Approach to A Child with Acute Gastroenteritis

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Paediatric Refresher Course
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Outline of Lecture

• Introduction
• Clinical features
• AGE related morbidity & mortality
• Home management & safety net
• Case scenario
• Principles of Fluid therapy in AGE
• Summary
Introduction

• Acute gastroenteritis is a common cause of morbidity and mortality worldwide.

• Clinical features
  self-limiting $\leftarrow \rightarrow$ varying degree of dehydration $\leftarrow \rightarrow$ death

• Diarrhoea
  – passage of unusually loose or watery stools
  – consistency $>$ most important than frequency
  – Frequent formed stools $=/=$ diarrhoea
ACUTE DIARRHOEA STILL A LEADING CAUSE OF CHILD DEATHS

Major causes of death among children under five in developing countries, 2002

- Acute respiratory infections
- Diarrhoea
- Malaria
- Measles
- HIV/AIDS
- Perinatal
- Other
Clinical Features

- Vomiting
- Diarrhea
- Fever
Causative Agents of AGE

- **Viruses**: rotavirus, astrovirus, calicivirus, enteric adenovirus
- **Bacteria**: Vibrio cholerae, Enteropathogenic E coli (EPEC), enterotoxigenic E coli (ETEC), Shigella, Campylobacter jejuni, Salmonella spp
- **Parasites**: E. histolytica, Giardia lambia
“AGE” associated morbidity & mortality: What’s behind the occurrences?

Possible reasons:

1. Failure to detect dehydration (beware of an obese child)
2. Failure to consider another diagnosis: the diagnosis of AGE may be incorrect!
3. Failure to detect parenteral diarrhoea (diarrhoea caused by an illness outside GIT)
4. No safety net
1. Failure to detect dehydration

- Beware of a well nourished child (signs of dehydration may be subtle)
Fluid Intake vs Fluid Losses

**Intake**
- Amount
- Baseline
- Eagerness
- Type of feed

**Diarrhea**
- Frequency
- Consistency
- Colour
- Smell
- Mucus
- Trend of above

**Vomiting**
- Amount
- Content
- Frequency
Dehydration: Red flags

Losses >>> Intake

1) Vomits out all or most of the feeds
2) Passes out explosive, watery stools
3) Frequent change of nappies
Things to look for during observation #1

Signs of dehydration

- Reduced level of consciousness
- Sunken fontanelle
- Dry mucous membranes
- Eyes sunken and tearless
- Tachypnoea
- Prolonged capillary refill time
- Tachycardia
- Hypotension
- Peripheral vasoconstriction
- Reduced tissue turgor
- Sudden weight loss
- Oliguria
Things to look for during observation #2

1) Child’s level of consciousness
   - Alert
   - Crying persistently (Irritable)
   - “Sleeping” (Lethargic)
   - Unconscious

2) Any sunken eyes
   - If unsure, check with parents are the eyes sunken?

3) Respiratory rate – Is the child tachypneic?
   - Tachypnea ≠ pneumonia
   - Think of metabolic acidosis!

Q: differential diagnosis of rapid breathing?
Things to look for during observation #3

4) Child’s ability to drink
   - Could the child drink well or not at all?
   - Is the child thirsty?

5) Cold peripheries
   - Always compare temperature of peripheries with central / truncal temperature

6) Poor pulse volume
   - DO NOT just copy the number shown on the pulse oxymeter!
   - Feel the patient’s pulses

Q: what are the pitfalls of pulse oxymetry?
• Tachypnea:
  – Age < 2 months : > 60 breaths/min
  – Age 2 months – 1 yr : > 50 breaths/min
  – Age 1 yr – 5 yo : > 40 breaths/min
  – Adolescents : > 20 breaths/min

• Tachycardia
  – Age < 2 months : > 160 bpm
  – Age 2 months – 2 yo : > 140 bpm
  – Age 2 yo – 10 yo : > 120 bpm
  – Age > 10 yo : > 100 bpm
2 & 3) Failure to consider Another Diagnosis/Parenteral Diarrhoea

• Is it really acute gastroenteritis?

Vomiting / Diarrhea ≠ Acute gastroenteritis!

