Significant Causes of Pediatric Abdominal Pain

Abdominal distress is suspicious for different conditions at different ages. The authors provide an age-based guide to major concerns in the differential diagnosis and a review of three painful illnesses that may present in children of any age: appendicitis, gastroenteritis, and constipation.

By Alex Yeats, MD, and Jon D. Mason, MD

A major challenge that frequently confronts emergency physicians is accurately diagnosing and treating children with abdominal complaints. Although most presentations are non-life-threatening, certain disease states have a high potential for morbidity and mortality if unrecognized or not identified in a timely manner.

Many factors contribute to the difficulty of this process, most notably the variability of disease presentations and the inability of young children to verbalize their complaints or give an accurate history. Furthermore, abdominal pain may be the only presenting complaint in some conditions that are rooted in distant anatomic locations, including pharyngitis, pneumonia, urinary tract infections, diabetic ketoacidosis, sickle cell crisis, and myocarditis.

This article will review some of the most serious medical conditions causing abdominal pain in various pediatric age-groups followed by discussions of appendicitis, acute gastroenteritis, and constipation, which affect children of all ages.

UP TO 1 YEAR

PYLORIC STENOSIS

Pyloric stenosis occurs early in life, usually between 2 and 5 weeks of age. The underlying problem is hypertrophy of the pyloric muscle, of which the cause is unknown. It occurs in 1 out of 250 births in a 4:1 male to female ratio.[1] There also appear to be a familial predisposition and a higher prevalence in first-born males.

Dr. Yeats is a senior resident in emergency medicine and Dr. Mason is a professor of emergency medicine at Eastern Virginia Medical School in Norfolk, Virginia.

History and physical. In the first few weeks of life, the infant will be asymptomatic and will appear healthy. Subsequently, the caregiver will observe vomiting after feeding, usually within 30 minutes of each meal. After vomiting, the patient will frequently want to eat again. As the condition worsens, it causes projectile nonbilious vomiting, which may be frequent or strenuous enough to produce the "coffee ground" appearance or streaks of blood that indicate Mallory-Weiss tears.

The physical examination findings depend on the duration of symptoms. Early in the course, the patient may look well or, if vomiting has been severe, may show signs of dehydration and weight loss. While palpation of a pyloric mass known as the "olive" is well described in the literature, it is very difficult to palpate even for experienced practitioners. It is most often felt after the child has vomited and is calm.

Laboratory studies and imaging. Electrolyte and acid base status should be investigated. Upper gastrointestinal loss of hydrochloric acid will often result in hypochloremic alkalosis with concomitant hypokalemia. Blood urea nitrogen (BUN) may be elevated as a consequence of dehydration. In severe alkalotic states, one should carefully monitor breathing for apnea. Indirect hyperbilirubinemia can lead to jaundice.

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Pylorotomy by open incision or laparoscopy is the definitive treatment of pyloric stenosis.

The imaging study of choice is ultrasound. Sensitivities and specificities are both well above 90%.[2] A

