

Approach to diarrhea

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1. Background

Definition- The World Health Organization defines diarrhea as the passage of three or more loose, watery stools per day. However, any deviation from a child's regular stool-passing behavior is a cause of concern and, clinically, a better working definition is any increased frequency or decreased consistency of stool. It is generally accepted to define diarrhea as *ACUTE* if duration is less than 2 weeks, and *CHRONIC* if the condition persists longer than 2 weeks.

Why is it important? Diarrhea remains one of the most common causes of morbidity and mortality in children worldwide. Almost every child will experience diarrhea at some point and the potential for dehydration is great. Always be concerned about hypovolemia and electrolyte abnormalities in a child with diarrhea.

Pathophysiology- Normal water absorption occurs in both the small bowel and colon with 99% of all fluids entering and produced within the GI tract being absorbed. In healthy adults, 93% of fluid entering the intestines is absorbed by the time it reaches the ileocecal valve. Thus, the small bowel absorbs the majority of water that reaches the intestine and therefore any disease affecting the small bowel can result in marked diarrhea. This is especially serious in the pediatric population because children become volume depleted more rapidly than adults (due to an increased surface/volume ratio and limited renal compensatory capacity).

There are four basic pathophysiological categories of diarrhea:

- (1) Osmotic Diarrhea: when an ingested solute is not absorbed properly, the higher concentration gradient within the gut lumen acts to draw water into intestinal lumen and greatly increases the water content of the stool. The classic example of this is the diarrhea caused by lactose intolerance. Enteric infections may also cause malabsorption via damage to intestinal epithelial cells (ex. Rotavirus or Shigella).
- (2) Secretory Diarrhea: this diarrhea is caused by the intestine actively secreting water into the gut lumen. Infections such as *Cholera*, *Clostridia Perfringens*, *Clostridia Difficile*, *E. Coli*, *Staph. Aureus*, and *Shigella* all cause secretory diarrhea mainly via preformed enterotoxins.
- (3) Inflammatory Diarrhea: Intestinal inflammation can lead to blood, mucus, and protein exudate losses, accompanied by fluid and electrolytes. The most common cause of this type of diarrhea is infection but can also be due to chronic diseases such as IBD or Celiac Disease.

- (4) Diarrhea due to Motility Disorders: although uncommon, both an increase and a decrease in gut motility can be a cause of diarrhea.

Note: diarrhea can be caused by one or any combination of these categories

2. Questions to Ask

A good history is crucial to gain a clinical picture of the patient's problem. Generally, the history should be directed to: (1) ensure that the child is, in fact, experiencing an episode of diarrhea, (2) determine the timing and severity, and (3) lead you to a differential diagnosis. The following questions may be helpful.

- When did the current problem start? How many bowel movements per day? What is the normal pattern for this child? Are the loose movements interspersed by normal ones? Has the child ever experienced this before? What is the child's dietary history (rule out overfeeding)?
- What is the consistency of the stool? What is the volume of stool that the child is passing? Is there blood or pus contained within the stool? Is it extremely foul-smelling or contain oil droplets (malabsorption)? Bloody diarrhea may suggest specific infectious agents, inflammatory bowel disease, bowel ischemia (or necrotizing enterocolitis) or cow's milk protein allergy.
- Does the child have a fever? Has the child also been vomiting (very common and can exasperate dehydration)? What is the child's current urine output (oliguria or anuria suggests a large volume deficit)? Has the child been able to take in any fluids? Do we have records of the child's weight (useful to compare these to the current to assess the degree of dehydration)?
- Is the child immunocompromised (if yes, think unusual infections)? Has the child been exposed to anyone else with a similar illness? Has the child been institutionalized? Has there been any travel or has the child newly immigrated? Has there been any recent use of antibiotics?
- Are there any other concurrent problems or pertinent past medical history?

3. Differential Diagnosis

ACUTE and CDRONIC diarrhea will be discussed simultaneously, considering that there is significant overlap in causes within these two categories.

Infectious

Enteral

- Infection of the gastrointestinal tract is the most common cause of acute diarrhea. Common viral, bacterial and parasitic infections are listed in **table 1**.
- Hemolytic Uremic Syndrome (HUS) is an important infectious cause of diarrhea, although often no infectious agent can be identified.
- Pseudomembranous Colitis secondary to Clostridium Difficile may occur in the

older child, especially after a course of enteral antibiotics.

Parenteral

- Acute infections elsewhere in the body (eg. UTI, Otitis Media, sepsis) can also lead to diarrhea in children.

Inflammatory

- Allergy (cow's milk, soy protein intolerance)
- Inflammatory Bowel Disease
- Necrotizing Enterocolitis
- Whipples disease

Malabsorption

- Lactase Deficiency
- Celiac Disease
- Pancreatic insufficiency - Cystic Fibrosis, pancreatitis
- Bile deficiency - biliary atresia, cirrhosis, hepatitis, primary bile acid malabsorption
- Short gut syndrome (after bowel resection), fistula or blind loop
- Defective sodium absorption
- Fructose intolerance

Feed related

- Overfeeding (infants)
- Excessive diet gum/ sorbitol/ lactulose ingestion

Immune deficiency related

- Hypogammaglobulinemia, IgA deficiency, SCIDs, AIDs, Chronic granulomatous disease, thymic hypoplasia

Toxin related

- Antibiotics Associated Diarrhea
- Toxin ingestion (arsenic, lead, organophosphates), chemotherapy, radiation
- Laxative abuse/ accidental ingestion

Surgical

- Intussusception
- Malrotation
- Partial small bowel obstruction
- Ischemic bowel
- Toxic Megacolon
- Intestinal Lymphangectasia
- Appendicitis

Endocrine

- Hyperthyroidism, Hypoparathyroidism, Addison's disease

Neoplastic

- Secretory tumors – carcinoid, Zollinger-Ellison syndrome (gastrin secreting tumor)
- Vaso-active substance secreting tumors, such as neuroblastoma
- Lymphoma
- Adenocarcinoma, Polyposis

Psycho-social

- Irritable bowel syndrome

4. Physical Exam

As always, your physical exam begins as you walk in the door and acquire your first impression, is the child in distress or not? After this, your initial goal should be to assess the volume status of the child, determining if there is dehydration.