• What are the other causes for vomiting/diarrhea in a child?
1) Differential Diagnosis

Other medical conditions:

• Any cause of raised intracranial pressure
• Endocrine causes: Diabetic ketoacidosis, hyperthyroidism
• Inborn error of metabolism
• Haemolytic uraemic syndrome
• Inflammatory bowel disease
• Malabsorption syndrome
• Drug induced
2) Differential Diagnosis

Surgical conditions:

• Acute appendicitis
• Strangulated hernia
• Intussusception especially in child < 1 year old.
• other causes of bowel obstruction
3) Differential Diagnosis

Parenteral diarrhoea (diarrhoea caused by an infection outside GIT):

- Urinary tract infection
- Meningitis
- Severe dengue
- Other types of sepsis
Clues to Another Diagnosis

1. Atypical history
2. Abdominal distension
3. Severe abdominal pain
4. Blood in stool
5. Vomitus: bile-stained; blood
6. Persistent vomiting
7. Vomiting in the absence of or >> than diarrhoea
8. Headache
Red Flags

Unwell child

1. High grade fever > 38.5°C
2. Looks sleepy / lethargic / not active / ill
3) Illness not appropriate for amount of fluid lost
4) Stools are mucoid or very foul smelling

* Pay extra attention to the child who is “sleeping”!

Q: explain why they may be sleepy
Referral for Hospital Care (1)

• Risk of severe dehydration or signs of moderate – severe dehydration
• Uncertain about degree of dehydration (obese child)
• Home treatment failure with ORS.
• Presence of social / logistic concerns – no transport to seek emergent treatment (safety net issues)
Referral for Hospital Care (2)

1. Atypical history: uncertain about diagnosis
2. Abdominal distension
3. Severe abdominal pain
4. Blood in stool
5. Vomitus: bile-stained; blood
6. Persistent vomiting
7. Vomiting in the absence of or >> than diarrhoea
8. Headache
Referral for Hospital Care (3)

Unwell child

1. High grade fever $> 38.5^\circ$C
2. Looks sleepy / lethargic / not active / ill
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Home management of AGE

Oral hydration with ORS is the cornerstone of AGE treatment / should be used as first-line therapy

If breastfeeding, continue breastfeeding

If formula-fed, continue usual feeding and offer extra water

For older children, continue normal diet with extra fluids.
ORS Rehydration

• Wash hands, use clean bottle
• Mix one sachet ORS with 250 ml of lukewarm water.
• Give frequent small sips from cup or spoon
• If the child vomits, wait 10 minutes then continue but at a slower rate
• Do not boil the solution
• Do not add extra sugar.

Q: How to prepare ORS?
How do ORS work?

- The glucose contained in ORS solution enables the intestine to absorb the fluid and the salts more efficiently.
  - Sodium-glucose cotransporter

Content of ORS:

<table>
<thead>
<tr>
<th>Element</th>
<th>Ionic Concentration (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>56</td>
</tr>
<tr>
<td>K</td>
<td>20</td>
</tr>
<tr>
<td>Cl</td>
<td>56</td>
</tr>
<tr>
<td>HCO3</td>
<td>20</td>
</tr>
<tr>
<td>Glucose</td>
<td>139</td>
</tr>
</tbody>
</table>

Q: are all ORS the same?
Q: If not in what way?
Q: why is it so?
Home management for AGE

Safety net:

• Is the mother competent of taking care of the child at home?

• Is the mother able to recognize the danger signs and seek help immediately?

• Is there ready transport for the family to bring the child to nearest health facilities or hospital?
Home care: Danger signs to watch out

Child:
- develops high fever
- has persistent vomiting or billous vomiting
- drinks poorly
- looks weak, not interest to play
- Reduced urine (difficult to differentiate between watery stools & urine)
- Any concern that child is getting worse
Retrospective history:
Upon discharged home at 2 am
  – Child still have diarrhea > 10 (loose watery)
  – Incessant crying initially at home
  – Child last feeding at 3am, 6oz of bottle feeding
  – Subsequently mother noted child less active, sunken eyes, last loose stool at 4 am, minimal amount.

