REPUBLIC OF RWANDA

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PAEDIATRIC EMERGENCIES

CLINICAL TREATMENT GUIDELINES

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Foreword

The guidelines presented in this document are designed to provide a useful resource for healthcare professionals involved in clinical case management. They were developed taking into consideration services provided at different levels within the health system and resources available. These guidelines are intended to standardize care at both tertiary and secondary levels of service delivery across different socio-economic stratifications of our society.

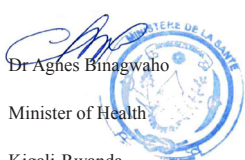
The clinical conditions included in this manual were selected based on facility reports of high volume and high risk conditions treated in each specialty area. The guidelines were developed through extensive consultative work sessions, which included health experts and clinicians from different specialties. The work group brought together current evidence-based knowledge in an effort to provide the highest quality of healthcare to the public. It is my strong hope that the use of these guidelines will greatly contribute to improved diagnosis, management and treatment of patients. And, it is my sincere expectation that service providers will adhere to these guidelines/protocols.

The Ministry of Health is grateful for the efforts of all those who contributed in various ways to the development, review and validation of the National Clinical Treatment Guidelines.

We would like to thank our colleagues from district, referral and university teaching hospitals, and specialized departments within the Ministry of Health, our partners and private health practitioners. We also thank the Rwanda Professional Societies in their relevant areas of specialty for their contribution and technical review, which enriched the content of this document. We are indebted to the World Health Organization (WHO) and the Belgium Technical Cooperation (BTC) for their support in developing this important document.

We would like to especially thank the United States Agency for International Development (USAID) for both financial and technical support through the Management Sciences for Health (MSH) Integrated Health System Strengthening Project-(IHSSP) and Systems for Improved Access to Pharmaceuticals and Services (SIAPS).

Finally, we wish to express thanks to all those who contribute to improving the quality of health care of the Rwanda population.



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CHAPTER 1

EMERGENCY ASSESSMENT

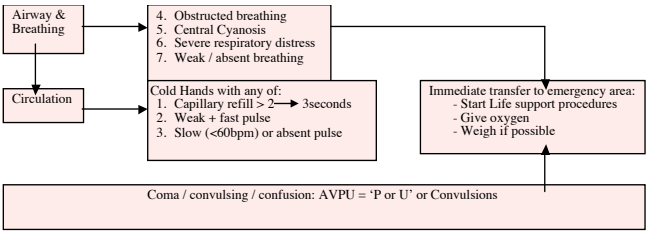
1. PAEDIATRIC EMERGENCIES

1.1. TRIAGE

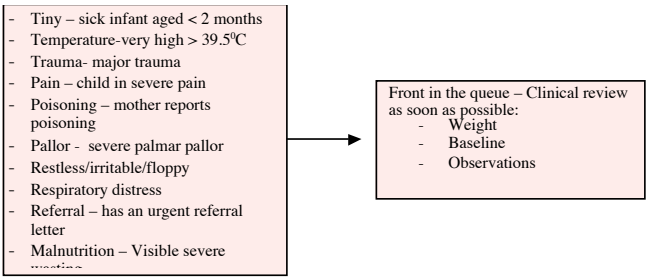
Definition: Triage is the process of rapidly screening sick children soon after their arrival in hospital in order to identify:

- Those with emergency signs, who require immediate emergency treatment
- Those with priority signs, who should be given priority while waiting in the queue so that they can be assessed and treated without delay
- Non-urgent cases, who have neither emergency nor priority signs

Emergency signs



Priority signs



Assessment of emergency

Assessment prior to a full history and examination

	Observations	Actions
- Observe	- Safe - Stimulate – *if not alert* - Shout for Help – *if not alert* - Setting for further evaluation *If alert*	- Eye contact / movements - Shout unless obviously alert - Place on resuscitation couch - It is better to continue evaluation while child is with parent
- AIR	- Assess for obstruction by listening for stridor / airway noises - Look in the mouth if not alert - Position – *if not alert* (appropriate for age)	- Position to open airway only if not alert and placed on couch - Suction (to where you can see) if indicated (not in alert child) - Use Guided airway only if minimal response to stimulation
- Breath	- Assess adequacy of breathing: • Cyanosis • Grunting • Head nodding • Rapid or very slow breathing • In-drawing • Deep sighing (acidotic) breathing • If signs of respiratory distress, listen for wheezing or crackles.	- Decide: • Is there a need for oxygen? • Is there a need for immediate bronchodilators?

- Cilculation	- Assess adequacy of circulation: • Large pulse very fast or very slow • Coldness of hands and line of demarcation • Capillary refill • Peripheral pulse weak or not palpable • (Note initial response to stimulation / alertness) • Check for severe pallor • If signs of very poor circulation: • Check for severe malnutrition • If not shock but significant circulatory compromise: • Check for severe dehydration	- Decide: • Does this child need fluids for shock? • If shock treatment is required, does the child have severe malnutrition? • Does the child need immediate blood transfusion? • If there is circulatory compromise but no shock does the child need Step 1 fluids for severe dehydration? (If not severely malnourished)
- Drugs	- Assess AVPU • (If a bolus of fluid is being given for shock assess AVPU and prepare glucose to follow bolus)	- Decide: • Does the child need 10% dextrose?

N.B.: ***It is important to start with resuscitation and stabilization of patient before investigation and specific treatment***

1.2. PAIN MANAGEMENT IN CHILDREN

Pain definition: Unpleasant somatic or visceral sensation associated with actual, potential or perceived tissue damage.

Classification of pain severity

- Self-reporting: use of number or faces scale
- Observational: based on behaviors (crying, shaking, etc.) or clinical signs (facial expression, elevated Blood Pressure or heart rate etc.)

Management

Non Drug Treatment

- Treat the underlying condition without increasing the pain
- Use non medical support such as:
  - ➔ Emotional support
  - ➔ Physical methods such as touching, stroking, massage and applying ice or heat
  - ➔ Cognitive method such as preparing for procedures, distraction with music or imagery, play, etc.
  - ➔ Non harmful traditional practices
  - ➔ Address psychosocial issues
  - ➔ Continue to assess the pain

Drug Treatment

Note: ***Respiratory depression with morphine is not a problem in children over 1 year old if treatment is started in standard doses and thereafter increased or reduced according to needs.***

Pain Medication

Pain Severity	Medication	Dosing
Mild pain	-Acetaminophen/ Paracetamol	-10-15 mg/kg/dose every 4-6 hours (Maximum 90 mg/kg/day) -Over 40 kg: 0.5 – 1 gram every 4-6 hours. *(Maximum 4 grams/day)*
	-Ibuprofen	-10 mg/kg/dose every 6-8 hours -Over 40 kg: 400-800 mg every 6-8 hours (Maximum dose 2.4 grams/day)
	-Diclofenac	-Over 40 kg: 25-75 mg every 12 hours
Moderate pain	-Codeine	-0.5-1 mg/dose every 4-6 hours -Over 40 kg: 15-60 mg/ dose every 4-6 hours (max dose. (Maximum dose 240 mg/day)
	-Tramadol	-Over 40 kg: 25-75 mg every 6 hours
Severe pain	-Oral morphine	-0.15-0.3 mg/kg/dose every 4 hours -Titrate to patient comfort -Over 40 kg: 2.5-10 mg every 4 hours. May give double dose at bedtime. No maximum dose. Titrate to patient comfort.
Neuropathic pain	Amitriptyline	-0.1 mg/kg/dose once per day. Increase as needed by 0.2-0.4 mg/kg every 2-3 days until good effect or a maximum dose of 2 mg/kg/day -Over 40 kg: 10-25 mg once/day

Adjuvant Therapy for pain in children

SYMPTOMS	MEDICATIONS	DOSAGE
Itching	-Antihistamines (chlorpheniramine)	-0.1mg/kg every 8hours
Muscle spasms	-Benzodiazepines (e.g. diazepam)	-0.2 to 0.5 mg/kg every 24hours in 3 to 4 divided doses
General pain	-Feeding, sucking, and eating are part of children's development and provide comfort, pleasure and stimulation	

CHAPTER 2

GASTROINTESTINAL DISORDERS

2. GASTROINTESTINAL DISORDERS

2.1. GASTRO INTESTINAL TRACT EMERGENCIES

2.1.1. Bleeding Oesophageal Varices

Management

Non Pharmaceutical

- Fluid resuscitation especially fresh frozen plasma and blood transfusion if necessary
- For secondary prophylaxis after a bleed, endoscopic injection sclerotherapy or variceal banding every 2 weeks until eradicated
- If either or both treatments fail then surgical over-sewing is done
- For local control of acute bleeds that are not controlled with medicine treatment,
- Sengstaken tube is used

Pharmaceutical

- *Octreotide, IV* bolus, 1–2 mcg then 1–5 mcg/kg/hour by infusion. Specialist initiated.
- Post bleed prophylactic management.
  - → *Omeprazole*, oral
    - Neonate 0.5–1 mg/kg, every 12– 24 hours
      - 1 month–2 years 2.5mg, every 12 hours
      - 2–6 years 5 mg, every 12 hours
      - 7–12 years 10 mg, every 12 hours

AND

→ *Propranolol* oral, 2–8 mg/kg/24 hours in 3 divided doses. Aim to reduce the pulse rate by 25%.

- Previously bled but not actively bleeding

  → Surgical oversewing if endoscopy and sclerotherapy or banding has failed

- Never bled

  → Expectant management only

  → Neither prophylaxis nor elective endoscopy/sclerotherapy

Recommendations

- Refer all to establish diagnosis and initiate treatment
- Bleeding varices - only after commencement of resuscitation (and octreotide, if available)

2.1.2. Acute Gastroenteritis

Definition: Gastroenteritis is an inflammation of the stomach and intestines that causes diarrhea, vomiting, nausea and other symptoms of digestive upset.

Diarrhea is the passage of three or more loose or watery stools per day. It can be watery, bloody or containing mucus.

Causes

- Viral gastroenteritis: Rotaviruses are the most likely cause of infectious diarrhea in children under the age of 5
- Bacterial gastroenteritis : Campylobacter, Salmonella or E. coli
- Intestinal parasites: Giardia lamblia
- Other causes include life threatening conditions including: Intussusception; Appendicitis which may be initiated by diarrhea

Signs and Symptoms

CLINICAL EVALUATION OF DEHYDRATION

Mild dehydration : 3 - 5% *(Plan A)*	No signs of dehydration
Moderate dehydration : 6-9% *(Plan B)*	Able to drink plus 2 or more of: Sunken Eyes and / or Skin pinch 1 - 2 seconds Restlessness / irritability
Severe dehydration : 10-15% *(Plan C)*	Pulse fine but unable to drink plus: Sunken eyes Skin pinch ≥ 2 seconds

Complications

- Hypovolemic shock (Tachycardia, cold hands, weak or absent pulse, capillary refill > 2 sec, not alert)
- Electrolytes imbalance: severe hyponatremia (<130mmol/L), severe hypernatremia (>150mmol/L), severe hypokalemia (<3mmol/L)
- Cerebral œdema (headache, convulsions, vomiting, nausea, weakness) due to rapid rehydration with hypotonic solutions
- Intracerebral haemorrhage (due to severe dehydration in infants and young children)

Investigations

- Stool exam: Direct/culture (if blood or pus in stool)
- FBC, CRP, Hemoculture if suspicion of bacterial blood stream
- Electrolytes (Sodium and Potassium)
- Glyceamia, urea/Creatinine if shock

Note: *Qualitative evaluation of dehydration (according to Natremia)*

- ***Isotonic dehydration*****:** Na 130 to 150 mmol/L
- ***Hypertonic dehydration*****:** Na > 150 mmol/L
- ***Hypotonic dehydration*** **:** Na < 130 mmol/L

Management

- Admit the child
- Absolute criteria of admission
  - Profuse diarrhea (> 8 stools/24h) with vomiting
  - Incoercible vomiting
  - Severe dehydration
  - Failure of home oral rehydration
- If dehydration and shock are accompanied without signs of malnutrition, give appropriate treatment as follows:
  - Consider CABD
  - 20ml/kg of Normal saline (NS) or Ringers Lactate(RL) as

quickly as possible IV or IO in 15 minutes (see table below for estimation of required volume for 20ml/kg):

- Repeat the bolus of NS or RL 3-4 times if signs of shock persists
- Treat as severe dehydration after correction of shock

- If severe dehydration without shock (Plan C):

Full Strength Ringers **(Normal Saline if unavailable)**	**Age < 12 months**	**Age ≥ 12 months to 5 years**
Step 1	30 mls / kg over 1 hour	30 mls / kg over 30 minutes
Step 2	70 mls / kg over 5 hours	70 mls / kg over 2.5 hours
Then reassess the child – if still signs of severe dehydration repeat step. If signs improving treat for moderate dehydration		

- If moderate dehydration (Plan B)
  - Best treated with *ORS* 75ml/kg during 4 hours
  - Give *Ringers Lactate* 75ml/kg during 4 hours in case of incoercible diarrhea and/or vomiting
  - After 4 hours
    - → Reassess the child and classify the child for dehydration
    - → Select the appropriate plan to continue treatment
    - → Begin feeding the child in clinic

HOW TO ADMINISTER ORS

By bottle	- Give 1/3 during 1st h, then 2/3 during 3 following h. - E.g.: 10 kg; dehydrated 7%. Should receive 75 ml/kg = 750 ml SRO in 4 hours - Give 60 ml every 15 min during 1st hour - Then 170 ml every hour during for 3 hours
Spoon or seringues	- Very efficacious if vomiting +++ - Allows important volumes E.g.: 5 ml every 1 to 2 min → 300 to 150 ml in 1 hour
Naso-gastric tube	-Vomiting +++ -Fatigue +++

NB: ORS is Contra-indicated if ileus or alteration of conscience

- If the mother must leave before completing treatment
  - Show her how to prepare ORS solution at home
  - Show her how much ORS to give to finish 4-hour treatment at home
  - Give her enough ORS packets to complete rehydration
    - → Explain the 4 rules of home treatment
      - Give extra fluid: give to the child more to drink as he/she wants
      - Give *Zinc* supplements for 10–14 days
        - Up to 6 months: 1/2 tablet (10 mg) per day, 6 months and more 1 tablet (20 mg) per day
        - Continue feeding: initial 4hour rehydration period, breastfed children should continue to breastfeed frequently throughout
        - Give advice on when to return for review

- When the child has to be returned to the health facility
  - Drinking poorly or unable to drink or breastfeed
  - Becomes sicker
  - Develops fever
  - Has blood in the stool
- If no dehydration (Plan A)
  - Treat the child as an outpatient; give ORS 10ml/kg after each watery stool
  - Counsel the mother on the 4 rules of home treatment (See above)

Particular forms of dehydration

Type	Intervention	Comment
Hyponatremia (Na < 130mmol/L)	**Na Deficit = 0.6 x W in kg x (Na^+_d - Na^+_m)** during 4 hours **W=** weight **d =** desired sodium **m =** measured sodium	Do not correct too quickly to avoid CNS lesion
Hypernatremia (Na > 150mmol/L)	Slowly correct dehydration over 48 hours	Risk of convulsions in case of rapid correction
Hypokalemia	If Potassium< 2.5 mmol/L give KCl 30-40 mmol/ L/24hours	Give KCl if urine

2.1.3. Persistent Diarrhea

Definition: Persistent diarrhea is a diarrhea, with or without blood, which begins acutely and lasts for 14 days or longer.

Causes

AGE	AETIOLOGIES
Infancy	- Postgastroenteritis malabsorption syndrome - Cow's milk/soy protein tolerance - Secondary disaccharidase deficiencies - Cystic fibrosis
Childhood	- Secondary disaccharidase deficiencies - Giardiasis - Postgastroenteritis malabsorption syndrome - Celiac disease - Cystic fibrosis - HIV - Malnutrition
Adolescence	- Irritable Bowel Syndrome - HIV - Inflammatory Bowel Disease

Complications

- Dehydration
- Failure to thrive, malnutrition
- Immunosuppressant

Investigations

(Will vary according to the suspected etiology)

- Stool examination: PH, White Blood Count, fat, ova, osmolarity, culture
- FBC, CRP, electrolytes, urea and creatinine
- Sweat chloride if suspicion of cystic fibrosis
- Barium study

- Small bowel biopsy
- Endoscopy: Sigmoidoscopy or coloscopy with biopsy

Management

- Oral rehydration
- Treat the cause (see algorithm)

2.1.4. Bloody Diarrhea

Definition: Frequent (>3/day) passage of blood and/or mucus in the stool

Causes

- Amoebic dysentery is the most common serious cause in children
- Bacterial infections (e.g. Shigella, salmonella)
- Parasitic infestations (e.g. amoebic dysentery)
- Milk allergy
- Chronic inflammatory bowel disease

Signs and symptoms

- Sudden onset
- Abdominal cramps
- Peritonism urgency, fever and diarrhea with blood and mucus in the stool
- meningismus and convulsions may occur
- Exclude intussusceptions which includes:
    - Pain or abdominal tenderness
    - Bile-stained vomitus
    - Red currant jelly-like mucus

Complications

- Dehydration
- Convulsions
- Shock
- Toxic megacolon
- Acidosis
- Rectal prolapse
- Renal failure
- Haemolytic uraemic syndrome

Investigations

- Stool culture to confirm diagnosis of Shigellosis
- Stool microscopy reveals many polymorphs and blood
- Immediate microscopy of warm stool to diagnose amoebic dysentery

Management

Non-pharmacological

- Ensure adequate nutrition and hydration

Pharmacological

- Fluid and electrolyte replacement (see Acute Diarrhea)
- *Ciprofloxacin*, oral, 15 mg/kg/dose every 12 hours for 3 days

OR

- *Ceftriaxone, IV*, 20–80 mg/kg as a single daily dose for 5 days(If hospitalised or if unable to take oral antimicrobial agents)
- *Metronidazole, oral*, 15 mg/kg/dose 8 hourly for 7 – 10 days (if amoebic dysentery, seen on stool microscopy)

Recommendation

- Refer patient to the specialist, if dysentery with complications, e.g. persistent shock, haemolytic uraemic syndrome and toxic megacolon

2.1.5. Upper GIT Bleeding

Upper gastrointestinal bleeding (arising proximal to the ligament of Treits in the distal duodenum) commonly manifested by hematemesis and/or melena.

Causes

- Neonates
  - False bleeding (maternal blood swallowed)
  - Vit K1 deficiency
  - Stress gastric/ ulcer
  - Coagulopathy (infection, liver failure, coagulation disorder)
  - Hemangioma
- Infants and toddlers
  - Malory Weiss Syndrome
  - Non steroid anti-inflammatory drugs
  - Oesophagitis
  - Caustic ingestions, iron poisoning
  - Oesophageal varices bleeding
- Old children and adolescent
  - Malory Weiss SyndromePeptic ulcer/gastritis
  - Rendu Osler Syndrome
  - Gastric polypes
  - Oesophagal varices

Clinical manifestations

- Hematemesis
- Melena
- Other signs according to the causative agent

Assessment

- History: The clinical history should include information concerning
  - The time course of the bleeding episode
  - Estimated blood loss, and any associated symptoms
  - Gastrointestinal symptoms including dyspepsia, heartburn, abdominal pain, dysphagia, and weight loss. In infants, these features may be reflected in poor feeding and irritability
- The history should also include information about the following symptoms or signs which may provide clues to an underlying disorder
  - Recent onset of jaundice, easy bruising or change in stool color, which may suggest underlying liver disease
  - Recent or recurrent epistaxis, to investigate the possibility of a nasopharyngeal source of bleeding
  - History of easy bruising or bleeding, which suggests a disorder of coagulation, platelet dysfunction, or thrombocytopenia
  - Personal or family history of liver, kidney or heart disease, or coagulation disorders
  - A drug history is important to assess potential contributions from medication that may induce ulceration (such as NSAIDs and corticosteroids); Tetracyclines, may cause a pill esophagitis
  - If the patient has been taking drugs or has a cardiac condition that affects homeostatic responses (such as beta-adrenergic antagonists), these may mask tachycardia associated with life-threatening hypovolemia and shock.

- Physical examination :The physical examination should include the following elements
  - The skin for cutaneous signs of generalized vascular malformations/disorders (cutaneous hemangiomas, mucocutaneous telangiectasia)
  - Evidence of portal hypertension, (splenomegaly , prominent abdominal and hemorrhoid vessels)

- Inspection of the naso-pharynx
- Check for hemodynamic failure (signs of shock)

Differentials diagnosis

- Swallowed maternal blood during delivery or while nursing
- Ingested epistaxis – naso-pharynx bleeding

Investigations

Depending on suspected cause and magnitude of the blood loss, laboratory assessment should include:

- FBC, cross-match blood in case transfusion is required , LTF, blood urea nitrogen, aserum creatinine, coagulation tests
- Upper digestive endoscopy (diagnosis and interventional)

Management

Main objectives

- Relieve or treat hemorrhagic shock if present
- Stop bleeding
- Treat the causative agent Emergency treatment
- ABC (include blood transfusion if necessary
- Assess to causative agent and treat according if there is a need of endoscopy then refer to center where it's available

NB: ***The most common cause according to age and treatment***

Neonates (Stress ulcers secondary to severe illness)

- *Cimetidine* IV 5-20mg/kg divided in 2 doses ***OR*** Ranitidine IV 2mg/kg/24 divided in 2-3 doses
- *Omeprazole, PO* 0.5–1 mg/kg, every 12– 24 hours

Infants and toddlers (common cause is gastric ulcers and other causes can be evaluated after endoscopy)

- *Octreotide, IV* bolus, 1–2 mcg then 1–5 mcg/kg/hour by infusion, initiated by the specialist in case of cases of variceal bleeding (difficult to control, to help control bleeding before endoscopy, or when endoscopy is unsuccessful, contraindicated, or unavailable)
- *Omeprazole, PO*
  - 1 month–2 years 2.5mg, every 12 hours
  - 2–6 years 5 mg, every 12 hours initiated by the specialist for post bleed prophylactic management

Old children and adolescents (common cause is gastric ulcers and other causes can be evaluated after endoscopy)

- Omeprazole, PO
  - < 20 kg: 10 mg QD
  - >20 kg: 20 mg QD

Recommendations

- Refer all cases to the specialist for appropriate diagnosis and treatment
- Refer all bleeding varices - after commencement of resuscitation and octreotide, if available

2.1.6. Peptic Ulcer Disease

Definition: This refers to ulceration of gastric or duodenal mucosa that tends to be chronic and/or recurrent

Causes

- Helicobacter pylori (H. pylori) in developing nations, the majority of children are infected with *H. pylori* before the age of 10 and adult prevalence peaks at more than 80% before age 50

Signs and Symptoms

- Most common: ulcer-like or acid dyspepsia (burning pain; epigastric hunger-like pain; relief with food, antacids, and/or antisecretory agents)
- Peptic ulcers may be present with dyspeptic or other gastrointestinal symptoms or may be completely asymptomatic, sometimes until complications such as hemorrhage or perforation occur. The symptoms associated with peptic ulcers are not sensitive or specific and the differential diagnosis is broad.
- Food-provoked dyspepsia or indigestion (postprandial epigastric discomfort and fullness, belching, early satiety, nausea, and occasional vomiting) food-stimulated acid secretion persists for three to five hours; thus classic symptoms occur two to five hours after meals
- Reflux-like dyspepsia

Complications

- Acute or chronic blood loss or perforation
- Iron deficiency anaemia

Investigations

- Stool analysis for occult blood
- FBC
- For HP
    - It is recommended that the initial diagnosis of *H. pylori* infection be based on positive histopathology plus positive rapid urease test, or positive culture.

- A validated ELISA for detection of *H. pylori* antigen in stool is a reliable non-invasive test to determine whether *H. pylorus* has been eradicated.

- Tests based on the detection of antibodies (IgG, IgA) against *H. pylori* in serum, whole blood, urine and saliva are not reliable for use in the clinical setting

Management

Non Pharmaceutical

- Avoid any foods that cause pain to the patient (e.g. acidic foods, cola drinks, etc.)
- Avoid gastric irritating drugs (NSAIDs)
- Give magnesium-based antacids or combined magnesium-aluminium

Pharmaceutical

- First line H pylori eradication regimens are

→ Triple therapy with a *PPI* + *Amoxicillin* + *Imidazole*

OR

→ *PPI* + *Amoxicillin* + *Clarithromycin*

OR

→ *Bismuth salts* + *Amoxicillin* + *Imidazole*

OR

→ *Omeprazole PO*

→ 15-30 kg: 10 mg twice daily

→ 30 kg: 20 mg twice daily

OR

→ *Cimetidine* 20–40mg/kg/day

+

→ *Clarithromycin* : 500mg BID

+

→ *Amoxicillin* 1g twice daily

OR

- *Metronidazole* 500 mg (15–20mg/kg/day) BD
  - Duration: 10 – 14 days, a reliable non-invasive test for eradication is recommended at least 4 to 8 weeks following completion of therapy

Recommendations

- Refer to a specialist, if there is severe haemorrhaging
- Stabilize the patient before transfer
- Infuse IV fluids/blood to maintain normal volume/pulse
- Ensure continuous assessment of further blood loss (Persistent tachycardia, postural hypotension, continuing haematemesis)
- Definitive treatment/Eradication of *H. pylori*

2.2. POISONING EMERGENCIES

2.2.1. Acute poisoning

Definition: A poison is any substance that is harmful to the body. It might be swallowed, inhaled, injected or absorbed through the skin. Poisoning can be acute or chronic.

Causes

- Foods : Some mushrooms, polluted drinking water, certain improperly prepared or handled food
- Drugs : Sometimes drugs may be toxic and even deadly when taken in excess e.g. analgesics, vitamins, cardiovascular drugs, herbal medications
- Other causes : Contact or ingestion of products such as cyanide, pesticides, paint thinners, household cleaning products

Signs and Symptoms

Symptoms and signs of acute poisoning depend on the agent ingested and therefore vary widely

ODOR	Possible Poison
Bitter almonds	Cyanide
Acetone	Isopropyl alcohol, methanol; paraldehyde, salicylate
Alcohol	Ethanol
Wintergreen	Methyl salicylate
Garlic	Arsenic, thallium, organophosphates
Violets	Turpentine
OCULAR SIGNS	Possible Poison
Miosis	Narcotics (except meperidine); organophosphates, muscarinic mushrooms, clonidine, phenothiazines, chloral hydrate, barbiturates (late), PCP (phencyclidine)
Mydriasis	Atropine, alcohol, cocaine, amphetamines, cyclic antidepressants, Cyanide, carbon monoxide
Nystagmus	Phenytoin, barbiturates, ethanol, carbon monoxide
Lacrimation	Organophosphates, irritant gas or vapors
Retinal hyperemia	Methanol
Poor vision	Methanol, botulism, carbon monoxide
CUTANEOUS SIGNS	Possible Poison
Needle tracks	Heroin, PCP, amphetamine
Bullae	Carbon monoxide, barbiturates
Dry, hot skin	Anticholinergic agents, botulism

Diaphoresis	Organophosphates, nitrates, muscarinic mushrooms, aspirin, cocaine
Alopecia	Thallium, arsenic, lead, mercury
Erythema	Boric acid, mercury, cyanide, anticholinergics
ORAL SIGNS	Possible Poison
Salivation	Organophosphates, salicylate, corrosives, strychnine
Dry mouth	Amphetamine, anticholinergics, antihistamine
Burns	Corrosives, oxalate containing plants
Gum lines	Lead,mercury,arsenic
Dysphagia	corrosives, botulism
INTESTINAL SIGNS	Possible Poison
Cramps	Arsenic, lead, thallium, organophosphates
Diarrhea	Antimicrobials, arsenic, iron, boric acid
Constipation	Lead, narcotics, botulism
Hematemesis	Aminophylline, corrosives, iron, salicylates
CARDIAC SIGNS	Possible Poison
Tachycardia	Atropine, aspirin, amphetamine, cocaine, cyclic antidepressants, aminophylline/ théophylline
Bradycardia	Digitalis, narcotics, mushrooms, clonidine, organophosphates, ß-blockers, calcium channel blockers

Hypertension	Amphetamine, LSD (lysergic acid diéthylamide), cocaine, PCP
Hypotension	Phenothiazines , barbiturates, cyclic antidepressants, iron, ß-blockers, calcium channel blockers
RESPIRATORY SIGNS	
Depressed respiration	Alcohol, narcotics, barbiturates, cyanide
Increased respiration	Amphetamines, aspirin, ethylene glycol, carbon monoxide
Pulmonary edema	Hydrocarbons, heroin, organophosphates, aspirin
CENTRAL NERVOUS SYSTEM SIGNS	Possible Poison
Ataxia	Alcohol, antidepressants, barbiturates, anticholinergics, phenytoin, narcotics
Coma	Sedatives, narcotics, barbiturates, PCP, organophosphates, salicylate, cyanide, carbon monoxide, cyclic antidepressants, lead.
Hyperpyrexia	Anticholinergics, quinine, salicylates, LSD, phenothiazines, amphetamine, cocaïne
Muscle fasciculation	Organophosphates, théophylline
Muscle rigidity	Cyclic antidepressants, PCP, phenothiazines, haloperidol
Paresthesia	Cocaine, camphor, PCP, MSG

Peripheral neuropathy	Lead, arsenic, mercury, organophosphates,
Altered behavior	LSD, PCP, amphetamines, cocaine, alcohol, anticholinergics, camphor

*LSD: Lysergic Acid Diethylamide. MSG: Monosodium Glutamate. PCP: Phencyclidine.