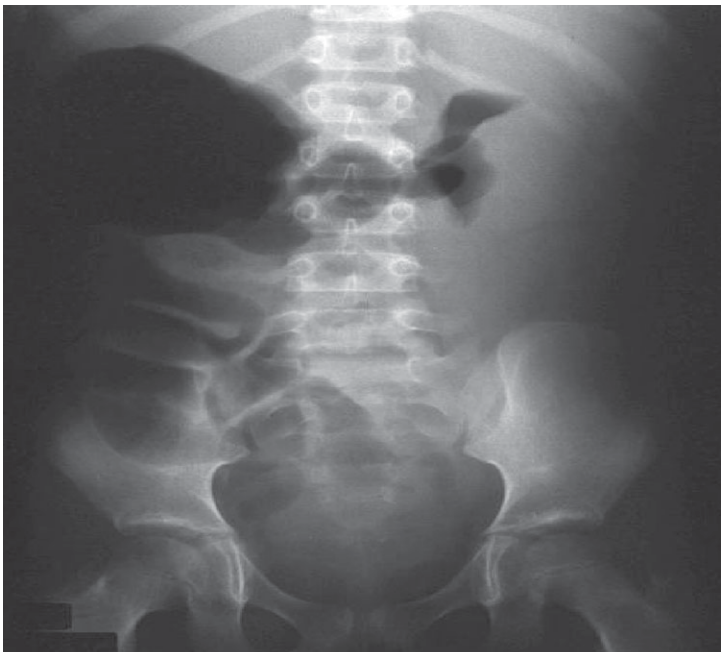

FIGURE 1. Clues to possible intussusception. Plain radiograph reveals a paucity of gas on the left side of the abdomen and dilated loops of bowel on the right.

Reproduced with permission from Rosen LM, Yamamoto LG.[4]

positive result will show a pyloric diameter between 10 mm and 14 mm. If the ultrasound is negative, an upper gastrointestinal study is often done next to rule out other conditions. Plain radiography may demonstrate excessive air within the stomach, showing it highly distended with a prominent incisura angularis (the "caterpillar sign").

Treatment. All affected infants require replenishment of intravascular volume deficits and correction of electrolyte abnormalities. Normal saline is the fluid of choice for volume replacement. Once that has been achieved, maintenance solutions will suffice.

Pylorotomy by open incision or laparoscopy is the definitive treatment of pyloric stenosis. The laparoscopic approach is no less effective and is associated with shorter hospital stays. Rarely, pyloric stenosis can also be managed medically.

MALROTATION WITH OR WITHOUT VOLVULUS

In children under the age of 1 year who manifest abdominal pain, one must consider intestinal malrotation, with or without volvulus. One of the most dangerous conditions of early infancy, volvulus is associated with significant morbidity and mortality, making prompt recognition imperative. Between 75% and 90% of cases of symptomatic malrotation are seen in children less than a year old; half occur within the first month of life.[3]

History and physical. In a child with volvulus, the most typical presentation is abdominal distension associated with bilious vomiting. Other frequently encountered symptoms include feeding intolerance, extreme irritability, fever, and signs of shock. Parents may also give a history of blood in the stool. Typically, the child appears ill, often with signs of hemodynamic compromise, and is inconsolable. Peristaltic waves in the epigastrium support the diagnosis.

Laboratory studies and imaging. As in any patient with signs of shock, a complete blood count (CBC), basic metabolic panel, and blood gas analysis should be ordered to assess for electrolyte abnormalities and acidosis. A high white blood cell count in association with acidosis is a strong indication of sepsis. Stool sampling for the presence of occult bleeding is indicated. Other considerations in the initial workup include blood and urine cultures.

The classic radiographic presentation of this diagnosis is the "double bubble sign," in which both duodenal and gastric air fluid levels are seen due to obstruction of the duodenum. Other features suggestive of obstruction are a bowel loop overriding the liver and a lack or paucity of bowel gas in the lower intestine (Figure 1).[4]

Treatment. Volume resuscitation should be initiated immediately to maintain cardiac output, and surgical consultation should be promptly undertaken. As in any patient with signs of obstruction, nasogastric tube placement is necessary.

Messineo and colleagues found that the presence and extent of bowel necrosis largely determines morbidity and mortality. In their investigation the survival rate was above 93% when 10% or less of bowel became necrotic. When 75% of bowel became necrotic, the survival rate dipped to 35%.[5]

INTUSSUSCEPTION

Intussusception occurs when a portion of bowel telescopes into an adjacent segment, leading to ob-

structive symptoms. The majority of cases occur in children between the ages of 6 months and 2 years. Two-thirds of cases occur before 1 year of age. The diagnosis should also be entertained in older children with certain medical conditions that predispose them to the condition.