• Reasons not taking child to hospital
  – Unable to get transport
Case 1

- Name: K  Age: 1 year 2 months
- Gender: Male
- Date of Admission: 12/02/2017
- Date of Discharge: 25/02/2017
- Diagnosis:
  - Severe AGE with hypernatraemic dehydration
  - Klebsiella pneumonia sepsis with hepatitis
  - Likely HIE (post-CPR)
History

• Watery stool since 11/02/2017 afternoon
  – Countless episode, about every 2 minutes
  – Large amount, soaked linen, no blood
• Vomiting – milk curd, non-bilious
• Low grade fever
• Cough
• Reduced oral intake – from 9oz to 2oz at 3am
• Less active at 11am
• No ill contact
Timeline of Illness

11th Feb, afternoon
Watery diarrhoea, vomiting

12th Feb, 0300 hours
Reduced feeding

12th Feb, 1100 hours
Became less active. Mother attempted to find transport to hospital but unsuccessful

12th Feb, 1342 hours
Called PK Oya. Staff helped to call for ambulance

12th Feb, 1425 hours
Reached ETD

Severe dehydration
CPR
Hypoglycaemia
Seizures
Ambulance call on 12/02/2017

- Received call 1342H
- EMT activated 1343H
- Despatched EMT 1345H
- Reached scene 1406H
- Reached ETD 1425H
In ED

• Child severely dehydrated, lethargic

• Vital signs
  – HR 190-200/min, CRT 3 secs, cold peripheries
  – SPO2 undetectable due to poor perfusion

• Intubated

• Started CPR x6 mins for HR 50+

• Intraosseous access inserted over left tibia

• Given
  – IO Adrenaline 0.7ml x 1
  – IO NS 20ml/kg x2
  – IO Ceftriaxone 350mg stat

• HGT – 2.6, given IO D10% 14ml, rechecked HGT 5.8
In ED/ ICU

• Fitted total x3
  – Loaded with IV Phenobarbitone 140mg
  – Given IV Diazepam x1
  – Started IV Phenobarbitone

• Femoral line inserted, started
  – IVI NaHCO3
  – IVI Noradrenaline
  – IV Metronidazole 105mg Stat then 55mg TDS
  – IV Sterofundin 140ml over 1 hour
  – Transfused FFP 20ml/kg
Progress

- Started IVI Frusemide due to poor urine output
- Weaned off inotropes 15/02/2017
- Added IV Fluconazole on 15/02/2017
- Off Ceftriaxone and started IV Unasyn and IV Amikacin on 17/02/2017
- Extubated to Airvo on 17/02/2017
- Changed to NPO2 on 22/02/2017
- Weaned off oxygen on 24/02/2017
Progress

- Poor neurological recovery, opening eyes but not focusing, hypertonia
- Planned for MRI Brain on 15/05/2017
- Counsellled for palliative care
- Discharge on 25/02/2017
- He died at home on 27.02.2017
Case 2

1 year 5mo girl
Previously healthy child
FTSVD, uneventful antenatal / neonatal period
Presented to ED hospital Sibu at day 2 illness
History

Fever, Diarrhea & vomiting for 2 days
Child’s condition worsen on Day 2 of illness
he had frequent diarrhea & vomiting
and less active

Parents seek medical attention at day 2 of illness,
was seen at KK at 1355 hr

Child was brought to ED hospital Sibu in the midnight
in view of less responsive
Child arrive at ED hospital Sibu at 0045 (3/1/15) and was triage to red zone for resuscitation.

there is difficulty in getting peripheral venous assess

Case was referred to Paediatric team at 0105
Initial assessment:

• Child was weak, opening eyes, no interactions, not withdrawing to painful stimulus

• Cyanosed, breathing spontaneously, SPO2 on ambubagging 88 – 90 %

• CRT 5s, thready pulse, HR 55 – 60

• Child fitted during assessment and was aborted with rectal diazepam

• Capillary blood sugar 2.1

• pH 6.73  HCO3 6  BE -29  PCO2 45  PO2 70
Immediate Treatment

Intubation was performed immediately after fit aborted. ET tube positioned was confirmed, SPO2 100% on ambubagging.

Intraosseus needle was inserted at right proximal tibia at 0115. IO normal saline bolus was started. IO D10% 50ml (3ml/kg).
Child was noted not responsive, no spontaneous breathing and pulseless at 0115

CPR started
- CPR for 25 minutes
- IV adrenaline 1:10,000 x7
- IV normal saline 750 ml (50ml/kg)
- IV NaHCO3- 4.2 % x1
- IV calcium gluconate x1

Child ROSC with sinus tachycardia HR 130 – 140
BP 62/22, IV dopamine 15mcg/kg/min was initiated
Child pronounced death 1045 pm 3/1/16
Cause of death: Hypovolemic shock due to severe AGE
Renal failure / Liver failure/ DIVC
Principles of Fluid Therapy

Fluid Balance = Maintenance

+ Deficit

+ On going losses

* DO NOT underestimate the on-going losses!
Things to do upon admission

• Establish IV access as soon as possible
  – Send BUSE/VBG/HPC

• If the child requires a bolus of NS, it needs to be given urgently!