Investigations

- FBC
- Glycemia
- Urea and creatinine
- Liver function
- Electrolytes (Sodium, potassium, calcium, magnesium)
- Chest x- ray (Hydrocarbons and corrosives)

Management

Non-pharmaceutical

- Maintain airway, establishing effective breathing and oxygen where necessary
- Support circulation and correct hypoglycaemia
- Gastric lavage: activated charcoal (*0rganophosphate* if present within 1 hour of ingestion, *Phenobarbital, Theophylline*)

Amount of activated charcoal per dose

Children up to one year of age	1g/kg
Children 1 to 12 years of age	25 to 50 g/kg
Adolescents and adults	25 to 100 g/kg

- Provide supportive care (IV fluids, oxygen etc.)
- Use specific antidote where applicable

Clinical features and treatment of common acute poisonings		
Substance	**Clinical features**	**Recommended action**
1. Household agents and industrial chemicals		
Kerosene (paraffin)	Nausea, vomiting, cough, pulmonary irritation, difficulty breathing, headaches, loss of consciousness	- Remove contaminated clothing; wash exposed skin with water and soap - Activated charcoal, maintain airways and respiratory support. - DO NOT INDUCE VOMITING or perform gastric lavage
Carbon monoxide, e.g. car exhaust or house fire	Headache, dizziness, confusion, slurred speech, convulsions, coma, symptoms vary with percentage of carboxyhaemoglobin	- 100% oxygen - Hyperbaric oxygen

Corrosives e.g. acids, alkalis, hydrogen peroxide	Excruciating pain in the mouth, the pharynx, epigastric area,dysphagia, drooling, vomiting and haematemesis, later develops laryngeal oedema and obstruction, oesophageal perforation Long-term: Stenosis of oesophagus	- Liberal water or milk orally - Analgesic injection to relieve pain - DO NOT INDUCE VOMITING - DO NOT PERFORM LAVAGE
Methanol	Intoxication, drowsiness, muscle, weakness, blurred vision, photophobia, papilloedema blindness, coma, cerebral oedema, cardio-respiratory depression, seizures, DEATH	- IV sodium bicarbonate - 10% Ethanol in 5–10% dextrose as oral or IV infusion - Loading dose 0.7g/kg over 1 hour. Maintain at 0.1–0.2g/kg/hour up to ethanol level of 100mg/dl
Alcohol	Lethargy, coma Slurred speech Hypogylcemia Depressed respiration	- Treat hypoglycemia - IV fluids

2. Pharmaceuticals		
Paracetamol	Nausea, vomiting, altered mental status, abdominal pain, evidence of liver failure (elevated transaminases, abnormal coagulation profile)	- Gastric lavage within 1 hour - Activated charcoal - Antidotal therapy with N-acetylcysteine for up to 72 hours
Chloroquine	Convulsions, cardiac arrhythmia, cardiogenic shock and cardiac arrest	- Gastric lavage - IV diazepam for convulsion Epinephrine - Refer if in coma
Digoxin	Arrhythmias, ventricular fibrillation, anorexia,nausea,vomiting,confusion, amblyopia	- Discontinue drug, administer potassium - Treat arrhythmias with lidocaine *OR* Phenytoin - Antidigoxin FAB fragments
Iron tablets, e.g. FeSO4, vitamins with iron	Vomiting, abdominal pain, pallor, cyanosis, diarrhoea, shock, GI bleeding	- Gastric lavage - Desferoxamine 15 mg/kg/hour IV max 6 grams in 24 hours

Opiates, narcotics (drugs of abuse)	Drowsiness, pinpoint pupils, shallow respiration, spasticity, respiratory failure	- Do not give emetics - Gastric lavage - Activated charcoal - Naloxone 5µg/kg IV to awaken and improve respiration - IV fluids to support circulation
Isoniazid	CNS stimulation, seizures, coma	- Emesis, gastric lavage - Diazepam - Pyridoxine (1mg for 1mg ingested up to 200mg) - Sodium Bicarbonate for acidosis
Warfarin	Generalized bleeding, with intracranial haemorrhage being most serious	- Vitamin K 10mg IV STAT + OD for 5 days - Transfuse fresh frozen plasma - Packed red blood cells if hemorrhagic shock

3. Pesticides		
Organo-phosphates, e.g. diazinon, dimethoate	Headache, weakness, vomiting, colicky abdominal pain,profuse cold sweating, hypersalivation, muscular twitching, fasciculations, diarrhea, tenesmus, convulsions, dyspnoea with bronchoconstriction, miosis, bilateral crepitations	- Decontaminate (see above). - Remove contaminated clothing; wash exposed skin with water and soap. **DO NOT INDUCE VOMITING** - IV atropine 2–4mg STAT, repeat after 10–20 min until full atropinization (pulse 100–120, dilated pupils) and maintain on SC/IV atropine 4–6 hours x 24–48 hours. - Pralidoxime (PAM) 1–2g (children 30mg/kg) STAT, repeat every 4 hours, 12–24 hours depending on response
Rodenticides, e.g. zinc phosphide	Severe abdominal pain, nausea, vomiting and diarrhea; strong garlic smell; severe respiratory distress; myocardial injury	- Supportive - Maintain airways - Assist ventilation - Observe for pulmonary oedema

Rodenticide (anticoagulant based)	Generalized bleeding, with intracranial haemorrhage being most serious	- Vit. K 10mg IV STAT - Transfuse fresh blood/fresh frozen plasma
Acaricides, e.g. Amitraz	Weakness, difficulty breathing, convulsions, coma.	- Remove contaminated clothing; wash exposed skin with water and soap. **DO NOT INDUCE VOMITING** - IV Sodium Bicarbonate
Herbicides, e.g. Paraquat	Oral/pharyngeal inflammation, later multi-organ failure within hours or days depending on dose. Later interstitial pulmonary oedema and fibrosis. Multi-organ failure or pulmonary oedema invariably leads to death	- Lethal dose as low as 10ml - Gastric lavage with 50–100g activated charcoal every 4 hours until patient improves

Organochlorines e.g. DDT, aldrin, dieldrin	Excitement, tremors, convulsions with respiratory failure due to convulsions	- IV diazepam for convulsions - Gastric lavage if within 1 hour - Survivors beyond 48 hours almost invariably recover
4. Others		
Lead: e.g. lead salts, solder, toys, paints, and painted surfaces	Thirst, abdominal pain, vomiting, diarrhea, encephalopathy following ingestion of suspicious substance	- Eliminate source of poisoning - Chelation with Dimercaprol (BAL) Inj 4mg/ kg and combined with calcium sodium editate (EDTA) with close monitoring for renal function DMSA
Mercury	Acute: gastroenteritis,vomiting, nephritis, anuria, delayed GI motility Chronic: gingivitis, mental disturbances, neurodeficits, pneumonitis	- Gastric lavage - Activated charcoal - Penicillamine - Haemodialysis for renal failure - Look out for GIT perforation - Lungs: supportive care

Specific management

- Ingested poisons
  - → Check the child for emergency signs and check for hypoglycemia
  - → If possible identify the specific agent and remove or adsorb it as soon as possible.
  - → If the child has swallowed kerosene, petrol or petrol-based products or if the child's mouth and throat have been burned, then do not make the child vomit but give water orally, do not send the child home without observation of 6 hours
  - → Never use salt as an emetic as this can be fatal
  - → Do the gastric lavage where applicable
  - → If the child has swallowed other poisons: Do not induce vomiting and give activated charcoal by mouth or NGT according to table below.
- Poisons in contact with skin or eyes
  - → Skin: Remove all clothing and personal effects and thoroughly flush all exposed areas with copious amounts of tepid water.
  - → Eye: Rinse the eye for 10–15 minutes with clean running water or saline, ensuring that the run-off does not enter the other eye.
- Inhaled poisons
  - → Remove from the source of exposure
  - → Administer supplemental oxygen if required
  - → Apply intubation accompanied with bronchodilators in case of inhalation of irritant gases that cause bronchospas

CHAPTER 3
RESPIRATORY DISORDERS

3. RESPIRATORY DISEASES

3.1. RESPIRATORY DISTRESS

Definition: It is a condition characterised by difficulty in breathing

Causes

- Upper airway obstruction: Foreign body, tracheolaryngitis, retropharyngeal abscess, choanal atresia
- Lower airway obstruction: Bronchiolitis, asthma, pneumonia, trachea-esophageal fistula
- Cardiac disease: Congestive heart failure (left to right shunt, left ventricular failure, pulmonary embolism)
- Pleural disorders: Pleural effusion, empyema, pneumothorax
- Neurological disorders : Increased intracranial pressure, neuromuscular disorders
- Other causes: Diaphragmatic hernia, massive ascites, severe scoliosis, severe anemia, electrolyte imbalance (DKA)
- HIV infection: Pneumocystis pneumonia, Lymphocytic Interstitial Pneumonia (LIP)

Signs and symptoms

- Cyanosis (central or peripheral) /hypoxia (check oxygen saturation)
- Grunting
- Head nodding
- Rapid or very slow breathing (according to age)
- Chest muscles In-drawing
- Deep sighing (acidotic) breathing
- Wheezing
- Stridor
- Absent breath sounds (i.e. with pneumothorax)

Complications

- Respiratory failure
  - Apnea
  - Lethargic
  - Reduced alertness
  - Restlessness
  - Sweating
- Paradoxical pulse
- Coma

Investigations

- Chest x-ray
- Urea and Electrolytes
- Blood glucose
- Full blood count
- Laryngoscopy, Bronchoscopy where applicable
- Cardiac investigation (ultrasound)

Management

- Admit the child
- Keep the child in semi-sitting position
- Maintain clear airway
- Administer oxygen

Oxygen administration by mask or nasal prongs

Oxygen Administration Device	Flow rate and inspired O_2 concentration
- Nasal prong or short nasal catheter	- Neonate – 0.5 L/min - Infant / Child – 1 – 2 L/min - O_2 concentration – approx 30-35%
- Naso-pharyngeal (long) catheter	- Neonate – not recommended- - Infant / Child – 1 – 2 L/min - O_2 concentration – approx 45%
- Plain, good fitting oxygen face mask	- Neonate / Infant / Child – 5 - 6 L/min (check instructions for mask) - O_2 concentration – approx 40 - 60%
- Oxygen face mask with reservoir bag	- Neonate / Infant / Child – 10 - 15 L/min - O_2 concentration – approx 80 - 90%

- Keep the child calm (minimal handling)
- Give antipyretics (*Paracetamol*) if temperature > 39.5^0C
- Nil Per Os (NPO) for severe respiratory distress
- Insert a naso-gastric tube, empty the stomach and allow free draining
- IV line for fluids and specific medication (antibiotics, steroids) as necessary
- Nebulisation with *β-2 agonists* (salbutamol) in case of asthma
- Refer to ENT after stabilization when foreign body in airway is suspected/confirmed
- Give *Sodium Bicarbonate* or Ringer lactate in case of Kussmauls breathing

3.2. PNEUMONIA

Definition: Pneumonia is an inflammation of the parenchyma of the lungs classified according to the infecting organism.

Causes

- Bacterial: Streptococcus pneumonia is the most common at all ages followed by Chlamydia pneumonia and Mycoplasma pneumonia (over 5 year old age), Chlamydia trachomatis (infant) Staphylococcus aureus, Haemophilus influenza (in case of no vaccination), Pseudomonas aeruginosa (in immunocompromised patients), Klebsiella pneumonia
- Viral: Respiratory Synctitial Virus, Adenovirus, Influenzae A and B, Parainfluenzae types 1 and 3, Metapneumovirus
- Fungal Cryptococcus neoformans, Aspergillus spp
- Mycobacterial: Mycobacterium tuberculosis, Mycobacterium avium, Mycobacterium intracellulare
- Parasites: Pneumocystis jiroveci

Signs and symptoms

- Fever
- Tachypnea
- Respiratory distress (inter-costal, sub-costal recession)
- Nasal flaring
- Use of accessory muscles
- Cyanosis and respiratory fatigue (in severe case especially for infants)
- Crackles and wheezing in auscultation
- bronchial breathing

Findings suggestive of viral and bacterial pneumonia

Findings	**Viral Pneumonia**	**Bacterial Peumonia**
Initial signs	Upper respiratory tract infection	Upper respiratory tract infection (in case of super infection)
Fever	Low	High
Pulmonary sign	Tachypnea Bronchial, crackles	Tachypnea Crackles
Clinical signs		
WBC	<20000 Lymphocytes predominance	15000-40000 Granulocytes predominance
Inflammatory test(CRP and ESR)	Low	High
Chest X-Ray	Perihilar changes Diffuse findings on chest exam are common Often peribronchial thickening	Alveolar pneumonia Bronchopneumonia usually bilateral Lobar pneumonia Lung abscess

N.B It is often not possible to distinguish viral pneumonia from disease caused by bacterial pathogens.

Clinical staging of pneumonia

Type	Signs	Symptoms
Very severe pneumonia	Cyanosis Inability to drink/ breastfeed AVPU = V, P or U Grunting	History of cough or difficulty of breathing Fever Abdominal/chest pain (sometimes)
Severe pneumonia	Lower chest in-drawing Nasal flaring Grunting	
Non severe Pneumonia	Fast breathing presence or absence of crackles	

Complications

- Empyema
- Pleural effusion
- Pneumothorax
- Sepsis/ meningitis / arthritis

Investigations

- FBC
- Chest x-ray
- Blood culture
- HIV test

Management

Factors for admission of children with pneumonia:

- Age < 6 months
- Sickle cell anaemia with acute chest syndrome
- Multiple lobe involvement
- Immunocompromised state
- Toxic appearance
- Very severe or severe pneumonia (clinical staging)
- Severe respiratory distress:
    - Supplemental oxygen
    - Dehydration
    - Vomiting
    - No response to appropriate oral antibiotic therapy

Management summary of pneumonia

Type	Management	Comments
Very severe pneumonia	Hospitalization Oxygen Correct shock, hypoglycaemia and dehydration Fluid maintenance Ampicillin 200mg/kg Q6hr ***or*** Benzyl penicillin 50,000 units/kg IM/IV Q6hr **Plus** Gentamycine IV 7.5mg/kg IV over 3-5 minutes Q 24 hours ***OR*** Cefotaxime 50mg/kg/dose Q 8 hours **(second line)**	Duration 10 days Switch to oral treatment with amoxicillin if improvement in clinical symptoms
Severe pneumonia	Hospitalization Oxygen Correct hypoglycaemia and dehydration Fluid maintenance Ampicillin 100mg /kg/day (33 mg/kg/dose Q8 hours)	Duration 7 days
Non severe Pneumonia	Amoxycilline 5025mg/kg/dose Q 12 hours	Duration 5 days

Note: If pneumonia due to staphylococcus is suspected give Cloxacillin 100mg/kg/day for 7days in 3doses and Gentamycine IV 7.5mg/kg IV twice daily.

3.3. WHEEZING CHILD/ASTHMA AND BRONCHIOLITIS

3.3.1. Wheezing child

Definition: A wheeze is a musical and continuous sound that originates from oscillations in narrowed airways. Wheezing is heard mostly in expiration as a result of critical airway obstruction.

Causes/ differential diagnosis

- Bronchiolitis
- Asthma
- Oesophageal foreign bodies
- Aspiration Syndrome (gastro-oesophageal reflux diseases)

3.3.2. Acute Bronchiolitis

Definition: Bronchiolitis is an inflammation of the bronchiole tubes due to viral organism resulting in wheezing. In children under 2 years old, it may lead to fatal respiratory distress. Occurs with seasonal variations and has epidemic potential.

Causes

- Acute bronchiolitis is a predominantly a viral disease
- Respiratory Syncytial Virus is the most common (>50% cases)
- Other agents: parainfluenza, adenovirus, Mycoplasma, and, occasionally, other viruses especially human metapneumovirus

Clinical signs

- Dyspnea with cough (both day and night)
- distension of the thorax
- Low-grade fever
- Prolonged expiration with diffuse wheeze on pulmonary auscultation:

- Occasionally fine, diffuse, bilateral late inspiratory crepitations
- Signs of serious illness include tachypnea, central cyanosis (tongue and gingiva), nasal flaring, chest in-drawing, Periods of apnoea, altered level of consciousness, difficulty drinking or breastfeeding, and silence on auscultation (corresponding to an intense bronchospasm)

Complications

- Bacterial secondary infection
- Atelectasis
- Apnoea especially in neonatal and infant period

Investigations

- FBC
- CRP (less contributory as viral infection)
- Chest x-ray: show hyperinflated lungs with patchy atelectasis
- Viral testing (usually rapid immunofluorescence, polymerase chain reaction, or viral culture) is helpful if the diagnosis is uncertain or for epidemiologic purposes

Management

Non Pharmaceutical

- Hospitalize children if signs of serious illness
- Administer high humidified oxygen at 8L/min in 30 to 40 % oxygen
- Attention to pulmonary toilet including suctioning, percussion and postural drainage
- IV fluid > maintenance
- Tube feeding when the child is in improved respiratory distress state
- In case of respiratory failure, use non-invasive naso CPAP or mechanical ventilation

Pharmaceutical

- Antibiotic treatment only indicated for children with secondary infection according to severity of clinical signs, high fever > 39°C, purulent sputum, aggravation of respiratory symptoms
- Give oral or parenteral antibiotics for 5 days based on severity and/or condition of the patient as follows:
  - *Amoxicillin 25mg* per dose/kg/day Q12hr PO

  OR

  - *Ampicillin IM*: 100 mg/kg/day in 3 divided doses or injections
- Alternative treatment:
  - *Erythromycin* 30 -50 mg per dose/kg/day x3/day/7-10days

Recommendations

- Treatment of bronchospasm:

  Data does not support routine use of bronchodilators, steroids or antibiotics. If bronchodilators to be used, closely monitor effect as it might worsen respiratory distress.

3.3.3. Asthma

Definition: Asthma is a chronic inflammatory condition of the lung airways resulting in episodic airflow obstruction.

Causes

- Unknown but the following factors have been identified
  - Allergens (e.g. house dust, perfumes, food, animal airs, mites)
  - Medicines (e.g. propranolol and aspirin)
  - Environmental (e.g. change of weather, pollutants), infections (viral or bacterial)
  - Emotions
  - Family history (genetic factors)
  - Gastro-esophageal reflux

Signs and symptoms

- Breathlessness
- Wheezing/ prolonged expiratory
- Cough (chronic nocturnal cough)
- Exercise induced cough
- Chest tightness
- Sputum production

Severity of Asthma Exacerbation

Parameter	Mild	Moderate	Severe	Respiratory arrest imminent
Breathless	Walking Can lie down	Talking Infant - softer, shorter cry; difficulty feeding Prefers sitting	At rest Infant stops feeding Hunched forward	
Talks in	Sentences	Phrases	Words	
Alertness	May be agitated	Usually agitated	Usually agitated	Drowsy or confused
Respiratory rate	Increased	Increased	Greatly increased	

Normal rates of breathing in awake children				
< 2 months : < 60/min				
2-12 months : < 50/min				
1-5 years : < 40/min				
6-8 years : < 30/min				
Accessory muscles and suprasternal retractions	Usually not	Usually	Usually	Paradoxical thoraco-abdominal movement
Wheeze	Moderate, often only and expiratory	Loud	Usually loud	Absence of wheeze

Severity of Asthma Exacerbation (cont.)				
Parameter	**Mild**	**Moderate**	**Severe**	**Respiratory arrest imminent**
Pulse/min.	<100	100 - 200	>120	Bradycardia
Guide to limits of normal pulse rate in children Infants : 2-12 months : < 160/min Preschool : 1-2 years : < 120/min School age : 2-8 years : < 110/min				
Pulsus paradoxus	Absent < 10 mm Hg	May be present 10 - 25 mm Hg	Often present> 25 mm Hg (adult) 20 - 40 mm Hg (children)	Absence suggests respiratory muscle fatigue
PEF after initial bronchodilator % predicted or % personal best	Over 80%	Approx. 60-80%	< 60% predicted or personal best or response lasts < 2 hrs	
PaO2 (on air)† and/or paCO2†	Normal < 45 mm Hg ***Test not usually necessary***	>60 mm Hg < 45 mm Hg	< 60 mm Hg > 45 mm Hg ***Possible cyanosis and respiratory failure***	
SaO2% (on air)†	>95%	91 - 95%	<90%	

Hypercapnia (hyperventilation) develops more readily in young children than adults and adolescents

*__Note:__ ***The presence of several parameters, but no necessarily all, indicates the general classification of the exacerbation.***

Note: ***Kilopascals are also used internationally; conversion would be appropriate in this regard.***

Diagnosis

- Asthma can often be diagnosed on the basis of a patient's symptoms and medical history
- Presence of any of these signs and symptoms should increase the suspicion of asthma
  - Wheezing high-pitched whistling sounds when breathing out-especially in children. (A normal chest examination does not exclude asthma)
  - History of any of the following
    - → Cough, worse especially at night
    - → Recurrent wheeze
    - → Recurrent difficult breathing
    - → Recurrent chest tightness
    - → Symptoms occur or worsen at night, waking the patient
    - → Symptoms occur or worsen in a seasonal pattern
    - → The patient also has eczema, hay fever, or a family history of asthma or atopic diseases
    - → Symptoms occur or worsen in the presence of
      - Animals with fur
      - Aerosol chemicals
      - Changes in temperature
      - Domestic dust mites
      - Drugs (aspirin, beta blockers)
      - Exercise
      - Pollen
      - Respiratory (viral) infections
      - Smoke
      - Strong emotional expression

- Symptoms respond to anti-asthma therapy
- Patients colds "go to the chest" or take more than 10 days to clear up

Complications

- Uncontrolled/poorly controlled asthma can lead to severe lung damage
- Severe asthma exacerbation can cause respiratory failure and death

Investigations

- Lung function to confirm diagnosis and assess severity
- Peak expiratory flow rate can help diagnosis and follow up
- Additional diagnostic tests
  - Allergy testing (where applicable)
  - Chest x-ray (for differential diagnosis)
  - FBC for exclusion of super-infection

Management

- Treatment of asthma exacerbation (see algorithm below)
- **Definition:** Asthma exacerbation (asthma attacks) are episodes of a progressive increase in shortness of breath, cough, wheezing or chest tightness or a combination of these symptoms.

  Asthma attack requires prompt treatment

  - Bronchodilators
    - → *Salbutamol*: begin with 2-4 puffs/20 min first hour then depending on severity:
      - Mild: 2-4 puffs/3 hours
      - Moderate: up to 10 puffs / hour
      - Alternatively (especially in severe cases), use nebulization of *Salbutamol* 2.5mg in 2 ml of normal saline /20 min first hour

- Glucocorticosteroïds: early if moderate or severe attack
  - → *Prednisolone* per os 0.5 to 1 mg/kg or equivalent over 24 hour period
  - → Alternatively, *Hydrocortisone* IV, 5 mg / kg (Adult 400 mg), repeat every 6 hours during 24 hours
- Oxygen: Very efficient bronchodilator to achieve SaO2 ≥ 95 % if hypoxemic patient

Alternative treatment

- → *Ipratropium bromide* (if available): nebulization increases effect of salbutamol
- → *Theophylline* can be used if salbutamol not available but causes many side effects
- → *Adrenaline* in case of anaphylaxis but not indicated for asthma attack (10µg/kg IM then infusion 0.1µg/kg/min)

- Monitor response to treatment
  - → Clinical evolution (signs of respiratory distress)
  - → Peak flow if possible
  - → Oxygen saturation
  - → Arterial blood gas (severe cases)
- Maintenance treatment: (see tables below)
  - → Clinical initial check- up
  - → Check risk factors
  - → Patient education: discuss the management plan, importance of adherence to treatment
  - → Medication: inhaled corticosteroids
  - → Example: start with *Beclomethasone* inhaled 250µg, once to twice a day with inhalation chamber then step up or step down according to the evolution (close follow up after discharge)
  - → Treatment of co-morbid conditions (Rhinits, sinusitis, gastroesophagial reflux)

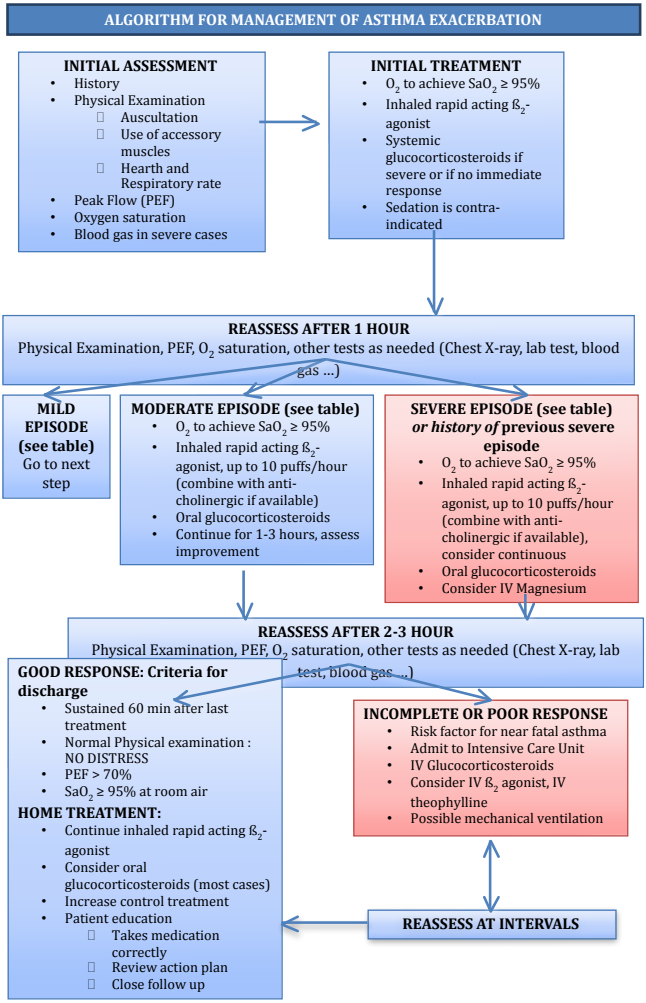
Stepwise approach for maintenance treatment

Level of control	Treatment action
Controlled	Maintain and find lowest controlling step
Partially controlled	Consider stepping up to gain control
Uncontrolled	Step up until controlled
Exacerbation	Treat exacerbation

Step 1	Step 2	Step 3	Step 4	Step 5
Asthma education environmental control. (If step-up treatment is being considered for poor symptom control, first check inhaler technique, check adherence, and confirm symptoms are due to asthma).				
As needed rapid acting $ß_2$-agonist	As needed rapid acting $ß_2$-agonist			
Controller option	Select one	Select one	To step 3 , select one or more	To step 4 Add either
	Low doses ICS (inhaled costicostreroid)	Low doses ICS plus long acting $ß_2$-agonist	Medium or high doses ICS plus long acting $ß_2$-agonist	Oral glucocorticostréroids (lowest dose)
	Leucotriène modifier	Medium or high doses ICS Low doses ICS plus leukotriene modifier		Anti IgE treatment
		Low doses ICS plus sustained release theophylline		

Estimated equipotent dose of inhaled glucocorticostreroids			
Drug	**Low Dose (µg)**	**Medium Daily Dose (µg)**	**High Daily Dose (µg)**
Beclomethasone dipropionate - CFC	200 – 500	> 500 - 1000	> 1000 - 2000
Beclomethasone dipropionate - HFA	100 – 250	> 250 - 500	> 500 - 1000
Budesonide	200 – 400	> 400 - 800	> 800 - 1600
Ciclesonide	80 – 160	> 160 - 320	> 320 - 1280
Flunisolide	500 – 1000	> 1000 - 2000	>2000
Fluticasone propionate	100 – 250	> 250 - 500	>500 - 1000
Mometasone furoate	200	>400	>800
Triamcinolone acetonide	400 – 1000	>1000 - 2000	>2000

NB: *The most important determinant of appropriate dosing is the clinician's judgment of the patient's response to therapy. The clinician must monitor the patient's response in terms of clinical control and adjust the dose accordingly. Once control of asthma is achieved, the dose of medication should be carefully titrated to the minimum dose required to maintain control, thus reducing the potential for adverse effects.*


ALGORITHM FOR MANAGEMENT OF ASTHMA EXACERBATION
INITIAL ASSESSMENT
History
Physical Examination
Auscultation
Use of accessory muscles
Hearth and Respiratory rate
Peak Flow (PEF)
Oxygen saturation
Blood gas in severe cases
INITIAL TREATMENT
O_2 to achieve $SaO_2 \geq 95\%$
Inhaled rapid acting $ß_2$-agonist
Systemic glucocorticosteroids if severe or if no immediate response
Sedation is contra-indicated
REASSESS AFTER 1 HOUR
Physical Examination, PEF, O_2 saturation, other tests as needed (Chest X-ray, lab test, blood gas ...)
MILD EPISODE (see table)
Go to next step
MODERATE EPISODE (see table)
O_2 to achieve $SaO_2 \geq 95\%$
Inhaled rapid acting $ß_2$-agonist, up to 10 puffs/hour (combine with anti-cholinergic if available)
Oral glucocorticosteroids
Continue for 1-3 hours, assess improvement
SEVERE EPISODE (see table)
or history of previous severe episode
O_2 to achieve $SaO_2 \geq 95\%$
Inhaled rapid acting $ß_2$-agonist, up to 10 puffs/hour (combine with anti-cholinergic if available), consider continuous
Oral glucocorticosteroids
Consider IV Magnesium
REASSESS AFTER 2-3 HOUR
Physical Examination, PEF, O_2 saturation, other tests as needed (Chest X-ray, lab test, blood gas ...)
GOOD RESPONSE: Criteria for discharge
Sustained 60 min after last treatment
Normal Physical examination : NO DISTRESS
PEF > 70%
$SaO_2 \geq 95\%$ at room air
HOME TREATMENT:
Continue inhaled rapid acting $ß_2$-agonist
Consider oral glucocorticosteroids (most cases)
Increase control treatment
Patient education
Takes medication correctly
Review action plan
Close follow up
INCOMPLETE OR POOR RESPONSE
Risk factor for near fatal asthma
Admit to Intensive Care Unit
IV Glucocorticosteroids
Consider IV $ß_2$ agonist, IV theophylline
Possible mechanical ventilation
REASSESS AT INTERVALS

CHAPTER 4

EAR NOSE AND THROAT CONDITIONS

4. EAR NOSE AND THROAT CONDITIONS

4.1. ACUTE OTITIS MEDIA

Definition: It is the inflammation of the middle ear cavities

Causes

- Viral
- Bacterial (Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis etc.)
- Predisposing factors include poor living conditions, adenoids, sinusitis, allergic rhinitis, tonsillitis, asthma etc.