History and physical. The classic triad of abdominal pain, vomiting, and rectal bleeding unfortunately is featured in only one-third of case histories.[6] Conversely, del Pozo and colleagues found, only 30% to 68% of patients with findings suggestive of intussusception actually have it.[2]

The pain of intussusception is colicky and parents will describe the patient as drawing up the legs to the abdomen or kicking them into the air. Between episodes, the child will often appear well. The vomiting will frequently be nonbilious early in the course. An interesting phenomenon has been the presence of lethargy in some infants. Many clinicians have noted this finding after the pain and vomiting paroxysms have remitted.[6] Simple diarrhea has also been noted to be an early symptom. These observations are important to consider because it may be tempting to ascribe the symptoms to a benign process such as gastroenteritis. Later in the course, vomiting becomes bilious and, as bowel necrosis occurs, the shedding of mucosa and blood will produce the more familiar "currant jelly stool" in about half of patients. A fecal occult blood test will be positive in 75%.[7]

Laboratory studies and imaging. In patients suspected of having intussusception, one should initially analyze a complete blood count and basic chemistry panel, focusing on BUN. Blood typing should also be ordered. Stool studies should focus on presence of occult blood. The diagnosis and therapy are radiographically accomplished by an air contrast or barium enema.

Abdominal radiographs and ultrasound are the two best choices for screening, but both have significant limitations. The overall sensitivity of radiography ranges from 40% to 90%.[2] Ultrasound sensitivity is highly user-specific; thus, ultrasound may not be appropriate in practitioners without significant experience in the pediatric population.

When analyzing plain radiographs, there are certain hallmarks to look for. A good place to begin looking is in the right upper quadrant, where a mass or filling defect known as the "target sign" may be apparent. A mass of telescoped bowel will have concentric areas of lucency that arise from mesenteric fat accumulation. Other possible clues are obscurity of the liver edge ("absent liver edge sign"); the meniscus sign, a crescent-shaped area of gas in the colonic lumen at the apical section of the intussusceptum (Figure 2)[8]; dilated loops of small bowel, and a paucity of gas in the distal colon. Conversely, a normal cecal gas pattern strongly points away from the diagnosis of intussusception.[9]

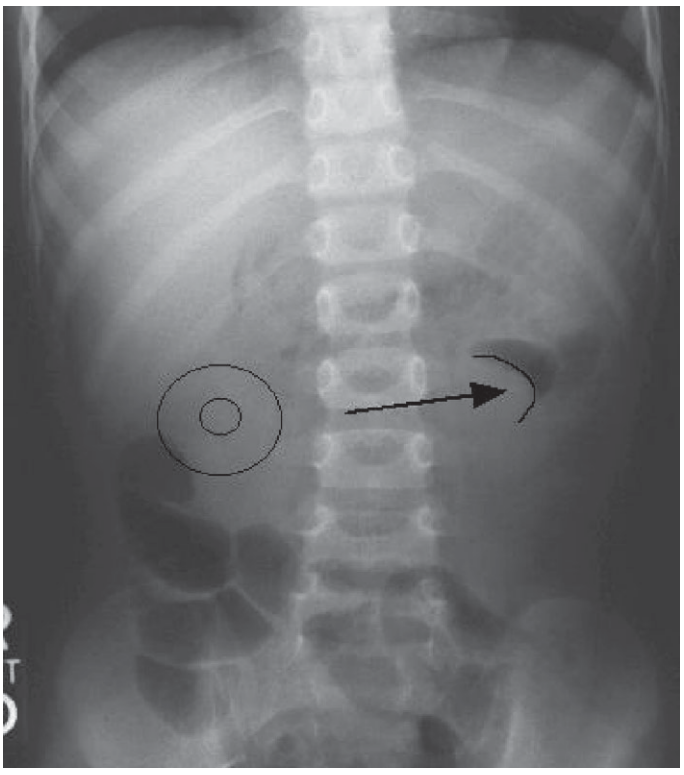

FIGURE 2. Crescent sign in intussusception. The "telescoped" bowel leaves this sign in some radiographs.

