

Chapter 8B

PEDIATRIC EMERGENCIES

Learning Objective:

- To be able to identify and treat common acute emergencies.

INTRODUCTION

Dealing with a pediatric emergency is one of the most stressful calls health personnel encounter. Their anatomy and physiology differ from an adult. Early identification and treatment of respiratory failure and shock in children improve survival, from a dismal 10 percent to an encouraging 85 percent.

ANATOMICAL AND PHYSIOLOGICAL DIFFERENCES

Airway

1. Back of the head is larger in a child, so head positioning requires more care.
2. The tongue is proportionally larger and more anterior in the mouth
3. The trachea is smaller in diameter and more flexible & the epiglottis is larger.
4. The airway itself is lower and narrower.
5. Cricoid cartilage is the narrowest portion of the airway as versus the larynx in an adult.

Breathing

1. Infants (3-6 months old) are obligate nose breathers
2. Infants & children have a relatively thin chest wall
3. Children, use diaphragm as the major muscle for respiration
4. Too much volume or pressure when ventilating can cause a Pneumothorax.
5. Children with respiratory distress fatigue more rapidly than adults. Thus, supplemental oxygen is always a priority when a child experiences respiratory distress.

Circulation

1. Infants and young children have higher metabolic rate than adults.
2. An infant's high glucose needs, can rapidly lead to hypoglycemia.
3. Infants have smaller stroke volume (SV) than adults, thus increasing heart rate is the infant's primary method of increasing cardiac output ($CO = SV \times HR$).
4. Tachycardia is early sign of both shock and respiratory distress.
5. Bradycardia is a very ominous sign, Pulse <60-80 in a child.

Musculoskeletal

1. A child's bones are more flexible and elastic than those in an adult's skeleton.
2. The child's ribs are softer and more flexible; hence they may compress the underlying lungs and heart, causing life-threatening conditions without obvious external damage.
3. Children are particularly prone to head injuries because their heads are proportionally larger and heavier in comparison to the rest of their body.

RESPIRATORY EMERGENCIES

Categories of Respiratory Problems

A. Upper airway obstruction: (nose, pharynx, larynx, or subglottic space)

Symptoms are more apparent during inspiration than expiration. The child may have stridor, hoarseness of voice, or change in voice or cry, drooling, inspiratory retractions, use of accessory muscles, and nasal flaring. The respiratory rate is often only mildly elevated.

B. Lower airway obstruction: (Trachea, bronchi or bronchioles)

Symptoms are more apparent during expiration than on inspiration. The child often has wheezing and prolonged expiratory phase. The respiratory rate is usually elevated, particularly in infants.

C. Parenchymal lung disease

Retractions are common with marked hypoxemia (cyanosis). Tachypnea is common and there may be grunting.

D. Abnormal control of ventilation

There may be apnea, bradypnea or funny breathing or periods of increased effort followed by decreased effort (abnormal rhythm).

Management of Respiratory Distress

- Allow child to assume position of comfort
- Administer oxygen (100%) as tolerated
- Attach pulse oximetry and ECG monitor
- Maintain NPO, if significant distress is present
- Assist or provide ventilation
- Establish vascular access (IV/IO)
- Management for upper airway obstruction: Consider steroids and nebulized adrenaline
- Management of lower airway obstruction: Consider steroids and nebulized salbutamol

Table 8B.1 Common Causes of Respiratory Distress

Upper airway disease	Lower airway disease	Lung disease	Disordered control of breathing
<ul style="list-style-type: none"> • Croup • Foreign body • Bacterial infections • Retropharyngeal abscess • Tracheitis • Diphtheria • Epiglottitis • Angioneurotic edema 	<ul style="list-style-type: none"> • Bronchiolitis • Asthma • Foreign body 	<ul style="list-style-type: none"> • Pneumonia • Bronchiolitis • Aspiration • Pneumothorax • Left heart failure • Toxic inhalation • Pulmonary contusion 	<ul style="list-style-type: none"> • Intoxication/poisoning • Traumatic brain injury • Spinal cord injury • Chest injury • Flail chest / rib fractures
Diagnosis or underlying cause		In favor	
Pneumonia		<ul style="list-style-type: none"> —Cough with fast breathing and fever —Development over days, getting worse —Crepitations on auscultation 	
Asthma		<ul style="list-style-type: none"> —History of recurrent wheezing —Prolonged expiration —Wheezing or reduced air entry —Response to bronchodilators 	
Foreign body aspiration		<ul style="list-style-type: none"> —History of sudden choking —Sudden onset of stridor or respiratory distress —Focal reduced air entry or wheeze 	
Retropharyngeal abscess		<ul style="list-style-type: none"> —Slow development over days, getting worse —Inability to swallow —High fever 	
Croup		<ul style="list-style-type: none"> —Barking cough —Hoarse voice 	

	<ul style="list-style-type: none"> —Associated with upper respiratory tract infection —Stridor
Diphtheria	<ul style="list-style-type: none"> —Bull neck appearance of neck due to enlarged lymph nodes —Red throat —Grey pharyngeal membrane —No DTP vaccination

PNEUMONIA

Pneumonia is usually caused by viruses or bacteria.