Signs and symptoms

- Fever
- Retroauricular pain
- Crying with ear scrubbing
- Gastro intestinal signs
- Otalgia
- Cervical lymphadenopathy
- Otorrhea (if tympanic membrane perforated)
- Impaired hearing
- Redness of eardrum
- Sometimes bulging of the eardrum

Complications

- Secretory otitis media (ear glue)
- Chronic otitis media with perforation
- Acute mastoiditis sometimes with periosteal abscess
- Intracranial (meningitis, brain abscess, subdural abscess, etc.)
- Facial paralysis
- Labyrinthitis

Management

General measures: Elimination of risk factors

Pharmaceutical

Treatment of first choice

- *Amoxicillin*, Po 30mg/kg/dose P.O. Q every 8 hours for 7-10 days
- When associated with rhinitis add *Xylometazoline (Otrivine)* 0.5% nose drops or simple argyrol drops 1% , 0.05%
- *Paracetamol* 10-15mg/kg/dose Q every 6 hours if high fever or pain

Alternative treatment

- *Amoxi-clav (Augmentin)* 50mg/kg/day P.O , Q every 8 hours for 7 -10 days

OR

- *Cefadroxyl (Oracefal):* 25mg/kg/dose Q every 12 hours for 7 days
- *Cefuroxime (Zinat):* 15mg/kg /dose Q every 12 hours for 7 days
- *Azithromycine* 5mg/kg/dose Q every 24 hours for 3 days
- *Erythromycine* 20 mg/kg/dose Q every 8 hours for 10 days

Surgical:

Myringotomy if necessary

Recommendation

- Avoid getting in the inside of the wet ear

4.2. CHRONIC SUPPURATIVE OTITIS MEDIA

Definition: It is a chronic inflammation of the middle ear with recurrent ear discharges or otorrhoea through a tympanic perforation for more than 2 weeks.

Predisposing risk factors

- Inadequate management of otitis media
- Frequent upper respiratory tract infections
- Anatomic factor: Short Eustachian Tube
- Poor living conditions, poor housing, hygiene and nutrition analphabetism
- Immunosupression (e.g.: HIV infection)

Causes

- Tuberculosis
- P. aeruginosa
- S.pneumoniae
- Staphyllococcus aureus
- H. Influenza

Signs and symptoms

- Recurrent pus ear discharge
- Large perforation of the eardrum on examination
- Progressive hypoacousia with impaired hearing
- Buzzing (acouphene)
- History of recurrent otitis media
- Loss of transparency of tympanic membrane

Complications

- Subperiosteal abscesses
- Facial nerve paralysis
- Lateral sinus thrombophlebitis

- Suppurative labyrinthitis
- Brain abscess
- Meningitis
- Mastoiditis
- Extradural and subdural empyema
- Otitic hydrocephalus
- Hearing impairment
- Deafness

Investigations

- Bacterial Cultures
- Search for predisposing factors
- Audiogram
- CT-scan

Management

Non pharmacological management

- Dry mopping
- Aural toilet by medicines' droppers (with hydrogen peroxide or polyvidone iodine saline solutions)
- Avoid getting the inside of the ear wet e.g. bathing and swimming

Pharmacological management

- Topical quinolones (*Ciprofloxacin* ear drops Q12h for 7 days)
- Systemic treatment: *Ceftazidime* IV or IM 50mg/kg/dose Q every 8 hours (max:6gr/day) for 7 days
- In case of mastoiditis: Mastoidectomy

Recommendations

- Proper management of acute otitis media
- Avoid getting the inside of the ear wet e.g. bathing and swimming
- Refer to the tertiary health facility for further management

4.3. TONSILLITIS

Definition: It is an inflammation of the tonsils

Causes

- Bacterial infection (*Group A β-hemolytic streptococcal, staphylococcal*)
- Viral infection (Rhinoviruses, influenza)
- Fungal infection

Signs and symptoms

- Difficult and painful swallowing (Dysphagia)
- Refusal of breastfeeding
- Fever, chills
- Headache
- Vomiting
- Sore throat - lasts longer than 48 hours and may be severe
- Enlarged and tender submandibular lymph nodes
- Swollen red tonsils with white spots

Complications

- Rheumatic heart disease
- Acute glomerulonephritis
- middle ear infections
- Peritonsillar abscess (quinsy)
- Abscess of the pharynx

- Sinusitis
- Septicaemia
- Bronchitis or pneumonia
- Airway obstruction

Investigations

- Swab for laboratory analysis
- Complete blood count if signs of sepsis
- Streptococcal screen

Management

- Ensure enough fluids to avoid dehydration

Pharmaceutical:

Antibiotics, analgesics, anti-inflammatory

Treatment of first choice

- *Amoxicillin* 15-30 mg/kg/dose Q every 8 hours for 10 days

OR

- *Penicillin* V tabs: 15mg/kg/dose Q every 12 hours for 10days
- In case of allergy to penicillin use:
- *Erythromycine* 15-20mg/kg/dose Q every 8 hours for 10 days

OR

- *Azithromycine* 5mg/kg/dose Q every 24 hours for 3 days
- If fever or pain, give *Ibuprofen*: 2-3mg/kg/dose Q8h o r *Paracetamol* 10-15mg/kg Q6h, max 60mg/kg/day

If no response with the first choice,

- *Amoxi-clav (Augmentin)* 15-20mg/kg/dose P.O , Q every 8 hours 7 -10 days

OR

- *Cefuroxime (Zinat): 15mg/kg /dose* Q every 8 hours for 7 days

Surgical treatment

- Tonsillectomy indicated in:
  - ➔ Chronic repetitive tonsillitis
  - ➔ Obstructive tonsils

Recommendations

- Systematically give Antibiotherapy for children > 3 years in order to prevent rheumatic heart disease
- For chronic and obstructive tonsillitis refer to the ENT specialist

4.4. ACUTE MASTOIDITIS

Definition: Acute mastoiditis is sudden onset bacterial infections of the mastoid bone

Causes

- Spread of pathogens causing acute otitis media to the mastoid bone

Signs and symptoms

- Fever
- Pain, tenderness, discomfort and swelling behind the ear
- In some instances, the ear on the affected side seems pushed out and quite prominent. This is caused by a high concentration of pus in the mastoid
- Sometimes associated suppurative otitis media
- Tympanic membrane is usually perforated with otorrhoea
- Occasionally, pus breaks through the mastoid tip and forms an abscess in the neck (Bezold's abscess)
- Headache
- Hearing loss

Diagnosis

- Clinical
- X-Ray of the mastoid bone

In selected cases

- CT-scan of the middle ear
- Culture of the pus from the mastoid bone
- Hemoculture
- LP if signs of meningitis

Complications

- Facial paralysis
- Brain abscess
- Meningitis
- Neck abscess
- Extradural abscess
- Septicemia
- Subdural abscess

Management

Pharmacological

- *Cephalosporine* 3rd generation
  - → Cefotaxime IV 30-50 mg/kg/dose Q every 8 hours for 7-10 days
    OR
  - → Ceftriaxone IV 100mg/kg/dose Q every 24 hours for 7-10 days

- If 3rd generation cephalosporine not available,
  - → *Ampicillin* iv 50mg/kg/dose Q every 6 hours for 7-10 days
  - → and Gentamycin iv 5mg/kg/dose Q every 24 hours 5 days
  - → If fever or pain, give *Ibuprofen*: 2-3mg/kg/dose Q every 8 hours or *Paracetamol* 10-15mg/kg Q every 6 hours, max 60mg/kg/day

Surgical

- Mastoidectomy
- Incision of abscess
- When anaerobic infection is suspected : add metronidazole IV 15-20 mg/kg/dose Q every 8 hours and culture sensitivity where possible

4.5. EPISTAXIS

Definition: Epistaxis is nose bleeding.

Causes

- Local (trauma, inflammation, foreign bodies, tumours of the nose and rhinopharynx, chronic using of nasal steroides, intra nasal growth like polyps,)
- Systemic (cardiovascular diseases, blood diseases, liver diseases, kidney diseases, febrile diseases)
- Upper respiratory disease (sinusitis, allergic rhinitis)
- Juvenile nasopharyngeal angiofibroma if profuse unilateral epistaxis associated with a nasal mass in adolescent boys
- Idiopathic (causes not known)

Signs and symptoms

- Blood coming from the nose or the rhinopharynx
- History of recurrent nasal bleeding

Complications

- Hypovolemic shock
- Anaemia

Investigations in complicated or recurrent cases

- Full Blood Count, clotting time, bleeding time, prothrombin time
- CT scan and MRI if Juvenile nasopharyngeal angiofibroma

- Other investigations should be requested based on general examination findings

Management

Non pharmaceutical treatment

- Sit the patient up to avoid aspiration
- Cleaning of blood clots from the nose
- Direct pressure applied by pinching the soft fleshy part of the nose applied for at least five minutes and up to 20 minutes
- Application of cold compresses on the nose
- Room humidifier
- Pack with ribbon gauze impregnated with topical ointments (Vaseline) and remove it after 12-24 hours.

Pharmaceutical treatment

- Application of a topical antibiotics ointment to the nasal mucosa has been shown to be an effective treatment for recurrent epistaxis
- Topical vasoconstrictor: *Xylometazoline* spray (otrivine) 0.5mg/ml
- Cauterization of the bleeding site with *Silver nitrate* or 20% of solution *Trichloracetic acid* under topical anesthesia
- Electro coagulation
- If severe bleeding with shock/or anemia, immediate blood transfusion is recommended

Recommendations

- Investigate for underlying causes
- Refer cases of severe and recurrent epistaxis
- Refer to ENT specialist for otolaryngologic evaluation if bilateral bleeding or hemorrhage that not arise from Kiesselback plexus

4.6. LARYNGITIS

Definition: Laryngitis: is the inflammation involving the vocal cords and structures inferior to the cords

Causes

- Viral respiratory tract infection (Parainfluenza Virus Type 1 and 2, Rhinoviruses, Syncytial Viruses, adenoviruses)

Signs and Symptoms

- Progressive Laryngeal dyspnea
- Sore throat
- Hoarseness of voice
- Stridor
- Barking cough
- Fever
- Erythema and Edema of larynx

Investigations

- Unless there are signs of secondary infection

Complications

- Severe respiratory distress
- Secondary infection
- Airway obstruction

Management

Non Pharmacological management

- Leave child in caregiver's arms as much as possible (except if near respiratory arrest) as you manage the child
- Humidified O2 therapy
- Plenty of fluids

Pharmacological treatment

- *Adrenaline* Nebulisation 0.5ml/kg [of diluted 1:1000 (1 mg/ml)] in 3 ml *Normal saline*. Maximum dose 2.5ml for ≤ 4yrs old and maximum 5ml for > 4yrs old.
- *Dexamethasone* IM 0.3-0.6mg/kg per dose x 2/day/2days or *Prednisolone* PO 1-2mg/kg/day divided in 2 doses (maximum dose 50mg in 24 hours)

Recommendation

- Patient who doesn't improve on treatment should be intubated

4.7. EPIGLOTTITIS

Definition: Acute epiglottitis is a life-threatening emergency due to respiratory obstruction. It is due to intense swelling of epiglottis and surrounding tissues with septic signs.

Cause

- Haemophilus influenza type b

Signs and symtomes

Signs/symptoms	Croup (laryngitis)	Epiglottitis
Onset	Over days	Over hours
Preceding coryza	Yes	No
Cough	Severe, barking	Absent or slight
Able to drink	Yes	No
Drooling saliva	No	Yes
Appearance	Unwell	Toxic, very ill
Fever	<38,5°C	>38,5°C
Stridor	Harsh, rasping	Soft, whispering
Voice, cry	Hoarse	Muffled, reluctant to speak

Management

- Urgent hospital admission and treatment
- Move the child only when ready for intubation under anesthaesia
- Intubation by senior anesthaesist, paediatrician and ENT in surgical room
- Urgent tracheostomy if intubation impossible
- Antibiotic treatment
  - *Cefotaxime* IV 30-50 mg/kg/dose Q every 8 hours for 7-10 days

  OR

  - *Ceftriaxone* IV 100mg/kg/dose Q every 24 hours for 7-10 days

CHAPTER 5

CARDIOVASCULAR DISEASES

5. CARDIOVASCULAR DISEASES

Most cardiac diseases in young children are congenital, while those in older children may be acquired or congenital.

5.1. CARDIO-VASCULAR EMERGENCIES

5.1.1. Cardiac failure

Definition: It is the inability of the heart to deliver adequate cardiac output to meet the metabolic needs of the body.

Causes

- Congenital heart disease: Aortic valve stenosis, coarctation, septal defect (atrial or ventricular)
- Acquired heart disease: Rheumatic fever/rheumatic heart disease, myocarditis, infective endocarditis, pericarditis/tamponade
- Other causes: severe anaemia, fluid overload, acute hypertension etc

Signs and symptoms

- Signs due to congestion
- Polypnea, cough
- Exercise induced dyspnoea and orthopnoea on lying flat
- Enlarged, tender liver
- Basal crackles on auscultation
- Elevated jugular venous pressure (JVP)
- Weight gain due to oedema
- Peripheral or central cyanosis
- Cold extremities
- Capillary refill time > 2 sec

- Tachycardia (heart rate >160/minute in a child under 12 months old/gallop rhythm, >120/ minute in a child aged 12 months to 5 years)
- Weak pulse
- Decreased Blood Pressure
- Oliguria
- Agitation/ altered consciousness

Complications

- Failure to thrive
- Cardiogenic shock and death

Investigations

- FBC (Full Blood Count), ESR (Erythrocyte Sedimentation Rate), CRP
- ASOT (Anti Streptolysine - O - titre)
- BUN (Blood Urea Nitrogen), creatinine, creatinine clearance, urine analysis
- Liver function tests (ASAT and ALAT)
- Serum electrolyte test (sodium, potassium)
- Chest x-ray
- Ultrasound (cardiac, abdomen)
- ECG

Management

Non Pharmaceutical

- Admit the child
- Keep the child in semi-upright position
- General measures and resuscitation
- Oxygen therapy
- Restrict fluid intake even in cardiogenic shock

- Limit salt intake but supply adequate calories
- Limit strenuous activities
- Monitor vital signs (heart rate, respiratory rate, pulse oximetry, urine output), liver size and body weight

Pharmaceutical

- Diuretics (*Frusemide inj. IV* 1-4 mg/kg/day divided into 2-3 doses. Maximum dose 8 mg/kg/day)
- Supplementary *Potassium* if *Frusemide* is given for more than 5 days
- Treating the underlying cause (surgical treatment): refer to a specialized centre. See section on cardiology for more details on diagnosis and treatment of cardiovascular disorders.

5.1.2. Shock

Definition: It is an acute dramatic syndrome characterized by inadequate circulatory provision of oxygen, so that the metabolic demands of vital organs and tissues are not met.

Causes

- Hypovolemic causes: Severe dehydration (diabetes, burns, diarrhea and vomiting), severe haemorrhage,
- Septic causes: Bacterial, fungal and viral infections
- Cardiogenic causes: Congenital heart diseases, cardiomyopathy, ischemia, dysrrhythmias
- Distributive causes : Anaphylaxis (drugs, food, plants, insects, and snake bites)
- Obstructive causes : Large pulmonary embolism, Coarctation of aorta, tension pneumothorax, pericardial tamponade

Signs and symptoms

- Low Blood Pressure for age
- Weak or undetectable pulses
- Cold extremities, prolonged capillary refill (more than 2 seconds)
- Skin moist and clammy
- Altered mental status, confusion, coma
- Low urine output, anuria
- Heart failure
- Irregular heart beat

Note: ***All of the above signs are exaggerated in uncompensated very severe shock***

Complication

- Immediate death

Investigations

- Hemoculture for bacterial, fungal or viral infections
- Full Blood Count
- Other investigations according to suspected diagnosis

Management

General measures

- CABD
- Put patient in left lateral position, maintain airway and give oxygen
- Empty the stomach; maintain free drainage via naso-gastric tube and NPO
- Intubation and mechanical ventilation if patient is apneic or agonal breathing/gasps
- IV line (0-5 min) if not possible, put Intraosseous and draw blood for emergency laboratory investigations

- Evaluate for signs of infection
- Evaluate for the signs of malnutrition (need different fluids management)
- Patient usually needs high care

Shock in children without malnutrition

- Hypovolemic shock
  - ➔ Attach Ringer's lactate or normal saline and make sure the infusion is running well
  - ➔ Infuse 20mL/kg as rapidly as possible

Age/weight	**Volume of Ringer's lactate or normal saline solution (20 ml/kg)**
2 months (<4 kg)	75 ml
2–<4 months (4–<6 kg)	100 ml
4–<12 months (6–<10 kg)	150 ml
1–<3 years (10–<14 kg)	250 ml
3–<5 years (14 – 19 kg)	350ml

➔ Reassess child after each infusion

- Reassess after first infusion: If no improvement, repeat 20ml/kg as rapidly as possible.
- Reassess after second infusion: If no improvement, repeat 20 ml/kg as rapidly as possible.
- Reassess after third infusion: If no improvement, give blood 20 ml/kg over 30 minutes (if shock is not caused by profuse diarrhea, in this case repeat Ringer's lactate or normal saline)

- Reassess after fourth infusion: If no improvement, see disease-specific treatment guidelines. You should have established a provisional diagnosis by now.

→ After improvement at any stage (pulse slows, faster capillary refill, urine output) continue management as in severe dehydration without shock (Plan C)

- Septic shock
  - → General measures (see above)
  - → Blood transfusion if haemoglobin is < 10g/dl
  - → Broad spectrum antibiotics (usually combination depending on the type of suspected bacterial infection
    - Third-generation cephalosporin preferred. *Cefotaxime* 150-200 mg/kg/day in 3-4 divided doses per day or *Ceftriaxone* 100 mg/kg/day given once per day)
  - → If no improvement on fluid therapy
    - Give Inotropic drugs (*Dopamine* 5-15µg/kg/min
    - Dilution: 200 mg in 50 ml of normal saline
  - → Abscess, if present should be drained
- Cardiogenic shock
  - → See section on management of cardiac diseases
- Anaphylactic shock
  - → General measures as above
  - → Place patient in Tredelenberg position with head at 30 degree angle below the feet.
  - → Rapid fluid resuscitation with IV bolus 20 mL/kg. Repeat if needed.
  - → Give supplemental oxygen
  - → Give *Adrenaline solution* 1/1000 (1ml = 1mg IV slowly 0.25 mg in 10ml of normal saline. Or 0.01 mL/kg of adrenaline solution 1/1000 given intramuscular or subcutaneous in the lateral thigh. Maximum dose 0.5 mL. (Repeat every 15 minutes as needed.)

- → *Hydrocortisone* 5mg/kg IV divided in three daily doses
- → H_1 antagonist (*Chloramphiramine* or *Diphenhydramine* 1-2 mg/kg IV, IM or PO. Maximum dose 50 mg)
- → *Salbutamol* nebulization 2.5-5 mg inhaled if wheezing

Shock with severe malnutrition

- Give treatment only if the child has signs of shock and is lethargic or has lost consciousness
  - → Insert an IV line (and draw blood for emergency laboratory investigations)
  - → Weigh the child (or estimate the weight) to calculate the volume of fluid to be given
  - → Give IV fluid 15 ml/kg over 1 hour. Use one of the following solutions (in order of preference) and according to availability
    - *Ringer's lactate* with 5% *Glucose* (dextrose) or
    - Half *Normal saline* with *5% Glucose* (dextrose) or
    - Half-strength *Darrow's solution* with *5% Glucose* (dextrose) or if these are unavailable give *Ringer's lactate*
  - → Measure the pulse and breathing rate at the start and every 5–10 minutes thereafter. If there are signs of improvement (pulse and respiratory rates fall, Blood Pressure normalizes):
    - Switch to oral or nasogastric rehydration with *ReSoMal* 10 ml/kg/h up to 10 hours
    - Initiate refeeding with starter F-75

- If the child fails to improve assume the child has septic shock and treat as follows
  - → Give maintenance IV fluid (4 ml/kg/h) and start antibiotic treatment (see section on septic shock above for details on antibiotics) while waiting for blood

→ When blood is available, transfuse fresh whole blood at 10 ml/kg slowly over 3 hours (use packed cells if in cardiac failure) then

  ▪ Initiate refeeding with starter F-75

→ If the child deteriorates during the IV rehydration (breathing increases by 5 breaths/min or pulse by 15 beats/min or other signs of respiratory distress), stop the infusion because IV fluid can worsen the child's condi

5.2. HEART FAILURE (CONGESTIVE CARDIAC FAILURE)

Definition: It is a clinical syndrome reflecting the inability of the myocardium to meet the oxygen and nutritional metabolic requirements of the body.

Causes

- In normal heart anatomy
  - Anemia
  - Infection/sepsis
  - Volume overload
  - Arrhythmia
  - Cardiomyopathies
  - Hypertension
  - Renal failure
  - Acquired valvulopathies
  - Hypothyroidism
  - Kawasaki disease

- In Congenital heart disease
  - Left to Right shunt (Ventricular Septal Defect, Patent Ductus Arteriosus)
  - Aortic coarctation

- Aortic valvular stenosis
- Supra valvular aortic stenosis
- Mitral stenosis, mitral regurgitation
- Pulmonary veins stensosis
- Single ventricle

Signs and Symptoms

- Tachypnea/dyspnea
- Cough
- Sweating
- Excessive weight gain/oedema
- Poor feeding/ failure to thrive
- Tachycardia
- Gallop rhythm with or without heart murmur
- Weak pulses
- Hypotension
- Pallor
- Cold extremities
- Prolonged capillary refill > 2seconds
- Oliguria
- Hepatomegaly / increased jugular vein pressure
- Crepitations (in older children) / wheezing

Investigations

- FBC, Electrolytes, Urea and Creatinine, Blood Gas if available.
- Chest X-ray
- ECG
- Echocardiogram

Management

Non pharmacological treatment

- Oxygen therapy
- Semi- Sitting position (cardiac bed)
- Restrict fluids to 2/3 of maintenance (aim at urine output of 2ml/kg/h)
- Low sodium diet
- Strict bed rest
- Ensure adequate nutrition
- Recognize and treat the underlying conditions e.g. fluid overload, hypertension, infection
- Monitoring of vital signs: RR, HR, BP, O2 saturation, urine output

Pharmacological treatment

- *Frusemide* IV 1-4mg/kg divided in 2 doses (to be increased progressively)
- *Digoxin* per os 0.01mg/kg/day (no loading dose)
- *Captopril* 1-4mg/kg/day divided in 3 doses if normal creatinine (to be increased progressively, beware hypotension)
- *Carvedilol* for stable older children > 30 kg: initiate with 3.125mg BID, increase every 15 days if good tolerance. Maximum dose: 12.5mg BID.

Recommendations

- If isolated right sided heart failure: use furosemide (see dosage above) and aldactone 2mg/kg/day divided in 2 doses.
- Administration of carvedilol and aldactone should be discussed with the cardiologist.

Note : Any patient with heart failure due to heart disease must be referred to the cardiologist

5.3. CARCINOGENIC SHOCK

Definition: It is a dramatic syndrome characterized by inadequate circulatory provision of oxygen due to cardiac pump failure secondary to poor myocardial function, so that the metabolic demands of vital organs and tissues are not met.

Signs and symptoms

- Hypotension
- Tachycardia
- Gallop rhythm
- Hepatomegaly
- Crackles/wheezes
- Weak and fast pulses (or absent)
- Cold extremities/ pallor
- Capillary refill > 2 seconds
- Oliguria/anuria

Management

Non pharmacological management

- Avoid excessive IV fluids, the patient is fluid overloaded in this case, give 2/3 of maintenance (aim at urine output of 2ml/kg/h)
- Oxygen therapy: 10-15l/min with mask and reservoir bag
- Semi-sitting position (cardiac bed)
- Low sodium diet
- Strict bed rest
- Ensure adequate nutrition
- Correct hypoglycemia with 3-5ml/kg IV of Dextrose 10%

Pharmaceutical treatment

- *Dopamine* IV 5-10 microgram/kg/min, may increase to 20 microgram/kg/min ***OR***

- *Dobutamine* IV 2 to 20 microgram/kg/min
- *Furosemide* IV 2mg/kg/dose if adequate peripheral perfusion. Repeat the dose according to estimated fluid overload up to 8mg/kg/day
- Correct arrhythmia if present with digoxin 0.04mg/kg/day in 3 divided doses (maintenance: 0.01mg/kg/day)
- Monitor: Heart rate, respiratory rate, BP, urine output, pulse oxymetry for oxygen saturation

5.4. PULMONARY OEDEMA

Definition: Pulmonary oedema is the accumulation of fluid in the alveoli due to an increase in pulmonary capillary venous pressure resulting from acute left ventricular failure.