Reproduced with permission from Yamamoto LG.[8]

>>FAST TRACK<<

Only 30% to 68% of patients with findings suggestive of intussusception actually have it.

Ultrasound has proved to be highly sensitive and specific for diagnosing intussusception. Examination of current literature shows sensitivities near 100% and specificities ranging from 88% to 100%.[10,11] One of the key benefits of ultrasound is its ability to detect other pathological conditions that can mimic the presentation of intussusception. As more and more practitioners become skilled in the use of ultrasound,

the use of enemas may become limited to the treatment of established intussusception.

Treatment. Initial treatment is aimed at correcting fluid and electrolyte abnormalities. Enema is currently the modality of choice for both diagnosing and treating intussusception. There is no universal consensus as to which of three main types of enemas is best. Barium enema has the advantage of a low perforation rate (0.39%-0.7%).[2] The downsides of using barium are radiation exposure and the risk of chemical peritonitis if perforation should occur. As a consequence, many institutions prefer water-soluble contrast material. The other method used is air insufflation, which poses a slightly higher risk of perforation (2.8%).[2] Given the slight chance that this complication will make an urgent operative procedure necessary, it is prudent to notify the on-call surgeon when an air enema is about to be performed.

It is important to note that while the vast majority of cases of intussusception occur in infants, certain conditions do predispose older children to acquiring the condition. These include Henoch-Schönlein purpura, intestinal polyps (Peutz-Jeghers syndrome, familial polyposis coli, juvenile polyposis), cystic fibrosis, Meckel's diverticulum, and lymphoma.

INCARCERATED INGUINAL HERNIA

Diagnosing an incarcerated inguinal hernia can be a challenge as its presentation can be subtle. Premature infants, especially boys, are at increased risk.

History and physical. These hernias, which tend to be right-sided, are most often detected in the first year of life. The child typically will present with poor feeding, irritability, vomiting and, in males, a scrotal mass. Therefore it is critical to fully undress the child. If a scrotal mass is noted, the differential diagnosis should include testicular torsion, hydrocele, abscess, inguinal lymphadenopathy, and trauma.

A major error on the part of clinicians is not to examine the groin and genitalia in a vomiting or irritable infant. Removing the diaper for a complete physical examination may be all that is needed to make this diagnosis.

Treatment. Manual reduction is often successful. The patient should be placed in Trendelenburg position and sedated with morphine or a short-acting agent such as midazolam. The goal is to make the child as comfortable as possible and minimize crying to keep intra-abdominal pressure low. After a slow milking of the intestines back to their original position has been accomplished, the patient can be discharged to close follow-up by a pediatric surgeon. If the procedure fails, surgical reduction will be necessary.

1 TO 10 YEARS

HEMOLYTIC UREMIC SYNDROME

Hemolytic uremic syndrome (HUS) is a potentially fatal condition that frequently causes abdominal pain. It is the most common cause of renal failure in children and is seen most often in infants and young children. Two thirds of cases are in children under the age of 5 years.[12]

While there are many factors that are implicated in the pathogenesis of the condition, the result is always a triad of acute renal failure, hemolytic microangiopathic anemia, and thrombocytopenia. The precipitating event is a diarrheal illness in the vast majority of cases or, less commonly, an upper respiratory one.

The most common pathogen associated with HUS is a subtype of *Escherichia coli*, O157:H7, which produces a shiga toxin that affects vero cells and is therefore known as a vero toxin. Another bacterium that produces a similar toxin is *Shigella dysenteriae*. These two bacteria have been found to be associated with more than two thirds of HUS cases in children.[13] Other bacteria implicated include *Salmonella*, *Shigella*, *Campylobacter*, and *Yersinia* species. Additionally, some viruses such as coxsackie and echovirus have associations with HUS.