Table 8B.2 Classification of the severity of pneumonia (IMNCI)

Sign or symptom	Classification	Treatment
<ul style="list-style-type: none"> • Central cyanosis • Severe respiratory distress (e.g. head nodding) • Not able to drink • Chest in-drawing 	Severe pneumonia	<ul style="list-style-type: none"> • Admit to hospital • Give recommended antibiotic • Give oxygen • Manage the airway • Treat high fever if present
Fast breathing <ul style="list-style-type: none"> ✓ RR >60 /min in a child aged <2 months ✓ RR >50 /min in a child aged 2–11 months ✓ RR >40 /min in a child aged 1–5 years • Definite crackles on auscultation 	Pneumonia	<ul style="list-style-type: none"> • Home care • Give appropriate antibiotic for 5 days • Soothe the throat and relieve cough with a safe remedy • Advise the mother when to return immediately (explain danger signs) • Follow up in 2-3 days
No signs of pneumonia	No pneumonia	<ul style="list-style-type: none"> • Home care • Soothe the throat and relieve cough with a safe remedy • Advise the mother when to return immediately • Follow up in 5 days if not improving

RR – Respiratory rate (count for one full minute and ensure the child is calm)

Investigation

For severe pneumonia: Chest X-ray, CBC, Blood culture, Biochemistry.

Table 8B.3 Antibiotic Therapy

Severe pneumonia	<ul style="list-style-type: none"> • Give Ampicillin (50 mg/kg IV q.i.d.) OR Benzyl penicillin (50,000IU/kg/dose q.i.d) & Gentamicin (7.5 mg/kg IV o.d.) for 5 days; • If improving complete treatment with oral amoxicillin (15 mg/kg t.i.d.) for 5 days (total of 10 days). • If IV access is difficult – Administer both the antibiotics IM • Alternatively, can give Chloramphenicol (25 mg/kg IM / IV t.i.d.) until the child has improved. Then continue orally q.i.d. for a total course of 10 days. • If the child does not improve within 48 hours, switch to ceftriaxone 40mg/kg/dose b.i.d. • If signs of staphylococcal pneumonia ** present, add cloxacillin 50mg/kg/dose q.i.d IV for 7 days, if improving switch to oral cloxacillin same dose (total duration of 21days)
Pneumonia	<ul style="list-style-type: none"> • Treat the child as an outpatient. • Give co-trimoxazole (4 mg/kg trimethoprim / 20 mg/kg sulfamethoxazole b.i.d.) for 5 days or amoxicillin (15 mg/kg t.i.d.) for 5 days. • Give the first dose at the clinic and teach the mother how to give the other doses at home.

** Staphylococcal pneumonia is suspected if:

- There is rapid progression of the disease OR,
- There is Pneumatocele, OR pneumothorax OR pleural effusion OR child has large skin boils or abscess or infected scabies OR
- Post measles pneumonia which is not responding within 48 hrs to the initial therapy.

Oxygen Therapy

- Give oxygen to all children with very severe pneumonia
- Use pulse oximetry to guide oxygen therapy
- Use nasal prongs, a nasal catheter, or a nasopharyngeal catheter.
- Use of **nasal prongs** is the best method for delivering oxygen to young infants.
- Continue giving oxygen until the signs of hypoxia (such as severe lower chest wall indrawing or breathing rate 70/minute) are no longer present.
- Discontinue oxygen if the saturation remains stable above 94%.
- Nurses should check every 3 hours that the catheter or prongs are not blocked with mucus and are in the correct place and that all connections are secure.

Supportive care

- For fever give paracetamol (10- 15mg/kg/dose), tepid sponging
- For wheeze give salbutamol nebulization every 4 hrs. or 6 hrs.
- Remove any thick secretions in the throat by gentle suction and clear nose
- IV maintenance fluids appropriate for the child's weight
- Encourage the child to eat as soon as food can be taken

ASTHMA

Very Severe asthma: history of cough, past history of recurrent wheeze, prolonged expiration and reduced air entry.