Causes

- Heart not removing fluid from lung circulation properly (cardiogenic pulmonary edema)
- A direct injury to the lung parenchyma

Signs and symptoms

- Breathlessness/ Respiratory distress
- Sweating
- Cyanosis (decreased oxygen saturation)
- Frothy blood-tinged sputum
- Ronchi and crepitations/wheezes

Investigations

- Chest x-ray shows loss of distinct vascular margins, Kerley B lines, diffuse haziness of lung fields, pleural effusion.
- Blood gas if possible
- ECG
- Echocardiography

Management

- Maintain patient in a semi sitting position
- Oxygen by facial mask with reservoir bag if available
- *IV Furosemide* 2mg/kg/dose, maximum 8mg/kg/day
- Inotropic support with *Dopamine* or *Dobutamine* if signs of shock
- Transfer to cardiologist for further management

5.5. CONGENITAL HEART DISEASES

Definition: Congenital heart disease refers to a problem with the heart's structure and function due to abnormal heart development before birth. Often divided into two types, non-cyanotic and cyanotic (blue discoloration caused by a relative lack of oxygen).

5.5.1. Non Cyanotic Heart Diseases

Common lesions

- Ventricular Septal Defect (VSD) most common congenital heart disease
- Patent ductus arteriosus (PDA)
- Atrio-ventricular septal defect (AVSD) or endocardial cushion defect (common in trisomy 21)
- Atrial septal defect (rarely causes heart failure)
- Coarctation of aorta

Signs and symptoms

- Tachypnea, dyspnea,
- Tachycardia
- Sweating
- Feeding difficulties / failure to thrive
- Recurrent chest symptoms
- Hepatomegaly
- Increased jugular venous pressure

Complications

- Failure to thrive
- Infective endocarditis
- Pulmonary vascular obstructive disease (pulmonary hypertension) which can lead to
- Eisenmenger Syndrome

Investigations

- Chest x-Ray
- ECG
- Echocardiogram
- Cardiac catheterization/angioscan in special cases.

Management

Treatment depends on the specific condition. Some congenital heart diseases can be treated with medication alone, while others require one or more surgeries.

- *Lasix* 2mg/kg/day
- *Captopril* 1-3mg/kg/day (start with 1mg/kg)
- Increase calories in feeding
- Iron if Hb less than 10g/dl (preferably reach 15g/dl)
- Surgical repair generally before 1 year if possible

5.5.2. Cyanotic heart diseases

Definition: Cyanotic heart disease is a heart defect, present at birth (congenital), that results in low blood oxygen levels (< 90 % even with oxygen).

Common lesions

- Decreased flow to the lungs (does not cause heart failure)
  - Tetralogy of fallot
  - Pulmonary atresia

- Increased flow to the lungs (does cause heart failure and failure to thrive)
    - Transposition of great vessels (TGA)
    - Truncus arteriosus
    - Single ventricle / Tricuspid atresia

5.5.3. Tetralogy of Fallot

Definition: Tetralogy of Fallot refers to a type of congenital heart defect comprising of:

- Large ventricular septal defect
- Narrowing of the pulmonary outflow tract (pulmonary stenosis)
- Overriding aorta
- Right ventricular hypertrophy

Signs and symptoms

- Progressive cyanosis with pulmonary systolic murmur
- Digital clubbing occurs after long time
- Hallmark: Paroxysmal hyper cyanotic attacks (blue spells) with the following manifestations:
    - Hyperpnea and restlessness
    - Increased cyanosis
    - Gasping respiration
    - Syncope or convulsions
    - Spontaneous squatting position is frequent (in older children)
    - Heart murmur disappears

Complications

- Delayed development/growth
- Polycythemia
- Hypercyanotic attack, sometimes associated with seizures and death
- Infective endocarditis
- Brain abscess

Investigations

- Chest x-ray
- Complete blood count (CBC)
- Echocardiogram
- Electrocardiogram (EKG)

Management

- Avoid dehydration and stress (treat early infections, quite environment)
- *Propanolol* 0.5-1mg/kg every 6 hours to prevent hypercyanotic attacks
- Iron 5mg/kg /day to prevent microcytosis
- Surgical repair, urgent as soon as spells begin
- In case of Hypercyanotic attacks
  - Squatting position (hold the infant with the legs flexed on the abdomen)
  - *Oxygen* 6l/min with mask
  - *Diazepam* 0.3mg/kg IV or 0.5mg PR if convulsing
  - *Normal saline* 10-20ml/kg/ 30 minutes
    - → *Sodium Bicarbonate* 8.5% 1ml/kg to correct acidosis
  - *Morphine* 0.1mg/kg IV if persistent attacks (but risk of respiratory depression)
  - *Propranolol* IV 0.1 – 0.2 mg/kg slowly then continue oral maintenance to relax the infundibular spasms

Common causes of heart failure in Neonates

Clinical manifestations	Likely lesions
Very poor pulses	- Hypoplastic Left Ventricle Syndrome - Critical aortic stenosis
Poor femoral pulses	- Coarctation of aorta
Bounding pulses	- Patent ductus arteriosus (PDA) - Troncus arteriosus - Severe anemia

Recommendations

- All children with cyanotic heart diseases who come with diarrhea and vomiting should be admitted for closer observation. *Furosemide is contra-indicated*
- All new born babies with suspected cyanotic heart disease should be referred to a cardiologist/tertiary hospital immediately

5.6. ACQUIRED HEART DISEASES

5.6.1. Acute rheumatic fever

Definition: This is an acute, systemic connective tissue disease in children related to an immune reaction to untreated group A Beta haemolytic streptococcus infection of the upper respiratory tract .The initial attack of acute rheumatic fever occurs in most cases between the ages of 3 and 15 years.

Causes

- Auto-immune disease

Signs and symptoms (Revised Jones Criteria)

Major manifestations:	Minor manifestations:	Group A Strep(GAS) Infection:
Carditis	Fever	GAS on throat swab (culture)
Arthritis	Arthralgia	Raised Anti-streptolysin O titre (ASOT)
Sydenham's Chorea	Prolonged P-R interval on ECG	Raised Anti-deoxyribonuclease B (Anti-DNase B)
Erythema marginatum	Raised ESR or CRP	
Subcutaneous nodules		

Criteria for ARF diagnosis according to the WHO

- The first episode of ARF can be confirmed if:
  - MAJOR, **or** 1 MAJOR and 2 MINOR manifestations are present **plus** there is evidence of preceding Group A streptococcal infection.
- Recurrent ARF (with no RHD) can be confirmed if:
  - MAJOR, **or** 1 MAJOR and 2 MINOR manifestations are present **plus** there is evidence of preceding Group A streptococcal infection.

- Recurrent ARF (with existing RHD) can be confirmed if
  - MINOR manifestations are present **plus** there is evidence of preceding Group A streptococcal infection.

Complication

- Rheumatic heart disease

Investigations

- Throat swab for culture (positive throat culture of group A Streptoccocal infection)
- Raised ASOT/ASLO antibodies titre (Anti-streptolysin-0-titre – ASOT of 1:300)
- Anti DNase B
- FBC/ ESR/CRP
- Chest x-ray – Features of cardiomegaly
- ECG
- Echocardiogram

Management

- Admit the patient

  N.B: Persons with symptoms of ARF should be hospitalized to ensure accurate diagnosis, and to receive clinical care and education about preventing further episodes of ARF

- Give
  - A single injection of *Benzathine penicillin G (Extencilline):* 25,000–50,000 units/kg/dose STAT; maximum 1.2 mega units dose

OR

- Oral *Penicillin* (Pen V) 25–50mg/kg/day in divided 3 doses for 10 days (*Erythromycin* 30-50mg/kg/day divided in 3 doses if penicillin allergy)

- Relieve symptoms
  - Arthritis and fever
    - → *Aspirin* 75–100mg/kg/day in 4–6 divided doses. Treatment continued until fever and joint inflammation are controlled and then gradually reduced over a 2-week period
    - → Add an antacid to reduce risk of gastric irritation
    - → *Prednisolone* 1-2mg OD for 2 weeks then taper for 2 weeks with good response begin
    - → *Aspirin* in the 3rd week and continue until 8th week tapering in the final 2 weeks
  - Chorea
    - → Most mild-moderate cases do not need medication
    - → Provide calm and supportive environment (prevent accidental self-harm)
    - → For severe cases:
      - *Carbamazepine* per os:
        - <6 years: 10-20mg/kg/day divided in 3 doses,
        - 6-12 years: 400-800mg/day divided in 3 doses,
        - >12 years: 200mg x 2/day
      - *Valproic acid* 20-30mg/kg/day divided in 2 doses
        - Duration: 2 weeks
    - → Carditis
      - Bed rest if in cardiac failure
      - Anti-failure medication as above
      - Anti-coagulation medication if atrial fibrillation is present
  - Management plan when the acute episode is controlled
    - → Administer the first dose of secondary prophylaxis
    - → Register the individual with the local health authority or RHD Program:

- → Provide disease education for the person with ARF and the family
  - Understanding of ARF and RHD and risks of ARF recurrence
  - Importance of regular secondary prophylaxis and medical review
  - Recognising own signs and symptoms of ARF and RHD
  - Risks associated with future RHD (e.g. pregnancy, surgery and high level of aftercare)
  - Importance of dental health
- → Include an ARF diagnosis alert on computer systems and/or medical files (if applicable)
- → Refer to local health facility for ongoing management
- → Arrange dental review (and provide advice about endocarditis prevention)

- Long-term Management
  - → Regular secondary prophylaxis (refer to 5.5 Table 6 Recommended Secondary Prophylaxis Regimen)
  - → Regular medical review
  - → Regular dental review
  - → Echocardiogram (if available) following each episode of ARF, and routine echocardiogram
    - Every 2 years for children (sooner if there is evidence of cardiac symptoms)
- Secondary prophylaxis
  - → Aim
    - Prevents the occurrence of GAS infections which can lead to recurrent ARF
    - Reduces the severity of RHD (and can result in cure of RHD after many years)
    - Helps prevent death from severe RHD

- Indications for Use
  - ARF confirmed by the Jones Criteria
  - RHD confirmed on echocardiogram
  - ARF or RHD not confirmed, but highly suspected
- Dosage
  - *Benzathine Penicillin* G IM every 4 weeks:
    - 1,200,000 units for all people ≥30kg
    - 600,000 units for children <30kg
  - *Penicillin V* if injections not tolerated or contraindicated
    - 250mg oral, twice-daily for all children.
  - *Erythromycin* if proven allergy to Penicillin: 250mg oral, twice-daily for all people

Recommended Secondary Prophylaxis Regimens

Disease Classification	Duration of Secondary Prophylaxis
ARF (No proven carditis)	1. Minimum of 5 years after last ARF, or 2. Until 18 years of age (*whichever is longer)*
Mild-moderate RHD (or healed carditis)	1. Minimum 10 years after last ARF, or 2. Until 25 years of age (*whichever is longer)*
Severe RHD and following **Cardiac Surgery** for RHD	Continue medication for life

5.6.2. Rheumatic Heart Diseases

Definition: It is an inflammatory damage of the heart valves, as a complication of acute rheumatic fever. The mitral valve is the most commonly involved valve, although any valve may be affected.

Types

- Mitral regurgitation/stenosis
- Aortic regurgitation/stenosis
- Tricuspid regurgitation
- Mixed regurgitation and stenosis
- Multivalvular heart diseases

Signs and symptoms

- May be asymptomatic when minor lesions
- Heart murmurs over affected valve

Complications

- Congestive cardiac failure with pulmonary oedema
- Bacterial endocarditis.

Investigations

- Chest x-ray
- ECG
- Echocardiography

Management

- Treat underlying complication e.g. heart failure, pulmonary oedema
- Continue prophylaxis against recurrent rheumatic fever
- Ensure oral hygiene
- Endocarditis prophylaxis if dental procedures, urinary tract instrumentation, and GIT manipulations:

- Above the diaphragm
  - → *Amoxicillin* 50mg/kg (Max 2gr) 1 hour before the procedure
  - → OR
  - → *Erythromycin* 50mg/kg (max 1.5gr) – if allergic to penicillin

- Below the diaphragm
  - → *Ampicillin 50mg/kg IV or IM (max 2gr) with Gentamycine,*
  - → *2mg/kg (max 120mg) 30minutes before the procedure then*
  - → *Amoxycillin* per os 25mg/kg (max1gr) 6 hours after the procedure

- Ensure good follow up by cardiologist

5.6.3. Infective endocarditis

Definition: Infection of the endothelial surface of the heart. Suspect infective endocarditis in all children with persistent fever and underlying heart disease.

Causes/predisposing factors

- Rheumatic valvular disease
- Congenital heart disease

Signs and symptom

- Persistent low grade fever without an obvious underlying cause
- Fatigue, joint pain, new murmurs, clubbing, splenomegaly and haematuria

DUKE CRITERIA IN CHILDREN:

MAJOR CRITERIA	MINOR CRITERIA
Positive blood cultures: - Typical micro-organisms from two separate blood cultures; *S. viridans*, including nutritional variant strains, *S. bovis*, HACEK group, *S. aureus*, or - Enterococci, in the absence of a primary focus, or - Persistently positive blood culture with a micro-organism consistent with IE from blood cultures drawn > 12 hours apart, or - All 3 or a majority of 4 or more separate blood cultures, with the first and last drawn at least one hour apart, or - Positive serology for Q fever evidence of endocardial involvement - Positive echocardiogram for IE: oscillating intracardiac mass, on valve or supporting structures, or in the path of regurgitant jets, or on implanted materials, in the absence of an alternative anatomic explanation , or - Abscess, or - New partial dehiscence of prosthetic valve, or new valvular regurgitation	Predisposing heart condition or IV drug use: - Fever ≥ 38°C - Vascular phenomena - major arterial emboli - septic pulmonary infarcts - mycotic aneurysm - intercranial haemorrhage - conjunctival haemorrhages - Janeway lesions

DEFINITE IE	POSSIBLE IE	REJECTED
Pathological criteria: - Micro-organisms o by culture or histology in a vegetation o In a vegetation that has embolised o in a intracardiac abscess, or Lesions - Vegetation or intracardiac abscess present confirmed by histology showing active IE - Clinical criteria see Table 1 o 2 major criteria o 1 major and 3 minor o 5 minor	- At least one major and one minor criterion, or 3 minor - At least one major and one minor criterion, or 3 minor - At least one major and one minor criterion, or 3 minor at least one major and	- Alternative diagnosis for manifestation of endocarditis, or - Resolution of manifestations, with antibiotic therapy ≤ 4 days, or - No pathologic evidence of IE at surgery or autopsy, after antibiotic therapy for ≤ 4 days

Investigations

- Blood cultures (at least 3 cultures) before antibiotics
- FBC /CRP/ESR
- Urine test strips – haematuria
- Echocardiography

Management

Non-pharmacological management

- Bed rest/limit physical activity
- Ensure adequate nutrition
- Maintain haemoglobin > 10 g/dL
- Measures to reduce fever

Pharmacological management

- *Paracetamol,* oral, 20 mg/kg at once, then 10–15 mg/kg/dose, every 6 hours as required
- Antibiotics regimen: IV antibiotics are always given, based on culture and sensitivity results

→ Native valve endocarditis (NVE) due to Streptococci:

- *Benzylpenicillin* (Penicillin G), IV, 300 000 units/kg/day divided in 4 doses for 4 weeks

OR

- *Ceftriaxone* 100mg/kg/day as single dose (maximum 2g) for 4 weeks

PLUS

- *Gentamicin,* IV, 3mg/kg/day divided in 3 doses (maximum 240mg/day) for 2 weeks.

→ Patients allergic to penicillin and cephalosporines:

→ *Vancomycine* 40mg/kg/day divided in 3 doses (max 2g/day) for 4 weeks.

→ NVE due to staphylococci

- *Cloxacillin* 200mg/kg/day divided in 4 doses 6 for 4 weeks

PLUS

- *Gentamicin* 3mg/kg/day divided in 3 doses (maximum 240mg/day) for first 5 days.

OR

→ (Cloxacillin-resistant strains or allergy to penicillin)

- *Vancomycine* 40mg/kg/day divided in 3 doses (max 2g/day) for 6 weeks.

Note: ***All highly suspected cases of infective endocarditis must be referred to the cardiologist where blood cultures and proper management will be done.***

5.7. CARDIOMYOPATHIES

Definition: Dilated cardiomyopathy refers to a group of conditions of diverse etiology in which both ventricles are dilated with reduced contractility.

Classification

- Classification based on the predominant structural and functional abnormalities:
  - Dilated cardiomyopathy: primarily systolic dysfunction,
  - Hypertrophic cardiomyopathy: primarily diastolic dysfunction,
  - Restrictive cardiomyopathy: primarily diastolic but often combined with systolic dysfunction

5.7.1. Dilated cardiomyopathy

Causes

- Infections (e.g. Viral+++, Rickettsia, Chagas disease)
- Neuromuscular disorders (e.g. Duchenne dystrophy, Becker dystrophy)
- Endocrine, metabolic and nutritional (e.g. hyperthyroidism, Fatty acid oxidation disorders, beriberi, kwashiorkor)
- Diseases of coronary arteries (e.g. Kawasaki, Aberrant Left Coronary Artery - ALCAPA)

- Autoimmune diseases (e.g. Rheumatic carditis, juvenile rheumatoid arthritis, systemic lupus erythematosus, dermatomyositis, systemic lupus erythematosus)
- Drugs toxicity (e.g. doxorubicin, cyclophosphamide, IPECA)
- Hematologic diseases (e.g. anemia, Sickle cell anemia, hypereosinophilic syndrome: Löffler Syndrome)

Signs and symptoms

- See signs of Congestive Heart Failure

Investigations

- ECG: prominent P wave, LV or RV hypertrophy, nonspecific T-wave abnormalities
- Chest X-ray: cardiomegaly, pulmonary edema
- Echocardiogram: confirm diagnosis and shows LA and LV dilation, poor contractility
- FBC, Urea and creatinine, Electrolytes (Na, K)
- Myocardial biopsy, PCR, genetic according to the etiology

Management

- Refer to principles and medication of congestive heart failure

5.7.2. Hypertrophic cardiomyopathy

Causes

- Left ventricle obstruction (coartation of aorta, hypertension, aortic stenosis)
- Secondary (infants of diabetic mothers, corticosteroids in premature infants)
- Metabolic (Glycogen storage disease type II (Pompe disease)
- Familiar hypertrophic cardiomyopathy
- Syndromes (Beckwith - Wiedman Syndrome, Friedereich, ataxia)

Signs and Symptoms

- Weakness
- Fatigue
- Dyspnea on effort
- Palpitations
- Angina pectoris
- Dizziness and syncope
- Increased risk of sudden death

Investigations

- ECG: LV hypertrophy
- Chest x-ray: Mild cardiomegaly
- Echocardiogram: LV hypertrophy, ventricular outflow tract gradient

Doppler flow studies may demonstrate diastolic dysfunction before the development of hypertrophy

Management

- Prohibit competitive sports and strenuous physical activities
- *Propranolol* 0.5 -1mg/kg/day devised in 3 doses or atenolol
- Implantable cardioverter-defibrillator if documented arrhythmias or a history of unexplained syncope
- Open heart surgery for septal myotomy: rarely indicated

5.7.3. Restrictive cardiomyopathy

Definition: Restrictive cardiomyopathy refers to a group of disorders in which the heart chambers are unable to properly fill with blood because of stiffness in the heart muscle. Its prognosis is poor, and clinical deterioration can be rapid.

Causes

- Idiopathic, Systemic disease (scleroderma, amyloidosis, or sarcoidosis)
- Mucopolysaccharidosis
- Hypereosinophilic syndrome; malignancies
- Radiation therapy
- Isolated noncompaction of the left ventricular myocardium

Signs and symptoms

- Dyspnea
- Edema and ascites
- Hepatomegaly with increased venous pressure
- Pulmonary congestion

Complications

- Arrhythmias
- Mitral regurgitation
- Progressive heart failure
- Tricuspid regurgitation

Investigations

- ECG: Prominent P waves, ST segment depression, T-wave inversion
- Chest x-ray: mild to moderate cardiomegaly
- Echocardiogram: markedly enlarged atria and small to normal-sized ventricles with often preserved systolic function but highly abnormal diastolic function

Management

- *Lasix* 2mg/kg divided in 2 doses
- *Aldactone* 1-2mg/kg devised in 2 doses
- Antiarrhythmic agents / biventricular pacing are used as required
- *Aspirin* or *Warfarin* in case of noncompaction LV with an increased risk of mural thrombosis and stroke
- Cardiac transplantation where possible and indicated

5.7.4. Pericarditis/Pericardial Effusion

Definition: Pericarditis is the inflammation of the pericardium. Pericardial effusion is the abnormal build-up of excess fluid that develops between the pericardium, the lining of the heart, and the heart itself.

Causes

- Infection such as viral, bacterial (tuberculosis)
- Inflammatory disorders, such as lupus
- Cancer that has spread (metastasized) to the pericardium
- Kidney failure with excessive blood levels of nitrogen
- Heart surgery (postpericardectomy syndrome)

Signs and symptoms

- Pericardial tamponade
- Chest pressure or pain and signs of congestive heart failure with shock in some cases

Note: ***Many patients with pericardial effusion have no symptoms. The condition is often discovered on a chest x-ray or echocardiogram that was performed for another reason.***

Investigations

- ECG
  - Small complexes tachycardia
  - Diffuse T wave changes
- Chest x-ray: "water bottle" heart, or triangular heart with smoothed out borders
- Echocardiogram
- Tuberculin skin test
- Diagnostic pericardiocentesis
  - in all patients with suspected bacterial or neoplastic pericarditis and patients whom diagnosis is not readily obtained
- Cell count and differential, culture, gram stain, PCR

Management

Non-pharmacological management

- Semi-sitting position if tamponnade suspected
- Pericardiocentesis:
  - ➔ preferably under ultrasound guidance
  - ➔ Performed by an experienced person
  - ➔ Indicated in children with symptomatic pericardial effusion

Pharmacological management

- If hypotensive, rapidly administer intravenous fluids 20ml/kg of Normal saline over 30 minutes to 1 hour
- If suspected TB pericarditis: standard anti TB treatment + steroids
- In case of purulent pericarditis: *Cloxacillin*, IV 50 mg/kg/dose every 6 hours for 3 – 4 weeks + *Ceftriaxone*, IV, 100 mg/kg as a single daily dose, to adapt according to culture results
- Treat heart failure (See Section on Heart Failure)

Recommendation

- All patients with pericardial effusion should be referred to a cardiologist

5.8. HYPERTENSION IN CHILDREN

Definition: Hypertension is defined as systolic and/or diastolic Blood Pressure ≥ the 95th percentile for gender, age and height percentile on at least three consecutive occasions.

A sustained Blood Pressure of > 115/80 is abnormal in children between 6 weeks and 6 years of age.

Causes

- Severe hypertension suggests renal disease
- Coarctation of aorta
- Rarely pheochromocytoma
- Long term steroid therapy

Most common causes of secondary hypertension by age

- New born
  - Renal abnormalities
  - Coarctation of the aorta
  - Renal artery stenosis
  - Renal artery or veinal thrombosis
- First year
  - Coarctation of the aorta
  - Renal vascular disease
  - Tumor
  - Medications (steroids)
- 1-6 years
  - Renal vascular diseases

- Renal parenchymal diseases (glomerulonephritis, hemolytic-uremic syndrome)
- Coarctation of the aorta
- Medication
- Essential hypertension

- 6-15 years
  - Renal vascular diseases
  - Renal parenchymal diseases (glomerulonephritis, hemolytic-uremic syndrome)
  - Essential hypertension
  - Coarctation of the aorta
  - Endocrine causes
  - Nutritional causes (obesity)

Signs and symptoms

- Headache
- Convulsions, coma and visual symptoms
- Oedema, haematuria, proteinuria
- Acute heart failure and pulmonary oedema
- Some children may be asymptomatic

Blood Pressure in children correlates with body size and age.

Age of child	95th Percentile of Systolic and Diastolic Blood Pressure	
	First 12 hours	First week
newborn prem	65/45 mmHg	80/50 mmHg
newborn fullterm	80/50 mmHg	100/70 mmHg
	Systolic mmHg	Diastolic mmHg
6 weeks–6 years	115	80
8 years	120	82
9 years	125	84
10 years	130	86
12 years	135	88
14 years	140	90

95th Percentile of systolic and diastolic BP correlated with Height

Height cm	Systolic mmHg	Diastolic mmHg
100	114	70
110	116	72
120	118	74
130	120	74
140	125	75
150	130	75
160	135 (131)	77
170	140 (133)	80
180	145 (135)	83

Investigations

- Urea, creatinine, electrolytes (Na+, K+)
- Fundoscopy
- ECG
- Echocardiogram
- Abdominal ultrasound (focused on kidneys)
- Others according to the suspected etiology

Management

Acute hypertension (hypertension of sudden onset)

Non-pharmacological treatment

- Admit patient to paediatric high dependence care unit
- Monitor BP every 10 minutes until stable – thereafter every 30 minutes for 24 hours
- Insert two peripheral intravenous drips
- Rest on cardiac bed
- Control fluid intake and output (restriction)
- Restrict dietary sodium

Pharmacological treatment

- Do not combine drugs of the same class
- *Frusemide,* IV, 1–2 mg/kg as a bolus slowly over 5 minutes

- Increase up to 8 mg/kg/day oliguric
- *Nifedipine* 0.25-0.5mg/kg (max: 10mg) sublingual

OR

- *Amlodipine,* oral, 0.2 mg/kg/dose. May be repeated 6 hours later, thereafter every 12 hours
- Refer the patient to a specialist when the patient is stable

Recommendations

- For acute or chronic hypertension Blood Pressure needs to be lowered cautiously
  - Aim to reduce the SBP slowly over the next 24 - 48 hours
  - Do not decrease BP to < 95th percentile in first 24 hours
- Advise a change in lifestyle
- Institute and monitor a weight reduction program for obese individuals
- Regular aerobic exercise is recommended in essential hypertension
- Dietary advice
- Limit salt and saturated fat intake
- Increase dietary fiber intake

Chronic Hypertension

Non-pharmacological management

- Introduce physical activity, diet management and weight reduction, if obese
- Advise against smoking in teenagers
- Follow up to monitor Blood Pressure and educate patient on hypertension
- If Blood Pressure decreases, continue with non-drug management and follow up
- If BP is increasing progressively, reinvestigate to exclude secondary causes or refer to the specialist

- If BP is stable but persistently > 95th percentile and secondary causes have been excluded, start drug treatment after failed non-drug management for 6 months
- Consider earlier initiation of drug treatment if positive family history for cardiovascular disease, essential hypertension or diabetes mellitus

Pharmacological management

Recommended medication and dosage for patients with Chronic Hypertension

Drug	Dosage	Side effect/ comment
First line Hydrochlorothiazide	-1-2mg/kg/day once daily (maximum 25mg/ day).	-Hypokalemia
Second line Nifedipine ***OR*** Amlodipine	- 0.3-1mg/kg/day divided in 3 doses - 0.1mg/kg/day (maximum dose 10mg/ day) once daily	-Not well studied in children under 6 years of age
Third line Captopril ***OR*** Lisinopril	-0.5 – 4mg/kg/day divided in 2 doses -0.07- 0.6mg/kg daily	-Hyperkalaemia -Check renal function and Serum-K periodically, not used in bilateral renal artery stenosis, contraindicated in renal failure -Can cause cough

Fourth line Atenolol	-0.5-1mg/kg/day once daily (max up to 2mg/kg/day, do not exceed /100mg/day)	-Bradycardia
Furosemide (lasix) if associated edema or stage 4 chronic kidney disease **Note:** Do not associate Furosemide with Hydrochlorothiazide	-1-4mg/kg/day in 2 to 4 divided doses	Hyponatremia Hypokalemia

Recommended hypertension medication for patients with Renal Failure

For CKD 1-3 (GFR>=30, creatinine <2x normal value for age	
First- line drug	Lisinopril
Second -line drug	Hydrochlorothiazide
Third- line drug	Amlodipine
Forth- line drug	Atenolol (use half of normal recommended dose)
For CKD 4 or 5 (GFR < 30, creatinine >=2x normal value for age	
First-line drug	Furosemide
Second-line drug	Amlodipine
Third-line drug	Atenolol (use half of normal recommended dose).