History and physical. Hemolytic uremic syndrome is described as having two subtypes referring to the presence (D+HUS) or absence (D-HUS) of diarrhea. The vast majority of cases are D+HUS, with diarrhea that can be bloody. The most common risk factors include eating poorly cooked beef and being exposed to farm animals. Additionally, human-to-human fecal-oral transmission is possible.

It is important to ask about urine output, which will be greatly diminished or absent. While HUS is commonly not thought to produce neurological symptoms, seizures are possible as a consequence of high levels of BUN.

Specific findings on the physical examination will often include petechiae or purpura, evidence of gastrointestinal hemorrhage. There is a potential for cardiac involvement and one should be attentive to signs of congestive heart failure.

Laboratory studies. To establish a diagnosis, microangiopathic hemolytic anemia must be demonstrated with the presence of schistocytes on peripheral smear. Bilirubin levels will be elevated with the unconjugated form predominating. A basic metabolic panel should be ordered to assess BUN, creatinine, and electrolytes.

When any bleeding disorder of unknown etiology is suspected, it is advisable to test prothombin time, activated partial thromboplastin time, and international normalized ratio and to run a disseminated intravascular coagulation panel, all of which will be normal in cases of HUS. Additional laboratory tests that should be ordered include a urinalysis, stool antigen for *E coli* O157:H7, and liver function tests.

Treatment. Treatment is largely supportive. Attention should focus on fluid overload and hyperkalemia as in most cases of renal failure. In severe cases, dialysis is the treatment of choice. Indications for dialysis include BUN above 100 mg/dL, encephalopathy, congestive heart failure, and hyperkalemia.[12] Packed red blood cells and platelet transfusion are indicated for treating anemia and thrombocytopenia.

Plasma exchange is sometimes employed, although it has not been shown to be effective. Transfusion of fresh frozen plasma has also failed to prove efficacious, as has antibiotic therapy, which should be avoided in any case because it may be a predisposing factor for HUS. With aggressive supportive treatment, survival rates are very high and renal function will return to normal levels in many patients.

10 YEARS AND OLDER

INFLAMMATORY BOWEL DISEASE

Inflammatory bowel disease (IBD)—clinically, ulcerative colitis and Crohn's disease—was once considered primarily a condition of adults. However, there has been a recent rise in the rates of IBD in children.

A prospective study by Kugathasan and colleagues demonstrated that the overall incidence of IBD was less than 5 per 100,000 in patients younger than 8 years and rose sharply to 13 per 100,000 at age 8.[14] The mean age at diagnosis was 12.5 years, and 80% of cases were diagnosed after age 10.

History and physical. The most common clinical features of IBD are abdominal pain, diarrhea, gastrointestinal bleeding, and fever. All these signs and symptoms are seen in other conditions, but the patient's growth rate may offer a more specific clue. Impaired nutrient absorption in IBD often retards development. Both ulcerative colitis and Crohn's do show familial trends, so it is imperative to ask about family history.

The physical examination should initially focus on the patient's hemodynamic status, as dehydration and anemia can be present. Extraintestinal manifestations such as arthritis, uveitis, and dermatologic manifestations (erythema nodosum or aphthous ulcers) are also possible. Erythema nodosum is an inflammation of adipose tissue that causes tender nodules, mainly on the extensor surface of the lower leg. Hepatobiliary disorders such as hepatitis and sclerosing cholangitis can be part of the picture.

Laboratory studies and imaging. Initial laboratory studies should include a CBC and a complete metabolic panel including liver function tests and serum albumin level. If significant bleeding has occurred, blood typing should be ordered as well. An erythrocyte sedimentation rate can be helpful, since it is elevated in the vast majority of cases. Stool studies should also be ordered to assess for blood and markers of inflammation.

Plain abdominal films have little value in establishing a diagnosis but may suggest other conditions such as obstruction, colitis, or toxic megacolon.

