leukocyte count of >50,000/µL at diagnosis
- Slow response to initial chemotherapy
- Chromosomal abnormalities e.g. hypodiploidy, presence of Philadelphia chromosome and translocations [t (1:19) or t (4:11)]

Good prognostic criteriae

- Age: 1-9 years
- Initial WBC count: <50,000/ mm3
- Early response to induction chemotherapy
- Chromosomal alterations e.g. combinations of trisomies of chromosomes 4, 10 and 17
- Absence of Philadelphia chromosome
- B-Lymphoblastic type of leukaemia
- Absence of CNS disease

APLASTIC ANAEMIA

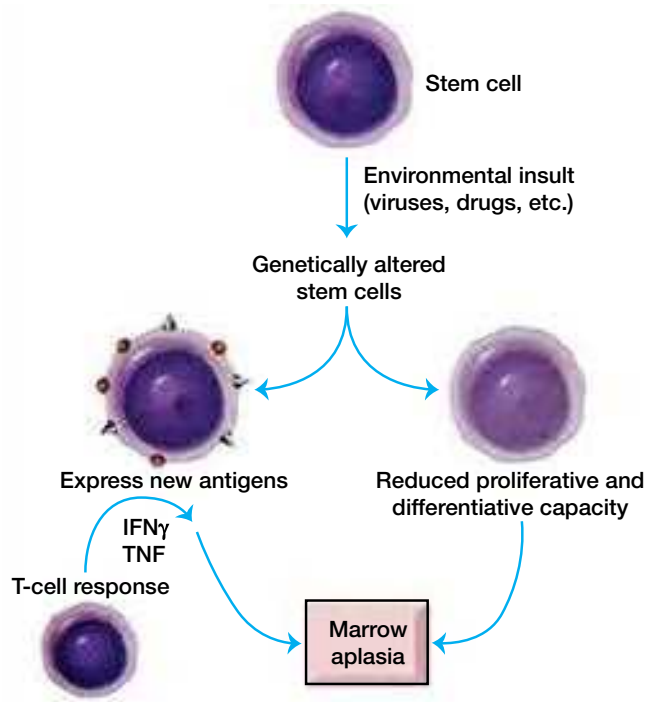
It is the failure of the bone marrow to produce adequate number of circulating blood cells e.g. RBC, WBC, platelets, resulting in peripheral pancytopenia.

Aetiology

- Idiopathic (>50% cases)
- Secondary
  - Viral infections e.g. HBV, EBV, HIV, parvovirus B19
  - Idiosyncratic reactions to drugs e.g. Phenylbutazone, Sulfonamides, NSAID and anticonvulsants
  - Exposure to radiation and chemicals e.g. benzene,insectiside, heavy metals drugs and elements e.g. chloramphenicol phenylbutazone, gold
- Congenital e.g. Fanconi's anaemia

Pathogenesis

The mechanism of marrow aplasia is not fully understood but is thought to be **immune-mediated** suppression & killing of haematopoietic progenitors. In addition, there is development of a clonal population with reduced proliferative and differentiative capability. Sometimes, intrinsic abnormality of stem cells may also predispose to DNA damage and marrow aplasia.



Pathogenesis of aplastic anaemia Adopted from Robbon & Cotran's pathology, 8th edition'2015

Clinical Manifestations

The cardinal features of bone marrow failure are related to pancytopenia that includes–

Clinical features	Related to
• Pallor and nonspecific symptoms e.g. weakness, fatigue, anorexia etc.	Low haemoglobin

• Bleeding in–
  ▫ Skin: petechiae, purpura, ecchymoses
  ▫ Mucosa: gum,nose,conjunctiva etc.
  ▫ Internal organs: brain, kidney, gut etc.
	Low platelet

• Frequent severe infections e.g. septicaemia, meningitis • Infections with fungus & unusual pathogens	Low WBC

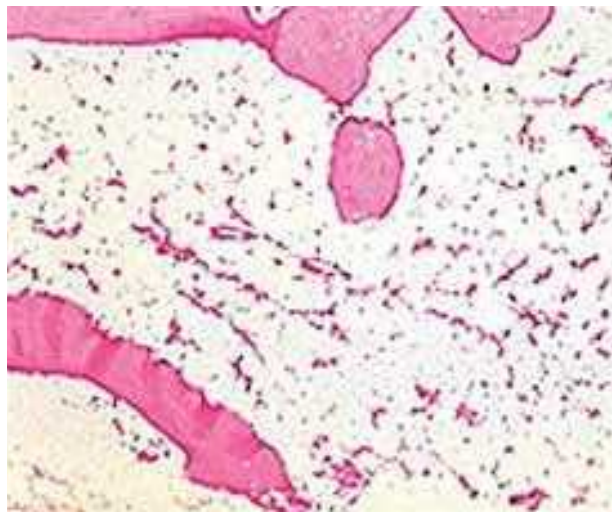
Aplastic child with severe anaemia & bleeding from multiple sites

DIAGNOSIS

Based on C/F & supports from the relevant investigations.

Investigations

- CBC with PBF
  - Usually pancytopenia (low Hb, leukopenia and thrombocytopenia). Occasionally bi/ monocytopenia
  - Reticulocytes: Low
  - PBF: Normocytic anaemia, Noabnormal cells
- Bone marrow findings
  - Cellularity:Markedly hypocellular marrow, largely devoid of haematopoietic cells, often there is presence of only fat cells, fibrous stoma and few scattered lymphocytes and plasma cells
  - Markedly reduction in granulopoiesis, erythropoiesis and megakaryopoiesis
- Other investigations
  - Chromosomal analysis: To assess chromosome break & rearrangements in peripheral lymphocytes as seen in Fanconi's anaemia
  - Cytogenetic analysis of marrow particles to predict the subsequent development of leukaemia
  - Viral markers e.g. HBsAg



Source: Internet

Aplastic bone marrow

TREATMENT

A. Counsel parents, about the disease, it's treatment and the consequences

B. Comprehensive supportive care
  - Quick evaluation of a febrile case and prompt starting of broad spectrum parenteral antibiotics. Consider adding anti-fungal drugs, if necessary
  - Transfusion of peaked cells to alleviate symptoms of anaemia. Platelet transfusion may be required in life-threatening bleeding
  - Diet: Neutropenic. Raw meats, dairy products, fruits and vegetables that are likely to be colonized with microbes should not be given to the patient

C. Immunomodulation with–
  - Anti-thymocyte globulin
  - Cyclosporine
  - Tacrolimus (associated with a high response rate and overall survival)

D. Haematopoietic stem cell transplantation: The specific treatment

Prognosis

- Bone marrow transplantation (BMT) from HLA-identical sibling ensures long-term survival of >80%

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]S

1. What are the common childhood cancers?
2. What are the different steps of treatment of acute leukaemia?
3. Name 5 chemotherapeutic agents used for treatment of acute lymphoblastic leukaemia?
4. What are the pre-chemo measures to be taken during treatment of a leukaemic child?
5. Outline the principles of treatment of aplastic anaemia.
6. Write down the clinical features of acute leukaemia.
7. How will you investigate acute leukaemia?
8. How will you investigate aplastic anaemia?
9. A 5 year old boy presented with fever and pallor for last 2 months along with hepatosplenomegaly.
   a) Write three common differential diagnosis. b) How will you investigate the boy?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Blood picture of acute leukaemia includes–
   ___ a) leukocytosis ___ b) thrombocytopenia ___ c) nucleated RBC
   ___ d) target cells ___ e) immature WBC (blast cells)
2. Thrombocytopenia is found in–
   ___ a) ITP ___ b) haemophilia ___ c) von Willebrand disease
   ___ d) acute leukaemia ___ e) Henoch-Schönlein purpura
3. A child with aplastic anaemia may present with–
   ___ a) fever ___ b) severe anaemia ___ c) bleeding manifestation
   ___ d) hepatosplenomegaly ___ e) generalized lymphadenopathy
4. Poor prognostic criteriae of ALL includes the associated–
   ___ a) chromosomal abnormality ___ b) high leukocyte count ___ c) thrombocytopaenia
   ___ d) ALL in infants ___ e) rapid response to therapy
5. Immunotherapeutic agents for aplastic anemia include–
   ___ a) Anti Thymocytic Globulin ___ b) Granulocyte Colony Stimulating Factor
   ___ c) Tab. Cyclophosphamide ___ d) Cap. Cyclosporine ___ e) Tab. Prednisolone
6. The drugs used for maintenance treatment of ALL include–
   ___ a) Etoposide ___ b) Methotrexate ___ c) Daunorubicin
   ___ d) Cotrimoxazole ___ e) Marcaptopurine
3. Common childhood malignancies include–
   ___ a) Neuroblastoma ___ b) Hepatoblastoma ___ c) Adenocarcinoma
   ___ d) Lymphoma ___ e) Cholangiocarcinoma

Chapter 25

Bruising and Bleeding

When a child presents with bleeding, the following conditions should be taken into consideration–

- Idiopathic thrombocytopenic purpura (ITP)
- Leukaemia
- Dengue haemorrhagic fever (DHF)
- Aplastic anaemia
- Haemophilia A, B
- von Willebrand disease
- Henoch Schönlein purpura

Rarely thrombasthenia e.g. Glanzmann disease and Bernard Soulier syndrome may also present with bleeding.

In this chapter, ITP, haemophilia and von Willebrand disease will be discussed.

IDIOPATHIC THROMBOCYTOPENIC PURPURA (ITP)

This is the most common bleeding disorder of children where platelets are coated by a circulating antibody, developed against platelet glycoprotein antigens and eventually destroyed in the spleen.

Types

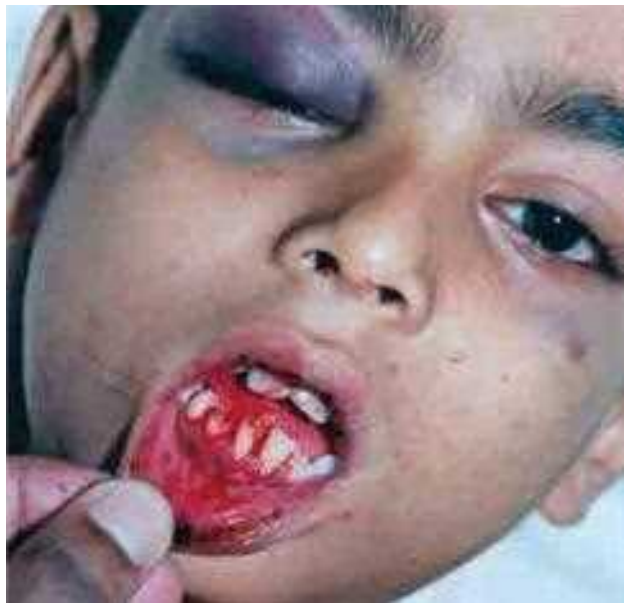
- Acute ITP
- Chronic ITP (persistent thrombocytopenia >12 months)

Aetio-pathogenesis

Unknown. However, in about 50-60% cases, this platelet destruction may follow an episode of viral upper respiratory tract infection about 2-3 weeks prior to the bleeding episodes. The viruses commonly involved are Epstein–Barr virus (EBV), Rubella, Varicella, Measles, Parvovirus B19 and Influenza. The viruses produce anti-platelet antibodies and these coat the circulating platelets and the coated platelets are finally destroyed and removed by the spleen.

Clinical Manifestations

- Sudden onset of muco-cutaneous bleeding (distinguishable from coagulopathy) in a previously healthy child
  - Skin: petechiae, purpura, ecchymoses and easy bruising
  - Mucosa: bleeding from gum, nose, conjunctiva, menorrhagia

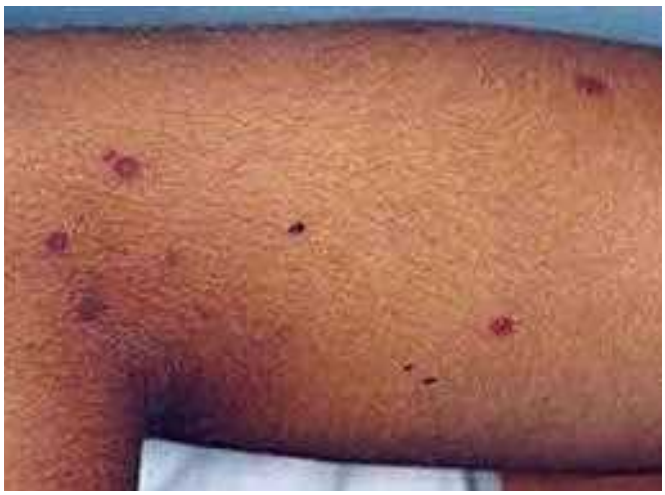


Periorbital ecchymosis & gum bleeding

- Internal bleeding e.g. haematuria, haematemesis & malaena, haemoptysis and intracranial bleeding are uncommon but can occur in severe thrombocytopenia and may be fatal

Physical Examination

- Evidence of bleeding in
  - Skin e.g. petechiae, purpura or ecchymosis
  - Mucosa e.g. nose, gum, oral cavity, conjunctiva



Multiple purpuric spots, do not blanch on pressure

However, patients neither have significant pallor, hepatosplenomegaly, lymphadenopathy nor bony tenderness.

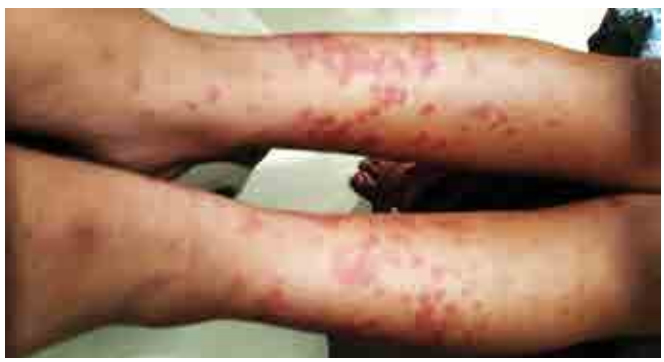
DIFFERENTIAL DIAGNOSES

- Henoch Schönlein purpura
- Dengue haemorrhagic fever (DHF)
- Leukaemia
- Aplastic anaemia
- Meningococcal septicaemia

I. Skin rash of Henoch-Schönlein purpura

(Anaphylactoid purpura: Immune mediated vasculitis)

These rashes are characterized as palpable purpura that evolve from red to purple and then to rusty brown

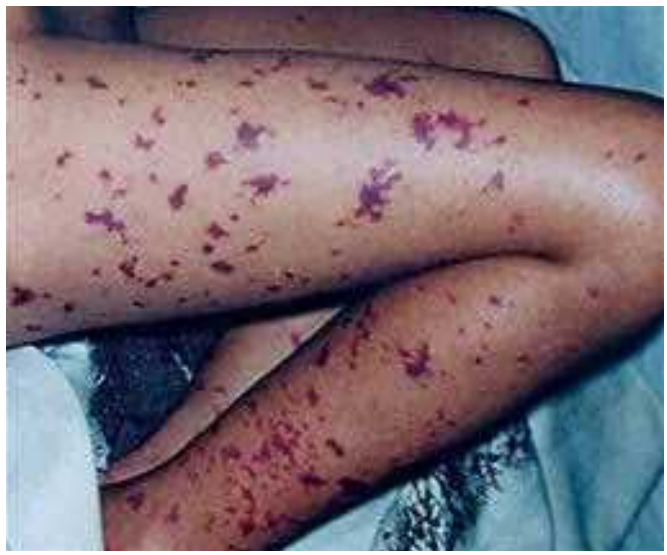


Skin rash of HSP

before they eventually fade. These are non tender, do not blanch on pressure. Lesions usually involve buttock, lower extremities and the hands (**waist down distribution**).

II. Skin lesions of acute meningococcaemia

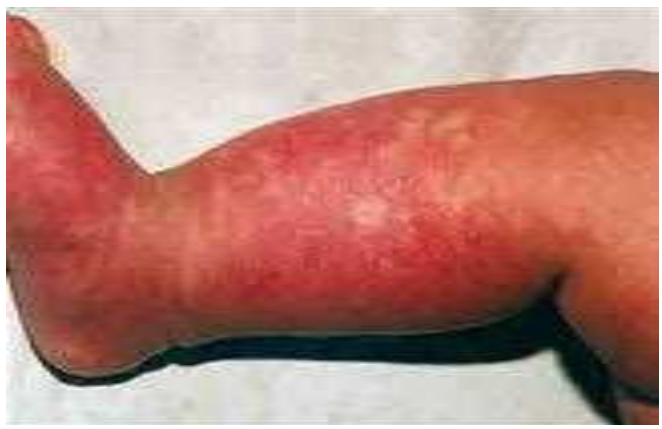
Lesions consist of tender pink macules, petechiae and purpura. These are most prominent on the extremities and may progress to form areas of frank necrosis.



Skin lesions of acute meningococcaemia

III. Skin lesions of Dengue fever

Transient macular rash in first 1-2 days, maculopapular, scarlet morbilliform, from day 3-5.



Skin rash of DHF

Clinical severity of acute ITP

- **Mild**: Bruising and petechiae, occasional minor epistaxis, very little interference with daily living
- **Moderate**: More severe skin and mucosal lesions, more troublesome epistaxis and menorrhagia
- **Severe:** Bleeding episodes e.g. menorrhagia, epistaxis, melena, requiring transfusion or hospitalization. Symptoms interfere seriously with the quality of life

DIAGNOSIS

ITP is diagnosed by–

- Excluding other causes of thrombocytopenia e.g. acute leukaemia, aplastic anaemia
- Analysing the clinical & laboratory data of the case

Investigations

- CBC & PBF
  - Haemoglobin: Usually normal unless massive haemorrhage
  - TC and DC of WBC: Usually normal
  - Platelet counts: Low
  - PBF: RBC (normal), WBC (mature). No blast cells. Larger platelets may be seen
- Coagulation profile (usually not required to do):
  - **Bleeding time (BT): Prolonged**
  - Prothrombin time (PT): Normal
  - aPTT: Normal
- Bone marrow study: Generally, not required for patients with isolated thrombocytopenia, who fit the diagnostic criteriae above, but indicated, when–
  - Patients fail to respond to the recommended therapy for ITP
  - Cell lines, other than platelets are affected
  - Steroid is planned to treat the case
  - Bone marrow study findings: Megakaryocytes are increased. Erythroid and myeloid cellularity as well as myeloid erythroid ratio are normal

Differences between acute ITP, leukaemia and aplastic anaemia

A. Clinical

Parameters	Acute ITP	Acute leukaemia	Aplastic anaemia
Skin/gum/nose bleeding	Present	Present	Present
Fever	Usually absent	Usually present	Usually present
Appearance	Normal	Sick, irritable	Sick
Pallor	Insigni-ficant	Severe	Severe
Lymph-adenopathy	Absent	Present	Absent
Bony tenderness	Absent	Present	Absent
Liver size	Normal	Enlarged	Normal
Spleen size	Normal	Enlarged	Normal

B. Laboratory

Parameters	Acute ITP	Acute leukaemia	Aplastic anaemia
Haemo-globin	Normal or slightly reduced	Low	Low
WBC count	Normal	Usually very high	Low
Platelet counts	Low	Low	Low
Blood film	Normal	Presence of Blast cells	Pancytopenia but cell morphology are normal
Bone marrow findings	Increased mega-karyocytes	Hypper cellular Blast cells >25% in diagnostic	Markedly hypocellular marrow, devoid of haematopopietic cells

TREATMENT

Acute ITP is a self limiting disease and > 80% of children require no therapy. Only–

- Counseling to parents & patients about the disease
- Close observation of the patients
- Avoidance of aspirin, NSAID and
- Restriction from physical contact activities are recommended.

However, when platelet count falls <20,000/cmm, treatment is required to induce a rapid rise of platelets to the safe level. The following drugs are recommended in this situation–

- **IVIG**: The treatment of choice for severe, acute bleeding and may also be used as an alternative or adjunct to steroid in both acute and chronic ITP. Dose (0.8-1.0 g/kg/day) for 1-2 days. It induces a rapid rise of platelet count (>20 × 10^9/L) in 95% of patients within 48 hours. IVIG appears to induce the response by down regulating Fc-mediated one phagocytosis of antibody-coated platelets
- **Prednisone**: Patients with clinically significant but non-life-threatening bleeding may benefit from a short course of steroid. Dose (1-4 mg/kg/day), continued for 2-3 weeks until platelet count is >20 × 10^9/L
- **IV anti-D** to Rh-positive patients: Single dose (50-75 µg/kg) induces a rapid rise of platelet count >20 ×10^9/L within 48-72 hours in 80-90% of patients. This polyclonal immunoglobulin binds to the D antigen on RBCs. The splenic clearance of anti-D-coated RBC interferes with removal of antibody-coated platelets, resulting in improvement in thrombocytopenia

- Other options–
  - Splenectomy: Reserved for refractory thrombocytopenia with life-threatening haemorrhage.
  - Platelet transfusion: Usually not indicated in acute ITP because the transfused platelets will be coated with anti-platelet-antibodies and destroyed. If it is life-saving, transfuse along with IVIG or steroid

Treatment of chronic ITP

- Splenectomy & post-splenectomy penicillin prophylaxis, induces complete remission in 65-90% of cases
- Monoclonal anti-B cell antibody e.g. Rituximab
- Drug that stimulates thrombopoiesis e.g. Romiplostin
- IVIG (1g/kg/dose), every 2-6 weeks
- Immunosuppressive drugs Azathioprine, Cyclosporin

Prognosis

About 80% of children with acute ITP will achieve a remission and 20% may turn into chronic ITP and the predictors of chronicity are • female gender • age>10 years at presentation • insidious onset of bruising and • presence of other autoantibodies.

HAEMOPHILIA

The commonest hereditary coagulopathy from deficiency of factor VIII, IX and XI. The prevalence of haemophilia are as follows–

- Haemophilia **A** (Classical):1 in 5,000 males
- Haemophilia **B** (Christmas disease):1 in 30,000 males

These, along with von Willebrand disease accounts for >90% of hereditary coagulopathies.

- Haemophilia **C** contributes about <5% of all haemophiliacs

Types, deficient factors and inheritence

- **Haemophilia A:** Deficiency of factor VIII (X-R)
- **Haemophilia B:** Deficiency of factor IX (X-R)
- **Haemophilia C:** Deficiency of factor XI (A-R)

In this section, we will concentrate on haemophilia A & B.

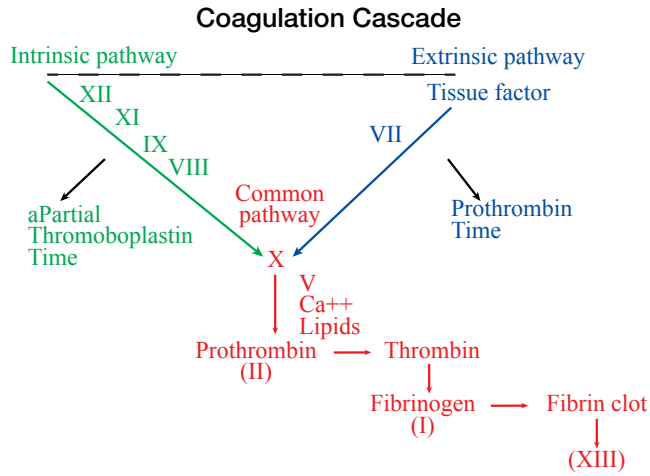
PATHOGENESIS

Both haemophilia A & B exhibit **X-liked Recessive** characters where males suffer and females carry the disease. Family history of bleeding in relatives on maternal side is present in about 80% cases. In about 20% cases, family history of bleeding is absent and this is perhaps due to new mutation of genes that regulate the synthesis of factor VIII and IX.

The genes for synthesis of both factor VIII & IX are present on X chromosome. Due to mutation of the genes, the haemophiliacs have reduced synthesis of either VIII or IX. This adversely affects the intrinsic coagulation cascade with delay in clot formation and consequent prolonged bleeding.

Neither factor VIII nor IX cross placenta and thus bleeding may present since birth or even in utero.

The mode of inheritence of haemophilia C, on the otherhand is autosomal recessive, where both males & females can suffer from the disease.



Clinical Severity

Severity of haemophilia is related to the concentration of factor VIII or IX present in plasma and is expressed as percentage or level of activity.

For example–

If 1 unit of either factor VIII/IX is present in 1 ml of plasma, then it is equivalent to 100% factor activity.

Severity	Level of VIII or IX activity	Patterns of Haemorrhage
Severe	<1%	**Spontaneous**: Deep soft tissue haemorrhage & haemarthrosis
Moderate	1-<5%	**Mild to moderate trauma:** Gross bleeding. Seldom spontaneous haemorrhage. Sometimes, haemarthrosis
Mild	5-25%	Moderate haemorrhage only following moderate to severe trauma or Surgery

CLINICAL MANIFESTATIONS

- Bleeding is the main symptom. Depending on the extent of factor deficiency, bleeding may be either spontaneous or following trauma. It may occur at any age and anywhere in the body
- Deep-seated bleeding induced by relatively minor trauma are characteristics of coagulopathy

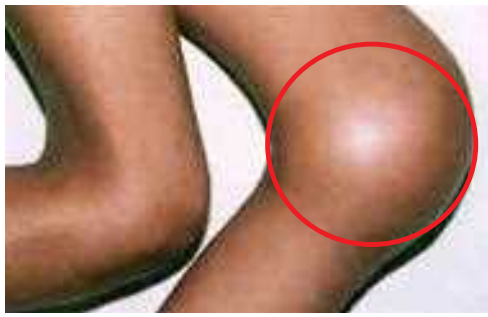
Neonatal, Infancy & childhood bleeding

- There may be history of bleeding from umbilical cord, cephalhaematoma or intracranial haemorrhage in newborn
- Easy bruising, formation of haematoma or haemarthrosis may occur at crawling, walking and following vaccination
- Excessive bleeding following circumcision may be the first presentation of haemophilia
- Prolonged bleeding may also occur at the time of teething

Sites of Bleeding

I. Joints

Haemarthrosis is the hallmark of haemophilia. Haemarthrosis begins in toddler age and ankle joints are affected earliest. When child tries to maintain upright posture, the knee joints are second most common joint affected. As the age advances the common bleeding sites become knees and the elbows. Patients with haemophilia often develop a **target joint** where repetitive episodes of bleeding occur. **Chronic arthropathy** is the major long-term morbitity of haemophilia.



Haemarthrosis at left knee joint

II. Muscles & Soft tissue

- Mostly occurs in gastrocnemius, quadriceps and iliopsoas and form haematoma

III. Oral cavity (teeth & gum)

Prolonged bleeding from minor traumatic laceration in mouth or following tooth extraction may occur in many patients.

Bleeding following tooth extraction

IV. CNS

- Life threatening and patients present with altered consciousness, convulsions and other neurological manifestations

V. Other sites

- Abdomen (formation of big haematoma and complicated by circulatory failure, shock and presssure over vital structures in abdomen

Bleeding in inguinal area and scrotum with haematoma formation following riding on bicycle rod

- Gut (haematemesis and melaena)
- Nose (epistaxis)
- Urinary tract (haematuria)
- Upper airway (severe respiratory distress, cyanosis)
- However, bleeding in skin (petechiae) is usually uncommon

Extensive ecchymosis over the left arm & muscle bleeding

Complications

- Haemodynamic instability because of massive bleeding
- Severe pallor
- Pain and pressure effects from haematoma over the vital organs
- Permanent joint damage due to frequent bleeding inside the joint cavities
- Development of antibodies in the recipient's blood against the infused factor VIII & IX
- Transfusion transmitted infections

DIAGNOSIS

Based on through clinical evaluation and support from relevant investigations.

- Clinical evaluation with particular emphasis on–
  - Age of onset of bleeding
  - Characteristics of bleeding
  - Site of bleeding
  - Target joints, if any
  - Family history of similar disease

Investigations

Investigations	Results
• Complete Blood Count	Haemoglobin: Low and is related to extent of haemorrhage. WBC, platelet counts: Normal
• Peripheral blood Film	Normal
• Bleeding time (BT) • Prothrombin time (PT)	Normal
• Activated partial thromboplastin time (aPTT)	Prolonged (Normal: 25-36 sec)
• Factor VIII	Reduced in Haemophilia A
• Factor IX	Reduced in Haemophilia B

- The diagnosis of haemophilia A is confirmed by decreased factor VIII activity with normal vWF activity
- In a male foetus or newborn with a family history of haemophilia A, cord blood sampling for factor VIII is accurate and important in diagnosis

TREATMENT

- Counsel parents about the natural history of the disease

A. Replacement therapy

Factor VIII (in Haemophilia A) and Factor IX (in Haemophilia B) concentrate following the standard protocol.

Dose calculation for haemophilia A & B

- Dose of F VIII (IU) = % desired (rise in F VIII) × Body weight (kg) × 0.5
- Dose of F IX (IU) = % desired (rise in plasma F IX) × Body weight (kg) × 1.4

Types of haemorrhage	Dosage of factor VIII
Haemarthrosis	❑ 50 U/kg stat on day 1, then ❑ 20 U/kg on days 2, 3, 5 until the joint function normalizes or back to baseline
Intramuscular haematoma	❑ 50 U/kg on Day 1 then ❑ 20 U/kg every other day until haematoma is well resolved
Major surgery, life threatening bleeding (e.g. CNS, GI bleeding etc)	❑ Stat: 50-75 IU/kg ❑ Next 5-7 days: 25 IU/kg 8-12 hourly to maintain trough level >50 IU/dl ❑ Next 7 days: 50 IU/kg once daily to maintain trough > 25 IU/dl

- When factor VIII or IX are not available–
  - Cryoprecipitate (does not contain factor IX)
  - Fresh frozen plasma
  - Whole blood may be given
- **Life style modification:** Avoiding contact sports e.g. football, hockey, basketball etc.
- **Prophylactic factor VIII infusion** (2-4 times weekly) may prevent development of arthropathy in severe haemophiliacs

B. Supportive Treatment of haemarthrosis

- **RICE** (rest, ice, compression, elevation): The bleeding joints and muscles can be kept at rest by splinting or by casting
- **Analgesics:** Paracetamol or Ibuprofen may be sufficient. Aspirin and narcotic analgesics should be avoided
- **Ice therapy:** It relieves pain and reduces bleeding by promoting vasoconstriction. It is applied to the skin for a period of 24-48 hours, wrapping ice in a thick towel, not directly
- **Physiotherapy:** Should be initiated as soon as active bleeding stops and pain is diminished. However, prophylactic factor VIII concentrate may be required to prevent physiotherapy-induced haemorrhage

C. Other haemostatic measures

- **Desmopressin acetate:** Used in mild cases. It helps release of endogenously produced factor VIII. Desmopressin is not effective in factor IX deficient haemophilia
- **Tranexamic acid** or **Aminocaproic acid:** These antifibrinolytic agents are used locally in case of mouth and dental bleeding

Carrier detection: Carriers of haemophilia is suspected by determining the ratio of factor VIII activity to vWF antigen and definitely by molecular genetic technique.

VON WILLEBRAND DISEASE (VWD)

Inheritance: Most often transmitted as an autosomal dominant trait but sometimes autosomal recessive (Chromosome 12). The disease may also be acquired, developing in association with hypothyroidism, Wilms tumor, SLE, patient reeceiving valproic acid.

Sex: Children of both sexes are equally affected, unlike that of haemophilia A and B.

PATHOPHYSIOLOGY

Normally, von Willebrand factor (vWF)–

Functions of vWF

- Supports, carries and delivers factor VIII to the site of injury
- Helps adhesion between the platelets to form platelet plugs
- Helps adhesion of platelets to the sub-endothelial connective tissue at the site of vascular injury

But, in its deficiency, these functions do not occur and as a result, haemorrhage occurs.

Types

- Type 1: (70-80%): Partial quantitative deficiency of vWF
- Type 2: Qualitative deficiency of vWF
- Type 3: Nearly complete deficiency of vWF

CLINICAL MANIFESTATIONS

- Affected children may be asymptomatic
- Symptomatic patient usually have muco-cutaneous bleeding e.g. easy bruising, recurrent epistaxis, gum bleeding, menorrhagia, bleeding in postoperative cases (particularly after tonsillectomy or tooth extractions)
- May have positive family history
- Patients neither have pallor nor hepatosplenomegaly & their haemodynamic status are usually stable

DIFFERENTIAL DIAGNOSES

- Haemophilia A and B
- ITP
- Thrombasthenia

DIAGNOSES

Investigations

Investigations	Results
CBC with PBF	Usually normal
Bleeding time (BT)	Prolonged
Prothrombin time (PT)	Normal
Activated partial thromboplastin time (aPTT)	Prolonged
von Willebrand factor (vWF) assay	Reduced

Coagulation profile of ITP, Haemophilia, vWD

Diseases	Bleeding time	Prothrombin time	aPTT
ITP	Prolonged	Normal	Normal
Haemophilia	Normal	Normal	Prolonged
vWD	Prolonged	Normal	Prolonged

TREATMENT

Counseling parents about the disease, it's treatment and prognosis.

- Mild case
  - Desmopressin Acetate (DDAVP): It helps release of vWF from endothelial storage sites. Intranasal DDAVP (Stimate) 150 µg (1 puff) for cases <50 kg and 300 µg (2 puff) for those >50 kg
  - Antifibrinolytic agents: Epsilon aminocaproic acid, useful for mucosal bleeding
  - Estrogen containg contraceptive therapy for menorrhagia
- Severe Case
  - Plasma-derived vWF is recommended

Prognosis

With the availabity of effective treatment and proohylaxis for bleeding, life expectancy in vWD is normal.

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SELF ASSESSMENT

SHORT ANSWER QUESTION [SAQ]

1. Classify haemophilia according to severity.
2. What findings do you expect to get in coagulation profile of a child with von Willebrand disease?
3. A girl has been hospitalized with bleeding from gum and generalized pupuric rash.
   a) what are the clinical possibilities?
   b) what are the investigations required for diagnosing the case?
   c) outline the management of a child with ITP.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Bleeding time is prolonged in–
   ___ a) haemophilia ___ b) von Willebrand disease ___ c) dengue haemorrhagic fever
   ___ d) Henoch-Schonlein purpura ___ e) fulminant hepatic failure
2. The clinical features of acute ITP includes–
   ___ a) petechiae ___ b) mild pallor ___ c) lymphadenopathy
   ___ d) splenomegaly ___ e) bony tenderness.
3. The recommended treatment options of acute ITP are–
   ___ a) prednisolone ___ b) cyclophosphamide ___ c) IVlg
   ___ d) anti-D immunoglobulin ___ e) platelet transfusion
4. The haematological profile of haemophilia A includes–
   ___ a) thrombocytopenia ___ b) prolonged bleeding time ___ c) prolonged aPTT
   ___ d) prolonged prothrombin time ___ e) normal reticulocyte counts
5. The haematological profile of von Willebrand disease include–
   ___ a) thrombocytopenia ___ b) reticulocytosis ___ c) prolonged bleeding time
   ___ d) normal prothrombin time ___ e) normal aPTT
6. DDAVP is recommended to treat–
   ___ a) von Willebrand disease ___ b) haemophilia ___ c) ITP
   ___ d) Henoch-Schonlein purpura ___ e) thrombasthenia
7. A 5-years old boy, clinically diagnosed as a case of haemophilia, has–
   ___ a) prolonged clotting time ___ b) prolonged PT
   ___ c) normal bleeding time ___ d) prolonged PTT ___ e) reduced vWF activity
8. The coagulation factors consumed in DIC include–
   ___ a) Factor II ___ b) Factor VII ___ c) Factor VIII
   ___ d) Factor V ___ e) Factor IX

Chapter 26

Puffy Face and Scanty Urine

Puffiness of face and low urine output is the usual clinical presentation of renal diseases. The two most common kidney diseases affecting children, with these presentations include–

- Acute glomerulonephritis (AGN)
- Nephrotic syndrome (NS)

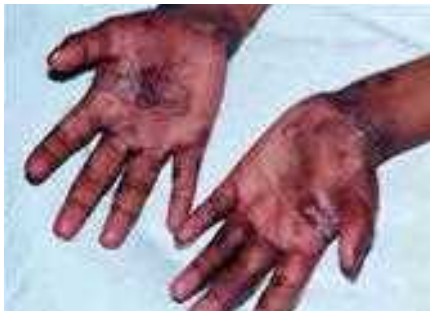
In addition, other life-threatening kidney diseases are acute kidney injury (AKI) and chronic kidney disease (CKD). In this section we will discuss AGN, NS, AKI, CKD.

ACUTE POST STREPTOCOCCAL GLOMERULONEPHRITIS (APSGN OR AGN)

Acute post streptococcal glomerulonephritis (APSGN) is the most common cause of gross haematuria in children. In addition to haematuria, puffy face, scanty urine and hypertension are other common presentations.

Aetio-pathogenesis

AGN is an immune-complex mediated disease that occurs following an infection in the skin or in throat by certain nephritogenic strains (e.g. 49-skin, 12-throat) of group A beta haemolytic streptococci.



Scabies, infected with streptococci

After infection, antibody is produced against the streptococcal antigens. Antigen-antibody complexes are thus formed in the blood, deposited in the glomeruli, where they incite glomerular inflammation and activate the complement cascade. As a result of this inflammation, the following clinico-pathological events occur–

- Reduced renal blood flow with consequent low GFR and **oliguria**
- Passage of RBC in urine **(haematuria)**
- Accumulation of water, electrolytes, toxic waste materials and acids in the body, leading to **acidosis, azotaemia and hyperkalaemia**
- Intravascular volume overload systemic giving rise to systemic **hypertension** and it's
- Sudden rise may increase cardiac workload and ensues **acute left heart failure** and **hypertensive encephalopathy**

Clinical Manifestations

- Age: Between 5-12 years. Uncommon before 3 years
- H/o skin or throat infections: May be present, 1-6 weeks prior to disease manifestations
- The manifestations are variable and are related to severity of renal involvement ranging from asymptomatic microscopic haematuria with normal renal function to acute kidney injury (AKI). The affected child usually presents with–

Smoky urine

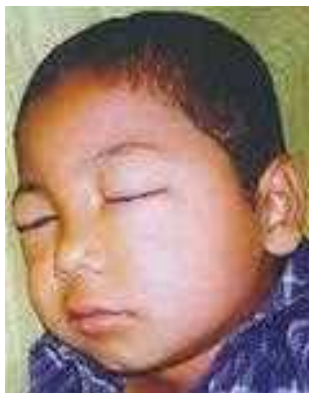
- Passage of **scanty high coloured urine**. Sometimes, may have **anuria**
- **Puffiness** of face
- Fever: Uncommon, but may have low grade fever
- Non-specific symptoms e.g. malaise, lethargy, headache or vomiting may be present

- Sometimes, patients may present with features of complications like–

- Sudden severe respiratory distress (acute left ventricular failure)
- Convulsion & unconsciousness (hypertensive encephalopathy)
- Complete cessation of urine (acute renal failure)

Physical Examination

- Face: Puffy i.e. swelling of eyelids (periorbital) and also of face
- Pallor : Mild
- Skin: Evidence of infected scabies or scars of previous infected scabies
- Oedema: Present
- Blood Pressure: High
- Features of **heart failure (LVF)**
  - Severe respiratory distress, orthopnoea, feeding difficulties, tachypnoea
  - Pulse: Tachycardia
  - Jugular Venous Pressure (JVP): Raised
  - Precordium: Hyperdynamic
  - Apex beat: May be shifted to the left
  - Gallop rhythm: May be present
  - Lung bases: Crepitations on auscultation
  - Liver: Enlarged and tender
- Features of hypertensive **encephalopathy**
  - Headache
  - Blurred vision
  - Convulsion
  - Papilloedema
  - Nausea, Vomiting
  - Restlessness
  - Alterad sensoriu
- Features of **renal failure**
  - Oliguria
  - Vomiting
  - Anuria
  - Drowsiness



Puffy face

Other causes of haematuria

- IgA nephropathy
- Renal TB
- Renal calculi
- Wilms tumour
- Coagulopathy
- SLE, HSP, UTI

DIAGNOSIS

Based on typical C/F & supportive laboratory findings.

Investigations

Investigations	Results
Urine for R/M/E	❑ RBC ❑ RBC cast *(coagualated protein)* Mild proteinuria
Complete blood counts	❑ Hb: Mildly reduced ❑ TC&DC: Mild polymorphonuclear leukocytosis ❑ PBF: Normochromic anaemia ESR: High
Blood for ASO/ anti DNase B	Elevated
Blood for C_3	Low
S. Electrolytes	May show hyperkalaemia, acidosis
S. Creatinine	May be elevated
Streptozyme test	A useful and simple diagnostic test that detects antibodies to streptolysin O, DNAse B, hyaluronidase, streptokinase
X-Ray chest	May show cardiomegaly with promiment pulmonary vasculature suggesting left heart failure

TREATMENT

- Counsel parents about the nature of the disease, its complications, treatment and prognosis
- Treatment, mainly supportive and includes–
  - Bed rest
  - Diet: Restriction of–
    - Protein to 0.5 gm/kg/day
    - Salt: No added salt in the diet
    - Potassium (K^+) & K^+ rich food and fruits
    - Fluid: 400 ml/m^2 + Output of previous day
  - Diuretics: Frusemide (1-2 mg/kg/day)
  - Antibiotics
    - Oral Phenoxymethyl Penicillin (50 mg/kg/day) in 4 divided doses for 10 days

Penicillin does not alter the course of the disease but it prevents spreading of remaining nephritogenic strain of streptococcus to the contacts.

- Antihypertensives
  - For rapid reduction of BP –
    - Nifedipine (0.3-0.5 mg/kg) sublingual
  - For maintenance of normal BP
    - Captopril (0.25-6 mg/kg/day) in 2-4 doses
    - Nifedipine (0.25-0.5 mg/kg/day) in 2-4 doses
- Follow up: Daily to assess clinical response and to search for any complications

Prognosis

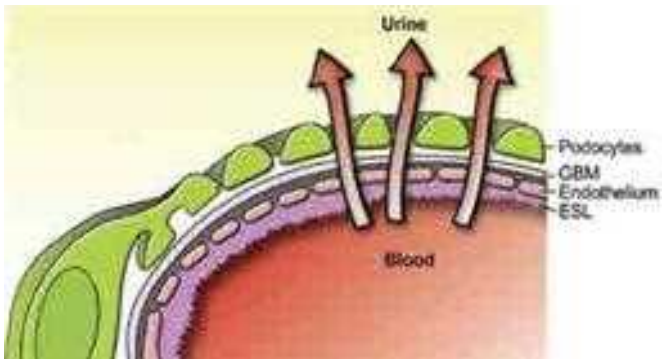
Usually good with complete recovery in > 95% cases. Recurrences are rare.

NEPHROTIC SYNDROME (NS)

- The commonest kidney problem in children
- Incidence:2-7 per 100,000 children <16 years of age
- Peak age of onset: Around 3 year

4 Cardinal features	
	◆ Massive proteinuria (>1 gm/m^2/day) ◆ Hypoalbuminaemia (<2.5 gm/dl) ◆ Generalized oedema and ◆ Hyperlipidaemia (>200 mg/dl)

To understand the disease it is essential to know the histological components of **glomerular filtration barrier** (GFB). It consists of –



Glomerular filtration barrier (GFB)

- Fenestrated capillary endothelium
- Glomerular basemen† membrane
- Podocytes (with foot processes and intercalated slit diaphragm)

AETIOLOGY & TYPES OF NEPHROTIC SYNDROME

Idiopathic	Secondary
Types ◆ Minimal change disease ◆ Mesangial proliferation ◆ Focal segmental glomerulo-sclerosis	◆ Infection: HBV, HCV, HIV, Malaria, Syphilis, Toxoplasma ◆ Drugs: Penicillamine, Gold NSAIDs, Na Stibogluconate ◆ System illnesses: SLE, Henoch-Schönlein purpura (HSP) ◆ Malignancy: Leukaemia, lymphoma ◆ Allergic reaction: Bee stings

Of the different types, **minimal change nephrotic syndrome** (MCNS) is the most common type among children and will be discussed in this section

PATHOGENESIS

Damage of the podocytes (**effacement of foot process**)

↓

Increases permeability of GFB

↓

↑↑ passage of albumin across GFB into the uninary space

This massive albumin loss in urine **(Albuminuria)** gives rise to **hypoalbuminaemia** with fall of plasma Colloidal osmotic pressure. As a result, fluid shifts from plasma to interstitial space, resulting in –

- **Generalized Oedema**, Accumulation of fluid in serous cavities giving rise to ascites, pleural & pericardial effusion
- Contraction of intravascular volume **(Haemoconcentration)**

The reduced intravascular volume compromises renal perfusion with consequent low GFR and **oliguria**. This activates **renin-angiotensin-aldosterone** system and promotes release of ADH, resulting in reabsorption of sodium from tubules and water from collecting ducts and this further aggravates oedema. In addition, **Hypoalbuminaemia** induces lipoprotein synthesis in liver which causes elevation of **cholesterol** and triglycerides in blood.

The Essential Characteristics of MCNS–

- No appreciable glomerular pathology, noted in light microscopy but effacement of foot processes of podocytes in GBM seen under electron microscope
- Prompt response to steroid but high tendency to relapse
- Not associated with hypertension, haematuria and azotaemia

CLINICAL MANIFESTATIONS

- Age: Common in between 2 to 8 years, peak ~3 years
- The affected children may present as initial case or may present with h/o recurrent attacks (relapse) with–
  - Facial puffiness, massive peri-orbital swelling
  - Generalized oedema
  - Scanty urination (colour usually normal)

- Sometimes, patients may additionally present with features of complications like–

- Cough & respiratory distress (pneumonia, pleural effusion, huge ascites)
- Abdominal pain (gut ischaemia, peritonitis, renal vein thrombosis)
- Pain, redness & tenderness of skin (cellulitis)
- Fever & dysuria (UTI)
- Haematuria (NS other than MCD, UTI, renal vein thrombosis)
- Diarrhoea (impaired absorption of foods due to oedema of the bowel wall)
- Neurodeficit like hemiplegia (stroke from thrombo-embolism due to haemoconcentration)

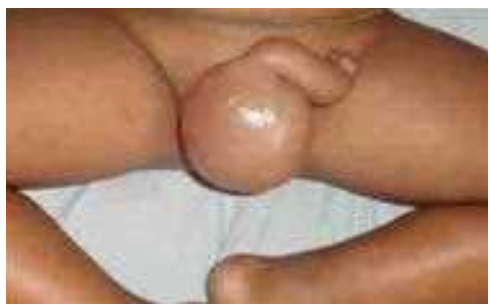
Physical Examination

I. Signs secondary to hypoalbuminaemia

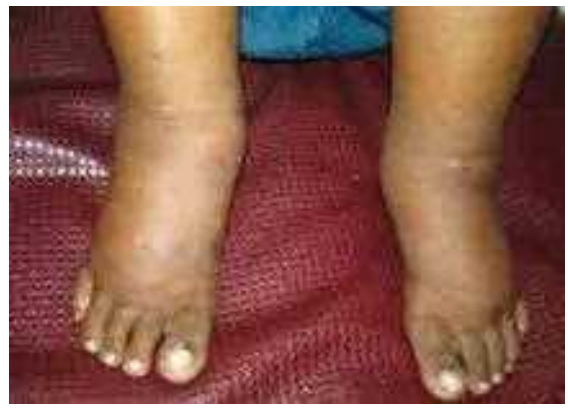
- Swelling of eye lids extending to chin and neck (double chin)
- Huge ascites with or without parietal oedema
- Oedema and swelling of scrotum & penis with cracks & fissuring of skin with exudation
- Clinical features of pleural effusion and increased respiratory rate
- Oedema of ankles & back e.g. sacral area
- Oedematous chest wall with full intercostal spaces and
- Oedema of scalp

Puffy face, Periorbital swelling and double chin

Huge ascites with transversely slit umbilicus



Peno-scrotal swelling



Ankle and pedal oedema

II. Signs related to diminished circulatory volume

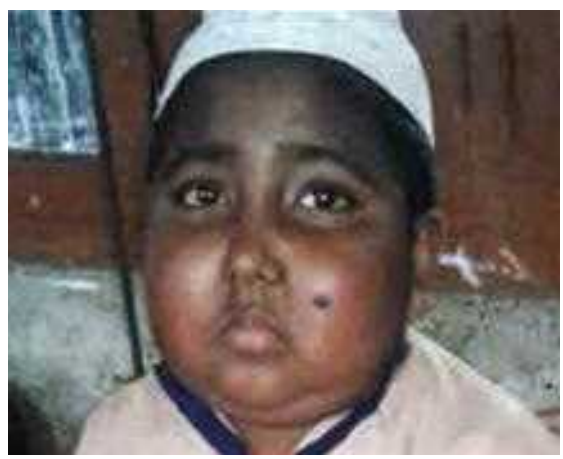
- Pulse: Weak, low volume
- Body extremities: May be cold
- BP: Usually low
- Capillary refill time: Prolonged (>3 seconds)

III. Signs related to complications

- Shiny abdominal wall, rigidity & tenderness and absent bowel sounds (peritonitis from Strpt pneumoniae)
- Palpable kidney & haematuria (renal vein thrombosis)
- Alterations of consciousness, hemiplegia (stroke)

IV. Signs related to steroid toxicity

- Cushingoid facies
- Buffalo hump
- Abdominal striae
- Hirsutism
- Hypertension
- Cataract
- Muscular weakness (due to steroid induced proximal myopathy)



Cushingoid face from prolonged steroid use

DIAGNOSIS

Based on typical C/F & supportive laboratory evidences

Investigations

- Urine
  - Routine & Microscopic examination
    - Albuminuria (done by Albustix or Heat coagulation test)
    - Granular and hyaline casts
    - Pus cells, when associated with UTI
    - RBC and RBC cast usually absent in MCNS

Positive heat coagulation test

Albustix

  - 24 hours urinary total protein (UTP): Proteinuria exceeding > 3.5 gm/day

or

  - Spot urinary protein-creatinine ratio: If >2, suggests significant proteinuria indicating NS

$$\frac{\text{Urine protein (mg)}}{\text{Urine creatinine (mg)}}$$

- Blood: Biochemistry
  - Serum total protein: Reduced
  - Serum albumin: Reduced
  - Serum albumin globulin ratio: Altered
  - Serum cholesterol: Elevated
  - Serum C_3: Normal in MCNS, but when decreased indicates NS of other types
  - Serum urea/creatinine/BUN: Usually normal
  - Serum electrolytes: Usually normal
- CBC
  - TC, DC of WBC: Usually normal
  - Haematocrit and ESR: Increased
  - Peripheral blood film: Normal
- Other investigations to assess aetiology, the extent of the disease, complication & to confirm the diagnosis
  - Blood for HBsAg, Anti HCV
  - Urine for C/S: When UTI is suspected
  - X-Ray Chest: To look for pleural effusion, pneumonia
  - Ultrasonogram of chest /abdomen: To see pleural effusion, ascites and to assess the kidney morphology
  - Renal biopsy: To determine the histological type

Indications for Renal Biopsy

At Onset

- Age of onset of NS<1 year or >12 years
- Gross haematuria, persistent microscopic haematuria or low serum C_3
- Sustained hypertension
- Renal failure not attributable to hypovolaemia
- Suspected secondary causes of nephrotic syndrome

After Initial Treatment

- Proteinuria persisting despite 4-weeks of daily corticosteroid therapy
- Before starting treatment with Cyclosporin A or Tacrolimus

TREATMENT

Counsel parents about the nature of the disease, its treatment and prognosis.

A. Specific: Prednisolone

I. First attack

Prednisolone 60 mg/m²/day in a single morning dose for 6 weeks (followed by 40 mg/m² as single morning dose) on alternate day for another 6 weeks. The alternate day dose then slowly tapered and discontinued over the next 4-8 weeks.

II. Relapse cases

(When urine albumin is 3+ or 4+ or proteinuria >40 mg/m²/hour for 3 consecutive days in patients who had been in remission previously).

Prednisolone 60 mg/m²/day in a single morning dose till urine is free of albumin for 3 consecutive days, followed by 40 mg/m² as single morning dose on alternate day for another 4 weeks and gradually tapered over 4-8 weeks.

B. Supportive

- Diet
  - Normal family diet, adequate in protein (1.5-2 g/kg/day), ≤ 30% of calorie from fat
  - Salt restriction: a 'no added salt'/salt free diet is usually sufficient
  - Patient can take rice, vegetables, meat, fish, egg without yolk, dal, milk, sugar etc.
- Fluid
  - Liberal fluid intake in mild oedema
  - Severe oedema: Restricted to 400 ml/m² + Output of the previous day

- Management of oedema
  - Diuretics should be avoided in mild oedema
  - In case of severe and persistent oedema
    - Oral Frusemide (1-2 mg/kg/day)
    - Oral Spironolactone (3 mg/kg/day)
  - Hypovolaemic patients should receive normal saline bolus and/or albumin infusion prior to diuretic administration
- Antibiotics: Oral Penicillin, 50 mg/kg/day till massive oedema persist (usually for 10-14 days). If patient is febrile or systemically unwell or showing evidence of infection, parenteral antibiotics like, Ampicillin with Gentamycin (renal dose) or Ceftriaxone may be started
- Support to scrotum, if it is tense and susceptible to ulceration
- Prescribe other medication e.g.
  - Antacid or Ranitidine, if upper GI discomfort
  - Supplement Calcium, if the child getting steroid for >3 months

C. Follow up

- In Hospital: Keep records of vital signs e.g. pulse, BP, resp. rate, weight, oedema, abdominal girth, intake output, bed side urine for albumin, etc.
- After discharge: 2-4 weekly follow up to check–
  - Albuminuria, to assess response to drugs
  - Cushingoid features to assess drug toxicities
  - Any complications e.g. infection
  - Renal functional status

Prognosis

Usually good. But children <1 year or >10 years, who have haematuria or hypertension, prognosis is guarded.

Spectrum of nephrotic syndrome

I. Remission

- Urine Protein:Creatinine ratio of <2 or
- <1+ protein on urine dipstick test for 3 consecutive days

II. Relapse*

- Urine Protein : Creatinine ratio of >2 or
- 3^+ protein on urine dipstick test for 3 consecutive days

III. Frequent relapses **

- Two or more relapses in initial 6 months or
- >3 relapses in any 12 months

IV. Infrequent relapse **

- One relapse within 6 months of the initial response (<2 relapse in 6 months for initial attack) or
- One to 3 relapses within any 12 months period (<4 relapse in one year)

V. Steroid dependent *

- Two consecutive relapses when on alternate day steroids or within 4 weeks of discontinuation of steroid

VI. Steroid resistance *

- Failure to achieve remission after 8 week of steroid therapy

DIFFERENCE BETWEEN AGN AND MCNS

Characteristics	AGN	MCNS
Age of onset	5-12 years	2-8 years
H/O sore throat or skin infection	More pertinent	May present
Extent of swelling	Usually confined to face	Generalized
Ascites	Unlikely	Usually present
Urine Colour	High/Reddish	Normal
Hypertension	Present	Usually absent
Proteinuria	Mild	Massive
Urine R/M/E	RBC, RBC cast: Present	RBC, RBC cast: Absent Hyaline, granular cast: Present
S Albumin	Normal	Decreased
S Cholesterol	Normal	Increased
Serum C_3	Decreased	Normal
Relapse & Remission	Rare	Common

ACUTE KIDNEY INJURY (AKI)

AKI denotes sudden inability of kidneys to excrete urine of sufficient quantity or composition, to maintain body fluid homeostasis.

AETIOLOGY

I. Pre renal

- Ischaemia
  - Hypovolaemia e.g. acute diarrhoea with severe dehydration, vomiting, acute haemorrhage
  - Hypotension
  - Sepsis
  - Ingestion of nephrotoxic drug e.g. diethyl glycol in paracetamol
- Toxins e.g. wasp sting, snake bite, plant toxin etc.

II. Renal

- Glomerulonephritis (GN) e.g. PSGN, SLE, HSP
- Vascular e.g. HUS, renal vein thrombosis, renal arterial thrombosis
- Acute pyelonephritis
- Acute interstitial nephritis

III. Post renal (Obstructive uropathy)

- Structural • Post. urethral valve • PUJ obstruction
- Crystalluria
- Calculi, blood clot in urinay tract

PATHOGENSIS

Because of insault from the above-mentioned causes, there is rapid deccline in GFR and which results in–

- Accumulation of nitrogenous wastes in the body
  and
- Impairment of water, electrolytes and acid-base balances

The net clinico-biochemical manifestations are–

- Oliguria, anuria
- Retention of nitrogenous waste products in the body as evident in elevation of blood urea, creatinine, blood urea nitrogen (BUN)
- Dyselectrolyteaemia e.g. hyperkalaemia
- Acid-base imbalance e.g. metabolic acidosis
- Fluid overload, hypertension

AKI GRADINGS

In children, extent of AKI are graded according to–

(i) Extent of fall of GFR as measured by estimated creatinine clearance (eccl) and

(ii) Urine output, as below–

Stages	Creatinine criteria	Urine output (UO) criteria
I: Risk	Increased creatinine *(1.5 times of normal)* or GFR decreases >25%	UO ≤0.5 ml/kg/ hr × 8 hrs
II: Injury	Increased creatinine *(2 times of normal)* or GFR decreases >50%	UO ≤0.5 ml/kg/ hr × 16 hrs
III: Failure	Increased creatinine *(3 times of normal)* or GFR decreases >75% or GFR<35 mL/min/1.73 m^2	UO ≤0.3 ml/kg/ hr × 24 hrs or anuria ×12 hrs
IV: Loss	Persistent failure for	> 4 weeks
V: Endstage	Persistent failure for	> 3 months

How to calculate eccl? *By Schwartz formula*

$$\text{e ccl} = \frac{k \times \text{height (cm)}}{\text{S. creatinine (mg/dl)}}$$

k= 0.55 (for children)

CLINICAL MANIFESTATIONS

- Scanty urine (oliguria) or complete cessation of urine (anuria), the hallmark of AKI
- Other manifestations *e.g. vomiting, convulsions*

ASSESSMENT

History

- H/o anuria/oliguria, vomiting
- History to find out the causes behind AKI–
  - Fluid loss e.g. diarrhoea, severe vomiting
  - Pre existing kidney disease e.g. AGN, NS
  - Ingestion of nephrotoxic drug e.g. diethyl glycol in paracetamol

Physical Examination

- Features of fluid overload–
  - Facial puffiness, oedema, hypertension
  - Heart failure (hepatomegaly, pulmonary oedema)
- Features of severe dehydration e. g. drowsiness, skin pinch not going back quickly, urine output
- Haemodynamic status e.g. pulse, BP, capillary refil time
- Features of AKI e.g. unconsciousness, arrhythmia, vomiting, convulsion etc.

Investigations

- Complete blood counts with PBF
- Blood biochemistry
  - S electrolytes: hyperkalaemia, acidosis
  - S creatinine, urea, BUN: Raised
  - Arterial blood gas: Metabolic acidosis
- Urine R/M/E: RBC, pus cells, crystal, cast
- ECG: To note any change from dyselectrolytaemia
- To find out cause: ASO titre,C_3,C_4, ANA, Anti-ds DNA
- Others
  - Chest X-Ray: To see pulmonary oedema & cardiac enlargement
  - USG abdomen: To assess renal anatomy
- Renal biopsy

Treatment

- Stage I & II: Only supportive treatment
- Stage III: Ensure the following treatment–

A. General

- Counseling parents about the nature, treatment options and prognosis of the disease
- Urgent referral to a paediatric nephrologist/tertiary centre

B. Supportive

- Discontinue **nephrotoxic agents**, if any
- **Fluid resuscitation**
  - If the child is dehydrated, give bolus normal saline @ 20 ml/kg over 30 min. After volume resuscitation, hypovolaemic patients generally void within 2 hours

3. Diuretic therapy

- After establishing adequate circulatory volume, if no voiding. Give Frusemide IV, 1-5 mg/kg/dose
- If no response, seen within an hour of maximum dose of Frusemide or if the urine output remains low (< 0.5 ml/kg/hour), then–
  - Stop further administration of diuretics
  - Restrict fluid to insensible losses (400 ml/m2/24 hours) plus urine output of the previous day
  - Monitor fluid intake, urine and stool output, body weight, and s electrolytes, creatinine, BUN daily

4. Peritoneal dialysis (PD): Start as soon as possible

Indications of Peritoneal Dialysis (PD)

- Volume overload with hypertension and/or pulmonary oedema refractory to diuretic therapy
- Severe metabolic acidosis unresponsive to medical management
- Persistent hyperkalaemia
- Symptoms of uraemia *e.g CNS depression*
- BUN of >100-150 mg/dl
- Calcium/phosphorus imbalance with hypocalcaemic tetany

5. Nutrition

- Encourage high calorie diet, rich in carbohydrate and fat to reduce protein catabolism.
- Restrict protein intake
  - 0-6 mo: 1.8 g/kg/day
  - 6 mo-3yrs: 1.0-1.5 g/kg/day
  - Children & adolescents: 1 g/kg/day
  - Protein intake should be more, if peritoneal or haemodialysis is going on
- Restrict extra salt intake intake
- Avoid foods rich in potassium e.g. citrus fruits, tomato paste, chocolates and potato crisps

6. Management of associated conditions

- Hyperkalaemia: Management is discussed in chapter 39: p 323
- Metabolic acidosis: Sodibicarb (1ml/kg), IV
- Hypocalcaemia: Calcium gluconate (1-2 ml/kg), IV
- Hyponatraemia, most commonly dilutional
  - Restrict fluid intake
  - Symptomatic hyponatraemia e.g. seizures, lethargy and S Na^+ if, <120 mEq/L should be corrected as mentioned in chapter 39: p 321
- Hypertension
  - Asymptomatic cases, Nifedipine,0.3-0.5mg/kg PO
  - Symptomatic hypertension e.g. hypertensive encephalopathy, Na Nitroprusside (0.5-10 µg/kg/min) or Labetalol (0.25-3.0 mg/kg/hour) by infusion under supervision of ped cardiologist
- Seizures: Diazepam (0.5 mg/kg PR) most effective
- Anaemia
  - If Hb <7 g/dl, transfusion of packed red blood cells (10 ml/kg) very slowly over 4–6 hours

7. Treatment of underlying cause of AKI: If any.

CHRONIC KIDNEY DISEASE (CKD)

CKD is the gradual loss of kidney function over a period of time. In children, it commonly results from developmental malformations. It is defined as renal injury/proteinuria and/or GFR <60 ml/min/1.73 m^2 for more than 3 months.