Management of Very Severe asthma:

- Oxygen to keep SpO₂ >94%
- Salbutamol nebulization 2.5mg/dose (min 0.3ml) every 20 min for 3 doses
- Consider adrenaline 0.01ml/kg SC (1:1000; max 0.3ml) S/C every 20 mins X 3 times if unable to cooperate with nebulizer, or very poor air movement.
- Start (Prednisolone 2mg/kg /day PO) or inj. hydrocortisone 10mg/kg stat then 5mg/kg 6 hourly.
- Reassess every 30 to 60 mins, if poor response: repeat initial treatment and add ipratropium bromide (mix with or alternate with salbutamol).

Ipratropium bromide dose:

<12 years- 250mcg every 20 mins 3 times, then repeat 2-4 hourly PRN.

>12 years- 500mcg every 30 mins 3 times, then repeat 2-4 hourly PRN.

Reassess after 30-60 minutes:

If no improvement: continue salbutamol 1-2 hourly, give one dose of MgSO₄: 50% MgSO₄ 25-50mg/kg/dose dilute in 50ml N/S over 30 mins "OR" Deriphylline 5mg/kg in 50ml of maintenance fluid (up to max of 300mg) in 30 mins followed by maintenance infusion of 0.9mg/kg/hr. in maintenance IVF. Good response at any stage, follow the principle of last drug in– first out.

Life threatening asthma:

Features of life-threatening asthma are:

1. Severe respiratory distress or poor respiratory effort
2. Cyanosis
3. Silent chest
4. Exhaustion
5. Altered sensorium

Treatment:

- s/c injection of adrenaline immediately
- combination of salbutamol and ipratropium nebulization followed by oxygen
- injection hydrocortisone 5-10mg/kg/dose IV stat
- Maintenance IVF and continue treatment as in severe attack of asthma.

CROUP

Croup presents with barking cough, hoarseness of voice, inspiratory stridor and respiratory distress if severe.

Treatment:

- Keep the child calm with minimal disturbance allowing mother to nurse if possible
- Humidified oxygen to keep saturation >94%.
- Nebulized adrenaline 0.5ml/kg of 1: 1000(maximum of 5 ml) diluted in 3 mL Normal saline
- Repeat every 20 min for three times and assess **AND**
- Give Dexamethasone 0.6 mg/kg IV/IM stat dose or 0.15mg/kg IV q.i.d.
- Alternative steroid is Prednisolone 1 mg/kg PO "OR" Nebulized budesonide 2 mg for all ages.
- Intubation only if hypoxic or exhausted.
- If no improvement, reconsider diagnosis- Consider upper airway foreign body, bacterial infections, tongue obstruction, anaphylaxis ± angioneurotic edema.

- Close observation for at least three hours before discharge after a single oral steroid dose/dexamethasone.
- Admit if persisting stridor at rest or if under 12 months of age.

ACUTE DIARRHEA

Acute diarrhea is one of the common problems seen in children attending OPD. Most diarrheas are usually viral in etiology and are self-limited, although some can present with dysentery.

Assessing dehydration

In all children with diarrhea, decide if dehydration is present. Hydration status should be classified as severe dehydration, some dehydration or no dehydration.

Table 8B.4 Classification of the Severity of Dehydration in Children with Diarrhea

Classification	Signs or symptoms	Treatment
No dehydration	Not enough signs to classify as some or severe dehydration	Give fluid and food to treat diarrhea at home Advise mother on when to return immediately Follow up in 5 days if not improving
Some dehydration	Two or more of the following signs: restlessness, irritability sunken eyes drinks eagerly, thirsty skin pinch goes back slowly	Give ORS After rehydration, advise mother on home treatment and when to return immediately Follow up in 5 days if not improving
Severe dehydration	Two or more of the following signs: lethargy/unconsciousness sunken eyes unable to drink or drinks poorly skin pinch goes back very slowly (2 sec or more)	Give IV fluids (Plan C)

Investigation:

- Stool for RE & culture, CBC, PBS, Biochemistry

SEVERE DEHYDRATION

Children with severe dehydration require rapid IV rehydration with close monitoring, which is followed by oral rehydration once the child starts to improve sufficiently.

Treatment

- Give 100% oxygen to keep saturation > 94%
- Children with severe dehydration should be given rapid IV rehydration followed by oral rehydration therapy.
- Start IV fluids immediately. While the drip is being set up, give ORS solution if the child can drink.