Treatment. Two important considerations that should serve as a guide to treatment include disease severity and history of previous IBD diagnosis. There are various classification systems to determine the severity of disease, but most are based on number of stools per day and associated laboratory values, as shown in Table 1.[12]

In moderate and severe cases, appropriate supportive care should be instituted with intravenous hydration to maintain hemodynamic stability followed by hospital admission. In cases with a previously established diagnosis, care should be directed by the patient's gastroenterologist.

In mild cases, one can discharge the patient to close follow up with a gastroenterologist even if a diagnosis has not been officially made. However, patients with moderate to severe abdominal pain should have a surgical consultation to rule out other intra-abdominal conditions that can mimic IBD.

Long-term treatment is centered around immunomodulators and anti-inflammatory agents with the goal of reducing inflammation while keeping side effects to a minimum. Among the most common med-

TABLE 1. Classification of Inflammatory Bowel Disease

Severity	Stools/day	Signs/symptoms	Laboratory values
mild	<6	absence of fever	absence of anemia
moderate	>6	temperature >38°C	serum protein <3.2 g/dL, hemoglobin <10 g/dL
severe	>6	severe abdominal pain/cramping, fever	low hemoglobin, WBC >15, hypoalbuminemia (<3.0 mg/dL)

Data extracted from Fleisher GR et al.[12]

ications are 5-aminosalicylate (5-ASA), 6-mercaptopurine, and infliximab. Steroid preparations, such as methylprednisolone, are useful in acute episodes.

COMMON CONDITIONS

APPENDICITIS

Appendicitis is the most common nontraumatic surgical disease of childhood. While appendicitis does occur in children less than 2 years old, the presentation is often different from that seen in older patients. Due to the inability of very young patients to accurately communicate their symptoms, presentation is delayed and perforation is more likely. Infants frequently present after perforation has occurred and peritonitis has set in. Perforation is associated with increased complication rates. The most common complications are infection at the incision site (3%) and abscess formation (less than 5%).[15]

>>FAST TRACK<<

Appendicitis is the most common nontraumatic surgical disease of childhood.

History and physical. Older children and adults will frequently complain initially of vague periumbilical pain followed by lateralization to the right lower quadrant before generalized peritonitis develops. Fever, anorexia, and vomiting usually begin after the onset of pain, but in approximately one-third of children, vomiting will be the first symptom reported by parents.[15] The position of the appendix within the abdomen also significantly influences where the pain will be felt. For example, an appendix that resides in the lateral gutter may produce flank pain, whereas an appendix pointing toward the left lower quadrant can cause dysuria secondary to bladder irritation.

Initial examination should focus on the behavior of the child. Lying still or complaining of pain while walking should raise suspicion for peritoneal irritation.

Auscultation may reveal absence of bowel sounds.[1] Depending on the progression of disease, pain may be localized to the right lower quadrant or involve the entire abdomen. Guarding or rebound tenderness is not always reliable early in the course.[15] Fever and anorexia, while common, are not universal. To further complicate the diagnostic process, appendicitis can follow a bout of gastroenteritis, which means that a child with presumed gastroenteritis whose pain is worsening needs vigilance and reassessment.

TABLE 2. Ondansetron Dosing During Oral Rehydration

Weight	Ondansetron dose
<8 kg	not established
8-15 kg	2 mg PO once
15-30 kg	4 mg PO once
>30 kg	8 mg PO once

PO = orally
Data extracted from Ramsook et al[16]; Reeves JJ et al.[17]

TABLE 3. Physiologic vs. Functional Causes of Constipation

Age	Cause	Considerations
infants	Hirschsprung disease	difficulty in passing stool from birth, or not passing meconium within first few days of birth
infants	cow's milk insensitivity or allergy	transitioning from breast milk to formula or formula to whole milk
toddlers	functional	start of toilet training
toddlers	illness	any cause of dehydration or diaper dermatitis
older children	attending school	reluctance to pass stool while attending school

There are a variety of examination findings that may aid in determining the presence of localized peritonitis. The most commonly noted ones include the obturator, psoas, and Rovsing's signs. However, the absence of a positive result should never be used to exclude the diagnosis. Other bedside tests that can be employed are the cough sign and the Markle sign. To check for the Markle sign, have the patient first stand on tiptoe and then quickly drop back to the flat-footed stance. The test is positive if the heel strike elicits abdominal pain. If coughing on command provokes or exacerbates pain in the tender area, the child has a positive cough sign.