AETIOLOGY

- Idiopathic
- Congenital malformations *e.g.*
  - *Hypoplastic or dysplastic kidneys*
  - *Polycystic kidney disease*
- Chronic glomerulonephritis
- Irreversible nephrotoxic injury
- Obstructive uropathy *e.g.*
  - *Posterior urethral valve (PUV)*
  - *PUJ obstruction*
  - *Bladder neck obstruction*
  - Vesico-ureteric reflux (VUR)

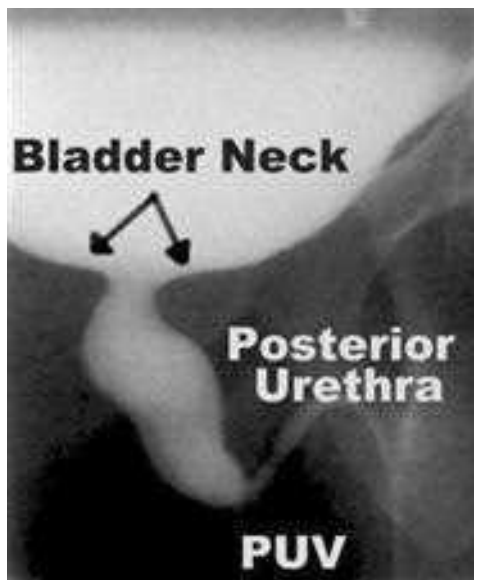
CKD: The Major Clinico-Pathological Events

- Damage/loss of nephrons & disruption of concentrating ability of nephron - polyuria, polydipsia
- Accumulation of nitrogenous waste products- vomiting, fatigue, poor concentration
- Fluid & Electrolyte imbalance -
  - Volume overload & Na^+ retention (excess Renin production) - hypertension
  - Accumulation of K^+: Hyperkalaemia
- Reduced production of erythropoietin - anaemia
- Decreased active form of vitamin D - renal osteodystrophy, hypocalcaemia, hyperphosphataemia
- Growth retardation & FTT: Renal osteodystrophy & anaemia
- Platelet dysfunction and other coagulopathy leading to bleeding especially in GIT
- Seizures: Untreated hypertension or hypocalcaemia
- Hypertension, uraemia: CCF, pulmonary oedema and pulmonary hypertension

Investigations

Parameters	Results
CBC, PBF	Normocytic normochromic anaemia
Blood urea nitrogen (BUN) S Creatinine, Urea	Raised
S Electrolytes	Hyperkalaemia, Hyponatraemia
S Ca^{++}, PO_4^{---}, Alkaline phosphatase, Parathormone	Hypocalcaemia, Hyperphosphatemia, Raised ALP & PTH
Fasting Lipid profile	Hyperlipidaemia
Iron profile	Iron deficiency
Urine R/M/E	Proteinuria
USG KUB	Bilateral shrunken echogenic kidneys /Hydronephrosis
DTPA/DMSA scan	Renal scarring/impaired renal excretion
MCU/VCUG	To evaluate PUV (posterior urethral valve)
IVU	To evaluate VUR, urinary tract & status of kidneys
Creatinine clearance to assess GFR	Reduced

MCU – Micturating Cystourethrogram
VCUG – Voiding Cystourethrogram
IVU – Intravenous Urography
DTPA – Diethylene Triamine Penta Acetic acid
DMSA – Dimercaptosuccinic Acid scan



Posterior urethral valve in a 7-year-old male child. An oblique VCUG image shows a dilated posterior urethra (arrow) with an abrupt transition to a normal-calibre. anterior urethra. Note the bladder neck hypertrophy, the irregular trabeculated bladder wall, and the left-sided grade III vesicoureteric reflux (curved arrow)

Management

A. Supportive

- Counsel parents about the nature and future of the disease, treatment options and prognosis. Refer the child to a paediatric nephrologist/tertiary centre
- Diet
  - Restrict Protein to 1 g/kg/day, 60-70% from animal source to reduce muscle wasting
  - Don't allow any added salt or any K^+ rich foods e.g. citrus fruits, tomato paste, chocolates and potato chips, banana etc in the diet
- Supplement Calcium
  - Age 1-10 years: 500-600 mg/day
  - Age 11-18 years: 800-1000 mg/day
- Control hypertension
  - Frusemide (1-4 mg/kg/day). If BP is not controlled
  - ACE inhibitor e.g. Captopril (0.25-6 mg/kg/day) in 2-4 divided doses,orally
- Treat Renal osteodystrophy
  - Rocaltrol, Calcitriol: 1, 25 $(OH)_2$ cholecalciferol supplementation–
    - 0.01-0.05 µg/kg/day PO, <3 years of age
    - 0.25-0.75 µg/day PO, >3 years of age
  - Calcium carbonate (1 gram gives 400 mg of elemental Ca) to facilitate phosphate excretion
- Correct Hyperkalaemia: As mentioned in chapter 37
- Correct Metabolic acidosis
  - Inj Sodibicarb (1-2 mEq/kg). Half should be given immediately and the remaining half, in IV infusion over next 12-24 hours
- Correct Anaemia
  - Human recombinant erythropoietin (50-150 U/kg/dose), 3 times a week, subcutaneously
  - Iron supplementation (2-6 mg/kg/day)
  - Packed Red cell) transfusion (10 ml/kg), when Hb < 6gm/dl
- Immunize the child with all routine vaccines along with
  - MMR
  - Pneumococcal conjugate vaccine
  - Meningococcal conjugate vaccine
  - Influenza vaccine annually
- Treat associated infections with non-nephrotoxic antibiotics

B. Specific: Renal Transplantation

End Stage Renal Disease

When GFR < 10 ml/min/1.73 m^2 and progression of disease can no longer be managed by medical means then treatment options include–

- Peritoneal dialysis, or
- Haemodialysis (preferable) or
- Renal transplantation

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SELF ASSESSMENT

SHORT ANSWER QUESTION [SAQ]

1. Write down the essential features of minimal change nephrotic syndrome.
2. What investigations will you do and what are the expected findings in a case of nephrotic syndrome?
3. How will you treat a child with 1st attack of minimal change nephrotic syndrome?
4. A 6 years old boy presents with puffy face and smoky urine for 5 days. His BP is 130/100 mm Hg.
   a) What is the probable diagnosis?
   b) What complications can develop if the child remains untreated?
   c) What investigations will you plan and what findings are expected?
   d) How will you treat the child?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. The characteristic features of MCNS are–
   ___ a) heavy proteinuria ___ b) haematuria ___ c) azot emia
   ___ d) hypertension ___ e) hyperlipidaemia
2. Blood biochemistry of MCNS includes–
   ___ a) low C3 level ___ b) high BUN ___ c) hyperkalaemia
   ___ d) hypoalbuminaemia ___ e) hypercholesterolaemia
3. Complications that may occur in untreated AGN are–
   ___ a) heart failure ___ b) encephalopathy ___ c) renal failure
   ___ d) thrombo-embolism ___ e) gut ischaemia
4. A 6 years old boy presents with generalized swelling, scanty urine and abdominal discomfort. He had similar problem 1 year back and improved with prednisolone. His BP is 120/70 mmHg. Bed side urine shows albumin +++. Choose the commonest pathological type of this problem is–
   ___ a) MCNS ___ b) FSGS ___ c) membranous GN
   ___ d) membranoproliferative GN ___ e) mesangiocapillay GN
5. The proposed diagnostic criteriae of acute renal failure are–
   ___ a) S creatinine > 3 times normal ___ b) urine output < 0.3 mllkg/day ___ c) anuria> 12 hours
   ___ d) generalized oedema ___ e) haematuria
6. The diagnostic criteria of nephritic syndrome include–
   ___ a) generalized edema ___ b) hypertension ___ c) hypercholesterolaemia
   ___ d) haematuria ___ e) hypoalbuminaemia
7. Indications for Renal Biopsy are–
   ___ a) Age of onset <6 months ___ b) Gross haematuria ___ c) low serum C4
   ___ d) Sustained hypertension ___ e) Suspected secondary causes of nephrotic syndrome
8. Causes of haematuria include–
   ___ a) AGN ___ b) UTI ___ c) CKD
   ___ d) Renal TB ___ e) CLD
9. Features of hypertensive encephalopathy–
   ___ a) Headache ___ b) Vomiting ___ c) Slurred speech
   ___ d) Convulsion ___ e) Unconsciousness

Chapter 27

Smoky/Red urine

Whenever a child presents with red or smoky urine, one should consider it as haematuria, *i.e.* presence of blood in the urine, either from kidney or from any parts of urinary tract (coming from renal pelvis to urethra). In such situation, the following conditions should be considered.

- Glomerulonephritis (GN) *e.g. acute post-strptococcal, membranous, membrano-proliferative*
- Urinary tract infection
- Severe thrombocytopenia
- Wilm's tumor
- Polycystic kidney disease
- Renal TB
- Coagulopathy
- IgA nephropathy
- Renal stones
- Others *e.g. Henoch Schonlen purpura, SLE, renal vein thrombosis, Alports syndrome, heavy exercise*

One thing should be mentioned here, that smoky urine can also occur due to presence of haemoglobin in urine from excessive intravascular haemolysis, as occur in autoimmune haemolytic anaemia, falciparum malaria, transfusion reaction etc.

Sometimes, children can pass red urine without RBC as occurs in ingestion of few drugs, dyes in foods etc. which may create confusion with haematuria.

Traits	Upper urinary tract	Lower urinary tract
◆ Origin	❑ Nephron (glomerulus, tubules, interstitium)	◆ Pelvi-caliceal system, ureter, bladder, urethra
◆ Colour of urine	❑ Brown, cola or tea colored	◆ Bright red or pink colour
◆ Haematuria in relation to time of micturition	❑ Throughout the whole phase of micturition	◆ At the end of micturition
◆ Pain	❑ Usually painless	◆ Associated with dysuria
◆ Clot in the urine	❑ Absent	◆ May be present
◆ RBC morphology	❑ Dysmorphic	◆ Normal
◆ Proteinuria	❑ >100mg/dl	◆ Minimal proteinuria (<100mg/dl)
◆ Cellular cast	❑ RBC case, leukocyte or tubular cast may be present	◆ Cellular cast absent

Types

- Gross haematuria: Urine looks as smoky, pink or tea-coloured in naked eye
- Microscopic haematuria: Urine looks normal in naked eyes, but RBC seen under microscope
  - In uncentrifused urine: RBC > 5/µL OR
  - In centrifused urine: RBC >3/high power field

We have already discussed acute post-streptococcal GN, UTI, thrombocytopenia, coagulopathy, falciparum malaria in other sections. In this chapter, we will briefly discuss the cardinal features of renal TB, IgA nephropathy, Alport's syndrome and polycystic kidney disease.

RENAL TUBERCULOSIS

Rare in children because of long incubation period.

Transmission: Lymphohaematogenous

Pathogenesis

After reaching kidney, the bacilli form small caseating foci in the renal parenchyma from which bacilli are released in the renal tubules. Subsequently a large mass is developed near renal cortex and organisms are discharged into renal pelvis through a fistula and may spread to adjacent structures like ureter, prostate, epididymis etc.

CLINICAL MANIFESTATIONS

- Asymptomatic
- Haematuria. Sometimes, dysuria, flank pain, abdominal pain

Investigations

- Urine R/M/E of morning sample: Sterile pyuria (early stage), RBC
- Urine sediment for AFB stain: Reveals the bacilli in 50-70% cases
- Urine C/S: Positive in 80-90% cases
- MT: May be negative in 20% cases
- Pyelogram / CT scan: Mass lesion, dilated proximal ureter, hydronephrosis (most often unilateral)

TREATMENT

Anti tubercular drugs.

IGA NEPHROPATHY

Immune-complex mediated chronic glomerular disease, occurs after1-2 days following a viral respiratory tract or GIT infection

CLINICAL MANIFESTATIONS

- Painless gross haematuria, moderate proteinuria, mild to moderate hypertension

DIAGNOSIS

- Confirmed by renal biopsy that shows IgA in the mesangial cells

TREATMENT

- ACE inhibitors, corticosteroids

Prognosis

- End stage renal disease (rare)

ALPORT SYNDROME

Hereditary nephritis, characterized by-

- Haematuria
- Mild to moderate proteinuria
- Bilateral sensori-neural hearing loss (not congenital)
- Ocular abnormalities

TREATMENT

Symptomatic e.g. control of hypertension and proteinuria with ACE inhibitors

Prognosis

Risk of progressive renal dysfunction leading to ESRD.

POLYCYSTIC KIDNEY DISEASE

Genetic (AD, AR) kidney disorder characterized by development of multiple cysts in the kidneys and liver. The cardinal features are-

- Neonatal period: IUGR, potter facies, respiratory distress, spontaneous pneumothorax.
- Hypertension, proteinuria, haematuria
- Hepatic disease manifestation as portal hypertension, variceal bleeding, hepatosplenomegaly.
- Sometimes, bilateral flank pain, abdominal mass and hypertension

How to evaluate a child with haematuria

The aim of evaluation is to find out the source of bleeding. It needs careful history, thorough physical examination and relevant investigations.

History

- Recurrent gross haematuria: IgA nephropathy, Alport syndrome, thin glomerular basement membrane disease
- Presence of fever: Pyelonephritis
- Presence of urinary symptom: urgency, frequency: Cystitis
- Haematuria in relation to time of micturition:
  - Throughout the whole micturition: Glomerular cause
  - At the end of micturition: Urinary bladder
- Abdominal pain:
  - Lower abdominal pain: Cystitis,
  - Colicky pain: Nephrolithiasis
- Passage of blood clots: Haemorrhagic cystitis
- Swelling of the body, scanty urine, headache, blurring of the vision: AGN
- Presence of rash, joint swelling: SLE, HSP
- History of trauma
- Bleeding from other sites of the body: Coagulopathy, severe thrombocytopenia
- History of preceding or recent respiratory tract, skin or GI infection: APSGN, HUS, IgA nephropathy

- Family history of haematuria: Hereditary nephropathy, thin glomerular basement membrane disease, IgA nephropathy
- History of visual or hearing problem: Alport syndrome

General Physical examination

- Appearance, any dysmorphism: Syndromic renal problems, hereditary nephropathy
- Puffy face, HTN, oedema: Glomerulonephritis
- Pallor: SLE, coagulation disorders, HUS, CKD
- Malar rash, photosensitive rash, oral ulcer: SLE
- Palpable purpura: HSP
- Bed side urine for albumin (Proteinuria) : Glomerular diseases
- Examination for hearing and vision

Abdomen

- Suprapubic tenderness: Cystitis
- Renal angle tenderness: Pyelonephritis, renal vein thrombosis
- Palpable flank mass: Hydronephrosis, renal vein thrombosis, polycystic kidney diseases, renal tumours
- Palpable urinary bladder: Obstructive uropathy
- Ascites: Glomerulonephritis
- Liver (hepatomegaly): Heart failure
- Genitalia: Meatal stenosis

Other systems

- Musculoskeletal system (Arthritis): HSP, SLE
- Cardiovascular system (Tachycardia, galloping): Features of heart failure
- Other systems: For congenital anomalies in different malformation syndromes

Investigations

- Urine R/M/E:
  - Proteinuria, RBC, RBC cast and dysmorphic RBC: Glomerular diseases
  - Significant pus cells, WBC cast: UTI
  - Crystalluria: Urolithiasis, nephrocalcinosis
- Urine C/S: Growth of microorganism (UTI)
- USG of the KUB region: Renal cystic disease, hydronephrosis, tumour, urolithiasis, nephrocalcinosis
- CBC with PBF:
  - When anemia, thrombocytopenia: SLE
  - Leukocytosis, thrombocytosis: HSP
- Blood biochemistry
  - Serum electrolytes, calcium may be altered
  - Renal function test
  - Serum protein, albumin
  - Serum cholesterol
  - Spot urinary protein creatinine ratio
  - C3, ASO titre, streptozyme test, anti DNase b : APSGN
  - C3,C4, ANA, Anti dsDNA antibody: SLE
- Renal biopsy
- Coagulation screening and factor assay: Coagulation defect
- Investigations to find out other causes of haematuria
  - Urinalysis of siblings and parents: Thin glomerular basement membrane disease
  - Urine calcium/creatinine: > 0.2 in idiopathic hypercalciuria.
  - 24 hours urine for Ca, uric acid, oxalate: For urolithiasis and nephrocalcinosis
  - Cystogram and renal scan: If hudronephrosis found in USG

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS (SAQ):

1. Define haematuria. Enumerate the common causes of haematuria in children.
2. How will take history during evaluation of a child with haematuria?
3. How will you investigate a child with haematuria?
4. How will you differentiate haematuria due to renal and extra renal origin?
5. What are the features of stone in the urinary tract? How will you investigate and treat such a case?

MULTIPLE CHOICE QUESTIONS (MCQ)

1. Following are the causes of haematuria–
   ___ a) UTI ___ b) Myoglobin ___ c) Renal stone
   ___ d) Ingestion of beet ___ e) Trauma
2. Characteristics of urine in haematuria of renal origin are as follows–
   ___ a) Bright red ___ b) Dysmorphic RBC ___ Presence of clots
   ___ RBC cast present ___ Usually painful
3. Which statements are correct regarding the aetiology of haematuria–
   ___ a) Abdominal lump in AGN ___ Suprapubic tenderness in cystitis ___ c) Fever in renal stone
   ___ d) Positive family history in coagulopathy ___ e) Facial dysmorphism in SLE
4. What are the baseline investigations for painful haematuria–
   ___ a) Urine R/M/E ___ b) USG of KUB region ___ c) Renal biopsy
   ___ d) DMSA scan ___ e) Plain X-ray of abdomen
5. Following is/are the infectious causes of haematuria–
   ___ a) APSGN ___ b) Pyelonephritis ___ c) Cystitis
   ___ d) Ig A nephropathy ___ e) Renal TB

Chapter 28

Dysuria

Dysuria usually represents urinary tract infection (UTI), which is a common cause of morbidity in children. Many UTI cases have an underlying urinary tract anomaly e.g. vesico-ureteric reflux (VUR), obstruction etc. and if that remains untreated, may predispose to renal damage. In this chapter we will highlight UTI.

URINARY TRACT INFECTION (UTI)

Aetiology & Risk factors

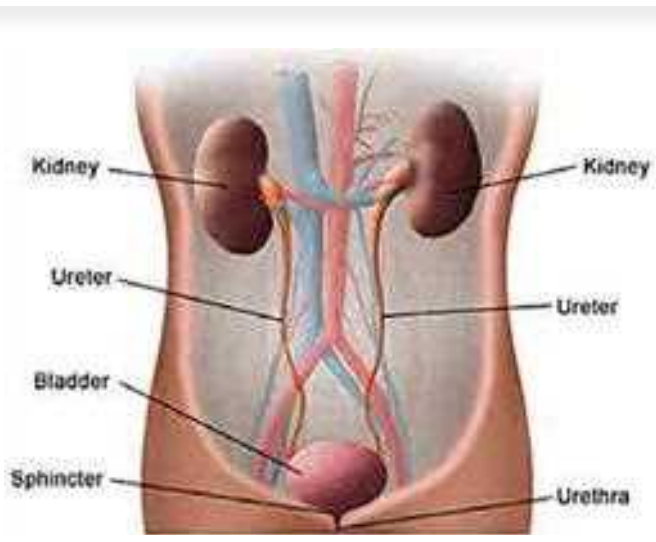
Virtually UTIs are the ascending infections where bacteria from faecal flora colonize in the perineum and subsequently enter into bladder via urethra (cystitis) and finally find their way to the kidneys (pyelonephritis).

Risk factors

- Voiding dysfunction
- Obstructive uropathy
- Urethral instrumentation
- Vesico ureteric reflux (VUR)
- Neuropathic bladder
- Constipation
- Pinworm infestation
- Wiping of perineum from back to front in females
- Female gender
- Uncircumcised males
- Tight clothing
- Bubble bath
- Poor perineal hygiene

Pathogensis

The risk factors mentioned above interfare with complete emptying of urinary bladder and thereby facilitate urinary stasis. This promotes colonization of urinary bladder with bacteria and subsequently infection **(cystitis)**. Then, infection ascends up to pelvi-calecial system **(pyelitis)**. Infection in renal pelvis also damages the adjacent nephrons **(pyelonephritis)**. Subsequently, **scars** are formed in the damaged renal tissues, contributing, development of **hypertension**, **renal dysfunction** as well as **renal failure**.



Organism

Most common	*E. Coli (90%), Klebsiella, Proteus*
Less common	*Pseudomonas,* enterococcus, coagulase negative staph, *Strept. faecalis*

Types & Clinical Features of UTI

Acute Pyelonephritis *(Infection of renal parenchyma)*	◆ High fever, chills and rigor, abdominal or flank pain, nausea, persistent vomiting, dehydration, renal angle tenderness ◆ Presentations of **neonates** are non-specific. They usually presents with features of sepsis e.g. fever, vomiting, lethargy, hypothermia, poor feeding, irritability, failing to thrive and sometimes prolonged neonatal jaundice ◆ Passage of foul-smelling or cloudy urine
Acute Cystitis *(Infection of urinary bladder)*	◆ Dysuria, urgency, frequency, incontinence, suprapubic pain and malodorous urine ◆ Fever usually not common

◆ **BP should be measured in every case of UTI** as it may increase when complicated

ASYMPTOMATIC BACTERIURIA

Defined as isolation of a specified quantitative count of bacteria in an appropriately collected urine specimen from an individual without symptoms or signs of UTI.

DIAGNOSIS

Based on C/F & supports from the relevant investigations.

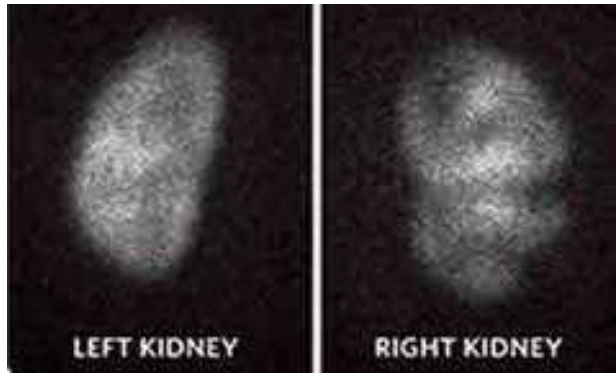
Investigations

- Urine R/M/E: Shows many pus cells (>5)/HPF. Sample should be sent to laboratory within 30 minutes of collection
- Urine for C/S: Will identify the organisms and their antibiotic sensitivity pattern

Diagnostic significance of colony count in urine

Method of Collection	Colony count	Probability of infection
Clean voided	1 specimen $>10^5$	80%
	3 specimen $>10^5$	95%
Catheterization	$>10^5$	95%
	10^4-10^5	Infection likely
	$<10^3$	Infection unlikely
Suprapubic puncture	Gram-Ve bacilli: Any number	99%
	Gram +Ve cocci: > few thousand	

- CBC: Neutrophilic leukocytosis
- Imaging studies: To find out the cause as well as extent of renal damage
  - Renal ultrasound
  - Voiding/micturating cystourethrogram (MCU)
  - DTPA renogram: Done to understand the functional status of kineys by analysing the arrival, uptake and elimination of injected DTPA (Diethylene Triamino Pentaacetic Acid)
  - DMSA (dimercaptosuccinic acid): Done to asses renal morphology particularly the presence of any scar, renal masses etc.



Source: Internet

DMSA scan showing UTI-related scarring of the right kidney.

TREATMENT

A. Supportive

- Counsel parents about the nature & future of the disease
- Encourage the patient to drink more liquid
- Teach parents, on how to avoid the risk factors

B. Specific

- Selection of appropriate antibiotics

UTI Types	Antibiotics, Route, Dose	Treatment Duration
Acute Pyelonephritis	Ceftriaxone, IV, 100 mg/kg/day or Cefotaxime, IV, 150 mg/kg/day or Gentamicin, IV, 5 mg/kg/day	10-14 days
Acute Cystitis	Cotrimoxazol or Amoxicillin or Co-Amoxiclav or Cefadroxil or Ciprofloxacin/ Levofloxin	7-10 days

Recurrent UTI

- Children with > 1 attacks of UTI, irrespective of age is called recurrent UTI. They should be evaluated with ultrasound, DMSA scan and MCU to find out the cause of recurrence and to asses the extent of renal damage.

RISK FACTORS

- Vesico-ureteric reflux (VUR)
- Urinary tract abnormalities
- Diseases e.g. diabetes mellitus, neurogenic bladder, immune deficiency disorder etc.

TREATMENT

A. Supportive

- Counsel the parents, about recurrent UTI, its complications and outcome
- Encourage the patient to drink more liquid
- Teach parents, on how to avoid the risk factors
  - Correction of constipation
  - Complete voiding
  - Washing of perineum from front to back after defaecation in females
- Identification & elimination of the underlying cause of recurrent UTI
- Emphasize **Antibiotic prophylaxis**: Indications–
  - First febrile UTI
  - UTI with bowel, bladder dysfunction
  - Grade III or IV vesico-ureteric reflux
- **Drugs used for Prophylaxis**

  - Cotrimoxazole: 1-2 mg of Trimethoprim/kg/day, or
  - Nitrofurantoin: 1-2 mg/kg/day or
  - Cephalexin: 10 mg/kg/day, or
  - Cefadroxil: 3-5 mg/kg/day

- **Duration of Prophylaxis**

  Varies according to the underlying cause of persistent infection. Prophylaxis may be discontinued if the cause is removed and the repeat urine C/S shows no growth. Sometimes, it may be discontinued after 5-6 years of age, even if low grade reflux persists.

PREVENTION OF UTI

- Avoiding constipation. A healthy eating diet which includes high fibre should be encouraged. Sometimes laxatives may be prescribed
- Encourage children to drink plenty of water and empty the bladder adequately. Sometimes children have to be reminded to use the toilet every 2-3 hours. Also ensure that the child is using the toilet at break-time at school
- In young girls, proper wiping from front to back after they have been to the toilet may also be important
- Ensure that your children wear loose cotton underwear rather than tight nylon underwear
- Foreskin should be kept clean in uncircumcised boys

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SELF ASSESSMENT

SHORT ANSWER QUESTION [SAQ]

1. What are the microorganisms responsible for UTI?
2. Write down the treatment of acute pyelonephritis.
3. A 4 year old girl has complaints of dysuria, increases frequency of micturition and fever.
   a) What is your probable diagnosis?
   b) How to investigate the child?
   3) Write down her management.

MULTIPLE CHOICE QUESTION [MCQ]

1. The known risk factors of UTI are–
   ___ a) vesicoureteric reflux ___ b) obstructive uropathy ___ c) neuropathic bladder
   ___ d) constipation ___ e) pin worm infestation.
2. The recommended drugs for prophylaxis of recurrent UTI are–
   ___ a) Nitrofurantoin ___ b)Trimethoprim ___ c) Cephalexin
   ___ d) Ampicillin ___ e) Erythromycin
3. The recommended drug for prophylaxis of recurrent UTI are-
   ___ a) Nitrofurantoin ___ b) Trimethoprim ___ c) Cephalexin
   ___ d) Amphicillin ___ e) Erythromycin
4. The following are causes of sterile pyuria,
   ___ a) Renal stones ___ b) membranous glomerulonephritis
   ___ c) Renal tuberculosis ___ d) Chlamydia ___ e) Appendicitis
5. A child presented with high fever and dysuria. Pus cells are present and culture shows 10^4 colonies of E.cloi. what would be appropriate
   ___ a) Treat as UTI ___ b) 104 can be considered insignificant
   ___ c) Repeat urine R/E and C/S ___ d) USG abdomen to rule out features of UTI.
6. A 2 yr old girl presents with culture positive UTI. What initial investigation would you suggest for her
   ___ a) USG of abdomen ___ b) USG+MCU
   ___ c) USG+DMSA ___ d) USG+MCU+DMSA

CHAPTER 29

EXCESSIVE URINE OUTPUT (POLYURIA)

Whenever, a child presents with history of passage of excess urine (>2000 ml/m^2/day), the following conditions should be taken into consideration–

- Diabetes Mellitus (DM)
- Diabetes Insipidus (DI)
- Chronic Kidney disease (CKD)
- Renal tubular acidosis (RTA)
- Psychogenic polydipsia

In this section, DM of children and its life-threatening complication like diabetic ketoacidosis (DKA) will be discussed. The cardinal features of the other causes of polyuria will also be highlighted.

DIABETES MELLITUS (DM)

It is a chronic metabolic disorder characterized by a sustained elevation of blood glucose due either to deficiency of insulin, secreted by β cells of pancreas or defect in its action. The function of insulin is to facilitate the entry of glucose from blood into the cells where it is metabolized to produce energy. When **β cells** fail to produce adequate amount of insulin or the effector cells have insulin resistance, DM occurs.

Diabetes Mellitus: Types

- **Type 1:** Most common among children & adolescents due to absolute insulin deficiency. They are prone to develop DKA
- **Type 2:** Common among people over 40 years of age, mostly insulin resistant, may run in families and often associated with overweight. They have less chance of DKA
- **Other types**
  - Malnutrition-related DM
  - Fibrocalculous pancreatopathy
  - Neonatal DM etc.

PATHOGENESIS

In DM, the body is unable to utilize glucose to generate adequate energy due to insulin deficiency or resistance. To fill this energy gap, fat and proteins (from muscle) are broken down resulting in **weight loss**. Whenever the elevated glucose level in blood exceed the renal thresould, the excess glucose is excreted in the urine **(glycosuria)**, dragging water with it resulting in excessive urination (**polyuria)** and with excessive thirst (**polydipsia)**. Younger children often resume **bedwetting**.

Breakdown of fat causes excess ketone production and accumulation in the blood **(ketosis/acidosis)**. If the diagnosis & treatment is delayed, excess glucose and ketones are excreted in urine, resulting in **severe dehydration** and loss of electrolytes from the body. This is called DKA.

The presence of ketones and the accompanying acidosis may cause an acetone/**sweet smell** on the breath, vomiting, abdominal pain, decreased level of consciousness and rapid deep breathing (**Kussmaul respiration**). If untreated, shock, cerebral oedema, coma and death may occur.

CLINICAL MANIFESTATIONS

More common	Less common	Features of DKA
◆ Weight loss ◆ Polyuria; bed wetting in younger children ◆ Excess thirst ◆ Tiredness-not want to work or to play	◆ Excessive hunger ◆ Blurred vision ◆ Mood changes ◆ Skin infection ◆ Oral or vaginal thrush ◆ Abdominal pain	◆ Frequent vomiting ◆ Acute abdominal pain ◆ Cheek: Flushed ◆ Breathing: Acetone smell ◆ Dehydration with continuing polyuria ◆ Altered consciousness ◆ Kussmaul respiration ◆ Shock, Cerebral oedema,Coma

Complications

- Acute: DKA, hypoglycaemia, hyperglycaemic hyperosmolar state
- Chronic:
  - Microvascular:Neuropathy, retinopathy, nephropathy
  - Macrovascular:cerebro-vascular disease, coronary artery disease, peripheral vascular disease.
  - Others : growth failure, delayed puberty

Diagnosis

Diagnosis is based on classical clinical features and Persistently elevated blood sugar level

Category	Fasting plasma glucose (FPG)	2 hrs PG after a 75 g *(for children- 1.75 g/kg)* glucose	HbA_1C
Normal	<5.6 mmol/L (100 mg/dl)	<7.8 mmol/L (140 mg/dl)	<6.5%
Impaired Fasting glucose (IFG)	5.6-6.9 mmol/L (100-125mg/dl)	Normal <7.8 mmol/L	
Impaired glucose tolerance (IGT)	Normal <5.6 mmol/L	7.8-<11.1 mmol/L (140-200 mg/dl)	
DM	≥ 7.0 mmol/l (126 mg/dl)	≥ 11.1 mmol/l (200 mg/dl)	≥ 6.5 %

Management

I. Supportive: Counsel–

- Parents about the nature & future of the disease, complications
- On different aspects of management e.g. insulin, adjustment of dose, monitoring glucose etc
- For Life style modification e.g. regular exercise etc.
- For personal hygiene e.g. foot care
- To Select appropriate diet. The calory mixture will be as follows: Carbohydrate (55%), Fat (30%) and Protein (15%)

II. Specific

- Type 1 DM: Subcutaneous Insulin, mainly short acting & intermediate acting
- Type 2 DM : Oral hypoglycaemic agents

III. Regular Follow up: To assess, control of DM

IV. Treatment of complications

e.g. DKA, hypoglycaemia

DIABETIC KETOACIDOSIS (DKA)

DKA is a medical emergency and occurs whenever there is profound insulin deficiency. It may be the first presentation of DM or occurs when insulin is missed or discontinued in a known diabetic child or if inadequate dose of insulin is given at times of acute illness. Cerebral oedema is the most dangerous event of DKA.

Diagnosis

Based on cardinal clinical features (mentioned in the table) and on the following Biochemical criteriae–

- Blood glucose: ≥ 11.1 mmol/L (200 mg/dL)
- Venous blood pH: <7.3
- S Bicarbonate: <15 mmol/L
- Ketonaemia & ketonuria

Management

I. Quick Clinical & Laboratory assessment e.g.

- Level of consciousness
- Status of dehydration
- Presence or absence of shock, and
- Any evidence of infection

III. Send blood for • CBC, PBF • Ketone bodies in blood and in urine • Glucose, ABG, S electrolytes, Urea, Creatinine, HBA_1C

III. Rehydration

- If in shock: Infuse Normal saline (NS) @ 20 ml/kg bolus, as quickly as possible along with appropriate life support (ABC). Additional 10ml/kg bolus infusions may be needed, once or twice until circulation is stable.
- If no shock, but dehydration of >5%, resuscitate with Normal Saline @ 10 ml/kg bolus over 1 hour.

NB. The more ill the child, the slower the rate of rehydration to avoid the risk of cerebral oedema.

IV. Monitoring

- Level of consciousness
- Hourly of vital signs
- Intake-output chart
- Hourly, Capillary blood glucose status
- Ketones in every sample of urine passed

- Once circulating blood volume is restored, calculate ongoing fluid requirements as follows: **Requirement** = existing deficit + Maintenance fluid for next 48 hours
- Once blood glucose is <15 mmol/l, change NS to 5% DNS
- When oral fluid is tolerated, IV fluid should be reduced accordingly.
- Once shock/severe dehydration is corrected after 1-2 hours of IV rehydration, start-

- **Insulin in IV Infusion** as earlier start of insulin before rehydration is associated with cerebral oedema. It is started at a dose of 0.1 unit/kg/hour using insulin pump

V. Potassium replacement, if patient is hypokalaemic. Dose: 20 mmol/l in IV maintenance fluid, once urine output has been documented

VI. Broad spectrum Antibiotics, IV in suspected sepsis

NB: NaHCO3 is not Routinely used except when the child is in shock with severe acidaemia (pH <6.9).

VII. Treatment of cerebral oedema

Features: Headache, vomiting or slowing of heart rate, high BP, alterated sensorium, abnormal respiratory pattern

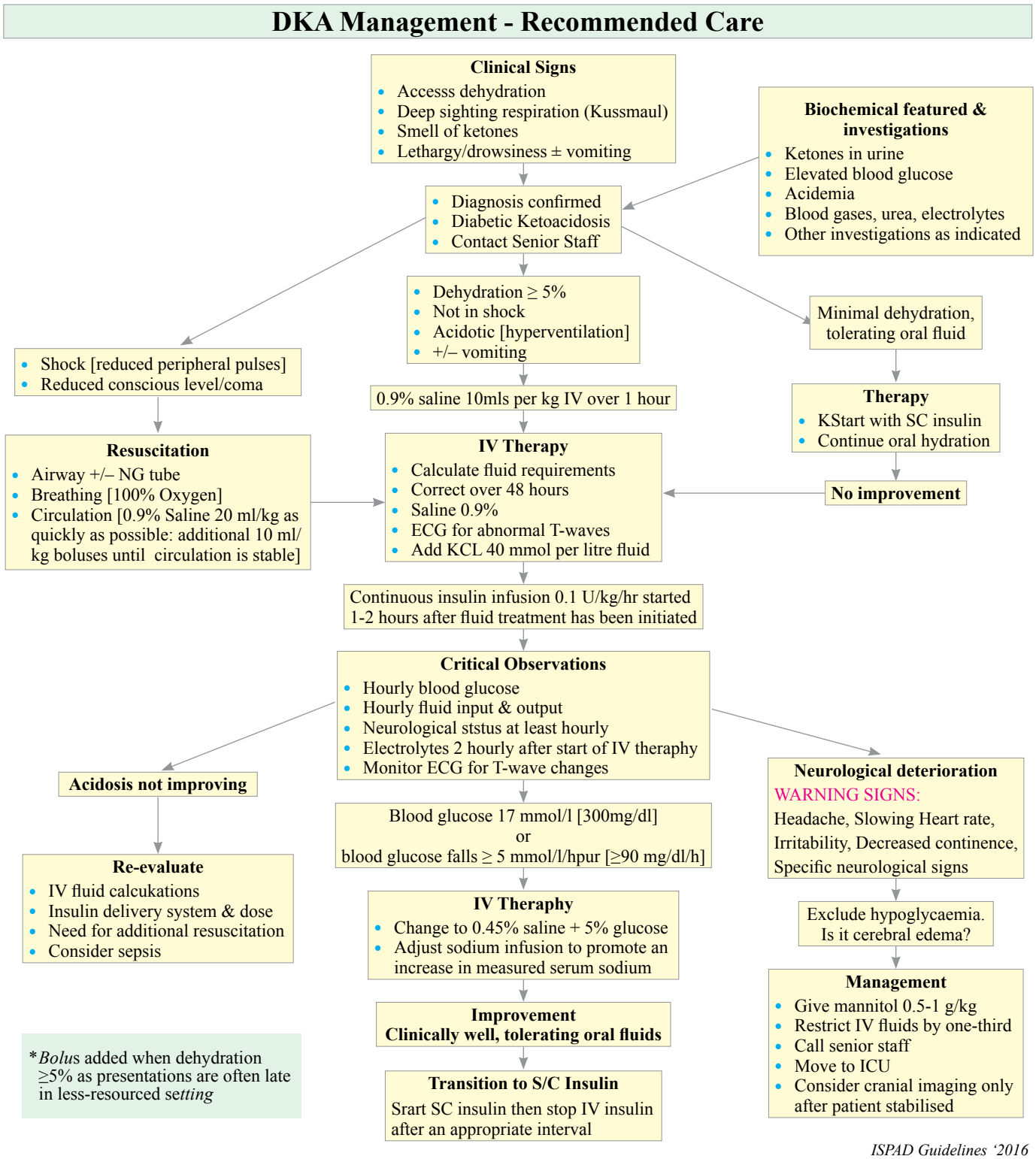
- **Supportive:** Elevation of head, respiratory support, fluid restriction
- Mannitol (0.5-1 g/kg) IV over 10-15 minutes
- Hypertonic saline (3%), 2.5-5 ml/kg over 10-15 minutes may be given as an alternative to mannitol, especially if there is no initial response to mannitol

VIII. Monitoring of the child

- Follow up: Hourly after starting treatment, then 4 hourly on–
  - Monitoring vital signs
  - Intake output chart
  - Blood glucose, S electrolytes, ABG
    - Once DKA has been adequately treated (hydration corrected, glucose controlled, ketones cleared) the child can be transitioned to Subcutaneous (SC) insulin. The first SC dose of short-acting insulin should be given 1-2 hours before stopping the insulin infusion

Patho-physiology, cardinal features & treatment of other causes of polyuria

	Diabetes mellitus	Diabetes insipidus	RTA	CKD
Patho-physiology	Decrease level of insulin in blood/ lack of insulin	Lack of ADH secretion/ lack of ADH action	Failure of H^+ secretion/ decreased HCO_3 absorption	Renal loss involving both glomeruli and tubule
Effect	Inability to utilise glucose	Inability to concentrate urine	Inability of the renal tubules to maintain normal acid-base balance	Tubulopathy interfering with salt & water reabsorption
Affected Site	Pancreatic β cell	Pituitary, Renal collecting tubule	Proximal & distal renal tubules	Glomeruli and renal tubules
Biochemical changes	Hyperglycaemia, ketonemia, ketonuria, ketoacidosis	Heamoconcentration, hypernatreamia, dilute urine	Non anion gap metabolic acidosis, hypercalciurea, phosphoturia, glycosuria	Metabolic acidosis, high BUN, creatinine hyperkalaemia, hyponatreamia, anaemia
Clinical consequences	Polyuria, polydipsia, polyphagia, weight loss, features of DKA	Polyuria(enormous diluted urine), polydipsia, weight loss±, dehydration	Respiratory distress, growth failure, features of rickets, polyuria, polydipsia	Respiratory distress, hypertension, growth failure, anaemia, features of rickets, polyuria, polydipsia
Investigation to confirm the diagnosis	Blood glucose level, urinary sugar, urinary acetone, blood gas analysis	Serum osmolality, urinary osmolality, urinary specific gravity, Water deprivation test	Arterial blood gas analysis, serum electrolyte, urinary pH & electrolyte	Renal function test, serum electrolyte, Hb%, Imaging study
Treatment	Insulin, oral hypoglycaemic drug	Desmopressin acetate, thiazide diuretics	Sodium bicarbonate, Shohl's solution	Renal replacement therapy



Psychogenic polydipsia

Psychogenic polydipsia is an uncommon clinical disorder characterized by excessive water-drinking in the absence of a physiologic stimulus to drink. The excessive water-drinking is well tolerated unless hyponatraemia supervenes.

The diagnosis of psychogenic polydipsia is one of exclusion and requires specialist investigation and management; the most important test is the water deprivation test which should be undertaken carefully.

TREATMENT

- Restriction of fluid
- Behavioural therapy
- Treatment of any other underlying cause

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SELF ASSESSMENT

SHORT ANSWER QUESTION [SAQ]

1.
2.
   a)

MULTIPLE CHOICE QUESTION [MCQ]

1. Regarding Diabetes Insipidus (DI) the following statements are true–

___ a) lack of Antidiuretic hormone ___ b) failure to respond to ADH in collecting duct in kidney

___ c) lack of Insulin secretion ___ d) poor response to insulin

___ e) reduction in ACTH secretion

2. In Diabetes Insipidus there is–

___ a) increased thirst ___ b) increased urine volume ___ c) high coloured urine

___ d) failure to thrive ___ e) intermittent fever

3. The following statements are true in Diabetes Insipidus–

___ a) serum Osmolality is >300 mOsm/L ___ b) serum Sodium level 156 meq/L

___ c) serum Osmolality 275 ___ d) urine specific gravity 1010

___ e) urine specific gravity 1005

3. The treatment options for DI are as follows–

___ a) DDAVP ___ b) fluid therapy ___ c) hydrochlorothiazide

___ d) Indomethacin ___ e) high solute diet

4. Polyuria , polydipsia, not gaining weight are features of –

___ a) Diabetes mellitus ___ b) Diabetes insipidus ___ c) Thyrotoxicosis

___ d) Psychogenic polydipsia ___ e) Renal tubular acidosis

5. The followings are assessed in Diabetes Mellitus–

___ a) glycaemic status ___ b) growth and development ___ c) Thyroid function

___ d) vision ___ e) compliance to Rx

6. The following investigations done for considering oral hypoglycaemic agent in DM patient are–

___ a) blood glucose level ___ b) insulin Level ___ c) C-peptide level

___ d) HbA1c ___ e) urine for microalbumin

7. In DKA the following could be present–

___ a) Ketonaemia ___ b) Ketonuria ___ c) acidosis PH <7.3

___ d) Bicarbonate <15 ___ e) all of above

8. Diabetic Ketoacidosis is treated with–

___ a) fluid therapy ___ b) IV insulin in infusion ___ c) Insulin pump

___ d) Sodium bi carbonate ___ e) Inj. KCL

9. Sign-symptoms of hypoglycaemia are–

___ a) confusion ___ b) convulsion ___ c) drowsiness

___ d) palpitation ___ e) tachycardia

10. In Diabetes Mellitus there are–

___ a) increased thirst ___ b) polyphagia ___ c) abdominal pain

___ d) increased frequency of micturition ___ e) dehydration

11. The following statements are true in Diabetes Mellitus–

___ a) abnormal metabolism of carbohydrate ___ b) abnormal metabolism of fat

___ c) normal metabolism of protein ___ d) hyperglycaemia ___ e) All of above

12. In Diabetes Mellitus there may be–

___ a) absolute deficiency of insulin ___ b) relative deficiency of insulin ___ c) Insulin resistance

___ d) genetic defect in insulin action ___ e) all of above

13. The followings are the acute complications of DM–

___ a) DKA ___ b) hypoglycaemia ___ c) coronary artery disease

___ d) retinopathy ___ e) growth retardation

Chapter 30

Sudden Paralysis of Limbs

Whenever, a child presents with sudden onset of paralysis, one should think of the following possible problems involving–

- **Spinal cord**: Poliomyelitis, transverse myelitis (TM), spinal cord tumor
- **Peripheral nerves**: Guillain–Barré syndrome (GBS) diphtheria, porphyria
- **Neuromuscular junction**: Tick, botulism
- **Brain**: Stroke

In this chapter, diseases those give rise to acute flaccid paralysis e.g. Poliomyelitis, GBS, TM will be highlighted.

POLIOMYELITIS

Aetio-pathogenesis

Organism: Polio virus type 1, 2, 3.

All the 3 types can cause paralysis but **type 1** is associated with most of the major epidemics and shows the greatest propensity to cause paralytic form of the disease.

Transmission: Faecal-oral route

Incubation period: 1-3 weeks

The areas of spinal cord and brain affected by polio virus are–

Spinal cord	Anterior horn cells
Medulla & Pons	Motor cranial nerve nuclei
Cerebellum	Nuclei in the roof and vermis
Pons	Substantia nigra, and occasionally the red nucleus

Clinical Manifestations

Presentations are variable.

A. Asymptomatic: About 90-95% of patients

B. Symptomatic: About 5-10% cases and they present as one of the following 3 ways–

- Abortive polio:
  - Like any viral infection.
  - No paralysis
  - Recovery is complete
- Nonparalytic aseptic meningitis: Characterized by fever, headache and neck stiffness without paralysis
- Paralytic poliomyelitis: According to the site of lesions, paralytic poliomyelitis are of 3 types
  - Spinal
  - Bulbar
  - Polio encephalitis

A child with paralyzed right lower limb from polio

Cardinal features of 3 types of Paralytic Poliomyelitis

Parameters	Spinal poliomyelitis	Bulbar poliomyelitis	Polio encephalitis
Site of lesion	Anterior horn cells of spinal cord	Motor cranial nerve nuclei at Medulla & Pons	Brain
Presentation	◆ Initially high fever, severe myalgia, herald progression to– ❑ Loss of tendon reflexes and subsequent Flaccid paralysis ◆ Paralysis,usually asymmetrical ◆ Proximal limb muscles more affected than distal ◆ Lower limbs are affected more than the upper limbs ◆ Affected muscles are floppy ◆ Sensation remains intact ◆ Hyperaesthesia of skin overlying paralyzed muscles is common & pathognomonic	◆ Nasal intonation of voice ◆ Nasal regurgitation of saliva & fluids during swallowing ◆ Absence of effective coughing ◆ Deviation of the palate, uvula or tongue ◆ Involvement of vital centers in the medulla, which usually manifest as– ❑ Irregularities in rate, depth and rhythm of respiration ❑ Changes in Blood pressure ❑ Cardiac arrhythmias ❑ Flactuations in body temperature ❑ Paralysis of 1 or both vocal cords, causing hoarseness, aphonia and ultimately asphyxia	◆ Higher center of brain involved ◆ Cranial nerve involvement ◆ Irritability/ drowsiness ◆ Seizure ◆ Coma

- ❑ Bladder distension and marked constipation accompany paralysis
- ❑ Paralysis is complete by the time temperature normalize
- ❑ Muscle atrophy evident by 4-8 weeks
- ❑ Most improvement of paralysis

COMPLICATIONS

- ◆ Respiratory, pharyngeal and bowel malfunction. Death is usually the consequence of respiratory dysfunction

DIAGNOSIS

- ◆ Characteristic clinical manifestations
- ◆ Isolation of virus from stool is confirmatory

After receiving the patient, it has to be notified to AFP surveillance office and stool sample should be sent. (2 samples of 8-10 gm stool each to be collected 24 hours apart within 14 days of onset of AFP & to be sent in cold box at 4-8°C to National Lab for Polio & Measles at IPH building, Mohakhali, Dhaka).

- ◆ PCR is the method of choice for polio detection

TREATMENT

Counsel parents that polio is a non curable disease and the treatment is mainly supportive and rehabilitative. The aim of treatment is to–

- ◆ Strengthen all the affected muscles
- ◆ Prevent contractures and deformities
- ◆ Make the patient as self sufficient as possible
- ◆ Provide emotional and psychological support

Treatment in the acute stage of muscle paralysis (7-10 days)

- ◆ Give NG tube feeding if unable to feed orally
- ◆ Apply moist hot packs to the affected muscles along with analgesics to treat pain
- ◆ Support the spine, hip, knee, foot and other joints to prevent contracture, sores and deformities. e.g.
  - ❑ Change posture 2 hourly
  - ❑ Rest on a firm mattress with back supported on a lumbar board. Early spinal bracing, if back is weak
  - ❑ Support the feet by rigid boards at 90˚ angle
  - ❑ Apply passive range of movement for the joints
  - ❑ Position hip & knees as straight as possible and arms in abduction with mild support
  - ❑ Avoid forceful exercise as this may increase paralysis
- ◆ No IM injection during acute phase
- ◆ Do intubation or tracheostomy for ventilation and secretion control
- ◆ Do catheter drainage of urinary bladder, if required
- ◆ Treat pulmonary atelectasis and infections with antibiotics and chest physiotherapy

Treatment in the convalescent stage (upto 2 years)

- Encourage sitting up if the paralysis is not severe
- Start passive exercise first, and then begin active assisted to active resisted exercises
- Gradually introduce sitting balance training & standing balance training in parallel bars, gait training etc.
- Crutches, leg brace (calipers) and other devices may help the child to move better and prevent contractures or deformities
- Introduce active games, swimming and other activities to keep limb moving

PREVENTION

- Immunize with polio vaccine according to EPI & NID programme

Prognosis

- Paralyzed muscles generally recover power to a variable degree over time. If no recovery by 6 months then it will be parmanent
- Mortality is about 5-10%, mostly due to cardio-respiratory dysfunction

GUILLAIN–BARRÉ SYNDROME (GBS) ACUTE POST-INFECTIOUS DEMYELINATING POLYNEUROPATHY

GBS is a postinfectious polyneuropathy involving mainly motor but sometimes sensory and autonomic nerves as well.

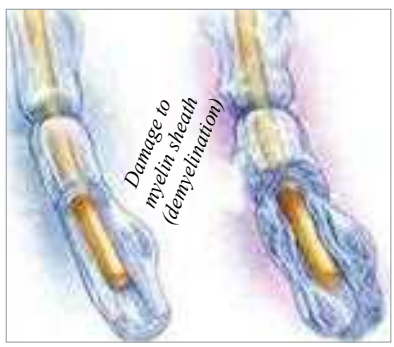
Aetiology

The pathogenic triggers are–

- *Campylobacter jejuni* (most common)
- *Mycoplasma pneumoniae*
- Viruses e.g. Epstein-Barr virus, Cytomegalovirus, Enteroviruses, Hepatitis A and B, Varicella

Pathogenesis

The syndrome usually develops 1-4 weeks after a gastrointestinal *(Campylobacter jejuni)* or respiratory tract *(Mycoplasma pneumoniae)* infection. The major pathological event is an immune mediated demyelinating neuropathy where there is damage of myelin sheath and also degeneration of the axon. This damage of myelin sheath of peripheral nerves blocks/interferes with conduction of nerve impulse.



Source: Internet

Types

- Acute inflammatory demyelinating polyneuropathy (AIDP)
- Acute motor axonal neuropathy (AMAN)
- Acute motor sensory axonal neuropathy (AMSAN)
- Miller-Fisher syndrome (MFS)
- GBS with severe bulbar and facial paralysis
- Congenital GBS

CLINICAL MANIFESTATIONS

- Pain & tenderness in muscles of neck, back, buttock and leg at the onset
- Abrupt onset of–
  - Symmetrical weakness usually in the lower extremities
  - Progressive ascending paralysis gradually involving the trunk and upper limbs and, finally, the bulbar muscles, a pattern known as Landry ascending paralysis
  - Distal muscles more affected than proximal muscles
- Affected muscles show signs of lower motor neuron paralysis e.g.
  - Profound muscle weakness
  - Loss of movement
  - Reduced tone and strength
  - Loss of deep tendon reflexes
  - Absence of planter reflexes
- Respiratory failure due to paralysis of diaphragm & other muscles of respiration and presents as–
  - Dyspnoea
  - Prominence of accessory muscles of respiration
  - Cyanosis
  - Progressive elevation of the respiratory rate
  - Tachycardia
  - Agitation, confusion, coma

- Bulbar palsy: Results from the weakness/paralysis of muscles supplied by the motor nuclei of V, VII, IX-XII, cranial nerves. Muscles involved are:
  - Muscles of jaw & face
  - Sternocleidomastoid and upper part of Trapezius
  - Muscles of tongue pharynx and larynx, presents as–
    - Dysarthria
    - Dysphagia (often with chocking episodes and nasal regurgitation of fluids)
    - Dysphonia (nasal intonation of voice)
    - Poor cough and susceptibility to aspiration pneumonia
- Manifestations of autonomic involvement are–
    - Fluctuation of BP and heart rate
    - Fluctuation of body temperature
- Bladder dysfunction: Usually absent but may occur on about 20% cases, sometimes there may be pain at the back (radiculopathy)
- Complications of immobility: Aspiration pneumonia, bed sore etc.

DIAGNOSIS

Diagnosis based on clinical with support from thr relevant investigations

INVESTIGATIONS

- CSF study: characteristic **Albumino-Cytological** dissociation evident after 7 days of onset of symptoms
  - Cytology: Usually normal (<10 cells/cmm)
  - Biochemistry: Increased protein (may be as high as 400-500 mg/dl). Increased CSF protein is thought to reflect the wide spread inflammation of the nerve roots
  - Glucose: Normal
- Stool culture: *C. jejuni may be found*
- Motor nerve conduction velocity: Reduced
- Electromyogram (EMG): Shows evidence of acute denervation of muscle
- Sural nerve biopsy: Shows segmental demyelination, focal inflammation and Wallerian degeneration – which is diagnostic. But virtually never required for diagnosis

TREATMENT

A. Specific

- Intravenous immunoglobulin (IVIG): 400 mg/kg/day for 5 consecutive days (total dose 2 g/kg)
- Plasmapheresis (Here whole blood drawn from patient is separated into plasma and blood cells; the plasma is replaced with saline/albumin or specially prepared donor plasma, reconstituted with blood cells and retransfused into the patient): Helps speedy recovery. It is more beneficial when started within seven days of the disease onset
- Combination of IVIG and interferon
- Corticosteroids: No role

B. Supportive

- Counsel parents about the disease, prognosis and to provide psychological support
- Bed rest (pneumatic bed is preferable) and frequent change of posture to avoid bed sores
- Feeding: NG tube feeding, if unable to take orally
- Maintain personal hygiene e.g. bathing, hand washing etc.
- Care of bowel: By ensuring regular bowel movement by a high fiber diet, adequate and timely fluid intake, medications to regulate bowel evacuations e.g. Lactulose, enema if necessary
- Care of the bladder: By catheterization with regular check up
- Avoidance of aspiration pneumonia by clearing the throat off secretions by oropharyngeal suction, chest physiotherapy
- Assisted ventilation if respiratory failure (arterial PO_2 falls below 70 mmHg)
- Management of pain with NSAIDs e.g. Ibuprofen
- Physiotherapy
  - Should be started before recovery begins by moving patients' limbs manually to help keep the muscles flexible and strong

Follow up

- Improvement usually occurs in 2-3 weeks but may need 1 to 2 months
- Sometimes complete recovery may occur in 1-2 years

Prognosis

- More than 90% of children recover fully, while a small minority has mild weakness. **Predictors** of poor outcome are–
  - Cranial nerve involvement
  - Required intubation
  - Maximum disability at the time of initial presentation
- Mortality is low (1–2%) and generally results from respiratory failure, cardiac arrhythmia, hemodynamic instability etc.

TRANSVERSE MYELITIS (TM)

The term transverse means across the width, myelitis refers to inflammation of the spinal cord. So transverse myelitis means inflammatioin across the width of one level or segment of spinal cord.

AETIO-PATHOGENESIS

Inflammation of spinal cord causes–

- Damage or destruction of nerve cells in the inflamed segment
- Interruption of connection between brain and spinal nerves below the level of lesion

Therefore, the net neurological consequences in TM are–

At the level of lesion	Signs of LMN lesion
Below the level of lesion	Signs of UMN lesion
Above the level of lesion	Normal nerve function

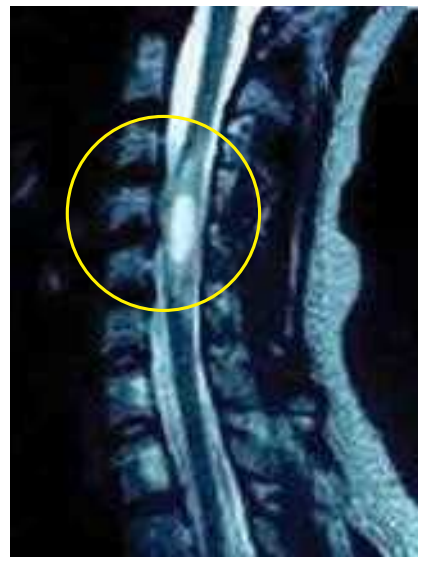
LMN: Lower motor neuron, UMN: Upper motor neuron

CLINICAL MANIFESTATIONS

- Non-specific symptoms–
  - Initially paraesthesias ascending from the feet, or
  - Back pain at the level of myelitis (usually at thoracic level)
- Sensory loss: Loss of sensation with a definite upper level. Pain, temperature, and light touch sensation are affected, but joint position and vibration sense may be preserved
- Motor dysfunction: Characterized by flaccid paralysis in the initial phase (2-3 days) of "spinal shock" (lower motor neuron signs). Thereafter, flaccidity gradually changes to spastic paraparesis with exaggerated deep tendon reflexes (upper motor neuron signs)
- Autonomic dysfunction
  - Fluctuation of blood pressure
  - Sweating
  - Urinary retention with dribbling
  - No spontaneous bowel movement

INVESTIGATIONS

- MRI of spine: Mild fusiform swelling of cord over several segment, most frequently in thoracic segments
- CSF study
  - Cytology: Moderate pleocytosis (50-100 lymphocytes/mm^3).
  - Biochemistry: Elevated protein (≈100 mg/dl)



Source: Internet

Fusiform swelling of spinal cord in TM

TREATMENT

A. Supportive

- Counsel parents about the disease, its prognosis and provide psychological support
- Bed rest (pneumatic bed is preferable) and change of posture 2 hourly to avoid bed sores
- Maintain personal hygiene e.g. bathing, hand washing etc.
- Ensure chest physiotherapy to prevent hypostatic pneumonia
- Care of urinary bladder: By catheterization
- Care of bowel: Ensuring regular bowel movement by–
  - High fiber diet
  - Adequate and timely fluid intake
  - Medications to regulate bowel evacuations e.g. Lactulose
  - Enema, if necessary
- Physiotherapy
  - Should be started when pain subsides. It is done by passive movement of patients' limbs
- Anti-spasticity drugs e.g. • oral/intrathecal Baclofen • Tizanidine and Benzodiazepines • therapeutic Botulinum toxin injections and • serial casting

B. Specific

- **Steroid:** Pulse IV Methylprednisolone, 30 mg/kg/day (max1gm) diluted with 50-100 ml of DNS over 2 hours daily for 5 days
- **Plasmapheresis:** Indicated in patients who don't show much improvement with IV steroids

Prognosis

- Recovery may occur over a period of weeks or months
- One third completely recovers, one third live with residual symptoms and the remaining show no improvement at all

Differences between the common causes of AFP

Parameters	Poliomyelitis	GBS	TM
Paralysis	Asymmetric paralysis, proximal muscles are more affected than distal muscles	Symmetrical ascending paralysis, distal muscles are more affected than proximal muscles	Initially LMN, subsequently UMN paralysis
Site of lesion	Anterior horn cells of spinal cord and motor cranial nerve nuclei at medulla	Peripheral nerves	Inflammation across the width of one level or segment of spinal cord
Sensory loss	Absent	Minimum may be	Present with a definite upper level
Cranial nerve involvement	May be present most commonly IX & X	May be present& commonly affected are VII, IX, X, XI, XII	Usually absent
Respiratory insufficiency	Present in both Bulbar & Bulbo-spinal polio	Present & Life threatening	Usually absent
Autonomic involvement	Absent	May be present e.g. fluctuant BP, body temperature, excessive sweating	May be present
Bladder dysfunction	Present	Usually absent	Usually present
CSF changes	Cytology: Pleocytosis, mostly lymphocyte Biochemistry : Protein normal	Cytology: Usually normal (<10/cmm) Biochemistry: Protein (Albumino-Cytological dissociation)	Cytology: Moderate pleocytosis Biochemistry: Mild elevation of protein

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the causes of sudden paralysis in children?
2. What are the common clinical features in GBS?
3. How will you treat a case of GBS?
4. What are the net neurological dysfunction in TM?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Characteristic features of acute poliomyelitis are–

___ a) symmetrical, ascending paralysis ___ b) loss of sensation ___ c) loss of bladder function
___ d) high chance of respiratory insufficiency ___ e) more cells and normal proteins in CSF

2. The following features are characteristics of GBS–

___ a) sensory loss ___ b) paralysis of distal than proximal muscles ___ c) ascending type of paralysis
___ d) bladder dysfunction ___ e) more protein and normal cells in CSF

3. Autonomic dysfunction found in transverse myelitis include–

___ a) fluctuation of blood pressure ___ b) Sweating ___ c) deviation of the angle of the mouth
___ d) urinary retention with dribbling ___ e) no spontaneous bowel movement

4. Features of Bulbar palsy in GBS presents as–

___ a) Dysarthria ___ b) Dysphagia ___ c) Dysphonia ___ d) Poor cough ___ e) Excessive sweating

5. Signs of lower motor neuron paralysis include–

___ a) Profound muscle weakness ___ b) Loss of movement ___ c) Reduced tone and strength
___ d) Exaggerated deep tendon reflexes ___ e) Absence of planter reflexes

6.Spinal poliomyelitis is presented as–

___ a) Mild pain ___ b) asymmetric flaccid paresis ___ c) distal muscles are more affected then proximal muscle
___ d) Absent deep tendon reflexes ___ e) affected muscles are hyertonic

All of the following may be associated with Guillain-Barre Syndrome except:

___ a) Weakening or tingling sensation in the legs ___ b) Weakness in the arms and upper body
___ c) nearly complete paralysis ___ d) First symptom is altered mental status
___ e) Bladder dysfunction

Predictor of poor outcome in GBS–

___ a) Maximum disability at the time of initial presentation ___ b) hyper reflexia
___ c) required ventilator __ d) autonomic involvement ___ e) cranial nerve involvement

Spinal involvement of GBS consisting of–

___ a) Flaccid paralysis ___ b) hypertonia ___ c) areflexia ___ d) absent planter response
___ e) spastic paraplegia

Which best distinguishes transverse myelitis from peripheral neuropathy (GBS)–

___ a) Flaccidity ___ b) hyporeflexia ___ c) distinct level of sensory loss ___ d) autonomic manifestation ___ e) CSF pleocytosis

Chapter 31

Convulsion

Convulsion represents many serious underlying neurological illnesses.