- Vitals*- Heart rate and blood pressure are key predictors of dehydration. Tachycardia with a low blood pressure indicates severe hypovolemia and should be corrected immediately. Hypotension is a late finding in the child with hypovolemia. In older children, orthostatic hypotension should be assessed. Fever suggests infection (always record the child's temperature). Weak pulses support the finding of dehydration.
- Change in Weight*- If you have records of previous weight, this allows you to accurately estimate the volume deficit.
- Mental status*- A child that is inconsolably crying / irritable or a lethargic child that is difficult to arouse demands rapid attention with fluid resuscitation and treatment for possible sepsis.
- Mucous Membranes*- Determine if these are moist or dry. Check inside the mouth rather than the lips which may be parched due to tachypnea or other reasons. Remember that sunken eyes and/or the absence of tears also suggest dehydration.
- Anterior Fontanelle*- In infants, a flat or sunken fontanelle is also an indicator of dehydration. Fontanelles should be assessed in the sitting and not the supine position.
- Skin Turgor*- Gently pinch and release the skin over the abdomen to assess if the turgor is normal or decreased. Slow retraction is a sign of moderate dehydration whereas "tenting" (the lack of retraction) implies severe dehydration and should

be taken very seriously. In a normal, hydrated child, the skin should retract immediately.

- (g) Capillary Refill- If the capillary refill is delayed to more than 2 seconds in the periphery this may be due to vasoconstriction (accompanied by cold hands/feet), but if capillary refill is prolonged centrally, greater concern should exist for inadequate perfusion.

- (h) Urine Output- Normal output is approximately 1-2 mL/kg/hr. In infants, you can estimate output from the number of wet diapers/day. Decreased output is a cause of concern.

After fluid status has been assessed, a thorough physical exam should be performed as there are many systemic, non-enteric infections that can cause diarrhea (ex. Otitis media, UTI, pneumonia). In the case of chronic diarrhea, look for extra-intestinal manifestations of inflammatory bowel disease, including uveitis, aphthous ulcers, arthritis or a rash (erythema nodosum/pyoderma gangrenosum specifically).

An abdominal exam may reveal a palpable mass or peritonitis which should lead you to think of intussusception, appendicitis, and toxic megacolon. Be very wary of the potential for the child to enter shock due to volume depletion or sepsis. Also look for petechiae or ecchymoses which may suggest HUS. Reassess regularly.

5. Laboratory investigations

- Serum electrolytes should be performed on any child with significant volume depletion. Screen for poor kidney function with Urea and Creatinine. If Creatinine is increased to a smaller degree than is Urea, this is indicative of dehydration. If the kidney function is markedly reduced, consider further studies to screen for hemolytic uremic syndrome, including coagulation studies and markers for hemolysis (LDH, blood smear, haptoglobin).
- Obtain a complete blood count with differential count for evidence of 1) infection (abnormal WBC or differential), 2) dehydration (hemoconcentration), 3) anemia and or thrombocytopenia in HUS.
- Stool cultures should be considered in all febrile children with diarrhea. *C. Difficile* should be kept in mind for children who have been in hospital or on recent antibiotics (Infants are unlikely to have *C. Diff* infection as they not yet produce the receptor for this microbe to attach).
- Stool Ovum and Parasite investigation can be ordered for children who have traveled to any endemic areas.
- Viral antigen tests (Adeno and Rotavirus PCR) of stool can be used to distinguish viral from bacterial causes (remember Rotavirus is the most common cause of diarrhea in North America)
- A urinalysis should be considered as UTI's commonly occur with diarrhea, either as cause or as consequence.
- Blood cultures should be ordered if sepsis is a concern.

6. Imaging studies

Imaging is not routinely obtained in diarrhea, but should intussusception, appendicitis, or other intra-abdominal processes be suspected, an abdominal ultrasound or plain film may be indicated.

7. Conclusion

Diarrhea has many forms and many different causes. However, keep in mind that diarrhea can quickly lead to life-threatening problems such as dehydration, electrolyte abnormalities, and sepsis. Your primary goal should always be to assess the degree of dehydration of the child and begin appropriate therapy to replenish intravascular volume. Additional plans can be formed once this has been achieved.

Appendix

Table 1. Causal Agents of Acute Infectious Diarrhea in Children

BACTERIA	VIRUS	PARASITE
E. Coli	Rotavirus	Giardia
Campylobacter	Adenovirus	Entamoeba Histolytica
Salmonella	Norwalkvirus	Cryptosporidium
Shigella	Calicivirus	Isospora Belli
Enterobacter	Astrovirus	Strongyloides
Vibrio Cholera	Parvovirus	Trichuris Trichuria
Aeromonas Hydrophilia	Pestivirus	Balantidium Coli
Yersinia Enterocolitica		
Bacillus Cereus		
Clostridium Difficile		
Klebsiella		
Pseudomonas		