

Gastroenterology

Intestinal Infection

- **Acute** gastroenteritis is the most common cause of infant mortality worldwide
- **Viral** gastroenteritis is usually associated with small bowel disease, presenting with 5–10 watery, large-volume episodes per day
 - Rotavirus: lasts 5–7 days; symptoms include fever, vomiting, and profuse diarrhea
 - Adenovirus: milder than rotavirus, but lasts 8–12 days
 - Norovirus, calicivirus, and astrovirus: mildest, lasting 1–3 days
- **Bacterial** gastroenteritis usually starts watery; may become colitis or dysentery
 - Symptoms include frequent episodes (10–20/day); mucousy, bloody stools; positive hemocult test
 - Species include *Salmonella*, *Shigella*, *Escherichia coli* (enterohemorrhagic or enteroinvasive), *Campylobacter*, *Yersinia*, and *Clostridium difficile*
 - Enterotoxigenic *E coli* and cholera only cause watery diarrhea
- **Protozoal** can be dysenteric (*Entamoeba histolytica*) or consist of more chronic loose stools (*Giardia*, *Cryptosporidium*, etc)

Osmotic Diarrhea

- Osmotic diarrhea usually indicates an injury to the small bowel mucosa and can be seen transiently in postinfectious diarrhea
- Treat with soy or other lactose-free formula until healed
 - Rice formula is not recommended because it mainly consists of carbohydrates and lacks the protein and fat that the bowel needs to promote rapid healing and epithelial cell growth
 - Juice is not recommended

Allergic Colitis

- Allergic colitis is seen mostly in infants
 - Usually presents at age 6–8 weeks
 - Often diagnosed after clinical presentation of blood-tinged, mucousy diarrhea
 - Babies usually outgrow typical allergic colitis by 12 months of age
- Children with allergic colitis often appear well otherwise, but can present with malnutrition, protein-losing enteropathy, or anemia
- Skin manifestations are typically absent, especially in younger infants, because the colitis is frequently due to an immunoglobulin G-mediated allergy (rather than an immunoglobulin E-mediated one)
- To treat: remove all cow's milk protein from the patient's diet
 - If the baby is not severely ill, try feeding with soy formula
 - If the baby is severely ill, treat with semielemental formula (eg, Nutramigen or Pregestamil [Mead Johnson Nutrition, Glenview, Ill] or Alimentum [Abbott Laboratories, New York, NY]) or amino acid-based formula
 - If the infant's mother can breast-feed, continue breast-feeding, but remove all cow's milk from the mother's diet

Malabsorption

- Malabsorption disorders in infants are usually manifestations of chronic duodenal infection, such as occurs with parasites
- May also be caused by genetic disorders that lead to fat malabsorption (cystic fibrosis is the common etiology for fat malabsorption in the first year of life)
- In the second year of life, infection is still likely, but celiac disease also becomes more prevalent
 - Celiac disease is an autoimmune disorder that requires gluten, a byproduct of wheat-containing foods, to manifest itself (thus, it is less common in certain areas of the world)
 - Treatment is a gluten-free diet for the patient's lifetime
- In older children showing evidence of malabsorption, infection and inflammatory bowel disease are the two most likely causes
 - Inflammatory bowel disease is an autoimmune disorder

- that is rarely seen in underdeveloped countries
- Protein-losing enteropathy presents with diarrhea and edema and has many etiologies
 - Begin by ruling out allergic colitis, infection, and other inflammatory conditions
 - In remote locations, the diagnosis can be made by evidence of protein malnutrition, low serum albumin, and a urinalysis that is clear of protein
 - The differential also includes primary protein malnutrition from deficient dietary protein; a dietary history is essential in any child with diarrhea
 - Treatment of protein malabsorption requires determining the etiology
 - ▶ In the meantime, use an amino acid-based formula or a formula that is as elemental as possible (eg, breast milk from a mother who has removed dairy from her diet)
 - ▶ Some children need total parenteral nutrition for nutritional rehabilitation if feeding exacerbates the symptoms

Constipation

- Functional constipation usually begins at age 1½–2 years old, when toilet training begins
- It manifests as infrequent, large, hard stools, sometimes predisposing to anal fissures
- Encopresis (overflow of bowel movement into the underwear) or intermittent overflow diarrhea can occur in severe cases
 - Treatment: clean out (typically administered over 2–3 days) is usually required first because megarectum tends to develop following chronic retention
 - Administer enema once a day for 2 days, followed by bisacodyl (5 mg tablet orally [PO] or 10 mg suppository every day for 1–2 days)
 - ▶ When used in an enema or child dose, halve the adult size (60 cc of phosphosoda)
 - ▶ **Never give an infant with rectal outlet obstruction an electrolyte solution**, such as phosphosoda enemas or polyethylene glycol 3350 electrolyte solution; this type of treatment has been reported to cause severe electrolyte disturbances and death in infants

