

American Pediatric Surgical Association

Standardized Toolbox of Education for Pediatric Surgery

APSA Committee of Education
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FLUIDS AND ELECTROLYTES



Fluids and Electrolytes

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History

- 5 year old male admitted to pediatric service with 3 day history of vomiting diarrhea and poor PO intake.
- Surgery consult for abdominal pain and lethargy
- Previously healthy, attends pre-school, full term. Many other children out this week from school with similar illness

History Discussion Slide

- **History should focus on severity of dehydration:**
 - How long?
 - Symptoms began at 3 days ago
 - Frequency?
 - Initially both nausea and vomiting, now neither and has abdominal pain
 - Character of emesis?
 - Non-bilious at first, last 2 times with “yellowish tinge”
 - Frequency of urine output?
 - Last “pee” was yesterday
 - Activity level?
 - Seems less active and more sleepy
 - No Family History of similar condition

Physical Exam

- Vitals: Temp 38.2 HR 125 BP 90/70
- Appearance:
 - Lethargic, tired
- Relevant exam findings
 - Dry mucous membranes, decreased capillary refill
 - Abdomen: mild distention, diffuse tenderness, no rebound.

Physical Exam

- Vitals: Temp 38.2 HR 125 BP 90/70
- Appearance:
 - Lethargic *due to dehydration*
- Relevant exam findings
 - Dry mucous membranes, decreased capillary refill (*represent dehydration*)
 - Abdomen: mild distention, diffuse tenderness, no rebound. (*also represents dehydration*)

Studies: Labs, Imaging

- Serum Electrolytes
- Complete Blood Count
- Urinalysis

- Abdominal Ultrasound

Study Results

- **Serum Electrolytes**
 - Bicarbonate 21

- **Complete Blood Count**
 - HCT 48

- **Urinalysis**
 - Ketones 40

Case Discussion

- **Diagnosis**
 - Dehydration
 - Cause—Most likely gastroenteritis
 - Surgical causes of dehydration
 - Appendicitis
 - Intussusception
 - Bowel obstruction
 - Need to treat dehydration while continuing workup

Case Discussion

- **Resuscitation with IV fluids is key**
 - Dehydrated patients need initial resuscitation with IV bolus
 - Fluid bolus should be 20 mL/kg of crystalloid
 - NSS or LR
 - Repeat 20 ml/kg boluses x 2 or 3 if no response in heart rate
 - Ongoing workup
 - Ultrasound for appendicitis and intussusception

Case Discussion

– Resuscitation with IV fluids is key (cont)

- Calculate maintenance IV fluids
 - For 1-10 kg: 4 mL/kg/hr
 - For 11-20 kg: 2 mL/kg/hr
 - For > 21 kg: 1 mL/kg/hr
- Example: Maintenance IVF (per hr) for 26 kg:
 - $(4 \text{ mL/kg} \times 10 \text{ kg}) + (2 \text{ mL/kg} \times 10 \text{ kg}) + (1 \text{ mL/kg} \times 6 \text{ kg})$
= 40 mL + 20 mL + 6 mL = **66 mL per hr**
- After boluses, this patient still dehydrated
 - Continue MIVF x 1.5 maintenance to continue to replace losses if not tolerating PO

Composition of fluid losses

Table 3 Composition of GI losses

SOURCE	DAILY LOSS (ML)	[Na+]	[K+]	[Cl-]	[HCO ₃ -]
Saliva	1,000	30-80	20	70	30
Gastric	1,000-2,000	60-80	15	100	0
Pancreas	1,000	140	5-10	60-90	40-100
Bile	1,000	140	5-10	100	40
Small Bowel	2,000-5,000	140	20	100	25-50
Large Bowel	200-1,500	75	30	30	0
Sweat	200-1,000	20-70	5-10	40-60	0

University of Michigan Health System Pediatric
Critical Care Medicine.

<http://www.learnpicu.com/fluids-electrolytes>

Composition of IV crystalloid fluids

Table 4 Commonly Used Intravenous Fluids

SOLUTION	pH	[Na+]	[Cl-]	[K+]	[Ca+2]	OTHER COMPONENTS	COMMENTS
Lactated Ringer's (LR)		130	109	4	3	Lactate 28 meq/L	Fluid choice for initial resuscitation
Normal saline (NS)		154	154	0	0		Alternative to LR; watch for hyperchloremic acidosis
D5LR	5	130	109	4	3	Dextrose 50 g, Lactate 28 meq/L	Initial postoperative maintenance; caution bolusing with dextrose
D5NS	4	154	154	0	0	Dextrose 50 g	Alternative to D5LR
D5.45NS	4	77	77	0	0	Dextrose 50 g	Hypotonic maintenance
D5.25NS	4	34	34	0	0	Dextrose 50 g	Hypotonic maintenance
7.5% NS	4	1,283	1,283	0	0	0	Hypertonic; further study
D5W	4.5	0	0	0	0	Dextrose 50 g	Free water; no role in resuscitation

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Case Discussion

- **Resuscitation with IV fluids is key**
- Thus, to replace fluid losses, the optimal initial fluid bolus is LR or NSS depending on source of fluid losses (majority of time it is LR)
- Usual MIVF after boluses is D5 1/2NS + 20KCl
 - Patient will require additional IVF above maintenance rate
 - Would run at 1.5 X maintenance rate
 - Use caution about adding KCl to MIVF before patient voids. Low risk but possible renal failure

Questions

- **What is the most common acid-base derangement in severe viral gastroenteritis?**
 - A. Metabolic Acidosis
 - B. Metabolic Alkalosis
 - C. Respiratory Acidosis
 - D. Respiratory Alkalosis

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Questions

- Which of the following is the most appropriate initial resuscitative strategy for a patient with severe dehydration?
 - A. 0.9% NS bolus 10ml/kg
 - B. 0.45% NS bolus 20ml/kg
 - C. LR bolus 20ml/kg
 - D. 3% NS bolus 10ml/kg

Questions

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 - B. 0.45% NS bolus 20ml/kg
 - C. LR bolus 20ml/kg**
 - D. 3% NS bolus 10ml/kg

Questions

- **All of the following are usual clinical signs of severe dehydration in a pediatric patient except**
 - A. Lethargy
 - B. Tachycardia
 - C. Shortness of breath
 - D. Abdominal pain

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 - A. Lethargy
 - B. Tachycardia
 - C. Shortness of breath**
 - D. Abdominal pain

Final Discussion/Review

Top 5 take home points for disease:

1. Dehydration is common result from multiple medical and surgical conditions. Delay in treatment can lead to severe electrolyte derangements, and eventually metabolic collapse.
2. Correction of hydration and electrolyte status is first priority and can be initiated even before final diagnosis is made.

Final Discussion/Review

Top 5 take home points for disease:

3. Calculate maintenance IVF rate
4. Determine whether patient needs more or less than maintenance rate
5. Determine the type of IVF based on need of patient

Acknowledgement Slide

The preceding educational materials were made available through the American Pediatric Surgical Association

In order to improve our educational materials we welcome your comments/ suggestions:

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