The best IV fluid solution is Ringer's lactate Solution. If RL is not available, normal saline can be used. 5% dextrose solution is **not** effective and should not be used.

Administration of IV fluid to a Severely Dehydrated Child

Repeat again if the radial pulse is still very weak or not detectable.

- Reassess the child every 15–30 minutes. If hydration status is not improving, give the IV drip more rapidly.
- Give ORS (about 5 ml/kg/hour) as soon as the child can drink: usually after 3–4 hours (infants) or 1–2 hours (children).
- Reassess an infant after 6 hours and a child after 3 hours.
- Classify dehydration. Then choose the appropriate plan (A, B, or C) to continue treatment.

Difficult IV cannulation or not sure of IO, insert nasogastric tube.

- Start rehydration by tube (or mouth) with ORS solution: Give 20 ml/kg/hour for 6 hours (total of 120 ml/kg).
- Reassess the child every 1–2 hours.
- If there is repeated vomiting or increasing abdominal distension, give the fluid more slowly.
- If hydration status is not improving after 3 hours, refer to higher center.
- After 6 hours, reassess the child. Classify dehydration. Then choose the appropriate plan (A, B, or C) to continue treatment.

Give Zinc supplements

- 2 to 6 months 1/2 tablet (10 mg) per day for 10–14 days.
- 6 months and more 1 tablet (20 mg) per day for 10–14 days.

Feeding: Encourage breast feeding, home available fluids and ORS. Give extra fluids.

Table 8B.5 Plan C: Give 100 ml/kg of the chosen solution

IV fluid (RL/NS)	First, give 30 ml/kg in:	Then, give 70 ml/kg in:
<12 months old	1 hour *	5 hours
>12 months old	30 minutes*	2 1/2 hours

CENTRAL NERVOUS SYSTEM EMERGENCIES**BACTERIAL MENINGITIS**

Acute inflammation of the meninges caused by bacteria-Positive CSF culture for a bacterial pathogen OR CSF WBC > 9 cells/mm³ in association with either a positive blood culture or a CSF latex agglutination study.

Clinical presentation

Infant presentation- Poor feeding, Lethargy, irritability, High-pitched cry, Vomiting, hypotonic, Jaundice, Seizure, Hypothermia, Coma, neck stiffness, bulging fontanelle, Shock.

Child presentation- Fever (90 to 95%), Anorexia or poor feeding, Myalgia, arthralgia, Headache, Vomiting, Opisthotonos, Seizure, Photophobia, Lethargy, Meningismus.

Causes: The usual organisms causing bacterial meningitis in children >2 months of age are, Streptococcus pneumoniae, Neisseria meningitides, Hemophilus influenzae type b (Hib uncommon after age 6), Tuberculosis.

Organisms to consider in infants <2 months of age are Group B streptococcus, E. coli and other Gram-negative organisms, Listeria monocytogenes, S. pneumoniae, N. meningitides, Hemophilus influenzae type b.

Investigation

- CBC, PBS, Blood culture, Biochemistry, Petechial culture.
- CSF by Lumbar Puncture for – Gram stain, AFB stain (only if TB suspected), Cells- (total cell count, differential cell), Culture, Biochemistry (sugar, protein, LDH).
- CT scan of the head- Obtain if focal neurologic signs or clinical signs of increased ICP.

If it is clinically indicated, children who have a 'normal' CSF should still be treated with IV antibiotics pending cultures.

Treatment: Even if LP cannot be done due to raised ICP or non-availability of facility, treatment must be started immediately.

Duration of Antibiotic Treatment

Neisseria meningitidis 5 to 7 days, *Hemophilus influenzae* 7 to 10 days, *Streptococcus pneumoniae* 10 to 14 days, *Enterobacteriaceae* 21 days, and Gram-negative enteric meningitis 21 days.

AGE GROUP	ANTIBIOTICS
Infants and children >2 months of age	<ul style="list-style-type: none"> • Ceftriaxone 100 mg/kg initial dose then 50 mg/kg/dose b.i.d. • OR Cefotaxime 50 mg/kg/dose q.i.d. • Ampicillin and chloramphenicol in patients allergic to 3rd generation cephalosporins. • Add vancomycin if pneumococcus suspected. • Dexamethasone 0.15 mg/kg IV q.i.d.