Laboratory studies and imaging. Initial testing should include a CBC, basic metabolic panel, and urinalysis. Two key points to remember are that normal leukocytes do not rule out appendicitis (only 70% to 90% will have leukocytosis) and that ureteral inflammation can be secondary to appendicitis, although a finding of more than 20 white blood cells per high-power field makes urinary tract infection the more likely cause.

Ultrasound and CT are the imaging modalities of choice. Different combinations of intravenous, oral, and rectal contrast are utilized and are institution-specific. If there is a strong suspicion of appendicitis on history and physical alone, no imaging studies need to be ordered.

For the sake of limiting radiation exposure, ultrasound may be the initial test of choice. Sensitivity ranges from 80% to 92% with a specificity of 86% to 98%.[12] The finding most suggestive of appendicitis is a noncompressible dilated appendix. Ultrasound can also detect other pathologic conditions such as tubo-ovarian abscess formation, ovarian torsion, and cysts.

If the sonographic findings are equivocal, a CT scan is appropriate. It performs with 87% to 100% sensitivity and 83% to 97% specificity[12] and may be superior to other methods for obese patients in particular.

Treatment. Initial treatment in the emergency department includes correction of fluid and electrolyte derangements. An initial bolus of isotonic fluid of 20 mL/kg followed by maintenance therapy is often adequate. If excessive vomiting and diarrhea have occurred, additional fluid boluses are indicated.

Rectal acetaminophen should be given if fever is present. Intravenous analgesics should also be administered for patient comfort without fear that subsequent abdominal exams may be unreliable. A broad-spectrum antibiotic such as ampicillin/sulbactam, cefoxitin, piperacillin/tazobactam, or cefotetan is warranted when perforation has occurred.

Surgical consultation is warranted in all suspected cases. The surgeon may elect to observe equivocal cases for a period of time, employing serial abdominal exams, or to perform an appendectomy. It is important to be wary of signs of symptomatic improvement. What looks like remission can actually be a transient effect of perforation that will be followed by peritonitis and clinical deterioration.

GASTROENTERITIS

Gastroenteritis, while mostly a benign condition in the United States, does have the potential for significant morbidity and mortality related to dehydration.

TABLE 4. Anatomic Causes of Constipation

Finding	Significance
loss of anal wink (elicited by stroking anal margin)	motor or sensory nerve defect
sacral dimple	caudal spinal cord abnormality
fissure, hemorrhoids	pain on defecation
anterior displaced anus	formation of posterior shelf causing constipation
passage of thin or ribbon-like stool	anal stenosis or anal flap

The history and physical is especially important to establish a diagnosis and assess the degree of dehydration. An attempt should be made to determine whether the cause is viral or bacterial, an important consideration for both treatment and disposition.

History and physical. Important aspects in the history that point to viral gastroenteritis include frequent watery stools in the absence of high fever and significant abdominal pain. In most cases of gastroenteritis, vomiting or diarrhea precede the onset of abdominal discomfort. Symptoms that last longer than 14 days point away from a simple viral cause and should raise suspicion for parasitic and noninfectious etiologies.

It is also important to identify the quantity and quality of both diarrhea and vomiting. Vomiting that is both predominant and persistent warrants consideration of gastroesophageal reflux disease, gastric outlet problems, central nervous system abnormalities, diabetic ketoacidosis, and urinary tract infection. Diarrhea that is bloody or mucoid makes a bacterial cause more likely. In such cases stool studies should be undertaken, including culture and Gram staining for fecal leukocytes.