Recommendations

- All patients with hypertension and persistent proteinuria should be treated with an ACE inhibitor
- Always exclude bilateral renal artery stenosis before treating with an ACE inhibitor
- Renal function must be monitored when an ACE inhibitor is prescribed because it may cause a decline in GFR resulting in deterioration of renal function and hyperkalaemia

- Patients with hypertension due to a neuro-secretory tumour (phaeochromocytoma or neuroblastoma), should receive an a-blocker either as single drug or in combination with ß-adrenergic blocker
- For patients with persistent hypertension despite the use of first line drugs, a second/third drug should be added
- Specific classes of antihypertensive drugs should be used according to the underlying pathogenesis or illness
- For patients with predominantly fluid overload: use diuretics with/without ß-blocker

5.9. CARDIAC ARRHYTHMIAS IN CHILDREN

Definition: Heart rate that is abnormally slow or fast for age or irregular.

Types

- Heart block
- Ventricular arrhythmias
- Paroxysmal atrial tachycardia

Type of Arrhythmia	*Causes*	*Signs and symptom*
Heart block: A delay or complete block of the electrical impulse as it travels from the sinus node to the ventricles	- Idiopathic and familial - Electrolyte disturbances(hyperkalaemia), - digoxin toxicity - Congenital heart disease, particularly transposition of the great arteries, and especially after surgery - Myocarditis - Post infective, for example in endocardial fibroelastosis or rheumatic fever	- Chest pressure or pain - Fainting, also known as syncopy, or near-syncope - Fatigue - Lightheadedness or dizziness - Palpitations, which can be skipping, fluttering or pounding in the chest - Shortness of breath

Type of Arrhythmia	*Causes*	*Signs and symptom*
Ventricular arrhythmias: A rapid heart rate, usually with a regular rhythm, originating from above the ventricles	- Heart attack - Cardiomyopathy - Heart failure - Heart surgery - Myocarditis - Valvular heart disease	- May be asymptomatic - Chest discomfort (angina) - Fainting (syncope) - Light-headedness or dizziness - Sensation of feeling the heart beat (palpitations) - Shortness of breath - Absent pulse - Loss of consciousness - Normal or low Blood Pressure - Rapid pulse
Paroxysmal atrial *Tachycardia:* A rapid heart rate, usually with a regular rhythm, originating from above the ventricles.		- Palpitation - lightheadedness - Weakness - Shortness of breath - Chest pressure

NORMAL HEART RATE/MINUTE FOR AGE

Age	Heart rate
Newborn	100–160
< 1 year	110–160
1–2 years	100–150
2–5 years	95–140
5–12 years	80–120
> 12 years	60–100

Signs and symptoms

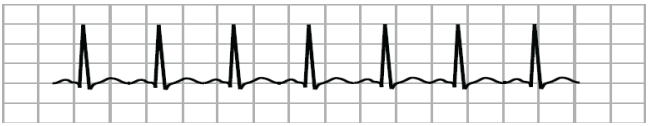
Infants	
Color changes (pale, mottled)	Irregular pulse
Irritability	Tachycardia
Feeding difficulties	Bradycardia
Sweating	Signs of cardiac failure
Tachypnoea/apnoeic spells	
Children	
Dizziness	Tachycardia
Palpitations	Bradycardia
Fatigue Syncope	
Chest Pain	Signs Of Cardiac Failure

Investigations

- ECG is essential for diagnosis, preferably a 12 lead ECG
- Echocardiogram
- Other according to the suspected etiology

TACHYARRHYTHMIAS:

Sinus tachycardia



ECG Criteria

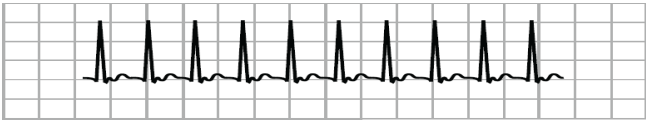
Rate: > upper limit for age

P wave: present and normal

Rhythm: regular

QRS: normal

Supraventricular Tachycardia



ECG Criteria

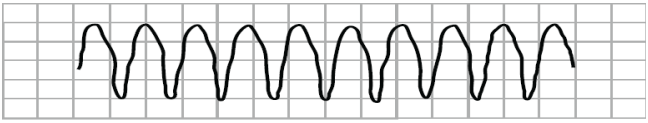
Rate: usually > 200 beats per minute

P wave: abnormal

Rhythm: regular

QRS: narrowed

Ventricular Tachycardia



ECG Criteria

Rate: generally 100–220 beats per minute

P wave: mostly not seen

Rhythm: generally regular

QRS: abnormal, large with QRS > 120 millisecond

Management

Non-pharmacological

- Sinus tachycardia usually requires management of the underlying condition
- ABC of resuscitation
- Admit to High Care or Intensive Care Unit
- Monitor ECG, oxygen saturation, Blood Pressure, haemoglobin, Heart Rate, acid–base status and blood gases, respiratory rate, maintain adequate nutrition and hydration, treat pyrexia

Pharmacological

- Emergency treatment

Narrow Complex Tachycardia (supraventricular tachycardia)

- Stable patient: Attempt vagal stimulation
  - Place icebag on face,
  - Infants: immerse face in ice-cold water for a few seconds
  - Older children: try a valsalva manoeuvre e.g. asks the patient to blow through a straw
  - Place NGT if other means are not available

Note: Eye-ball pressure and carotid massage is contraindicated in children.

  - *Adenosine*, IV, 0.1 mg/kg initially, increasing in increments of 0.05 mg/kg to 0.25 mg/kg. Follow with a rapid flush of at least 5 ml normal saline.

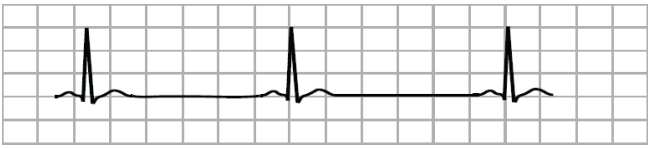
- Unstable patient: Heart failure / shock
  - DC synchronised cardioversion in increments of 0.5–1–2 J/kg
  - Empty the stomach before cardioversion is attempted
  - *Amiodarone*, IV, 5 mg/kg slowly over 20 minutes (NEVER as a rapid infusion)

5.10. BRADYARRHYTHMIAS

Causes

- Hypoxia
- Hypothermia
- Head injuries and increased intracranial pressure
- Toxins and drug overdose
- Post operative
- Congenital excessive vagal stimulation
- Electrolyte disturbances (Hypo- or hyperkalaemia, Hypocalcaemia)

Sinus Bradycardia



ECG Criteria

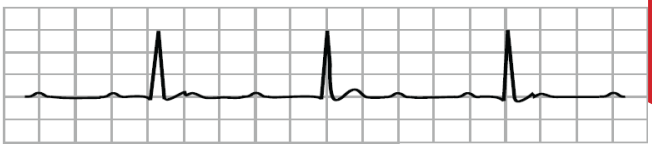
Rate: < lower limit for age

P wave: present, all look the same

Rhythm: regular

QRS: normal, 80–120 millisecond

Heart Block (Complete)



ECG Criteria

Rate: low, usually < 60 beats per minute

P wave: independent P waves

QRS's with no relationship between the two (AV dissociation)

Management

- If syncope and Heart Rate - below 50/min:
  - Start IV. *Isuprel (Isoprenaline)* 0. 05 – 0. 4 microgram/kg/min

  OR
  - *Dobutamine* (*Dobutrex)* 2 - 20 microgram/kg/min
  - Insert pacemaker if ineffective

CHAPTER 6
CENTRAL NERVOUS SYSTEM

6. CENTRAL NERVOUS SYSTEM

6.1. CENTRAL NERVOUS SYSTEM EMERGENCIES

6.1.1. Convulsions

Definition: Convulsions or seizure are disturbance of neurological function caused by an abnormal or excessive neuronal discharge.

Causes

Causes	Clinical signs/symptoms
Meningitis	- Very irritable - Stiff neck or bulging fontanelles - Petechial rash (meningococcal meningitis only) - Fever
Cerebral malaria (only in children exposed to P. falciparum transmission; often seasonal)	- Blood smear positive for malaria parasites - Jaundice - Anaemia/pallor - Splenomegaly - Hypoglycaemia - Fever - Altered consciousness/coma
Febrile convulsions (not likely to be the cause of unconsciousness)	-Prior episodes of short convulsions (< 15 minutes) when febrile - No signs of meningitis - Associated with fever - Age 6 months to 5 years - Generally grand mal seizures - Recover consciousness quickly
Hypoglycaemia (always seek the cause e.g. severe malaria, and treat the cause to prevent recurrence)	- Blood glucose low; responds to glucose treatment

Head injury	- Signs or history of head trauma
Poisoning	- History of poison ingestion or drug overdose
Hypertensive encephalopathy	- Raised Blood Pressure - Peripheral or facial oedema - Blood in urine - Decreased or no urine - Visual changes - Headache
Epilepsy	- Prior history of recurrent afebrile convulsions - Uncontrolled on anti-convulsant drugs - History of birth asphyxia, cerebral palsy/ mental retardation, microcephaly, growth retardation, hypertonicity - Hydrocephalus

Complications

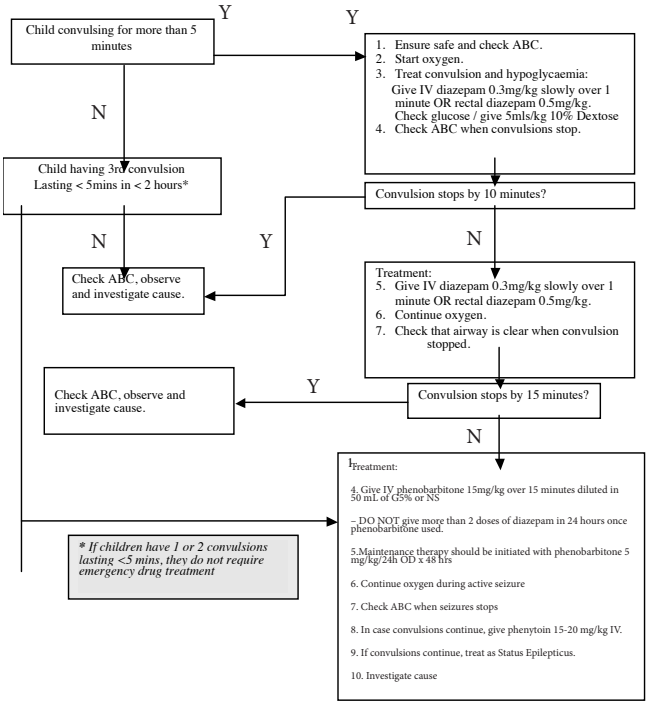
- Aspiration
- Tongue biting
- Status epilepticus
- Hypoxia
- Severe brain damage (if prolonged convulsions)
- Cerebral palsy
- Burns (if convulsions were near cooking fires)

Investigations

- Blood samples for malaria parasites, FBC, Urea and electrolytes, blood glucose, hemoculture if suspected meningitis
- Urinalysis
- Lumbar puncture for CSF analysis
- Fundoscopy
- CT scan/MRI of the brain (if suspected intracranial mass, trauma or brain abscess)
- EEG

Management

Children > 1month



6.1.2. Coma

Definition: It is a state of extreme unresponsiveness, in which an individual exhibits no voluntary movements or behaviour and cannot be aroused to consciousness.

Causes

Causes	Clinical signs/Symptoms
Meningitis	- Very irritable - Stiff neck or bulging fontanelles - Petechial rash (meningococcal meningitis only) - Fever
Cerebral malaria (only in children exposed to P. falciparum transmission; often seasonal)	- Blood smear positive for malaria parasites - Jaundice - Anaemia/pallor - Splenomegaly - Hypoglycaemia - Fever - Altered consciousness/coma
Hypoglycaemia (always seek the cause e.g. severe malaria, and treat the cause to prevent a recurrence)	- Blood glucose low; responds to glucose treatment
Shock	- Low Blood Pressure - Tachycardia - Delayed capillary refill, cool extremities - Low urine output
Head injury	- Signs or history of head trauma
Poisoning	- History of poison ingestion or drug overdose
Hypertensive encephalopathy	- Raised Blood Pressure - Peripheral or facial oedema - Blood in urine - Decreased or no urine - Visual changes - Headache

Diagnosis

- Clinical

  - The Glasgow coma scale shown below is applicable to children over 5 years old

Glasgow Coma Scale	
Eye Opening	
Spontaneous	4
To loud voice	3
To pain	2
None	1
Verbal Response	
Oriented	5
Confused, Disoriented	4
Inappropriate words	3
Incomprehensible words	2
None	1
Motor Response	
Obeys commands	6
Localizes pain	5
Withdraws from pain	4
Abnormal flexion posturing	3
Extensor posturing	2
None	1

  - AVPU scale for very young children (< 5 years of age)

    → Is the child in a coma? Check the level of consciousness on the AVPU scale:

      - A…….. Alert
      - V…….. Responds to voice
      - P …….. Responds to pain
      - U……...Unconscious

- If the child is not awake and alert, try to rouse the child by talking to him / her or shaking the arm
- If the child is not alert, but responds to voices, he is lethargic
- If there is no response, ask the mother if the child has been abnormally sleepy or has had difficulty waking up
- See if the child responds to pain, or if he /she is unresponsive to a painful stimulus. If this is the case, the child is in a coma (unconscious) and needs emergency treatment

Complications

- Aspiration
- Death

Investigations

- Blood samples for malaria parasites, Full Blood Count, CRP, urea/creatinine and electrolytes, glycemia, and hemoculture if suspected infection/meningitis
- Lumbar puncture for CSF analysis. (DO NOT perform lumbar puncture if focal neurologic signs, signs of increased intracranial pressure, respiratory distress and deep coma (Glasglow coma scale of 8 or less))
- Urinalysis
- Fundoscopy
- Chest x-ray
- CT scan/MRI of the brain if indicated

Management

- CABD assessment, place in recovery position, give oxygen, place nasogastric tube and urine catheter

Non Pharmaceutical

- Prevent dry cornea - instill *Normal saline* drops in the cornea, cover the eyes with a patch

- Maintain adequate nutrition through NGT feeding
- Correct electrolytes imbalance
- Monitor vital signs closely (temperature, HR, RR, urine output, level of consciousness)
- Prevent development of bed sores through frequent repositioning

Pharmaceutical

- If signs of increased intracranial pressure/cerebral edema, give *Mannitol inj* 20 % (0.25 – 0.5 g/kg in 10 min) and elevate head off the bed to 30 degrees
- Treat shock if present
- Check blood sugar and treat hypoglycaemia: 2- 5 ml/kg of *10% Glucose*
- Fever if present - apply tepid sponge, give *Paracetamol* 10 -15mg/kg/dose
- Other specific treatment is provided according to aetiology

  for example: antibiotic therapy for meningitis

6.2. EPILEPSY

Definition: Epilepsy is a condition characterized by recurrent seizures associated with abnormal paroxysmal neuronal discharges. When seizures are recurrent, persistent or associated with a syndrome, then the child may be diagnosed with epilepsy.

Causes

- Idiopathic (70-80%)
- Secondary causes:
  - Cerebral dysgenesis or malformation
  - Cerebral vascular occlusion
  - Cerebral damage like Hypoxic Ischemic Encephalopathy (HIE), intraventicular hemorrhage or ischemia, head injury, infections

- Cerebral tumors
- Neuro-degenerative disorders

Signs and Symptoms

Type	Clinical Signs/Symptoms
Infantile spasms (West's Syndrome)	- Onset is during the child's first year - Epileptic spasms (flexion and extension) associated with hypsarrhythmia on the EEG - Developmental regression - Child appears to stare, with a sudden flexion of the trunk and head, limbs either flung in or out but held in a tonic spasm for a few seconds - Red appearance in the face and may cry out
Severe Myoclonic Epilepsy of Infancy (SMEI)	- Occurs in children under 1 year of age - Recurrent clusters of febrile convulsions, severe neuro-regression and other non-febrile seizures by 2 - 3 years of age
Lennox-Gastaut syndrome (LGS)	- Onset between 2 - 3 years of age - Combination of Generalized Tonic Clonic Seizures (GTCS), atypical absences, myoclonic seizures, atonic drop attacks and - Occasionally complex partial seizures - Behavioral problems and neuro-regression

Benign rolandic epilepsy with centrotemporal spikes (BRECTS)	- Onset at ± 6–10 years (can occur before or after 6 years up to 10 years) of age - Sleep related events of hemi-facial clonic spasm - Inability to speak with retained awareness - Usually resolves by late adolescence
Primary generalized absence seizure of childhood (petit mal)	- Onset 4 - 6 years of age - Short spells of motor arrest of maximum 15 seconds duration with little or no associated movements and no post-ictal effect
Generalized epilepsy with febrile seizures	- Febrile convulsions which persist beyond 6 years of age - Often family history of febrile convulsions - Occasionally associated with afebrile convulsions

Note: ***Infantile spasms, Severe Myoclonic Epilepsy of Infancy and Lennox-Gastaut Syndrome are regarded as malignant forms of epilepsy and are associated with neuro-regression and behavioral problems.***

Complications

- Status Epilepticus
- Trauma secondary to loss of consciousness during seizures
- Mental retardation

Investigations

- EEG
- MRI of the brain
- CT scan of the brain

Management

Non Pharmaceutical

- Acute management
  - → Manage Airway-Breathing-Circulation-Disability and continue to monitor throughout seizures
  - → Place patient on side at 20 – 30° head up to prevent aspiration
  - → Monitor Heart Rate, respiratory rate, Blood Pressure, oxygen saturation (SaO2), neurological status, fluid balance
  - → Monitor laboratory values including blood glucose, electrolytes, blood gases, toxicology screen and if indicated anticonvulsant blood levels
  - → Control fever with tepid sponging
  - → Administer oxygen to maintain SaO2 of ≥ 95%
  - → If unable to protect airway or poor ventilation, consider use of an oral airway, bag-mask ventilation and/or intubation
  - → Admit to pediatric ward or to Intensive Care Unit if indicated
- Long-term management
  - → Minimize the impact of epilepsy by obtaining complete seizure control to maximize child's full potential
  - → Educate the patient and caregiver about epilepsy and associated complications (i.e. learning difficulties)

Pharmacological treatment in children >1 month of age

Please refer to neonatology protocols for management of convulsions in children <1 month of age.

- Monotherapy is preferred but combination therapy may be necessary. Combination therapy should be initiated by or in close consultation with a pediatric specialist or neurologist.

Drug levels are rarely indicated unless there is concern about toxicity or compliance.

- For acute generalized tonic clonic seizures in children > 1 month of age
  - → *Diazepam* rectal 0.5 mg/kg once OR IV 0.2-0.3mg/kg once
  - → May be repeated every 5 minutes for a total of 3 doses, monitor airway and breathing closely with repeat dosing
  - → ***OR*** (in the absence of diazepam)
  - → *Lorazepam* IV 0.05- 0.1 mg/kg once, may repeat in 5 minutes for a total of 3 doses
  - → *Clonazepam* IV 0.1 -0.15 mg/kg loading dose by slow IV injection
- For refractory status epilepticus
  - → *Midazolam* IV 0.1-0.3 mg/kg bolus followed by a continuous infusion starting at 1 ug/kg/minute. The infusion can be titrated upwards every 5 minutes as needed.
- If persistent seizure activity after benzodiazepines, start
  - → *Phenobarbital* 15 mg/kg IV or by NG tube loading dose over 15minutes, may use a dextrose containing solution. If no response after 30 minutes, repeat a 7.5 -10 mg/kg IV loading dose.
  - → *Phenytoin* 15-20 mg/kg IV infused over 30 minutes in a dextrose-free solution
  - → If seizures persist after loading of dose of either *Phenobarbital* or *Phenytoin*, please consult a specialist physician regarding combination therapy and referral for specialized care. Phenytoin and Phenobarbital may be used together but vital signs must be monitored closely and patient should be referred as soon as possible.
    - Monitor for bradycardia, arrhythmias, and hypotension and pause the infusion if they occur and restart at 2/3 of the initial loading dose.

MAINTENANCE DRUG TREATMENT CHOICES FOR DIFFERENT TYPES OF EPILEPTIC SEIZURES

Treatment	Seizure Type				
	Generalized tonic and/or clonic	**Partial seizures with/without generalization**	**Infantile spasms**	**Absence**	**Juvenile Myoclonic Epilepsy**
1st line	Levetiracetam, Valproic Acid (*Do not use valproic acid if <2 years; if not other first line medication available, use Phenobarbital in those infants.), Lamotrigine	Levetiracetam, Oxcarbamazepine	Refer to a neurologist. Medication options depend on the type of infantile spasms and include ACTH and Vigabitrin as first line agents. Second line agents include prednisone, valproic acid, topirimate, zonisamide, and benzodiazepines	Ethosuxomide, Valproic Acid	Refer all suspected cases to a neurologist for evaluation. First line medication options include: Levetiracetam, Lamotrigine, and Valproic Acid.
2nd line	Topiramate, Oxcarbamazepine; Phenytoin	Valproic Acid, Lamotrigine		Refer to a neurologist. Medication options include: Valproic Acid, Lamotrigine	
3rd Line	Refer to a neurologist. Medication options include: Phenobarbital, Zonisamide, Primidone	Refer to a neurologist. Medication options include Lacosamide, Topiramate, Zonisamide, and Phenytoin			

Drug doses

- ACTH (*Adrenocorticotropic hormone*): Optimal dose and duration of treatment are not established. Regimens include low dose ACTH 5-40 units/day for short periods (1-6 weeks) or larger doses 40-160 units/day for longer periods (3-12 months). This medication should be prescribed by or in close consultation with a neurologist.

- *Carbamazepine* oral 10 mg/kg/24 hours in 2- 3 divided doses. May increase by 10 5 mg/kg/day weekly to a maximum dose of 30 mg/kg/day. Do not use in myoclonic seizures or absence seizures as it may exacerbate it. It may cause leukopenia and the NFS should be monitored. If the absolute neutrophil count (ANC) falls below 1000, the medication should be stopped.

- *Ethosuxamide* 15 mg/kg/day divided in 2 doses with a maximum initial dose of 250 mg per dose. May increase dose weekly to maximum to 40 mg/kg/day in 2 divided doses with a maximum dose of 1.5 g/day

- *Lamotrigine* oral is a third line adjunctive agent that should be prescribed by a specialist physician. 0.2 mg/kg/day, use as a third line agent. Increase dose to 5 mg/kg/day slowly in combination with sodium valproate. It is given as add-on therapy for many seizure types drug-resistant pediatric epileptic syndromes, such as Lennox-Gastaut Syndrome

- *Levetiracetam*: Dosing not established for children <4 years. Initial dose 10-20 mg/kg/dose divided in 2 doses. May increase weekly by 10 mg/kg/day to effect to a maximum dose of 60 mg/kg/day.

- *Phenobarbital* maintenance oral dose 3–5 mg/kg/day as single dose at night. This should be the drug of choice for generalized seizures in children <2 years. It is not recommended as maintenance therapy for children older than 2 years due to side effects such as sedation, behavioral disturbances, hyperkinesia and dependence, except in situations where there is poor adherence to other drugs. It should not be used in absence seizures because it may exacerbate them. A loading dose (see above) is indicated.

- *Oxcarbamazepine*: Not approved for children < 2 years. Initial dose is 8-10 mg/kg/day in 2 divided doses (maximum: 600 mg/day). Children ages 2-4 years may metabolize the medication more quickly, as such for children <20 kg, consider initial dose of 16-20 mg/kg/day divided in 2 doses. Increase the medication

every 2-4 weeks. Target doses are: 20-29 kg: 900 mg/day divided in 2 doses; 29.1 9 39 kg: 1200 mg/day divided in 2 doses; >39 kg: 1800 mg/day in 2 divided doses. The maximum dose is 60 mg/kg/day.

- *Primidone*: <8 years: Initial dose is 50-125 mg/day at bedtime, increase by 50-125 mg/day weekly. Usual dose is 10-25 mg/kg/day in 3-4 divided doses. If >8 years: initial dose is 125-250 mg/kg day at bedtime and may be increased weekly by 125-250mg/day to the usual dose of 750-1500 mg/day in 3-4 divided doses. Maximum dose of 2 grams/day.
- *Topiramate:* No dosing information for children <2 years. Initial dose 1-3 mg/kg/day (maximum 25 mg) given at bedtime for 1 week. Increase every 2 weeks by 1-3 mg/kg/day given in 2 divided doses and titrate to response. Usual maintenance dose is 5-9 mg/kg/day in 2 divided doses.
- Valproic Acid (*Depakene, Sodium Valproate*) 15 mg/kg/day in 2-3 divided doses. May increase weekly by 5-10 mg/kg to a maximum dose of 30 mg/kg/day. Not recommended for children <2 years due to risk of fatal hepatotoxicity. Do not use if concurrent liver disease. Monitor liver function tests at baseline every 3 months. Post-pubertal female patients must be informed about neural tube defects and family planning methods should be encouraged.
- *Vigabatrin*: Used for treatment of specific forms of infantile spasms and should be prescribed by a neurologist or in close consultation with neurology. Initial dosing: 50 mg/kg/day divided in 2 doses. May increase ever 3 days by 25-50 mg/kg/day depending on response. Maximum dose 150 mg/kg/day in 2 divided doses. Medication should be tapered off; decrease by 25-50 mg/kg/day every 3-4 days.
- *Zonisamide*: This medication should be used by neurologists or in close consultation with neurology due to concerns for its use in patients <16 years. Dosing is 1-2 mg/kg/day in 2 divided doses. May increase every 2 weeks by 0.5-1 mg/kg/day. The usual dose is 5-8 mg/kg/day in 2 divided doses. The maximum dose is 12 mg/kg/day. In infantile spasms a higher initial dose may be used.

Recommendations

- The following conditions require referral for specialized services
- All cases of suspected infantile spasms or myoclonic seizures.
- If there is concern for a secondary cause of epilepsy requiring further evaluation (examples include brain tumors, tuberous sclerosis, brain abscess, cysticercosis, etc.). This is particularly true in partial seizures where there may be a focal neurological problem.
- Seizures that are not controlled on first-line medication within 1 month.
- Seizures associated with neuro-regression.
- Mixed seizure types within one patient.

6.3. CONVULSIVE STATUS EPILEPTICUS

Definition: Status epilepticus is a convulsion that persists for ≥ 30 minutes or is repeated frequently enough to prevent recovery of consciousness and return to baseline between attacks.

Causes

- Epilepsy syndromes may be present first as status epilepticus or status epilepticus may occur with inadequate anti-epileptic drug levels
- CNS infection
- Hypoxic ischemic insult
- Traumatic brain injury
- Cerebrovascular accidents
- Metabolic disease including severe hypoglycemia and inborn errors of metabolism
- Electrolyte imbalance
- Intoxication
- Cancer including primary brain tumors and metastatic disease

Clinical Signs and Symptoms

- Seizure lasting ≥ 30 minutes or repetitive seizure activity without return to baseline consciousness.