- Mineral oil enemas are sometimes effective (1–2 cc/kg as single dose)
- Recommended daily medications are as follows:
 - ▶ Polyethylene glycol at a dose of 1 capful mixed with water, juice, or poured on soft food, given 1–3 times per day; this treatment has largely replaced the other daily medications listed below and should be tried first
 - ▶ Milk of magnesia: 1–2 cc/kg/day
 - ▶ Mineral oil: 1–2 cc/kg/day
 - ▶ Lactulose: 1–2 cc/kg/day
- Organic disorders that cause constipation
 - Hirschsprung disease: usually presents with obstructive symptoms and no bowel movement in the first 24 hours of life, but can also present later in infancy
 - ▶ Take abdominal films prior to rectal examination, flat plate then prone, cross-table lateral with hips slightly flexed (ie, “butt up”)
 - ▷ These show distended loops of bowel, but also the absence of air in the area that should be the rectal vault
 - ▷ Because rectal air will be expelled with a digital rectal examination, films must be taken first
 - ▶ Bowel movements are usually explosive and watery, which can be documented on a digital rectal examination (in which forceful expulsion of soft stool occurs on extraction of the examiner’s finger)
 - ▶ The physical examination reveals a long, tight sphincter canal
 - ▶ Follow this with a contrast enema to rule out etiologies besides Hirschsprung’s, such as microcolon and imperforate anus
 - ▶ Confirmatory diagnosis is only made by rectal biopsy
 - ▶ Treatment is surgical, but can be temporized by frequent rectal washings with normal saline (5–10 cc every 3 h) via a rectal tube (10–12 Fr red rubber catheter inserted a few centimeters from the anus)
 - When a newborn does not stool in the first 24 hours of life, obstructive lesions are possible, but also consider meconium plug syndrome
 - ▶ Usually benign

- ▶ Symptoms are relieved after contrast enema or serial rectal washings
- ▶ May indicate cystic fibrosis, but is not pathognomonic
- Anatomical defects
 - Some anatomical defects that can result in constipation include:
 - ▶ Anorectal malformations, such as imperforate anus, rectal stenosis, and anterior displaced anus
 - ▶ Microcolon (especially in infants of diabetic mothers)
 - ▶ Obstructive intestinal lesions, such as ileal atresia
 - ▶ Neurological disorders, such as caudal regression syndrome
 - Treat first with oral hyperosmotic agents, such as lactulose or milk of magnesia; eventually administer enemas as needed (patients with these conditions do not have adequate sensation to have a bowel movement)

Vomiting and Gastroesophageal Reflux

- If vomiting is bilious, an upper gastrointestinal (GI) series is imperative to rule out malrotation with volvulus, duodenal atresia, or atresia of the small intestine
- For nonbilious vomiting in an infant 4–6 weeks old, consider hypertrophic pyloric stenosis
- If vomiting is chronic, consider gastroesophageal reflux disease
 - Gastroesophageal reflux in children may present as respiratory disease (either apnea and bradycardia in infants, or asthma in older children)
 - Severe vomiting with failure to thrive, lethargy, or delayed development can be a sign of metabolic disease in infancy
- Another etiology of chronic vomiting in infants and children is peptic ulcer disease (especially if accompanied with abdominal pain), with or without *Helicobacter pylori*; and urinary tract infection, especially with hydronephrosis
- Laboratory evaluation for chronic vomiting or vomiting causing chronic problems (such as failure to thrive, abdominal pain, etc) includes:
 - Complete blood count (CBC)
 - Erythrocyte sedimentation rate complete metabolic panel

- Amylase
- Lipase
- Urinalysis and culture
- If possible, an upper GI series can also rule out malrotation in the presence of chronic vomiting
- Treatment
 - Treat gastroesophageal reflux disease in children using any of the following:
 - ▶ Ranitidine: 1–2 mg/kg bid
 - ▶ Omeprazole: 0.7–3 mg/kg/day (capsule can be emptied into yogurt or applesauce to encourage ingestion)
 - ▶ Over-the-counter antacids, such as aluminum hydroxide with magnesium hydroxide (1–2 cc/kg given frequently through the day with feeds; watch for changes in bowel movements)
 - ▶ Metoclopramide (0.1–0.2 mg/kg 3–4 times per day prior to a meal) may be helpful for infants as well
 - ▷ If possible, rule out malrotation with severe gastroesophageal reflux before adding this medication (and definitely if the emesis is bilious)
 - If *H pylori* is expected, the suggested antibiotics are similar to those recommended for adults, including the following:
 - ▶ Amoxicillin: 80 mg/kg/day divided bid
 - ▶ Clarithromycin: 15 mg/kg/day divided bid
 - ▶ Metronidazole: 15 mg/kg/day divided tid
 - ▶ Proton pump inhibitors: 1–2 mg/kg/day at weight-appropriate doses for 2 weeks
 - ▶ The usual choices are amoxicillin, clarithromycin, and omeprazole, but that can be altered if the patient is allergic to amoxicillin

Gastrointestinal Bleeding

- To treat GI bleeding, first check ABCs (airway, breathing, and circulation) and perform hemodynamic stabilization if bleeding is severe
- Take a patient history and perform a physical examination to determine etiology or source of the bleeding and ongoing losses