Supportive Care

- Give Oxygen to keep saturation >94%.
- Reduce fever with paracetamol.
- IV fluids as per weight.
- Manage seizure with diazepam, phenobarbitone, phenytoin.
- Treat hypoglycemia.
- Manage increase intracranial tension with.
- Raise head end of bed 30°
- Mannitol 5ml/kg IV as loading dose and 3ml/kg IV t.i.d. (fast) for 3 days.
- Consider hyperventilation if advance airway in place.

SEIZURE:

Management

- Place IV line and check blood glucose.
- Draw blood for investigations like blood sugar, urea, electrolytes, liver enzymes, toxicology etc.
- Give 5ml/kg of 10% dextrose IV for hypoglycemia.
- Nasogastric decompression of stomach to prevent aspiration of vomitus.

Step I: Short acting anticonvulsants (One of the benzodiazepines)

- Diazepam: (0.2 - 0.3 mg)/kg IV slow.
- IM route is not effective for acute control of seizure.
- Rectal diazepam (0.5mg/kg) may be given if IV line is not established quickly.
- The other options are: Lorazepam (0.1mg/kg) IV, midazolam (0.1mg/kg) IV.
- Proceed to step II if seizures are not controlled with benzodiazepines.

Step II: Long acting anticonvulsant

Phenytoin: If the seizure is not controlled, use phenytoin 15-20 mg/kg as slow IV infusion at the rate of 1 mg/kg/min diluted with normal saline. Adverse effects are hypotension and arrhythmias. Monitor heart rate and if bradycardia, decrease infusion or stop.

Step III: Add another long acting anticonvulsant

Phenobarbitone: 20 mg/kg IV at the rate of 1mg/kg/min. adverse effect is respiratory depression especially if benzodiazepine is already given.

Step IV: If status is still refractory the child needs to be shifted to a higher center.

FEBRILE SEIZURES

A seizure associated with fever in a child age 6 months - 5 years without evidence of other cause (no evidence of trauma, CNS infection or metabolic cause, and no history of epilepsy).

Investigation

- CBC, Biochemistry, culture
- Consider Lumbar Puncture,
 - If 6-12 months.
 - If pretreated with antibiotics consider LP as antibiotics can mask the symptoms.

Treatment:

- Basic life support
- Give oxygen 100%
- Give IV Diazepam 0.2- 0.3mg/kg slow
- Give Diazepam per rectally if IV is difficult

If high fever:

- Sponge the child with room-temperature water to reduce the fever.
- Do not give oral medication until the convulsion has been controlled. There after use Paracetamol.
- Treat hypoglycemia.
- No long-term treatment (antiepileptic drug) is indicated in vast majority of cases.
- Prophylaxis at the time of a febrile illness may be used especially if the parents are very anxious.
- Use Diazepam 0.33mg/kg/dose PO or 0.5mg/kg /dose PR 8 hourly until the child is without fever for 24 hours or for 3 days, whichever is less.

How to give Diazepam Per Rectally (PR)?

- Draw up the dose from an ampoule of diazepam (0.5mg/kg) into a (2.5ml) syringe.
- Place the child in lateral position on the bed
- Insert an infant feeding tube into the rectum about 4 to 5 cm.
- Inject the required diazepam into the rectum and push air in.
- Hold buttocks together for a few minutes.
- If convulsion continues after 10 minutes, give a second dose of Diazepam rectally (or give diazepam intravenously (0.3 mg/kg) if IV access is established.
- If convulsion continues after another 10 minutes, give a third dose of Diazepam or consider using Phenytoin IV or Phenobarbitone IV.

SHOCK

It is a clinical condition in which tissue perfusion is inadequate to meet metabolic demands. In any form of shock, cardiac output and organ perfusion are inadequate in relative to metabolic needs. It is classified as compensated, uncompensated and irreversible shock.

Compensated Shock:

Cardiac output (HR x SV) and systemic vascular resistance keep Blood pressure (BP) within normal limits. In compensated shock, BP remains normal; it is low in decompensated shock.

Signs:

- Tachycardia
- Cool extremities
- Prolonged capillary refill (despite warm ambient temperature)
- Weak peripheral pulses compared with central pulses
- Normal blood pressure

Hypotensive (uncompensated) Shock:

Signs: As compensatory mechanisms fail, signs of inadequate end-organ perfusion develop. In addition to the above, these signs include

- Depressed mental status
- Decreased urine output
- Metabolic acidosis
- Tachypnea
- Weak central pulses
- Hypotension

Irreversible Shock:

Irreversible organ damage, death occurs.

Hypotension in Children: if Systolic blood pressure less than:

- <70 mm Hg in infants (1 month to 12 months).
- <70 mm Hg + (2 x age in years) in children 1 to 10 years.
- <90 mm Hg in children \geq 10 years of age.