Complications

- Death
- Neurologic morbidity including persistent seizures or encephalopathy
- Respiratory depression or failure due to neurologic status or aspiration
- Blood Pressure disturbances including severe hypotension or severe hypertension
- Hyperthermia
- Metabolic derangement including hypoglycemia, alterations in sodium, and acidosis
- Rhabdomyolysis
- Renal failure

Investigations

- Carefully evaluate vital signs as alterations in Blood Pressure or hypoxia may play a role
- Laboratory evaluation for underlying cause may include blood glucose, electrolytes, NFS, arterial blood gas, toxicology screen, and anticonvulsant drug levels if indicated
- If there is no contraindication, a lumbar puncture should be performed to exclude infectious etiology
- EEG
- CT scan of the brain
- MRI of the brain

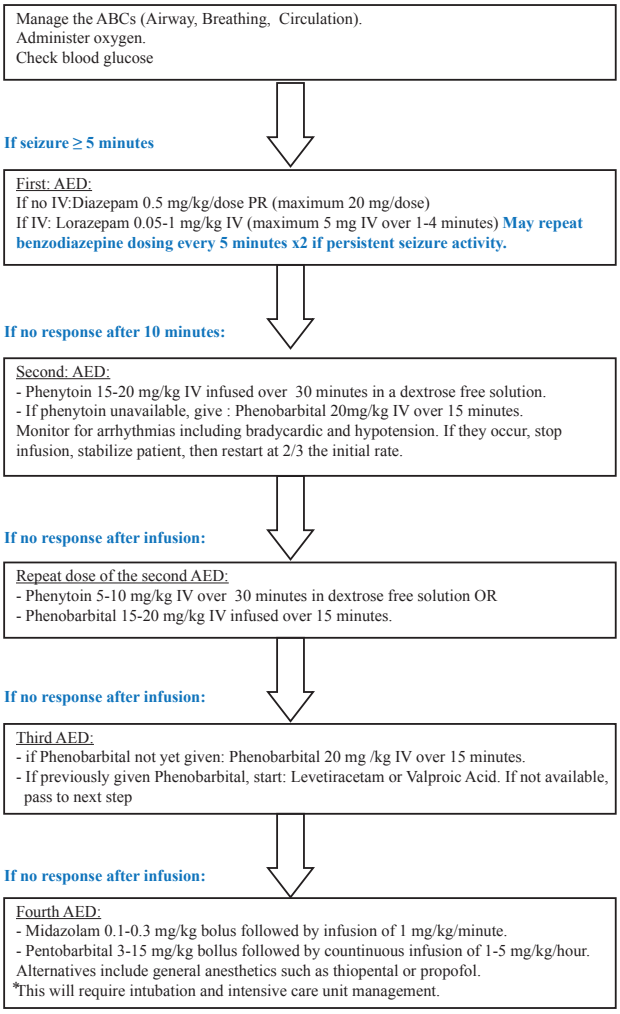
Management

Non-pharmaceutical Acute Management

- Manage Airway-Breathing-Circulation-Disability and continue to monitor throughout seizures
- Place patient on side at 20 – 30° head up to prevent aspiration
- Monitor Heart Rate, respiratory rate, Blood Pressure, oxygen saturation (SaO2), neurological status, fluid balance
- Monitor laboratory values including blood glucose, electrolytes, blood gases, toxicology screen and if indicated anticonvulsant blood levels
- Control fever with tepid sponging
- Administer oxygen to maintain SaO2 of ≥ 95%
- If unable to protect airway or poor ventilation, consider use of an oral airway, bag-mask ventilation and/or intubation
- Admission to Intensive Care Unit if possible

Pharmacological treatment

A flowchart showing medical management of Status Epilepticus



- While following medication flow sheet above, it is important to continue to address and manage the following
  - ➔ ABCs
  - ➔ Hypoxia: Administer oxygen, oral airway, bag-mask ventilation or intubation.
  - ➔ Hemodynamic: Assess for shock or hypertension and manage accordingly.
  - ➔ Hyperthermia: Treat with *paracetamol* 10-15 mg/kg orally or rectally every 4-6 hours as required.
  - ➔ Hypoglycemia: Treat with IV *dextrose* solution.
  - ➔ Hyponatremia: Assess etiology and manage accordingly.
  - ➔ If cerebral edema and normal renal function, consider *Mannitol* IV 0.5-1 gram/kg administered over 30–60 minutes.
  - ➔ If there is a known space-occupying lesion, consider dexamethasone IV 1-2 mg/kg IV as a single dose then 1-1.5 mg/kg/day divided into 4 doses.

Recommendations

- Once status epilepticus is resolved, consider maintenance therapy with an appropriate anti-epileptic drug depending on the etiology of seizure.
- Referral to a specialist is always appropriate in the case of status epilepticus. If possible, control seizures and stabilize the patient before referral. If status epilepticus has resolved, further work-up by a neurologist may be indicated.

CHAPTER 7
ENDOCRINE SYSTEM CONDITIONS

7. ENDOCRINE SYSTEM CONDITIONS

7.1. DIABETES MELLITUS (TYPE I AND TYPE II)

Definition: Diabetes mellitus is a disorder of absolute or relative insulin deficiency that results in increased blood glucose and disruption of energy storage and metabolism. Diabetes Mellitus is generally divided into two classifications: Diabetes Mellitus I and Diabetes Mellitus Type II.

- ***Diabetes Mellitus Type I*:** This results from the destruction of the pancreatic beta cells that leads to absolute insulin deficiency. Type IA is secondary to the autoimmune destruction of the beta cells. Type IB is secondary to non-autoimmune destruction of the beta cells. Type I diabetes accounts for approximately 2/3 of the new diagnosis of diabetes in patients $\leq$19 years old. There is a component of genetic susceptibility and close relatives of patients with type I DM are at higher risk of developing the disease.
- ***Diabetes Mellitus Type II*:** This is secondary to varying degrees of insulin resistance and insulin deficiency and is related to both genetic and environmental influences including predisposing medication such as steroids and some ARVs. It is the most common type of diabetes mellitus in adults.
- ***Neonatal diabetes*:** This is defined as persistent hyperglycemia occurring in the first months of life that lasts for more than 2 weeks and requires insulin therapy for management. It is a rare cause of hyperglycemia in the neonate and has an estimated incidence of 1/500,000 births. The majority of affected infants are small for gestational age experiences weight loss, volume depletions, hyperglycemia and glucosuria with or without ketonuria and ketoacidosis.

Signs and Symptoms

- Polyuria: This occurs when the serum glucose concentration rises above 180 mg/dL exceeding the renal threshold for glucose and leads to increased urinary glucose excretion and a subsequent osmotic diuresis. This may be present as nocturia, bedwetting, or daytime incontinence in a previously toilet trained child, or heavy diapers.

- Polydipsia: This is secondary to increased thirst from increased serum osmolality and dehydration.
- Polyphagia: This is due to an increased appetite that occurs secondary to loss of calories from glycosuria. These symptoms are not always present.
- Weight loss: This is due to hypovolemia and increased catabolism.
- Weakness/lethargy with ultimate progression to coma: This is secondary to hypovolemia and electrolyte disturbances including progressive acidosis.
- Visual disturbances: This is secondary to osmotic changes in the lens.

Diagnosis

- **Clinical:** The diagnosis should be suspected based on the signs and symptoms described above. Any of the above signs or symptoms should prompt further testing.

Investigations

- Blood sugar: The diagnosis is made based on abnormalities of the blood glucose. See diagnostic criteria below.
- Additional studies to evaluate severity and complications of the disease:
- Blood gas if concern for diabetic ketoacidosis
- Electrolytes
- Renal function tests (urea and creatinine) to evaluate for diabetic nephropathy and dehydration
- Urine analysis to check for glycosuria, ketones, and protein
- HbA1c: This can be used for diagnosis (see below) or to assess severity of disease and to assess response to therapy
- Lipid profile
- Fundoscopy: This is to evaluate for diabetic retinopathy
- Foot examination: This is to evaluate for diabetic neuropathy and assess for wounds that may already be present
- Further history and physical examination to exclude other co-

existing autoimmune disease such as hypothyroidism, vitiligo, rheumatoid arthritis, etc and to further inquire about a family history of endocrinopathies or autoimmune diseases

- Thyroid-stimulating hormone (TSH): This should be performed in type I diabetics as autoimmune diseases may occur together

Diagnosis criteria for diabetes mellitus

DIABETES MELLITUS (DM)

- Symptoms of DM plus random plasma glucose ≥200 mg/dL (11.1 mmol/L)

Or

- Fasting plasma glucose ≥126 mg/dL (7.0 mmol/L). Fasting is defined as no oral intake for at least 8 hours.

Or

- Two-hour plasma glucose ≥200 mg/dL during an Oral Glucose Tolerance Test (OGTT) as described by the WHO.

Or

- HgA1C ≥ 6.5% This test should be performed in a certified laboratory with an assay standardized to the diabetes control and complications trial (DCCT).

Complications

Short-term complications

- Diabetic ketoacidosis (DKA): Occurs more frequently in type I diabetes mellitus, but can also occur in some forms of type I diabetes mellitus.
- Hyperosmolar Hyperglycaemic State (HHS): Occurs in type II diabetes mellitus.
- Insulin resistance secondary to hyperglycemia: This occurs in both type I and type II diabetes mellitus.
- Infections due to immunosuppression and commonly include oral and vaginal candidiasis and urinary tract infections.

- Death: Patients presenting with DKA or HHS have a high mortality rate.

Long Term complications

- Vascular complications including both micro-angiopathy and macro-angioapthy:
  - → Nephropathy
  - → Retinopathy
  - → Neuropathy
  - → Cardiovascular disease
  - → Hypertension
- Dyslipidemia
- Growth retardation or obesity depending on the insulin therapy. Patients may also have delayed puberty secondary to poor growth.
- Psychiatric disorders including depression related to their chronic disease.

Management

General Objectives

- Maintain normal glycemia with insulin therapy or oral medication (in type II diabetes mellitus) to prevent both the signs and symptoms of uncontrolled hyperglycemia and the complications mentioned above.

Non- Pharmaceutical Management

- Assess A-B-C-D (Airway, Breathing, Circulation, Disability)
- If patient has signs or symptoms of diabetic ketoacidosis (DKA) or hyperosmolar hyperglycaemic state, this is an emergency and treatment must be initiated immediately.
- The patient and family should be counselled on the cause and treatment of diabetes as well as its management. The patient and family should be taught how to monitor blood glucose, record the test results, administer and adjust insulin doses based on blood glucose values and food intake.

- The family should be counselled on the complications of diabetes mellitus and how to manage them. In particular, they should know the signs and symptoms of acute hypoglycemia and its management. They should also understand the importance of maintaining normoglycemia to avoid long-term complications. They should be instructed on how to manage acute illnesses in the context of diabetes mellitus, for example how to manage an insulin dose if the patient is unable to tolerate an oral intake of it.
- Diet modification is important in both type I and type II diabetes mellitus. A nutritionist should be involved in providing individualized recommendations.

Pharmaceutical management:

- The majority of children with diabetes mellitus have type I diabetes and may have diabetic ketoacidosis (DKA). The management of DKA is detailed below.
- Diabetes Mellitus Type I: Children with diabetes mellitus type I require insulin therapy. The patient is insulin dependent and while the insulin therapy may be adjusted based on the clinical condition and blood glucose results; the insulin therapy should NEVER be stopped completely as this could result in the development of DKA and death.

7.2. DIABETIC KETOACIDOSIS

Definitions: It is defined as an increase in the serum concentration of ketones greater than 5 mEq/L, a blood glucose level greater than 250 mg/dL (although it is usually much higher), and blood (usually arterial) pH less than 7.3. Ketonemia and ketonuria are characteristic, as is a serum bicarbonate level of 18 mEq/L or less (< 5 mEq/L is indicative of severe DKA).

Mainly occurs in patients with type I diabetes, however it is not uncommon in type II diabetes

Causes

- Previously undiagnosed diabetes
- Interruption of insulin therapy
- Underlying infection and intercurrent illness
- Poor management of DM type I
- Stress
- Medication like corticosteroids, clozapine etc.

Signs and Symptoms

Symptoms	Signs
Polyuria	Dehydration with dry skin, reduced skin turgor or sunken eyes
Polydypsia	Deep and fast breathing (Kussmal respiration) with acetone (ketotic) breath odor
Nausea, vomiting	Low Blood Pressure
Abdominal pain	Fast and weak pulse
Relatives may report alteration in sensorium or collapse	Confusion, stupor or unconsciousness

Investigations

- Blood glucose
- Urine glucose
- Urine ketones
- Blood urea and electrolytes

- Blood film for malaria parasites (Unconscious in highly endemic area)
- Full Blood Count
- Blood and urine culture
- Electrocardiography

Management

Principles:

- Manage A,B
- Admission in ICU if possible
- Correction of fluid loss with intravenous fluids
- Correction of hyperglycemia with insulin
- Correction of electrolyte disturbances, particularly potassium loss
- Correction of acid-base balance
- Treatment of concurrent infection, if present

Rehydration

AGE	1st hour	Next 7 hours	Next 16hours
< 1 yr	20 ml/kg	15 ml/kg	7 ml/kg
1 - 7 yrs	20 ml/kg	10 ml/kg	5 ml/kg
8 – 14 yrs	20 ml/kg	9 ml/kg	5 ml/kg
> 15 yrs	20 ml/kg	8 ml/kg	4 ml/kg

- Correction of hydro-electrolytic disorder: initial correction of fluid loss is either by isotonic sodium chloride solution or by lactated Ringer solution
- If blood glucose falls to < 14mmol/l (250mg/dl) before DKA has resolved (PH < 7.3) add 5% glucose and continue with insulin

Emergency Insulin Therapy

- Delay insulin until serum K^+ is known to be > 3,5 mmol/l
- Insulin should only be started after ½ - 1 hour of fluid therapy, provided shock has been treated.

Doses and route

- Low dose hourly regimen
  - → Regular (neutral, soluble) Insulin (Actrapid or Humulin R), give 0.1 unit/kg per hour IV
  - → hourly;
    - Giving hourly bolus doses ensures regular medical and nursing supervision of the patient
    - If glucose fall inadequate, i.e. a fall of < 4 mmol/l/hr - double the dose
    - If glucose fall is excessive, i.e. a fall of > 5,5 mmol/l/hr - half the dose
    - Continue with hourly insulin until blood glucose and ketoacidosis are controlled. If blood glucose is stable and urine ketones negative, then start standard insulin regimen

- POTASSIUM (K+);
  - If hyperkalaemia (serum K+ or ECG) withhold potassium supplementation
  - If serum K+ is normal or low and patient is passing urine: Start K+ supplementation immediately
  - K+ replacement will be necessary in all cases (even with initial hyperkalaemia)

- DOSES:

SERUM POTASSIUM	POTASSIUM SUPPLEMENT (as KCl add to each litre of iv fluid)
<3,0 mmol/l	40 mmol
3,0 - 4,0 mmol/l	30 mmol
4,1 - 5,0 mmol/l	20 mmol
5,1 - 6,0 mmol/l	10 mmol
6,0 mmol/l	None

Transitional insulin therapy (- Sliding Scale)

Monitor Blood Glucose every 4hours and give the corresponding amount of Soluble/Regular insulin subcutaneously

Blood Glucose Result	Amount of Soluble/Regular Insulin to be given
Less than 6 mmol/L	No Insulin
6.1 – 9.0 mmol/L	0.06 units/kg body weight
9.1 – 12.0 mmol/L	0.09 units/kg body weight
12.1–15.0 mmol/L	0.12 units/kg body weight
15.1–18.0 mmol/L	0.15 units/kg body weight

- For transitional therapy consider patient
  - → No coma (still some clouding of consciousness), no acidosis
  - → Continue the sliding scale, making appropriate adjustments to the insulin dosage, until the patient is eating normally and urine is free of ketones. This may take on average between 12 – 24 hours.

Maintenance of insulin therapy

- Determine dose on normal requirement: 1 units/kg/day
- *2 Injections regimen*:
- Administer subcutaneously in the form of 50% intermediate–acting insulin (NPH or Lente) and 50% rapid insulin. Total dosage divided in 2 doses:
  - → 2/3 before breakfast (1/2 Rapid insulin and 1/2 Intermediate acting insulin)
  - → Remaining 1/3 before the evening meal(1/2 Rapid insulin and 1/2 intermediate acting insulin)

OR

4 Injections regimen (Prandial regimen)

- Total dosage divided in 4 doses
  - → 50% of intermediate–acting insulin at bed time
  - → 50% of rapid acting insulin dived in 3 doses – 20% before breakfast, 10% before lunch and 20% before dinner

- Treatment of intercurrent infection:
  - ➔ Start empiric antibiotics on suspicion of infection until culture results are available
    - Cefotaxime 100mg/kg/day/7days

Recommendations

- Regular follow-up of all individuals with diabetes is important to assess their metabolic control
- Dietary education
- Physical activity
- Diabetes education
- Keep urine free of ketones

7.3. HYPOGLYCEMIA

Definition: Blood glucose levels below the lower limit of the normal range (blood glucose < 2.2 mmol/L, for malnourished children <3 mmmol/L).

Causes/Risk factors

- Individuals with diabetes
- Excessive dose of medication anti–diabetic medication
- Omitted or inadequate amount of food
- Unaccustomed physical over activity
- Alcohol intake

Signs and symptoms

- Dizziness
- Blurred vision
- Headaches
- Palpitation
- Irritability and abnormal behavior
- Sweating
- Tremors
- Tachycardia
- Confusion
- Unconsciousness
- Convulsions

Investigation

- Blood glucose

Management

- 10% Glucose, IV, 2–4 ml/kg body weight 1 to 3 minutes through a large vein followed by 5–10% Glucose, IV, according to total daily fluid requirement until the patient is able to eat normally

  Alternatively,

  - Glucagon, IV, IM or subcutaneous,
  - Over 8 years of age (or body weight over 25 kg);

    → Give 1 mg stat IM if available
  - Under 8 years of age (or body weight less than 25 kg);

    → Give 500 microgram stat IM if available

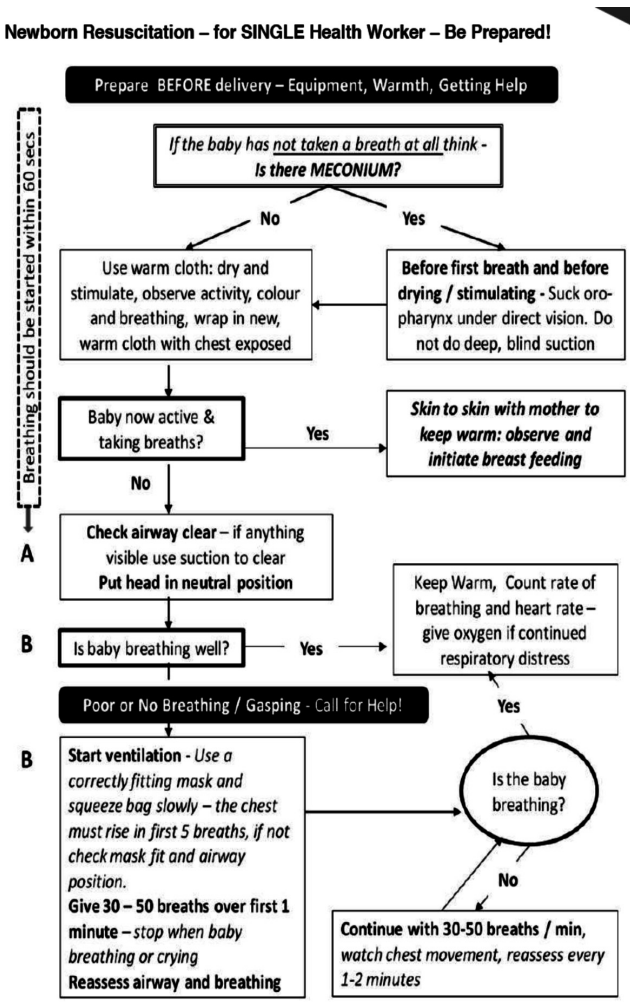
Recommendation

- Control blood glucose 30 minutes after 10% bolus of glucose

CHAPTER 8

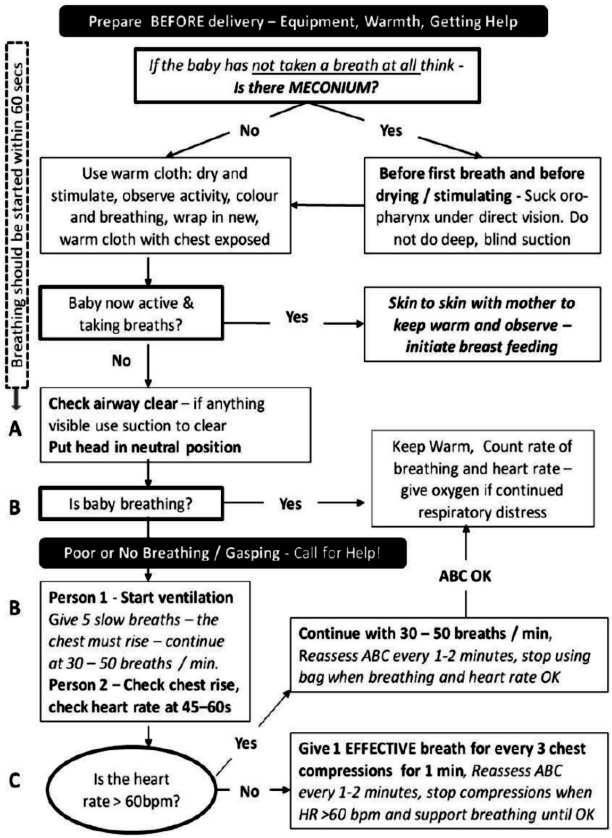
NEONATOLOGY EMMERGENCIES

8. NEONATOLOGY EMMERGENCIES



Reference taken from ETAT Manual (Rwanda) 2011
taken from ETAT Manual (Rwanda).

Newborn Resuscitation – for TWO trained Health Workers – Be Prepared!



8.1. PERINATAL HYPOXIA/HYPOXIC-ISCHEMIC ENCEPHALOPATHY

Definition: Hypoxic-ischemic encephalopathy is characterized by clinical and laboratory evidence of acute or subacute brain injury due to asphyxia (i.e. hypoxia, acidosis). Asphyxia is not a diagnosis derived from a poor Apgar score alone. It is the result of compromised gas exchange resulting in cardio-respiratory depression.

Cause

- Inadequate pre-, peri- intra- and/or post-partum oxygen delivery and blood flow ischaemia

Risk factors

- Failure of gas exchange across the placenta
- Interruption of umbilical blood flow
- Inadequate maternal placental perfusion, maternal hypotension/ hypertension
- Compromised fetus (anemia, IUGR)
- Failure of cardio respiratory adaptation at birth
- Decreased blood flow from the placenta to the fetus
    - Impaired gas exchange across placenta or fetal tissues
- Increased fetal oxygen requirement

Signs and symptoms

Characteristic stages of disease

MODIFIED SARNAT STAGE*			
STAGE	**Stage 1**	**Stage 2**	**Stage 3**
Level of Consciousness	**Hyperalert**	**Letheargic or obtunded**	**Stupor or coma**
Activity	**Normal**	**Decreased**	**Absent**
Neuromuscular Controls			
Muscle Controls	**Normal**	**Mild hypotonia**	**Flaccid**
Posture	**Mild distal flexion**	**Strong distal flexion**	**Intermittent decebration (exetension)**
Stretch Reflexes	**Overactive**	**Overactive**	**Decreased or absent**
Complex / Primitive reflexes			
Suck	**Weak**	**Weak or absent**	**Absent**
Moro (startle)	**Strong, low threshold**	**weak, incomplete high threshold**	**Absent**
Tonic neck	**Slight**	**Strong**	**Absent**
Autonomic Function			
Pupils	**Mydriasis**	**miosis**	**Variable; often unequal, poor light reflex; fixed; delated**
Heart Rate	**Tachycardia**	**Bradycardia**	**variable**
Seizures	**None**	**Common; Focal or multfocal**	**uncommon (excluding decerebration)**

* **Sanat H B, Smart MS: Neonatal encephal opathy following fetal distress. Arch Neurol 33: 698-705 1976**

- In mild hypoxic-ischemic encephalopathy
  - Muscle tone may be slightly increased and deep tendon reflexes may be brisk during the first few days
  - Transient behavioral abnormalities, such as poor feeding, irritability, or excessive crying or sleepiness, may be observed
  - The neurologic examination findings normalize by 3-4 days of life
- In moderately severe hypoxic-ischemic encephalopathy:
  - Lethargy, with significant hypotonia and diminished deep tendon reflexes
  - The grasping, moro, and sucking reflexes may be sluggish or absent
  - Occasional periods of apnea
  - Seizures within the first 24 hours of life
  - Full recovery within 1-2 weeks associated with a better long-term outcome

- An initial period of well-being or mild hypoxic-ischemic encephalopathy followed by sudden deterioration, suggesting ongoing brain cell dysfunction, injury, and death; during this period, seizure intensity might increase

- In severe hypoxic-ischemic encephalopathy

  - Typical stupor or coma
  - Not responding to any physical stimulus
  - Irregular breathing
  - Generalized hypotonia and depressed deep tendon reflexes
  - Neonatal reflexes (e.g. sucking, swallowing, grasping, moro) are absent
  - Disturbances of ocular motion, such as skewed deviation of the eyes, nystagmus, bobbing, and loss of "doll's eye" (i.e. conjugate) movements
  - Dilated pupils, fixed, or poorly reactive to light
  - Seizures occur early and often, initially resistant to conventional treatments
  - Subsided seizures with isoelectric EEG
  - Wakefulness deterioration, with fontanelle bulge (increasing cerebral edema)
  - Irregularities of Heart Rate and Blood Pressure (BP)
  - Death from cardio respiratory failure

Diagnosis

- History of

  - Fetal distress and/or meconium stained amniotic fluid
  - Profound metabolic acidosis (pH <7.0, BE >12mmol/L)
  - Persistence of an Apgar score of 0-3 for longer than 5 minutes
  - Neonatal neurological sequelae (e.g. seizures, coma, hypotonia
  - Multiple organ involvement (e.g. kidney, lungs, liver, heart, intestines)

- A significant hypoxic event immediately before or during labor or delivery

Complications

- Cardiovascular (Heart Rate and rhythm disturbances, cardiac failure and hypotension)
- Pulmonary (respiratory distress/respiratory failure, pulmonary hypertension and pulmonary haemorrhage)
- Renal (renal failure, acute tubular/cortical necrosis and urinary retention)
- Gastrointestinal tract (Ileus and necrotizing enterocolitis)
- Central nervous system (increased intracranial pressure, cerebral oedema, encephalopathy, seizures, inappropriate antidiuretic hormone (ADH) secretion, hypotonia and apnoea)
- Metabolic (hypoglycaemia, hyperglycaemia, hypocalcaemia, hypomagnesaemia and metabolic acidosis)
- Hypothermia/hyperthermia
- Disseminated intravascular coagulation

Investigations

- Serum electrolyte levels
- Renal function studies
- Cardiac and liver enzymes
- Coagulation system evaluation
- Arterial Blood Gases
- Brain MRI
- Cranial ultrasonography
- Head CT scanning

Management

Non-pharmaceutical

- Resuscitate
- Admit to neonatal high care or Intensive Care Unit, if available
- Maintain body temperature at 36.5-37.50
- Keep Sat O2 88–92% (normal range)
- Maintain
  - → Blood glucose at 2.6–6mmol/L
  - → Haematocrit at ≥ 40% – packed red cells, IV, 10mL/kg
- Give IV Fluids
- Restrict fluids with D 10% to 50–60 mL/kg in the first 24–48 hours
- Give Nutrition
  - → No enteral feeds for at least the first 12–24 hours
  - → Enteral milk feeds only after ileus has been excluded

Pharmaceutical

- If infection is suspected or confirmed (See table under sepsis 3.6a + 3.6b for empiric antibiotics for sepsis/meningitis)
- If hypotension
  - → Give *Sodium Chloride* 0.9% IV, 20 mL/kg over 1 hour + *Dopamine*, IV, 5–15 mcg/kg/minute. Alternatively give *Dobutamine*(if available), IV, 5–15 mcg/kg/minute until Blood Pressure is stable
- If Convulsions
  - → Give *Phenobarbital*
    - Loading dose: 20 mg/kg IV slow push. May repeat 10 mg/kg after 20-30 minutes if seizures continue
    - Maintenance: 3-5 mg/kg/day IV if seizures persists

→ Phenytoin IV

- Loading dose: 15 mg/kg diluted in 3 mL Sodium Chloride 0.9% given over 30 minutes by slow IV infusion
- Maintenance: IV/oral, 5–10 mg/kg/24 hours as a single dose or 2 divided doses
- Flush IV line with *Sodium Chloride* 0.9% before and after administration of the phenytoin

- If Cardiac failure

- Restrict fluids

→ *Give Furosemide IV/oral/nasogastric tube, 1 mg/kg/24 hours as a single daily* dose

- If Hypocalcaemia with Serum total calcium < 1.7mmol/L or ionized calcium < 0.7 mmol.L

→ Give *Calcium gluconate* 10%, slow IV, 1–2 mL/kg over 15 minutes under ECG control

- If Hypomagnesaemia with Serum magnesium < 0.7 mmol/L

→ Give *Magnesium sulphate* 50%, IV, 0.2 mL/kg as a single dose

- If Hypoglycaemia with Blood glucose < 2.6 mmol/L

→ Give *Dextrose,* IV as bolus, 250–500 mg/kg

- Do not repeat
- Dilute dextrose 50% solution before use to 10% strength
- 0.5–1 mL of dextrose 50% = 250–500 mg
- OR
- 2.5 mL of dextrose 10% = 250 mg

- If inappropriate ADH: Cerebral oedema/raised intracranial pressure**:**

- ➔ Moderate fluid restriction of 50–60 mL/kg/24hours for the first 24–48 hours
- ➔ Raise head of cot by 10–15 cm
- ➔ Moderate hyperventilation to lower PaCO2 to 30–35 mmHg, if ventilation facilities are available
- ➔ Steroids are not considered to be of value

Recommendations

- Monitor neurological status, fluid balance, vital signs, temperature, blood glucose acid-base status, blood gases, electrolytes, SaO2, minerals, Blood Pressure(where available) and renal function
- Newborns with stage 3 Hypoxic Ischaemic Encephalopathy should not be ventilated
- Refer survived child for neurological assessment 3 months
- Phenytoin must not be given in glucose/dextrose- containing solutions
- To minimize risk of precipitation administer phenytoin in 0.9% Sodium Chloride solution
- Do not administer phenytoin intramuscularly

8.2. NEONATAL INFECTION

Definition: Neonatal sepsis is a clinical syndrome of systemic illness accompanied by bacteremia occurring in the first 28 days of life. Bacterial or fungal invasion of blood before or after birth may spread to involve other organs/systems leading to, e.g. meningitis, pneumonia, osteomyelitis, and pyelonephritis.