It is a sudden, transient brain dysfunction manifested by involuntary motor, sensory, autonomic or psychic phenomena alone or in combination, often accompanied by loss/alteration in consciousness. Convulsions may occur either with fever or without fever.

The conditions given in the box should be taken into consideration whenever a child presents with convulsion. In this section, the common causes of convulsion in children will be discussed briefly.

Convulsing child with fixed stare and rigidity

Convulsions associated with fever	Convulsions not associated with fever
◆ Febrile convulsion ◆ Acute meningitis- bacterial or viral ◆ Cerebral malaria ◆ Viral encephalitis ◆ Tubercular meningitis (TBM) ◆ Brain abscess	◆ Epilepsy ◆ Encephalopathy e.g. ❑ hypertensive, hepatic or uraemic, hypoxic, ischaemic ◆ Trauma e.g. head injury ◆ Acute stroke syndrome ◆ Intracranial space occupying lesions ◆ Metabolic abnormalities e.g. ❑ Hypoglycaemia, hypocalcaemia ❑ Hypo or hypernatraemia ❑ Hypomagnesaemia ❑ Pyridoxine deficiency/ dependency

FEBRILE CONVULSION/SEIZURE (FS)

Febrile seizure are seizures that occur between the age of 6 months and 60 months with a temprature of 38.8° C (101.84° F) or higher, that are not due to

- ❑ CNS infection or
- ❑ Any metabolic imbalance and
- ❑ that occur in the absence of a history of prior Afebrile seizure.

Temp 38.8C (ref. current ped diag & treat, 23rd ed; p 756)

Types

Types	Duration	Pattern of seizure	Recurrence
Simple	< 15 minutes	GTCS	No recurrence within 24 hours
Complex (Atypical)	≥ 15 minutes	Focal seizures (usually)	Recurrence within 24 hours
Febrile status epilepticus	> 30 minutes	Focal or generalized	
Febrile seizure plus	Recurrence within 24 hours		

GTCS: Generalized tonic clonic seizure

Characteristics of Simple FS

- Convulsion/seizure occurs among children between 6 months to 6 years with a peak age of around 14-18 months
- Seizures are mostly generalized, occurs usually once in 24 hours, last from few seconds to few minutes but not exceeding 15 minutes; occur early in the illness causing fever.
- Absence of signs of meningitis e.g. bulging fontanelle, stiff neck, stupor and irritability
- No residual neurodeficit
- May have family history of febrile convulsion

Clinical Evaluation

History

- Age of the child
- Nature of fever
- Types & duration of seizure
- Family history of seizure disorder or febrile seizure
- Developmental status of the child

Physical Examination

- To assess patient's neurologic status e.g. level of consciousness
- To check airway, breathing and circulation
- To check anterior fontanelle
- To check signs of meningeal irritation e.g. neck stiffness, positive Kernig's sign & Brudziniski's sign
- Assess others e.g. OFC, status of cranial nerves etc.
- To find out the cause of fever e.g. otitis media, pneumonia, UTI, tonsilitis, pharyngitis or any viral exanthem

Diagnosis

Based on characteristic clinical features and absence of any evidence of meningitis clinically & in CSF profile

Investigations

While managing such a case, the most important decision is to rule out meningitis by **CSF study**. Other investigations are planned to find out the cause of fever and also of convulsion. These are–

- Blood for CBC, PBF, C/S
- Random blood sugar (RBS)
- Serum Calcium
- Serum electrolytes
- Throat swab for C/S
- X-Ray chest
- Urine R/M/E, C/S
- EEG: Not required in simple febrile seizure
- Neuro-imaging: No role

Indications of CSF study in febrile seizure

- Any suspicion of meningitis
- First attack of FS occurs at a age of <12 months
- Complex siezure
- Altered sensorium
- Recovery is slow or prolonged post-ictal sleep

Treatment

- Counsel parents about the nature and future of the disease
- Maintain airway, breathing and circulation (see status epilepticus p 254)
- Stop seizure by either–
  - Inj. Diazepam (0.5 mg/kg) per rectal (PR) or 0.2-0.3 mg/kg slow IV or
  - Inj. Midazolam (0.2 mg/kg) smeared on buccal mucosa or instilled intranasally
- Reduce body temperature by–
  - Paracetamol (15 mg/kg/dose), 6 hourly, orally or per rectally
  - Tepid sponging
- Appropriate antibiotics to treat associated infection. One important characteristics of FS is it's high tendency to recur during future febrile episodes. The following are the **Risk factors** for the recurrences–

- **Major** risk factors
  - Age <1 yr
  - Duration of fever <24 hr (i.e. have a shorter interval between the onset of fever and the seizure)
  - Fever 38-39°C (100.4-102.2°F i.e. have a lower degree of fever before their seizure)
- **Minor** risk factors
  - Family history of febrile seizures
  - Family history of epilepsy
  - Complex febrile seizure
  - Daycare
  - Male gender
  - Lower S Na^+ at time of presentation

Recurrences in relation to presence of risk factor
No : 12% 1 : 25-50%; 2 : 50-59% ≥ 3 : 73-100%

How to Prevent future recurrence of FS?

- Reduction of body temperature by adequate dose of paracetamol and tepid sponging
- Anti-convulsant prophylaxis
  - Continuous prophylaxis, not recommended
  - **Intermittent prophylaxis** with either of the following drug is recommended, till 5 years of age
    - Oral Diazepam: 0.5-1mg/kg/day (max.10 mg) in 3 divided doses, for 48-72 hours, OR
    - Oral Clobazam: 1mg /kg/day (max. 20 mg) as single/bd doses, for 48-72 hours

Prognosis

- Good, as it is a benign condition and leaving behind no death or neuro-disability
- However, only 2-7% of children who experience FS proceed to develop epilepsy later in their life.

MENINGITIS

Refers to inflammation of **leptomeninges** *e.g. pia & arachnoid mater* and **CSF** within the subarachnoid spaces. It is usually caused by microorganisms and is broadly grouped as–

a) Acute pyogenic meningitis

b) Acute viral meningitis

c) Chronic (TB, spirichetal) meningitis

In this chapter, we will discuss acute pyogenic and tubercular meningitis.

ACUTE PYOGENIC MENINGITIS

Acute pyogenic meningitis is the leading cause of death and neurodisability among children.

Risk factors

- Neonates
  - Maternal uro-genital infection
  - Prematurity
  - Neural tube defect (spina bifida)
- Infants & Children
  - Septicemia, pneumonia,otitis media, mastoiditis
  - Head trauma
  - Asplenia / splenectomy

Organisms

- **Neonatal period**: *E. coli*, Gr. B Streptococci, *L. monocytogenes*
- **Beyond neonatal period**: *H. influenzae, Strept. pneumoniae, N. meningitides*

Route of entry of organisms in CNS

- Through blood (bacteremia/septicaemia)
- Direct extension from the surrounding infection e.g. otitis media, mastoiditis etc

Pathogenesis

After entry into the choroid plexus of lateral ventricle, the organisms next enter into the extra-cerebral CSF and sub-arachnoid space, where they multiply and cause inflammation of the adjacent meninges (meningitis) and release many inflammatory mediators which also affect and irritate adjacent nerve roots. The inflammatory process then further spreads to the adjacent brain tissue and causes their damage to

- Brain (cerebritis, cerebral infarction, stroke)
- Blood vessels (vasculitis, vasodilatation, vasospasm, vascular occlusion) etc.

The net clinico-pathological effects of this inflammation are–

- **Signs of meningeal irritation** due to irritation of spinal nerve roots
- **Raised** intra cranial pressure **(ICP)** due to
  - Cytotoxic cerebral edema from cell death
  - Vasogenic cerebral edema due to increased vascular permeability
  - Interstitial cerebral edema due to increased hydrostatic pressure

- **Hydrocephalus**
  - Initially communicating i.e. obstruction of arachnoid villi around cistern at the base of the brain by purulent meningeal exudate
  - Later, non-communicating due to fibrosis and gliosis of aqueduct of Sylvius, foramen of Lushka and foramen of Magendi
- **Convulsion** due to cerebral infarction, cerebritis, electrolyte imbalance
- Cerebral infarction, stroke, cranial nerve palsy due to vasospam, vascular occlusion & thrombosis

CLINICAL MANIFESTATIONS

A. Older children: Classically presents with–

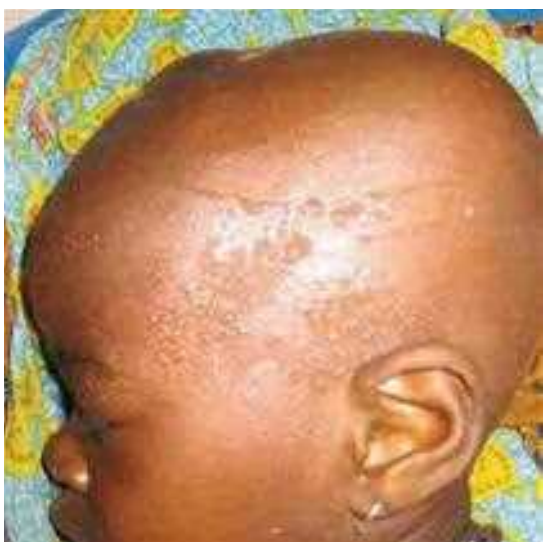
- High fever
- Vomiting
- Headache
- Recurrent convulsions
- Alteration of consciousness

B. Neonates: Presentations are Non-specific–

- Reluctant to feed
- High-pitched cry
- Vacant look
- Hypo/hyperthermia
- Jitteriness
- Bulged fontanelle
- Stiffness of limbs
- Convulsions
- Respiratory distress
- Evidence of sepsis

Physical Examination

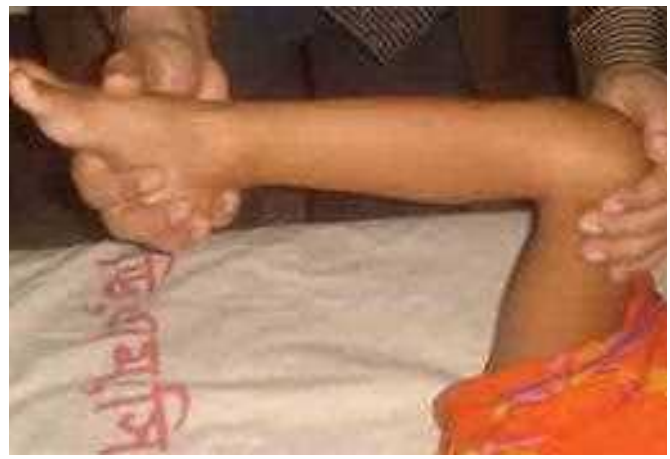
- Neurological examination to assess:
  - Altered sensorium/unconsciousness, stupor (a state of lethargy and immobility with diminished responsiveness to stimuli)
  - Anterior fontanelle to assess any bulging among (neonates and infants)



Bulged anterior fontanelle

  - Signs of meningeal irritation e.g.
    - Neck rigidity
    - Kernig's sign (may not be present <18 months)
    - Brudzinski's sign

Neck rigidity



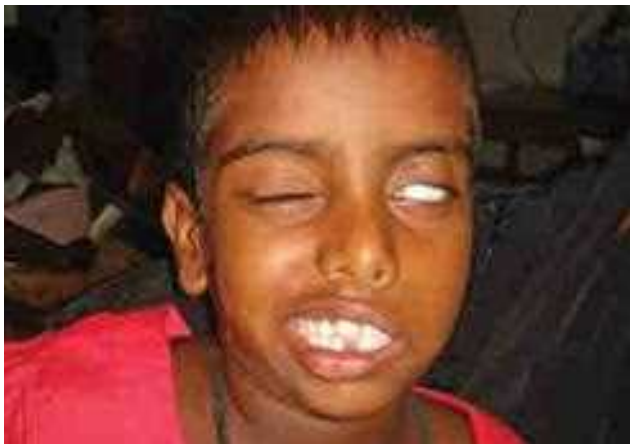
Kernig's sign

Source: Internet

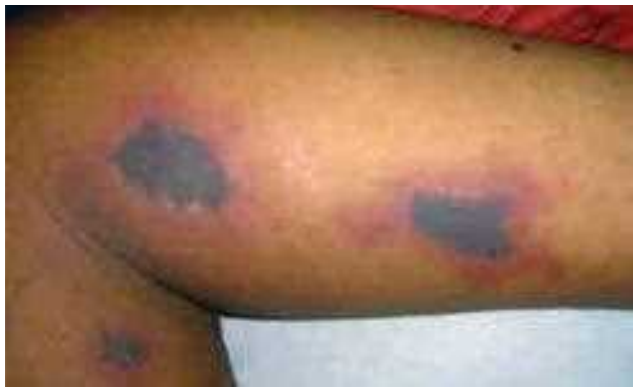
Brudzinski's sign

  - Muscle tone, strength, jerks, planter reflex (signs of UMN lesion may be present, when complicated)
  - Pupilary light reflex
  - Cranial nerves to assess for any palsy
- Fever: Usually high grade
- Ear: Evidence of ear infection, mastoiditis
- Hemodynamic status: Pulse, BP, capillary refill time
- Skin for any rash as found in meningococcaemia

Features of cranial nerve palsy



Left 7th cranial nerve palsy



Typical skin rash (different shape, irregular margin, reddish periphery with necrotic/ blackish centre) of Meningococcal sepsis.

- In **Meningococcal infection**, in addition to features of meningitis patient may additionally have–
  - Marked toxicity
  - Purpura, petechiae, and occasionally bright pink tender macules or papules over the extremities and trunk
  - Fulminant meningococcemia is characterized by DIC, massive skin and mucosal haemorrhage and
  - Features of shock e.g. Low volume pulse, low BP, narrow pulse pressure, prolonged CRT >3 sec.

Complications

Immediate	Long-term
Hydrocephalus	Cerebral palsy
Subdural effusion	Deafness
Subdural empyema	Intellectual disability
Ventriculitis	Epilepsy
Cerebral abscess	Visual impairment
Cerebral infarction e.g. acute stroke	Learning and language disability
Cranial nerve palsy	

Microcephaly and lateral squint (left 3rd cranial nerve palsy)

Hydrocephalus

DIAGNOSIS

Based on C/F & supports from relevant investigations.

Investigations

I. Blood

- CBC shows polymorphonuclear leukocytosis
- Culture & sensitivity to know the organism and the antibiotic sensitivity pattern

2. CSF study: To confirm the diagnosis

Precautions before doing LP–

- Fundus examination to rule out papilloedema
- No infection at the site of LP
- Bleeding diathesis to be excluded

- Physical appearance
  - Pressure: Usually elevated
  - Colour: Hazy, cloudy or purulent *(Normal CSF: crystal clear)*
- Cytological
  - Neutrophilic leukocytosis usually 300-2000 cells/cmm *(normal: 0-5 lymphocytes/cmm)*

Clear vs Purulent CSF

NB: CSF must be examined within 1/2 hour of LP to obtain correct results

- Biochemical
  - Glucose: Decreased, usually <40 mg/dl *(normal CSF glucose: 40-80 mg/dl) or less than 2/3 rd of blood glucose.* Corresponding blood sugar estimation is recommended half an hour before LP for this purpose
  - Protein: Increased, usually 100-500 mg/dl *(normal: 15-45 mg/dl)*
  - Chloride: Decreased,102-120 mmol/L *(normal: 120-130 mmol/L)*
- Microbiological
  - Gram staining: May reveal the organisms
  - Detection of bacterial antigens: By latex agglutination or by PCR.
  - Culture: May grow the causative organism

3. Other investigations
   - Blood glucose, S. calcium
   - S. electrolytes e.g. hyponatraemia & hypochrolaemia due to SIADH
   - Gram staining & Culture of swab taken from the skin rash: To search for meningococcal infection
   - X-Ray chest: To look for evidence of pneumonia
   - Urine R/M/E & C/S to exclude UTI

TREATMENT

A. Supportive

- Counsel parents about the nature & future of the disease, treatment, prognosis etc
- Nothing per oral, if convulsion & altered conciousness
- Maintain airway, breathing and circulation (details given in status epilepticus, p-254)
- To stop convulsion, give Inj. Diazepam 0.5 mg/kg per rectal (PR) or 0.2-0.3 mg/kg slow IV
- Start IV fluid : Normal daily allowance, but restrict, when patient has features of SIADH
  - 10% dextrose in 0.225% NaCl (Baby saline) or
  - 5% dextrose in 0.45 % NaCl (Junior saline)
- Add maintenance dose of K^+, 1-2 mmol/kg/day (not to exceed 20-40 meq/L) till patient is on NPO
- Give Paracetamol (15 mg/kg/dose) 6 hourly and tepid sponging, if fever
- Give NG tube feeding when patient is stable *e.g. no convulsion*
- Monitor vital signs *e.g. heart rate, respiration, urine output, BP or Capillary refill time* 4-6 hourly during the first 24-48 hours of treatment

B. Specific: Parenteral Antibiotics

Organisms	Antibiotics of choice	Duration
Unknown	Ceftriaxone/Cefotaxime plus Vancomycin	10 days
Meningococcus	Penicillin G	7 days
Pneumococcus	Ceftriaxone + Vancomycin	10-14 days
H. influenzae	Ceftriaxone or Cefotaxime	7-10 days
Gram–ve bacteria (Immunocompromized pt)	Meropenem or Cefotaxime + Amikacin	21 days
Pseudomonas	Ceftazidime	14-21 days
L. monocytogenes	Ceftriaxone+Ampicillin	

Ceftriaxone: 100 mg/kg/day, Once or 12 hourly
Cefotaxime: 200-300 mg/kg/day: 6/8 hourly
Ceftazidime: 150 mg/kg/day 8 hourly
Penicillin G: 300,000 units/kg/day 6 hourly

Meropenem: 40mg/kg/dose 8 hourly
Amikacin: 20-30mg/kg/day 8 hourly
Ampicillin: 300 mg/kg/day 6 hourly

C. Adjunctive therapy

In meningitis, much of the neuronal damage results from **high host immune response** and use of immune suppresants e.g. **Dexamethasone** in this regard is found beneficial. It–

- supresses cytokine mediated inflammatory cascade that occurs after rapid killing of bacteria by antibiotics.
- reduces cerebral oedema, neutrophil infiltration and ultimately prevents–
  - Further neurologic damage particularly the sensorineural hearing loss
  - Adhesion between meninges

Dose: 0.15 mg/kg/dose IV 6 hourly for 48 hours. It offers maximum benefit, if given 1-2 hours before starting antibiotics.

D. Treatment of complications

Whenever, despite sufficient treatment, fever persists (brain abscess) or head size is increased (hydrocephalous) or any evidence of (cranial nerve palsy) noted, evaluate the cases thoroughly to detect and treat the complication.

- SIADH: Fluid restriction
- Raised ICP
  - Elevate head end of bed by 30°
  - Infuse hypertonic saline
  - Frusemide (1mg/kg)
  - Mannitol (0.5-1gm/Kg)
  - ET intubation & Hyperventilation
- Subdural effusion
  - Aspirate fluid through open anterior fontanelle

E. Follow up: To detect any future neurodeficit

F. Prophylaxis for Contacts of meningococci

- Rifampicin (10 mg/kg/dose) orally every 12 hours for 48 hours, OR
- Ciprofloxacin (500 mg) orally as a single dose for persons > 18 years

G. Prevention: By vaccination with–

- Meningococcal conjugate vaccine: 2 doses are recommended anytime after 2 years of age
- Haemophilus influenzae type B vaccine: 3 doses from 1½ months of age (given in EPI schedule)
- Pneumococcal conjugate vaccine: 3 doses from 1½ months of age (given in EPI schedule)

TUBERCULAR MENINGITIS (TBM)

(Also discussed in chapter 7 along with TB)

The most dangerous form of TB infection

PATHOGENESIS

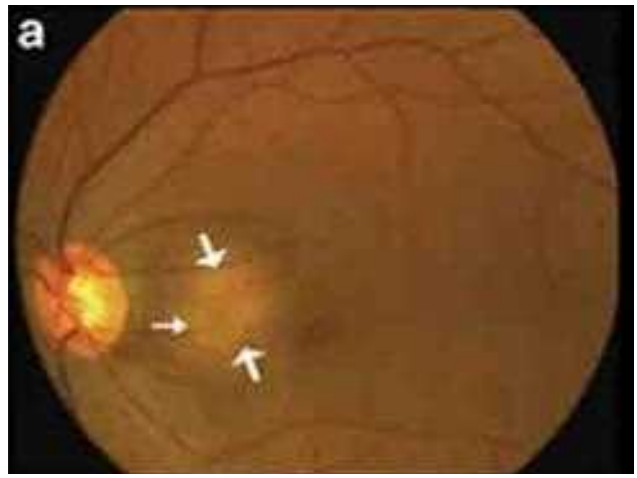
TB bacilli reach CNS by haematogenous route from a primary TB foci in lungs (milliary TB) or anywhere in the body. Initially, small tuberculous lesion (Rich's foci) develop in the CNS (meninges, subpial or subependymal surface of ventricle or of spinal cord) which may remain dormant there for years. Later on, rupture of these foci into the subarachnoid space or into the ventricular system results in meningitis.

CLINICAL MANIFESTATIONS

Onset of the disease is gradual and symptoms progress over several weeks and present through 3 stages:

Stage I Stage of invasion/ Prodromal stage	◆ Non-specific symptoms e.g. low grade fever, headache, malaise, irritability, behavioural change, drowsiness ◆ Focal neurological signs are absent
Stage II Stage of meningitis	◆ Neurological features e.g. lethargy, convulsions, vomiting ◆ Signs of meningeal irritation e.g. neck rigidity, Kernig's or Brudzinski's signs, hypertonia ◆ Cranial nerve palsies present ◆ Focal neurological signs present
Stage III Stage of coma/ Terminal stage	◆ Marked by coma, hemiplegia or paraplegia ◆ Decerebrate/decorticate posturing ◆ Deterioration of vital signs and ◆ Eventually death

- Examination of fundus: Choroid tubercle is highly specific for TBM



Choroid tubercle in TBM

DIAGNOSIS

Based on–

- Typical clinical features as mentioned in the chart
- H/O contact with an adult infectious TB patient
- Absence of prior BCG vaccination
- Evidence of TB infection elsewhere in the body e.g. lungs and
- Supports from relevant Investigations

Investigations

- CSF study: Classical features in TBM as well as other types of meningitis are given in the table below–

C S F	Pyogenic	Tubercular	Viral
Pressure	Elevated	Elevated	May be elevated
Colour	Hazy, cloudy or purulent	Straw	Usually clear
Cells	Neutrophilic leukocytosis 300-2000/ cmm	10-500 lymphocytes	10-100, mixed cells initially; becoming lymphocytic by 36 hours
Glucose	< 40 mg/dl or <50% of blood glucose	< 40 mg/dl	45-75 mg/dl
Protein	100-500 mg/dl	100-3,000 mg/dl	50-200 mg/dl
Gram stain/AFB	May show the organism	May show the bacilli	
Bacterial antigen	May be detected by latex agglutination or PCR	Gene-Xpert CSF for adenosine de aminase (ADA)	
Culture	May grow the organism		

- Mantoux test: Non reactive in about 50% of cases
- CBC: Hb% (reduced), DC (lymphocytosis), ESR (high)
- X-Ray chest: May show miliary mottling
- MRI of brain: Abnormal meningeal enhancement in basal cistern, the pathognomonic feature of TBM

Treatment

- Counseling parents about the nature & future of the disease.
- Anti TB drugs (4 drugs): 2 (HRZ)S and 10 (HR) for total 12 months or more
- Prednisolone (2 mg/kg/day) for initial 4 weeks and gradual tapering by another 2 weeks

Prognosis

Correlates mostly with the clinical stage of illness & when treatment is initiated. It is good in 1st stage but most patients in 3rd stage die and who survive have permanent disabilities *like blindness, deafness, intellectual disability, motor disabilities etc.*

VIRAL ENCEPHALITIS

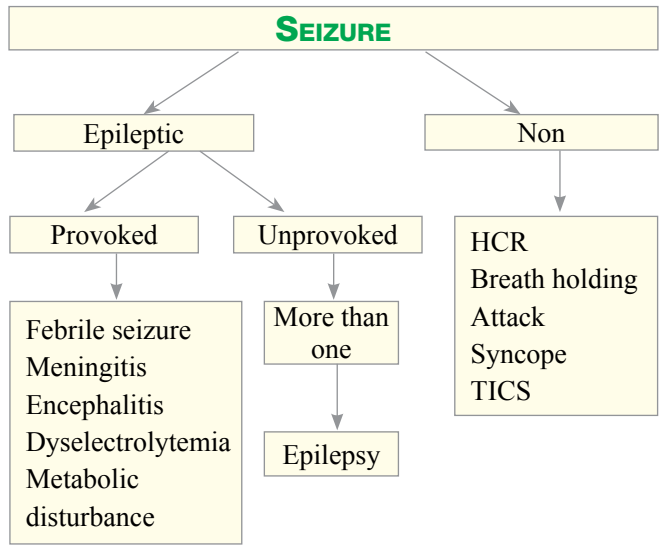
It is the inflammation of brain parenchyma.Patients however, have some degree of meningeal inflammation as well.

Aetiology

Organism: *Enteroviruses, Herpes Simplex Virus, Epstein-Barr Virus, Nipah, Japanese B encephalitis.*

Clinical Manifestations

The onset of the disease is usually abrupt. After a flu like prodrome, there is a rapid deterioration of CNS function and more than 80% of patients succumb into coma.



The patients commonly have–

- Fever, worsening headache, vomiting
- Drowsiness, confusion and behavioral change
- Convulsions and lethargy also develops rapidly
- Physical and neurological signs are variable

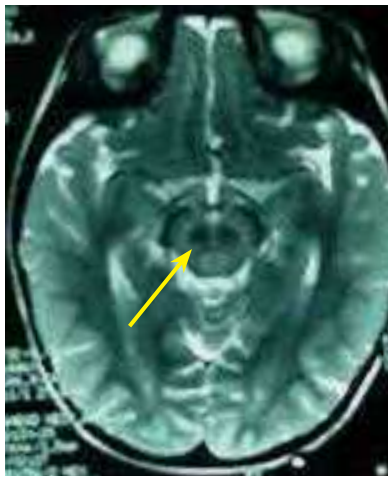
Diagnosis

Based on C/F & supports from relevant investigations.

Investigations

- CSF study
  - Routine examination
    - Modest lymphocytic pleocytosis
    - Mild rise of protein
    - Glucose level remain normal
  - PCR for viruses in CSF
  - Antibodies against viruses in CSF

- MRI of brain
  - Focal change
    - Temporal lobe pathology is seen in Herpes Simplex encephalitis
    - Bilateral thalamic haemorrhage seen as Eyes of Panda in Japanese B encephalitis



Courtesy: Dr Narayan Saha

Panda sign

TREATMENT

Counsel parents about the nature & future of the disease

A. Supportive

- Nothing per Oral, if convulsion
- Maintenance of airway, breathing and circulation (details given in page 254)
- To control convulsion, give Inj. Diazepam 0.5 mg/kg per rectal or 0.2-0.3 mg/kg slow IV *(if not controlled, treat as per algorithm discussed in status epilepticus)*
- Give IV fluid: ¾ of daily maintenance with–
  - 10% dextrose in 0225% NaCl OR
  - 5% dextrose in 0.45% NaCl
- Add maintenance dose of K^+ @ 1-2 mmol/kg/day (not to exceed 20-40 meq/L) till patient is NPO
- Paracetamol (15 mg/kg/dose 6 hourly) and tepid sponging, if fever
- Allow NG tube feeding, when patient is stable
- Ensure adequate nursing, especially taking care of–

  - Eyes: Apply eye drops & ointment to prevent exposure keratitis. Close the eyes with cotton pad, if necessary
  - Mouth: Clear mouth from secretion, apply antifungal drops, if required
  - Skin: Change posture 2 hourly. Gentle massage over pressure points to prevent bed sores
  - Bladder: Catheterization, if necessary
  - Bowel: Ensure regular bowel movement.Give enema, if necessary

- Give appropriate Antibiotic to prevent secondary infection, aspiration pneumonia and UTI

B. Specific

- Inj. Acyclovir, if *Herpes simplex* encephalitis
  - For older children: (10 mg/kg/dose) 8 hourly for 14 days
  - For Neonates: (20 mg/kg/dose) 8 hourly for 21 days

Precautions for contacts and health workers

- Close contacts and medical personnel should maintain **standard safety protocols** like hand washing, using gloves and masks while attending the patients

CEREBRAL MALARIA

(Discussed in the chapter 17)

EPILEPSY/RECURAENT SEIZURES

Epilepsy, the commonest neurological disorder affecting 50 million people globally. Over 60% has its onset in childhood and the incidence is highest in the neonatal period.

Epilepsy is defined as two seizures that are separated by at least 24 hours.

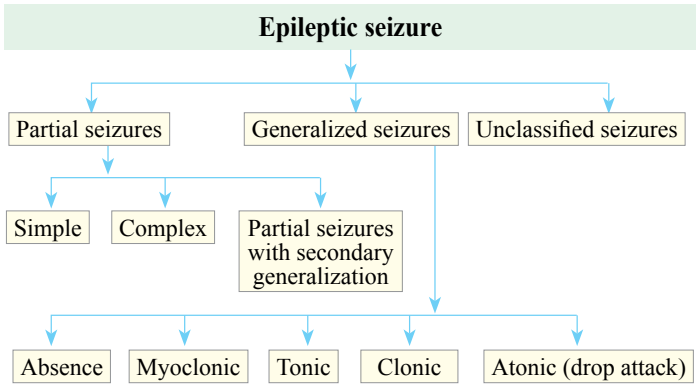
A **seizure** is a sudden, transient disturbance of brain function, manifested by involuntary motor, sensory, autonomic or psychic phenomena, alone or in any combination, often accompanied by alteration or loss of consciousness. It can be caused by any factor that disturbs brain function.They may occur after a metabolic, traumatic, anoxic or infectious insult to the brain or spontaneously without prior known CNS insult.

AETIO-PATHOGENESIS

- Idiopathic
- Intrauterine infection e.g. TORCH, HIV
- Abnormal brain development
- Hypoxic ischaemic encephalopathy
- CNS infections e.g. meningitis, encephalitis
- Brain injury & brain tumor
- Neurometabolic & neurodegenerative diseases
- Chromosomal disorders e.g. Fragile X, Trisomies

Classification

(International League Against Epilepsy, 1981)



A. Partial seizures: One cerebral hemisphere is affected and convulsions present on one side of the body.

Types	Characteristics
Simple partial seizure	Seizure involves one side of the body and the patient remains conscious after the seizure
Complex partial seizure	Seizure involves one side of the body but the patient become unconscious
Partial seizures with secondary generalization	Seizure starts on one side of the body & then spreads throughout the whole body

B. Generalized seizures: Both cerebral hemispheres are affected and seizures evident on both sides of the body.

Types	Characteristics
Absence	Sudden interruption of ongoing activities, blank stare, upward rolling of the eyes
Myoclonic	Sudden brief, shock-like muscle contractions, which may be generalized or confined to the face and trunk or one/more extremities or to group of muscles even individual muscle
Tonic	Rigid, violent muscular contraction, fixing the limb in some strained position. There is usually deviation of the eyes and of the head towards one side
Clonic	Repetitive clonic jerks
Atonic *(drop attack)*	Brief loss in muscle tone lasting for <15 seconds resulting in fall

C. Unclassified e.g. neonatal seizure, infantile spasm

Clinical manifestations

- Recurrent attacks of afebrile seizures. The characteristic features of different types are discussed previously
- Sometimes patient may present with status epilepticus.

Whenever, a child is suspected to have epilepsy, he/she should be evaluated clinically as below–

Clinical evaluation

- Provocation or trigger factors e.g., sleep deprivation, flicking of light, missing or withdrawal of anticonvulsant drugs etc.
- Warning phase or Aura e.g. epigastric pain, abnormal behaviour, feeling of fear/unwellness, numbness/tingling in the fingers or bright lights in one visual field etc.
- Febrile or afebrile
- Single or recurrent
- Gap between two seizure events
- Motor expression e.g. atonic, tonic, clonic, myoclonic, athetoid etc.
- Sensory expression e.g. pain, paresthesia
- Distribution of seizures e.g. focal or generalized
- Responsiveness of the patient e.g. alteration in consciousness
- Duration of seizure attacks
- Associated features e.g. tongue biting, loss of sphincter control etc.
- Recovery phase e.g. post ictal stage (headache, confusion, amnesia, sleep), prompt recovery etc.
- Milestones of development

Diagnosis

By clinical evaluation & relevant laboratory supports.

Investigations

- Electroencephalogram (EEG) is sometimes diagnostic. A normal EEG does not exclude epilepsy
- Neuro-imaging: Indicated in all suspected cases, where the cause is not obvious after clinical evaluation. MRI of brain is more sensitive than CT scan and is strongly recommended in partial epilepsy

TREATMENT

- Counsel parents about the nature of the disease, precipitating factors, chance of recurrence and importance of regular medications & prognosis
- Selection of anti-epileptic drug (AED), appropriate for seizure type. The table below, showing a list of appropriate AED, based on the seizure types

Seizure types	Anti-epileptic drug of choice
Partial	CBZ, PHT
GTCS	SVA, CBZ,PHT,PB
Absence	SVA, ESM, CZP, CLB
Myoclonic	SVA, CZP, CLB
Tonic	SVA
Atonic	SVA
Mixed	SVA

CBZ = Carbamazepine, PHT = Phenytoin, SVA = Sodium Valproate, ESM = Ethosuximide PB = Phenobarbitone, CZP = Clonazepam, CLB = Clobazam

- Life style modification. Patients should–
  - be away from bright & flashing lights e.g. TV, Video games, mobile phone, fire place
  - avoid driving, swimming, climbing tree etc.
- Periodic monitoring of the case/treatment, to note–
  - How is the control of seizure (by seizure diary)
  - Whether any side effects of drugs

Duration of treatment & Drug withdrawal

- If the patient remains **seizure free** for at least 2 years, AED may be withdrawn gradually over the next 6-12 weeks.

Prognosis

- 65-70% of children with epilepsy will achieve seizure remission with appropriate AED medication
- 5-10 % of cases may have relapse & remain uncontrolled
- 30 % are "Difficult to treat/control" from the outset

Sometimes, true seizures may be confused with pseudo or psychogenic seizures

The Characteristics of True & Pseudoseizures

Characteristics	Pseudoseizures	Epilepsy: True seizures
Precipitating factors & situations	Often emotional factors. Attacks generally occur in presence of others	No association with presence of others
Movement pattern during the attacks	Variable; no specific pattern	Similar pattern in different episodes
H/O self injury	No	May have e.g. tongue biting
Occurrence in sleep	No	May occur
H/O bowel or bladder incontinence	No	Often present
Recall of details	Generally can	Can not
Consciousness	Preserved; may appear unresponsive but response to painful stimuli	Loss. Unresponsive to pain
Movements	Bizarre, nonsynchronous or may lie motionless or stiffness of limbs for long time	Typical generalized tonic clonic movements
State of child after the ictal phase	No confusion no neurodeficit	Post ictal confusion or Todds paralysis may occur
Reflexes	No pathological reflexes	Hyperactive deep tendon reflexes and Babinski reflex after seizure
Demonstration on request	Often possible	Not possible
Stop on command	Can often stop	Cannot stop
Secondary gain	Generally present	None

STATUS EPILEPTICUS (SE)

SE is defined as continuous seizure activity or recurrent seizure activity without regaining of consciousness lasting for > 30 minitus. Some authors advocated 5 minutes (rather than 30 minutes) as the time limit. This is a medical emergency and the major concern is irreversible brain injury.

Precipitating factors

- Underlying neurologic disorders e.g.
  - CNS infection, tumour
  - Metabolic abnormalities e.g. hypoglycaemia, hypo or hypernatraemia, hypocalcaemia, hypomagnesaemia
- Sudden withdrawal of AED from an epileptic child. It can also happen if the AED are taken irregularly
- Exposure to flushed light from
  - video game • TV • computer etc.
- Others e.g.
  - sleep deprivation • intercurrent infection etc.

MANAGEMENT

Includes the following 4 Steps in sequence

- Maintenance of Airway, Breathing and Circulation
- Control of convulsion
- Assessment to find out the cause of SE
- Prevention of recurrence

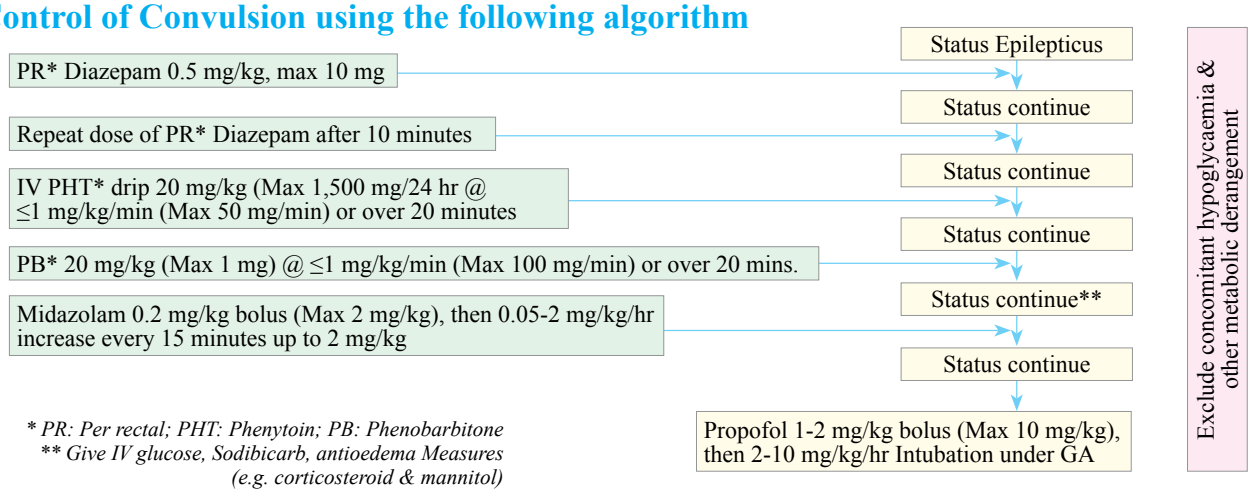
A. Management of Airway, Breathing and Circulation

	A–Airway	B–Breathing	C–Circulation

ASSESSMENT	• Assess airway by looking at
	  ▫ Nose
	  ▫ Oral cavity
	  ▫ Throat
	  ▫ Pharynx
	for any secretion or vomitus that could obstruct the airway
		• Assess breathing by looking
		  ▫ Respiratory rate (Tachypnoea/ apnoea)
		  ▫ Flaring of alae nasi
		  ▫ Cyanosis
		  ▫ Chest movement, expansibility and recession
		  ▫ O_2 saturations (SpO_2 <90%)
			• Assess circulatory status by looking
			  ▫ Pulse e.g. volume, rate, rhythm
			  ▫ Blood pressure
			  ▫ Pulse pressure
			  ▫ Capillary refill time (> 3 seconds)

ACTION	• Maintain airway by
	  ▫ Clearing the airway of secretions, vomitus by suction with sucker or by finger-sweep maneuver
	  ▫ Opening up the airway by head tilt-chin lift maneuver (to keep head and neck slightly extended)
	  ▫ Putting airway tube
	  ▫ Endotracheal intubation, may be necessary to maintain the airway
		If the patient have dyspnoea or cyanosis
		• Give O_2 through
		  ▫ Face mask (5L/min)
		  or
		  ▫ Nasal catheter (1-2 L/min)
		If features of impending respiratory failure (apnoea)
		  ▫ Bag & Mask ventilation or
		  ▫ Endotracheal intubation &
		  ▫ Mechanical ventilation
			• Secure an IV line and start IV crystalloid fluid (Baby saline/Junior saline/Normal saline)
			If patient is in shock *e.g. low systolic blood pressure and capillary refill time >3 seconds*
			• Give IV Normal saline bolus (20 ml/kg) rapidly
			• Reassess and if no improvement repeat the bolus
			• If shock still persists, give–
			  ▫ Inj. Dopamine (10-20 µg/kg/min) and/or
			  ▫ Inj. Dobutamine (10-20 µg/kg/min)

B. Control of Convulsion using the following algorithm



** PR: Per rectal; PHT: Phenytoin; PB: Phenobarbitone*
*** Give IV glucose, Sodibicarb, antioedema Measures (e.g. corticosteroid & mannitol)*

Monitoring

- Clinical e.g. heart rate, blood pressure, capillary refilling time (CRT), SpO_2 , respiratory rate & pattern
- Laboratory e.g. CBC, glucose, calcium, magnesium, ABG, anti-epileptic drugs level
- Continuous EEG monitoring

C. Screening to find out the cause of S E

- CSF study
- Sepsis screening
- Neuroimaging
- Metabolic screening

D. Prevention of recurences

Counsel parents emphasizing the importance of

- Regular intake of anti-epileptic drugs
- Avoiding the risk factors of SE

INTRACRANIAL SPACE OCCUPYING LESIONS (ICSOL)

ICSOL are the 2nd most frequent malignancy among children and adolescents.

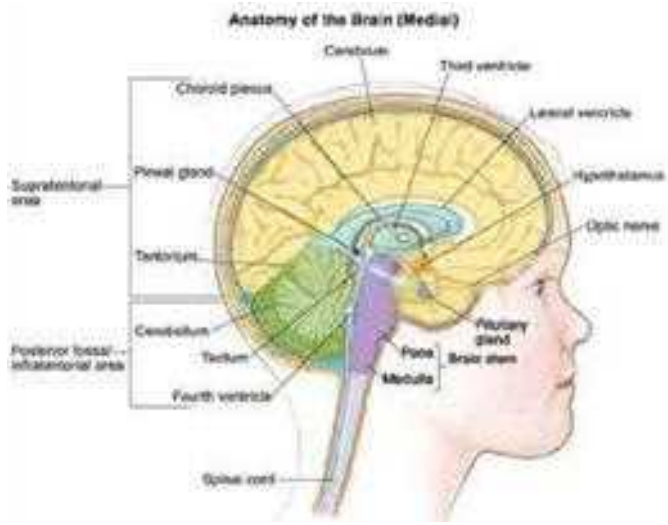
AETIOLOGY

- Unknown, mostly
- Radiation
- Hereditary syndromes

PATHOLOGY

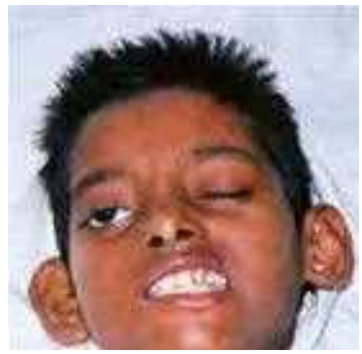
Tumor can occur anywhere inside the cranial cavity e.g. cerebrum, brain stem, cerebellum, etc. Grossly, these are classified as either supratentorial and infratentorial and the clinical presentation are related to the following consequences–

- Raised intra-cranial pressure (ICP)
- Focal brain dysfunction
- Impairment of CSF circulation



CLINICAL MANIFESTATIONS

- Cardinal features of raised ICP
  - Headache
  - Nausea, vomiting
  - Visual problem
  - Papilloedema
- Cranial nerve palsy
- Non-specific features
  - Change in personality, mentation and speech
  - Disorder of equilibrium, gait and coordination



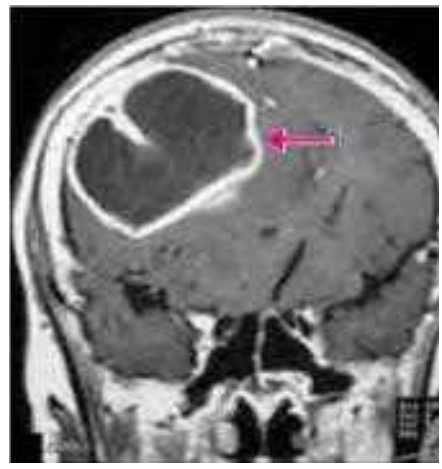
Right 7th cranial nerve palsy

DIAGNOSIS

Based on C/F and support from relevant investigations.

Investigations

- CT scan/MRI of brain



Coronal section of contrast-enhanced MRI scan showing the lesion

TREATMENT

According to the site and stage of disease. The options are–

- Surgery &/or
- Radiotherapy

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SELF ASSESSMENT

Short answer questions [SAQ]

1. Write down the treatment of 1 year old boy with pyogenic meningitis.
2. How will you manage seizure of a child with status epilepticus?
3. Write down the characteristic feature of febrile convulsion.
4. What are the causes of convulsion without fever? How will you prevent recurrence of febrile convulsion?
5. Write down the clinical feature of pyogenic meningitis.
6. Write down the comparative CSF findings of pyogenic meningitis with TBM.
8. Write down the difference between pseudoseizure & seizure.
9. A 8 months old child admitted with fever for 3 days and several episodes of convulsions for last 1 day. On examination the child was found drowsy and had bulged anterior fontanelle.
   i) What is the probable diagnosis?
   ii) Write the relevant investigations with expected findings.
   iii) Outline the management.
10. How will you differentiate febrile convulsion from meningitis clinically?

Multiple choice questions [MCQ]

1. The characteristic features of normal CSF include–
   ___ a) colour: straw ___ b) pressure: 100-300mmH2O ___ c) protein: 20-45mg/dl
   ___ d) glucose: 40-80mg/dl ___ e) cell count: 7-10/cumm
2. The conditions present with fever and convulsions are–
   ___ a) meningitis ___ b) cerebral malaria ___ c) acute stroke syndrome
   ___ d) hepatic encephalopathy ___ e) encephalitis
3. The classic CSF findings of pyogenic meningitis are–
   ___ a) hazy appearance ___ b) neutrophilic leukocytosis ___ c) normal protein
   ___ d) low chloride level ___ e) low glucose level
4. The precipitating factors of status epilepticus are–
   ___ a) hypoglycaemia ___ b) hypocalcaemia ___ c) intercurrent infection
   ___ d) sleep deprivation ___ e) sudden withdrawl of antiepileptic drugs
5. Following are the features of typical febrile seizure–
   ___ a) seizure persisting >15 minutes ___ b) occur >once in 24 hours
   ___ c) epilepsy is a common sequelae ___ d) CSF protein is elevated

___ e) associated with intracranial infection

6. Features of stage 3 TBM are–

___ a) nonspecific ___ b) neck rigidity ___ c) cranial nerve palsy

___ d) decerebrate rigidity ___ e) behavioural change

7. CSF finding of TBM are–

___ a) colour – clear ___ b) protein – 35 mg/dl ___ c) cells – mostly lymphocytes

___ d) glucose – 35 mg/dl ___ e) pressure – elevated

8. The common organisms for childhood (>2 months) meningitis are–

___ a) *Listeria monocytogen* ___ b) *H. influenzae* ___ c) Pneumococcas

___ d) *E. coli* ___ e) Meningococcas

9. Cardinal symptoms of raised ICP–

___ a) Headache ___ b) Nausea ___ c) Convulsion

___ d) Visual problem ___ e) Cranial nerve palsy

10. Circulatory status can be assessed by at looking–

___ a) O2 saturition ___ b) Blood pressure ___ c) Pulse pressure

___ d) Cardiac murmur ___ e) Capillary refill time

11. Drug of choice for absence seizure include–

___ a) Sodium Valproate ___ b) Ethosuximide ___ c) Phenobarbitone

___ d) Clonazepam ___ e) Clobazam

12. Common metabolic abnormalities that can cause seizure include–

___ a) hypoglycaemia ___ b) hypernatraemia ___ c) hypocalcaemia

___ d) hypochloremia ___ e) hypomagnesaemia

CHAPTER 32

DEVELOPMENTAL DELAY

DEVELOPMENTAL DELAY

It refers to failure on the part of a child to acquire age-appropriate milestones of development in any of it's domains. *For example, a 2 years old child who can not sit independantly from lying position.This is a delay in development in motor domain*

Types

Isolated	Delay restricted to a particular domain e.g. speech and language, motor etc.
Global	Significant delay in ≥ 2 domains

INTELLECTUAL DISABILITY (ID)

Intellectual disability (once called mental retardation) is a clinical situation, characterized by significant limitation in both-

- Intellectual functioning *e.g. learning, reasoning, problem solving skills etc.* and
- Adaptive behavior *e.g. such as conceptional, social and practical skills* which affect many everyday's social and practical skills.

ID, originates before 18 years of age and it's severity is categorized by measuring IQ status of the child.

Normal Reference value: If IQ is-

- 85-114:Average intelligence
- 70-84: Borderline intelligence
  - 55-69: Mild ID
  - 40-54: Moderate ID
  - 25-39: Severe ID and
  - IQ of <25: Profound ID

LEARNING DISABILITY (LD)

It is a neurological disorder where brain's communication channels are affected e.g. ability to receive, process, store and response to information. People who have LD generally have average or above-average IQ. The specific learning disabilities are dyslexia (problems in reading), dyscalculia (problem in mathematics), dysgraphia (problems in writing) etc.

When to suspect Developmental Delay?

If a child has not achieved–

Parameter	by
Social smile	3 months
Neck control	5 months
Sits without support	12 months
Stands without support	18 months
Walks well	20 months
2-3 words sentence	36 months
Tells self name	48 months
Toilet control	60 months

Whenever a child is brought with history of delay in achieving age-appropriate developmental milestone, one should consider the following diseases as the cause of developmental delay -

- Idiopathic
- TORCHES infection
- Chromosomal abnormalities e.g. Down syndrome, Klinefelter's syndrome, Fragile X syndrome
- Genetic disorders e.g. Hurler syndrome, Phenylketonuria
- Endocrine disorders e.g. congenital hypothyroidism
- Perinatal asphyxia (hypoxic ischaemic encephalopathy)
- CNS infections e.g. meningitis, encephalitis
- Protein energy malnutrition

In this chapter, Congenital Hypothyroidism, Down syndrome will be discussed.

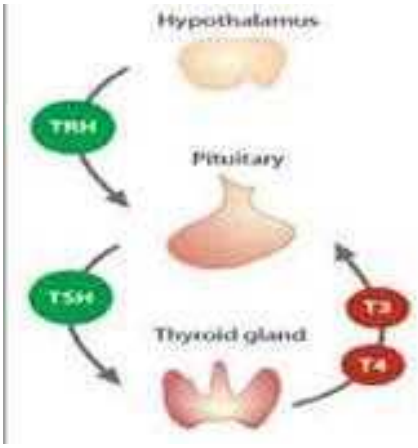
HYPOTHYROIDISM

A common endocrine disorder that results from a defect anywhere in the **hypothalamic-pituitary-thyroid** axis.

AETIOLOGY & CLASSIFICATIONS

A. Based on the site of pathology

- **Primary:** Pathology is in thyroid gland with deficient production of thyroxine
- **Secondary:** Pathology is either in pituitary gland or in hypothalamus, and is characterized by deficient production of TRH, TSH as well as thyroxine



B. Based on the time of onset of illness and aetiology

Congenital	Acquired
◆ Aplasia, hypoplasia or ectopy of thyroid gland ◆ Inborn errors of thyroid hormone biosynthesis ◆ Insensitivity of the tissue receptors to thyroid hormone	◆ Autoimmune thyroiditis ◆ Endemic iodine deficiency ◆ Exposure to goitrogen ◆ Irradiation or surgery to thyroid gland

CONGENITAL HYPOTHYROIDISM (CH)

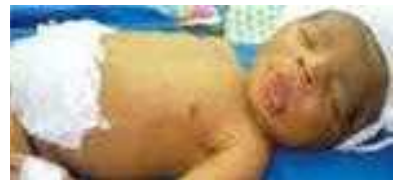
PATHOGENESIS

Due to deficiency of thyroxine, there is impaired development of CNS (leading to mental retardation) and skeletal system (short stature).

CLINICAL MANIFESTATIONS

Presentation of congenital hypothyroidism at birth may be overt, may be sub-clinical or asymptomatic. However, one should not miss to suspect CH, when a newborn presents with -

- Delayed passage of meconium (>24 hours after birth)
- Prolonged jaundice (jaundice persists beyond 2 weeks of age)
- Refractory constipation
- Little cry, somnolence, excessive sleepy, sluggishness
- Feeding difficulties



Prolonged jaundice & protruded tongue

- Coarse facies e. g. protruded tongue, puffy eye lids, wrinkled forehead, depressed nasal bridge
- Oedema of extremities & genitals
- Subnormal body temperature
- Widely open anterior fontanelle and open posterior fontanelle at birth

Physical Examination

Head	◆ Normal head size with widely open anterior and posterior fontanelles ◆ Hair dry & scanty
Face	◆ Coarse with wrinkled forehead and low hairline ◆ Large tongue protruding from the mouth ◆ Depression of nasal bridge ◆ Delayed dentition ◆ Swollen eyelids with narrow palpebral fissures
Neck	◆ Appears short because of the presence of myxoedematous pads of fat above the clavicles
Skin	◆ Feels dry, thick, cold and mottled (cutis marmorata)
Abdomen	◆ Distended and umbilical hernia
Hands & fingers	◆ Broad and stumpy
Muscles	◆ Usually hypotonic ◆ Ankle jerk shows slow relaxation
CVS	◆ Pulse slow ◆ Cardiomegaly, murmur ◆ Asymptomatic pericardial effusion
Growth and development	◆ Markedly stunted ◆ Maintain infantile body proportion ◆ Milestones of developments are delayed ◆ Sexual maturation is delayed or may not take place at all
Intelligence	◆ Mentally retarded. About 20% have sensory neural hearing loss

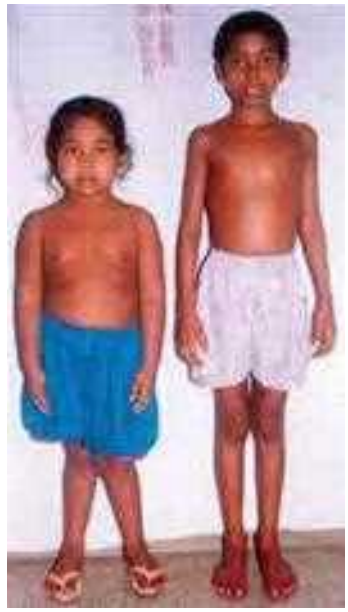
About10% of babies with CH may have associated congenital anomalies *e.g. cong heart disease*

Typical profiles of a child with congenital hypothyroidism

- Anthropometry
  - Length or height (stunted)
  - Ratio of upper to lower body segments reveals Infantile body proportion *(disproportionate short stature)*

Age-specific Normal body proportion

- At birth: 1.7:1
- At 6 years: 1.4:1
- At 11 years: 1:1



Courtesy: Dr Laila Yeasmin

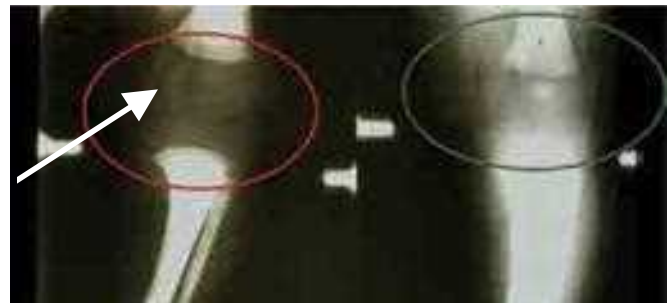
Short stature compared to a normal child of same age and sex

DIAGNOSIS

Based on characteristic symptoms, classical physical findings & supports from the relevant investigations.

Investigations

- Serum FT4, TSH: Low FT4 and high TSH (Primary hypothyroidism). If both TSH and FT4 are low, then problem is in pituitary or in hypothalamus
- CBC, PBF: Microcytic anaemia, refractory to treatment with haematinics
- Thyroid Scan: Iodine-123 (I-123) or Sodium pertechnetate 99 m (Tc99 m) uptake and scan: To detect an ectopic gland, thyroid hypoplasia or thyroid aplasia
- Thyroid ultrasonography: To assess the anatomy of thyroid whether enlarged or absent glands
- Skeletal survey:
  - Absent distal femoral and proximal tibial epiphyses which is supposed to present at 36 weeks of gestation
  - Epiphyseal dysgenesis for older children



Absent *Normal*

Dysgenetic femoral epiphysis

These radiological findings give clues to the diagnosis at places, where TSH, FT4 assay is not readily available.

TREATMENT

- Counseling parents about the consequences of untreated cases and the importance of regular continuation of treatment with Thyroxine
- Sodium L thyroxine should be started without delay after birth or at diagnosis

Dose & Duration

Age group	Dose	Duration
Neonate	10 – 15 µgm/kg/day	Life long
Beyond neonatal period	4 µgm/kg/day	

Profile before and 2 weeks after treatment

Course & Prognosis

Depends on the age at which the treatment is started. Early therapy within first week of life gives a greater chance for normal linear growth and intellectual achievement. But delay to start therapy even by 2 months may cause significant intellectual disability.

Follow up: Assessment

A. Biochemical: S. FT4 and TSH levels as follows-

Age of baby	Frequency
0-6 months	Every 6 weeks
6 months-3 years	Every 3 months
> 3 years	Every 6 months

B. Clinical: Height, development and hearing

- Expected response in weeks
  - Regular bowel movement
  - Reduction in weight and puffiness
  - Increase in the pulse rate
- Expected response in months
  - Reduction in hoarseness of voice
  - Correction of anaemia
  - Changes in skin and hair

How to identify CH at the earliest?

Neonatal screening (NS)

It is aimed to detect cases of CH immediately after birth so as to start treatment early and to prevent irreversible brain damage of the affected child.

Method	Filter paper spot technique by heel prick
Timing	3-5 days after birth *
Results	FT4: <7 µgm/dl TSH: > 40 mU/ml Borderline TSH level (20-40 mU/ml): should be repeated
* To avoid false positive result due to physiological surge of TSH causing increased T4 upto 48 hours	

DOWN SYNDROME

The commonest chromosomal anomaly. Overall incidence is about 1 in 700 live births and the incidence increases with advanced maternal age.

Aetio-pathogenesis

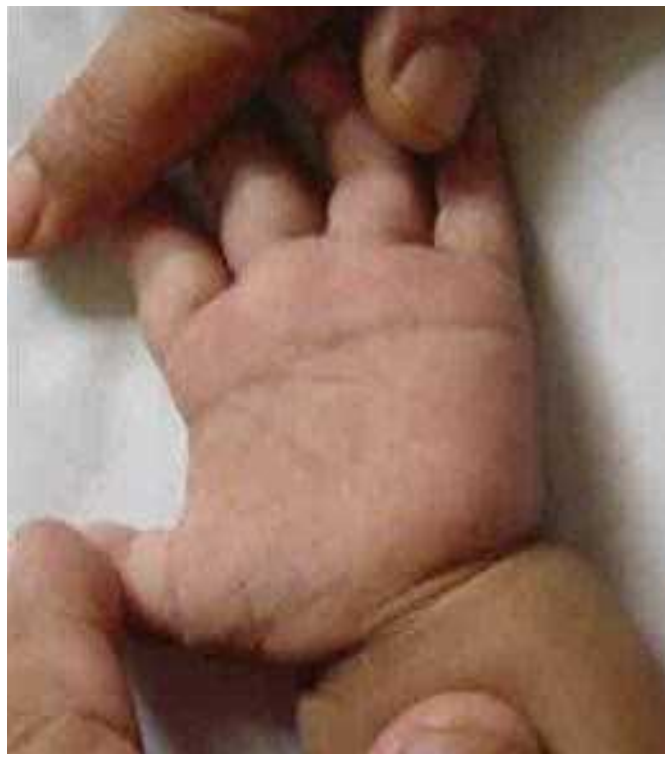
The exact cause is not known. The disease is characterized by the presence of an **extra copy of genetic material on chromosome 21,** either whole or in part and occurs in 3 ways-

- Chromosomal non-disjunction (in 95% of cases)
- Robertsonian translocation (in 4% of cases)
- Mosaicism (in 1% of cases)

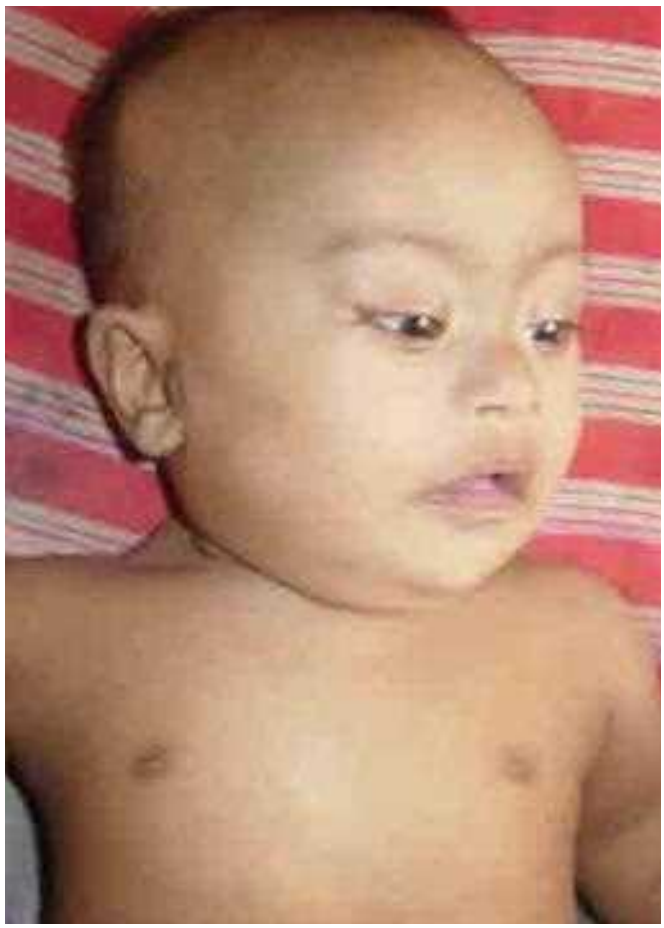
Clinical Manifestations

Regions	Features
Head & face	Brachycephaly, microcephaly, flat nasal bridge
Eyes	Upward slanting of palpebral fissure, epicanthic fold, Brush field spot, congenital cataract
Ears	Low set ears, chronic otitis media (glue ears)
Oral cavity & Teeth	Macroglossia, dental abnormalities like malposition and enamel hypoplasia etc.
Hands & feet	Broad and short hands, clinodactyle (short, incurved little fingers), single palmar crease (simian crease) increased gaps between 1st and 2nd toes and planter crease between them in the sole
Neuro-psychologic	Intellectual disability (IQ ranges from 20-75, average 50), delay in milestones of development, affinity for music
Muscle	Generalized hypotonia
Endocrine	Hypothyroidism
Sexual development	Delay in development of secondary sexual characteristics. Adult males are infertile but females are fertile

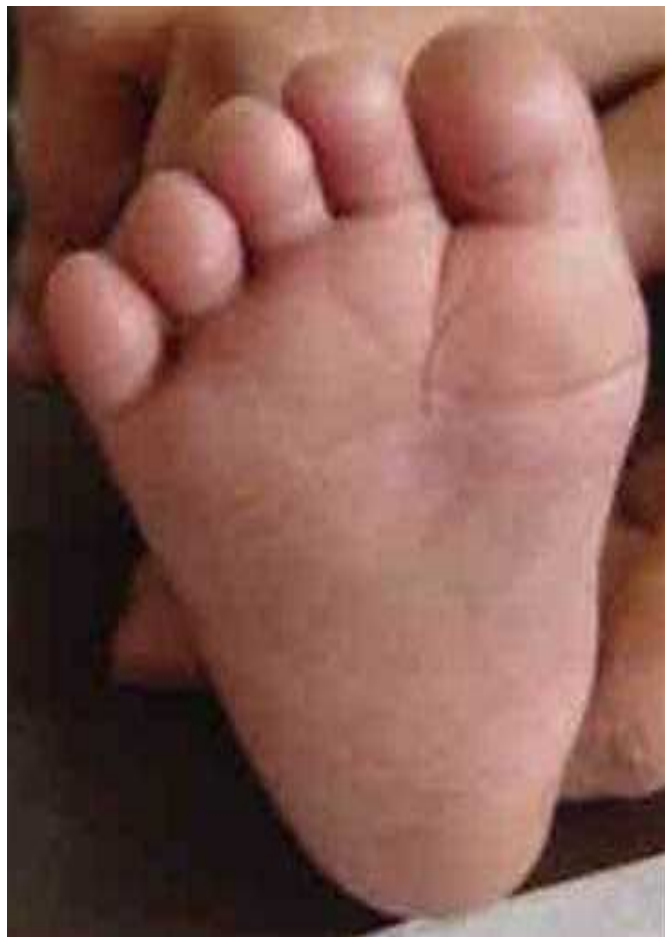
Brachycephaly



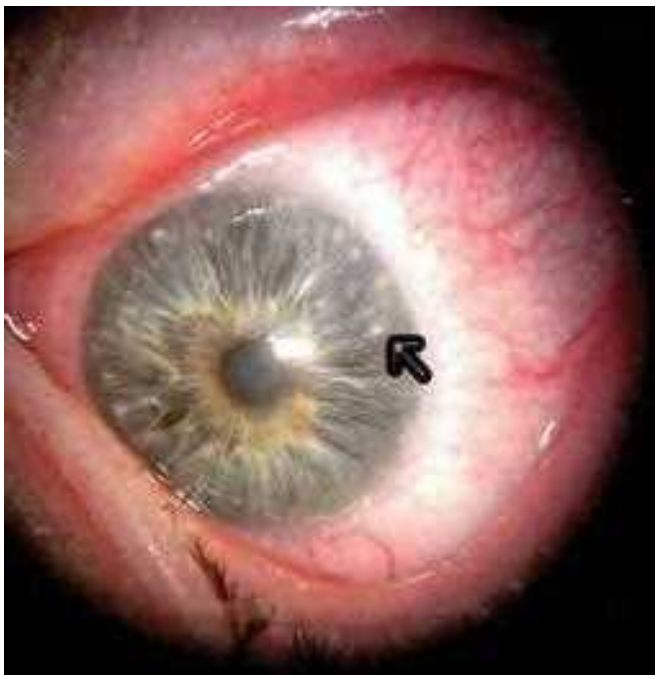
Simian crease



Upward slanting of palpebral fissure



Crease between 2nd and great toe



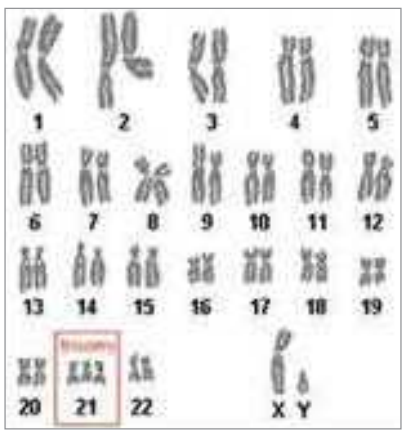
Common associated illnesses

- Congenital heart diseases e.g.VSD, AV canal defect
- GIT anomalies e.g. Hirschsprung disease, duodenal atresia, increased chance of coeliac disease
- Frequent infections e.g. recurrent respiratory tract infections
- Endocrinopathies e.g. hypothyroidism, diabetes mellitus
- Malignancy e.g. 10-20 times more chances of leukaemia
- Musculoskeletal e.g. atlanto-occipital subluxation, dislocation of hip
- Others e.g. Alzheimers disease

DIAGNOSIS

Made on the basis of-

- History of advanced maternal age
- Typical clinical features
- Karyotyping, confirmatory



Karyotyping showing trisomy 21

Investigations to screen out complications

- CBC, PBF: Polycythemia, infection, increased MCV
- CXR: Heart anomalies or pneumonia
- ECG: Ventricular hypertrophy
- Echocardiography: Done within first month of life to rule out cardiac defect
- TSH, FT_4: To rule out hypo or hyperthyroidism
- Developmental and psychological assessment: IQ varies from 20-75 with mean 50

ANTE-NATAL DIAGNOSIS

The risk of having a child with Trisomy 21 is highest in women who conceive at >35 years of age. Even though, younger women have a lower risk, they represent half of all mothers with Down babies, because of higher overall birth rate.