- Potential laboratory examinations include CBC, prothrombin time or activated partial thromboplastin time, liver function panel, disseminated intravascular coagulation panel, electrolyte panel with blood urea nitrogen/creatinine, blood type and cross-match, and stool guaiac
- If the patient has bloody diarrhea, send a stool sample for fecal leukocytes test and culture
- Consider blood transfusion
- Perform gastric lavage if upper GI bleeding is evident
- Etiologies are based on age
 - Toddlers to children of early school age: painless rectal bleeding (either hematochezia or melena) in large quantity that drops hemoglobin levels is likely Meckel's diverticulum
 - ▶ If this is suspected, admit the patient and observe by frequently checking hemoglobin levels
 - ▶ Radiologic diagnosis is made by Meckel's scan
 - ▶ Treat with surgical resection of the Meckel's diverticulum
 - In older children, significant upper GI bleeding is usually peptic disease, gastritis, or esophagitis
 - ▶ Occult liver disease can present as upper GI bleeding from esophageal varices in children
 - ▶ The other "at-risk" population includes patients who had omphalitis or umbilical cord catheterization complicated by portal vein thrombosis, causing portal hypertension
 - Another relatively common presentation of rectal bleeding is allergic colitis in an infant 1–2 months old
- The most common cause of lower GI bleeding in the first year of age is anal fissure. Treat using warm soaks and stool softeners

Chronic Abdominal Pain

- Warning signs of organic disease include frequent vomiting, diarrhea, GI bleeding, weight loss or failure to gain weight normally, associated systemic symptoms, nocturnal waking symptoms, localized pain, poor appetite, and early satiety
- *H. pylori* may cause vomiting associated with upper abdominal pain
- Intussusception presents with severe abdominal pain that

manifests as colicky pain, followed by bowel movement that may be appear as melena or bright red blood

- The classic appearance of the stool in the late stages is described as the “currant jelly stool” due to bowel wall ischemia
- In younger infants and children, subjective localized pain will be absent
 - ▶ On physical examination, tenderness can often be localized in the right lower quadrant
 - ▶ This presentation usually occurs in children 6 months–2 years old and is ileocolic
- A kidney, ureter, and bladder (KUB) radiograph will show paucity of bowel gas in the right lower quadrant, and a barium enema can be diagnostic and therapeutic
 - ▶ The risk of bowel perforation is higher during the diagnostic and therapeutic contrast enema if there has been a delay from the time of onset of symptoms; exercise caution
 - ▶ Admit and observe the patient; there is significant risk of recurrence in the first 24 hours, and fluids and electrolytes must be managed
 - ▶ If the enema does not reduce the intussusception, surgery will be needed for manual reduction
 - ▶ If it occurs in an older child or occurs in a less typical location, such as ileal-ileal, be wary of other types of lead points, such as polyp disease or cancer lesions (as in lymphoma)

Acute Abdominal Pain

- Omental cysts
 - May cause abdominal pain
 - May be difficult to diagnose on physical examination because of the large size and fluidity of the structure
 - Readily noticeable on ultrasound and computed tomography (CT) scan of the abdomen
 - Treatment is surgical resection
- Intraabdominal masses and tumors
 - Cause abdominal pain
 - Ultrasound and CT scan of the abdomen are sufficient for diagnosis

- Sometimes evident on a KUB radiograph
- Peptic disease, celiac disease, esophagitis, and colitis cause abdominal pain
- Nephrolithiasis and hydronephrosis, with or without urinary tract infection, can cause severe flank pain
- Cholelithiasis and cholecystitis
 - Uncommon in children; however, children may have congenital lesions that predispose them to these diseases
 - Sick cell and cystic fibrosis patients are also prone to these problems

Tube Feedings

- Tube feeding may be necessary for nutritional rehabilitation
 - Can be useful in the acute setting of a child with dehydration
 - Also useful for enteral drip fluid and electrolyte replacement when IV placement is impossible
- Usually the feeding tube is placed nasogastrically, but transpyloric feeds can be used in children if severe vomiting continues with a nasogastric (NG) tube
 - To encourage transpyloric stool passage, allow slack on the tube and add metoclopramide (0.1–0.2 mg/kg PO/IV)
 - Appropriate tube size depends on the patient's age (verify using Broselow tape):
 - ▶ Infants and toddlers: use an infant-sized tube or one measuring at most 6 Fr
 - ▶ Child 2–12 years old: 8 Fr; weighted tubes are easier to keep in place
 - ▶ Child > 12 years old: 10 Fr
 - Tube should be soft and changed periodically (approximately every 4–6 wk) if use is long term
- Feeding with a continuous drip is helpful in vomiting patients because more calories can be delivered with less vomiting
 - In the case of a transpyloric tube, continuous feeding is imperative; however, bolus feeds can also be given via the NG route
 - The appropriate fluids through an NG tube are formulas or electrolyte solution, not pureed foods