Table 8B.6 General Management Algorithm

Continually	First 5-15 mins.	First 15-30 mins.
<ul style="list-style-type: none"> • Monitor ABCDs. • Monitor physiologic goals (BP, skin, perfusion, pulse, mental status, UOP) pre and post interventions. • Consider advanced airway. 	<ul style="list-style-type: none"> • Identify life-threatening conditions. • Establish IV access. • 20 ml/kg crystalloid over 5-10 min (5-10 ml/kg if, cardiogenic shock over 10-20 mins and 10-20ml/kg over 1-2 hrs. if DKA). • Give IM epinephrine (0.1 mg/kg of 1:10,000 solution IM) if suspect. 	<ul style="list-style-type: none"> • Identify, start to correct abnormal glucose. • Electrolytes. • Give antibiotics in suspected septic shock (broad coverage). • Give inotropes if cardiogenic shock. • Continue 20 ml/kg boluses up to 60 ml/kg if required.

❖ Initial management of shock: Goal to normalize BP, perfusion.

Septic Shock:

- Give Oxygen 100%.
- IV fluid NS/ RL 20ml/kg bolus x 3 as fast as needed.
- Continue IV maintenance fluid.
- Classify: cold shock and warm shock.
- Cold shock- in cold shock there will be cold extremities, delayed capillary refill, and/or low BP: give epinephrine infusion (use dopamine infusion if epinephrine is not available).
- Warm shock- in warm shock there will be warm extremities, “flash” capillary refill, and/or low BP (typically diastolic): give nor-epinephrine infusion (use higher dose of dopamine if nor-epinephrine not available).
- Obtain blood and urine cultures but do not delay treatment
Age specific antibiotics IV or IO: ceftriaxone 75 mg/kg stat.

Cardiogenic Shock:

Refer BLS, PALS in **Chapter 3C**

- Ask for history of congenital heart disease.
- Look for chest scars or other signs of cardiac surgery.
- Assess for cardiac rhythm- Obtain ECG and look for dysrhythmia.
- Assess for cardiac failure.
- ✓ Carefully assess breath sounds.
- ✓ Palpate for hepatomegaly.
- ✓ Check cardiomegaly with rapid CXR.
- Consider immediate echocardiogram.
- Give isotonic fluid infusion 5-10 mL/kg slowly in 10-20 minutes.
- Assess frequently for pulmonary edema.
- Start dobutamine infusion at 2.5 to 20 mcg/kg/min.

Anaphylactic shock:

Give 100% oxygen.

Give Adrenaline.

1. Intravenous or Intraosseous route preferred
 - ✓ Give 0.01 mg/kg = 0.1 mL/kg of 1:10,000 solution
 - ✓ Give SLOWLY every 3 to 5 minutes as needed
 - ✓ For IV or IO be sure to use the 1:10,000 solution

OR

2. Subcutaneous or IM route if unable to give IO/IV
 - ✓ Give 0.01 mg/kg = 0.01 mL/kg of 1:1,000 solution
 - ✓ May repeat every 20 minutes as needed
 - ✓ Be sure to use the 1:1,000 solution
3. IV fluid boluses 20ml/kg x 3 as fast as needed
 - Hydrocortisone IV/ IO 1 - 2 mg/kg/dose IV Bolus
 - Ranitidine IV or IO 1.0 mg/kg
 - Salbutamol nebulizer if wheezing
 - Promethazine IV 0.5 – 1 mg/kg

Hypovolemic Shock:

The most common cause of shock is hypovolemia.

Cause: Gastrointestinal fluid losses- Dehydration (Acute gastroenteritis), Hemorrhage from injury-Multiple trauma, abdominal trauma, Chest trauma and Burns, Mixed causes- Sepsis.

Investigation: CBC, Biochemistry, U/A, Type and crossmatch blood, CXR PA, Abdominal CT for selected cases, Bedside ultrasound

Non-hemorrhagic hypovolemic shock:

Due to GI loss (vomiting, diarrhea), DI (urinary loss) and capillary leak (burns).

Hemorrhagic shock:

- Rapidly infuse 20ml/kg boluses of R/L or N/S. Failure of improve after 3 boluses indicate that
- Extent of fluid loss may be more.
- Type of fluid replacement need to be changed (e.g. Need of colloid or blood)
- There are ongoing fluid losses. (e.g. Occult bleeding).