Antenatal diagnosis of Down syndrome is done by screening tests during **first** and **second** trimesters

- **First trimester**
  - Foetal nuchal translucency (NT) thickness
  - Beta hCG level
  - Pregnancy-associated plasma protein-A (PAPP-A) in maternal serum
- **Second trimester** (Quad screening in maternal serum)
  - Free beta hCG
  - Unconjugated estriol
  - Inhibin
  - Alfa fetoprotein

MANAGEMENT

- Counseling parents about the nature & future of the problem
- Early & regular stimulation of the child e.g. exposure to games, music, interactions etc.
- Treatment of any associated illness e.g. cardiac problems, infections, thyroid replacement etc.
- Special education and occupational training to overcome mental subnormality

Prognosis

Around 20% patients die within 1st year, 45% survive up to 60 years of age and many of them suffer from Alzheimer's disease at 40-50 years of age.

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. Write down the clinical manifestation of Cong. Hypothyroidism.
2. Name the investigations of Cong. hypothyroidism.
3. Write down the typical clinical features of Down syndrome.
4. Write short note on : Mental Retardation.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Features of Down syndrome are–

   ___ a) brachycephaly ___ b) hypotonia ___ c) Brush field spots in eyes

   ___ d) downward slanting of palpebral fissures ___ e) incurving of little fingers

2. Features of congenital hypothyroidism are–

   ___ a) irritability ___ b) constipation ___ c) prolonged physiological jaundice

   ___ d) coarse wrinkled forehead ___ e) appearance of lower femoral epiphyses at birth

3. Cardinal biochemical & radiological features of primary hypothyroidism are-

   ___ a) delayed bone age ___ b) epiphyseal dysgenesis ___ c) low TSH

   ___ d) low FT4 ___ e) low T3 level

4. A 10 month old boy is admitted because he can not sit yet. On examination, you noted that he is hypotonic, his eyes are slunted upwards and have epicanthic folds–

   Choose the most common mechanism from the chart given below is associated with the child's problem

   ___ a) translocation ___ b) non-dysjunction ___ c) mosaicism

   ___ d) single gene mutation ___ e) deletion

5. A 4 weeks old baby is brought to you because of persistant yellow face and sclera and constipation. The following investigations are relevant to reach a diagnosis of the baby's problem–

   ___ a) X-ray knee joint ___ b) X-ray wrist joint ___ c) Serum TSH estimation

   ___ d) karyotyping ___ e) Serum growth hormone estimation

6. A 3 week old baby is admitted with persistent jaundice. The following clinical features are relevant for congenital hypothyroidsm–

   ___ a) brachicephaly ___ b) noisy respiration ___ c) excessive sleepiness

   ___ d) Simian crease ___ e) constipation

7. The following features are characteristics of congenital hypothyroidism of 5 years old boy–

   ___ a) short stature ___ b) 5 carpal bones ___ c) Brush field spots

   ___ d) epiphyseal dysgenesis ___ e) upper segment to lower segment of body ratio of 1.7: 1

Chapter 33

Abnormal Behaviour

Whenever, a child is brought with an abnormal behaviour or any deviation from age appropriate behaviour e.g. restlessness, lack of interaction, poor communication etc. then one should consider the possibilities of psychiatric problems. The following are the common psychiatric disorders of children.

- **Somatic symptom related disorder** e.g. Conversion disorder, somatic symptom disorder, fictitious disorder.
- **Rumination** and pica
- **Motor disorders** e.g. Tics, stereotype movement disorder
- **Habit disorder** e.g. Thumb sucking, nail biting, head banging, bruxism
- **Anxiety disorder** e.g. Obsessive compulsive disorder, school phobia, panic disorder
- **Mood disorders** e.g. Depressive disorder
- **Eating disorders** e.g. Anorexia nervosa, bulimia nervosa, binge eating disorder
- **Elimination disorder** e.g. Enuresis, encopresis
- **Disorder of impulse control** e.g. Temper tantrum, breath holding attack
- **Autism sprectrum disorder**
- **Neurobehavioral and learning disorder** e.g. attention deficit hyperactive disorder (ADHD), intellectual disability

In this chapter, we will discuss autism and ADHD attention deficit hyperactive disorder. The cardinal features of some of the psychiatric problems are also highlighted in the table below.

COMMON PSYCHIATRIC DISORDERS IN CHILDREN

Cardinal features

Disorders	Clinical features
Pica	Persistent eating of non nutritive substances e.g. plaster, charcoal, clay, ashes, paint, earth etc.
Thumb sucking	Normal among infants and toddlers but if continued, then it is considered as habit disorder. Thumb sucking provide a pleasurable sensation. This habit may interfere with dental alignment, may increase the incidence of helminthiasis. A bitter solution may be applied on the thumb to control thumb sucking & anthelmintics may be given
Head banging	Banging of head against the bed or wall when the child is under stress
Body rocking	Body rocking against bed during stress
Nail biting	Nail biting is an expression of anxiety, but if it is not associated with other symptoms, it should not be a matter of concern
Teeth grinding / Bruxism	May be associated with anxiety. Persistent bruxism can manifest as dental occlusion defect, muscular or temporomandubular joint pain

◆ Hair pulling / Trichotillomania	◆ Release of tension after hair pulling. Irregular areas of hair loss commonly seen over, occipital and parietal area of scalp and eyebrows or eyelashes
Disorders	**Clinical features**
◆ Temper tantrums	◆ Is an expression of anger and frustration. In this condition child lying or throwing himself down, kicking, screaming, throwing things or hitting
◆ Tics	◆ Sudden, rapid, recurrent, nonrhythmic, stereotype motor movement or vocalization e.g. eye blinking, neck jerking, shoulder shrugging, cough, throat clearing. Can be controlled voluntarily. Absent during sleep or physical activity and exacerbated during emotional stress
◆ Breath-holding spells	◆ Following a trauma or an emotional stress, the child cries briefly & holds the breath in expiration. This events may be cyanotic or acyanotic. The spell may resolve or the child may develop convulsion or become unconscious. No specific treatment is necessary or effective. Parents should be reassured
◆ School phobia	◆ School phobia is caused by unwarranted fear or inappropriate anxiety about leaving home or in particular, the child's mother. The phobia is often accompanied by a vague abdominal pain or headache alleviated by school absence
◆ Enuresis/ ◆ Bed-wetting	◆ Voiding of urine into clothes or bed twice or more in a week for at least three consecutive months after 5 years of age
◆ Encopresis	◆ Encopresis is usually defined as voluntary or involuntary passage of faeces into inappropriate places at least once a month for 3 consecutive months, in the absence of any physical pathology after 4 years of age. ◆ Encopresis is 4-5 times more common in boys than in girls and tends to decrease with age

AUTISM SPECTRUM DISORDERS

Autism spectrum disorders are neurodevelopmental disorder characterized by

- Impaired social interaction and communication and
- Restricted and repetitive pattern of behavior or interest

AETIOLOGY

- Mostly unknown
- Genetic
- Risk factors include -
  - Prenatal rubella or CMV infection of mother
  - Advanced age of either parent
  - Gestational diabetes mellitus
  - Use of psychiatric drugs by the mother during pregnancy

CLINICAL CHARACTERISTICS

Defects in social interaction and communitation	◆ Fails to respond to his or her name ◆ Resists cuddling and holding ◆ Unaware of others feeling ◆ Seems to prefer playing alone, lives in his or her own life ◆ Starts talking later than of 2 years of age ◆ Loses previously acquired ability to say words or sentences ◆ Does not make eye contacts upon request ◆ May use a singsong voice or robot like speech while talking ◆ Can't initiate a conversation or keep on going ◆ May repeat words or phrases
Restricted and repetitive pattern of behavior	◆ Performs repetitive movements, *such as rocking, spinning or hand-flapping* ◆ Develops specific routines or rituals ◆ Disturbed at the slightest change in routines or rituals ◆ Moves constantly ◆ May be fascinated by parts of an object, *such as the spinning wheels of a toy car* ◆ May be unusually sensitive to light, sound and touch and yet oblivious to pain

DIAGNOSIS

Mainly clinical. However, diagnosis is further strenthened with data from the following tools-

A. Screening tools

- Modified Checklist for Autism in Toddlers (MCHAT)
- Communication and Symbolic Behavioural Scale (CSBS)

B. Diagnostic Tool

- Autism Diagnosis Observation Schedule (ADOS)
- Autism Diagnostic Interview Revised (ADI-R)

MANAGEMENT

Current interventions include

- Psycho-educational & behavioral interventions e.g.
  - Teach-treatment and education of autistic and related handicapped children
  - Applied behavioral analysis communication
  - Alternative communication
  - Social skill technique
  - Parental involvement
- Psychopharmacological *e.g. antidepressants, selective serotonin reuptake inhibitors, beta blockers, mood stabilizers etc.*
- Others *e.g. megavitamin therapy, gluten and casein free diet, sensory and auditory integration etc.*

ATTENTION-DEFICIT HYPERACTIVITY DISORDER (ADHD)

ADHD is one of the most common neuro behavioural disorders of childhood, characterized by an age-inappropriate hyperactivity, impulsiveness and inattention.

CLINICAL CHARACTERISTICS

Persistent pattern of inattentiveness and hyperactivity	• Difficult to hold and soothe as an infant • Careless mistakes at school • Easily distracted • Unable to finish tasks • Does not follow instructions • Don't remain still in the classroom • Cannot sustain attention for either play or work • Excessive running or climbing • Talks excessively
Poor impulse control	• Blurt out answer before questions have been completed • Risky acts without considering consequences

- These symptoms must start before 12 years
- The symptoms must present in two of more different settings(school, home, work place)
- The symptoms should persists at least for 6 months

DIAGNOSIS

Mainly clinical. However, diagnosis is further strenthened with data from the following screening tools-

Screening tools

- Conner's Rating Scales
- ADHD Rating Scale
- Vanderbilt ADHD Rating Scale
- Child Behavioral Checklist

MANAGEMENT

- Behavioural therapy: parents are taught how to –
  - Reinforce positive behaviour by praising or by using daily contingency charts
  - Extinguish negative behaviours by active ignoring
- Pharmacotherapy includes
  - Methylphenidate (5-20 mg bd)
  - Atomoxetine (0.5 mg/kg/day OD)

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the common psychiatric disorders in children?
2. Write down the characteristics of autistic child
3. Mention the etiology of autism.
4. How will you treat a child with autism?
5. Write down the clinical manifestation of ADHD.
6. Write down the treatment plan of a child with ADHD.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Habit disorders are–
   __ a) Autism __ b) Head banging __ c) Trichotillomenia
   __ d) ADHD __ e) Breath holding attacks
2. In autism–
   __ a) Impaired social interaction & communication __ b) Language development is normal
   __ c) Restricted & repetitive behavior __ d) there may be underlying organic causes
   __ e) fails to response to his/her name
3. Characteristics features of ADHD–
   __ a) Inattentiveness __ b) hyperactivity __ c) Restricted & repetitive behavior
   __ d) poor impulse control __ e) Lack of communications

CHAPTER 34

SHORT STATURE

Whenever a child presents with short stature i.e the height or length of the child is more than -2 SD's for that specific age and sex, one should consider the following possibilities as the aetiology of short stature. The possibilities can be grouped under two headings-

A. Normal variants

- Familial (genetic) short stature
- Constitutional growth delay

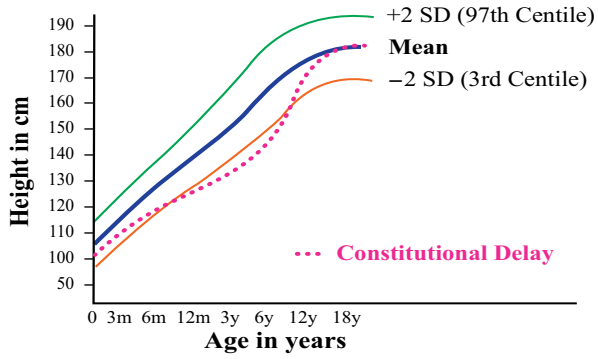
B. Pathological causes

- Idiopathic short stature
- Endocrinopathies e.g. growth hormone deficiency, thyroid hormone deficiency, diabetes mellitus, diabetes insipidus, cushing syndrome
- Psychogenic e.g. psychosocial deprivation
- Nutritional deficiency e.g. malnutrition, rickets
- Chronic illnesses e.g. inflammatory bowel disease, coeliac disease, chronic kidney disease
- Chromosomal abnormalities e.g. Down syndrome, Turner syndrome, Noonan syndrome
- Skeletal dysplasias e.g. achondroplasia, mucopolysaccharidosis

In this section, we will discuss constitutional growth delay, familial short stature, GH deficiency and Turner syndrome. The other causes of short stature like hypothyroidism, rickets, CKD, Down syndrome, malnutrition etc. are discussed in other sections.

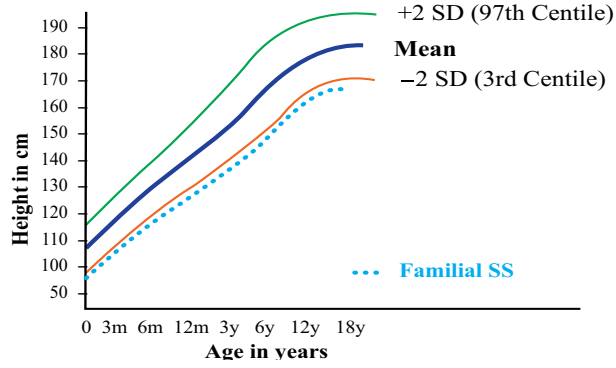
CONSTITUTIONAL GROWTH DELAY

In this condition, babies are born with normal size and grow normally during the 1st few months of life. However, between 6-36 months of age, their growth rate slows for no apparent reason and their height falls below 3rd centile and continue to grow below 3rd centile. In later part of puberty, growth spurt occur and growth curves re-enter above 3rd centile and results in achieving normal adult height as well as sexual development. The **bone age** is delayed but **height age** (the age at which the existing height of the child falls on 50th centile) corresponds with bone age.



FAMILIAL SHORT STATURE (FSS)

In this condition, short stature of the child is considered to be the influence of parent's height (genetic influence). Children with FSS have short parents and the child's height commensurate with his/her genetic potential. They are born small and adopt a place below 3rd centile and continue to grow along that channel with a **normal growth velocity.** Their bone ages as well as puberty are age appropriate but height age is less. The adult height is short but consistent with the familial pattern.



To determine the causes of short stature either genetic or other is evaluated at bedside by calculating & interpreting **Mid Parental Height** (MPH).

MID PARENTAL HEIGHT (MPH)

It is the average height of both father and mother. Since men are genetically pre determined to be taller than women by about 13 cm, one must add 13 cm to mother's height before averaging it with father's height to calculate MPH for a boy. On the other hand, calculating MPH for a girl, 13 cm need to be subtracted from the father's height, before averaging it with mother's height.

Thus formula for MPH is as follows:

MPH for a boy

$$\frac{\text{Fathers height} + (\text{mother's height} + 13\text{ cm})}{2}$$

MPH for a girl

$$\frac{(\text{Father's height} - 13\text{ cm}) + \text{mother's height}}{2}$$

How to assertain genetic or true short stature?

After calculating MPH, we need to calculate the **target height** range by the following formula: **MPH±8.5 cm.**

The target height range is then plotted on the line corresponds to 18 years of age on the growth chart. After that, the **existing height** of the child is plotted on the age-specific line of the growth chart. A line is then drawn from this point of existing height and extending line towards the 18 years age line to determine the adult **Projected height** of this child. If the projected height of the child pass below the target height range, then this child has **true** or **pathological short stature** but if child's projected height, pass within the range of target height range then his height will be considered as **genetic short stature.**

GROWTH HORMONE DEFICIENCY

AETIOLOGY

- Idiopathic
- Secondary e.g. CNS irradiation, histiocytosis, craniopharyngioma

CLINICAL MANIFESTATIONS

- Short stature
- Features of pituitary insufficiency e.g. manifestation of adrenal, thyroid and gonadal insufficiency
- Features of raised ICP as in pituitary tumor e.g. headache, vomiting, visual diturbances, polyurea, seizure etc.

DIAGNOSIS

Based on C/F & supports from the relevant investigations.

Investigations

Parameters	Results
◆ X-ray wrist & hand	◆ Bone age is delayed than chronological age
◆ RBS	◆ Low
◆ X-Ray skill: Distortion of sella turcica ◆ CT/MRI of brain	◆ Calcification/tumor of pituitary region
◆ Insulin like growth factor-1	◆ Decreased (if normal, it excludes GH deficiency)
◆ Growth hormone provocation test	◆ Confirmatory

TREATMENT

Replacement therapy with Recombinant Human Growth Hormone (rhGH). Dose: 0.07 - 0.1 IU/kg/day, given daily or every alternate day subcutaneously at night till adequate growth.

TURNER SYNDROME

- Karyotype: 45X0
- Incidence: 1 in 2500-3000 female births. However, it is estimated that 95% of conceptuses with monosomy X are miscarried and only 5% are liveborn.
- Sex: Female

AETIO-PATHOGENESIS

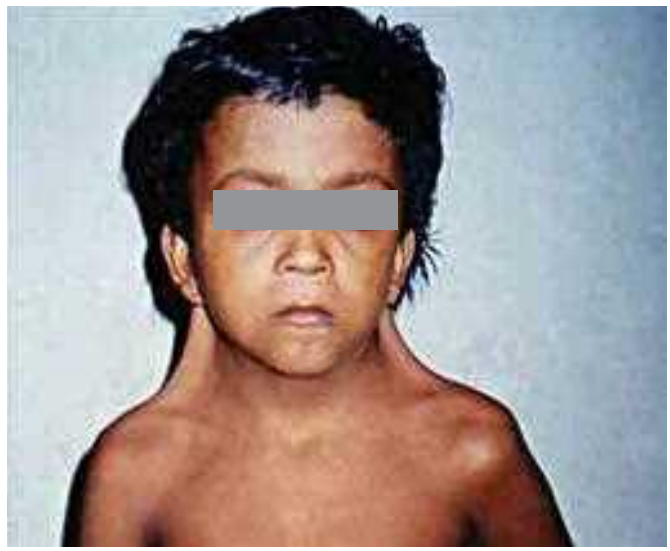
◆ Idiopathic ◆ Maternal age is not a predisposing factor

Clinical behaviour of Turner syndrome is due to a missing or incomplete X chromosome. As some of the genes, involved in physical growth & sexual development present on the X chromosome, girls with this disorder are shorter than normal and have incompletely developed sexual characteristics.

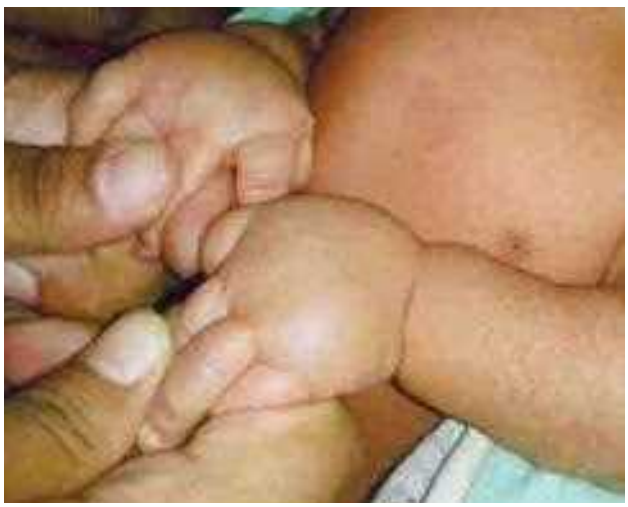
CLINICAL MANIFESTATIONS

- Short stature
- Characteristic clinical features (given on the table)

Regions	Features
Eyes	Inner canthal folds, ptosis, blue sclerae
Ears, Nose Mouth	Low-set prominent auricles, high arch palate, narrow mandible
Neck	Low posterior hairline, webbing
Chest	Shield chest e.g. Broad, widely spaced nipples. Pectus excavatum
Skeleton	Short stature, cubitus valgus, short fourth metacarpal and/or metatarsal, scoliosis, hypoplastic nails
Hand & Feet	Lymphoedema of hand and feet (at birth)

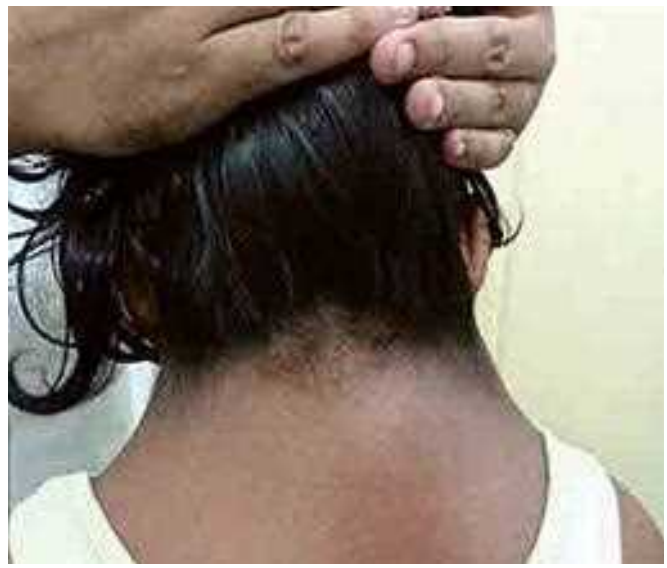


Turner child with Webbing of neck



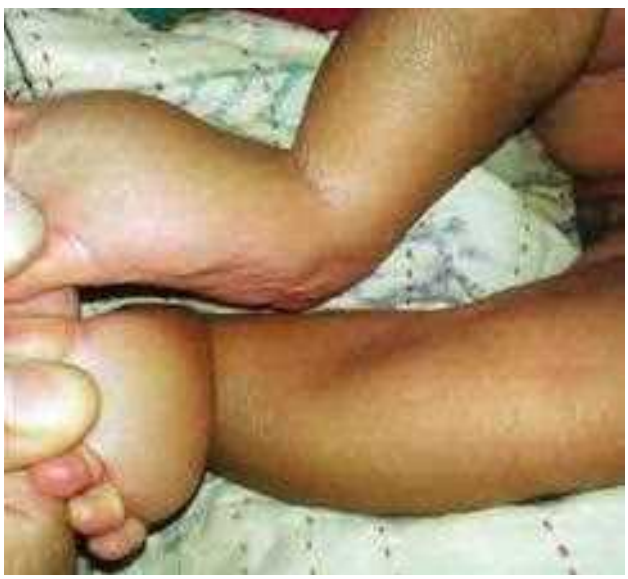
Courtesy: Dr Iffat Ara Shamshad

Turner - Newborn with oedema of hand

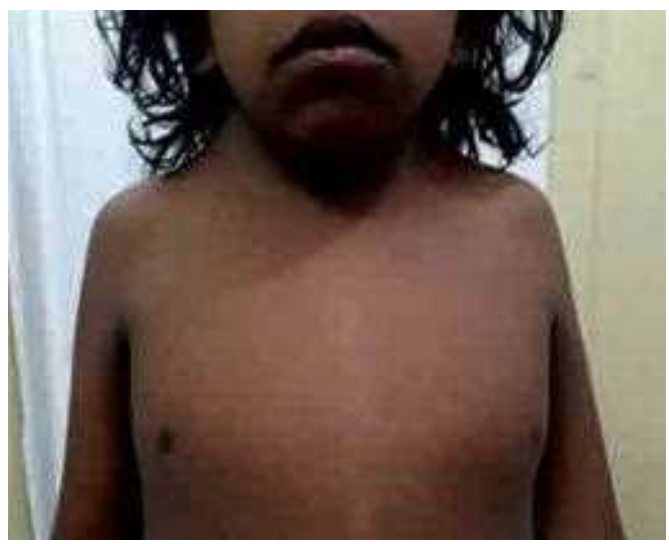


Courtesy: Dr Maliha Alam

Turner child with low posterior hair line



Turner - Newborn with oedema of leg and foot



Turner child with widely spaced nipples (shield chest)

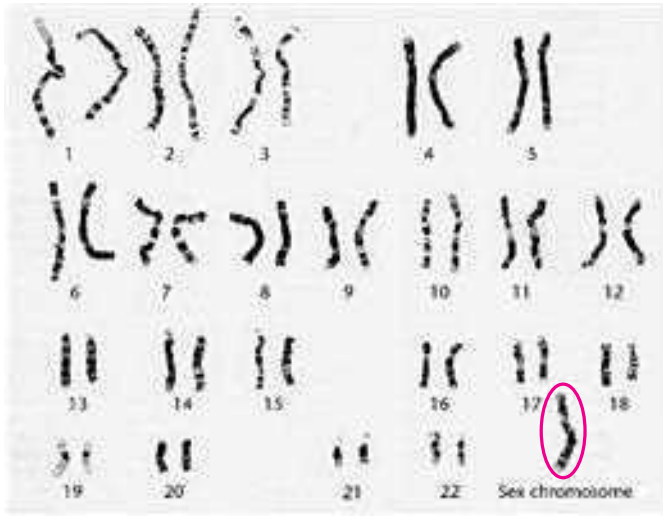
Turner - Newborn with redundant nuchal skin

Co-morbidities of Turner syndrome

- Learning disabilities
- Delayed pubertal development and failure of sexual maturation
- Gonadal dysgenesis and infertility
- Congenital heart diseases e.g. coarctation of aorta
- Renal malformations e.g. horse-shoe kidney
- Endocrinopathies e.g. Hypothyroidism, diabetes mellitus
- Most have normal intelligence
- May have behavioural problem

DIAGNOSIS

Virtually clinical and karyotyping is confirmatory.



TREATMENT

- Counseling parents about the nature & future of disease
- Growth hormone replacement, by 3-4 years of age to increase the height of the affected girl.
- Female sex hormone (Oestrogen & Progesterone) replacement during adolescence to develop secondary sex characteristics and normal menstruation and to prevents osteoporosis

Prognosis

Females with 45X or 45X mosaicism have a low fertility rate, and those who become pregnant have a high risk of foetal wastage e.g. miscarriage, stillbirth. Furthermore, their liveborn offsprings have an increased frequency of chromosomal abnormalities and malformations.

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. Name five important causes of short stature.
2. How will you diagnose and treat a child with Turner syndrome?
3. What are the common physical findings of Turner syndrome?
4. A 10 years old girl presented with short statures
   a) Write down 5 important differentials
   b) What relevant history will you expect?
   c) How will you investigate the child?

MULTIPLE CHOICE QUESTIONS [MCQ]

1. The major clinicopathological outcome of Turner syndrome are–
   ___ a) diabetes mellitus ___ b) short stature ___ c) renal failure
   ___ d) infertility ___ e) hypothyroidism
2. Turner's syndrome is characterized by–
   ___ a) female dominance ___ b) Tall stature ___ c) 45XO karyotype
   ___ d) absence of anti-androzen therapy response– ___ e) hypertension
3. The characteristic clinical features of Turner's syndrome are
   ___ a) shield chest ___ b) infertility ___ c) webbing of neck
   ___ d) simian crease ___ e) brushfield spots
4. The following are the normal variant short stature–
   ___ a) constitutional growth delay ___ b) genetic short stature ___ c) GH deficiency
   ___ d) phychosocial deprivation ___ e) achondroplasia

Chapter 35

Difficulties in Movement and Posture

When a child presents with difficulties in movement & posture i.e. **activity limitation**, one should consider cerebral palsy (CP) as the commonest possibility.

However, diseases of muscles e.g. Duchenne muscular dystrophy (DMD) and of brain & spinal cord e.g. spinocerebellar ataxia, subacute sclerosing panencephalitis (SSPE), Wilson disease, adrenolukodystrophy etc. also gives rise to such presentation. In this chapter CP, DMD and Wilson disease is highlighted.

CEREBRAL PALSY (CP)

Cerebral palsy (CP) is a nonspecific term used to describe a chronic disorders of movement and posture causing **activity limitation.** The condition is non-progressive and originated from some type of cerebral insult or injury before birth, during delivery or in the perinatal period. Other neurologic deficits or disorders *e.g. blindness, deafness, or epilepsy* may co-exist.

The fundamental course, severity, precise manifestations and prognosis vary widely.

Types

- Spasticity of limbs, (related to damage in the white matter) the most common form of CP (75%) e.g. Spastic quadriplegia, Spastic hemiplegia, Spastic paraplegia,Spastic diplegia, Spastic monoplegia
- Ataxia (related to damage in cerebellum or its pathways) is the 2nd common form of CP (15%).Here, fine coordinated movements of both upper, lower extremities and trunk are affected and the baby may present with • early hypotonia • poor balance an • delayed motor development • intension tremor etc.
- Dyskinetic movement (related to damage in basal ganglia or their associated pathways) and the affected child presents with involuntary movements e.g. chorea, athetosis, dystonia and poor postural control(5%)
- Persistent hypotonia without spasticity (1%)

Aetiology & Risk factors

In many cases, no definite cause is identified (Idiopathic). However, the known causes are-

- Abnormal brain development
- Intrauterine exposure to maternal infection
- Intrauterine hypoxia
- Perinatal asphyxia & hypoxic ischaemic encephalopathy (HIE)
- Intracerebral haemorrhage, infarction, periventricular leukomalacia
- Neonatal sepsis
- Extreme low birth weight & prematurity
- Hypoglycaemia or other metabolic abnormalities
- Kernicterus

Clinical Manifestations

Symptoms

- Not achieving or delay in achieving age appropriate Motor skills i.e. neck control, sitting, standing, crawling, walking, holding things etc.
- Involuntary movements e.g. choreoathetoid movements
- Drooling of saliva
- Other symptoms, occuring in variable frequencies are-
  - Seizure (50%)
  - Intellectual disability *(mild: 25%, severe: 27%)*
  - Abnormal behaviour
  - Disorders of-
    - Language, Speech e.g. dysarthria, dysrrhythmia
    - Vision e.g. squint, refractive error, defect in choroid/retina and blindness
    - Hearing
    - Sensory perception
    - Interaction
- Feeding problem

Physical Examination

The findings are variable and are related to involvement of pyramidal, extra-pyramidal system and cerebellum.

The usual findings are-

- Appearance: Dull & vacant
- Posturing: Abnormal
- Spasticity e.g. scissoring, tight tendoachilis
- Hyperreflexia, brisk or exaggerated deep reflexes e.g. knee, ankle jerks
- Involuntary movements e.g. chorea, tremor etc.
- Hypotonia, sometimes but deep tendon reflexes are brisk as in hypertonic CP
- Gait: Abnormalities, may be ataxic
- Other findings
  - Microcephaly (OFC<-3SD for age)
  - Squint, poor fixation of eyes due to cranial nerve palsy
  - Persistence of primitive reflexes e.g. palmar grasp, moro reflex etc. beyond the age of disappearance
  - Limb length discrepancy as noted in spastic hemiplegia
  - Evidence of congenital infections by CMV, Rubella e.g. CHD, cataract, retinopathy etc.
  - Malnutrition (FTT) due to feeding difficulties

CP with hypertonicity of both upper and lower limbs & fisting

Diagnosis

Diagnosis of CP is virtually clinical and by exclusion of other neurological disorders. Investigations have limited value. However,

- MRI scan may be helpful to understand the full extent of cerebral injury and occasionally the pathology of congenital CMV infection or brain malformation
- Genetic & metabolic screening may give some clue and should be planned, based on history or MRI findings

Management

A. Counseling parents regarding the disease, its treatment and outcome. Make it clear to parents that it is-

- A non progressive disease
- Not a mental illness and
- Not curable

B. The **Integrated management** is offered by a group of experts from different disciplines. Here the Paediatrician plays the pivotal role. This group will collectively offer maximum specialized services to attain maximal neurologic functioning with an appropriate and integrated approach emphasizing on physical, occupational and speech therapy.

The role of different specialties are given in the table -

Paediatrician	◆ Ensure appropriate nutrition ◆ Treat common illnesses ◆ Ensure complete immunization ◆ Make timely referral to appropriate authority
Physiotherapist	◆ Specific training e.g. sitting, standing, stepping & walking ◆ Exercise designed to increase muscle strength ◆ Prevention of contractures ◆ Control of movement
Speech language therapist	◆ Develop communication skills especially speaking
Occupational therapist	◆ Develop fine motor skills e.g. dressing, feeding, writing and other daily activities
Psychologist	◆ Improve cognitive and behavioural development
Audiologist	◆ Assist in hearing problems
Ophthalmologist	◆ Correct refractive error, squint and advice on eye exercise
Orthopaedic surgeon	◆ Correct deformities which are beyond medical treatment ◆ Surgical release of heel cord contractures
Special school and teachers	◆ Mild CP may attend normal school ◆ Moderate to severe CP needs special schools
Social worker	◆ Create social awareness to establish the right of the affected children & arrange various economic aids and legislative support

C. Management of feeding difficulty

- Use a shallow spoon and give soft food
- Place the food on the middle of the tongue
- Nasogastric tube feeding, if needed

D. Pharmacotherapy

- For spasticity -
  - Drugs: Tizanidine, Baclofen, Clonazepam, Diazepam etc.
  - Inj. Botox is used to treat spasticity. It blocks the transmission of overactive nerve impulses to the targeted muscle by selectively preventing the release of Acetylcholine (ACh) at the neuromuscular junction
  - Dyskinetic CP: Trihexiphenidyl hydrochloride (Pacitane)
- Convulsion: Give standard anticonvulsants (avoid Phenobarbitone)

E. Follow up: To assess efficacy of treatment by looking at status of disabilities

Prognosis

Depends greatly on child's IQ, severity of motor deficits, etiology of CP and degree of incapacity. In severely affected children, aspiration, pneumonia and other intercurrent infections are the most common causes of death. In contrast, children with mild CP, may improve with age.

DUCHENNE MUSCULAR DYSTROPHY

In this disease, boys suffer and females carry the disease only exception is Turners, where female are sufferers.

- Incidence: 1 in 3600 male births
- Defect: Mutation of the gene at Xp21 locus
- Mode of inheritance: X linked recessive trait

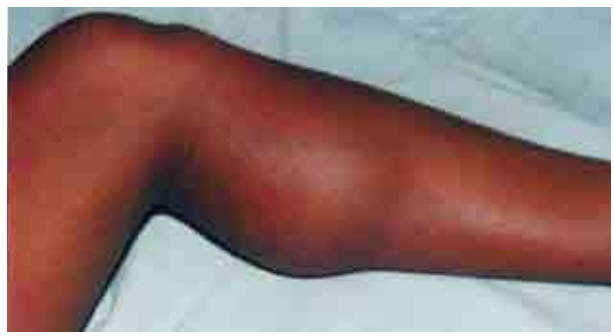
Pathogenesis

Due to mutation of the gene on X chromosome, there is deficient production of muscle cytoskeleton protein 'Dystrophin' which causes progressive weakness of muscles, particularly the proximal muscles (proximal myopathy).

Mutations in same gene that results in partial expression of dytrophin protein produce a less severe phenotype, 'Becker muscular dystrophy'.

Clinical Manifestations

- Normal at birth or during early infancy
- Clinical maenifestations usually appear by 3 years of age, e.g. frequent falls, trouble running, difficulties in climbing stairs as well as rising from floor/bed
- H/O recurrent respiratory infections
- Clinical examination shows -
  - Pseudohypertrophy of calves (due to hypertrophy of some muscle fibers, infiltration of muscle by fat and proliferation of collagen)



Pseudohypertrophy of calf muscle

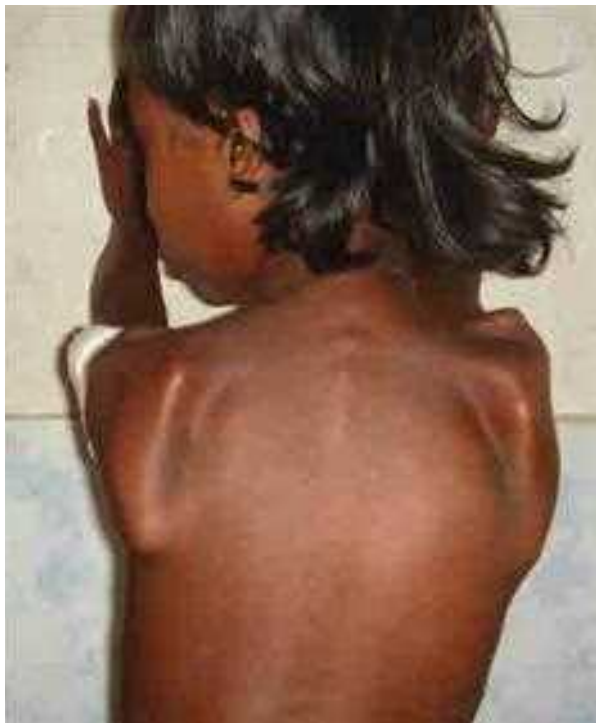
  - Wasting of thigh muscles (proximal myopathy)

Gower sign

Gower sign

Gower sign

- Lordotic posture
- Trendelenburg gait or hip waddle **(Waddling gait)**
- Presence of **Gower sign,** the characteristic posture
- Presence of **slip through sign** (as the boy is lifted up by holding around the sides of his chest right up under his arms, the weak shoulders move upward, almost allowing him to slip through the physician's hands)
- Presence of **winging sign** (winging of scapula)



Winging of scapula

- Hypertrophy of tongue and forearm may be present but no fasciculation

- **Other** features -
  - Contractures involving ankles, knees, hips & elbows
  - Scoliosis
  - Cardiomyopathy, presenting as cardiac failure, persistent tachycardia, murmur
  - Intellectual impairment

DIAGNOSIS

Based on characteristic C/F and supports from the relevant investigations.

Investigations

- Serum CK level: **Greatly elevated (15,000 -35,000 IU/L,** (normal: < 150 IU/L)
- Electromyogram (EMG): Characteristics myopathic feature but not specific for DMD
- X-Ray chest: May show evidence of pneumonia and/or cardiomyopathy (cardiomegaly)
- ECG & Echocardiogram: Evidence of Cardiomyopathy
- Muscle biopsy shows–
  - Endomysial connective tissue proliferation
  - Scattered degenerating and regenerating myofibrils
  - Foci of mononuclear cell infiltration
- Molecular analysis has largely replaced muscle biopsy to confirm the diagnosis

TREATMENT

Counsel parents about the nature & future of the disease.

Supportive

- Diet
  - Maintain good nutrition and to prevent obesity
  - Minimize osteoporosis by adequate calcium and fluoride supplementation
- Physiotherapy to delay contractures
- Prompt treatment of
  - Pulmonary infections
  - Cardiac decompensation (Digoxin)
- Steroid are useful in maintaining muscle strength. It does not slow the disease progression. Prednisolone, 10mg daily for 10 days of each month may be given.
- Immunization against influenza virus, in addition to other routine vaccinations

Prognosis

The relentless progression of weakness continues into the 2nd decade. Most patients continue to walk with increasing difficulty until 10 years of age and some are wheelchair bound by 7 years.

Death occurs usually around 18-20 yrs of age. The common causes of death are respiratory failure, intractable heart failure, pneumonia or occasionally aspiration and airway obstruction.

WILSON DISEASE

- Incidence: 1/5000 to 1/100,000 population
- Mode of inheritance: Autosomal Recessive
- Defect: Mutation of ATP7B gene on chromosome 13, coding for a specific P-type adenosine triphosphatase, involved in copper transport.

To learn Wilson disease, it is important to understand normal copper metabolism.

Normal Copper (Cu) metabolism

Ingestion of Cu containing food

↓

Absorption of ingested Cu (40-60%) in duodenum & proximal gut & it's entry into portal venous system

↓

Binding of absorbed Cu with with albumin and histidine in portal blood

↓

Transportation of Cu-albumin complex to liver

↓

Dissociation of Cu from albumin and histidine & taken up of Cu by hepatocytes

↓

Within hepatocytes Cu binds with apoceruloplasmin to form ceruloplasmin

↓

Release of ceruloplasmin (with Cu) in the systemic circulation

↓

After it's function is over, in blood, ceruloplasmin taken up by the liver from circulation

↓

Disialylation and degradation of ceruloplasmin within hepatic lysosomes

↓

Released Cu from ceruloplasmin & excretion into the bile

In Wilson disease, because of mutation in **ATP7B gene**, patients become deficient of adenosine triphosphatase, (ATP) protein which results in -

- Impaired incorporation of copper (Cu) into ceruloplasmin by the liver and thus decreased secretion of ceruloplasmin into blood
- Decreased excretion of copper into bile

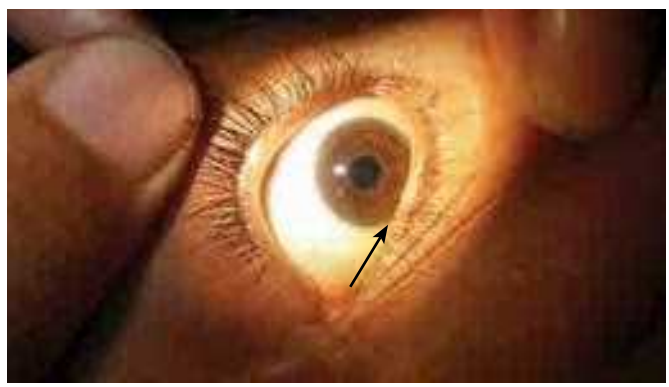
The net results are

- Reduction of ceruloplasmin in blood
- Accumulation of free Cu in hepatocytes and Cu induced toxic injury to hepatocytes
- Spilling over of free Cu from liver into circulation
- Cu induced toxic injury to RBC (haemolysis), basal ganglia, cornea, kidney, bone, joints & parathyroids
- Concomitant increase in urinary Cu excretion

Clinical Manifestations

Hepatic & haematological manifestations appear early & later on neurological manifestations.

Organs	Manifestations
Liver	◆ Acute hepatitis e.g. jaundice ◆ Fulminant hepatic failure ◆ Chronic liver disease, portal hypertension, ascites
Nervous system	◆ Extrapyramidal manifestations e.g. tremor, dysarthria, drooling, dystonia, choreoathetosis ◆ Psychiatric manisfestations e.g. dementia ◆ Deterioration of handwriting, school performance ◆ Speech disturbances
Eyes	◆ **KF (Kayser-Fleischer) ring** (Greenish brown ring due to Copper deposition in descemet's membrane of sclero-corneal junction (limbus) ◆ Sunflower cataract
Others	◆ Haemolytic anaemia ◆ Rickets ◆ Renal tubular acidosis ◆ Arthritis ◆ Cardiomyopathy ◆ Endocrinopathy e.g. Hypoparathyroidsm ◆ Infertility/Recurrent miscarriages



KF (Kayser-Fleischer) ring
Courtesy: Dr Farzana Sharmeen

Diagnosis

Based on C/F & supports from the relevant investigations.

Investigations

Parameters	Results
◆ Haemoglobin	Decreased
◆ S. ceruloplasmin	< 20 mg/dl *(normal 40 mg/dl)*
◆ 24 hours urinary Copper	> 100 µg/day *(normal < 40 µg/day)*
◆ SGPT, S. Bilirubin, ◆ Prothrombin time	May be raised
◆ MRI of brain	Reveals change in basal ganglia
◆ D- penicillamine challenge test ◆ *Patient will take Penicillamine (500 mg) 12 hourly for 24 hours and during this period all urine has to be collected in a jar for Copper estimation*	If urinary Copper exceeds > 1600 µg in 24 hours then it is suggestive of Wilson disease (done only when 24 hours urinary Cu is < 100 µg/day)
◆ Liver biopsy to measure hepatic coppper content	>250 µg/gm of dry weight of liver is confirmatory *(normal <10 µg/gm dry weight)*

TREATMENT

A. Supportive

- Copper Chelators
  - D-penicillamine 10-30 mg/kg/day twice daily before meal. Start with lower dose and increase over 1 to 2 weeks to the desired dose
  - Trientine hydrochloride 20 mg/kg/day
  - Tetrathiomolybdate, is being tested as an alternate therapy
- Others supportive agents
  - Zinc acetate: 25 mg, orally, 3 times a day may reduce copper absorption. Zinc should not be given at the same time as copper chelators
  - Pyridoxine: 25 mg/day is given daily during therapy with Penicillamine to prevent optic neuritis
  - Both the copper chelators and Zinc will be continued for life
- Diet
  - Allow diet deficient in copper e.g. milk & milk products, green leafy vegeables, sugar, cold drinks, lemon juice, tomato juice
  - Avoid diet rich in copper e.g.meat, chicken, honey, jam, chillie, garam masala, pulses, wheat-flour, chocolates, dried nuts, mushroom

B. Specific treatment: Liver transplantation.

Prognosis

The prognosis for untreated Wilson disease is poor.

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the cardinal features of cerebral palsy?
2. Write five important cardinal features of DMD.
3. Write two important investigations and their interpretations for diagnosing DMD.
4. What do you mean by pseudohypertrophy? Where does this occur in DMD?
5. Mention four important clinical consequences of DMD.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. The 2 common types of CP are–

   ___ a) spastic ___ b) ataxic ___ c) choreoathetoid

   ___ d) hypotonic ___ e) mixed

2. The known risk factors of cerebral palsy are–

   ___ a) severe neonatal jaundice ___ b) infants of diabetic mother ___ c) birth weight of 1000 gram

   ___ d) neonatal sepsis ___ d) hypoxic ischaemic encephalopathy

3. Drugs found useful in the management of cerebral palsy are–

   ___ a) Beclofen ___ b) Diazepam ___ c) Botulinum toxin

   ___ d) Multivitamin ___ e) Amoxicillin

4. Features characteristic of DMD are–

   ___ a) distal myopathy ___ b) enlargement of calf muscles ___ c) high CK level

   ___ d) convulsion ___ e) recurrent chest infection

Chapter 36

Accidents and Emergencies

Children are the frequent victims of various accidents and these pose them to life-threatening emergencies. The common accidents & emergencies (A&E) of children are–

- Accidental ingestion of poisons, household substances, drugs etc.
- Drowning
- Foreign body aspiration in the airway
- Burn & scald
- Road traffic accidents
- Snake, dog/insect biting
- Electrocution
- Injury by sharp objects & domestic animals

In this chapter, accidental poisoning, foreign body aspiration, drowning, burn, snake and dog bite will be discussed.

Accidental Poisoning

Accidental ingestion of poisonous agents is the most common way of poisoning among children. Of the different agents, the following substances are commonly associated with accidental poisoning.

- Kerosene
- Household products e.g.bleach, cosmetics, toiletries, detergents, disinfectants, petroleum distillates etc.
- Drugs, of other family members
- Organophosphorus compounds (OPC)

KEROSENE POISONING

- Commonest childhood poisoning (37% of all poisoning)
- At risk children: Age 1-5 years, due to their natural curiosity to explore
- Easy access to children due to it's availability in most poor households and wrong storage in beverage bottles
- Ingestion occurs more during summer months

Pathogenesis

The principal concern of kerosene oil poisoning is its aspiration into lungs that may occur during initial ingestion or during vomiting. Following aspiration, it causes inflammation to lungs parenchyma **(chemical pneumonitis)** which may progress to atelectasis, pneumothorax or pleural effusion and which interferes with gaseous exchange and hypoxia. This ultimately affects CNS and other vital organs.

Fatal dose: 30 ml and fatal period is 24 hours.

Clinical Manifestations

The child may–

- Be asymptomatic, just only have H/o kerosene ingestion
- Cry excessively because of pain and irritation in the throat
- Have sensation of choking, nausea or vomiting
- Have characteristic odour in breaths & vomitus
- Have features of pneumonia e.g. cough, breathlessness, wheeze, fever
- Have colicky abdominal pain, diarrhoea
- Have arrhythmias, congestive cardiac failure
- Rarely, seizure and coma

Physical Examination

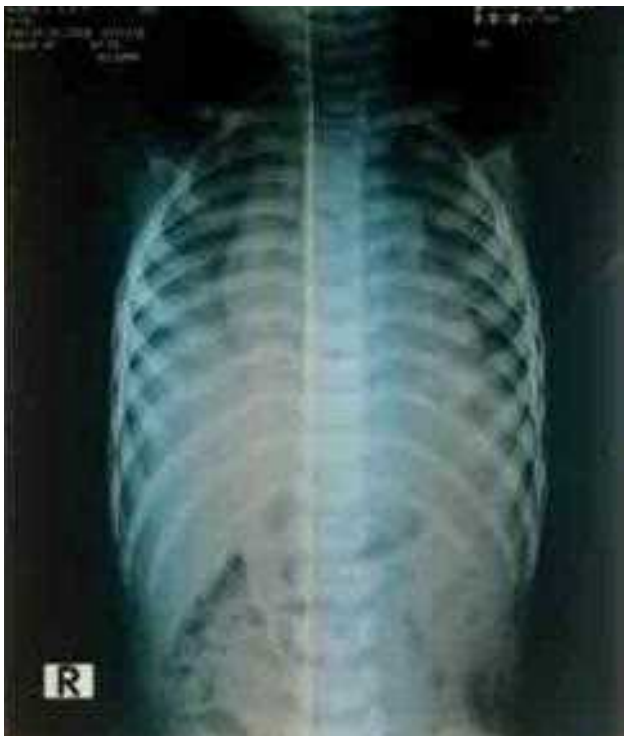
- General condition & vital signs are usually normal
- Sometime, high fever may be present
- Features of pneumonia may be present e.g. fast breathing, cheast indrawing, nasal flaring, creps etc.
- Pupils are usually normal but may be either constricted or dilated, if coma supervenes

DIAGNOSIS

Based on C/F and supports from relevant investigations.

Investigations

- X-Ray chest
  - Early stage: Fine, punctuate mottling present in perihilar areas



Patchy opacities in lungs

  - Later stage: Patchy ill-defined opacities may develop in both lungs particularly the lower lobes
  - Sometimes there may be evidence of pneumatocoele and later pneumothorax
- CBC: Neutrophilic leukocytosis, but may be normal

TREATMENT

Mainly supportive and includes–

- Care of airway & breathing (see page 254)
- IV saline, if patient is dyspnoeic or unable to tolerate oral or NG feed
- Provide O_2 inhalation, if there is respiratory distress/low SPO_2
- Observe for at least 24 hours to note evidence of respiratory or other complications (CNS) as an initial asymptomatic child may develop full-blown picture of kerosene oil poisoning after 24 hours of ingestion
- Give Antibiotics, when there is suspicion of secondary pneumonia

Gastric lavage is contraindicated as it is associated with aspiration of kerosene into the lungs.

ORGANOPHOSPHORUS COMPOUND (OPC) POISONING

PATHOGENSIS

Organophosphorus compounds causes neurotoxicity through inhibition of acetylcholinesterase: the enzyme that breaks Acetylcholine. So, acetylcholine is not metabolized. As a result, there is persistent cholinergic discharge at the neuromuscular junctions.

CLINICAL MANIFESTATIONS

- Smell of OPC are usually felt
- Clinical features appear within few hour of exposure, and the typical features are–

- Profuse sweating
- Increased salivation
- Muscle twitching
- Convulsion
- Muscle cramp
- Diarrhoea or vomiting
- Headache
- Pulmonary congestion
- Blurring of vision
- Constricted pupils
- Flaccid paralysis & deep coma in the late stage of the disease
- Variable haemodynamic status

INVESTIGATIONS

- RBC cholinesterase level. A decrease in <25% of normal indicate significant exposure

TREATMENT

- Hospitalize immediately
- Counsel parents about the nature & fate of OPC poisoning
- Remove all contaminated clothes and wash the body thoroughly with soapy water
- Give gastric lavage, if patient arrives within 30 minutes of ingestion
- Assess vital signs quickly e.g. pulse, BP, capillary refilling time, pupils etc. every 4-6 hours

- Clear the airway and support breathing (ABC)
- Keep the patient in lateral position to avoid aspiration
- Infuse IV fluid to maintain normal haemodynamic status, nutritional support and to administer drugs
- O_2 inhalation:1-2 liters/minute
- Inj Atropine (1 amp=0.6 mg): It is started at a dose of 0.05 mg/kg IV and repeated every 10-15 minutes to a maximum of 2-5 mg till the pupils are dilated (i.e. full atropinization)

Signs of atropinization

- Mydriasis (dilated pupil)
- Tachycardia
- Flushing
- Dry mouth and nose
- Anhydrosis (absence of sweating)
- Bronchodilatation

Then, gradually taper the dose of atropine and maintain for at least 2-3 days, based on the size of the pupils. Atropine antagonizes the muscarinic parasympathetic effects of OPC but does not affect the nicotinic receptor and it does not improve muscular weakness.

- Give Inj. Pralidoxime (Cholinesterase reactivator): 30 mg/kg diluted, and infused IV over 5-30 minutes) in addition to Atropine. It is most useful if given within 48 hours of exposure. It may be repeated every 6-12 hours as needed
- Give Antibiotics to prevent pneumonia and other infections
- Put catheter before starting atropine, as it constricts the sphincters
- Monitor the patient as needed to note the signs of atropinization & other vital parameters
- Provide other supportive care–
  - Maintenance of hygiene (including oral hygiene)
  - Care of bowel and bladder
  - Orophyaryngeal & nasopharyngeal suction when needed

FOREIGN BODY ASPIRATION (FBA)

The second leading cause of accidental death next to drowning among children between 6 months to 5 years of age. FBA is commonly seen with small, round foods such as nuts and seeds, berries, corn/popcorn, beans etc.

Pathogenesis

After aspiration, FB can lodge anywhere along the respiratory tract and produce variable features.

- When in the **Supra-glottic** airway (larynx & trachea), it triggers protective reflexes and laryngospasm and in about 90% cases, it is coughed out
- When small objects cross the glottis and lodge in the **lower airway (infra-glottic airway)**, it induces cough and variable respiratory distress of variable intensity**.** In 80-90% cases, it is lodged into right principal bronchus

In the airway, when it causes partial obstruction (**Ball-Valve effect),** air can enter during inspiration but find difficulties to come out during expiration and ultimately gives rise to unilateral hyperinflation. On the otherhand, when FB completely blocks the air passage (**Stop-valve effect),** air cannot enter distal to obstruction and ultimately the obstructed lungs collapse.

Clinical Manifestations

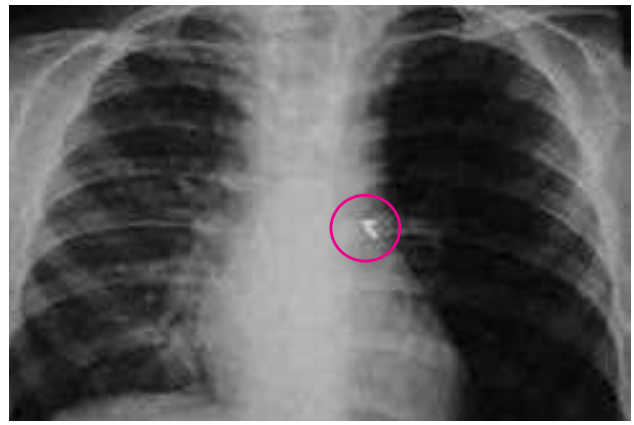
- Sudden onset of coughing, chocking or wheezing in a previously well child with a history that the child running with food in the mouth or playing with seeds, small coins or toys
- Inability to vocalize, presence of cyanosis (complete obstruction)
- Presence of stridor (partial obstruction)

Diagnosis

Based on clinical features and supportive investigation.

Investigations

- X-Ray Chest (frontal & lateral view). Features are–
  - Normal in about 80% of laryngotracheal lodging
  - Unilateral hyperinflation, when FB lodged in principal bronchus with ball valve effect. However, bilateral hyperinflation occurs when FB lodged in trachea



Unilateral hyperinflation of left lung and a metalic foriegn body in left principal bronchus

- Other findings are features of collapse, pneumonitis
  - In about 20% cases, FB is visible
- CT scan of chest: A helpful diagnostic tool

TREATMENT

- Back blow/Heimlich maneuver to expel the FB out

If this maneuver is failed, then–

- Refer the child to remove the FB by either fibreoptic or rigid bronchoscopy (the gold standard)
- Surgery in complicated cases

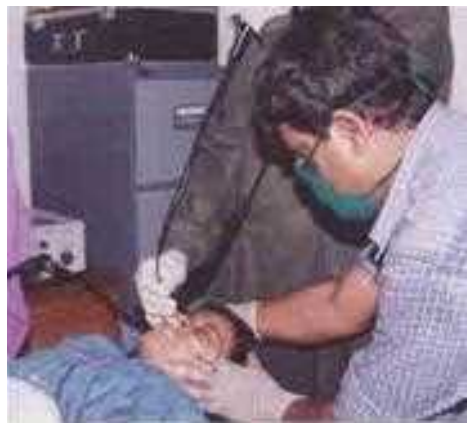
Prevention

- Do not let young children to play with toys, small enough to put in their mouths.
- Keep small objects *e.g. medicines, nuts etc.* out of reach of small children
- Educate doctors regarding the possibility of FBA when sudden onset of coughing and choking in a well child

BURN

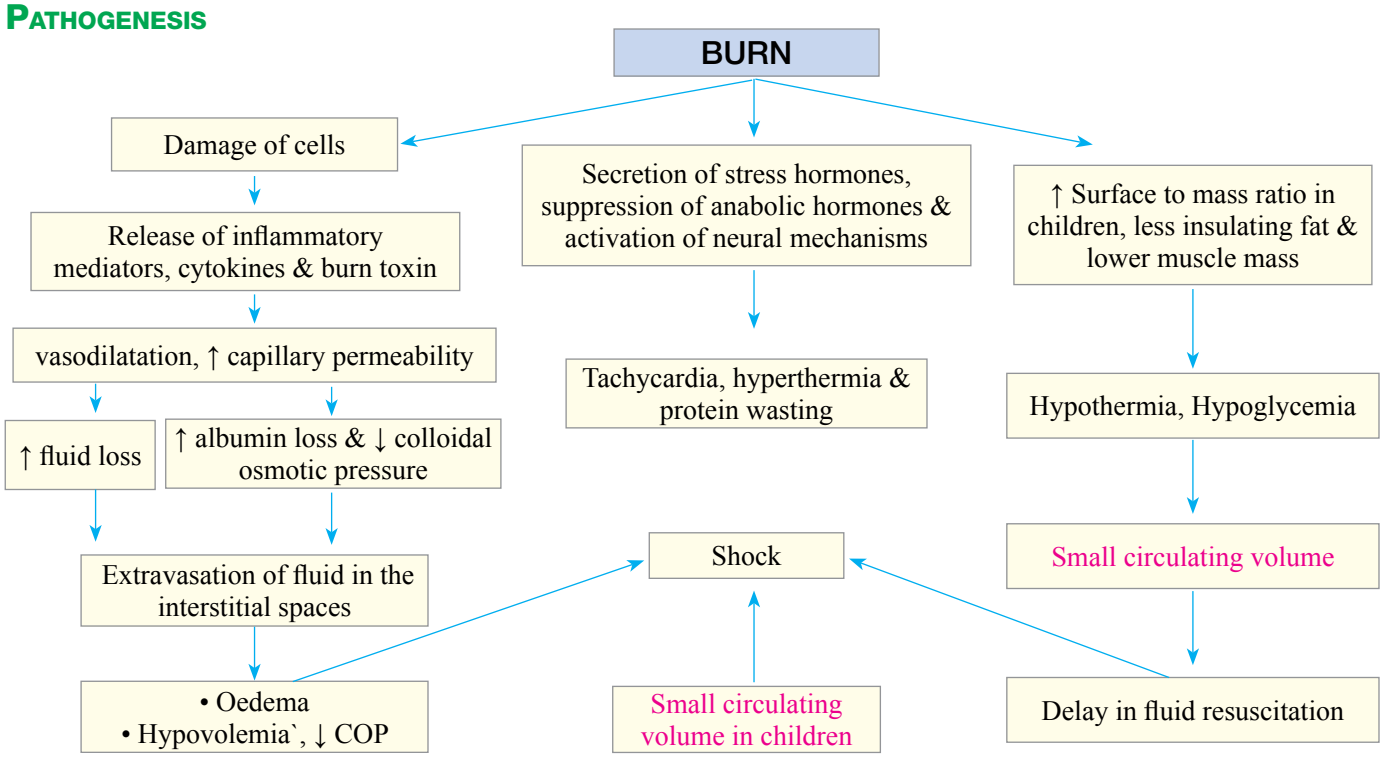
Burn is a global public health problem posing a significant mortality and morbidity. In Bangladesh, it is common among all age groups and children are particularly vulnerable.