• Administer antibiotics (if needed) ASAP

• Put child on cardiac monitor if child has danger signs
  – note the baseline heart rate; monitor trend

• Place urine bag for boys for inspection

• Inspect stools
Severity of Dehydration

- Mild
- Moderate
- Severe

- A dynamic process - Patient’s condition may change with time during admission
- Regular **RE-ASSESSMENT** of hydration status
- Alert doctors if hydration status is worsening
Laboratory data interpretation

1. ABG
2. BUSE
3. Blood glucose
Arterial Blood Gas

• Normal values :
  – pH : 7.35 – 7.45
  – pCO2 : 35-45
  – HCO3 : 22-26
  – BE : -2 to +2
# ABG (simplified)

<table>
<thead>
<tr>
<th>High pH</th>
<th>Low pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkalosis</td>
<td>Acidosis</td>
</tr>
<tr>
<td>High HCO₃</td>
<td>Low PCO₂</td>
</tr>
<tr>
<td>Metabolic Alkalosis</td>
<td>Respiratory Alkalosis</td>
</tr>
</tbody>
</table>

Look for this in the child with diarrhea!
# Why is the ABG important?

<table>
<thead>
<tr>
<th></th>
<th>Mild Dehydration</th>
<th>Moderate Dehydration</th>
<th>Severe Dehydration</th>
</tr>
</thead>
<tbody>
<tr>
<td>General appearance</td>
<td>Alert</td>
<td>Irritable, restless</td>
<td>Lethargic, extremely sleepy</td>
</tr>
<tr>
<td>Eyes</td>
<td>Normal</td>
<td>Sunken</td>
<td>Markedly sunken</td>
</tr>
<tr>
<td>Skin turgor</td>
<td>Normal</td>
<td>Reduced</td>
<td>Very reduced</td>
</tr>
<tr>
<td>Pulse</td>
<td>Full and normal</td>
<td>Rapid</td>
<td>Rapid and weak</td>
</tr>
<tr>
<td>Urine output</td>
<td>Mildly reduced</td>
<td>Markedly reduced</td>
<td>No urine</td>
</tr>
<tr>
<td>Acidosis</td>
<td>None</td>
<td>+</td>
<td>+++</td>
</tr>
</tbody>
</table>

**Metabolic acidosis** ➔ the child has significant dehydration
Interpreting BUSE

• Look at the sodium results:
  – Isonatremic dehydration (Na normal)
  – Hyponatremic dehydration (Na < 135)
  – Hypernatremic dehydration (Na > 145)
Isonatremic Dehydration

• Losses of sodium and water are proportional
• Plasma sodium remains within the normal range

Hyponatremic Dehydration

• Sodium losses exceed those of water
• Plasma sodium falls
Hypernatremic Dehydration

- Water loss exceeds the relative sodium loss
- Plasma sodium concentration increases
- Extracellular fluid becomes hypertonic with respect to the intracellular fluid
- Shift of water from the intracellular compartment → extracellular space.

**SIGNS OF DEHYDRATION ARE LESS OBVIOUS!**
What are the clues to Hypernatremic Dehydration?

• The degree of dehydration is not consistent with the amount of fluid lost
• Doughy skin feel
• Ix : HPC stat → look for hyperglycemia!
• Urgent BUSE : Na↑

In a child with diarrhea, the BUSE should be sent and traced urgently
Adjuvant therapy in AGE

1. Antibiotics are indicated in specific situations
2. Anti-diarrhoeal agents and other therapies
3. Probiotics and prebiotics
4. Nutritional therapy; special infant formula & Zinc supplementation
Summary

- Acute diarrhoea can cause death!
- Acute diarrhoea ≠ acute gastroenteritis
- Consider another diagnosis in the presence of atypical presentation
- Learn to recognize an unwell child (red flags)
- Beware of an obese child with dehydration
- Do remember the on going losses when correcting dehydration
- Assess the social / logistics issues when considering home management
Health Messages

1. Breastfeeding
2. Improved feeding practices
3. Handwashing with soap
4. Use of safe water
5. Food safety
6. Use of latrines and safe disposal of stools
7. Measles immunization
8. Rotavirus vaccines