Hemorrhagic-Hypovolemic shock:

- Give up to 3 boluses of 20ml/kg of crystalloids.
- Indications for blood transfusion are:
 - crystalloid-refractory hypotension or poor perfusion.
 - Known significant blood loss.

HYPOGLYCEMIA

Hypoglycemia is defined as blood glucose less than:

- ✓ Blood glucose < 60 mg/dL in child
- ✓ Blood glucose < 45 mg/dL in neonate

Draw blood and send for other investigation

If Low Glucose:

- If alert and awake feed orally or breast feed frequently in new born.
- If symptomatic and unconscious:
 - Give 5-10 mL/kg of 10% Dextrose OR D25W 2-4 mL/kg
 - Be careful with concentrated dextrose solution in infants and children
 - Repeat blood sugar after 30 mins and repeat the above dose if still low
 - Consider continuous infusion of 10% Dextrose
 - Feed the child as soon as conscious.
 - If not able to feed without danger of aspiration, give IV containing 5–10% glucose (dextrose), or milk or sugar solution via nasogastric tube. To make sugar solution, dissolve 4 level teaspoons of sugar (20 grams) in a 200-ml cup of clean water.

Identify and Treat Cause

- Sepsis
- Poisoning & toxic exposures
- Hypothermia
- Insulin overdose
- Oral hypoglycemic drug overdose

MAINTENANCE FLUID IN PEDIATRICS

Well children with normal hydration but no oral intake requires an amount of fluid that is often termed "maintenance".

Maintenance fluid rate can be estimated using the “4- 2-1” formula.

Calculated Using the "4-2-1" Rule:

For 0-10kg: 4 mL/kg/hr.

For 10-20kg: + 2 mL/kg/hr.

For >20kg: + 1 mL/kg/hr.

❖ For infant weighing less than 10kg: Infuse crystalloid (N/2 in 5% dextrose) @ 4ml/kg per hour.

E.g., the maintenance rate of an 8kg infant is **4ml/kg/hour x 8kg = 32ml/hr.**

❖ For children weighing 10- 20 kg: infuse (N/2 in 5% dextrose) @ 40ml/hr. plus 2ml/kg per hour for each kilogram between 10 and 20kg.

E.g., the maintenance rate for a 15kg child is **40ml/hr. + (2ml/kg per hour x 5kg) = 50 ml/hr.**

❖ For children weighing more than 20kg: Infuse (DNS/NS/RL) @ 60ml/hr. plus 1ml/kg per hour for each kilogram over 20 kg.

E.g., the maintenance rate for a 30kg child is **60ml/hr. + (1ml/kg per hour x 10 kg) = 70ml/hr.**

Caution: For resuscitation or in shock use only NS/RL 20ml/kg bolus and repeat 3 times i.e. 60 ml/kg. **Dextrose containing solutions** should not be used for boluses as they will likely cause hyperglycemia. Hyperglycemia is associated with poor neurological outcomes.

SEVERE MALNUTRITION

Severe malnutrition is defined in these guidelines as the presence of edema of both feet, and severe wasting (<70% weight-for-height/length or <-3SD), or clinical signs of severe malnutrition.

Key diagnostic features are:

Weight-for-length (or height) <70% or <-3SD (marasmus)

Edema of both feet (kwashiorkor or marasmic kwashiorkor).

Children with a Mid Upper Arm Circumference (MUAC) less than 115 mm

Hypoglycemia- All severely malnourished children are at risk of hypoglycemia. Hypoglycemia is present when the blood glucose (<54 mg/dl). Assume hypoglycemia in all severely malnourished children, and immediately on admission should be given a feed or 10% glucose or sucrose.

Treatment:

- Give the first feed of F-75 if it is quickly available and then continue with 2–3 hourly feeds.
- If the first feed is not quickly available give 50 ml of 10% glucose or sucrose solution (1 teaspoon of sugar in 3 1/2 tablespoons of water) orally or by nasogastric tube, followed by the first feed as soon as possible.
- Give 2–3hourly feeds, day and night, at least for the first day.
- If the child is unconscious, treat with IV 10% glucose 5 ml/kg or, if unavailable, 10% glucose or sucrose solution by nasogastric tube.

HYPOTHERMIA

If the axillary temperature is <35⁰ C (<95⁰ F) or does not register on a normal thermometer, assume hypothermia. Where a low-reading thermometer is available, take the rectal temperature (<35.5⁰ C or <95.5⁰ F) to confirm the hypothermia.