- Burn: A **dry** heat injury caused by the application of flame or heated solid substances to the body resulting in coagulation necrosis of the tissues.
- Scald: A **moist** heat injury caused by the application of a hot liquid, at or near its boiling point or in its gaseous form (such as steam), to the body.



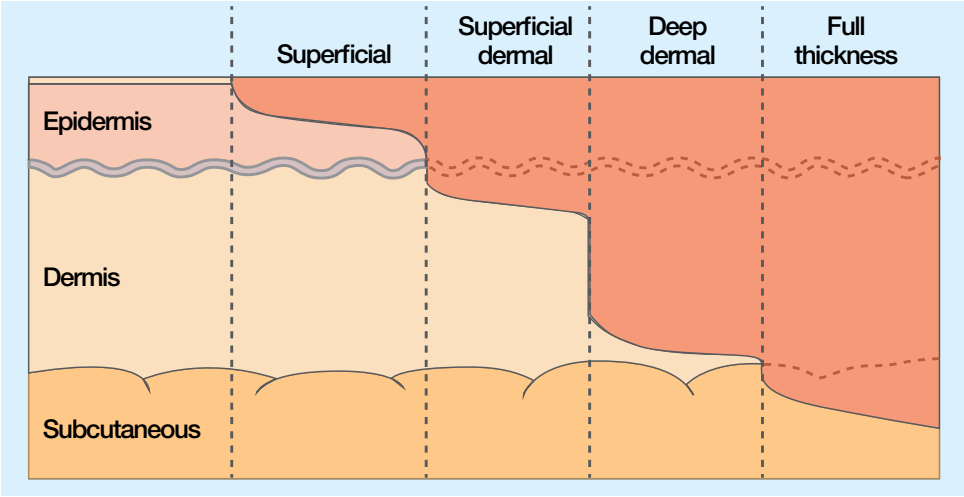
Apart from dry & moist heats, burn can also results from electricity, chemicals (e.g. acid, alkali), frost bite, friction, irradiation, thunder, coal tar, bitumen etc.

PATHOGENESIS



Types of burn injuries, based on depth of tissues/skin involved

- Partial thicness burn e.g. • Superficial • Superficial dermal • Deep dermal burns
- Full thickness burn: involve all layers of skin & other deep structures

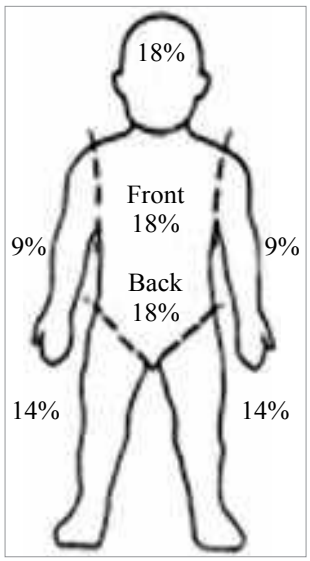


Burn injuries: Types, causes, characteristics and outline of management

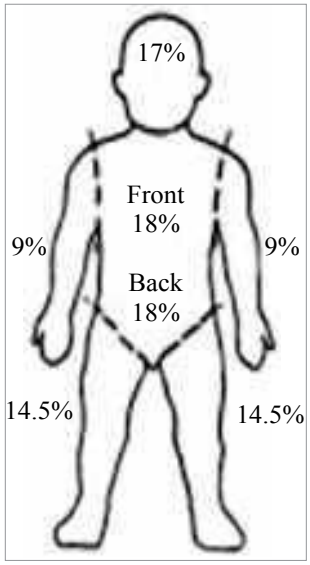
Types	Affected areas	Causes	Characteristics	Pain sensation & Healing	Dressing by
❑ Superficial burn	Epidermis only, no dermis	Sunlight, flash Minor scald	❑ Dry, erythema ❑ Brisk capillary refill	❑ Very Painful ❑ Heals by 5-7 days	❑ Ointment ❑ Hydrocolloid ❑ Collagen sheet
❑ Superficial dermal burn	Epidermis and deep upto papillary dermis	Hot liquid (scald)	❑ Moist, blister, reddened with broken blister ❑ Brisk CRT	❑ Painful ❑ Heals by10-14 days	❑ Hydrocolloid ❑ Collagen sheet ❑ Amniotic membrane
❑ Deep dermal burn	Epidermis, papillary dermis and deep upto reticular dermis	Hot liquid/ scald / minor flame contract	❑ Moist, white slough red mottled ❑ Sluggish CRT	❑ Pain, less ❑ Heals by 21-28 days	❑ Silver sulphadiazine cream ❑ Hydrocolloid, ❑ Early excision & grafting
❑ Full thickness/ deep burn	All layers of skin and deeper tissues e.g. muscles, bones, tendons are affected	Severe scald/flame/ electric burn	❑ Dry, charred, whitish Absent CRT	❑ Painless, ❑ Never heals	❑ Silver sulphadiazine cream ❑ Excision & reconstruction

BURN WOUND ASSESSMENT

Percentage of burn



Age 0-1 year



Age 2 year

Rule of 9

- **Age 0-1 years:** Head & Neck region: 18%; Trunk (front & back): 18%+18%; Upper limbs: 9%+9%; Lower limbs: 14% + 14%.
- For each year thereafter: Take1% from the head & neck and add it to the lower limbs (0.5% each)
- At 10 years, it attains the adult's measurement

Investigations

- Blood: CBC, CRP, Grouping & Rh typing
- Blood: S. electrolytes, albumin, creatinine, glucose
- X-Ray chest and Others, as indicated

MANAGEMENT

I. Infuse IV fluid

- Indications: Children >10% and Infant>5% burn
- Rationing: Initially to Resuscitate and thereafter as Maintenance fluid
- Fluids are infused simultaneously under 2 headings–
  - Resuscitation fluid
  - Maintenance fluid

For Resuscitation

- Fluid Type: Ringer's/Hartmann's solution
- Amount to be infused (calculation by Parkland formula): 3-4 ml × BW (Kg) × % of burn of TBSA
- How to infuse: Give ½ of total amount within first 8 hours and the rest ½ by next 16 hours

For Maintenance (according to page 319)

- Fluid type: 5% dextrose in 0.45% Saline
- Amount to be infused: For first 10 kg BW @ 100 ml/kg/24 hrs, + for next 10-20 kg@50 ml/kg/24hrs + for further 20-30 kg BW@20 ml/kg/24hrs
- Infuse: The measured amount continuously for 24 hours
- After 24 hours, Infuse 50% of the measured resuscitation fluids + Maintenance fluid
- After 48 hours, titrate according to the input-output chart

II. Give Analgesics, *if severe pain*

- Morphine (0.1-0.2mg/kg/dose), IV or
- Diclofenac or Ibuprofen or Paracetamol, oral/rectal
- Add H_2 blocker

III. Give Antibiotics

- 2nd and 3rd generation Cephalosporin, IV in adequate doses

IV. Monitor urine output

- Insert Indwelling catheter for burns of >10%, all electric and genital burns for meticulous assessment of urine output, which should be: 0.5-1 ml/Kg BW/hour or 30-60 ml/hour

V. Ensure wound care

- Clean the burnt area with normal saline and cover & dress with materials as mentioned in the table above
- *If such materials are not available*, then cover the area with a thick layer of Silver sulphadiazine cream and further bandage by sterile rolls, and to be changed every 24 hours


Photograph: 16% Superficial dermal burn in a 18 months old child (first photo) and after 14 days following dressing with hydrocolloid

VI. Ensure Feeding & Nutrition

- Provide high protein & high calorie diets, rich in vitamins & minerals and plenty of liquids
- Feeding may be given through NG tube, particularly, in facial burn, any severe burn, inhalation burn, electric burn or having any complications

VII. Start Managing the Scars early

(immediately following healing)

- Massage the area with vaseline, coconut oil or any lubricants, silicon based ointment etc.
- Apply Sunscreen lotion (SPF 35+) to prevent abnormal pigmentation

VIII. Prepare for Rehabilitation

- In acute phase, Splints and proper positioning are used to minimize joint deformities & contractures
- Start passive & active range of motion early
- Ensure gradual rigorous therapies like stretching, range of motion and strengthening exercise

IX. Manage post burn complications by early surgical interventions & physiotherapy for cases with–

- Non-healing ulcer, unstable scar, hypertrophic scar, keloid, contractures etc and
- Proper counseling for cases with post burn psychosis
- Counsel the family about complication, prognosis etc.

What to do at community?

- Ensure rescuer safety first to help/save the victim
- Encourage **STOP-DROP-ROLL** method to estinguish fire on the victim
- Remove the victim from the source of burn
- Remove all cloths to reduce contact burn
- Ensure airway, breathing, circulation
- First Aid: **COOL-COVER-CALL**

- Cooling all burns with running tap water for10 min
  Do not apply ice, cold water, toothpaste, ointments, butter or any other "home remedies".
- Cover the burnt area with a clean cloth
- Call for medical attention and hospitalize

SNAKE BITE

Incidence

- Global: 5.5 million/year; Deaths: 1,00,000/year
- Bangladesh: 8,000/year; Deaths: 1,600/year

Of the 3000 known species of snakes, only 200 are poisonous.

Snake venom

It is modified saliva comprised of proteins and different enzymes. These enzymes determine the toxicities.

Pathogenesis & Clinical manifestation

Whenever a poisonous snake bites, the clinical features solely depends on the toxins present in the venom as mentioned in the following table.

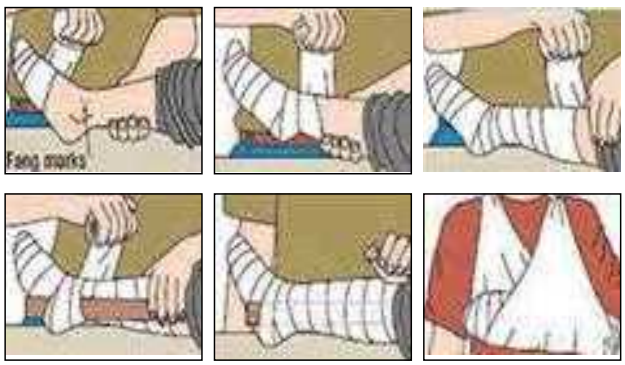
Toxins, Snake and Clinical manifestations

Types of venom	Snake	Clinical manifestations
Neurotoxin	Cobra and Coral snakes	❑ Generalized muscle weakness as manifested by ❖ Lethargy ❖ Ptosis  *Bilateral ptosis* ❑ Paralysis of eye ball muscles ❑ Broken neck sign  *Broken neck sign* *Courtesy: Prof M A Faiz* ❑ Difficulties in speech ❑ Difficulties in opening of mouth ❑ Protrusion of tongue ❑ Shallow respiration
Haemo-toxins	Vipers	❑ Haemolysis ❑ Haemorrhage and hypovolemic shock
Myotoxins & Nephro toxins	Sea snakes	❑ Severe bodyache ❑ Black urine, because of myoglobinuria from muscle breakdown ❑ Scanty urine, anuria (AKI)

MANAGEMENT

I. At Community

- **Reassure** the victim who may be very anxious
- **Immobilize** the bitten limb with splint and sling as practiced in fracture of long bone
  - If bite is in lower limb, not allow walking
  - If bite is in upper limb, do not allow moving the limb
- Ideally pressure immobilization method (by simple crepe bandage or any long strips of clothes (e.g. gamcha, lungi) can be helpful.



Source: Internet

Pressure immobilization

- **Transfer quickly** to the nearest health facility/hospital
  - During transfer, do not allow anything by mouth and keep the bitten part immobilized

II. At Hospital

- **Assess the Vital parameters quickly** e.g. respiration, cyanosis, pulse, BP, capillary refilling time
- **Start Resuscitation** e.g. maintenance of–
  - Airway (clearing airway) See page 254
  - Breathing (Bag & Mask ventilation or endotracheal intubation and artificial ventilation)
  - Circulation (IV crystalline fluid e.g. DNS, NS, Hartmann solution etc.)
- **Assess the case in details clinically**
- **Identify the species of the snake** (if brought)

Investigations

- 20 minutes whole blood clotting test (WBCT)
- ECG
- Complete blood counts
- Blood urea, S creatinine
- S. CPK
- Urine R/M/E
- Immuno-diagnosis by ELISA

Source: Internet

Blood in left test tube did not clot after 20 minutes

FURTHER TREATMENT

- Antibiotics, parenteral
- Tetanus prophylaxis
- Administration of polyvalent antivenom (effective against Cobra, Krait, Russel viper & Saw scaled viper) and frequent monitoring for its toxicities and response

- Dose: 10 vials irrespective of age and sex
- Preparation: Each vial is diluted with 10 ml distilled water. Then all 10 diluted vials (100 ml) are further diluted with 100 ml of IV fluid e.g. DA/DNS/NS (total 200 ml)
- Administration: through IV drip over 1 hour (@ 50 drops/min)

Indications for using polyvalent antivenom

- Neurotoxic signs
- Rapid extension of local swelling
- Acute renal failure
- Acute circulatory failure
- Bleeding abnormalities
- Hemoglobinuria/myoglobinuria

Other Treatment

- Neostigmine-atropine combination (for neurotoxic features only)
- Inj. Atropine 15 µgm/kg IV followed by Inj. Neostigmine 50-100 µgm/kg SC, 4 hourly, until neurotoxic features are overcome
- Fresh blood transfusion for patients with coagulopathy
- Care of the bitten part–
  - Wash with antiseptic solution
  - In case of local necrosis & gangrene surgical debridement and skin grafting may be needed

TREATMENT OF NON VENOMOUS SNAKE BITE

- Reassurance
- Tetanus prophylaxis
- Observation for 24 hours

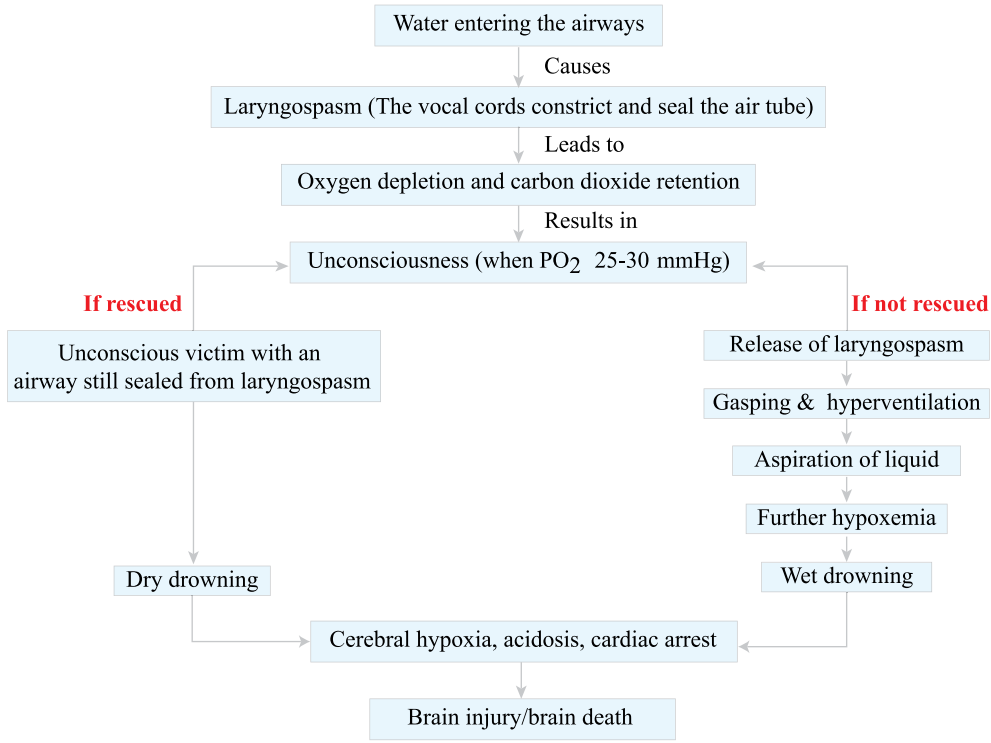
DROWNING

Drowning is a process that results in respiratory impairment from submersion/immersion in a liquid medium. In drowning, a liquid-air interface develops at the entrance of victim's airway, which prevents the individual from breathing oxygen. Outcome of drowning includes death, morbidity or complete recovery.

Incidence

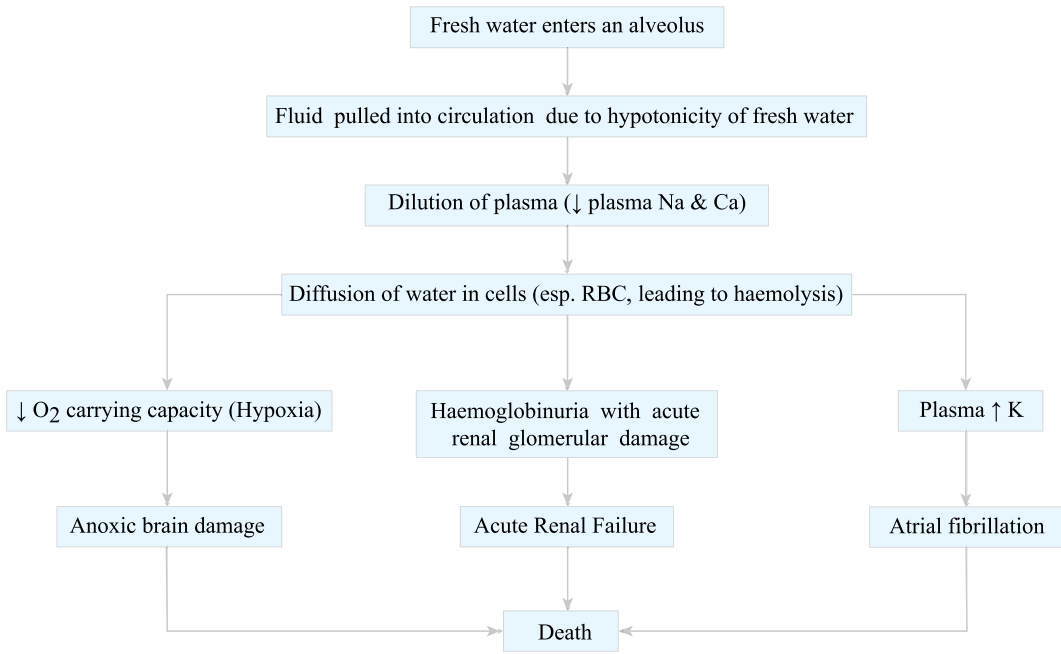
In Bangladesh, 20% of all deaths are from drowning and is more among under 5 children.

PATHOPHYSIOLOGICAL EVENTS OF DROWNING



FRESH WATER DROWNING

Drowning in fresh water leads to the rapid passage of large quantities of water from the lungs to the blood (as fresh water is hypotonic compared to the blood). This leads to haemodilution and hyponatraemia. The diluted hypotonic blood causes diffusion of water in the cells, (mainly in RBC) causing haemolysis, hyperkalaemia and, in severe cases, haemoglobinuria with glomerular damage. Severe hypoxia (due to haemolysis) results in severe anoxic brain damage and atrial fibrillation (due to hyperkalaemia) leading to immediate death.



SALT WATER DROWNING

Drowning in sea water leads to rapid transition of large quantities of water by osmosis (as salt water is hypertonic compared to the blood) from intravascular space to the lung parenchyma. The net results are–

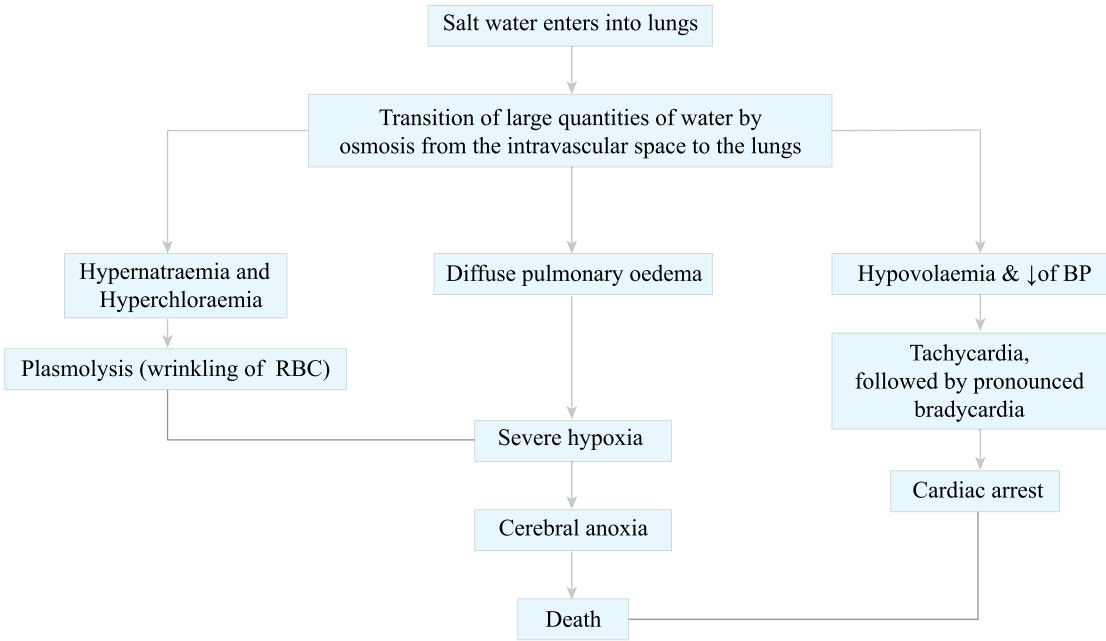
- Pulmonary oedema
- Increased blood osmolality & crenation of RBC
- Hypovolaemia

All these events cause–

- Hypoxaemia
- Cardiac arrest
- Cerebral anoxia and death

The clinical presentation, complications and outcome of the patients depend upon–

- Submersion time–
  - Submersion duration <5 min - associated with favourable outcome
  - Submersion duration >10 min - highly associated with poor outcome
- Water temperature
- Water tonicity (fresh water/salt water)
- Degree of water contamination
- Associated injuries (specially cervical spine & head)
- Type and timing of rescue and resuscitation efforts
- Response to initial resuscitation



CLINICAL MANIFESTATIONS

- Anxious appearance of victim
- Feartures, related to associated complication–
  - Altered vital signs e.g, hypothermia, tachycardia, bradycardia
  - Tachypnoea, dyspnoea (from pulmonary oedema)
  - Altered level of consciousness, neurological deficit (from cerebral oedema, cerebral hypoxia, stroke)
  - Acidotic breathing (metabolic acidosis)
  - Apnoea, Asystole (cardiac arrest)
  - Renal failure, & Death

Investigations

- CBC, coagulation profile: May be altered
- Arterial blood gas (ABG) analysis: Acidosis
- S electrolytes: Hypo or hypernatraemia, hyperkalaemia
- Random blood suger (RBS): Decreased
- SGPT, SGOT: May be raised
- BUN, S creatinine: May be altered
- Chest X-Ray: To assess any–
  - Evidence of aspiration, pulmonary oedema or segmental atelectasis suggesting foreign body(s) e.g. silt or sand aspiration
  - Displacement of endotracheal (ET) tube
- X-Ray cervical spine or CT scan of neck: When neck trauma is suspected
- ECG: To evaluate cardiac arrythmia

MANAGEMENT

I. At Community

Basic life support at the scene of event is the most important determinant of outcome.

- Rescue the patient from water as soon as possible
- Remove wet cloth & wrap the victim in warm blankets
- Assess vital signs e.g. pulse, BP, respiration
- Open the airway & remove visible debris, if present in the oropharynx with a **finger-sweep** maneuver
- Initiate rescue breathing immediately (mouth to mouth/ mouth to nose), if required

- Start chest compressions and Bag & Mask ventilation (CPR) if definite pulse is not felt within 10 seconds

- Give O_2 with face mask @ 5-6 L/min as soon as available
- Arrange for quick transfer to hospital

II. At Hospital

- Give O_2 with face mask@ 5-6 L/min
- Support Respiration: Intubate and start mechanical /AMBU ventilation when the patient has any of the following signs–

- Poor respiratory effort
- Altered sensorium
- Severe hypoxaemia
- Severe acidosis
- Severe dyspnoea

- Initiate IV infusion of normal saline or Ringer's lactate (10-20 ml/kg) in case of poor perfusion for volume expansion
- Keep the child warm by warm saline infusion, wrapping with blankets etc
- Antibiotic: Not indicated unless the patient was submerged in contaminated water or sewage
- Follow up: SPO_2, BP, blood sugar & temperature
- Observe the patient for 6-12 hours before discharge

Complications

- Cardiac arrest, bradycardia

Prognosis

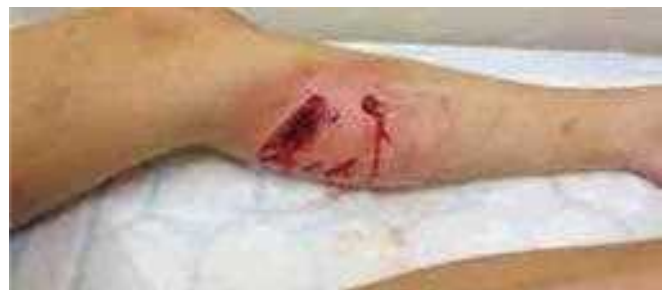
- Irreversible brain damage occurs after 4-6 minutes of submersion
- Most children who survive are rescued within 2 minutes of submersion and who die are rescued after 10 minutes of submersion
- Patients who are alert or mildly obtunded at presentation have an excellent chance of full recovery
- Of hospitalized victims–
  - 15% die
  - 20% survive with severe neurologic sequelae

PREVENTION

- Appropriate barriers must be built around ponds
- Parents should supervise their children around water
- Children should be taught safe conduct around water and during boating

DOG BITES

- Children (boys>girls) of ages, between 6-12 years are attacked more
- Injuries are of 3 types e.g. abrasions, puncture wounds and lacerations.



Source: Internet

- The major concern dog bite is about acquaring rabies with 100% mortality

DIAGNOSIS

Mainly clinical. Whenever, a child is brought with h/o dog bites, the following questions should be asked.

- What is the type of the animal? Domestic/wild
- Was it provoked/unprovoked attack?
- What is the tetanus immunization status?
- What is the status of the wound/underlying structure?
- Is there any H/O drug allergy

After clinical assessment, further evaluation includes–

- X-Ray of the affected part and sending
- Wound swab; For culture & sensitivity

Category of dog bite injury

Category	Characteristics	Treatment
I	Touching or feeding animals, licks on the skin	◆ No treatment except cleaning
II	Nibbling of uncovered skin, minor scratches or abrasions without bleeding, licks on broken skin	◆ Immediate vaccination only
III	Single or multiple transdermal bites or scratches, contamination of mucous membrane with saliva from licks; exposure to bat bites or scratches	◆ Immediate vaccination ◆ Administration of anti-rabies Immunoglobu

TREATMENT

- Clean the wound properly
- Give Antibiotics to avoid secendary infection
- Give inj Teavax and TIG, if tetanus vaccination status is uncertain
- Give Anti-Rabies vaccine (ARV): Cell culture vaccines e.g. Purified Vero Cell Rabies Vaccine & Purified Chick Embryo Cell Vaccine.
  - Dose: 0.1ml/dose, Intradermally
  - Sites:
    - For adults: At each deltoid muscles (2 sites)
    - For children (<2yrs): At antero-lateral thigh,
  - Total doses: 4 ; On **Day 0, Day 3, Day 7** and **Day 28**
- Give Rabies Immunoglobulin (RIG): In Category III injury only

Pre exposure prophylaxis

- **Indication:** Laboratory workers and health care providers who take care of infected animals (mainly dog) and human
- Anti-Rabies Vaccine Intradermally.
  - Dose: 0.1ml/dose in a single site
  - Total doses: **3**, On **Day 0**, **Day 7** and Day28

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. Write down the basic pathophysiology of OPC poisoning.
2. What agents are commonly involved in accidental poisoning in children?
3. Name five common accidents and emergencies in children.
4. Write down the pathological events of drowning.
5. Write down the management of Snake bite.
6. Write down the important complications and treatment of a child with kerosene poisoning.

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Agents commonly associated with childhood poisoning are–
   ___ a) corrosive agents ___ b) alcohol ___ c) kerosene
   ___ d) drugs ___ e) datura
2. The following antidotes are reccomended in OPC poisoning–
   ___ a) Atropine ___ b) Pralidoxime ___ c) Obidoxime
   ___ d) Naceylcysteine ___ e) Flumazenil
3. The pathognomonic features of organophosphate poisoning include–
   ___ a) miosis ___ b) dry mouth ___ c) fasciculation
   ___ d) bronchospasm ___ e) Central stimulation of respiratory center
4. First line management of snake bite in the community includes–
   ___ a) assurance ___ b) antivenom ___ c) tight tourniquet
   ___ d) quick referral to hospital ___ e) immobilization of affected limb
5. Cardinal features of OPC poisoning include–
   ___ a) Miosis ___ b) Fasciculation ___ c) Bronchospasm
   ___ d) Diarrhoea ___ e) Dry mouth
6. Anaphylactic shock–
   ___ a) Can be triggered by bee string ___ b) Is a type III immune response
   ___ c) Is characterized by vasodilatation ___ d) Is due to neurogenic vasomotor disturbance
   ___ e) best treated with anti-histamine

Chapter 37

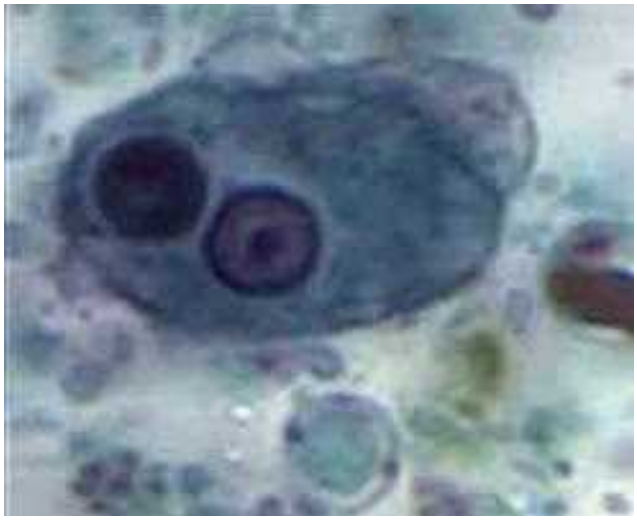
Parasitic Infestations

Intestinal infestation of parasites is quite common among children in a country like Bangladesh. In this chapter, the following common intestinal parasitic diseases will be discussed.

- Amoebiasis
- Giardiasis
- Ascariasis
- Enterobiasis
- Ankylostomiasis

AMOEBIASIS

Causative parasite: *Entamoeba histolytica*

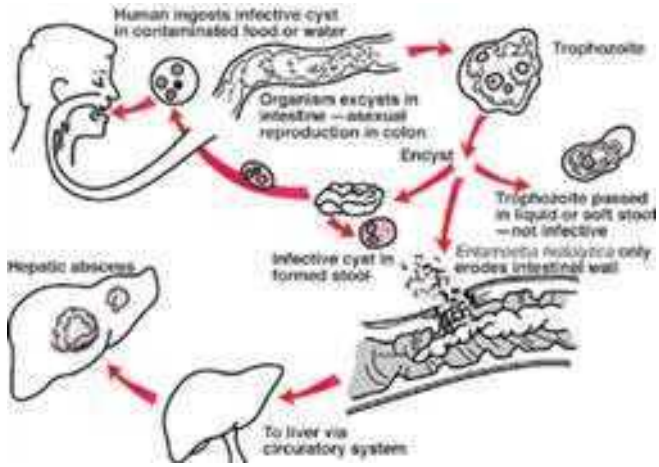


Source: Internet

Transmission

- Faecal-oral route i.e. ingestion of Entamoeba cyst
- Faecal contamination of drinking water, vegetables and foods
- Eating of uncooked vegetables and fruits which have been fertilized with infected human feces
- Handling of food by infected individual (cyst carriers)
- House flies and cockroaches passing from faeces to unprotected food

Pathogenesis

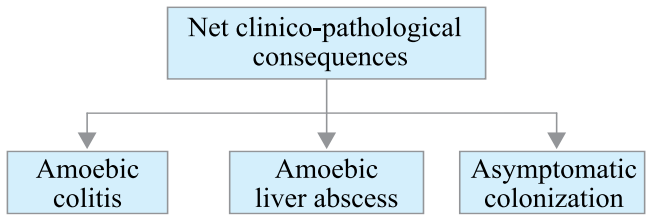


Source: Internet

Life cycle of E. histolytica

Life cycle at a glance

- Host: Man is the only host (definitive)
- Infective from: Mature quadrinucleate cyst
- Route of infection: Faecal – oral
- Pathogenic form: Trophozoite
- Site of lesion: Large intestine
- Diagnostic stage: Cyst & trophozoite



Amoebic Colitis

- Gradual onset of colicky abdominal pain, tenderness & fever
- Diarrhoea: 6-8 motions/day and frequently associated with tenesmus (painful sudden bowel evacuation)
- Stool: Blood stained and contain a fair amount of mucous
- Occasionally, there is severe diarrhoea resulting in dehydration and electrolyte disturbances

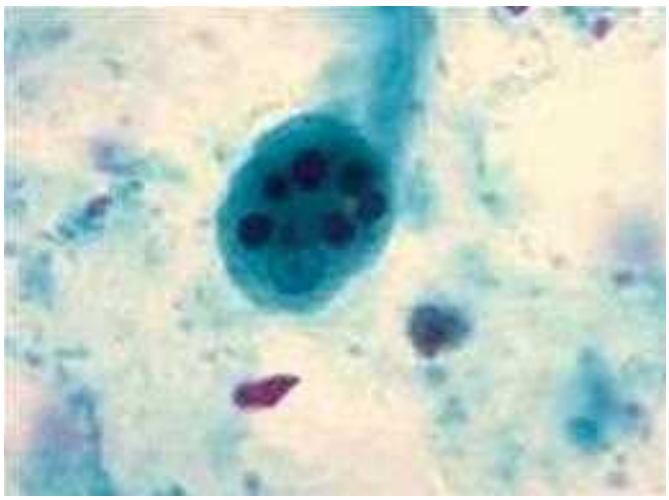
Amoebic Liver Abscess

The most common extraintestinal amoebiasis. It results from spread of the organisms from the intestine to the liver via the portal vein.

- High grade fever
- Pain: Constant, dull aching pain located in right upper abdomen or epigastrium
- Non specific symptoms e.g. nausea, vomiting, abdominal distention, diarrhoea, and constipation
- Jaundice is usually absent

Investigations

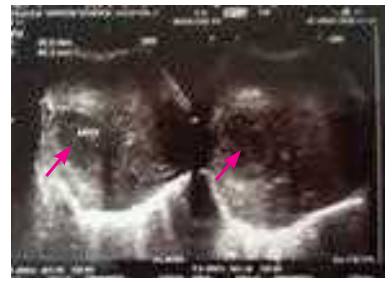
- Stool R/M/E: Shows trophozoites containing ingested RBCs



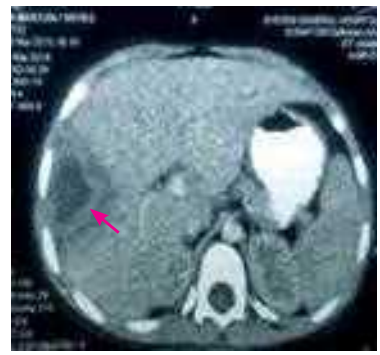
Source: Internet

Ingested RBCs in trophozoites

- CBC: Leukocytosis, mild anaemia, high ESR
- Others
  - Chest X-Ray: An elevated right hemidiaphragm and a right-sided pleural effusion may be seen
  - Ultrasonogram /CT scan of abdomen & hepatobiliary system : Shows position and size of liver abscess



USG showing abscess cavity



CT of abdomen showing abscess cavity

Complications

- Intestinal
  - Fulminant colitis with perforation
  - Toxic megacolon
  - Chronic nondysenteric colitis
  - Amoeboma
  - Perianal ulceration
- Hepatic: Rupture of liver abscess may lead to–
  - Granuloma cutis
  - Haemoptysis of anchovy sauce pus
  - Empyema thoracis
  - Generalized peritonitis
  - Fatal purulent pericarditis
- Metastatic lesion
  - Pulmonary amoebiasis
  - Cerebral amoebiasis
  - Cutaneous amoebiasis
  - Splenic abscess

TREATMENT

- Metronidazole: 35-50 mg/kg/day, 8 hourly for 10 days

(N.B. Metronidazole can be used in severe infection or if patient is unable to take orally.)

or

- Tinidazole: 50 mg/kg/day once daily for 3-5 days or
- Nitazoxanide: 7·5 mg/kg/dose, 12 hourly for 3 days. Very effective in intestinal amoebiasis

Followed by either–

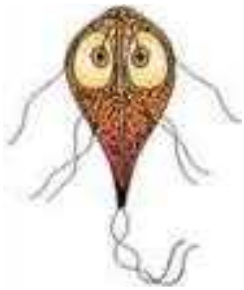
- Paromomycin: 25-35 mg/kg/day, 8 hourly for 7 days or
- Diloxanide furoate: 20 mg/kg/day, 8 hourly for 10 days

GIARDIASIS

Causative parasite: *Giardia intestinalis*

Transmission: Faecal–Oral route through ingestion of foods contaminated with cyst.

Life cycle



Cyst of giardia produce trophozoites that colonize the lumen of duodenum and proximal jejunum where they attach to the brush border of the intestinal epithelium and multiply by binary fission.

The parasites cause inflammation and partial villous atrophy there. This ultimately leads to malabsorption of foods and discomfort and malnutrition.

Life cycle at a glance

- Host: Man is the only host (definitive)
- Infective form: Cysts
- Route of infection: Faecal – oral
- Pathogenic form: Trophozoites
- Site of lesion: Small intestine

CLINICAL MANIFESTATIONS

- Asymptomatic
- Recurrent attacks of–
  - Nausea, vomiting or lethargy, flatulence bloating
  - Abdominal discomfort or pain and sometimes abdominal distension, weight loss
  - Acute diarrhoea
- Fever & vomiting are unusual

Complications

- Malabsorption syndrome
- Reiter's syndrome
- Reactive arthropathy
- Liver granuloma
- Deficiency of Vit A, B_{12}
- Lactose intolrance

DIAGNOSIS

- Basically clinical and
- Identification of cysts or trophozoites of parasite in stool
- Giardia antigen by ELISA

TREATMENT

- The following are the drug of choice
  - Tinidazole (>3 years): 50 mg/kg/day, Single dose
  - Nitazoxanide
    - 12-48 months: 100 mg, 12 hourly for 3 days
    - 4-12 years: 200 mg, 12 hourly for 3 days
    - >12 years : 500 mg, 12 hourly for 3 days
  - Metronidazole: 15 mg/kg/day, 8 hourly for 5-7 days

ASCARIASIS

Causative parasite: *Ascaris lumbricoides.*

Transmission:

Faecal-Oral route through ingestion of foods contaminated with mature ova containing developing embryos.

Life cycle

Life cycle starts with ingestion of eggs. After ingestion, larvae are liberated from the eggs which penetrate the gut wall to enter into portal vein and then into liver and right heart. From there, larvae enter into pulmonary artery and penetrate into the alveoli and then crawl up through bronchi and then coughed up and swallowed to Re-enter again into small intestine to grow up as adult worm.

Life cycle at a glance

- Host: Man is the only host (definitive)
- Infective from: Embryonated egg
- Route of infection: Faecal – oral
- Pathogenic from: Adult & larva
- Site of lesion: Small intestine

CLINICAL MANIFESTATIONS

- Non-specific symptoms e.g.
  - Nausea, colicky abdominal pain, irregular motions
- Sometimes–
  - Worms may pass through vomitus or in the stools
  - Patients may present with urticarial rash, cough, respiratory distress **(Löffler's syndrome)**

Complications

- Malabsorption & nutritional deficiency
- Intestinal obstruction (ascariasis crisis)
- Appendicitis
- Pancreatitis
- Acute cholecystitis
- Allergic reactions (urticaria)

DIAGNOSIS

Based on–

- Clinical suspicion
- Stool examination: Ova of the parasite or adult worms
- CBC: May show eosinophilia

TREATMENT

- Anthelmintics: Options are
  - Albendazole: < 2 years – 200 mg and >2 years – 400 mg as single dose or
  - Levamisole: 3 mg/kg as single dose or
  - Pyrantel pamoate: 10 mg/kg as single dose
  - Mebendazole: 100 mg 12 hourly for 3 days

All the family members should be treated simultaneously.

- Good nutritional support

ENTEROBIASIS

Causative parasite: *Enterobius vermicularis*

Transmission

Faecal-Oral route. The gravid female worm lays ova around the anus, especially at night. The ova are then carried to the mouth by the fingers and so re-infestation takes place.

Life cycle at a glance

- Host: Man is the only host (definitive)
- Infective from: Embryonated egg
- Route of infection: Faecal-Oral, retrograde through anus, autoinfection from hand to mouth
- Pathogenic from: Adult female & sticky eggs
- Site of lesion: Caecum

CLINICAL MANIFESTATIONS

- Perianal pruritus especially at night is the commonest symptom
- GIT symptoms like abdominal pain, nausea, vomiting, diarrhoea
- Sometimes adult worms are found moving over the stool

Complications

- Loss of appetite
- Weight loss
- Restlessness & irritability
- Vulvovaginitis, urethritis
- Appendicitis (rare)

DIAGNOSIS

Based on–

- Clinical presentation
- Stool exam: Presence of adult worms on naked eye
- Perianal skin swabs: Detection of ova

TREATMENT

- Mebendazole, a single dose (100 mg), PO for all ages. Repeated after 2 weeks with a cure rates of 90-100%

Alternative regimens include

- Albendazole (400 mg), Single oral dose for all ages, repeated in 2 weeks or
- Pyrantel Pamoate (11mg/kg, max.1gm) PO, Single dose

ANCYLOSTOMIASIS

Causative parasites: *Ancylostoma duodenale* or *Necator americanus*

Transmission

Transmission occurs through penetration of skin by the filariform larvae. When child walks bare foot on the contaminated soil, the filariform larvae penetrate directly through the skin, commonly through the thin skin between toes, dorsum of feet and inner side of sole.

Life cycle

Larvae from soil, after penetration through skin enter into lymphatics and then into blood stream. From blood, they enter into alveoli and then into bronchi and trachea. From trachea, larvae enter into oesophagus and then into small intestine to grow as adult worm. In the intestine, they suck blood and cause blood loss resulting in iron deficiency anaemia.

Life cycle at a glance

- Host: Man is the only host (definitive)
- Infective from: Filariform larva
- Route of infection: Penetration through skin
- Pathogenic from: Adult & larva
- Site of lesion: Small intestine

CLINICAL MANIFESTATIONS

- Symptoms related to skin e.g.Hook worm dermatitis (ground itch)
- GIT symptoms e.g. Loose stools, vomiting or upper abdominal pain
- Respiratory symptoms e.g. Paroxysmal cough with blood stained sputum
- Features of anaemia and oedematous swelling particularly in untreated patients

Complications

- Anaemia secondary to blood loss
- Pulmonary eosinophilia **(Löffler's syndrome)**
- Pruritus
- Cutaneous larva migrans
- Gastrointestinal bleeding

DIAGNOSIS

Based on clinical features and demonstration of eggs in stool.

Investigations

- CBC with PBF: Low Hb, microcytic hypochromic anaemia and eosinophilia
- S albumin: Low
- X-Ray chest: Done when patients present with respiratory symptoms

TREATMENT

- Anthelmintics–
  - Albendazole:<2 years (200 mg) and >2 years (400 mg) as single dose or
  - Levamisole: 3 mg/kg as single dose or
  - Pyrantel pamoate:11 mg/kg, orally, OD for3days or
  - Mebendazole: 100 mg 12 hourly for 3 days

All the family members should be treated simultaneously.

- Suppoert the child with good nutrition
- Correct anaemia oral iron. Consider Blood transfusion in severe anaemia

PREVENTION OF PARASITIC DISEASES

- Maintenance of proper hand hygiene
- Improving education about practice of sanitary condition and sewage facility
- Purification of public water supply by chlorination, sedimentation and filtration
- Discontinuing the practice of using human feces as fertilizer
- Regular washing and deworming the pets
- Regular inspection of meat at slaughter house
- Use of insect repellent while at work and use of insecticide treated mosquito net during sleeping
- Regular deworming of children

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. What are the clinical features of amoebic liver abscess?
2. How will you investigate a case of amoebic liver abscess?
3. Write down the complications & treatment plan of amoebic liver abscess
4. Write down the clinical features & treatment plan of giardiasis

MULTIPLE CHOICE QUESTIONS [MCQ]

1. Parasites enter the body through faecal-oral route are–
   ___ a) *G. Intestinalis* ___ b) *E. Vermicularis* ___ c) *A. Duodenale*
   ___ d) *N. Americanus* ___ e) *A. Lumbricoides*
2. Microcytic hypochromic anaemia commonly occurs in–
   ___ a) ancylostomiasis ___ b) giardiasis ___ c) enterobiasis
   ___ d) ascariasis ___ e) amoebiasis
3. Löffler's syndrome is associated with–
   ___ a) ancylostomiasis ___ b) ascariasis ___ c) giardiasis
   ___ d) enterobiasis ___ e) amoebiasis
4. Complications commonly associated with ascariasis are–
   ___ a) haemorrhage from gut ___ b) vulvo-vaginitis ___ c) intestinal obstruction
   ___ d) ground itch ___ e) urethritis
5. The following are antihelmentics–
   ___ a) Metronidazole ___ b) Tinidazole ___ c) Albendazole
   ___ d) Mebendazole ___ e) Pyrantel pamoate

Chapter 38

Common Surgical Problems of Children

Apart from medical problems, childrens also suffer from surgical problems, commonly from congenital and a few from acquired ones. In this chapter, common congenital surgical problems are discussed. The common acquired surgical problems are already discussed in chapter 13.

CLEFT LIP

A congenital defect in the upper lip and results from failure of union between medial nasal and maxillary processes (from which upper lip is developed). It may be either unilateral or bilateral.

CLEFT PALATE

A congenital defect of hard palate that results from failure of fusion of the palatine processes of the developing maxilla.

When cleft plate is associated with micognathia and glossoptosis, it is called Pierre Robin sequence.

The major concerns of both the clefts are–

- Feeding difficulty
- Aspiration pneumonia
- Middle ear infection
- Failure to thrive

TREATMENT

Medical

- Feeding
  - Isolated cleft lip: Help the baby ***to 'latch on'*** i.e attach to the nipple at the beginning of the feeding
  - Combined cleft lip & cleft palate: Feeding by long handled spoon in upright position
- Treatment of Respiratory tract infection and middle ear infection promptly with antibiotics

Surgery

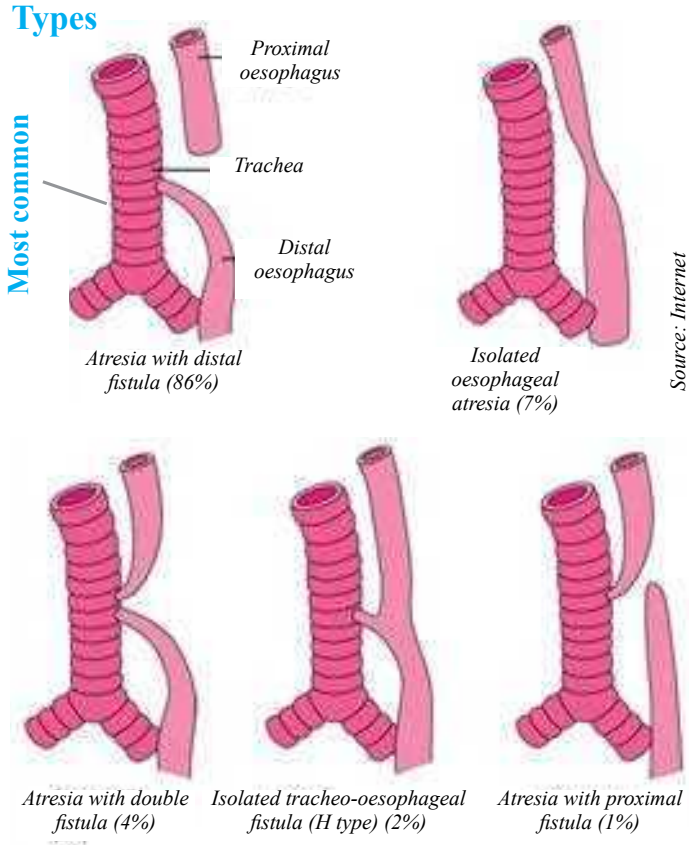
There is a conventional **'Rule of 10'** applied for surgical correction of cleft lip and palate

	Weight	Age	Haemoglobin
Cleft lip	10 lb (~4.5 kg)	10 weeks	10 gm/dl
Cleft palate	10 kg	10 months	10 gm/dl

OESOPHAGEAL ATRESIA WITH OR WITHOUT TRACHEOESOPHAGEAL FISTULA

The commonest malformation of upper gut

Types



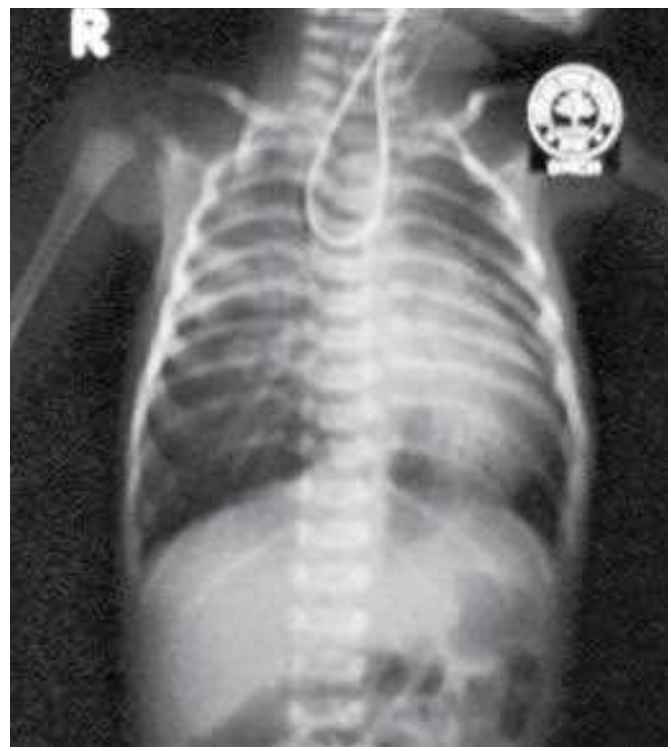
Source: Internet

CARDINAL FEATURES

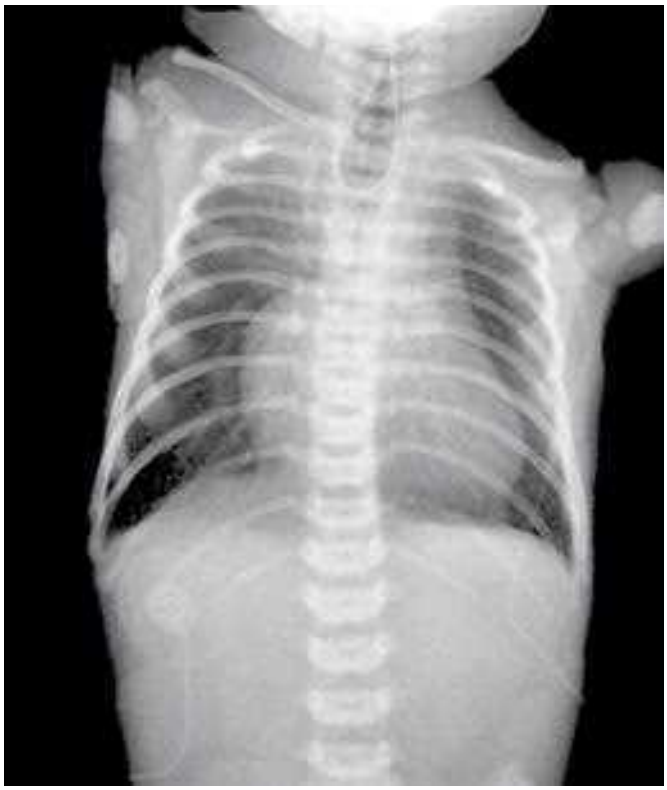
- History of maternal polyhydramnios
- Excessive **drooling** and secretions from mouth after birth
- Choking on attempted feeding indicates fistulous connections with trachea
- Respiratory distress as a consequence of aspiration of saliva
- Failure to pass a nasogastric/orogastic tube to the stomach

Investigations

- X-Ray chest and abdomen shows–
  - Presence of coiled nasogastric tube in the upper pouch. Along with it, if gas shadow is found in stomach & intestine, it means a tracheoesophageal fistula is present to the distal oesophagus. In oesophageal atresia without tracheoesophageal fistula, no gas is seen in stomach



Oesophageal atresia with tracheoesophageal fistule (presence of gas shadow in gut)



Oesophageal atresia without tracheoesophageal fistula (no gas shadow in gut)

TREATMENT

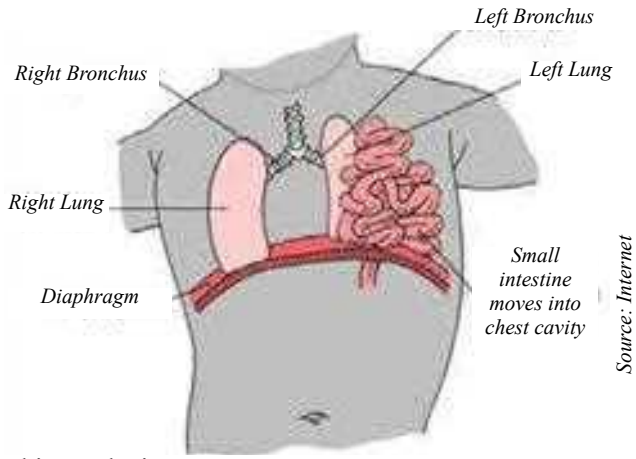
Medical

- Counsel the parents about the nature of the anomaly, treatment options and prognosis
- Keep the baby warm by keeping under overhead warmer
- Keep the baby, Nothing per oral
- Give maintenance IV fluid,10% DA /Baby saline
- Place a soft NG tube in upper pouch on low intermittent suction to drain secretions and to prevent aspiration
- The head of the bed should be elevated to prevent refux of gastric contents through the distal fistula into lungs
- Give IV Ampicillin plus Gentamicin, if aspiration is suspected
- Consult Paediatric surgeon immediately

Surgery: The definitive treatment.

CONGENITAL DIAPHRAGMATIC HERNIA (CDH)

A congenital defect of the diaphragm through which the coils of intestine from the abdominal cavity herniate up into the chest.



This results in–

- Respiratory distress since birth due to compression of the lung on the affected side
- Shifting of the heart and mediastinum to the side opposite to herniation

The rapidity and severity of presentation is related to–

- Degree of pulmonary hypoplasia resulting from lung compression by the intrathoracic abdominal contents in utero
- Degree of associated pulmonary hypertension
- Associated congenital heart defects
- Affected infants are prone to develop **pneumothorax** during attempt at ventilation of the hypoplastic lungs

CARDINAL FEATURES

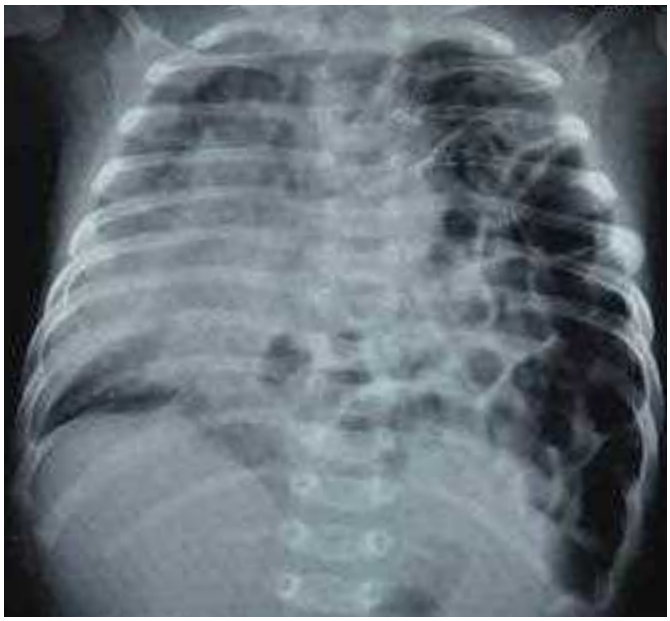
Severe respiratory distress and cyanosis since birth

Signs

- Flaring of alae nasi, cyanosis of lips, toung
- Chest
  - Inspection: Severe chest indrawing, fast breathing
  - Auscultation of lungs on the affected side of chest
    - Breath sounds: Poor or diminished
    - Additional sounds: Bowel sounds may be heard
  - Auscultation of heart
    - Heart sounds: Displaced to the normal side
    - Tachycardia
- Abdomen: Scaphoid shaped, indicates significant visceral herniation to the chest

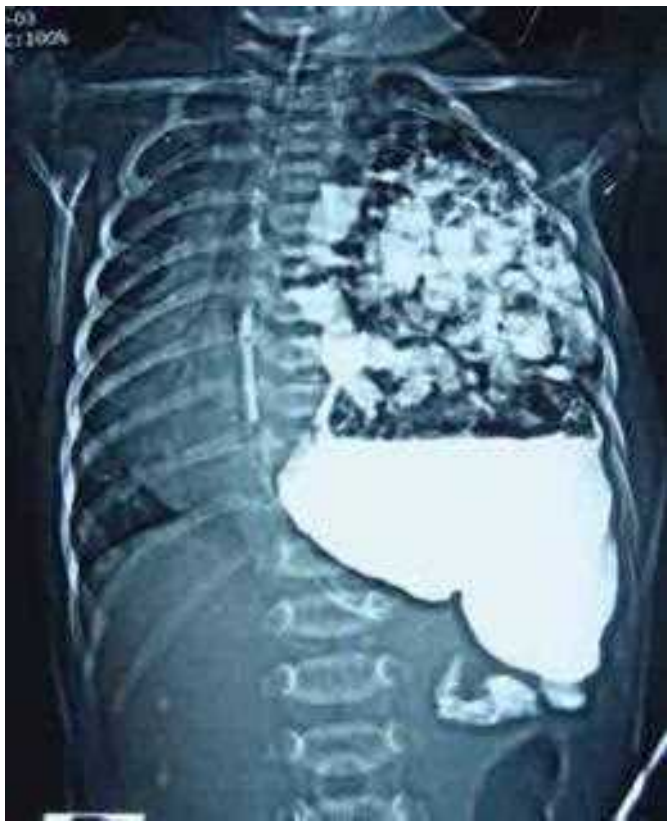
Investigations

- Chest X-Ray (plain & Contrast): Shows bowel loops in the chest with mediastinal shift to opposite side



Coils of intestine in the left side of chest with shifting of mediastinum (left dome absent)

- S Electrolytes: May be altered
- Arterial Blood Gas: May show respiratory and/or metabolic acidosis



Contrast X-ray of upper GI showing coils of intestine in left hemithorax

TREATMENT

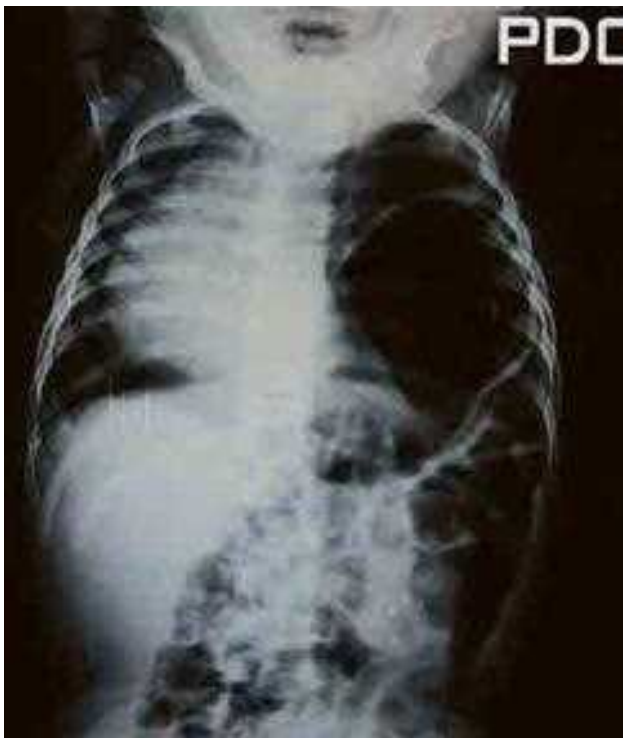
Medical

- Counsel the parents about the nature of the anomaly, treatment options and prognosis
- Keep the baby warm by either keeping inside incubator or under overhead warmer
- Keep the baby nothing per oral (NPO)
- Maintain an upright position so that head and chest is higher than abdomen and feet
- Give O_2 through a nasal cannula (**not by mask**) to avoid aerophagia (as it may distend the bowel loops which further compresses the lungs)
- If artificial ventilation is needed, avoid bag mask ventilation and immediately intubate the baby
- Insert NG tube for gastric decompression and thereby to prevent bowel distension and further lung compression
- Give maintenance IV fluid (10% DA /Baby saline
- Give IV Ampicillin plus Gentamicin
- If baby is in shock (weak pulse, CRT >3 sec) give–
  - Normal Saline,10-20 ml/kg over 30 min
  - Inotropic agents such as Dopamine (5-10 µgm/kg/min) or Dobutamine (10-15 µgm/kg/min) after volume correction
- Monitor SPO_2, Pulse, BP, and capillary refill time
- Consult Paediatric surgeon immediately
- Prepare the patient with pre-operative measures

Surgery: The definite treatment

EVENTRATION OF DIAPHRAGM

E**ventration** is another congenital malformation of diaphragm with similar clinico-pathological consequences as that of congenital diaphragmatic hernia. Here, the dome of diaphragm remains abnormally elevated because of it's **incomplete muscularisation**. The abnormally elevated diaphragm may compress the ipsilateral lungs with respiratory distress and causes shifting of mediastinum towards the normal (opposite) side.