Causes/risk factors

- Maternal fever (temp >38°C) during labor or within 24 hours after delivery
- Maternal urinary tract infection in current pregnancy or bacteruria
- Rupture of membranes > 18 hours before delivery
- Uterine tenderness or foul smelling amniotic fluid
- Obstetric diagnosis of chorioamnionitis
- Meconium Aspiration Syndrome
- Resuscitation at birth
- Invasive procedures
- Home delivery

Signs and symptoms

- Tachycardia, bradycardia, tachypnoea, lethargy, hypotonia, irritability– (always look at trends in the observation chart over last 24 hours.)
- Abdominal distension (+/- skin + colour changes, e.g. shiny, darkened skin)
- Feeding problems –(e.g. poor feeding, stopped feeding, increasing residuals, vomiting)
- Organomegaly
- Jaundice
- Signs of respiratory distress
- Petechiae haemorrhages, anaemia

- Diarrhea
- Convulsions
- Temperature instability – including HYPOTHERMIA or HYPER-THERMIA
- Apnoeas, desaturations or cyanosis
- Sclerema
- Bulging fontanelle

Complications

- Dehydration
- Septic shock
- Hypoglycaemia
- DIC and/or thrombocytopenia
- Osteomyelitis +/- septic arthritis
- Anaemia
- Respiratory failure
- Meningitis
- Necrotising enterocolitis
- Bronchopneumonia
- Cardiac failure
- Renal failure
- Multi-organ failure

Investigations

- Blood, urine and cerebrospinal fluid cultures
- Blood Count and differential count (WBC< 5000 or > 20000; Neutrophils > 70%)
- C-reactive protein
- Chest x-ray (if signs of respiratory distress

ALL babies with suspected sepsis should have a lumbar puncture, urine and blood culture

Management

Non-pharmaceutical

- Admit to neonatal high dependency or Intensive Care Unit, if available
- Ensure adequate nutrition
- Enteral feeding where possible, via oro/nasogastric tube after ileus, obstruction, or other contraindications to enteral feeding have been excluded (e.g. shock)
- If enteral feeding is not possible or is contra-indicated, commence IV fluids, e.g. neonatal maintenance solution (See chapter on neonatal nutrition)
- Insert naso/orogastric tube, open free drainage.
- Oxygen to maintain saturations 90-95%.
- CPAP if available and meets criteria (See separate criteria in unit)
- Monitor infants for the following:
- Ensure that temperature of baby is 36.5-37.5oC
- Blood glucose level greater than 2.6 mmol/L (45mg/dl)
- Haematocrit of 40–45%
- Vital signs within their normal physiological ranges (see appendix):
  - ➔ If sick/unstable – every 1 hour
  - ➔ If stable and improving – every 3-4 hours

Pharmaceutical

- If suspected sepsis
  - → Give *Ampicillin + Gentamicin*
- If suspected meningitis, first-line therapy
  - → *Ampicillin + Cefotaxime* (preferred)

    OR
  - → *Ceftriaxone*
- If the infant has adequate urine output (1ml/kg/hr)
  - → Do not stop Gentamicin before Ampicillin
- If the infant does not have adequate urine output,
  - → Use a third generation Cephalosporin *(Cefotaxime or Ceftriaxone)* instead of Gentamicin.

Table 3.6a **Antibiotic Dosing Chart for Newborns**

Medication	Dose/Frequency			Comments
	Age < 14 days		Age> 14 days	
	≤ 35 weeks PMA* (if PMA not known use current weight ≤ 2.0 kg)	> 35 weeks PMA* (if PMA not known use current weight > 2.0 kg)		
Ampicillin or *Cloxacillin*	If meningitis suspected :150 mg/kg IV every 12 hours If meningitis ruled out: 50 mg/kg IV every 12 hours		50 mg/kg IV every 6 hours Meningitis: 100 mg/kg IV every 6 hours.	-
Gentamicin	3 mg/kg IV once a day	5 mg/kg IV once a day	**> 1 month:** 7.5 mg/kg IV once a day	Use newborn dose through first month.
Cefotaxime	50 mg/kg IV every 12 hours	50 mg/kg IV every 8 hours	50 mg/kg every 6 hours	Preferred over Ceftriaxone due to improved safety profile
Ceftriaxone	50 mg/kg IV every 12 hours for sepsis/meningitis 50 mg/kg x1 IM for pus draining from eye For IM injection, dilute to 350 mg/mL. Max dose ½ mL = 175 mg			Contraindicated in setting of jaundice or within 48 hours of IV calcium administration

Metronidazole	7.5 mg/kg IV every 24 hours	7.5 mg/kg IV every 12 hours	7.5 mg/kg IV every 8 hours	Anaerobic coverage including treatment of necrotizing enterocolitis
Acyclovir	20 mg/kg IV every 12 hours	20 mg/kg IV every 8 hours		Treatment of herpes simplex infection: 14 days if localized, 21 days if disseminated
	20mg/kg PO every 6 hours if IV acyclovir not available			

Table 3.6b Duration of antibiotic therapy

Antibiotic Coverage Summary by Condition for infants < 1 month of age					
Condition	**Clinical Condition**	**Laboratory Results**	**Treatment Recommendation**	**Duration of Therapy**	**Comments**
Sepsis Evaluation: negative	Normal vital signs, well appearing	Normal WBC, differential, CRP, CXR	Ampicillin Gentamicin	48 hours	
Sepsis/ Pneumonia	Abnormal vital signs, ill appearing	Abnormal WBC, differential, CRP, CXR	Ampicillin Gentamicin	7 days	

Sepsis/ Pneumonia: Not improving	Abnormal vital signs, ill appearing, poor response to antibiotics after 48 hours	Abnormal WBC, differential, CRP, CXR	Ampicillin Add Cephalosporin Stop gentamicin	7 to 14 days	Cefotaxime preferred over ceftriaxone
Meningitis	Abnormal vital signs, ill appearing, abnormal neurological exam	Abnormal WBC, differential, CRP, CXR, CSF	Ampicillin Cephalosporin	14 days if gram positive 21 days if gram negative	Cefotaxime preferred over ceftriaxone *(see 3.7-meningitis protocol)*
Urinary Tract Infection	Abnormal vital signs, ill appearing	Urinalysis concerning for urinary tract infection	Ampicillin Gentamicin	7 days	Generally considered in infants □ 7 days

Inotropic support if septic shock

- If correct Blood Pressure cuff available, mean Blood Pressure should not be less than the gestational age (weeks) of the infant plus 5–10 mmHg. (e.g. a 34 week gestation) infant should have a mean Blood Pressure of 34mmHg
- If Blood Pressure is < 60/40 mmHg in term infant, < 50/35 mmHg in pre-term infant
    - Give *Dopamine*, IV, 5–15 mcg/kg/minute as a continuous infusion
    - Continue with *Dopamine* as long as it is necessary to maintain the Blood Pressure

Recommendations

- Refer all patients to NICU with:
    - Septicaemia with complications
    - Septicaemia not responding to treatment
- Cefotaxime: To replace Gentamicin in the treatment of sepsis in the setting of renal dysfunction, or to treat presumed meningitis due to poor CNS penetration of gentamicin, preferred to Ceftriaxone, especially in setting of hyperbilirubinemia
- Ceftriaxone: Do not use in setting of hyperbilirubinemia because it displaces bilirubin from albumin, do not administer within 48 hours of IV calcium in infants < 28 days of age due to risk of lethal precipitation

8.3. NEONATAL MENINGITIS (BACTERIAL)

Definition: A bacterial infection of the meninges in the first month of life. Meningitis should be **considered in any neonate being evaluated for sepsis** or infection as most organisms implicated in neonatal sepsis and neonatal meningitis.

Causes/Risk factors

- Gram positive: Group B ß-haemolytic streptococcus, *S. epidermidis, S. aureus, Listeria,*
- Gram negative: *E. Coli*, Klebsiella, Citrobacter, enterobacter
- Open defects or with indwelling devices such as VP shunts

Signs and symptoms

- Tachycardia, bradycardia, tachypnoea, lethargy, hypotonia , irritability– (always look at trends in the observation chart over last 24 hours)
- Temperature instability
- Altered level of consciousness
- Hypoglycaemia
- Bulging/full fontanel
- Vomiting
- Convulsions
- Feeding problems
- Apnoea (+/- desaturations)

Complications

- Cerebral oedema
- Convulsions
- Raised intracranial pressure
- Hydrocephalus
- Vasculitis, with haemorrhage
- Subdural effusions

- Ventriculitis
- Brain abscess
- Ischaemia and infarctions of the brain
- Inappropriate antidiuretic hormone secretion (SIADH)
- Neurological sequelae
  - Blindness
  - Deafness
  - Inappropriate antidiuretic hormone secretion (SIADH)
  - Mental retardation

Investigations

- Lumbar puncture
  - The CSF appears cloudy
  - Protein concentration is increased
  - Leucocyte count is increased with a predominance of polymorphonuclear leucocytes
  - Glucose concentration is low, < 2/3 of blood glucose
  - Gram stain, microscopy, culture and sensitivity of CSF
- Blood cultures: for microscopy, culture and sensitivity

Management

Non-pharmaceutical

- Admit to high dependency or Intensive Care Unit, if available
- Maintain infant temperature between 36.5 – 37.5oC
- Monitor neurological status including
  - → Pupil reaction to light and size of pupils
  - → Neurological exam (reflexes and tone)
  - → Note any seizures
  - → Head circumference (once per day during the acute illness, once per week when stable)

- Vital signs
- Blood glucose
- Haematocrit
- Fluid balance (hydration)
- Blood gases (if available)
- Ensure adequate nutrition
  - → Enteral feeding where possible, use nasogastric tube, if necessary
  - → If enteral feeding is not possible, IV fluids, e.g. neonatal maintenance solution (See chapter on neonatal nutrition and fluid management)
  - → Limit total daily fluid intake, IV and oral, do not exceed the daily requirements for age to prevent fluid overload – monitor daily weight

Pharmaceutical

DO NOT DELAY ANTIBIOTIC TREATMENT: Start antibiotics immediately after lumbar puncture. If lumbar puncture has to be delayed, start the antibiotics.

- Empiric antibiotics
  - → *Ampicillin* and *Cefotaxime* (See table under sepsis 3.6a + 3.6b for empiric antibiotics for sepsis/meningitis)
  - → Review the empiric antibiotics prescribed, based on results of blood and CSF cultures or when the child does not improve within 72–96 hours (See table under sepsis 3.6a + 3.6b for empiric antibiotics for sepsis/meningitis)
  - → If unconfirmed but suspected meningitis, continue empiric antibiotics for at least 14 days and review clinical response
  - → Antibiotic choice based on culture result
    - Group B β-haemolytic streptococci
      - *Cefotaxime* for 14 days (See table 3.6a for dosage)

- Listeria monocytogenes
  - *Ampicillin* for 21 days and gentamicin for the 1st 7 days only (See table 3.6a for dosage)
- Gram negative bacteria
  - *Cefotaxime* for 21 days

- For patients with no response to empiric antibiotics after 5-7 days and a negative CSF culture, or patients intolerant of ampicillin and cephalosporins, consider anaerobic bacteria
  - → *Metronidazole* (Refer to table 3.6a and 3.6b for dosage and duration)
- Methicillin resistant staphylococci, treat with
  - → *Vancomycin*, IV, 15 mg/kg loading dose followed by 10 mg/kg for 14 days
    - ≤ 7 days 10 mg/kg, every 12 hours
    - 7 days 10 mg/kg, every 8 hours
- Sensitive staphylococci, treat with
  - → *Cloxacillin*, IV, 50–100 mg/kg/dose for 14 days
    - ≤ 7 days 50–100 mg/kg, every 12 hours
    - > 7 days 50–100 mg/kg, every 6 hours
- Pseudomonas aeruginosa, treat with
  - → *Ceftazidime*, IV, 30 mg/kg/dose for 14-21 days
    - ≤ 7 days 30 mg/kg/dose, every 12 hours
    - > 7 days 30 mg/kg/dose, every 8 hours

- For fever
  - Give *Paracetamol*, oral, 10 mg/kg/dose, every 6 hours when needed until fever subsides
- Convulsions: See Neonatal Seizures
  - Raised intracranial pressure or cerebral oedema
    - → Avoid fluid overload (monitor daily weight)
    - → Limit total daily intake, IV and oral.
    - → Do not exceed the maintenance requirements for age

Recommendation

- Refer neonates with meningitis not responding to adequate treatment, with meningitis

8.4. NEONATAL HYPOGLYCEMIA

Definition: Neonatal hypoglycemia is low blood sugar (glucose) in the first few days after birth

- Moderate Hypoglycemia: Glucose is 1.4 – 2.5 mmol/L (25 - 45 mg/dL)
- Severe Hypoglycemia: Glucose is < 1.4 mmol/L (25 mg/dL)

Causes/Risk factors

- Prematurity/Low Birth Weight /large baby
- Infant of diabetic mother
- Sepsis
- Postmaturity
- Hypothermia/ hyperthermia
- Feeding difficulties
- Respiratory distress
- Birth asphyxia
- Rhesus iso-immunisation
- Hyperinsulinism

Signs and symptoms

- Lethargy
- Poor feeding
- Hypotonia
- Respiratory distress
- Apnoea
- Jitteriness

- Convulsions
- Irritability
- Metabolic acidosis
- Coma
- Cardiac failure

Investigations

- Blood tests for monitoring blood glucose (heel prick) < 2.6 mmol/L
- Newborn screening for metabolic disorders

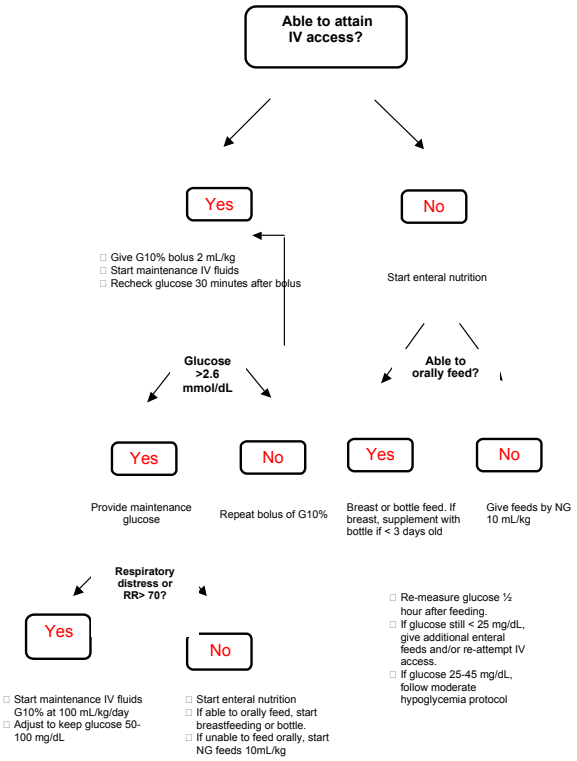
Management

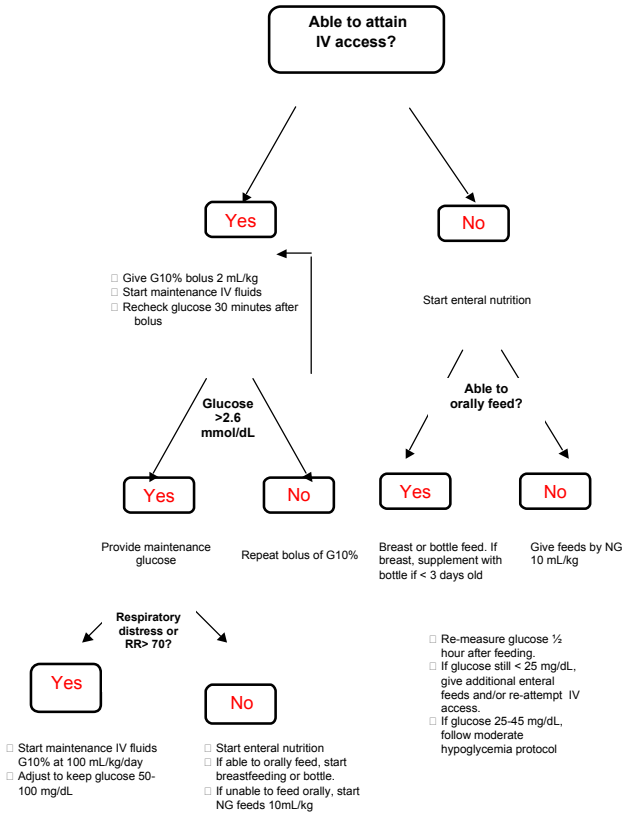
Non-pharmaceutical

- Determine and treat the underlying cause
- Enteral feeding, oral or via oro/nasogastric tube, after exclusion of vomiting, ileus or obstructionSource: Neonatal protocols Rwanda. 2011

Severe Hypoglycemia Protocol

Glucose < 1.4 mmol/L (25 mg/dL)


Able to attain IV access?
Yes
No
Give G10% bolus 2 mL/kg
Start maintenance IV fluids
Recheck glucose 30 minutes after bolus
Start enteral nutrition
Glucose >2.6 mmol/dL
Able to orally feed?
Yes
No
Yes
No
Provide maintenance glucose
Repeat bolus of G10%
Breast or bottle feed. If breast, supplement with bottle if < 3 days old
Give feeds by NG 10 mL/kg
Respiratory distress or RR> 70?
Yes
No
Start maintenance IV fluids G10% at 100 mL/kg/day
Adjust to keep glucose 50-100 mg/dL
Start enteral nutrition
If able to orally feed, start breastfeeding or bottle.
If unable to feed orally, start NG feeds 10mL/kg
Re-measure glucose ½ hour after feeding.
If glucose still < 25 mg/dL, give additional enteral feeds and/or re-attempt IV access.
If glucose 25-45 mg/dL, follow moderate hypoglycemia protocol



Notes:

Glucose conversion: 1mmol/L = 18 mg/dL

If unable to measure blood sugar for high risk but asymptomatic newborn, follow moderate hypoglycemia protocol

- ➔ High risk: Required resuscitation, concern for sepsis, premature (<35 weeks) or LBW (<2kg), poor feeding

- If unable to measure blood sugar for infant with symptoms of hypoglycemia,

→ follow severe hypoglycemia protocol Symptoms of hypoglycemia: jittery, lethargic, seizures

- If breast milk is not available,

→ Use artificial milk. If neither breast nor artificial milk is available, G10% IV fluid may be given enterally

CHAPTER 9
HYPOCALCAEMIA

9. HYPOCALCAEMIA

Definition: Hypocalcaemia = when blood level of calcium is less than 80mg/L (2mmol/L)

Causes

- Maternal factors
  - Diabetes
  - Toxaemia
  - Severe dietary calcium deficiency
- Intrapartum factors
  - Asphyxia
  - Prematurity
  - Maternal magnesium administration
- Postnatal factors
  - Hypoxia
  - Shock
  - Asphyxia
  - Poor intake
  - Sepsis
  - Exchange transfusion
  - Respiratory metabolic acidosis
- Neonatal hypocalcaemia usually resolves in 2 to 3 days
- Three days after birth, other causes may be
  - High phosphate diet
  - Mg deficiency
  - Renal disease
  - Hypoparathyroidism

Diagnosis

- Serum calcium < 2.2 mmol/L, or
- Ionised calcium < 1.2 mmol, equivalent to <3.8 mEq/L, or
- Ionized calcium < 4.0 mg/dL

Management

Pharmaceutical

- Symptomatic hypocalcaemia
  - → *Calcium gluconate* 10%, IV/oral, 1–2 mL/kg 6–8 hourly, 1 mL of calcium gluconate 10% = 100 mg calcium gluconate = 9 mg elemental calcium = 0.45 mEq/mL
  - → Correct hypomagnesaemia, acute hypocalcaemia with seizures
    - *Calcium gluconate* 10%, IV, 1–1.5 mL/kg over 5–10 minutes, administer slowly at a rate of 1 mL/minute. Rapid infusion causes bradycardia/arrhythmia
    - Repeat in 15 minutes
    - Electrocardiographic monitoring is advised
    - Monitor the Heart Rate

Recommendation

- Refer child with persisting or recurrent unexplained hypocalcaemia to a specialist for consultation

9.1. RESPIRATORY DISTRESS SYNDROME

Definition: Newborn experiencing difficulty breathing

Respiratory Distress Syndrome hyaline membrane disease / surfactant deficiency is a specific pathology of premature infants which is due to surfactant deficiency in the lungs, causing alveolar collapse, poor gas exchange and respiratory distress.

Causes

- Pulmonary
- Extra pulmonary

Pulmonary Causes	Extra pulmonary Causes
- Hyaline membrane disease (surfactant deficiency)	- Sepsis
- Meconium aspiration	- Cardiac failure irrespective of cause
- Pneumonia	- Pulmonary hypertension
- Pneumothorax	- Hypothermia/ hyperthermia
- Wet lung syndrome (Transient tachypnea of the newborn (TTN))	- Hypoglycaemia
- Pulmonary haemorrhage	- Anaemia
- Hypoplastic lungs	- Polycythaemia
- Diaphragmatic hernia	- Hypovolaemic shock
	- Perinatal hypoxia

Signs of breathing problems

- The baby's respiratory rate is more than 60 breaths per minute
- The baby's respiratory rate is less than 30 breaths per minute
- The baby has central cyanosis (blue tongue and lips)
- The baby has chest in-drawing
- The baby is grunting on expiration.
- The baby has apnoea (spontaneous stopping of breathing for more than 20 seconds).

Investigations

- Chest x-ray
- Oxygen saturations measure (aim saturations at 90-95% in infants if using oxygen)
- FBC, CRP, Hemoculture if infection is suspected
- Echocardiography (to exclude cardiac causes of respiratory distress)
- Blood gas (if available)

General Management

- Establish the classification of breathing problem

Respiratory Rate (breaths per minute)	Grunting or Chest Indrawing	Classification
More than 90	Present	Severe
More than 90	Absent	Moderate
60 to 90	Present	Moderate
60 to 90	Absent	Mild

Respiratory distress syndrome results in breathing difficulty with chest in-drawing and grunting often associated with apnoea. The general progression of RDS is to worsen within the first two days, remain constant for the next few days and then improves over the next 7 days. It is most common in babies less than 37 weeks gestation and less than 2.5Kg and starts within hours of birth. If the baby fits these criteria, treat as per moderate breathing difficulty due to RDS

- Nurse in a neutral thermal environment (incubator or infant

crib with overhead heater) and aim for the baby's temperature to be between 36.5-37.4C

- Admit to neonatal high care/intensive care facility, if available but stabilize infant first
- Monitor respiratory rate, oxygen saturations, pulse rate, and Blood Pressure (if available)
- Maintain saturations of haemoglobin at 90–95%
- Monitor the concentration or flow of oxygen being provided (if any)
- Monitor for Apnoea
  - → Stimulate the baby to breathe by rubbing the baby's back for 10 seconds
  - → If the baby does not begin to breathe immediately, resuscitate the baby using a bag and mask.
  - → (See specific management of apneas in chapter 10)
- Measure blood glucose and treat if less than 2.6mmol/l (45mg/dl) – See specific treatment chapter 7
- If the baby has breathing >60/min and is cyanosed (even with oxygen), and has NO grunting or in-drawing, suspect a congenital heart abnormality
- With the classification of breathing difficulty according to the WHO table above, treat baby as follows:

Specific Management

Severe breathing difficulty

- If saturations are less than 90%, give oxygen if available to maintain saturations 90-95%
- Give CPAP if available and meets criteria (See under CPAP criteria)
- Insert a gastric tube to empty the stomach of air and secretions
- Commence IV fluids.
- Treat for sepsis
- Monitor and record the baby's respiratory rate, presence of

chest in-drawing or grunting on expiration, and episodes of apnoea every three hours until the baby no longer requires oxygen and then for an additional 24 hours

- When the baby begins to show signs of improvement: give expressed breast milk by gastric tube
- When oxygen is no longer needed, allow the baby to begin breastfeeding
- If the baby cannot be breastfed, give expressed breast milk using an alternative feeding method
- If the baby's breathing difficulty worsens or the baby has central cyanosis give oxygen at a high flow rate
- If breathing difficulty is so severe that the baby has central cyanosis even in 100% oxygen, organize transfer and urgently refer the baby to a tertiary hospital or specialized centre capable of assisted ventilation, if possible.
- Observe the baby for 24 hours after discontinuing antibiotics
- If the baby's tongue and lips have remained pink without oxygen for at least two days, the baby has no difficulty breathing and is feeding well and there are no other problems requiring hospitalization – discharge the baby

Moderate breathing difficulty

- Give oxygen if saturations <90%
- Give CPAP if available and meets criteria (see under CPAP criteria)
- Establish an IV line and give only IV fluid at maintenance volume according to the baby's age for the first 12 hours
- Monitor and record the baby's respiratory rate, presence of chest in-drawing or grunting on expiration, and episodes of apnoea every three hours until the baby no longer requires oxygen and then for an additional 24 hours
- If the baby's breathing difficulty does not improve or worsens after
- Two hours, manage for severe breathing difficulty
- Monitor the baby's response to oxygen

- When the baby begins to show signs of improvement give expressed breast milk by gastric tube
- When oxygen is no longer needed, allow the baby to begin breastfeeding.
- If the baby cannot be breastfed, give expressed breast milk using an alternative feeding method

Mild breathing difficulty

- Give expressed breast milk by gastric tube or alternative method e.g. cup feed.
- Monitor and record the baby's respiratory rate, presence of chest in-drawing or grunting on expiration, and episodes of apnoea every three hours until the baby no longer requires oxygen and then for an additional 24 hours
- Only provide oxygen if saturations are less than 90% and maintain saturations 90-95%
- Monitor the baby's response to oxygen
- When oxygen is no longer needed, allow the baby to begin breastfeeding
- If the baby cannot be breastfed, continue giving expressed breast milk using an alternative feeding method
- If the breathing difficulty worsens at any time during the observation period
- If the baby does NOT have the typical pattern of RDS, look for signs of sepsis and treat if found
- If the baby's tongue and lips have remained pink without oxygen for at least one day, the baby has no difficulty breathing and is feeding well, and there are no other problems requiring hospitalization, discharge the baby
- Feeding and fluids with breathing difficulty, refer to chapter 6 for feeding a sick term or preterm baby.