Treatment:

- Feed the child immediately (if necessary, rehydrate first).
- Make sure the child is clothed (including the head), cover with a warmed blanket and place a heater (not pointing directly at the child) or lamp nearby, or put the child on the mother's bare chest or abdomen (skin-to-skin) and cover them with a warmed blanket and/or warm clothing.
- Always give feeds through the night.
- Place the bed in a warm, draught-free part of the ward and keep the child covered.
- Change wet nappies, clothes and bedding to keep the child and the bed dry.
- Avoid exposing the child to cold (e.g. after bathing, or during medical examinations).
- Let the child sleep with the mother for warmth in the night.

DEHYDRATION

Dehydration tends to be over diagnosed and its severity overestimated in severely malnourished children. Assume that all children with watery diarrhea may have some dehydration.

Treatment: Do not use the IV route for rehydration except in cases of shock

- Do not use Standard WHO-ORS solution for severely malnourished children. Instead, use Rehydration solution for malnutrition (ReSoMal).
- Give the ReSoMal rehydration fluid; orally or by nasogastric tube, much more slowly than you would when rehydrating a well-nourished child: — give 5 ml/kg every 30 minutes for the first 2 hours — then give 5–10 ml/kg/hour for the next 4–10 hours.
- The exact amount depends on how much the child wants, volume of stool loss, and whether the child is vomiting.
- Monitor the progress of rehydration half-hourly for 2 hours, then hourly for the next 4–10 hours. Be alert for signs of over hydration, which is very dangerous and may lead to heart failure.
- Check: respiratory rate, pulse rate, urine frequency, frequency of stools and vomit.
- If you find signs of over hydration (increasing respiratory rate by 5/min and pulse rate by 15/min), stop ReSoMal immediately and reassess after 1 hour.

Recipe for ReSoMal

Take 1 packet of standard ORS and add to 2 liters of cooled boiled water. Add 50 gm of sugar to it and if available add 40 ml of electrolyte/mineral solution.

ELECTROLYTE IMBALANCE

All severely malnourished children have deficiencies of potassium and magnesium and excess of sodium, which may take two weeks or more to correct.

Treatment

- Give extra potassium and extra magnesium by adding to the feeds during their preparation.
- Prepare food without adding salt. **Do not treat edema with a diuretic (Lasix).**

INFECTION

Assume that all malnourished children have an infection on their arrival in hospital and treat with antibiotics straightaway.

Treatment

- Give all severely malnourished children: a broad-spectrum antibiotic

- If the child appears to have no complications, give cotrimoxazole for 5 days
- If there are complications (hypoglycemia, hypothermia, or the child looks lethargic)
- Give ampicillin (50 mg/kg IM/IV q.i.d. for 2 days), then oral amoxicillin (15 mg/kg t.i.d. for 5 days) AND gentamicin (7.5 mg/kg IM/IV) o.d. for 7 days.
- If the child fails to improve within 48 hours, add chloramphenicol (25 mg/kg IM/IV t.i.d.) for 5 days.
- Give Albendazole 200mg<2yrs and 400mg> 2yrs

MICRONUTRIENT DEFICIENCIES

All severely malnourished children have vitamin and mineral deficiencies. Although anemia is common, do not give iron initially but wait until the child has a good appetite and starts gaining weight (usually in the second week), because iron can make the infections worse.

Treatment

Give daily (for at least 2 weeks):

- a multivitamin supplement
- folic acid (5 mg on day 1, then 1 mg/day)
- zinc (2 mg Zn/kg/day)
- copper (0.3 mg Cu/kg/day)
- Once gaining weight, ferrous sulfate (3 mg Fe/kg/day).
- Give vitamin A orally (<6 months: 50 000 IU; 6–12 months: 100 000 IU; older children: 200 000 IU) on day 1.

EYE PROBLEMS

- If the child has any eye signs of vitamin A deficiency, Give vitamin A orally on days **1, 2 and 14** (aged <6 months, 50 000 IU; aged 6–12 months, 100 000 IU; older children, 200 000 IU).
- For corneal clouding or ulceration, instill chloramphenicol or tetracycline eye drops, q.i.d. as required for 7–10 days. Instill atropine eye drops, 1 drop t.i.d. for 3–5 days
- Cover with saline-soaked eye pads. Bandage the eye(s).

For feeding F75 and F100 and other problems refer to manual on management of severe malnutrition.

Key Messages

- Do not give IV fluids routinely to children with severe malnutrition
- Do not give IV Lasix to treat edema
- Use ReSoMal for dehydration
- Treat hypoglycemia and hypothermia
- Give antibiotics
- Feed frequently and give slow feeds

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