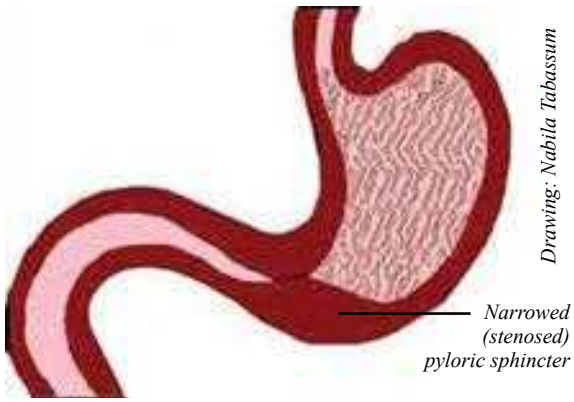


Abnormally elevated intact left dome of diaphragm with shifting of mediastinum to right chest

The main difference between these two conditions is that the dome of diaphragm remains intact in eventration, unlike that of hernia.

INFANTILE HYPERTROPHIC PYLORIC STENOSIS (IHPS)

It is a progressive **gastric outlet obstruction** occurring in infants younger than 12 weeks. It results from postnatal muscular hypertrophy & hyperplasia of the pylorus.



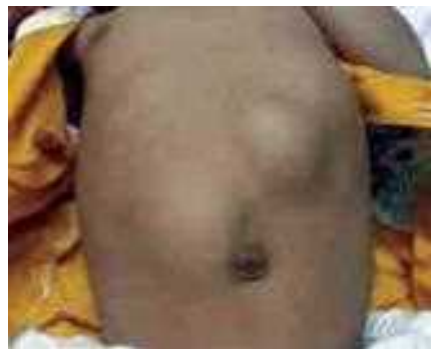
Drawing: Nabila Tabassum

AETIOLOGY: Unknown

CARDINAL FEATURES

- Projectile non bilious vomiting, almost after every feed usually begins between 2-4 weeks of age, but may start as late as 12 weeks. In about 10% of cases, vomiting may start at birth
- The baby always remains hungry and sucks vigorously after the episodes of vomiting

- The baby may be **dehydrated** due to repeated vomiting
- The upper abdomen may be distended after feeding, and prominent **gastric peristaltic waves** are seen passing from left to right of the abdomen and more obvious after feeding
- The enlarged pylorus, described as an "**olive mass**", of 5-15 mm in longest dimension may be felt on deep palpation in the right upper abdomen, specially after vomiting



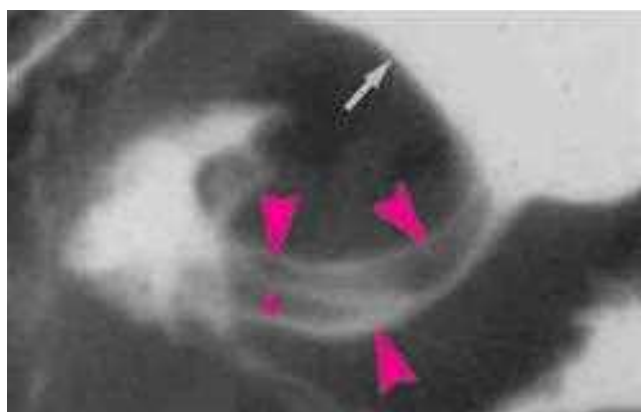
Olive shaped mass moving from left to right

Investigations

- Ultrasonography of abdomen: Diagnostic features are–

Pyloric muscle thickness	>4 mm
Diameter of pylorus	10-14 mm
Pyloric channel length	15-19 mm

- Barium meal X-Ray of upper gut: Shows an elongated pylorus with contrast material coursing through the mucosal interstices of the canal, forming the double-track sign/string sign (large arrowheads), with an additional central channel along the distal portion (small arrowhead). Mass impression on the gastric antrum (arrow), best seen during peristaltic activity, is termed the shoulder sign



Source: Internet

- CBC: Elevated Hb and haematocrit from dehydration
- S electrolytes: Hypochloraemic alkalosis with hypokalaemia is the classic metabolic abnormality. Hyponatraemia also present.
- S Bilirubin: Mild unconjugated hyperbilirubinaemia

TREATMENT

Medical

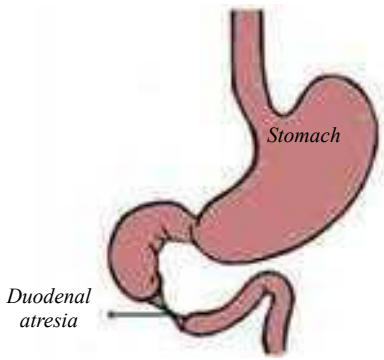
- Counsel the parents about the disease and its outcome
- Keep the infant NPO and decompress stomach by NG suction
- Correct dehydration & electrolyte imbalance before surgical intervention
  - If severely dehydrated: Infuse Normal Saline bolus @10-20 ml/kg over 30 minutes. Then–
    - Continue Baby saline (5% dextrose in 0.225%NaCl): 1.25-2 times, the normal maintenance requirment, until the baby is well hydrated (as assessed by good urine output)
    - Add 1-2ml of Inj. KCl per 100 ml of IV fluid once a good urine output is achieved

Surgery

Ramstedt pyloromyotomy is the treatment of choice.

DUODENAL ATRESIA

Congenital occlusion of duodenal lumen due to failure of the primitive solid gut tube to canalize. The occlusion may be complete or partial.



Drawing: Nabila Tabassum

CARDINAL FEATURES

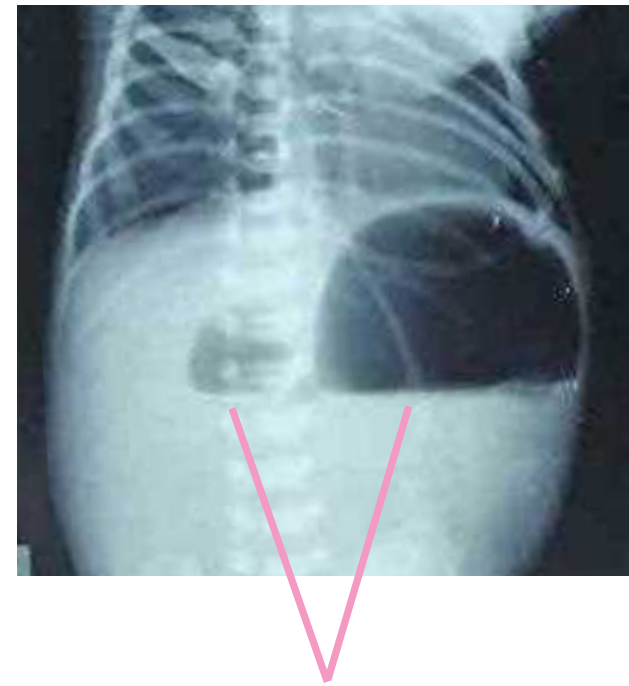
Recurrent attacks of vomiting (mostly bilious) within hours of birth.

Signs

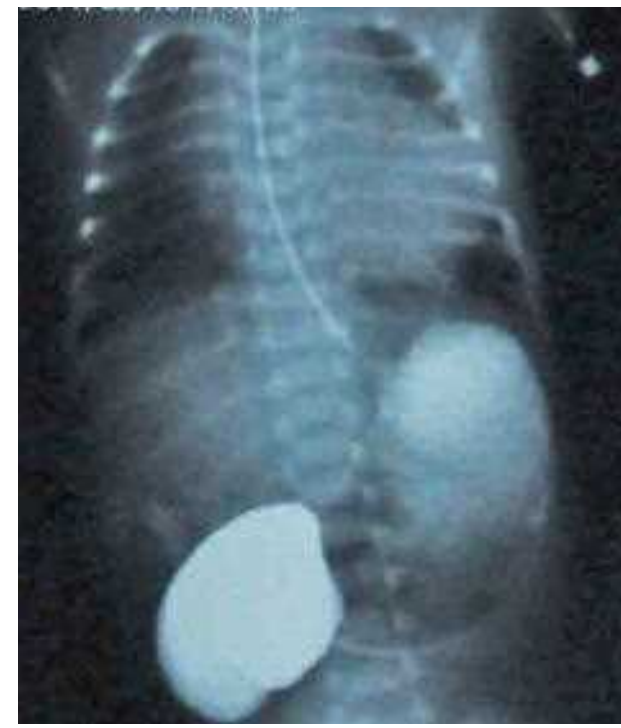
- Dehyration, because of repeated vomiting
- Abdomen:
  - May be scaphoid shaped
  - Sometines, epigastric fullness (due to dilation of the stomach and proximal duodenum)

Investigations

- Plain X-Ray abdomen erect posture: Shows "**double bubble shadow**"
- Contrast X-Ray of upper GIT: No dye passed beyond duodenum



Double bubble shadow.



No dye beyond duodenum

- S electrolytes: Dyselectrolytemia e.g. hyponatraemia, hypokalaemia, hypochloraemia and metabolic alkalosis

TREATMENT

Medical

- Counsel parents about the disease and its outcome
- Keep the infant NPO
- Decompress stomach by NG suction
- Give IV fluid (10% DA or 10% Baby saline)
- Correct hypokalaemia, if necessary
- Give antibiotics (Ampicillin+Gentamicin), if indicated
- Consult Paediatric surgeon immediately

Surgery

- Duodenoduodenostomy, either open or laparoscopic

INTUSSUSCEPTION

The most common cause of bowel obstruction during the first 2 years of life, mostly occurring around 6 months when complementary foods are introduced.

Intussusception is the invagination of one segment of intestine into another segment. It can occur anywhere along the small and large bowel, most commonly at ileo-caecal valve, where ileum invaginates into the caecum (ileo-colic).

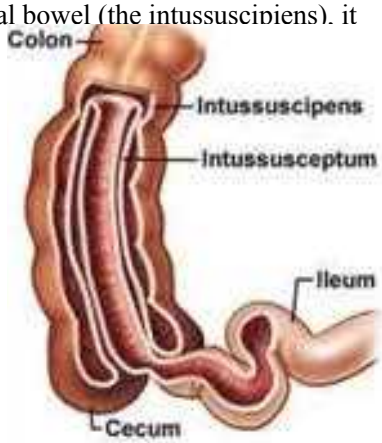
AETIOLOGY& RISK FACTORS

Unknown, (in 85% of cases). However, the Risk factors are – Small bowel polyp, Meckel diverticulum, viral enteritis, hypertrophy of Peyer patches, lymphoma etc.

PATHOLOGY

The proximal portion of bowel (the intussusceptum), while invaginates into the distal bowel (the intussuscipiens), it pulls it's mesentery along with it.

This causes constriction of mesenteric blood vessels, obstruction in venous return with engorgement (oedema) of the intussusceptum. This leads to it's necrosis, bleeding, perforation and peritonitis. On rare occasions, the advancing intestine may be prolapsed through the anus.



Source: Internet

Intussusceptum: Ileum invaginates into caecum

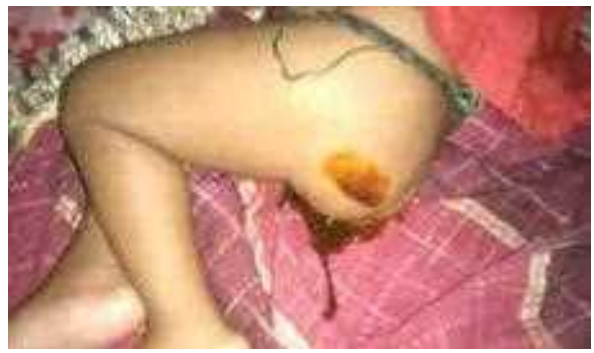
CARDINAL FEATURES

Signs

- Intermittent, severe colicky abdominal pain with screaming and drawing up of the knees in a previously well child
- The child appears calm and relieved in between attacks
- Vomiting and diarrhoea occur soon afterward in 90% of cases
- Stool looks like *red currant jelly*. This is a mixture of mucous, sloughed mucosa and blood

Abdomen

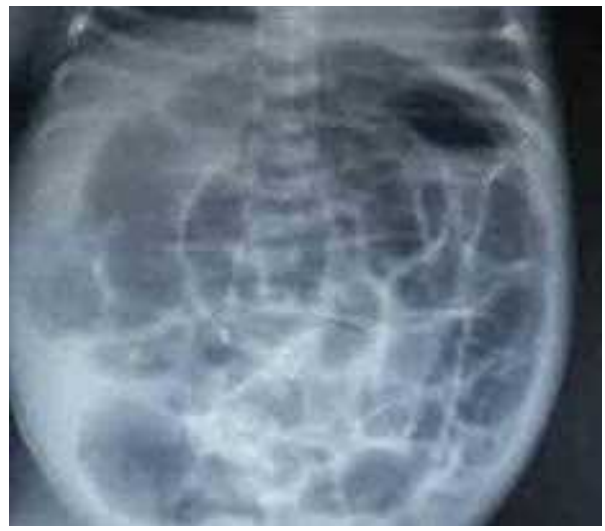
- Inspection: Distended
- Palpation: A tender sausage-shaped mass is felt in upper mid abdomen
- Auscultation: Bowel sound may be absent
- Digital rectal examination: The presence of bloody mucus on the finger as it is withdrawn after rectal examination supports the diagnosis of intussusception



Stool looks like red currant jelly

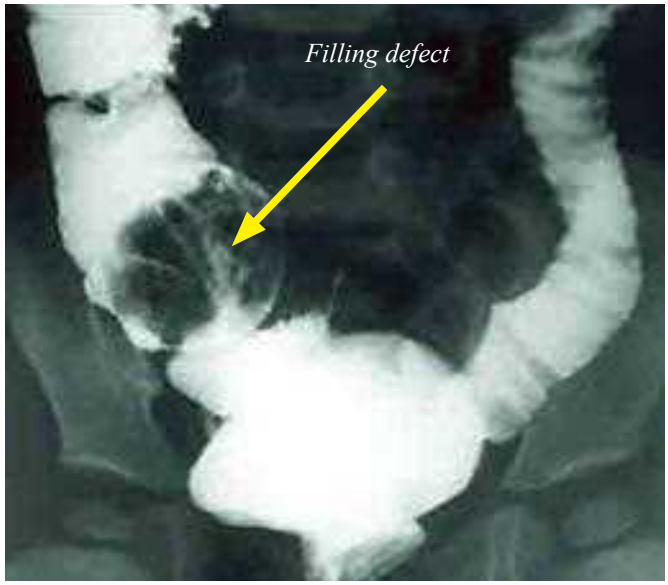
Investigations

- Plain X-Ray abdomen: Small bowel dilatation



X-ray abdomen showing distended bowel loops

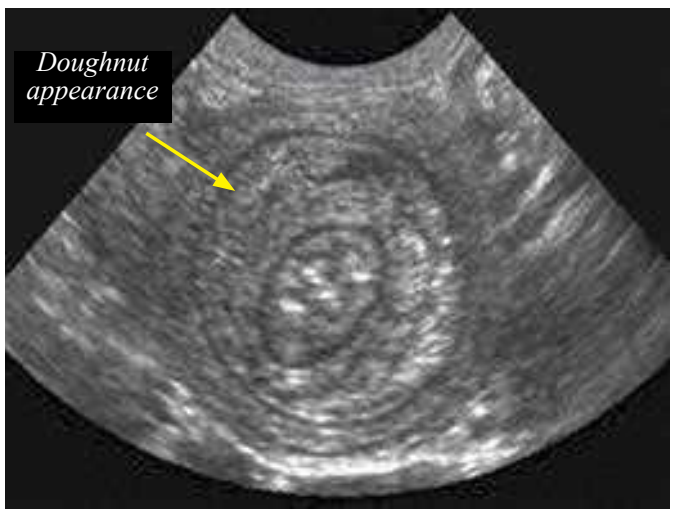
- Air or barium contrast enema: Shows intussusception in the caecum



Source: Internet

Contrast X-ray abdomen showing filling defect at caecum

- USG of whole abdomen: Classic doughnut or target appearance of an intussusceptum inside an intussuscipiens



Source: Internet

USG abdomen showing doughnut sign

TREATMENT

Medical

- Counsel parents about the disease, its consequences, treatment etc.
- Keep the baby NPO
- Give appropriate IV fluid *e.g. baby saline*
- Insert an NG tube & decompress stomach
- Give IV Ampicillin plus Gentamicin
- Give Potassium correction if necessary
- Consult Paediatric surgeon immediately
- Non-operative reduction with barium or water-soluble contrast, or air (pneumatic reduction). It should not be attempted if signs of strangulated bowel, perforation or toxicity are present

Surgery

In ill patients with evidence of bowel perforation or when hydrostatic or pneumatic reduction has been unsuccessful.

HIRSCHSPRUNG DISEASE (HD) (CONGENITAL AGANGLIONIC MEGACOLON)

The most common cause of lower intestinal obstruction in neonates (80%) and among older children.

AETIOLOGY & RISK FACTORS

- Down syndrome
- Familial
- Boys are 4 times more at risk than girls

PATHOGENESIS

HD results from an absence of ganglion cells in the mucosal (Meissner plexus) and muscle layers (Auerbach plexus) of large gut. The absence of ganglion cells result in failure of the colonic muscles to relax in front of an advancing bolus and give rise to colonic obstruction.

The normal colon proximal to the aganglionic segment gets dilated with increased intraluminal pressure. In addition, the mucosa of the dilated colon become thin and inflammed, causing diarrhoea, bleeding and protein loss (enterocolitis)

Types

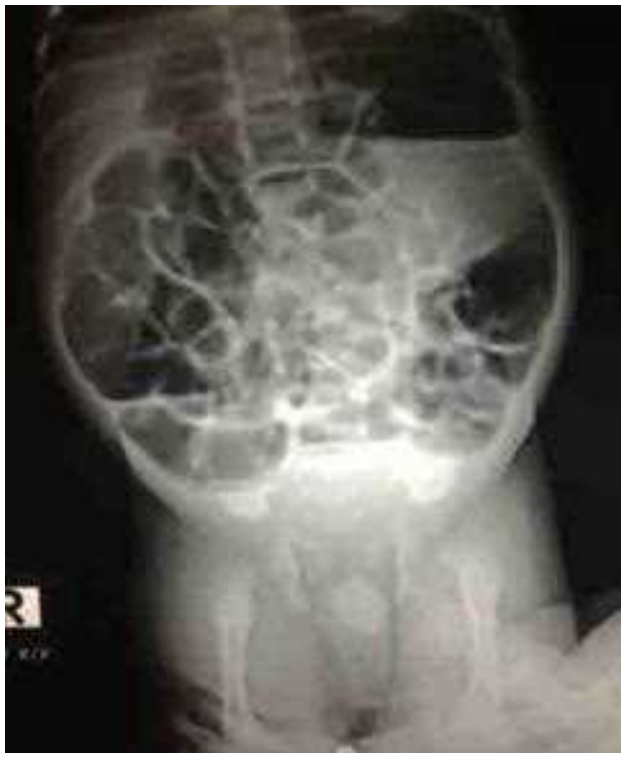
- Aganglionosis at recto-sigmoid area (80%): Short segment
- Aganglionosis extends proximal to sigmoid colon (15-20%): Long segment
- Aganglionosis affects the entire large gut (5%): Total segment

CLINICAL MANIFESTATIONS

Neonates	Older infants and children
◆ Delayed passage of meconium beyond the first 24-48 hours of life ◆ Repeated vomiting ◆ Abdominal distension ◆ If a soft rubber catheter is passed through the anal opening it's tip is stained with meconium on withdrawal ◆ Infants may also present with enterocolitis, sepsis, and perforation	◆ History of difficulties in passage of stools, since 1st few weeks of life ◆ Chronic constipation refractory to usual treatment ◆ Abdominal distention with palpable dilated loops of colon ◆ Rectal examination commonly reveals an empty rectum and forceful expulsion of faecal material upon withdrawal of finger ◆ Gripping of the examining finger (anal grip) may be felt due to spastic zone

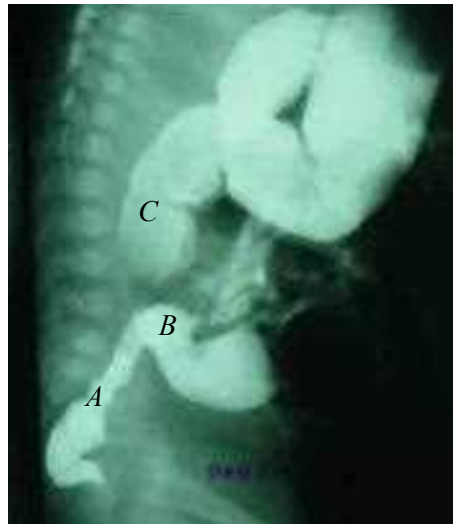
Investigation

◆ Plain X-Ray abdomen: Shows dilated proximal colon and absence of gas in the pelvic colon



Distended bowel loops and no gas shadow in the pelvic cavity

◆ Barium enema: Shows a transition zone between normal dilated proximal colon and a smaller-caliber constricted distal colon. Transition zone may not be seen in neonates since the normal proximal bowel has not had time to become dilated. Retention of barium for 24-48 hours is not diagnostic of HD in ilder children as it typically occurs in retentive constipation as well.



A Constricted zone B Transition zone C Dilated proximal colon

◆ Rectal biopsy: Reveals absence of the ganglion cells in the submucosal (Meissner) and myenteric (Auerbach) plexus and hypertrophied nerve trunks

TREATMENT

Medical

- Counsel parents about the disease and outcome

If the child presents with features of obstruction–

- Keep the baby NPO
- Give maintenance IV fluid e.g. Baby saline
- Give Potassium correction, if necessary
- Give IV antibiotics, e.g. Ampicillin plus Gentamicin
- Insert an NG tube & decompress stomach
- Give rectal irrigations with normal saline 3-4 times daily
- Consult Paediatric Surgeon immediately

Surgery

The definitive treatment.

ANORECTAL MALFORMATIONS

Anorectal malformations include a spectrum of developmental anomalies of the lowest portion of the intestinal and urogenital tracts. Most patients present with **imperforate anus**. Others present with a fistulous connection either with urethra (in males) or with vestibule (in females) and presents with history of passage of meconium through urethra (coloured urine), through vagina or through some abnormal openings in the perineum.

IMPERFORATE ANUS

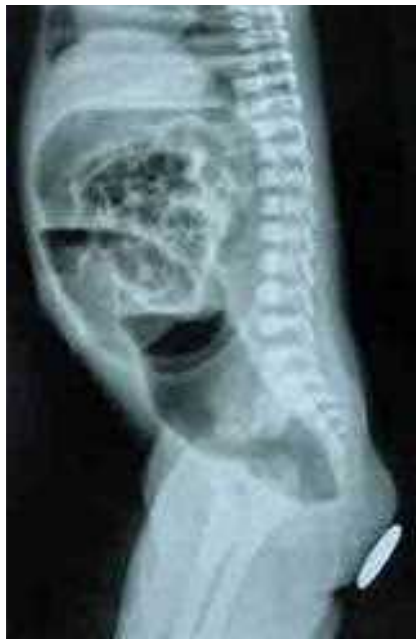
CLINICAL MANIFESTATIONS

- H/o failure to pass meconium by 24 hours after birth
- Absence of anal opening or visible anal pit
- Abdominal distention, may be in advanced cases

Absent anal orifice

Investigations

- Invertogram at 24 hours: The baby is held upside down and X-Ray is focused from a lateral side. This reveals the level of the gas shadow (rectal pouch) whether below the level of coccyx or not. Pouch above the tip of coccyx are regarded as high variety anomalies
- USG of abdomen: To evaluate associated urinary tract abnormalities



Invertogram showing gas shadow (rectal pouch) below the level of coccyx

TREATMENT

Medical

- Counsel parents about the disease and its outcome

If the child presents with features of obstruction

- Keep the baby NPO
- Give maintenance IV fluid e.g.10% DA/Baby saline
- Insert an NG tube & decompress stomach
- Give IV Antibiotics, e.g. Ampicillin plus Gentamicin
- Identifiy& treat associated co-morbidities promptly
- Consult Paediatric surgeon immediately

Surgery

The definitive treatment.

UNDESCENDED TESTIS (CRYPTORCHIDISM)

Cryptorchidism literally means hidden testis. It may be unilateral or bilateral. When a boy is seen with single or no testicle in the scrotum, one should think of the following possibilities–

- Testis is incompletely descended and remains anywhere in its normal pathway of descent e.g. inguinal canal, superficial and deep inguinal ring or in the abdomen
- Testis is in ectopic position e.g. femoral and perineal areas
- Agenesis of testis
- Testicular retraction, due to a hyperactive cremasteric reflex

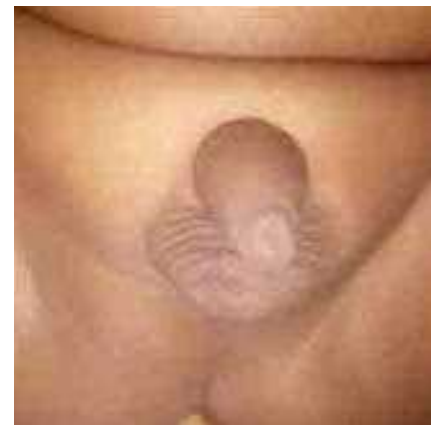
Ectopic tesis (in the perineum)

AETIOLOGY & RISK FACTOR

- Unknown but may be related to genetic, hormonal or mechanical factors
- Prematurity

CLINICAL MANIFESTATIONS

- The scrotum on the side of nondescent will be seen empty and not as well developed as the contralateral normal side
- Screen the perinium to search for any ectopic testis
- Any associated pathology e.g. inguinal hernia



Hypoplastic scrotum with undescended testes

Complications

- Infertility
- Testicular malignancy
- Associated hernia
- Torsion of the cryptorchid testis

Investigations

- Ultrasound of abdomen: To search the absent testicle
- MRI or CT scan of abdomen: For intra-abdominal testes
- Laparoscopy: Diagnostic

TREATMENT

Medical

- Hormonal therapy with hCG or LH-releasing hormones (LHRH): Controversial

Surgery

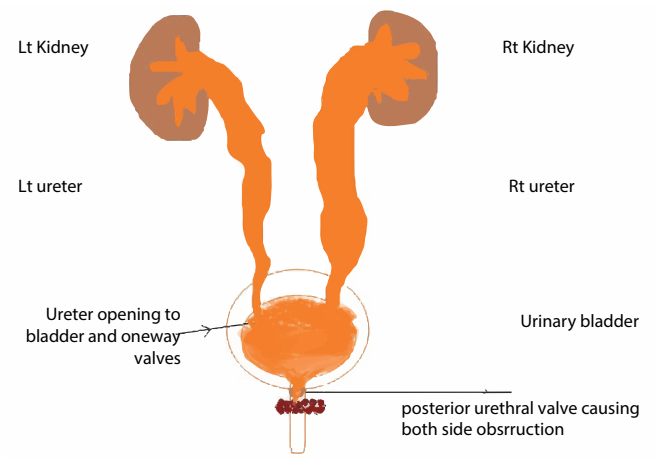
- Orchiopexy should be performed between 6-12 months of age or soon after diagnosis

POSTERIOR URETHERAL VALVE

The most common cause of severe obstructive uropathy among the boys.

PATHOGENESIS

Persistence of abnormal congenital leaflets in the prostatic part of the urethra causes narrowing of the bladder outlet with consequent obstruction of urine flow. This causes increased pressure in the organs proximal to the site of obstruction e.g. urinary bladder, ureters, renal pelvis resulting in their dilatation and enlargement. If not releived, it will give rise to vesico-ureteric reflux (VUR), hydroureter, hydronephrosis and renal insufficiency.



Posterior urethral valve

VUR GRADING

The International Classification System for VUR comprises the following five grades:

Grade I: Reflux into nondilated ureter

Grade II: Reflux into renal pelvis and calyces without dilation

Grade III: Reflux with mild-to-moderate dilation and minimal blunting of fornices

Grade IV: Reflux with moderate ureteral tortuosity and dilation of pelvis and calyces

Grade V: Reflux with gross dilation of ureter, pelvis, and calyces, loss of papillary impressions, and ureteral tortuosity

CLINICAL MANIFESTATIONS

Neonates: Distended bladder, palpable kidneys, vomiting, poor urinary stream, failure to thrive, renal insufficiency

Older children: Vomiting, poor urinary stream, urinary retension, bladder distension, renal insufficiency

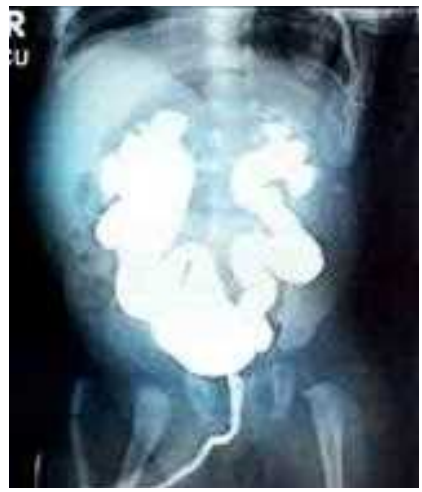
- Features of renal insufficiency e.g. paller, vomiting, etc.

DIAGNOSIS

Based on clinical features and findings from the relevant investigations.

Investigations

- Ultrasonogram of genito-urinary system
- Voiding cystourethrogram
- Assessment of renal function



Courtesy: Prof G. Muinuddin

Voiding cysto-urethrogram A/P view showing gross dilatation of ureters and renal pelvis

TREATMENT

Surgery

Transurethral ablation of the valves.

HYDROCEPHALUS

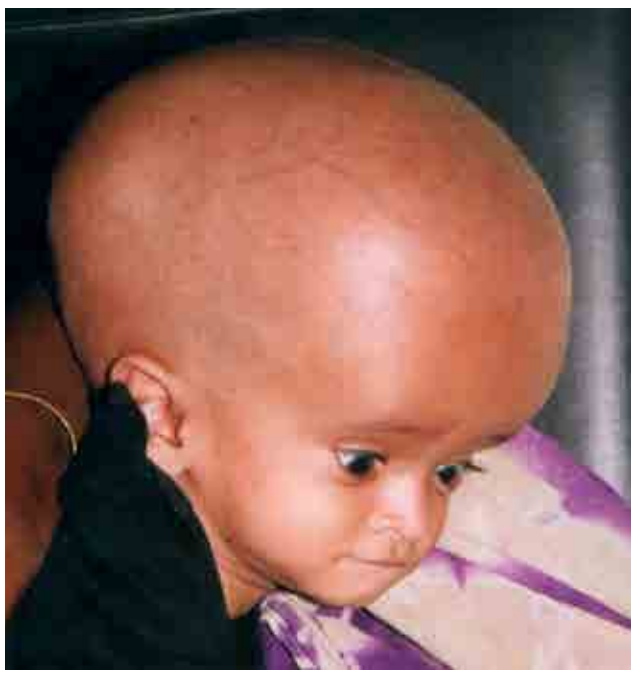
It is the enlargement of head size from ventriculomegaly due to accumulation of CSF either from overproduction or impaired circulation and absorption.

Types

- **Noncommunicating (Obstructive)**: Stenosis of aqueduct of Sylvius and pressure from CNS tumors over the CSF pathway
- **Communicating**: Results from obliteration of subarachnoid cistern or malfunctioning of arachnoid villi and occurs in meningitis, leukaemia and overproduction of CSF as in choroid plexus papilloma

Clinical Manifestations

- Progressive enlargement of head size, frontal bossing
- Delayed closure of anterior fontanelle and/or widely split cranial sutures
- "Sunsetting" of eyes (due to pressure on superior colliculus causing eyes to rotate downward
- Sometimes, there may be signs of raised intracranial pressure e.g. vomiting, headache, convulsion
  - OFC > 95th centile



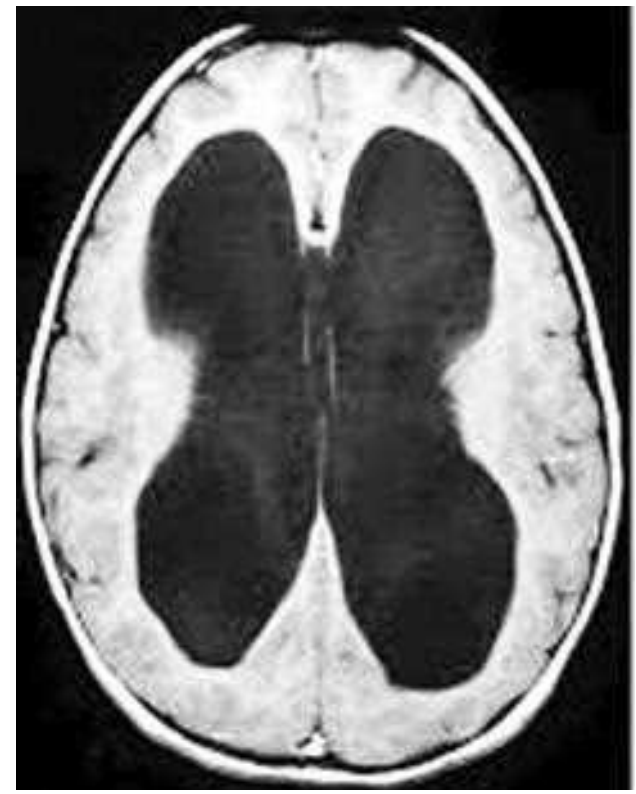
Hydrocephalus

Diagnosis

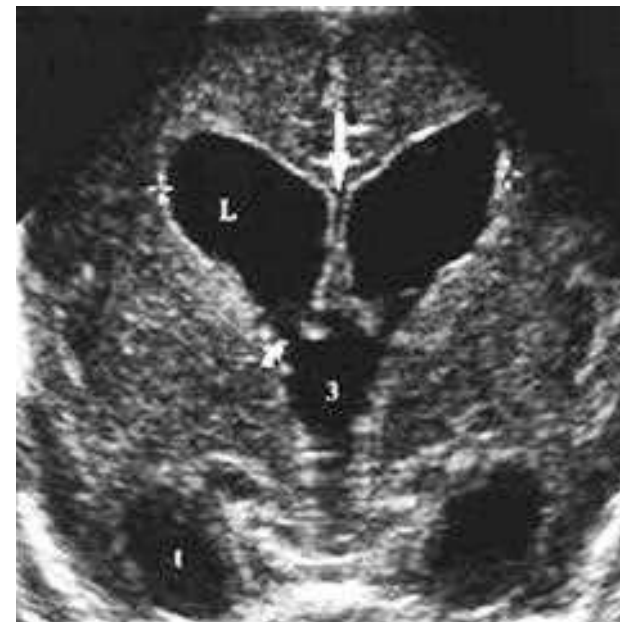
Based on clinical features and findings from the relevant investigations.

Investigations

Ultrasonogram/CT scan of brain.



CT scan of brainshowing bilaterally enlarged lateral ventricles



Ultrasonogram of brain showing bilaterally enlarged lateral ventricles

Treatment

Surgery

Ventriculo-peritoneal shunt.

SUMMARY OF OTHER SURGICAL PROBLEMS IN CHILDREN

Spinal defect

Other varietes of

- Spina bifida occulta: Bony defect without any herniation of meninges
- Meningocele: Protrusion of the meninges
- Myelomeningocele: Protrusion of the meninges along with portion of spinal cord through a bone defect in the vertebral column. The meninges covered sac is usually filled with CSF

Clinical presentation:

- Paraplegia
- Continuus dribbling of urine & saliva

Source: Internet

Tongue tie (Ankyloglossia)

- Too short frenulum lingula resulting in reduced mobility of tongue causing feeding and speech problem
- Treatment : Frenulotomy

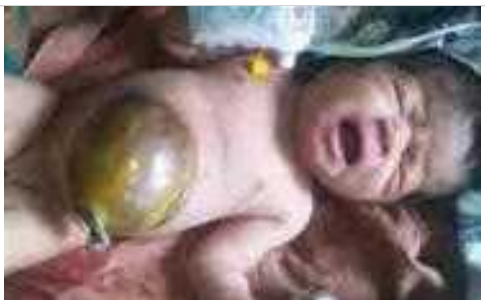
Umbilical hernia

- Swelling at the level of umbilicus due to protrusion of intestinal coils through weak periumbilical muscles
- Danger: Strangulation of gut
- Most cases usually disappear by 1–1½ years of age. Others require surgical repair

Courtesy: Prof. Md. Ashraf Ul Huq Kazal

Gastroschisis

- Full thickness defect in abdominal wall resulting in protrusion of intra-abdominal viscera to the exterior
- Protruded organs are not covered by peritoneum
- Treatment: Surgery

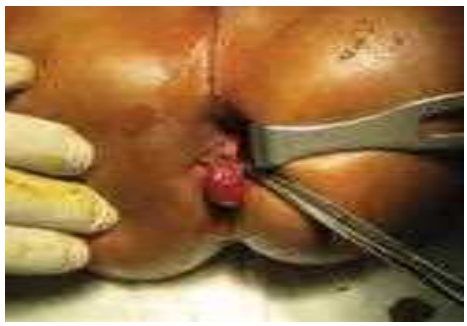


Omphalocoele

- A midline abdominal wall defect through which intra-abdominal viscera herniate into the base of the umbilical cord
- In contrast to gastroschisis, protruded organs are covered by a membrane and contained within the peritoneal sac
- Treatment: Surgery

A child with biliary atresia with liver failure (ascitis, FTT & jaundice)

- A whole or a part of the extrahepatic bile ducts is absolutely atretic
- Usually presents with jaundice (direct hyperbilirubinaemia), pale stool and hepatomegaly
- Treatment: Surgery (Modified Kasai Portoenterostomy) should be done as early as possible)



Courtesy: Prof. A Hanif Tablu

Rectal polyp

- Presents with history of passing of few drops of blood after the passage of stool
- Bleeding is painless and not smeared on stool
- Treatment: Polypectomy

Hypospadias

- Urethral opening is ectopically located on the ventrum of the penis proximal to the tip of the glans penis or as far down the scrotum or perineum
- The penis is more likely to have associated ventral shortening and curvature, called chordee
- Older children have difficulty in micturition as the urine 'spray' backwards
- Treatment: Surgery

Courtesy : Prof. Md. Ashraf Ul Huq Kazal

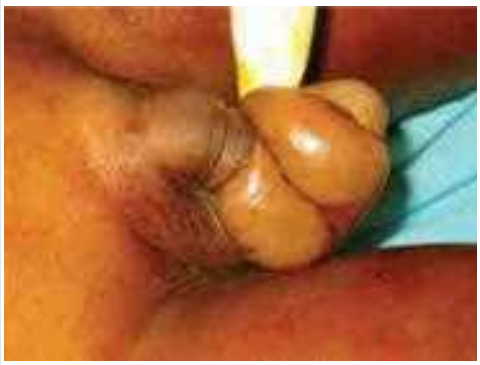
Epispadias

- Malformation of the penis in which the urethra ends in an opening on the upper aspect (the dorsum) of the penis
- This may lead to backward flow of urine into the kidney, repeated UTI and urinary incontinence
- Treatment: Surgery

Courtesy:Prof. A Hanif Tablu

Phimosis

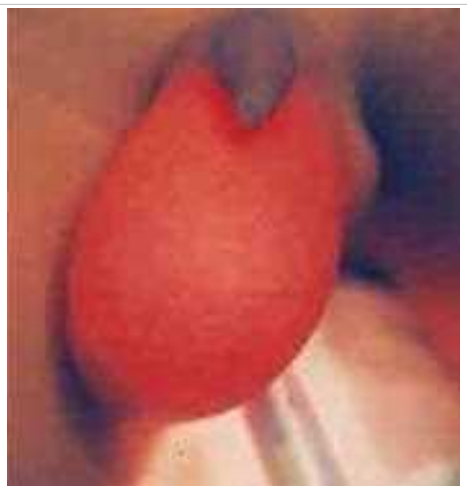
- Inability to retract the foreskin of the penis
- **Treatment**
  - Nonsurgical
    - Application of topical steroid creams such as betamethasone, mometasone furoate and cortisone: Steroids work by reducing the body's inflammatory and immune responses, and also by thinning the skin
    - Stretching of the foreskin can be accomplished manually
  - Surgical
    - Circumcision
    - Minor operations to relieve foreskin tightness



Courtesy: Prof. A Hanif Tablu

Paraphimosis

- Entrapment of a retracted foreskin behind the coronal sulcus results in impairment of venous return from the glans with consequent worsening venous engorgement of glans
- Furthermore this causes compromised arterial supply & painful swelling of the glans that may eventually lead to gangrene or autoamputation of the distal penis
- Treatment: Surgery



Courtesy: Prof. A Hanif Tablu

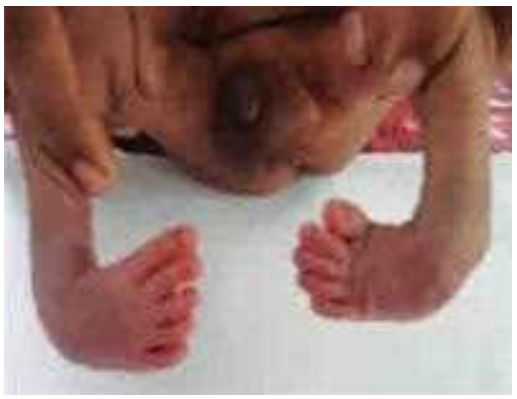
Hydrocoele

- A collection of fluid within the processus vaginalis that produces swelling in the scrotum
- Presents with irreducible swelling in the scrotum
- Transillumination test of the scrotum is positive displaying fluid in the tunica vaginalis
- Usually spontaneous resolution by 18 months, otherwise surgery. (herniotomy)

Courtesy: Prof. A Hanif Tablu

Inguinal hernia

- It results from persistent patency of the processus vaginalis
- Presents with reducible swelling in the groin or scrotum that increase in size on crying or after activity
- Treatment: Herniotomy as soon as diagnosed



Talipes equinovarous

- Congenital deformity involving one foot or both where the affected foot appears rotated internally at the ankle (inverted and adducted)
- Serial plaster cast with gentle manipulation of the foot towards the corrected position before the cast is applied and changed every 1-2 weeks
- Treatment: Surgery (If nonoperative treatment is unsuccessful)

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SELF ASSESSMENT

Short answer questions [SAQ]

1. How will you manage a case of cleft lip & cleft palate?
2. What is eventration?
3. Write down the difference between eventration & congenital diaphragmatic hernia
4. Write down the clinical features of congenital diaphragmatic hernia
5. How will you treat a neonate with congenital diaphragmatic hernia?
6. Write down the clinical features & investigations of infantile pyloric stenosis
7. Write down the clinical manifestation of Hirschsprung disease
8. How will you evaluate a neonate with imperforated anas?

Chapter 39

Fluid, Electrolyte and Acid-base Homeostasis

BODY FLUID

Our body is composed of both solids and water. Only total body water (TBW) alone constitutes about 60% of total body weight and the remaining 40% by the solids e.g. protein (18%), mineral (7%) and fat (15%).

Contribution of tbw to body weight in different stages of life

Foetus	85%
Neonate	75%(Term), Higher (Preterm)
Infant	65%
1st year-Puberty	60%

Distribution of total body fluid

- Two-third: Intra-cellular
- One-third: Extracellular, as follows–

Intracellular Fluid (40% of BW)	Extracellular Fluid 20% of body weight (BW) Interstitial fluid (15% of BW) Plasma (5% of BW)

Transcellular fluid is the portion of total body water contained within epithelial lined spaces. It is about 2.5% of the total body water. Examples of this fluid are cerebrospinal fluid, ocular fluid, joint fluid and urine in bladder.

The distribution of fluid across the plasma, interstitium as well as intracellular space is controlled by –

- **Oncotic pressure:** Exerted by Serum albumin
- **Osmotic pressure:** Exerted by S. electrolytes mainly by Na^+

Daily fluid requirement

Equal to **Daily Routine loss** through urine (50%), skin (30%), airways (15%) and stool (5%). To replenish this loss, one has to drink similar amount of fluid daily which is otherwise called **Maintenance fluid**.

Maintenance fluid: How much daily?

- **Neonates**
  - Age Day 1: 60 ml/kg/day (Term), 80-100 ml/kg/day (Preterm)
  - Thereafter, **daily increment** @ 20 ml/kg/day (Term) 15 ml/kg/day (Preterm) upto 1st Week of life

NB*: In preterm babies' amount of fluid can be raised up to 200 ml/kg/day by 14 days of age*

- **Infants & Children**
  - For 1st 10 kg body weight: 100 ml/kg/day
  - For Next 10 kg body weight: Add 50 ml/kg/day
  - Everything over 20 kg body weight: Add 20 ml/kg/day to a maximum of 2400 ml/day

Example: Maintenance fluid requirement for a 28 kg child will be as follows–

- For 1st 10kg: (100×10) ml/day +
- For 2nd 10kg(50×10) ml/day +
- For Weight >20kg (20×8) ml/day

Total = 1000+500+160 ml/day = 1660 ml/day.

Recommended Age-specific Maintenance fluid

Age	Birth to 24-48 hours	48 hours-1 year	1-10 years	> 10 years
Choice of Fluid	10% DA	5-10% Dextrose in 0.225% NaCl (Baby saline)	5-10% Dextrose in 0.45% NaCl (Junior saline)	5-10% dextrose in 0.9% NaCl (DNS)

Fluid deficit and **Ongoing loss:** These are additional losses apart from daily routine loss through–

- Gastro-intestinal tract e.g.diarrhoea, vomiting, naso-gastric suction
- Third space loss e.g. burn, trauma, sepsis, abdominal surgery
- Urine e.g. diabetes mellitus, diabetes insipidus etc.

Fluid Deficit: How to assess?

Fluid deficit is assessed on the basis of existing degree of dehydration and expressed as percentage loss of body weight as follows–

Degree of Dehydration	Percentage loss of Body weight
Mild	3-5%
Moderate	>5-10%
Severe	>10-15%

FLUID REPLACEMENT: HOW?

By considering–

- **Replacement of any existing fluid deficit** by any of the following fluids e.g. ORS, Normal saline, DNS, Baby saline, Cholera saline, Hartman, depending on the aetiology of fluid loss, electrolyte profile and severity of dehydration, and
- Continue providing the **daily age-specific maintenance fluid evenly over 24 hours**

Methods of fluid replacement

There are different ways to replace the fluid. A simple method is discussed below.

Phase I: Infuse immediate **bolus amount** @10 ml/kg of normal saline to replace any existing fluid deficit. It may be repeated until haemodynamic status is stable and urine output is adequate.

Then plan for replacement of **Remaining fluid deficit (RD)**, which is equal to = (Total fluid deficit – the amount administered as a bolus in Phase I). This, along with the amount allocated next 24 hours will be given in another 2 phases–

- **Phase II (8 hours): The** 1st half of the total amount will be replaced during this period
- **Phase III (16 hours):** The 2nd half of the total amount of fluid will be given in the next 16 hours.

Example: A 22 kg child is hospitalized with severe dehydration due to acute diarrhoea. He is estimated to have 10% weight loss. His S Na^+ is 140 meq/l. He has no ongoing losses.

Q. How to calculate & replace fluid ina child?

a) Total fluid deficit (10% of 22 kg) = 2.2 L/2200 ml

b) Maintenance fluid:

- First 10 kg of BW: 10×100 ml = 1000 ml/day
- Second 10 kg of BW: 10×50 ml = 500 ml/day
- Remainder 2 kg of BW: 2×20 ml = 40 ml/day

The total amount of **maintenance** fluid: 1540 ml, which should be replaced by next 24 hours @ 64 ml/hour

The total amount [a+b *i.e. deficit + maintainance*] has to be given over next 24 hours as follows:

i) Phase I: Two Bolus amount (as the child does not respond to a single bolus)

1st bolus: 10 ml/kg = 10×22 = 220 ml

2nd bolus: 10 ml/kg =10×22 = 220 ml

So, total bolus amount given is 440 ml of Normal saline.

Remaining deficit (RD): (2200 – 440) ml = 1760 ml

ii) Phase II: Replacement by first 8 hours–

a. 1st ½ of RD = 1760/2 i.e. 880 ml

b. Maintenance fluid = 64 ml×8 hours i.e. 512 ml

Total = (880+512) = 1392 ml @ 44 drops/minute

iii) Phase III: Replacement by next16 hours of

a. 2nd ½ of RD = 1760/2 i.e. 880 ml

b. Maintenance fluid = 64 ml×16 hours i.e. 1024 ml

Total = (880+1024) = 1904 ml @ 30 drops/min.

SERUM ELECTROLYTES & DYSELECTROLYTAEMIA

Electrolytes are the minerals present in the body fluid that dissociate into ions, carrying electric charges and exert their effects to maintain body fluid distribution, acid-base balance, muscle and nervous system functions and other important processes.

Common electrolytes in blood

Cations		Anions	
Name	**Serum level**	**Name**	**Serum level**
Na^+	135-145 mmol/L	Cl^-	98-106 mmol/L
K^+	3.5-5.5 mmol/L	HCO_3^-	22-30 mmol/L
Ca^{++}	8.4-10.2 mg/dl	PO_4^{--}	2.9-5.4 mg/dl
Mg^{++}	1.5-2.4 mg/dl	SO_4^{--}	2.4-4.1 mg/dl

In our body, normally, electrolytes and fluid remain in a state of equilibrium. But in disease process, this balance is altered and the patients suffer from dyselectrolytaemia, dehydration or fluid overload.The electrolyte imbalances, mostly encountered in clinical practices are abnormalities related to Na^+ (hypo or hypernatraemia) as well as abnormalities in K^+ (hypo or hyperkalaemia).

The different types of dyselectrolytaemia, their aetiology and their way of corrections are discussed below.

Q. How to correct Na^+ deficit?

Na^+ Requirement (mEq) = (Desired Na^+- Observed Na^+) × BW(Kg) × 0.6 + Daily maintenance dose of Na^+ (2-3 mEq/kg/day) for next 2 days.

Example: S. Na^+ level of a 7 day old baby (weight 1.5 kg) is 122 mEq/L.

- Existing Na^+ deficit = (135-122)×1.5×0.6 = 11.7 mEq
- Maintenance Na^+ =3×1.5×2 days = 9 mEq

- Total Na^+ Requirements =11.7+9 = 20.7 (appro.21mEq) and this amount has to be replaced over next 48 hours
- Fluid requirement during this 48 hours =1.5×150×2 = 450 ml

Therefore, total 21 mEq Na^+ has to be replaced through 450 ml appropriate IV fluid over 48 hours.

- Appropiate fluid here: 0.3% NaCl, as it contains 51 mEq Na^+/L or 22 mEq in 450 ml (see chart on p 324)
- Rate of infusion: 9 microdrops/min as at this rate Na^+ correction will be 11 mEq/day

Important notes

- Avoid rapid correction because it may cause central pontine myelinolysis
- Daily Na^+correction should not be >12 mEq /L
- Daily maintenance Na^+ should also be added, during the deficit correction
- In severe hyponatraemia (S. Na^+<120 mEq /L), 3% NaCl may be used

HYPONATRAEMIA (S. Na^+ <135 mEq/L)

AETIOLOGY

- Water overload, SIADH, Sepsis
- Excess Na^+ loss through stool, as in diarrhoea
- Congenital adrenal hyperplasia
- Hypoaldosteronism

PATHOGENESIS

In hyponatremia, cells of the body are swollen and if this occur in the brain, serious neurological consequences (e.g. permanent disability and death) can occur.

CLINICAL MANIFESTATION

- Nausea, irritability, malaise, lethargy
- Dehydration
- Headache, coma, Seizures when S Na^+ falls <120mEq/L

HYPERNATRAEMIA (S. Na^+ >145 mEq/L)

AETIOLOGY

- Ingestion of excess Na^+ through improperly mixed formula milk or ORS, $NaHCO_3$, seawater
- Persistent fever
- Infusion of hypertonic IV fluid
- Water deficit
  - Increased insensible loss as occurs in preterm infants, babies under radiant warmer, phototherapy
  - Decreased fluid intake, in hot humid environment
- Endocrinopathies e.g. hyperaldosteronism, diabetes insipidus

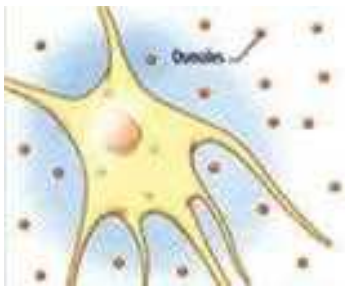
PATHOGENESIS

In hypernatraemia, high S Na^+ draws fluid from inside the cells, causing the cells to become crenated. This cellular changes can occur in any organs of the body. When occurs in neurons, this intracellular to extracellular fluid shift causes decrease in brain volume and the shunken brain tends to move away from the skull and meninges. This predisposes tearing of intracerebral and the bridging vessels with intracranial e.g. subarachnoid, subdural, and parenchymal hemorrhages, and patients present with seizures, coma or other neurological manifestations.

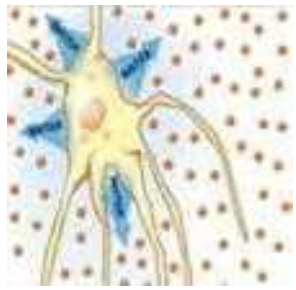
To combat this osmotic dysequilibrium, the neurons automatically generate intracellular idiogenic osmoles to prevent fluid shifting from intracellular space. This information is very important to consider during Na^+ correction. If correction is done rapidly, there will be a high chance of shifting of fluid from the extracellular to intracellular space of neurons and this will cause brain swelling, central pontine myelinolysis (CPM) seizures or coma. Therefore, hypernatraemia should be corrected slowly (<12 mEq/day @ 0.5 mEq/hour).

Severity

- Mild: >145-155 mEq/L
- Moderate: >155-175 mEq/L
- Severe : >175 mEq/L



Normal neuron



Crenated neuron in severe hypernatremia

CLINICAL MANIFESTATION

- Irritability, restlessness, lethargy, high pitched cry
- Variable degree of dehydration
- Doughy feeling of skin
- Sometimes, apnoea, convulsions, coma

MANAGEMENT

The goal is to bring S Na^+ level slowly towards normal value. The steps of management are as follows–

- Restore intravascular volume with Normal Saline (NS) @ 20 ml/kg body weight. Repeat additional boluses @ 10-20 ml/kg, if signs of dehydration e.g. hypotension, tachycardia, poor perfusion still exists
- After restoration of intravascular volume–
  - Select, half strength NS (0.45% NaCl) as the **maintenance** fluid
  - Determine, the duration of correction of high Na^+ level to normal, based on the existing S Na^+ level e.g.

[Na] 145-157 mEq/L	24 hour
[Na] 158-170 mEq/L	48 hour
[Na] 171-183 mEq/L	72 hour
[Na] 184-196 mEq/L	84 hour

  - Calculate, the amount of maintenance fluid to be infused for the projected duration as shown above. Allocate extra 20-30% greater than the calculated amount and adjust the rate of infusion accordingly
- Assess, clinical status, particularly hydration and S Na^+ level of the patient and adjust fluid management. If–
  - Signs of **volume depletion** again from ongoing loss, Administer NS bolus @ 20 ml/kg
  - S Na^+ decreases **too rapidly**, then either– a) increase Na^+ concentration of IV fluid or b) decrease rate of IV fluid infusion
  - S Na^+ decreases **too slowly**, then– a) decrease Na concentration of IV fluid or b) increase rate of IV fluid infusion
  - Replace ongoing losses as those occur

HYPOKALAEMIA (S K^+ level<3.5 mmol/L)

AETIOLOGY

- PEM
- Diarrhoea, nasogastric loss, persistent vomiting
- Long-term use of diuretics (thiazides), laxatives, steroids, digoxin, amphotericin B, mineralocorticoids
- Intrinsic renal disease e.g. Bartter syndrome
- Cushing syndrome, DKA

PATHOGENESIS

Potassium is an important electrolyte for nerve and muscle cell function, specially cardiac muscles.

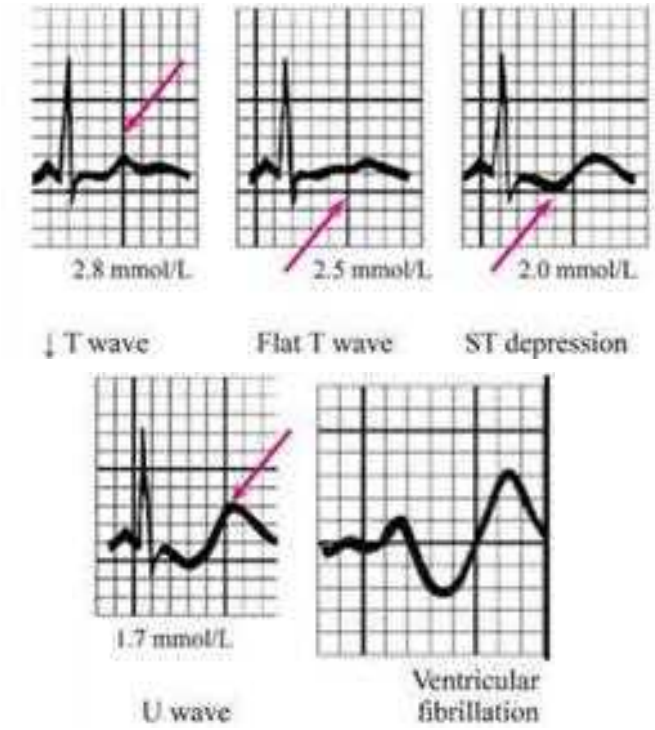
In low K^+, muscles and nerves cannot function properly and patients presents with weakness and cardiac symptom

CLINICAL MANIFESTATION

- Skeletal muscle e.g. weakness, fatigue, cramp, hyporeflexia, paralysis

- Smooth muscle e.g. decreased peristalsis, constipation, ileus, urinary retention
- Heart muscle: palpitation, arrythmias e.g. ectopic beats, atrial & ventricular tachycardia/arrest

Investigations: ECG changes



MANAGEMENT

How to correct K+ deficit?

- Required K^+(mmol): (Desired – Existing K^+ levels) × BW (Kg) × 0.3

Easy way to correct hypokalaemia

S K^+ level (mmol/L)	Amount of Inj. KCl to be added in with 100 ml IV fluid
3.5-4.5	1 ml = 2 mmol
3.0-3.5	1.5 ml = 3 mmol
2.5-3.0	2 ml = 4 mmol
2.0-2.5	3 ml = 6 mmol
<2	KCl drip 0.5-1mmol /kg/hour under close cardiac monitoring

Important notes

- Oral correction should be continued for 5-7 days after acute phase management
- IV correction should be given when strictly needed and provided that the patient is not in renal failure
- Correction of concomitant hypocalcaemia and acidosis should be delayed till potassium level improves as this will further lower down S. Potassium

HYPERKALAEMIA (S K^+ level>5.5 mmol/L)

AETIOLOGY

- Haemolysis, rhabdomyolysis
- Renal failure e.g. acute or chronic
- Mineralocorticoid deficiency, Addison's disease

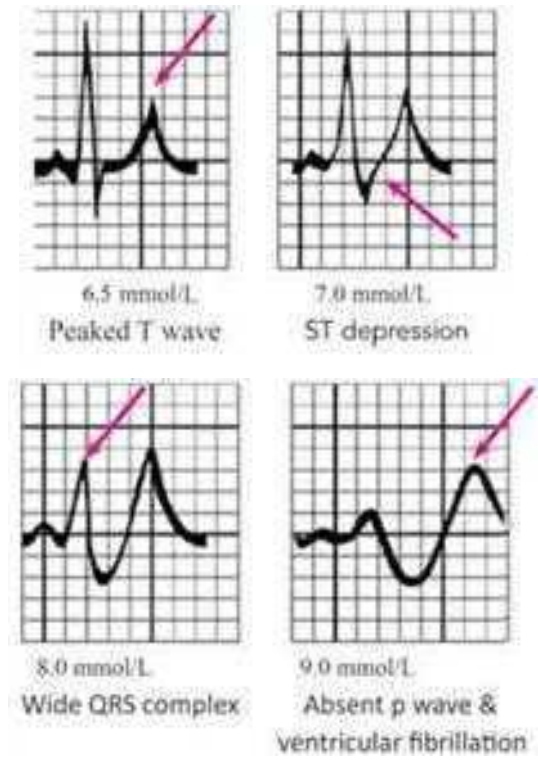
PATHOGENESIS

Both hypo and hyperkalemia can lead to abnormal heart rhythm and the important clinical effect is related to electrical rhythm of heart.