Management of other specific causes of respiratory distress

Anaemia

- Hct < 40 % and Hb <13 g/dL
  - → Give red cells, packed, IV, 10mL/kg over 1–2 hours

Polycythaemia

- Treat with isovolaemic dilutional exchange transfusion using sodium chloride 0.9% if the venous haematocrit is Hct > 65%: Hb >22 g/dL and the baby is symptomatic.
  - → Formula taking
  - → Desired Hct = 50:
  - → Volume to be exchanged (mL) = [Baby's Hct – desired Hct (i.e. 50) x body mass (kg)] x 90 ÷ Baby's Hct

Respiratory Distress Syndrome (Hyaline membrane disease / Surfactant deficiency)

- Refer to specific management of breathing difficulty according to classification
- Ensure baby is maintained at correct temperature(36.5-37.4C)
- If baby stable, obtain CXR and look for
  - → Air bronchiograms
  - → Hyper expanded chest
  - → Ground glass appearance of lung fields
- Treat baby for presumed sepsis with *Ampicillin* and *Gentamicin* (See chapter on sepsis management)
- Co-manage other problems associated with prematurity
- Baby may likely require CPAP see the following
- If Infection
  - → Bronchopneumonia, is present or suspected, give antibiotics based on antibiogram and/or blood culture results

Breathing difficulty due to congenital heart abnormality:

- The diagnosis of a heart abnormality is made by exclusion of other diagnoses or by echo when baby is stable (if expert and machine is available)
    - → Give oxygen at a high flow rate. In cyanotic heart disease, there will be no response to maximum oxygen
    - → Give expressed breast milk by gastric tube
    - → If the baby cannot tolerate feeding, establish an IV line and give IV fluid at maintenance volume according to the baby's age
    - → Organize transfer and refer the baby to a tertiary hospital or specialized centre for further evaluation, if possible

9.2. APNEA AND BRADYCARDIA FOR LBW (<1500 KG) OR PREMATURE INFANTS (<33 WEEKS GESTATION)

Definitions

- Apnea: Pause in breathing for > 20 seconds
- Bradycardia: Abnormally slow HR; <100 beats/minute in the preterm infant

Causes by type

- Central apnoea
    - Prematurity
    - Intraventricular haemorrhage
    - Hypoxia
    - Patent ductus arteriosus
    - Sepsis
    - Hypoglycaemia
    - Acidosis
    - Hypermagnesaemia

- Meningitis
- Sedatives
- Temperature disturbances
- Atypical convulsions
- Rough handling

- Obstructive apnoea
  - Choanal atresia
  - Gastro-oesophageal reflux
  - Micrognathia
  - Macro glossia
  - Secretions (milk, meconium, blood, mucus) lodged in the upper airway
- Reflex apnoea or vagally mediated apnoea
  - Endotracheal intubation
  - Passage of a nasogastric tube
  - Gastro-oesophageal reflux
  - Overfeeding
  - Suction of the pharynx or stomach
- Mixed apnoea
  - Apnoea caused by a combination of the above causes

Management

Non-pharmaceutical

- **Small baby**

  Small babies are prone to episodes of apnoea, which are more frequent in very small babies (less than 1.5 kg at birth or born before 32 weeks gestation) but they become less frequent as the baby grows.

  → Teach the mother to observe the baby closely for further episodes of apnoea. If the baby stops breathing, have the mother stimulate the baby to breathe by rubbing the baby's back for 10 seconds. If the baby does not begin to

breathe immediately, resuscitate the baby using a bag and mask

- → Review the general principles of feeding and fluid management of small babies
- → Encourage the use of Kangaroo Mother Care if possible. Babies cared for in this way have fewer apnoeic episodes, and the mother is able to observe the baby closely.
- → If the apnoeic episodes become more frequent, treat for sepsis

- **Term baby**
  - → If a term baby has had only a single episode of apnoea:
    - Observe the baby closely for further episodes of apnoea for 24 hours,
    - Teach the mother how to do so.
    - If the baby does not have another apnoeic episode in 24 hours, is feeding well, and has no other problems requiring hospitalization,
    - discharge the baby
  - → - If apnoea recurs,
    - Manage for multiple episodes of apnoea, below.
  - → If a term baby has had multiple episodes of apnoea
    - Treat for sepsis
- **For all forms of neonatal apnoea**
  - → Identify and treat the underlying cause
  - → Maintain the temperature at 36.5–37.5°C
  - → Maintain oxygen Saturation at 90–95%
  - → Maintain haematocrit at 40%
  - → A baby with apnoeas may benefit from stimulation with Nasal CPAP. See criteria under CPAP

Pharmaceutical

- Start respiratory stimulant (*Caffeine or Aminophylline*) when birth weight <1.5 kg or GA <33 weeks

  → *Caffeine*

  - Loading dose: 20 mg/kg NG/PO on day 1 then,
  - Maintenance dose 10 mg/kg/day NG/PO

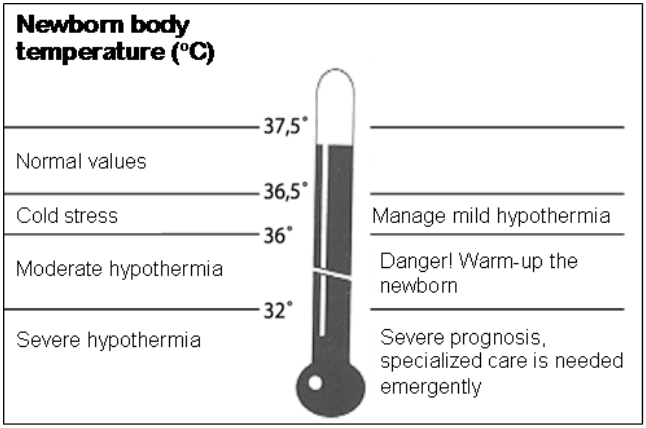
  OR

  → *Aminophylline*

  - Loading dose: 10mg/kg IV x1 on day 1 then
  - Maintenance dose
    - ≤ 7 days of age: 2.5 mg/kg/dose IV or NG/PO every 12 hours
    - 7 days of age: 4 mg/kg/dose IV or NG/PO every 12 hours

9.3. HYPOTHERMIA

Definition: Temperature less than 36.5°



Risk factors

- Low Birth Weight and/or premature newborns
- Septic newborns
- Newborn with asphyxia at birth
- All newborns who do not receive heat loss prevention measures

Signs and symptoms

- Lethargy and refusal to breastfeed
- Dyspnea and apnea
- Cyanosis and pallor
- Shock and sclerema
- Hemorrhage and hypoglycemia

Complications

- Increase in oxygen consumption
- Increase in glucose utilization and decrease of glycogen reserves
- Increase in brown fat metabolism
- Increase in metabolism leads to growth impairment, lethargy, hypotonia and feeding difficulties
- Decrease of surfactant production which can lead to respiratory distress
- Difficulties with extra-uterine adaptation because of hypoxia
- Thermal shock which can lead to death

Management

- Immediately after birth or arrival to hospital:
  - Dry infant and keep under warming light
  - Obtain temperature within first hour of life
  - Normal temperature range 36.5-37.5°C

9.4. NEONATAL JAUNDICE

Definition: Yellow staining of the skin and mucous membranes due to hyperbilirubinaemia.

Types of jaundice

- Physiological jaundice
  - Does not appear before 24hours after birth
  - Rarely lasts more than 10 days in the full term infant and 14 days in the pre-term infant
  - Only the unconjugated bilirubin fraction is increased
  - Total peak serum bilirubin concentration is usually below 275 micromol/L in the term infant
  - Total bilirubin concentration does not rise by more than 85 micromol/L/24 hours
  - The baby thrives and shows no signs of illness or anaemia treatment is unnecessary
- Pathological jaundice
  - Appears within the first 24 hours of birth but may also appear at any other time after birth
  - Persists for longer than 10 days in the full term infant or 14 days in the pre-term infant
  - The unconjugated and/or conjugated fractions of bilirubin are increased
  - The conjugated bilirubin level exceeds 10% of the total bilirubin value, or the conjugated bilirubin fraction is 30 micromol/L or more
  - Total bilirubin concentration rises by more than 85 micromol/L/24 hours
  - The total serum bilirubin level is above physiological level
  - There are signs and symptoms of illness in the baby
  - Stool is pale in conjugated hyperbilirubinaemia (obstructive jaundice)

Signs and symptoms

- Yellow color in the eyes and on skin on physical examination
- Changes in muscle tone, seizures, or altered cry characteristics
- Hepatosplenomegaly
- Petechiae
- Hemolytic anemia
- Signs of Sepsis

Investigations

- Measurement of Bilirubin level
- Blood type and Rh determination in mother and infant
- Direct antiglobulin test (DAT) in the infant (direct Coombs test)
- Hemoglobin and hematocrit values
- Ultrasonography

Causes of Unconjugated hyperbilirubinaemia

Excessive haemolysis	Defective conjugation
- ABO incompatibility - Rhesus disease - Enclosed haemorrhages - Polycythaemia - Infections - Spherocytosis - G6PD deficiency	- Prematurity - Infection - Hypoxia - Hypoglycaemia - Hypothyroidism - Breast milk jaundice

Management

Non-pharmaceutical

- Treat the underlying cause
- Monitor the infant's body temperature
- Maintain adequate nutrition and hydration

- Correct factors known to increase the risk of brain damage in babies with jaundice. Examples:
  - → Hypoxia
  - → Prematurity
  - → Hypoglycaemia
  - → Hypothermia
  - → Acidosis
  - → Hypoalbuminaemia and haemolysis

Guideline for Initiating Phototherapy

Body mass	**Unconjugated bilirubin (micromol/L)**
1 000 g or less	85–100
> 1 000–1 500 g	> 100–150
> 1 500–2 000 g	> 150–200
> 2 000–2 500 g	> 200–250
> 2 500–3 000 g	> 250–275
> 3 000 g with jaundice caused by haemolysis or an identifiable serious disease process, e.g. sepsis)	> 275
> 3 000g without any identifiable cause for jaundice	300
After exchange transfusion irrespective of body mass and unconjugated bilirubin level	

- Determine phototherapy when the unconjugated bilirubin level is lower than the recommended phototherapy initiating level, and the cause of jaundice has been determined and adequately addressed. The skin color of the baby receiving phototherapy doe not reflect the degree of jaundice (bilirubin blood level) or the efficacy of the phototherapy
- Undress the baby and cover the eyes with gauze pad

- Position the phototherapy unit (fluorescent light bulbs of 400-500nm wavelength) not higher than 45 cm above the baby, a rebound increase in bilirubin may follow termination of phototherapy
- Monitor bilirubin levels ± 6 hours after phototherapy has been stopped
- Exchange transfusion is indicated when the risk of bilirubin encephalopathy and kernicterus is significant

Diagnosis

At birth	History of Rh incompatibility Cord unconjugated bilirubin level > 85 micromol/L Cord haemoglobin level 10 g/dL or lower	
Within 24 hours	A rise in the serum unconjugated biliruin level exceeding 20 micromol/L/hour despite phototherapy	
After 24 hours	**Body mass**	**Unconjugated bilirubin** (micromol/L)
	1 000 g or less	200
	>1 000–1 500 g	250
	>1 500–2 500 g	300
	>2 500–3 000 g	340
	> 3 000 g with jaundice caused by haemolysis or an identifiable serious disease process, e.g. sepsis	340
	> 3 000 g without any identifiable cause of jaundice	425

Management

Pharmaceutical

As soon as the diagnosis is confirmed

- Give Gammaglobulin, IV, 500 mg/kg over 1 hour, for ABO incompatibility, repeat once after 6–8 hours
- Mothers of babies with Rh incompatibility as soon as possible after birth but within 72 hours of birth
- Give anti D immunoglobulin, IM, 100 mcg

9.5. CONJUGATED HYPERBILIRUBINAEMIA

Causes

- Hepatocellular disease bile duct obstruction
- Hepatitis
- Total parenteral nutrition
- Syphilis
- Other congenital infections
- Galactosaemia
- Bile duct hypoplasia/atresia
- Choledochal cyst
- Cystic fibrosis

Signs and symptoms

- Cholestasis in the second week of life or later
- The baby has a green yellow skin discoloration, dark bile stained urine and pale acholic stool
- Hepatomegaly is commonly present
- Infant often fails to thrive
- Neonatal hepatitis
- Prolonged total parenteral nutrition and biliary atresia or hypoplasia

Management

Non -pharmaceutical

- Treat the underlying cause
- Dietary modifications to counteract the malabsorption of fat and fat soluble vitamins (A,D,K) that may occur in patients with a prolonged conjugated hyperbilirubinaemia
- Avoid lactose containing feeds, i.e. breast milk and lactose containing formula, when galactosaemia is suspected

Pharmaceutical

- Fat soluble *Vitamins A, D, E* and *K*

Surgical

- Conditions amenable to surgery e.g. biliary artresia
- Hepatoporto-enterostomy for biliary atresia done before 60 days of age for optimal outcome

9.6. PROLONGED NEONATAL JAUNDICE

Definition: Jaundice for more than 10 days in a term infant and 14 days in a preterm infant (Static or rising bilirubin).

Causes

- Breast milk jaundice
- Hypothyroidism
- Hepatitis
- Galactosaemia, and
- Infections, e.g. UTI's

Note:

- Breast milk jaundice may be confirmed by substituting breast feeding with formula feeds for 24–8 hours
- The bilirubin level will always drop to a lower level and increase again when breastfeeding is resumed
- Breast milk jaundice is an unconjugated hyperbilirubinaemia and the infant is always well and thriving

Investigations

- Hepatitis may be confirmed by abnormal liver function tests, i.e. raised values of:
  - AST
  - ALT
  - Alkaline phosphatase
  - Bilirubin, mainly the conjugated fraction
  - ɣ-GT

Management

Non - pharmaceutical

- Monitor bilirubin levels
- Treat the underlying cause

- Dietary adjustment for prolonged conjugated hyperbilirubinaemia to neutralize the malabsorption of fat and fat soluble vitamins (A,D, K)
- Avoid lactose containing feeds, i.e. breast milk and lactose containing formulae, when galactosaemia is suspected
- Regular follow up until the underlying condition has been resolved

Pharmaceutical

- Fat soluble vitamins, A, D and K

Recommendations

A patient with the following presentation should be referred for specialist management

- Pathological jaundice, unconjugated and/or conjugated, where the underlying cause cannot be identified
- Serum unconjugated bilirubin at exchange transfusion level
- Jaundice, unconjugated and/or conjugated, not improving on adequate treatment
- Conjugated hyperbilirubinaemia due to conditions requiring surgical intervention e.g. biliary atresia
- Prolonged neonatal jaundice, excluding breast milk jaundice

9.7. PATENT DUCTUS ARTERIOSIS (PDA) IN A NEWBORN

Definition: This is the persistence of the normal fetal vessel that joins the pulmonary artery to the aorta extra-uterine

Causes

- Congenital
- Prematurity
- Pulmonary hypertension
- Hypoxia
- Sepsis
- Fluid overload
- Lung disease
- Anaemia
- Congenital cardiac abnormalities

Signs and symptoms

- Depend on size of PDA
- Systolic or continuous murmur at left sub clavicular area
- Hyperactive precordium with easily palpable bounding peripheral pulses

Complications

- Cardiac failure
- Systemic hypotension
- Pulmonary haemorrhage

Investigations

- Echocardiography

Management

Non pharmaceutical

- Identify and treat underlying risk factors
- Restrict fluid intake to 80–120 mL/kg/24 hours
- Maintain haematocrit at ≥ 40% and Hb ≥ 13 g/dL
- Monitor cardiac function, renal function and urinary output
- Provide adequate nutrition
- Nurse in neutral thermal environment

Pharmaceutical

If cardiac failure, give diuretics

- *Furosemide*, IV/oral, 1 mg/kg/24 hours + Short term digoxin, IV/oral, 0.005 mg/kg/dose every 12 hours
- Closure of PDA in preterm infant less than 14 days of age with oral ibuprofen
  - → First dose: 10 mg/kg followed by 2 additional doses after 24 hours
  - → Additional doses: 5 mg/kg each 12–24 hours apart

Note: ***Contraindications to ibuprofen therapy include thrombocytopenia (<50 000/mm3), bleeding disorders, impaired renal function, and jaundice approaching exchange transfusion levels***

Surgical

- If medicine treatment is contraindicated or failed

Recommendations

- Refer patients to specialist if
  - Complications, e.g. cardiac failure, pulmonary hemorrhage
  - PDA which remained patent despite adequate treatment
  - Term babies with symptomatic or persistent PDA

9.8. NECROTIZING ENTEROCOLITIS

Definition: It is a syndrome characterized by abdominal distension, bilious aspirates, bloody stool and intramural air (pneumatosis intestinalis) on abdominal x-ray. There is inflammation of the bowel wall, which may progress to necrosis and perforation. It may involve a localized section of bowel (most often the terminal ileum) or be generalized.

Risk factors

Pathogenesis is unknown, but several risk factors have been identified.

- Prematurity: The main risk factor
- Feeding
- Rapid increase in enteral feeds
- Formula feeds >breast milk
- Hypertonic formula
- Infection
- Hypoxia–ischemia to the bowel

Signs and symptomes

Onset is at 1–2 weeks but may be up to several weeks of age, with:

- Bilious aspirates/vomiting
- Feeding intolerance
- Bloody stool
- Abdominal distension and tenderness, which may progress to perforation
- Features of sepsis
- Temperature instability
    - Jaundice
    - Apnea and bradycardia
    - Lethargy
    - Hypoperfusion, shock

Diagnosis

- Lab
  - Raised acute-phase reactant (C-reactive protein, CRP or procalcitonin)
  - Thrombocytopenia
  - Neutropenia, neutrophilia
  - Anemia
  - Blood culture positive
  - Coagulation abnormalities
  - Metabolic acidosis
  - Hypoxia, hypercapnia
  - Hyponatremia, hyperkalemia
  - Increased BUN (blood urea)
  - Hyperbilirubinemia
- Radiologic abnormalities
  - Dilated loops of bowel
  - Thickened intestinal wall
  - Inspissated stool (mottled appearance)
  - Intramural air (pneumatosis intestinalis)
  - Air in portal venous system
  - Bowel periforation:
    - → Gasless abdomen/ascites
    - → Pneumoperitoneum
    - → Air below diaphragm/around the falciform ligament

Complications

- Peritoxnitis/perforation
  - Abdominal tenderness
  - Guarding

- Tense, discolored abdominal wall
- Abdominal wall edema
- Absent bowel sounds
- Abdominal mass

Management

Non Pharmaceutical

Management of Necrotizing Enterocolitis

- Treatment
  - Secure airway and breathing
    - → Maintain adequate oxygenation and ventilation
    - → Abdominal distension may compromise breathing
  - NPO (nil by mouth)
  - Place large-bore naso/orogastric tube
    - → Intestinal decompression, bowel rest
- Circulation
  - Establish vascular access
    - → Infusion of fluids
  - Give intravascular volume replacement (saline, blood, fresh frozen plasma)
    - → Treat hypoperfusion / hypovolemic shock
  - correct metabolic acidosis
    - → Improve organ and tissue perfusion
  - Treat coagulopathy (fresh frozen plasma, platelets, cryoprecipitate)
    - → Avoid bleeding complications
  - Avoid bleeding complications radiographic and laboratory investigations
    - → Necrotizing enterocolitis can worsen very quickly

Pharmaceutical

- Broad-spectrum antibiotics
  - → Gram-positive, negative and anaerobic coverage (Metronidazole)

Surgical

- Indication: Bowel perforation or failure to resolve on medical treatment
- Option: Laparotomy – resection of non-viable bowel and anastomosis or ileostomy or anastomosis or ileostomy or colostomy

9.9. ANEMIA IN A NEWBORN

Definition: Infants are born with a physiologic polycythemia due to relative hypoxia in utero. Normal haemoglobin of the newborn is between 15 –18, and normal hematocrit is 45 – 55 for neonate (conversion: haemoglobin x3= hematocrit)

Causes

- Anaemia and Jaundice
  - Hemolysis
    - → Immune (Rhesus or ABO incompatibility or other red cell antibodies)
    - → Enzyme (G6PD deficiency, pyruvate kinase deficiency)
    - → Red blood cell membrane defects (spherocytosis)
    - → Acquired (infection, disseminated intravascular coagulopathy)
- Anemia without jaundice
  - Blood loss
    - → Fetal (Fetomaternal, twin-twin transfusion)

- → Obstetrical (placental abruption, placenta praevia, cord accidents)
- → Neonatal (cephalohematoma, subgaleal hemorrhage, intracranial hemorrhage, bleeding into abdominal organs)
- → Iatrogenic (Blood sampling, accidental loss from an arterial line)

- Diminished red blood cell production
  - → Infection: Diamond Blackfan
  - → Congenital: e.g. parvovirus

Clinical features of anemia

- History
  - Blood loss with Pallor
  - Family history
    - → Anemia, jaundice (Jaundice from hemolysis), Splenomegaly from hemolytic disease.
  - Obstetric history
    - → Antepartum hemorrhage (Maternal blood type – rhesus or other red cell antibodies potential for ABO incompatibility (mother O, infant A or B)
  - Ethnic origin
    - → Hemoglobinopathies and G6PD deficiency more common in certain ethnic groups
- Examination
  - Pallor
  - Jaundice
  - Apnea and bradycardia
  - Tachycardia
  - Heart murmur – systolic, flow murmur
  - Respiratory distress
  - Heart failure

- Hepatomegaly and/or splenomegaly
- Inadequate weight gain from poor feeding

Investigations

- Laboratory testing including
  - Complete Blood Count
    - → Reticulocyte count
    - → Direct antiglobulin (DAT, Comb's test)
    - → Bilirubin level
    - → Blood smear
    - → Cranial ultrasound

Management

- Blood transfusion
  - Indications for red blood cell transfusion
    - → Significant cardio respiratory distress
  - Blood loss more rapid than ability for infant to generate red blood cells (e.g. rapid bleeding, severe hemolysis)
  - Severe anemia (hemoglobin <7) with poor reticulocytosis or impaired infant growth (e.g. average of <10 gm/day) despite adequate nutrition.

Transfusion Procedure

- Typical transfusion is 10ml/kg given over 3 to 4 hours.
- May need second transfusion (preferably from same donor) if anemia not adequately corrected.

Volume of transfusion

- To calculate volume based on observed and desired hematocrit, estimated blood volume of 80 ml/kg

Calculation: (desired hematocrit – observed hematocrit) x weight x 80 ml Hematocrit of blood to be given (typically 60-90%)

NB. ***Whole blood should be given to correct the anemia of rapid blood loss. If hematocrit is not available: give 10ml/kg and monitor***

Prevention: Infants at risk of iron deficiency should receive supplemental oral iron (2-4 mg of elemental iron/kg/day) once they are tolerating full enteral feeds. At risk infants include those who are premature and those with substantial blood loss via bleeding or phlebotomy.

10. APPENDIX

Chart **1**

Infant feeding guide: Term Baby

Term baby daily fluid/milk requirements

Age	Total daily fluid/milk volume
Day 0	60 ml/kg/day
Day 1	80 ml/kg/day
Day 2	100 ml/kg/day
Day 3	120 ml/kg/day
Day 4	140 ml/kg/day
Day 5	160 ml/kg/day
Day 6	180 ml/kg/day

Always use birth weight to calculate fluid requirements until baby weighs more than birth weight

Weigh baby 2-3 times per week

For IVF from Day 1 use 2 parts 10% dextrose to 1 part Ringers Lactate e.g.200ml 10% D + 100ml RL.
If not able to give, use 10%D with Na+2-3 mmol/kg/day and K+ 1-2mmol/kg/day
Ensure sterility of iv fluids when mixing adding

Titrate iv fluids with milk feeds to keep total volume for appropriate day of life

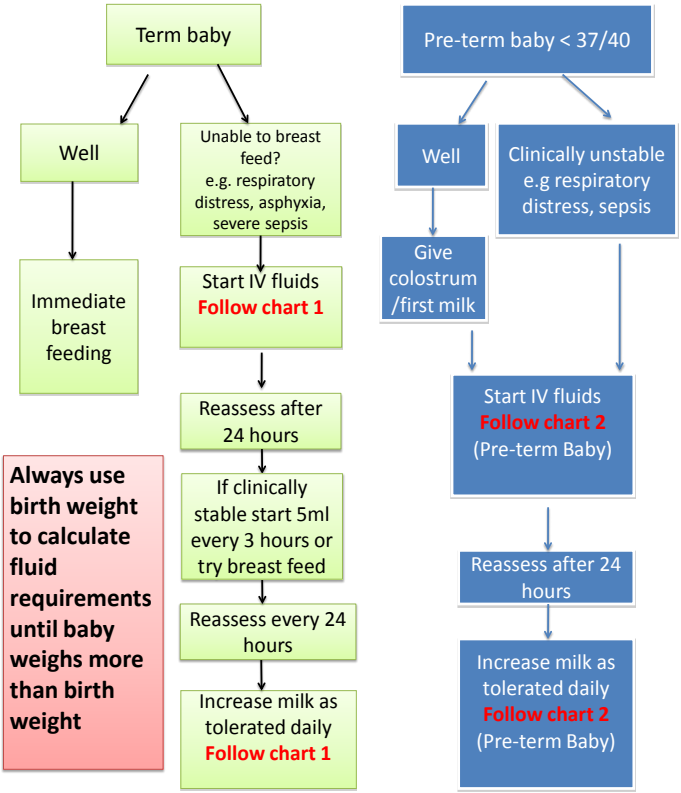
IV fluid rate (ml/hr) for Sick Term newborns who cannot be fed

Weight (kg)	2.0-2.1	2.2-2.3	2.4-2.5	2.6-2.7	2.8-2.9	3.0-3.1	3.2-3.3	3.4-3.5	3.6-3.7	3.8-3.9
Day 0	5	6	6	7	7	8	8	9	9	10
Day 1	7	8	8	9	10	10	11	12	12	13
Day 2	9	10	10	11	11	13	14	15	15	16
Day 3	11	12	13	14	14	16	17	18	19	20

If clinically stable after 24 hours of iv fluids:
Consider starting feeds at 5 mls every 3 hours or try breast feed
After 24 hours, if tolerated give 10 mls every 3 hours or try breast feed
Increase milk volume as tolerated

Birth Weight < 1.0 kg (ELBW) (Estimated as 0.9 kg for calculation)						
DOL	IV Fluid	Total Fluid: IV+PO ml/kg/day	IV		Enteral	
			ml/kg/24hrs	ml/24 hrs	ml/kg/24hrs	ml/3hrs
0	G10%	80	80	70	0	0
1	G10%	100	90	80	10	1
2	G10%	120	90	80	30	3
3	G10%	140	90	80	50	5
4	G10%	150	80	70	70	8
5	G10%	150	55	50	95	11
6	G10%	150	30	30	120	14
7	G10%	150	0	0	150	17(full)

Infant Feeding Algorithm



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