CLINICAL MANIFESTATION

- Asymptomatic, non specific – weakness, fatigue.
- Cardiac arrhythmia
- Muscle weakness, tinglings, paraesthesias
- Paralysis, tetany
- Palpitation or chest pain

Investigations: ECG changes



MANAGEMENT

I. Mild hyperkalaemia (S K+ >5.5-6 mmol/L)

- Restrict/avoid intake of extra potassium through potassium rich fluid or foods e.g. fruits or drugs

II. Moderate to severe hyperkalaemia (S K^+ > 6 mmol/L)

❑ Myocardial cell membrane stabilization	◆ **Calcium gluconate (10%)** Dose: 0.5-1 ml/kg, IV, slowly over 5-10 minutes
❑ Redistribution of extracellular K^+ into cells	◆ **Insulin** (short acting) Dose: 0.1 unit/kg, IV with 10% DA @ 5 ml/kg, over 30 minutes ◆ **Salbutamol nebulization** Dose: 2.5 mg (<25 kg) or 5 mg (>25 kg) with normal saline (2 ml) ◆ **Sodium bicarbonate** Dose: 1-2 mmol/kg, IV over 10-15 min
❑ Enhance elimination of K^+ from the body through gut	◆ **Sodium polystyrene sulfonate resin** (Kayexalate) ❑ Oral: 1 month-18 years Dose: 125-250 mg/kg (max.15 g) in 15-30 mL 70% sorbitol, 3-4/day ❑ Rectal: Neonate Dose: 125-250 mg/kg, dilute each gm resin in 5-10 ml methylcellulose or water, repeated as necessary, every 6-8 hours
❑ Other ways to eliminate K^+ from body (refractory cases)	◆ **Renal replacement therapy** ❑ Peritoneal dialysis ❑ Haemodialysis

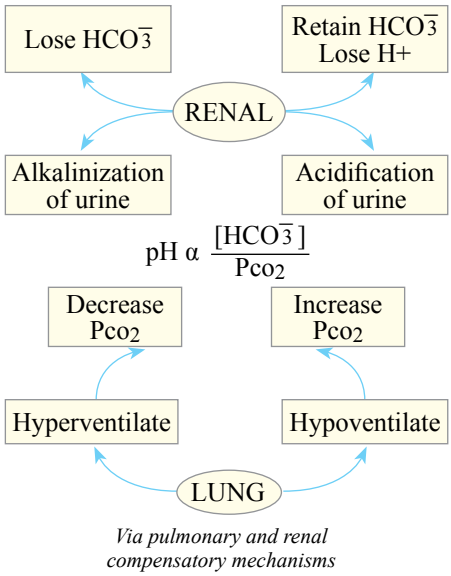
Electrolytes & ionic concentration and tonicity of commonly used oral and IV fluids

Types of fluids	Na+	K+	Cl-	HCO3-	Glucose	Ca ++	Acetate	Lactate	Tonicity
Low osmolality ORS	75	20	65	20	75	--	--	--	Hypotonic
ReSoMal	45	40	70	7	125	--	--	--	Hypotonic
Plasma	140	45	100	26		2.3	--	--	Isotonic
0.9% Saline/Normal Saline	154	--	154	--	--	--	--	--	Isotonic
0.45% Saline /Junior Saline	77	--	77	--	--	--	--	--	Hypotonic
0.3% Saline	51	--	51	--	--	--	--	--	Hypotonic
0.225% Saline	42	--	42	--	--	--	--	--	Hypotonic
5% Dextrose in 0.9% Saline	154	--	154	--	5	--	--	--	Hypertonic
5% Dextrose in .45% Saline	77	--	77	--	5	--	--	--	Hypertonic
D5 0.225% Saline	42	--	42	--	5	--	--	--	Hypertonic
D10 0.225% Saline	42	--	42	--	10	--	--	--	Hypertonic
3% Saline	514	--	514	--	--	--	--	--	Hypertonic
Cholera Saline	133	13	98	--	--	--	48	--	Hypertonic
Hartman's Solution	131	5	111	--	--	2	--	29	Isotonic
Ringer's Lactate	130	4	109	--	--	1.5	--	28	Isotonic
D5 in Lactated Ringer's	130	4	109	--	5	1.5	--	28	Hypertonic

ACID-BASE BALANCE

Acid-base balance i.e. maintaining arterial blood pH between 7.38-7.42 is very important to ensure normal functioning of pH-sensitive enzyme systems in our body. It is regulated by the interactions between the **lungs, kidneys** and **chemical buffer systems** (e.g.carbonic acid-bicarbonate buffer system, hemoglobin, phosphate, ammonium) present in our body. Over 50% of the blood's buffering capacity is provided by the Carbonic acid-Bicarbonate buffer system, 30% by haemoglobin and the remainder by phosphates and ammonium.

Whenever, there is disturbances in acid-base balance, the Chemical buffers principally the Carbonic acid-Bicarbonate buffer system initially come into action to correct the imbalance. Subsequently, the Pulmonary and Renal compensatory mechanisms augment the process towards further correction. The final stabilization of acid-base balance of course depends on elimination of primary cause.



Via pulmonary and renal compensatory mechanisms

The **pulmonary** regulation is accomplished by maintaing appropriate CO_2 concentration in the extra-cellular fluid (ECF) by adjusting the rate & depth of respiration.

The **renal** regulation is accomplished by–

- reabsorption of filtered HCO_3^- primarily in the proximal tubule, and
- excretion of H^+ or HCO_3^- in the distal tubules to match the net input of acid or base

For example, when body is in **acidosis**, the kidneys then do 2 things i) excrete acidic urine i.e, secrete H^+ into tubular lumen ii) reabsorb all the filtered HCO_3^- which are added back to the ECF and balances the acids (H^+) and bases (HCO_3^-) towards normal.

On the otherhand, when the body is in **alkalosis,** the kidneys excrete alkaline urine i.e. excrete excess HCO_3^- in urine. As HCO_3^- normally buffers H^+ in the extracellular fluid (ECF), this excess urinary HCO_3^- loss indirectly conserves H^+ in the ECF and ultimately brings body's pH back to normal.

Normal Arterial Blood Gas and interpretation

Analyte	Normal Range	Interpretation
pH	7.35-7.45	The pH indicates if a patient is acidaemic (pH < 7.35) or alkalaemic (pH > 7.45)
PaO_2	80-100 mmHg or 9.3-13.3 kPa	A low PaO_2 indicates that the patient is not oxygenating properly, and is hypoxaemic
$PaCO_2$	35-45 mmHg or 4.7-6.0 kPa	A high $PaCO_2$ (respiratory acidosis) indicates underventilation, a low $PaCO_2$ indicates (respiratory alkalosis) hyper or over ventilation
HCO_3^-	22-26 mmol/L	A low HCO_3^- indicates metabolic acidosis, a high HCO_3^- indicates metabolic alkalosis

The 4 major types of Acid-Base disorders

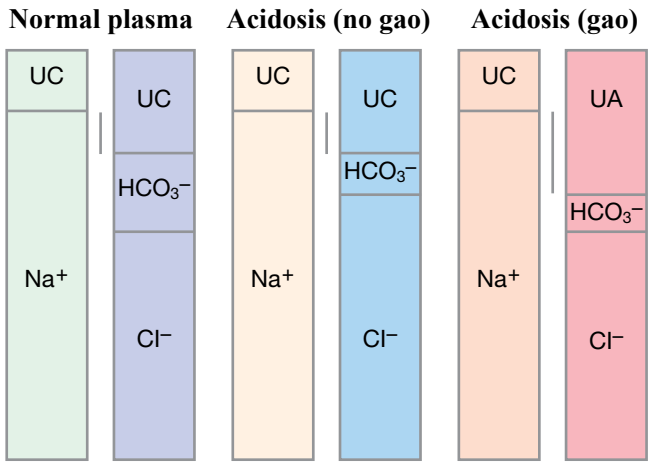
Conditions	pH	HCO_3^- (mEq/L)	pCO_2 mmHg	Causes
Normal	**7.4**	**24**	**40**	
Metabolic acidosis	<7.4	<22		❑ Aspirin poisoning ❑ DKA, RTA ❑ Diarrhoea
Metabolic alkalosis	>7.4	>26		❑ Prolonged vomiting ❑ $NaHCO_3$ ingestion ❑ Cushing's disease ❑ Conn's disease
Respiratory acidosis	<7.4		>45	❑ CNS Depression ❑ Airway Obstruction ❑ Pneumonia ❑ Pulmonary edema ❑ Pneumothorax ❑ Myopathy
Respiratory alkalosis	>7.4		<35	❑ Hyperventilation as in anxiety ❑ Mech Ventilation ❑ Salicylates/Sepsis

ANION GAP (AG)

Defination: It is the difference between the measured cations (Na^+) and the measured anions (Cl^- & $HCO3^-$). It is principally affected by changes in unmeasured anions in the blood. In clinical practice, the plasma anion gap helps us to evaluate patients with **metabolic acidosis**, in relation to their aetiology. Sometimes, In some diseases, patients have metabolic acidosis with normal anion gap (Non anion gap metabolic acidosis NAGMA). On the otherhand, some patients have metabolic acidosis with high anion gap (High anion gap metabolic acidosis HAGMA).

It is determined by this formula: **(Na^+- (Cl^-+$HCO3^-$)** and a **Normal anion gap is 4-11**.

In our body, the number of serum anions must be equal to the number of serum cations to maintain electrical neutrality, as described in the diagram below.



UC = unmeasured cation; UA = Unmeasured anion

Characteristics

From the above diagram, it is clear that-

In NAGMA, there is fall in serum HCO3- (hypobicarbonataemia) and this fall is matched by an equivalent increament in serum Cl- (hyperchloraemia) to maintain the electrical neutrality of blood. Here, there is no increament in unmeasured anions**.**

In HAGMA, there is increament in unmeasured anions e.g. ketoacids, e.g. beta hydroxyl butyrate and acetoacetate other acids, phosphates, urea along with fall in serum HCO3- (hypobicarbonataemia). Here, no change in serum Cl-

Mechanism

NAGMA results from direct loss of NaHCO3 from diseases of gut e.g. acute diarrhoea, where fall of serum Na+ and a reduction of ECF volume will stimulate renal retention of Na+ and Cl-. Thereby the lost HCO3- (i.e. anions) being replaced by the anions of retained Cl- and thus electrical neutrality is maintained. That is why hyperchloraemic metabolic acidosis is an alternate term for NAGMA. It can also occurs by the use of drugs which inhibit renal reabsortion of $HCO3^-$ e.g. acetazolamide, amiloride, PG inhibitors

In HAGMA, as already mentioned that there is an increament in unmeasured anions. The aetiology behind HAGMA, can be expressed by the mnemonics GOLD MARK.

G = Glycols

O = Oxoproline (toxic metaboletes of paracetamol)

L = L-Lactate e.g. lactic acidosis

D = D-Lactate (exagonous LA produced by gut bacteria)

M = Methanol (alcohol)

A = Aspirin (Salicylate)

R = Renal failure (uraemia)

K = Ketones (deabetic, alcoholic, starvation)

	Normal anion gap MA (NAGMA)	**High Anaion gap MA (HAGMA)**
$HCO3^-$	↓	↓
Cl^-	↑	No change
Unmeasured Anions	No change	↑

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SELF ASSESSMENT

SHORT ANSWER QUESTIONS [SAQ]

1. How can you calculate daily fluid requirement? Calculate the fluid requirement of a child weighing 15 kg.
2. What are the causes of hyponatraemia? Write down the principles of management of hyponatraemia.
3. Write down the causes and clinical features of hyperkalaemia.
4. Name the important causes of hypokalaemia. How can you correct the deficiency of potassium of a baby weighing 10kg (Serum K+ 2.4 mmol/L)?
5. Write down the composition of cholera saline.
6. Write down the normal value of ABG.

MULTIPLE CHOICE QUESTIONS [MCQ]

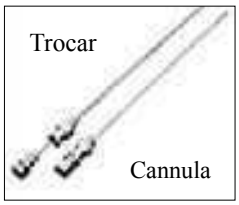
1. While assessing daily fluid requirement, the following should be taken into consideration–
   ___ a) urinary loss ___ b) respiratory loss ___ c) sweating ___ d) loss with diarrhoea ___ e) loss with vomiting
2. Major cations of plasma
   ___ a) Sodium ___ b) Potassium ___ c) Magnesium ___ d) Calcium ___ e) Ammonium
3. Major components of fluid compartments are–
   ___ a) intracellular ___ b) interstitial ___ c) plasma ___ d) peritoneal ___ e) transcellular
4. The following are examples of transcullular fluid–
   ___ a) CSF ___ b) ocular fluid ___ c) joint fluid ___ d) plasma ___ e) peritoneal fluid
5. Causes of hypernatraemia–
   ___ a) diabetes insipidus ___ b) pancreatitis ___ c) diarrhoea ___ d) diuretics ___ e) hyperaldosteronism
6. The ECG changes in hyperkaliemia–
   ___ a) ST elevation ___ b) narrow QRS complex ___ c) tall R wave
   ___ d) prolonged PR interval ___ e) T inversion
7. Treatment options of hyperkalaemia includes–
   ___ a) Sodi-bicarb ___ b) Insulin ___ c) 10% DA ___ d) dialysis ___ e) Calcium gluconate
8. The following statement regarding acid-base homeostasis is true–
   ___ a) normal pH of blood is 7.0 ___ b) a low HCO3 indicates alkalosis
   ___ c) hyperventilation causes low PCO2 ___ d) pH is proportionate to H+ content of the body
   ___ e) acid imbalances are controlled by kidney alone

Chapter 40

Instruments & Procedures in Paediatrics

Lumber puncture needle

- **Parts**
  - Trocar (stilette) with knob
  - Cannula



Use: Lumber puncture

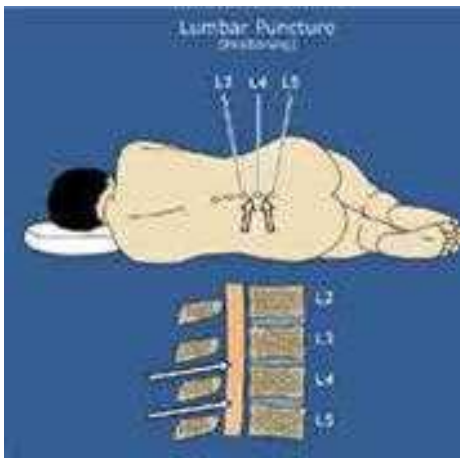
Lumber puncture

Site

Usually done in 3rd intervertebral space (between 3rd & 4th lumber vertebra).

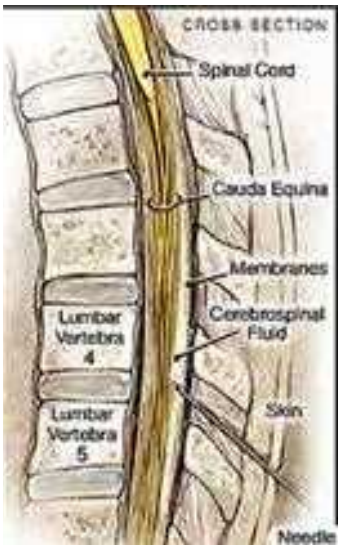
Procedure

- Take consent from the parents before doing the procedure
- Patient should be lying on his side on a firm table with the knees and chin as nearly apposed as possible (restrained position)



- Back of the patient should be right at the edge of the table, its transverse axis i.e. a line passing through the posterior superior iliac spine should be vertical
- An expert assistant is needed to hold the patient in position

- After positioning, site of lumber puncture is identified by 4th lumber vertebra, which is in the same plane with iliac crest
- Physician should wear mask, gown and gloves
- After putting skin wash draping, LP is done with all aseptic precautions by putting thumb of left hand on the spine and introducing the needle by right hand firmly through the skin in the mid-line between the spines
- Direction of the needle should be forward and slightly towards the head
- As the dura is pierced there is a sense of pressure release



- As the needle enters subarachnoid space, CSF comes out
- After withdrawal of LP needle a sterile dressing should be applied
- Patient should lie flat for 8-12 hours without pillow and should be given drink immediately after the maneuver

During LP, spinal needle traverses through the following layers

1. Skin
2. Facia and SC fat
3. Surpaspinous ligament
4. Interspinous ligament
5. Ligamentum flavum
6. Epidural space and fat (epidural anesthesia needle stops here)
7. Dura mater
8. Subdural space, and
9. Arachnoid mater

Indications

- **Diagnostic**
  - Suspicion of meningitis (pyogenic, tubercular, viral), encephalitis
  - Systemic diseases e.g. multiple sclerosis, SLE
  - Suspicion of GBS, sub-arachnoid haemorrhage, multiple sclerosis
  - Evaluation for CNS leukaemia
  - For diagnosis e,g. myelography, cysternography
- **Therapeutic**
  - Intrathecal chemotherapy, as in leukaemia
  - Relief of pseudotumor cerebri
  - Spinal anaesthesia

Contraindications

- Raised ICP due to mass lesion of brain or spinal cord with high risk for transtentorial or cerebellar tonsillar herniation (e.g. posterior fossa tumor, midline shift)
- Critically ill patient
- Skin infection at site of LP
- Thrombocytopenia <20x10^9/L

Complications

- Headache
- Local pain
- Brain stem herniation
- Haemorrhage
- Introduction of infection
- Injury to vertebral disc

SALAH BONE MARROW ASPIRATION NEEDLE

Parts

- Trocar (stilette) with knob
- Cannula
- Adjustable guard

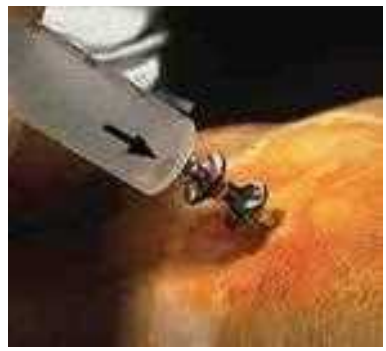
BONE MARROW ASPIRATION

Sites

- Children <2years: Medial aspect of upper end of tibia
- Children >2years: Posterior iliac crest, spinous process of vertebrae, manubrium sterni (rare)

Procedure

- First take written consent from the parents or legal gurdian before doing the procedure
- Fix the guard of the aspiration needle about ½ the depth of bone
- Then ask the patient to lie down in prone position for iliac crest site or on his back for manubrium sterni
- Wear mask, gown and gloves
- After putting skin wash and draping, inject 2% xylocaine at the site of puncture and infiltrate upto the periosteum



- Then push the aspiration needle through the skin vertically down by screwing method until bone is penetrated
- A sudden loss of resistance indicates that the needle entered in the marrow space
- Now remove the stilette and attach a syringe to the cannula
- Aspirate marrow by negative suction
- Then withdraw the needle, press the puncture site and seal with a sterile swab
- Then prepare film on glass slide and preserve the rest of the aspirate in EDTA

Indications

DIAGNOSTIC

- Haematological disorders e.g. leukaemia, ITP, non Hodgkin lymphoma, myeloproliferative disorders, plasma cell disorders, megaloblastic anaemia, multiple myeloma
- Infectious diseases e.g. Kala-azar, TB, PUO
- Storage diseases e.g. Gaucher disease, Niemann-Pick disease

- Infectious diseases e.g. Kala-azar, TB, PUO
- Storage diseases e.g. Gaucher disease, Niemann disease
- **Therapeutic:** Bone marrow transplantation

Contraindications

- Local skin infection or recent irradiation therapy at the sampling site
- Known case of haemophilia, thrombocytopenia
- Bone marrow disorders e.g. osteomyelitis, osteogenesis imperfecta
- While using anticoagulants

Complications

- Shock e.g. vaso-vagal/haemorrhagic
- Local suction pain
- Introduction of infection e.g. osteomyelitis
- Haemorrhage
- Overpuncture (injury to deep structures) e.g.great vessels

AMBU (ARTIFICIAL MANUAL BREATHING UNIT)

Self-inflating bag having the following parts

- Mouth piece/mask
  - AMBU bag proper
- O_2 connector
  - O_2 reservoir
- Pop-up valve

Indications

- Resuscitation of neonates as in-
  - Perinatal asphyxia
  - RDS
  - Apnoea e.g. sepsis, IVH
- Respiratory failure from any cause, e.g.
  - GBS
  - Pneumonia
  - Head injury
  - Severe acute asthma
  - Poisoning

Contraindications

- Diaphragmatic hernia
- Tracheo-oesophageal fistula (except high variety)

TONGUE DEPRESSOR

A tool, used to depress the tongue allowing the examination of mouth and throat.

Types: Metallic, Plastic, Wooden

Uses

To observe the throat and oral cavity clearly to note any sign of -

- Faucal diphtheria
- Tonsillitis
- Pharyngitis
- Retropharyngeal abscess
- Koplick's spot
- Oral thrush
- Palatal palsy
- Cleft palate, and also to
- Remove any foreign body from posterior part of tongue

THREE-WAY STOP COCK

Uses

- To facilitate administration of drugs or fluids through multiple channels in a single IV access
- Exchange Transfusion

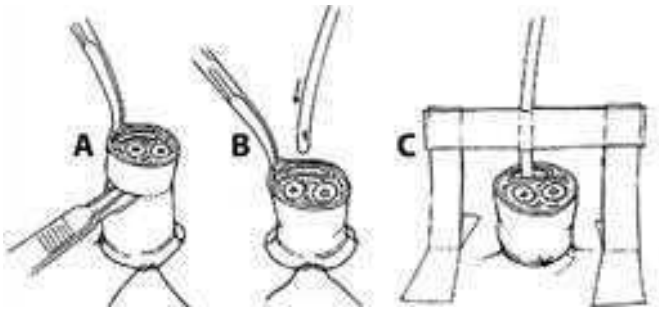
UMBILICAL VEIN CATHETERIZATION

This procedure is done in the first few days of life for–

- Infusion of a very sick newborn e.g. preterm VLBW baby, whose peripheral veins are not accessable
- Exchange transfusion (ET)

Procedure

- Clean the cord and surrounding skin with an antiseptic solution. Then tie a suture around the base of the cord



Steps in umbilical vein catheterization

- Cut the cord, 1-2 cm from the base with a sterile scalpel (A), Identify the umbilical vein (single, larger, thin walled vessel) and umbilical arteries (two thicker walled vessels). Hold the cord near the vein with sterile forcep
- Hold near end of the catheter with sterile forceps and advance it into the vein (it should pass easily) for 4-6 cms (B)
- Check that catheter is not kinked and that blood draws back easily; if not (when any block), pull back the catheter partly and re-introduce
- Secure with 2 sutures into the cord leaving 5 cm long suture ends. Tape suture and catheter (C)

After removing the catheter, apply pressure to the umbilical stump for 5-10 minutes

EXCHANGE TRANSFUSION (ET)

Indications

- Severe hyperbilirubinaemia secondary to haemolytic disease of newborn e.g. Rh or ABO incompatibility
- Sepsis, DIC
- Polycythaemia (partial exchange transfusion)
- Metabolic disorder causing severe acidosis
- Severe fluid-electrolyte imbalance

Aims of ET in Haemolytic Disease of Newborn

- To reduce hyperbilirubinaemia
- To correct anaemia
- To remove damaged and antibody coated RBCs
- To remove unfixed antibodies

Selection of Blood in ET

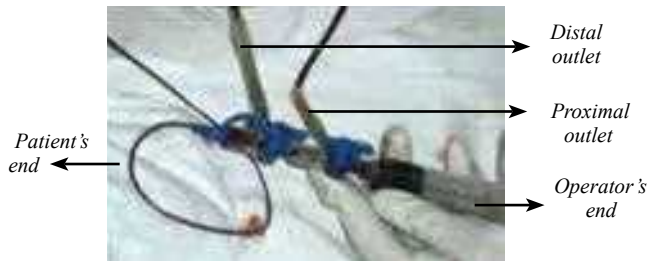
a) Rh-incompatibility: Rh-negative blood of same group as infant or O blood group compatible with serum of mother and infant

b) ABO incompatibility: O group of homologous rhesus type or mother's group should be used

(Ref. Absar N, Kawser CA. et al. BJCH 1985; 9(3);180-84)

Procedure

- The whole procedure is done in an isolated room with strict aseptic precautions. An assistant is needed to help, monitor and tally the volume of blood exchanged
- Umbilical catheterization is done first
- 2 three way stop cocks are attached end-to-end to make 4 ways



Exchange transfusion

- One way is connected with distal end of umbilical catheter and another (opposite) end is connected to 20 ml disposable syringe
- Distal sideway from the operator is connected to donor blood set
- Proximal sideway is connected to a saline set leading to an empty saline bag into which patient's blood is expelled out and discarded
- One round should be made to confirm the functioning of the ET set up. Then exchange is done by push-pull technique
- The amount of blood is removed that is tolerated by the infant. This is usually-
  - For <1500 gms: 5 ml.
  - For 2500 gms: 10 ml.
  - For <3500 gms 15 ml.
  - >3500 gms: 20 ml.
- The defined amount of blood is withdrawn first from the patient slowly and steadily, it is then expelled out through proximal sideway outlet, by keeping the inlet closed
- Then 15 ml of donor's blood is drawn from the suspended bag through distal sideway outlet, keeping the proximal one closed and this drawn blood is pushed slowly to the infant

- To prevent metabolic acidosis it was a common practice to inject Inj. Sodi-bi-carb (8.4%) 1ml after each 100ml of blood exchange, which is not indicated now a days. If the baby is symptomatically hypocalcaemic 1ml of Ca-gluconate can be given very slow I/V under monitoring of heart rate
- During ET, baby has to be kept warm and preferably done in open warmer. An intake output chart along with monitoring of heart rate, respiratory rate, temperature, colour any important events has to be noted
- At the end of procedure blood sample is sent for post exchange estimation of -
  - Serum bilirubin
  - Serum electrolytes
  - Serum calcium
  - Blood glucose level
  - Haemoglobin
- Serum bilirubin level has to be checked routinely
- If no further ET is required umbilical catheter is withdrawn and a dry sterile dressing is applied to the umbilicus
- After ET, phototherapy may be continued

Complications

- During Exchange
  - Air embolus • Volume imbalance • Acidosis
  - Arrhythmias • Respiratory distress
  - Hyperkalaemia • Anaemia/Polycythaemia
  - Fluctuating BP and cerebral blood flow
- After Exchange
  - Infection • Hypoglycaemia • Hypernatraemia
  - Thrombocytopenia • Polycythaemia or anaemia
  - Coagulopathy or neutropenia • Necrotising enyerocolitis • Blood borne infections
  - Graft versus host disease

SMALL VOLUME BLOOD TRANSFUSION

Requirements

- 50 cc syringe
- Blood bag with anticoagulant
- Blood transfusion set
- Butterfly niddle (19G)

Indications

When transfusion of small amount of blood is required for critically ill small infants, for their overall welbeing, as in–

- Severe anaemia
- Severe sepsis

Procedure

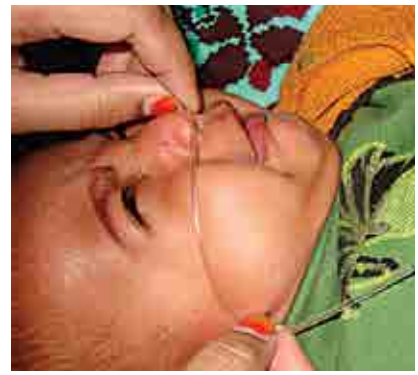
- First do blood grouping of both donor and recipient and cross-matching
- Wash hands thoroughly and then put on gloves
- Wash the donor's antecubital area with iodine and spirit throughly and cover the area with a sterile sheet
- Calculate the amount of blood to be transfused to the baby
- Draw anticoagulant in the 50cc syringe from the transfusion bag (3ml for each 20 ml blood, e.g. 3ml anticoagulant for 17ml donor's blood. Likewise 6 ml anticoagulant for 34 ml blood and so on..
- After taking requisite amount of anti-coagulant in the 50 cc syringe, empty the blood bag of the remaining anticoagulant
- Now draw the calculated amount of blood from the donor, puncturing the antecubital vein by19 G butterfly needle in the 50cc syringe and then transfer into the empty blood bag
- Finally, transfuse this blood to the infant following the standard procedure

Complications

Usual hazards of blood transfusion.

NASOGASTRIC (NG) TUBE INSERTION

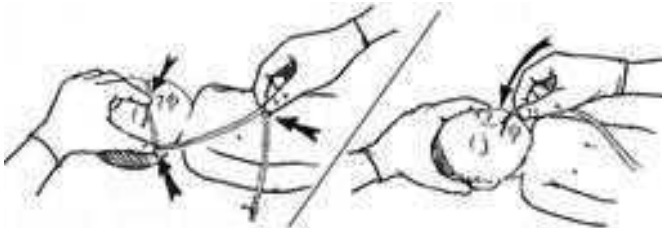
Insertion involves the placement of a tube into stomach via nose. The main purposes are to-



- Deflate stomach in acute abdomen
- Feed the preterm, very LBW, sick or neurologically unstable babies
- check patency or obstruction of oesophagus, when suspicion of esophageal atresia
- assess feed tolerance in preterm, LBW babies
- collect gastric lavage for AFB in tuberculosis
- check blood in gastric contents as occurs in NEC

Procedure

- Wash hands properly
- Hold the tip of the tube against the child's nose, measure the distance from the nose to the ear lobe, then from there to the xiphisternum (epigastrium)



- Mark the tube at this point
- Hold the child firmly. Lubricate the tip of the catheter with liquid paraffin and pass it through nostril, pushing slowly until it enters into the stomach without any resistance. When the measured distance is reached, fix the tube with tape at the nose
- Aspirate a small amount of stomach contents with a syringe to confirm that the tube is in place. If no aspirate is obtained, inject air down the tube and listen with a stethoscope over the abdomen
- If any doubt about the insertion, withdraw it and insert again

OROGASTRIC TUBE INSERTION

Insertion involves the placement of a tube into stomach via oropharynx for the purposes mentioned in NG tube feeding insertion.

NEBULIZATION

Parts

- Motor or pump
- Air inlet, air outlet
- Filter
- Air tube
- Mask
- Mixing chamber or cup
- T piece or mouth piece

Procedure

- Clean all the parts before use
- At first, attach the air tube to the air outlet of the machine
- Fit the air tube with mixing chamber and mask
- Take measured amount of drugs into the mixing chamber by syringe & mix with normal saline to make a total volume of 3 ml
- Connect the electrical line and turn on the switch
- Look whether fine mist (wet aerosol) is coming out through the mask adequately
- Place the child in upright position & facilitate to take slow deep breaths through mouth
- Put the mask to the face of the child covering nose and mouth adequately (not so tightly)
- Continue nebulization until fine mist is no longer present
- Clean the machine after use & store the drugs in right place

Drugs with dose

- Salbutamol (5 mg/ml): 0.15 mg(0.03 ml)/kg/dose to a maximum 5 mg (1 ml)/ Salbutamol (2.5 mg/2.5ml): 0.15 mg (0.15ml)/kg/dose.
- Ipratropium bromide: 250 µgm/dose

PEAK FLOW METER

It is a small hand-held device used to monitor a person's ability to breath-out air. It measures a person's strength of air-flow through the bronchi and thus the degree of obstruction in the airways.

Peak expiratory flow rate (PEFR)

It is the maximum speed of expiration of a person, as measured with a peak flow meter. If PEFR is higher, airway is well, but if lower, airway is contricted.

Parts

- Mouth piece
- Indicator/Cursor
- Measuring scale

Uses

- To assess the status of a patient with asthma & COPD
- To assess the efficacy of management in asthma, COPD

How to use?

1. Place the indicator at the base of the numbered scale
2. Stand up or sit in upright posture
3. Take a deep breath
4. Place the meter in mouth and close lips around the mouth piece. Do not put tongue inside the hole & do not put finger over measuring scale
5. Blow out as hard and fast as can
6. Write down the number you get
7. Repeat the steps 1 to 6 two more times
8. Write down the highest of the three numbers achieved

Peak Flow Meter usually not applicable for <5 years of age.

CAPILLARY BLOOD GLUCOSE MONITORING

Instruments

- Lancing device
- Gloves
- Gauze
- Alcohol as antiseptic
- Bandages and micropore tape
- Glucometer and strip

Puncture sites

- Finger stick (for older child): Palmar surface of the distal segment of the middle finger, ideally of the non-dominant hand
- Heel stick (for neonate and infant): Lateral or medial plantar surface of the heel

Amount of blood needed: 1 drop

Procedure

1. Keep the Glucometer & strip ready with appropriate code number
2. Wash hands and put on gloves
3. Advice the patient to sit or lie down
4. Select appropriate puncture site
5. Warm the puncture site
6. Clean the puncture site with disinfactant and allow it to air dry to provide effective disinfection
7. Puncture the skin with the disposable lancing device
8. Wipe away the first drop of blood with a dry gauze pad
9. Squeeze gently the puncture site to allow free flow of blood
10. Touch the test strip on to the blood drop and allow it to flow into the test strip in capillary action

When adequate amount of blood is drawn, Glucometer will automatically produce a beep sound and starts to function. Usually reading will appear within 10-15 seconds

- Dispose the used materials (gloves, gauze etc.) properly in a container approved for their disposal
- Remove gloves, wash hands before proceeding to the next patient

OXYGEN THERAPY IS LIFE SAVING

Delivery system

- Nasal canula/ nasal prong
- Masks e.g. simple mask, partial re-breather mask, non re-breather mask, ventury mask
- Oxygen hood
- Oxygen tent
- AMBU bag
- T-piece

Indications

- Central cyanosis
- Grunting
- Feeding difficulty due to respiratory distress
- Severe lower chest wall indrawing
- Head nodding
- Respiratory rate ≥ 70/min

Ways to give oxygen

- **Nasal prong:** These are short tubes inserted & placed just inside into the nostrils and secure with a piece of tape on it

Oxygen delivery: 1-2 L/min.
Humidification, not required

- **Nasal catheter:** This is a 6-8 FR catheter, which is passed to the back of the nasal cavity. The catheter is placed at a distance equal to that from the side of the nostrils to the inner margin of the eyebrow

Oxygen delivery: 1-2 L/min. Humidification, not required

- **Nasopharyngeal catheter:** This is a 6-8 FR catheter, which is passed to the pharynx just below the level of uvula. The catheter is placed at a distance equal to that from side of the nostrils to the front of ear

Oxygen delivery: 1-2 L/min. Humidification is required

- **Face mask**: Oxygen delivery, 5 L/min.

- **Head box:** Oxygen delivery, 7 - 10 L/min.

Side effects

- Fatigue
- Nasal dryness/bloody nose
- Morning headache

Chapter 41

Model OSPE for Practice

In this chapter few model OSPE stations are given comprising of X-rays, instruments, photographs, clinical & laboratory data and case scenarios. Students are advised to go through these and think of other possible questions related to the given OSPE stations. They can also be acquainted with other OSPEs from different other clinical problems in light of these examples to prepare themselves optimally for examination.

OSPE station: 1

Instruction to the student

Please look at the X-ray and answer the questions given below -

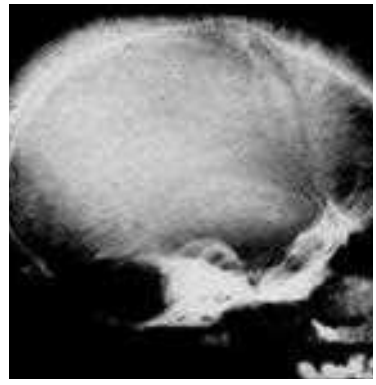
1. Name 3 findings in this X-ray.
2. What is the probable diagnosis?
3. Name 2 other radiological features you expect in this disease?
4. What is the basic pathology of the disease?
5. Write 2 common way of presentation.

OSPE station: 2

Instruction to the student

Please look at the X-ray and answer the following questions -

1. Write 3 important findings on this X-ray.
2. What is the likely diagnosis?
3. Write two important investigations to reach a diagnosis.
4. Name the major biochemical change in the blood that determine the pathological consequence of the disease.
5. Outline the principal of management.
6. What is the specific treatment of this condition?



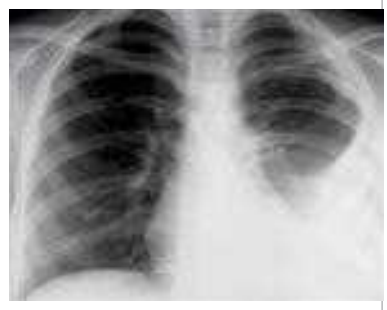
OSPE station: 3

CXR of a 7 years old boy with fever, cough & breathlessness

Instruction to the student

Please look at the X-ray and answer the following questions -

1. Write down 2 important findings in this X-ray.
2. What is your radiological diagnosis?
3. Mention 2 important diseases that may give rise to these findings.
4. Write the findings on chest examination that you expect here
5. What investigations will you do to confirm the diagnosis?



OSPE station: 4

Instruction to the student

Please look at the X-ray and answer the following questions -

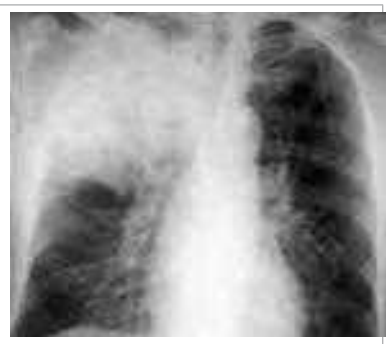
1. Mention 3 findings that you see in this X-ray.
2. What is your radiological diagnosis?
3. Mention 3 important information that you may need in history.
4. Name 5 relevant investigations that will help you to reach the diagnosis.

OSPE station: 5

Instruction to the student

Please look at the X-ray and answer the questions given below -

1. Write down the findings present in this chest X-ray.
2. What is your radiological diagnosis?
3. Mention 3 important organisms responsible for this change.
4. Write the findings on chest examination that you expect in this patient.
5. Name 3 important complications those may occur if it remains untreated.



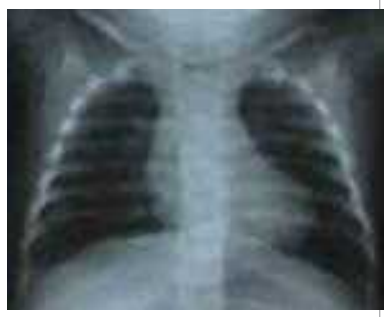
OSPE station: 6

This is an X-ray of a 12 months old boy presented with blue lips since birth and growth failure.

Instruction to the student

Please look at the X-ray and answer the following questions -

1. What do you see in this chest X-ray ?
2. What is your radiological diagnosis?
3. What the cardiac anomalies that is present in this disease?
4. Write 3 important complications of this disease.



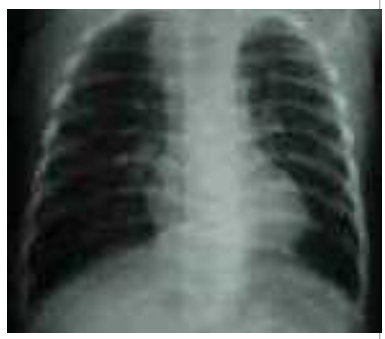
OSPE station: 7

This is an X-ray of a 7 months old child admitted with cough, wheeze & breathlessness.

Instruction to the student

Please look at the x ray and answer the following questions -

1. Mention 3 important findings present in this chest X-ray.
2. What is your radiological diagnosis?
3. Name the most important organism responsible for this disease.
4. What is the mainstay of treatment of this illness?

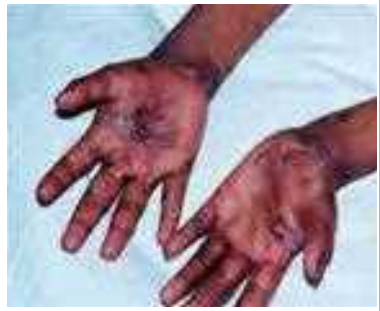


OSPE station: 8

Instruction to the student

Please look at the photograph and answer the questions -

1. What do you see in the photograph?
2. What is the most likely diagnosis?
3. What organism is responsible for the disease?
4. Write down the systemic complication related to this skin lesion.
5. Write down two drugs used to treat this skin lesion.



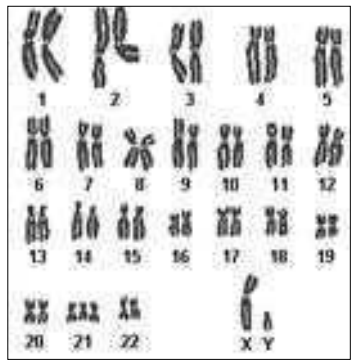
OSPE station: 9

This is the karyotype of a 6 month old baby from a 36 years old mother. This baby was not growing properly, facing difficulties to feed and had a systolic murmur on precordial examination.

Instruction to the student

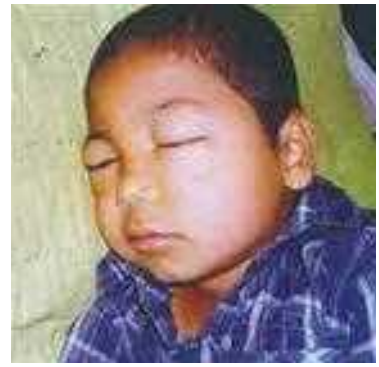
Please look at the photograph and answer the questions -

1. Write comment on the above karyotype.
2. What is your diagnosis?
3. Write 5 important clinical features of this baby.
4. Write 3 important cardiac defects associated with this condition.



OSPE station: 10

This photograph is taken from a 6 years old child presented with generalized oedema and scanty urine.



Instruction to the student

Please look at the photograph and answer the questions -

1. What is your provisional diagnosis?
2. Name 4 important investigations with findings that will help to reach the diagnosis.
3. Name 5 important complications that may develop in this disease.
4. Write the treatment of this disease.

OSPE station: 11

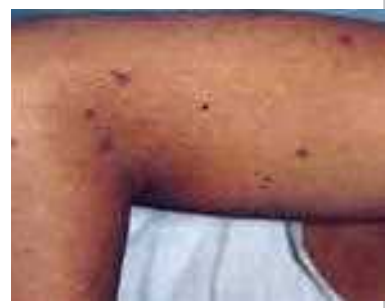
Instruction to the student

Please look at the photograph and answer the questions -

1. Mention 3 important features evident in this photo.
2. Mention 4 questions that you need to ask the mother to reach a diagnosis.
3. What investigation will you do to diagnose this child?
4. What complications can arise if this patient remains untreated?
5. What is the treatment of the disease and for how long?

OSPE station: 12

This photograph is from 6 years old boy who presented with gum bleeding and purpuric spots following an episode of viral infection 14 days back. O/E he was mildly anaemic and had no organomegaly.



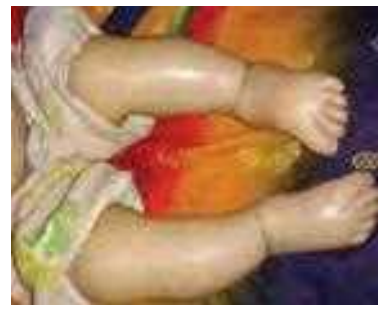
Instruction to the student

Please look at the photograph and answer the questions -

1. What is your likely diagnosis?
2. Write down 2 important investigations with expected findings to reach the diagnosis.
3. Write down the treatment options for this disease.

OSPE station: 13

This is a photograph of a 2 years boy from a very poor family weighing 5kg who was admitted with skin change and bipedal oedema.



Instruction to the student

Please look at the photograph and answer the questions -

1. Why these changes happen to the child?
2. What changes in the eyes can occur in this child?
3. Summerize the skin abnormalities you can see.
4. Write down the expected anthropometric findings in this child?
5. Outline the steps of management of this case.

OSPE station: 14

Instruction to the student

Please look at the instrument provided and answer the question -

1. Identify the instrument.
2. Write down indications of its use.
3. Mention 4 contraindications of its use.

OSPE station: 15

Instruction to the student

Please look at the instrument provided and answer the questions -

1. Identify the instrument.
2. Write 4 important indications of its use.
3. Mention the sites for doing the procedure by this instrument.

OSPE station: 16

Instruction to the student

Please look at the instrument provided and answer the questions -

1. Identify the instrument.
2. Mention 2 important clinical use of it in paediatric patients.
3. Mention 5 important differential diagnoses of white patches in throat.

OSPE station: 17

A 7 years old girl presented with fever, swelling of knee and ankle joints one after another for 5 days & chest pain for last 2 days. Her lab reports showed Hb 11gm/dl, TC of WBC 15,000/cmm, neutrophil 78%, lymphocyte 18%, monocyte 2%, ESR 56 mm, CRP 24 mg/L and ASO titre 600 IU/L

Instruction to the student

Go through the scenario and answer the following questions-

1. What abnormalities are present in the data?
2. What is your likely diagnosis?
3. Name 4 other investigations you think relevant to this case.
4. What immediate measure will you take in this case?
5. What long term complications can develop if this patient is not managed properly?

OSPE station: 18

A 6 years old boy presented with irregular fever, anorexia and occassional gum bleeding for last 1 month. His CBC showed Hb 6gm/dl, TC of WBC 32000/cmm, neutrophil 28%, lymphocyte 68% and atypical cells 4%, platelet count 36000/cmm.

Instruction to the student

Go through the scenario and answer the following questions-

1. Summerise the abnormalities in the Haemogram.
2. What is your likely diagnosis?
3. What findings do you expect in physical examination and in the peripheral blood film?
4. How will you confirm the diagnosis?
5. Name the different steps of treatment of the disease.

OSPE station: 19

A 14 months old child presented with high fever and vomiting for 2 days and few attacks of generalized convulsions prior to hospitalization. His CSF was hazy and had glucose 26 mg/dl, protein 130 mg/dl, chloride 98meq/l, cells 200/cmm mostly neutrophil.

Instruction to the student

Go through the scenario and answer the following questions-

1. Comment on the case scenario.
2. What is the diagnosis?
3. Name 2 common organisms responsible for this problem.
4. Outline the treatment plan for this child.
5. Name 4 complications that may occur, if not properly treated.

OSPE station: 20

Lab reports of an 8 years old boy who presented with polyuria and short stature revealed Hb 7g/dl, platelet count 2,00,000/cmm, S. creatinine 260 µmol/L, Blood urea 10 mmol/L, S. K+ 2.6 mmol/L, S. Ca++ 2.2 mmol/L, increased S. PO4 and blood pH 7.2.

Instruction to the student

Go through the scenario and answer the following questions -

1. What abnormalities do you see in the lab data?
2. What is your probable diagnosis?
3. Name 4 important clinical presentations of this patient.
4. Outline 5 principles of management.
5. What is the specific treatment for this patient?

OSPE station: 21

A 20 hours old baby presented with jaundice of face, trunk and palm.

Instruction to the student

Go through the scenario and answer the following questions -

1. Enumerate 2 possible important causes of this jaundice.
2. Write 5 investigations which will help to explain the aetio-pathogenesis.
3. Write down 2 options of treatment required for this baby.
4. What can happen if this baby remains untreated?

OSPE station: 22

A 3 years old boy who had been suffering from recurrent cough and wheeze suddenly developed severe respiratory distress. On examination you noted profuse rhonchi in both lungs.

Instruction to students

Go through the scenario and answer the following questions-

1. What is your diagnosis?
2. Name 5 important parameters to be used to assess the severity of the condition.
3. Outline 5 immediate steps of managing the situation.
4. What informations do you think important to classify the disease?

OSPE station: 23

A 9 months old child weighing 7 kg is admitted with frequent, loose watery stool & vomiting for last 2 days.

Instruction to students

Go through the scenario and answer the following questions-

1. What clinical parameters will you consider to assess the dehydration of this child?
2. Name 3 important organisms responsible for this diarrhoea.
3. Write 2 investigations important for this case.
4. Outline the management of this child if he is severely dehydrated.
5. What fluid can be used to rehydrate this child?
6. Name 3 important complications, those can arise if he is not properly rehydrated?

OSPE station: 24

A 15 months old girl is admitted with low grade fever, runny nose, barking cough, stridor and breathing difficuly.

Instruction to students

Go through the scenario and answer the following questions-

1. What is your likely diagnosis?
2. Write down 3 important organisms responsible for this illness.
3. What simple investigation will help to diagnose the case?
4. Write 4 important options of treatment.

OSPE station: 25

Please go through the following CSF data of a 18-month old child who presented with fever and recurrent attacks of generalized convulsions and answer the attached questions -

a. Pressure: High
b. Appearance: Hazy
c. WBC: 320/cmm
d. Protein: 97 mg/dl
e. Glucose: 40 wgl/dl
f. Chloride: 96 mmol/L

1. What abnormality do you see here?
2. What is the likely diagnosis?
3. What organism, commonly associated with?
4. Write the name of the drugs, effective here

OSPE station: 26

Instruction to students

Go through the scenario given below and answer the questions -

A 7-year old boy is admitted with puffy face & history of scanty high coloured urine. His laboratory reports are given below-

a. Urine R/M/E shows RBC, RBC cast, Mild proteinuria
b. Blood biochemistry shows S.Na^+ : 130 mmol/L, K^+ 5.2 mmol/L, CI : 95 mmol/L, S. Creatinine : 1.6 mg/dl.

1. What is your inference from the laboratory data?
2. Write down the diagnosis?
3. Name one drug which is required immediately.
4. Name 3 complications of this disease.

OSPE station: 27

Instruction to students

Go through the given clinic-haematological profile of a 3-year old boy who presented with gum bleeding and answer the following questions -

a. HP : 10gm/dl,
b. WBC : 9000/cmm
c. 40,000/cmm
d. PBF : Non-specific
e. BT : 10 minute
f. CT : 6 minute

1. What is the likely diagnosis?
2. What investigations will help you to confirm the diagnosis?
3. What are the treatment options?

Annexure

RECIPE/COMPOSITION OF

(a) F-75 and F-100

Type of milk	Ingredients	Amount for F-75 	Amount for F-100 
Dried skimmed milk	Dried skimmed milk	25 g	80 g
	Sugar	70 g	50 g
	Cereal flour	35 g	--
	Vegetable oil	30 g (or 35 ml)	60 g (or 70 ml)
	Electrolyte Mineral mix	20 ml	20 ml
	Water: make up to	1000 ml	1000 ml
Dried whole milk	Dried whole milk	35 g	110 g
	Sugar	70 g	70 g
	Cereal flour	35 g	--
	Vegetable oil	20 g (or 20 ml)	30 g (or 35 ml)
	Electrolyte Mineral mix	20 ml	20 ml
	Water: make up to	1000 ml	1000 ml
Full-cream cow's milk	Full-cream cow's milk	300 ml	880 ml
	Sugar	70 g	75 g
	Cereal flour	35 g	--
	Vegetable oil	20 g (or 20 ml)	20 g (or 20 ml)
	Electrolyte Mineral mix	20 ml	20 ml
	Water: make up to	1000 ml	1000 ml

(b) Oral Re-hydration Salt [ORS]

Composition	WHO ORS (Low osmolarity) g/L	WHO ORS (Old) g/L
Glucose	13.5	20
NaCl	2.6	3.5
Trisodium citrate	2.9	2.9
KCl	1.5	1.5
Molar contents	**mmol/L**	**mmol/L**
Glucose	75	111
Na	75	90
K	20	20
Cl	65	80
Citrate	10	10
Total osmolarity	**245 mmol/L**	**311 mmol/L**

(c) ReSoMal Oral Re-hydration solution

Ingredients	Amount
Water (boiled and cooled)	850 ml
WHO-ORS (New low osmolarity formulation)	One 500 ml packet
Sugar	20 g
Electrolyte-mineral solution	16.5 ml

(d) Electrolyte content of various body fluids

Fluid source	Na^+ (mmol/L)	K^+ (mmol/L)	Cl^- (mmol/L)
Stomach	20-80	5-20	100-150
Small intestine	100-140	5-15	90-120
Ileostomy	45-135	5-15	20-120
Diarrhoeal stool	10-90	10-80	10-110

(e) Electrolyte-mineral solution

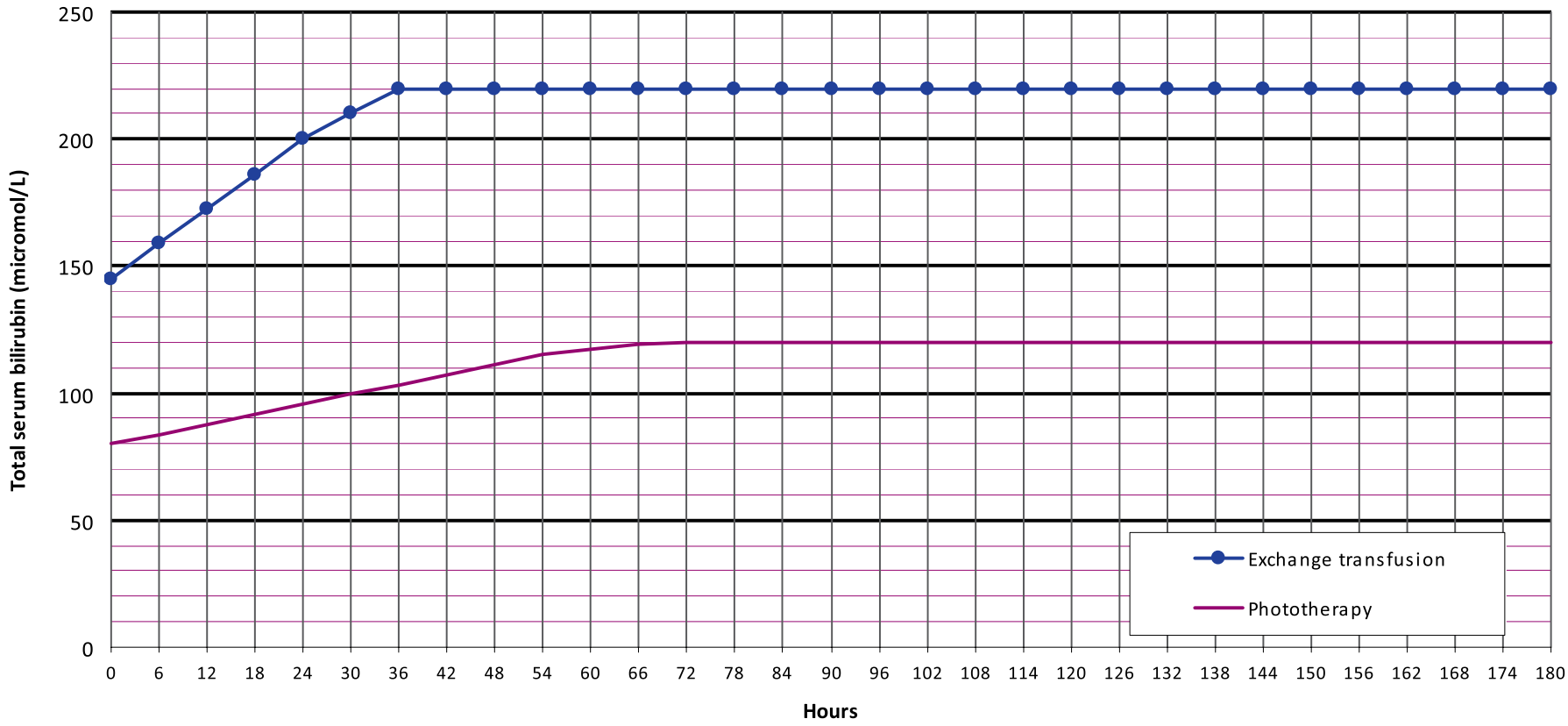
Ingredients	Quantity (g)	Molar content of 20 ml
Potassium Chloride	224	24 mmol
Tri-potassium Citrate	81	2 mmolv
Magnesium Chloride	76	3 mmol
Zinc Acetate	8.2	300 µmol
Copper Sulphate	1.4	45 µmol
Water: make up to	2500 ml	

Weight band table for 'NEW'/Upcoming FDCs for TB

Weight Bands (Kg)	Number of Tables		
	Intensive Phase		Countinuation Phase
	RHZ (mg)	E (mg)	RH (mg)
	75/50/150 per tablet	100 per tablet	75/50 per tablet
4-7	1	1	1
8-11	2	2	2
12-15	3	3	3
16-24	4	4	4
25+	Use adult dosages and preparations		

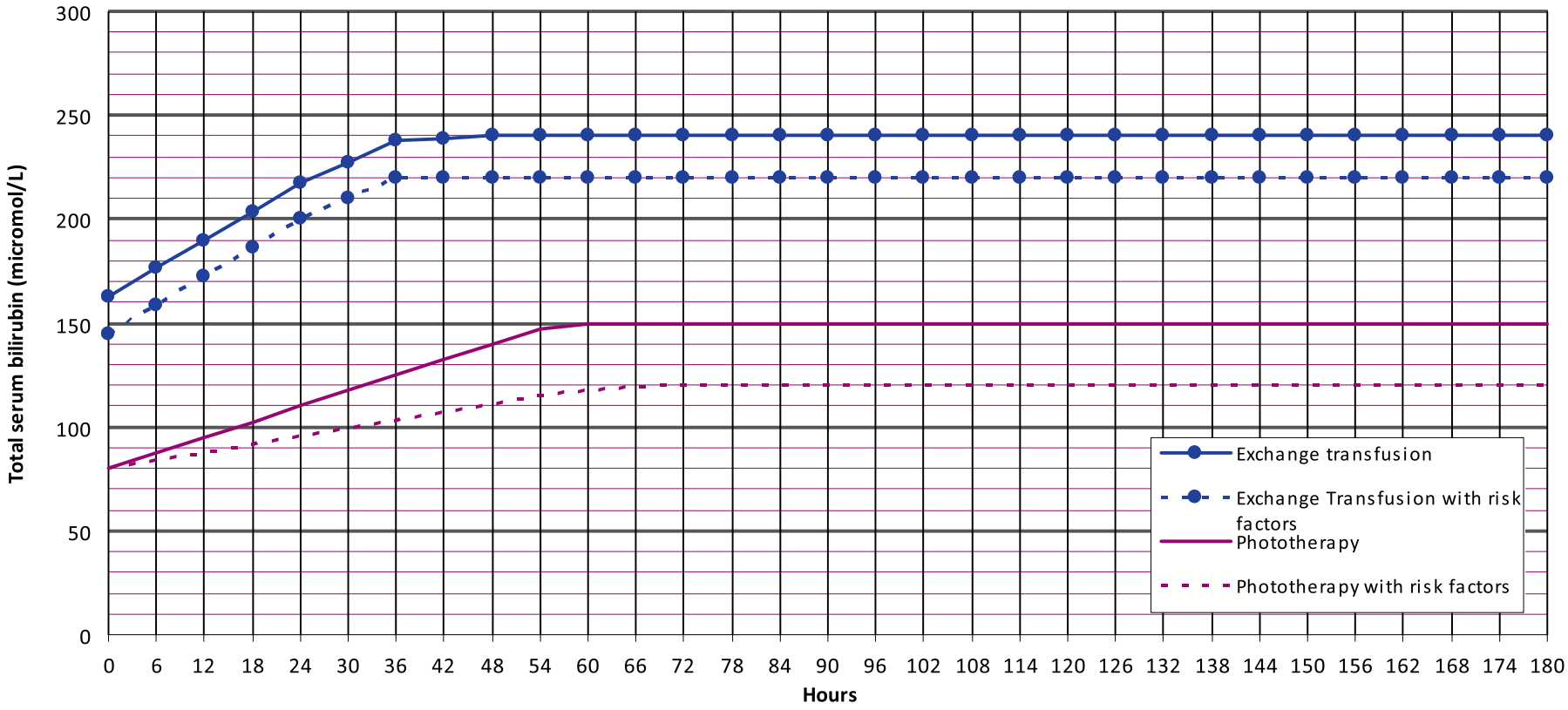
Jaundice management for babies born at <35 weeks, <1000g

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
    a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
    b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy



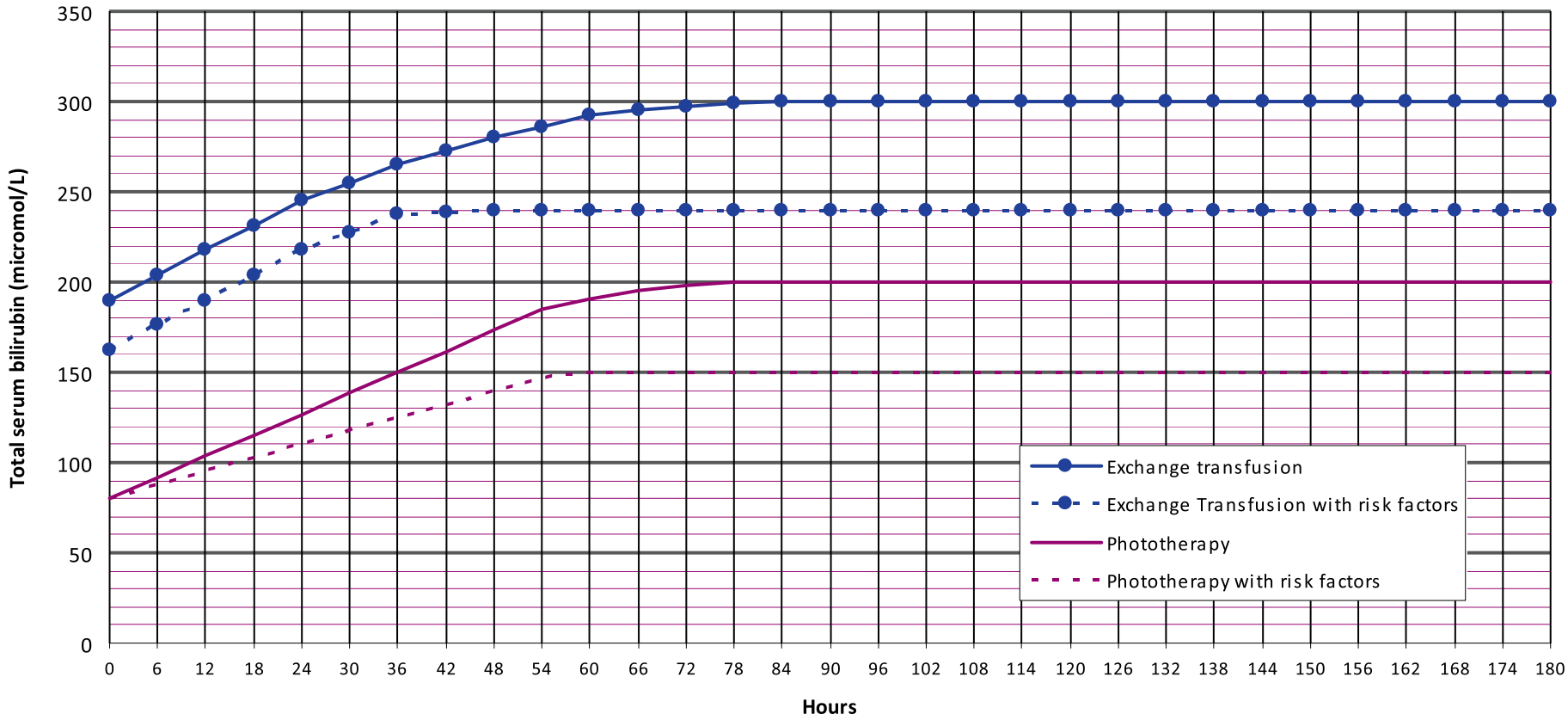
Jaundice management for babies born at <35 weeks, 1000g - 1499g

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
    a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
    b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy



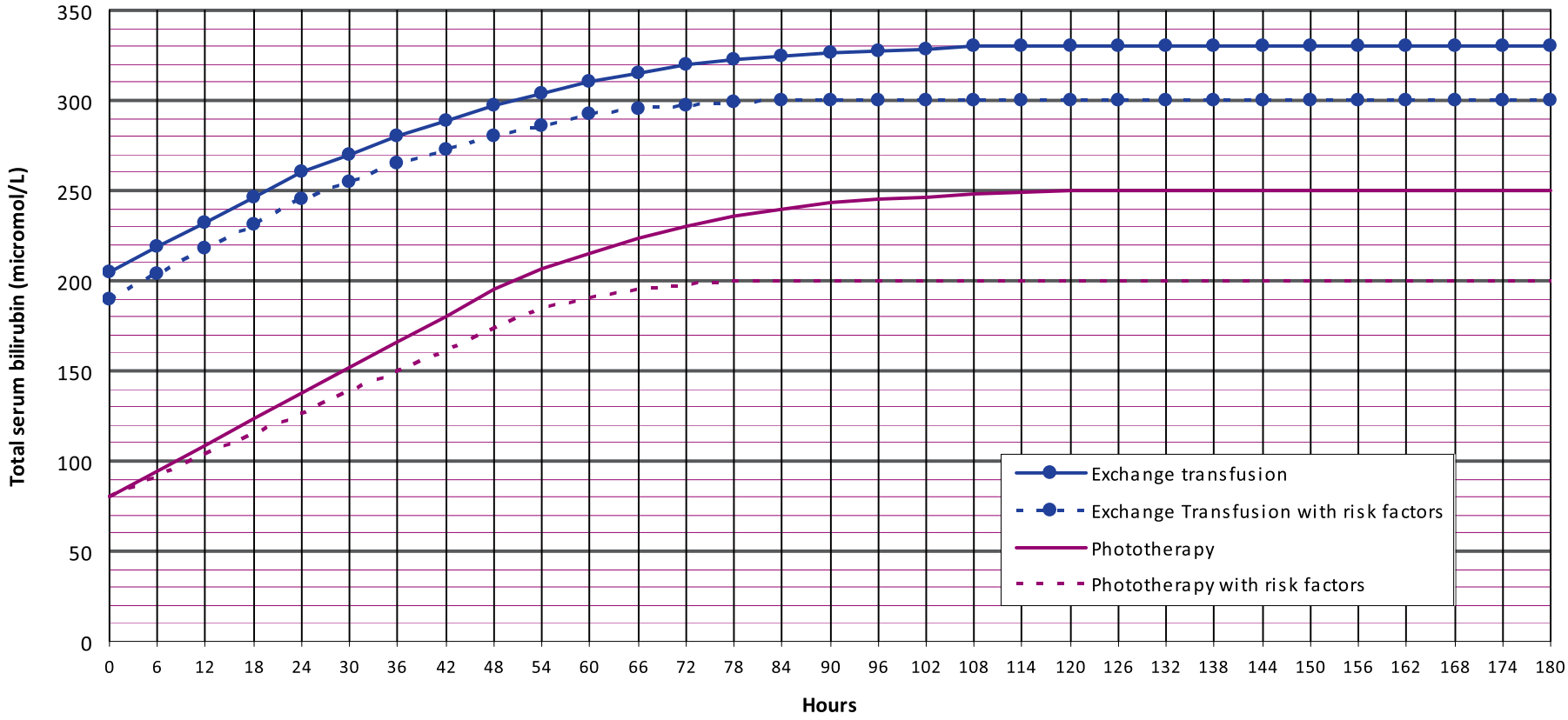
Jaundice management for babies born at <35 weeks, 1500 - 1999g

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
    a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
    b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy



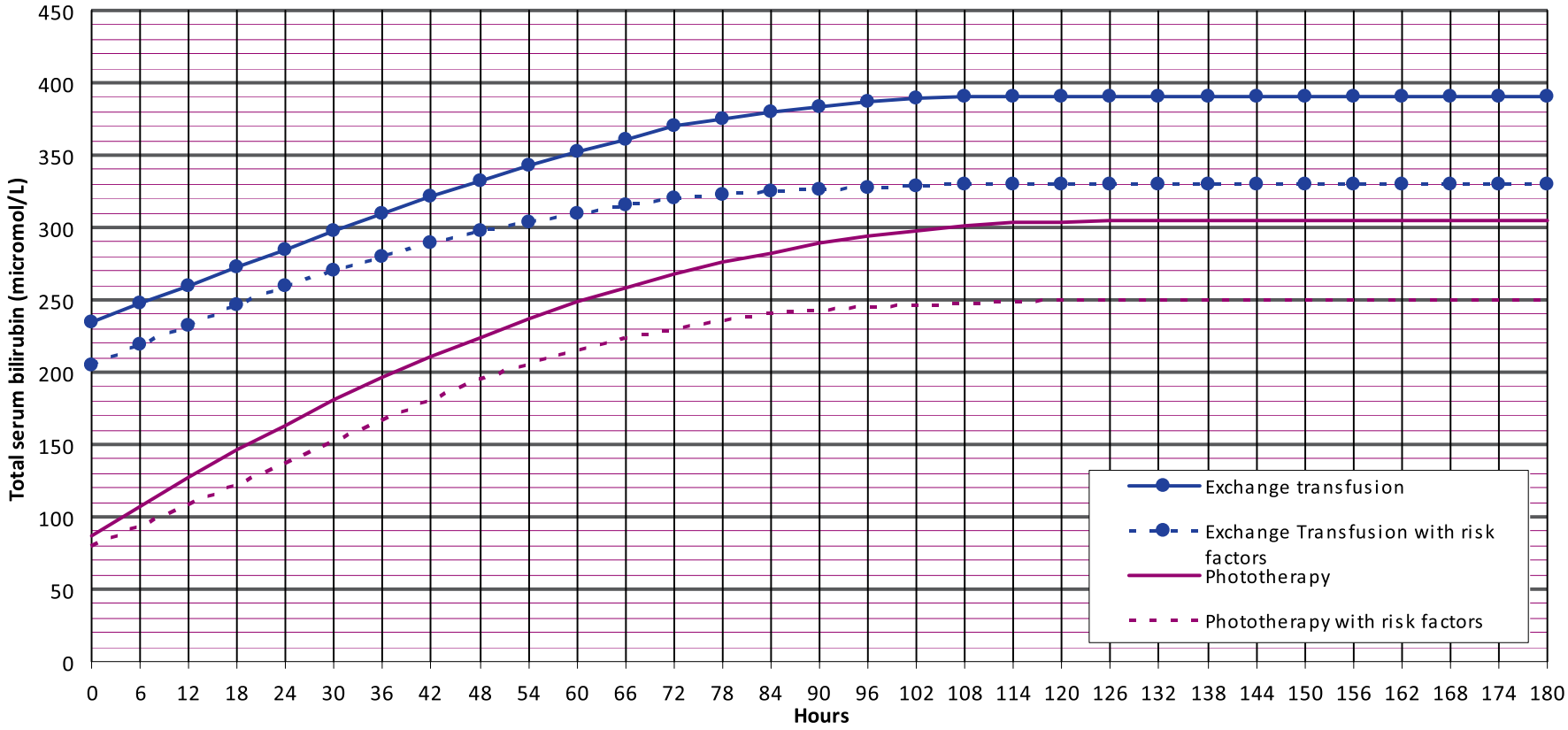
Jaundice management for babies born at <35 weeks, >1999g

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
    a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
    b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy



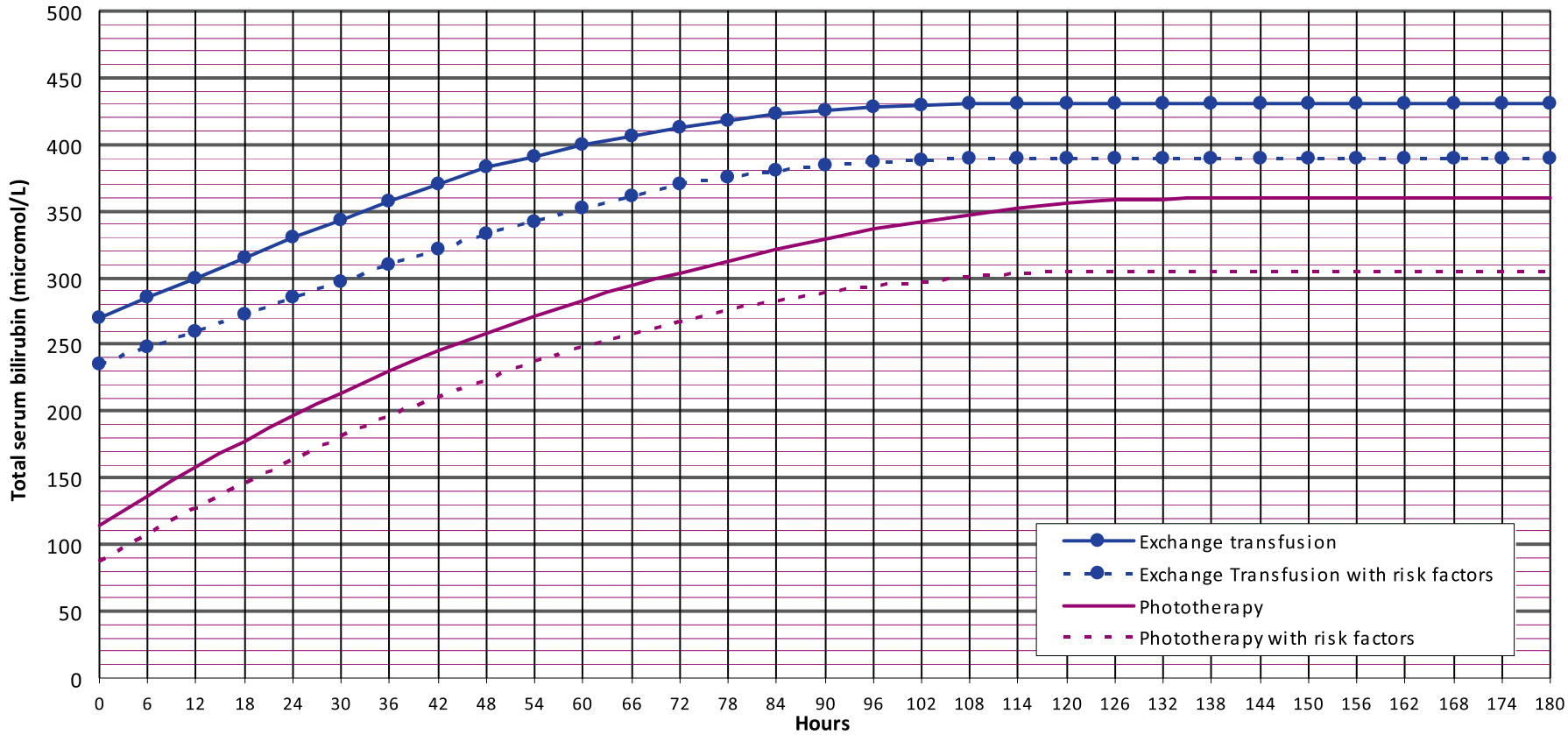
Jaundice management for babies born at 35 - 37+6 weeks

1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
    a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
    b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy

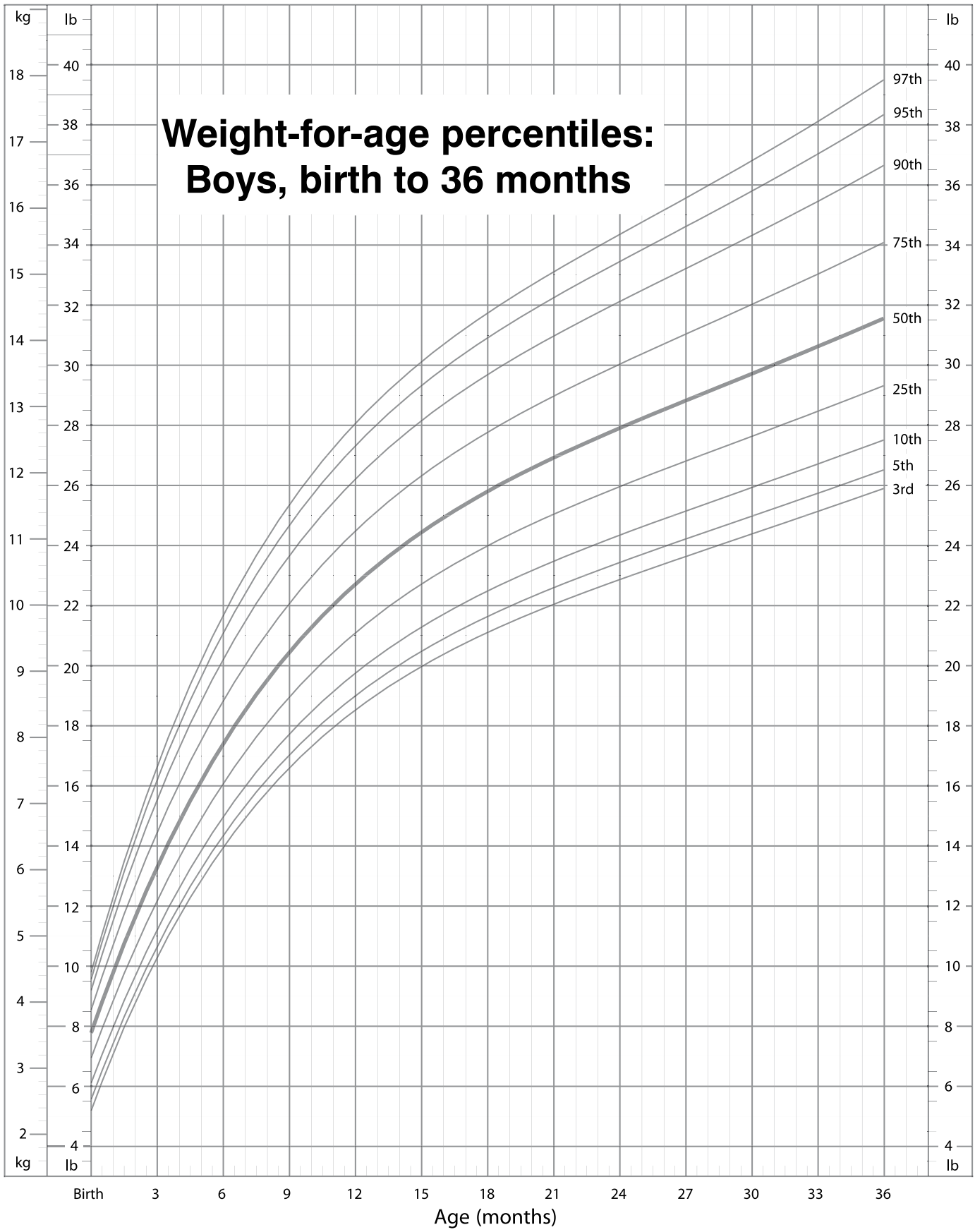


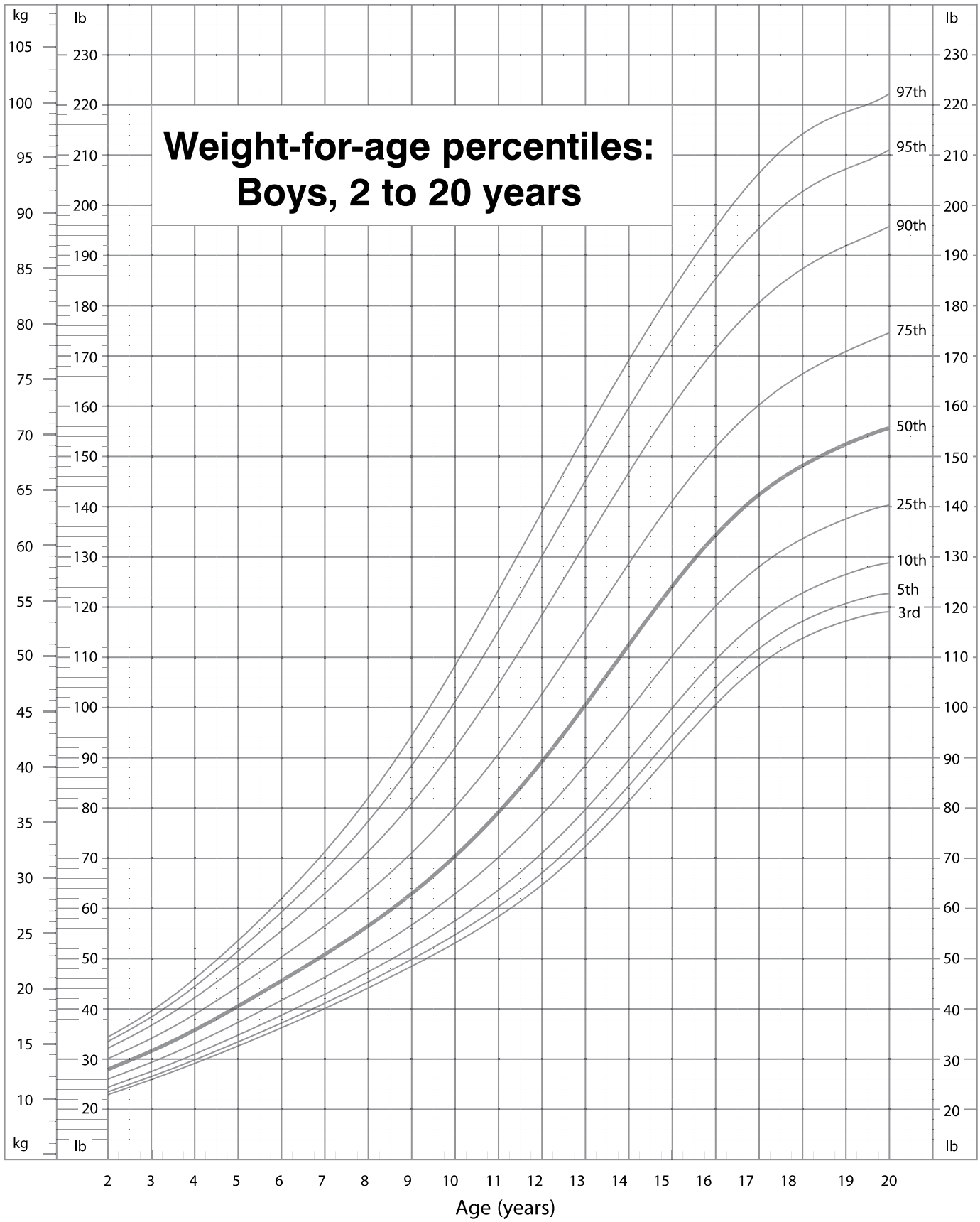
Jaundice management for babies born at 38+0 weeks or older

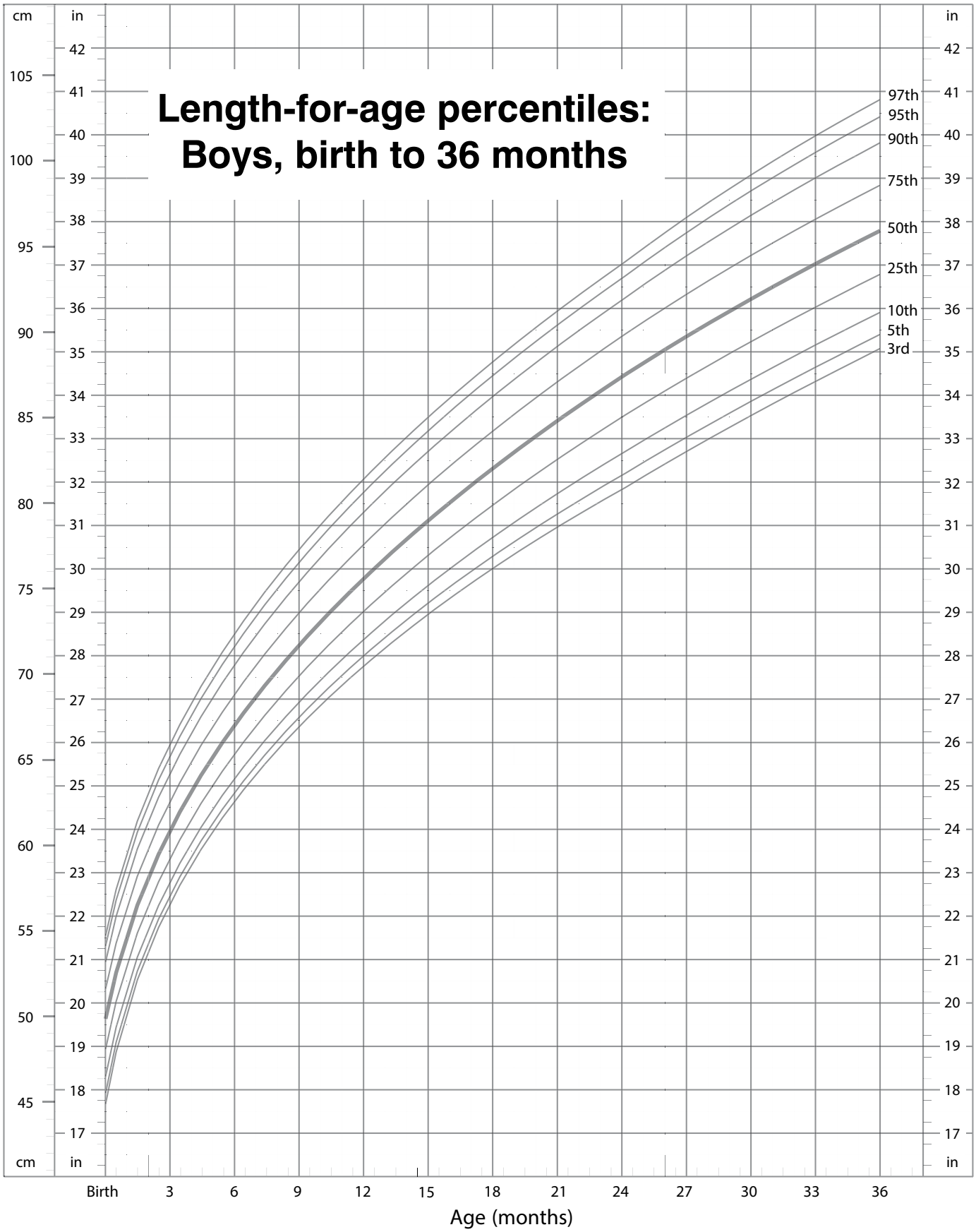
1. In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.
2. Infants greater than 12 hours old with total serum bilirubin (TSB) level 1-50 micromol/L below the line should have repeat TSB within 6-24 hours.
3. Babies under phototherapy:
    a. Consider measuring the TSB 4-6 hourly until the rise of serum bilirubin is known to be controlled, then measure TSB 12-24 hourly
    b. Stop phototherapy if TSB greater than 50 micromol/L below line and recheck in 12-24 hours.
4. Infants who present with TSB above threshold should have an exchange transfusion done if the TSB is not expected to be below the threshold after 6 hours of intensive phototherapy.
5. An immediate exchange transfusion is recommended if there are signs of bilirubin encephalopathy

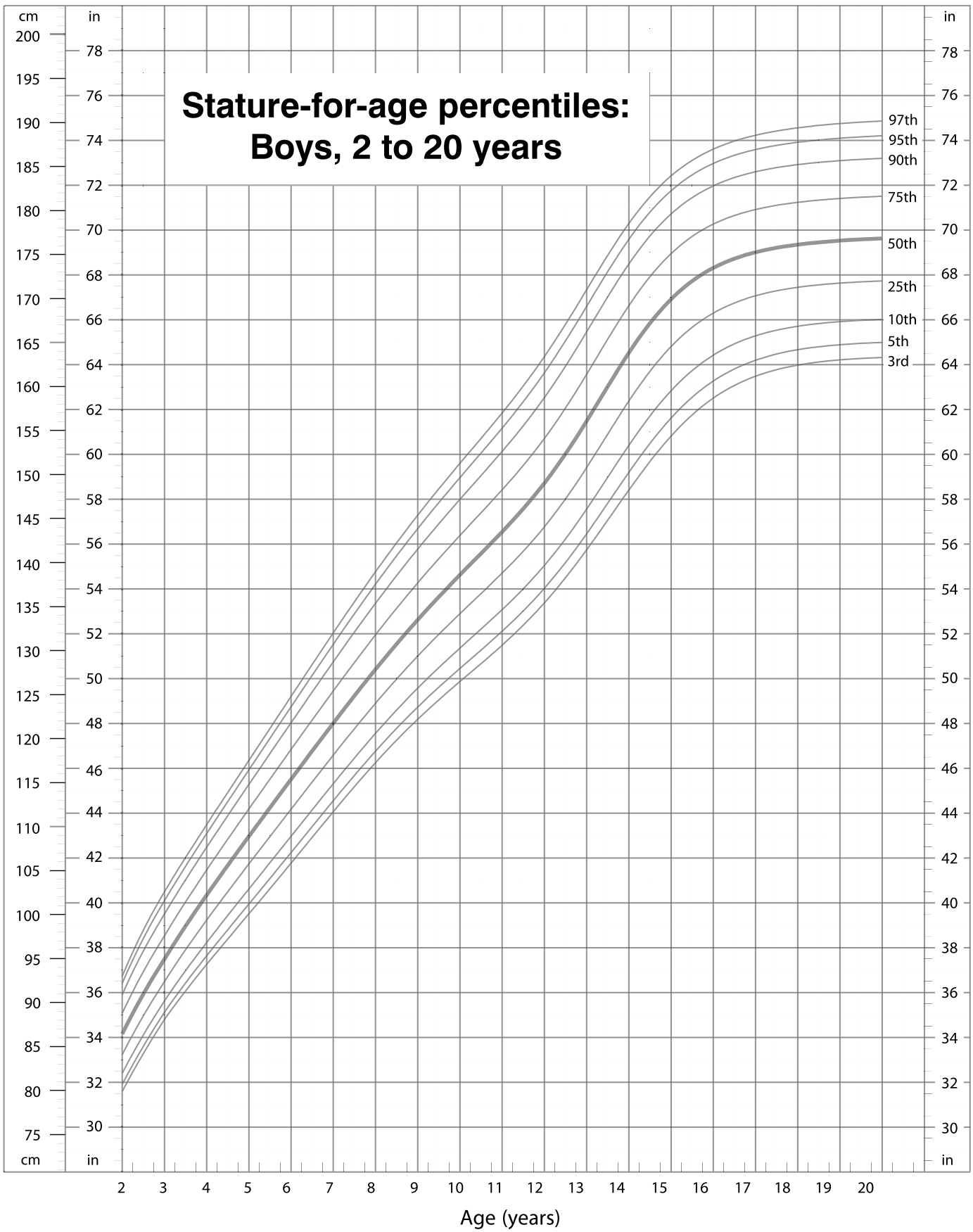


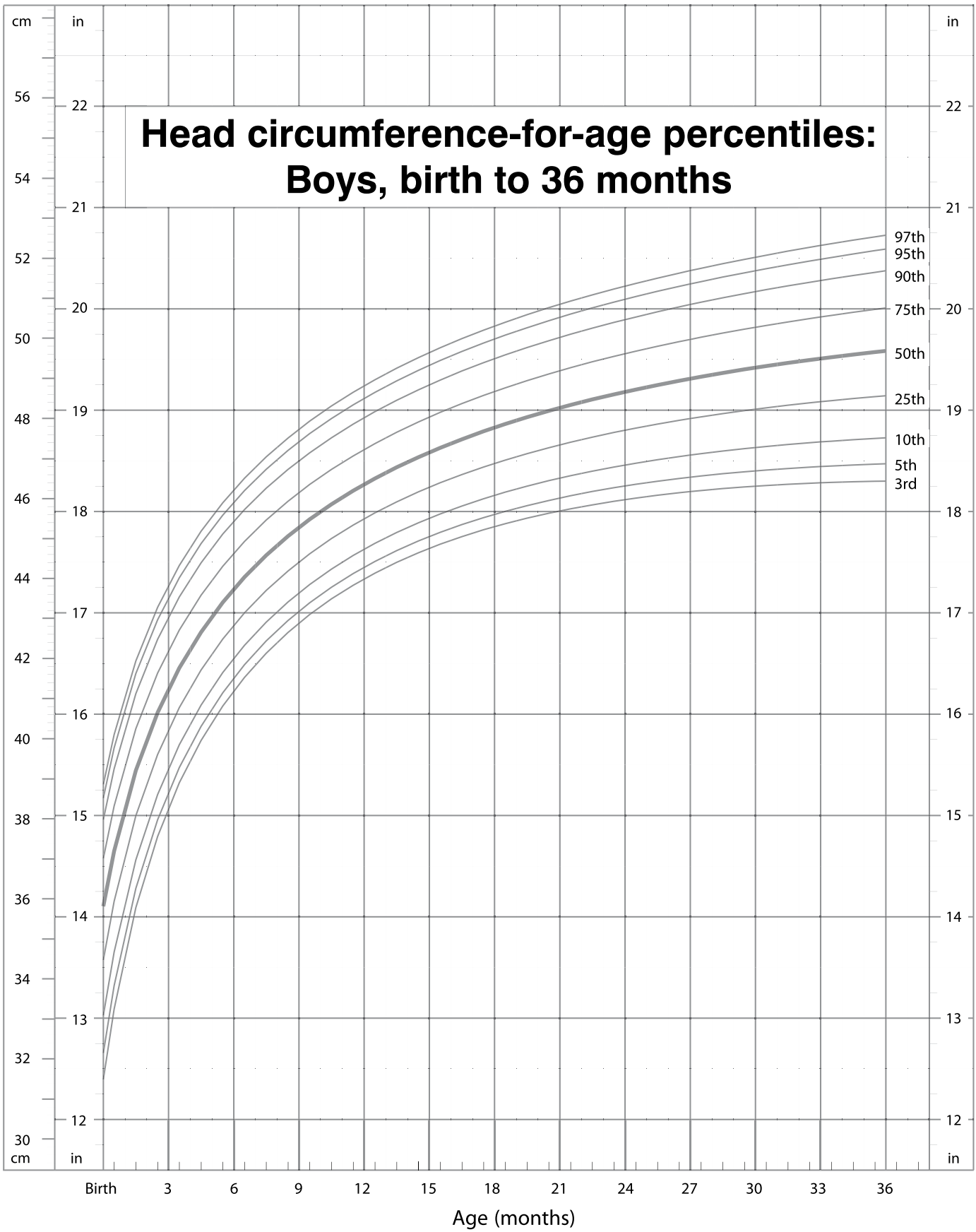
1. American Academy of Pediatrics Subcommittee on Hyperbilirubinaemia, 2. Clinical Practice Guideline: Management of hyperbilirubinaemia in the newborn infant 35 or more weeks of gestation. Pediatrics.2004; 114:297-316, 3. Horn A. et al. Phototherapy and exchange transfusion for neonatal hyperbilirubinaemia: neonatal academic hospitals' consensus guidelines for South African hospitals and primary care facilities. South African Medical Journal, 2006; 96(9):819-24, 4. Morris BH et al. Aggressive vs conservative phototherapy for infants with extremely low birth weight. New England Journal of Medicine. 2008; 359(18):1885-96, 5. Queensland Maternity and Neonatal Clinical Guideline: MN12.7-V4-R17 Neonatal jaundice

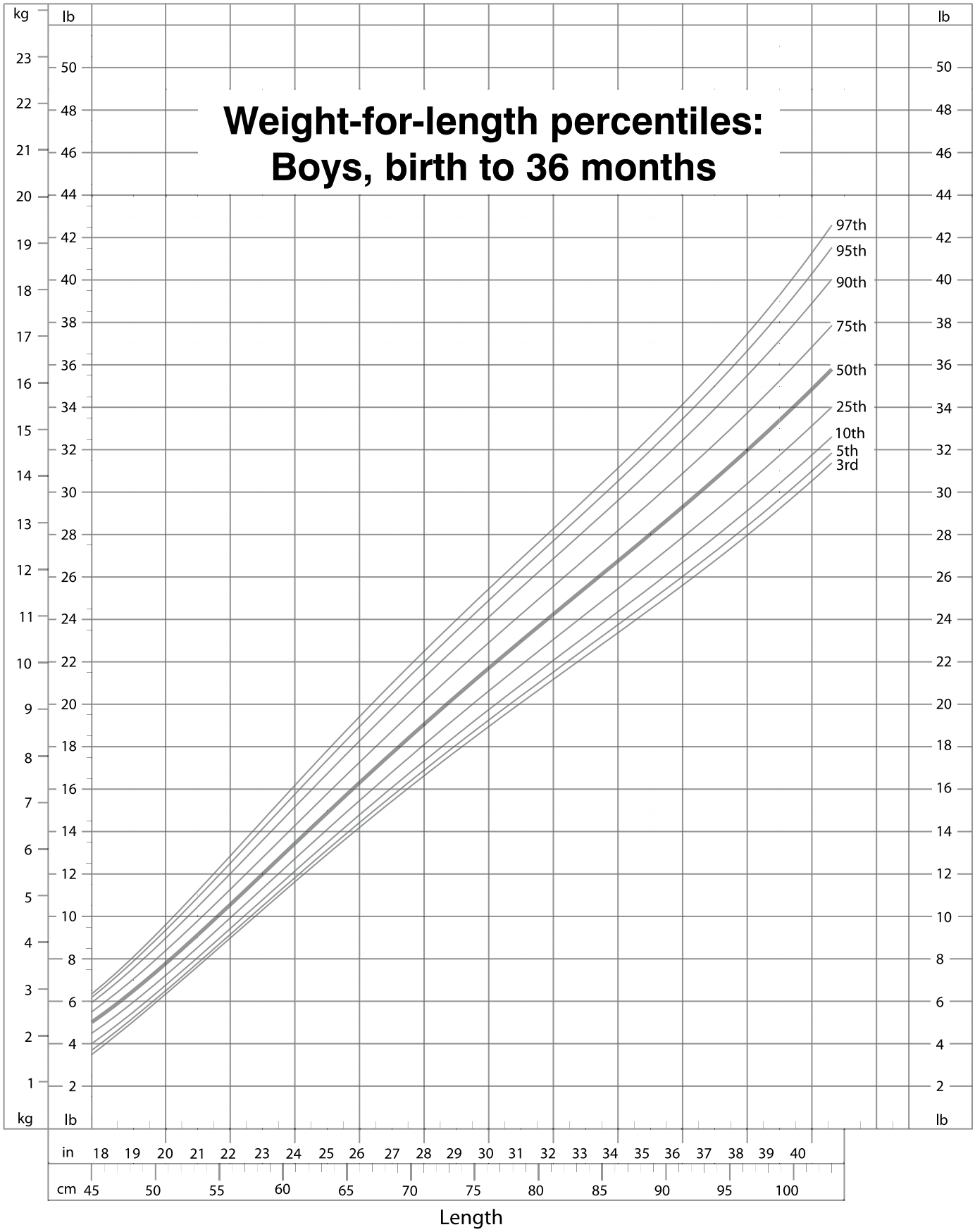

Weight-for-age percentiles:
Boys, birth to 36 months
kg
lb
97th
95th
90th
75th
50th
25th
10th
5th
3rd
Birth
3
6
9
12
15
18
21
24
27
30
33
36
Age (months)

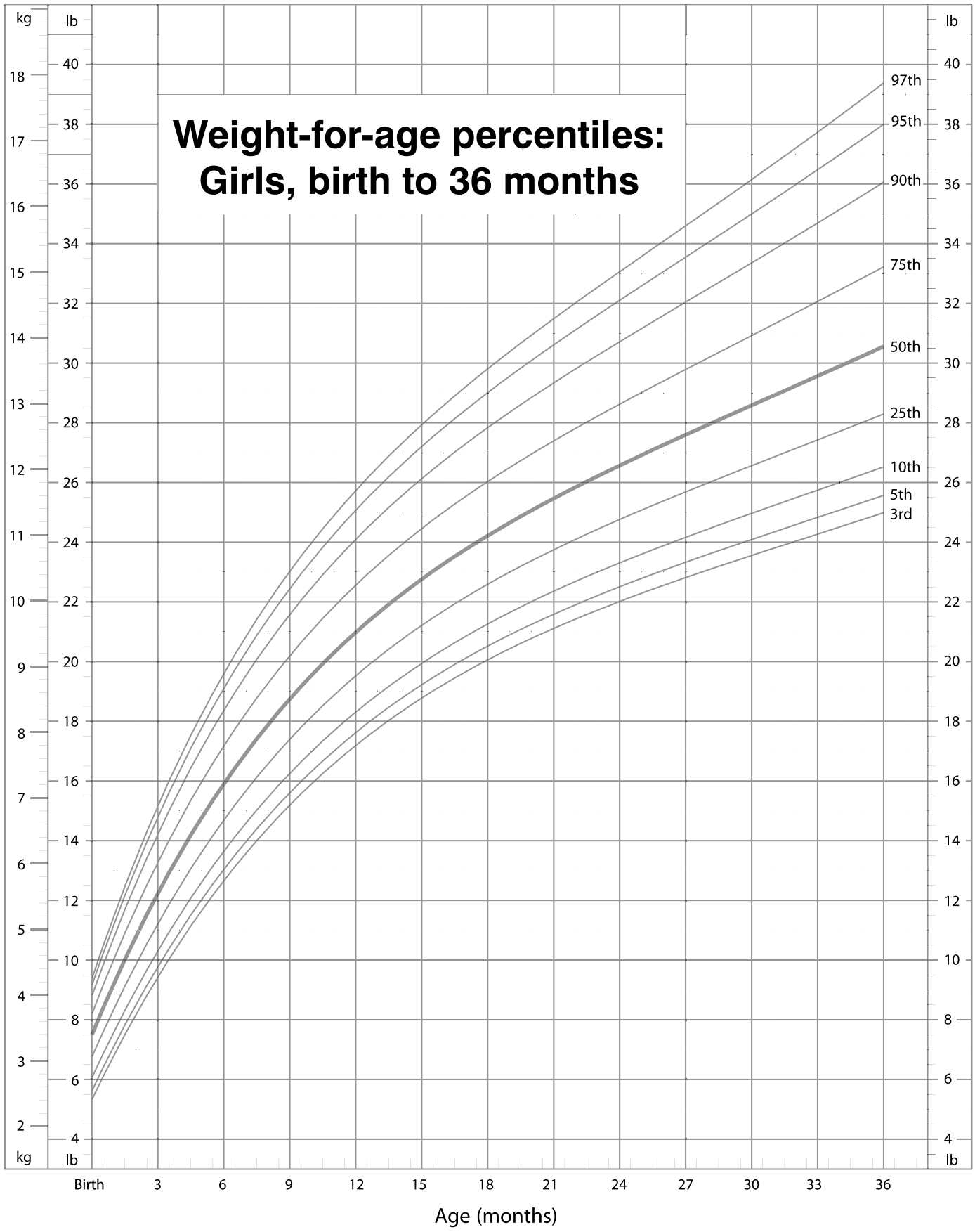

Weight-for-age percentiles:
Boys, 2 to 20 years
kg
lb
97th
95th
90th
75th
50th
25th
10th
5th
3rd
Age (years)

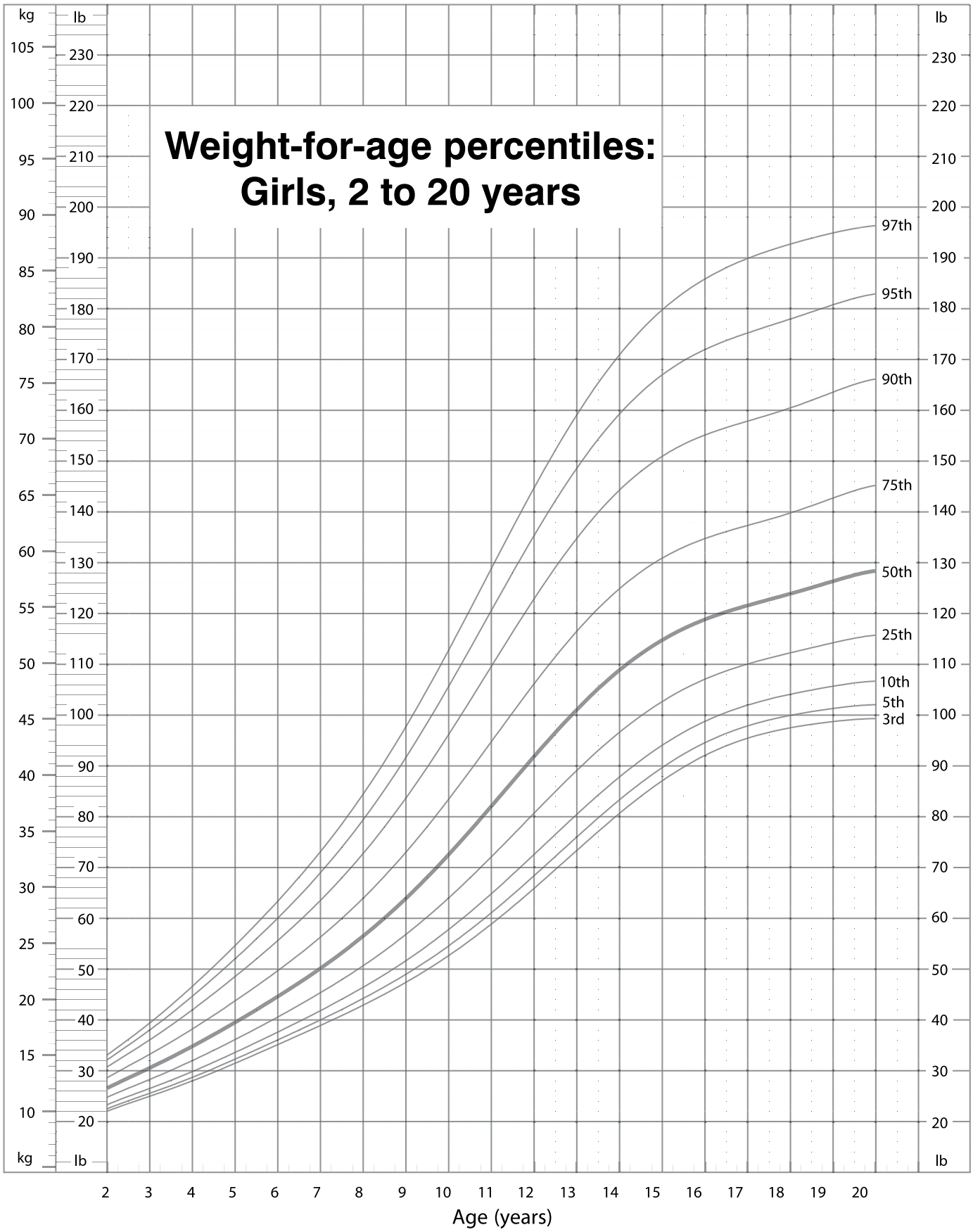

Length-for-age percentiles:
Boys, birth to 36 months
cm
in
105
100
95
90
85
80
75
70
65
60
55
50
45
42
41
40
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
97th
95th
90th
75th
50th
25th
10th
5th
3rd
Birth
3
6
9
12
15
18
21
24
27
30
33
36
Age (months)

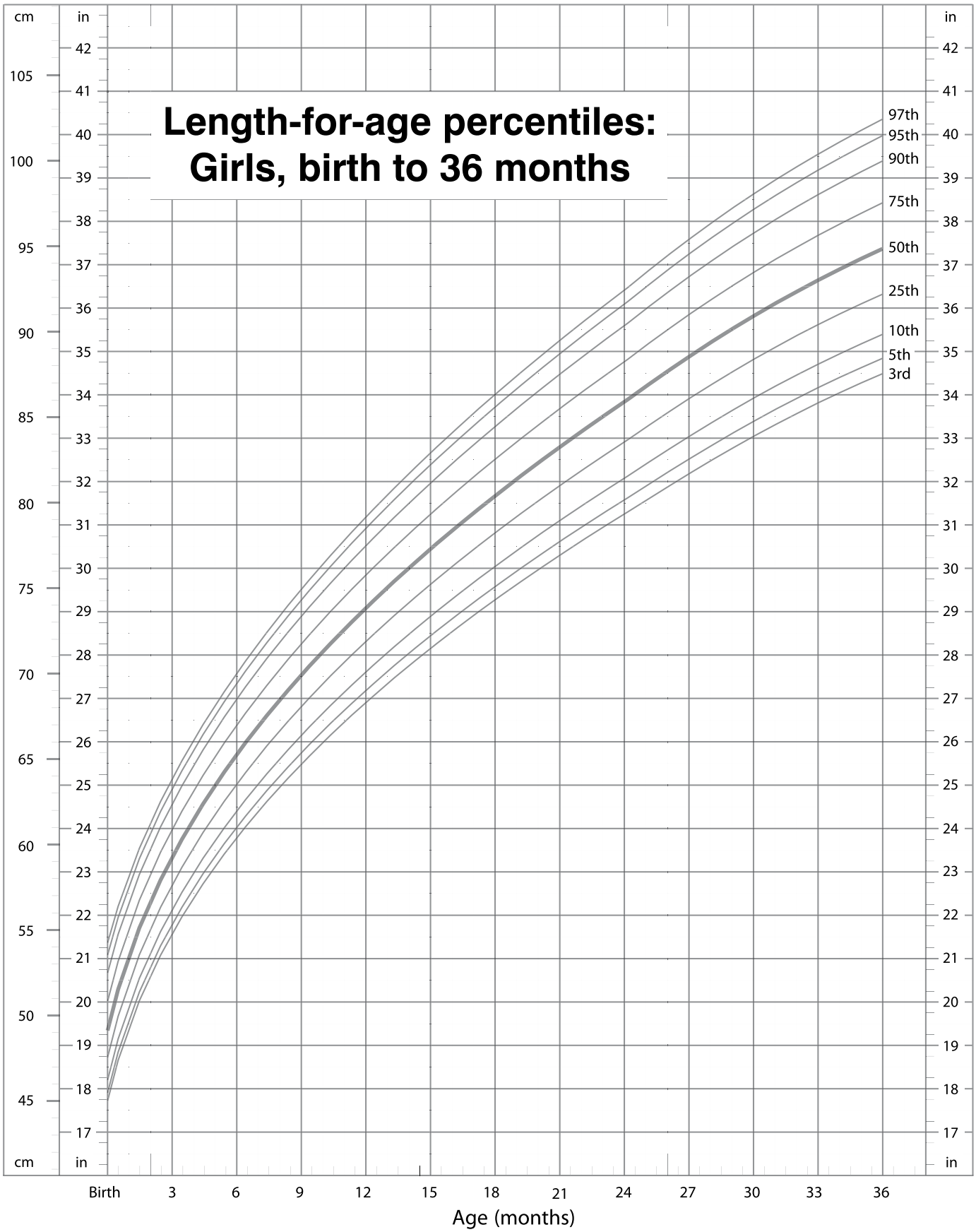

Stature-for-age percentiles:
Boys, 2 to 20 years
cm
in
200
195
190
185
180
175
170
165
160
155
150
145
140
135
130
125
120
115
110
105
100
95
90
85
80
75
78
76
74
72
70
68
66
64
62
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
97th
95th
90th
75th
50th
25th
10th
5th
3rd
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Age (years)

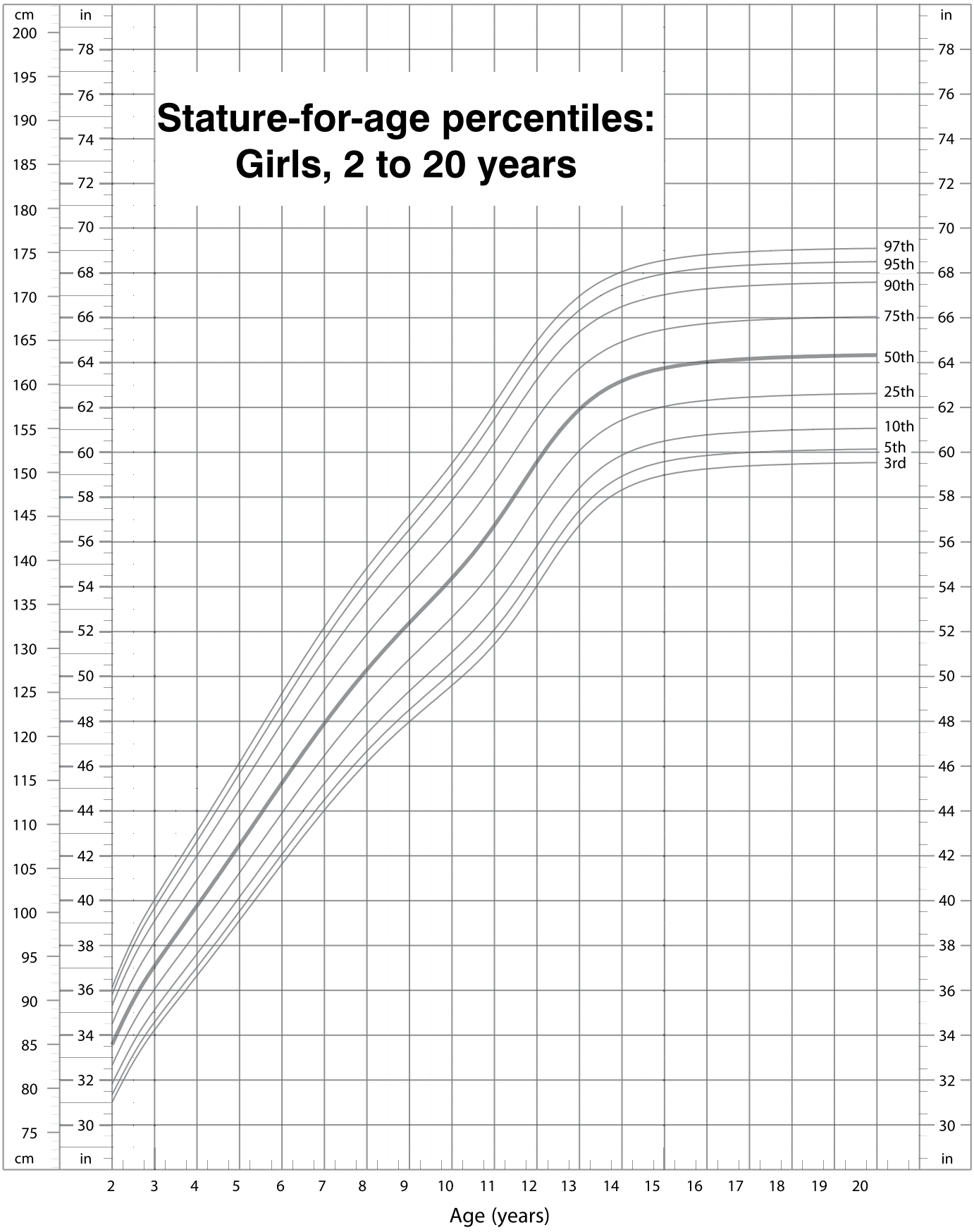

Head circumference-for-age percentiles:
Boys, birth to 36 months
cm
in
56
54
52
50
48
46
44
42
40
38
36
34
32
30
22
21
20
19
18
17
16
15
14
13
12
97th
95th
90th
75th
50th
25th
10th
5th
3rd
Birth
3
6
9
12
15
18
21
24
27
30
33
36
Age (months)

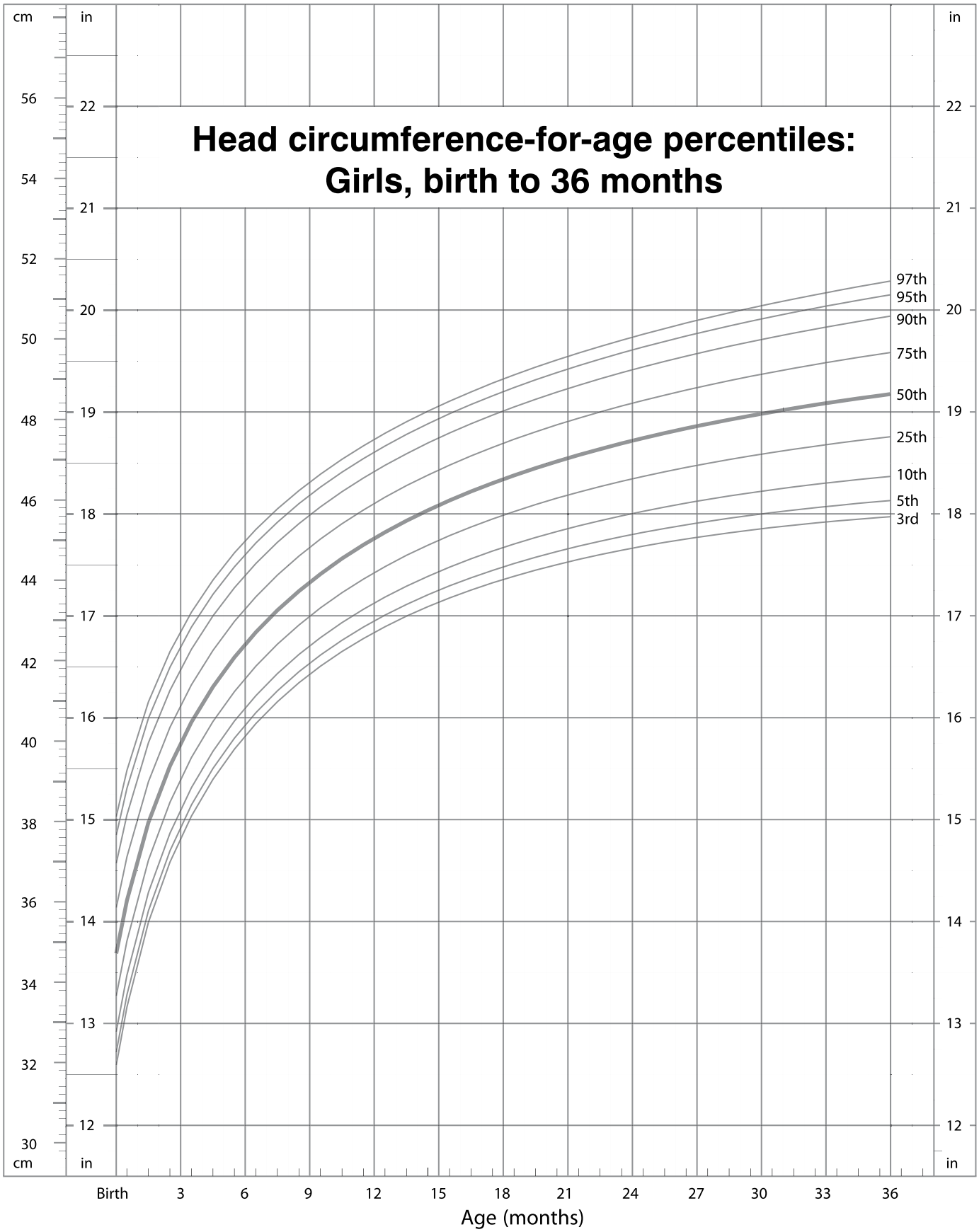

Weight-for-length percentiles:
Boys, birth to 36 months
kg
lb
97th
95th
90th
75th
50th
25th
10th
5th
3rd
in
cm
Length

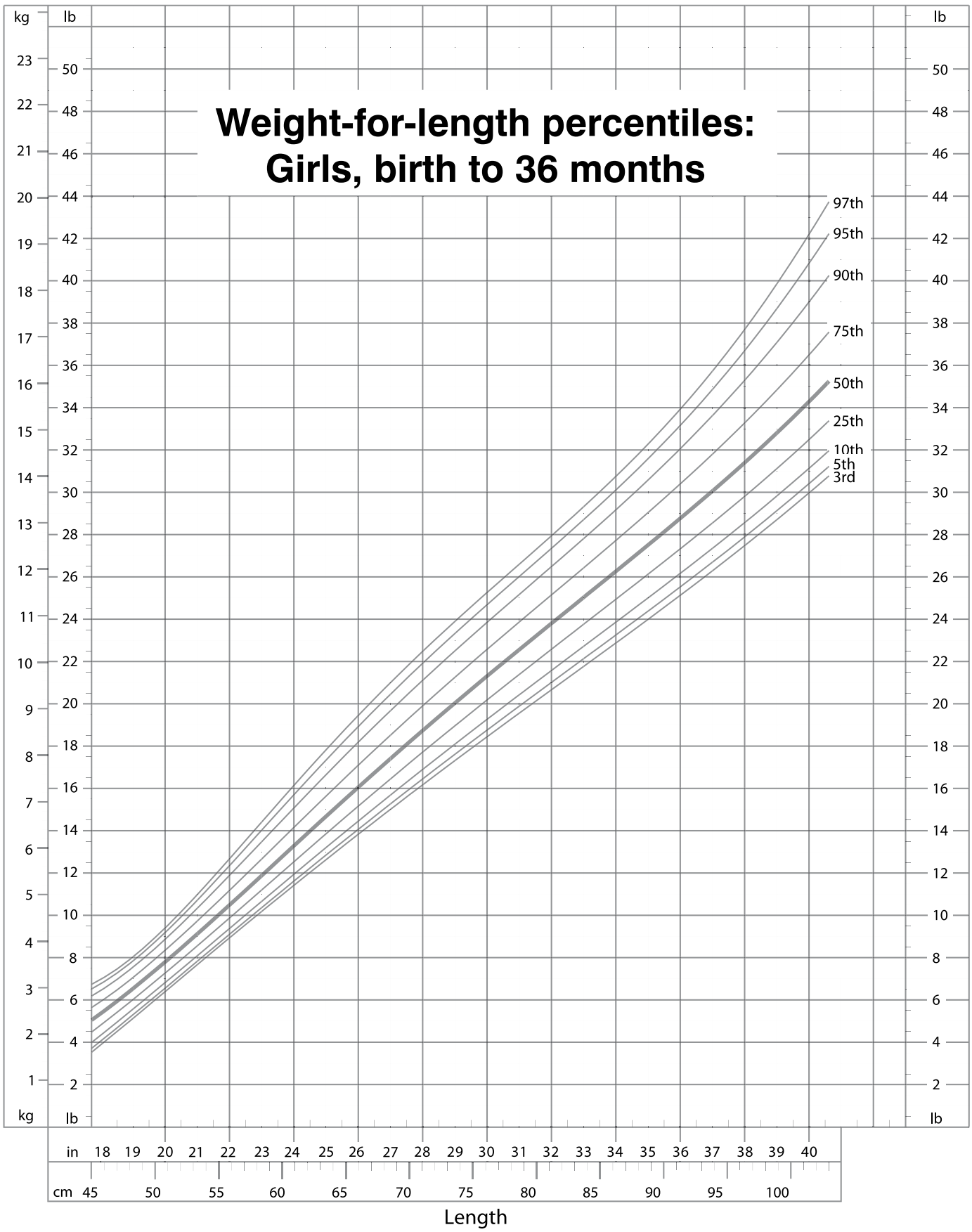

Weight-for-age percentiles:
Girls, birth to 36 months
kg
lb
97th
95th
90th
75th
50th
25th
10th
5th
3rd
Birth
3
6
9
12
15
18
21
24
27
30
33
36
Age (months)

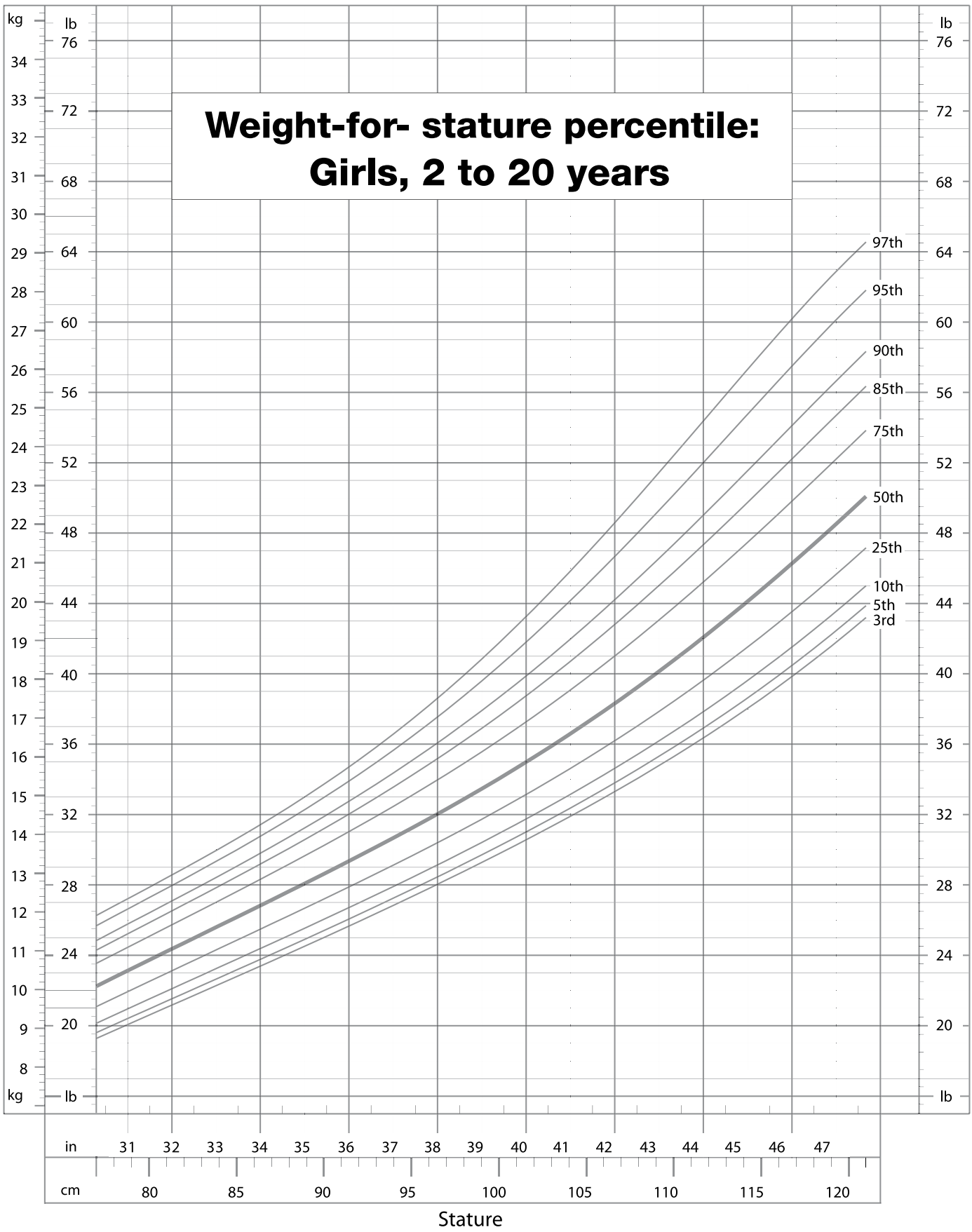

Weight-for-age percentiles:
Girls, 2 to 20 years
kg
lb
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
97th
95th
90th
75th
50th
25th
10th
5th
3rd
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Age (years)


Length-for-age percentiles:
Girls, birth to 36 months
cm
in
105
100
95
90
85
80
75
70
65
60
55
50
45
42
41
40
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
97th
95th
90th
75th
50th
25th
10th
5th
3rd
Birth
3
6
9
12
15
18
21
24
27
30
33
36
Age (months)


Stature-for-age percentiles:
Girls, 2 to 20 years
cm
in
97th
95th
90th
75th
50th
25th
10th
5th
3rd
Age (years)


Head circumference-for-age percentiles:
Girls, birth to 36 months
cm
in
56
54
52
50
48
46
44
42
40
38
36
34
32
30
22
21
20
19
18
17
16
15
14
13
12
97th
95th
90th
75th
50th
25th
10th
5th
3rd
Birth
3
6
9
12
15
18
21
24
27
30
33
36
Age (months)


Weight-for-length percentiles:
Girls, birth to 36 months
kg
lb
97th
95th
90th
75th
50th
25th
10th
5th
3rd
in
cm
Length


Weight-for- stature percentile:
Girls, 2 to 20 years
kg
lb
97th
95th
90th
85th
75th
50th
25th
10th
5th
3rd
in
cm
Stature


Body mass index-for-age percentiles:
Girls, 2 to 20 years
BMI
BMI
kg/m²
kg/m²
97th
95th
90th
85th
75th
50th
25th
10th
5th
3rd
34
32
30
28
26
24
22
20
18
16
14
12
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Age (years)