Treatment. Determining the degree of dehydration is an important consideration in choosing a resuscitative strategy. Indicators that can help to categorize dehydration as mild, moderate, or severe based on percentage of water loss include skin turgor, condition of mucous membranes, heart rate, respiratory rate, capillary refill time, sunken fontanelle, sunken orbits, and mental status. In severely dehydrated patients (which implies greater than 10% fluid loss), depressed level of consciousness, delayed capillary refill (exceeding 2 seconds), cool, mottled extremities, sunken orbits, and tachycardia may be seen. Aggressive intravenous rehydration should be instituted immediately. Differentiating mild (3% to 5% fluid loss) from moderate (6% to 9% loss) dehydration is more challenging.

While many studies have attempted to quantify degrees of dehydration, their methods can be impractical in clinical settings. A recent meta-analysis determined that only decreased skin turgor, capillary refill, and hyperpnea had statistically significant positive and negative likelihood ratios for detecting dehydration in children.[5] Therefore, if a child is not already classified as severely dehydrated, the presence of one or more of the three previously mentioned findings indicates moderate dehydration.

In cases of mild to moderate dehydration, oral rehydration therapy may be instituted. Oral rehydration therapy has been credited with shorter hospital stays, fewer adverse events, and a failure rate (patients requiring intravenous hydration) of only 4%.[5]

The type of oral rehydration solution that should be used has been subject to debate, but in the United States, reduced-osmolarity formulas such as Pedialyte, Infalyte, or Naturalyte are recommended. One should attempt to give 50 to 100 mL/kg over 2 to 4 hours. Essentially, 5 mL every one to two minutes will achieve adequate results.

Various antiemetics have been studied in conjunction with oral rehydration therapy. Administration of ondansetron (Table 2) is associated with decreased frequency of vomiting, fewer treatment failures, and fewer hospital readmissions.[16,17]

CONSTIPATION

Constipation (defined as infrequent or painful defecation) is another very common complaint in the pediatric population and one that can develop at any age. It

accounts for 3% to 5% of all visits to outpatient clinics and 35% of visits to pediatric gastroenterologists.[5]

History and physical. Obtaining a thorough history is important in determining the cause. Table 3 highlights some of the key issues at various ages. Distinguishing between functional causes and underlying anatomic or physiologic problems is crucial to the assessment. The physical examination should focus on the anus and perineum. Table 4 lists some anatomic abnormalities that can cause constipation. Radiographs can aid the diagnosis, but it is essentially clinical.

Functional constipation develops when children associate defecation with pain and consequently resist the urge to defecate. As time progresses, the normal physiologic reflexes within the rectum are lost. The result is rectal dilation and more infrequent passage of large stool, which further reinforces the behavior. Rectal sensitivity further declines, leading to fecal incontinence (encopresis).

Patients with anatomic defects should be referred to a pediatric gastroenterologist or surgeon. Those with medical conditions that can produce constipation should be evaluated for corresponding signs and symptoms. Any disease state that can lead to water loss, such as recent gastroenteritis, fever, diabetes mellitus, diabetes insipidus, or renal tubular disorder, can result in constipation. Other medical conditions that may account for constipation include hypothyroidism, hyperparathyroidism, and neuromuscular disorders such as cerebral palsy, myasthenia gravis, and muscular dystrophies.

Treatment. Constipation may require a multifaceted therapeutic approach, depending on the cause. For immediate symptomatic relief, stool evacuation should be accomplished using stool softeners, cathartics, or enemas. Cathartics include sodium phosphate, magnesium citrate, and polyethylene glycol. It may be difficult to get younger children to ingest these substances, making the use of enemas or suppositories more practical. The patient's age should dictate which enema is used. In infants it is important to avoid tap water or soap enemas because water intoxication can occur; a phosphate solution is preferable. Generally, in patients over 3 years of age an adult dose can be used, and for younger patients, one pediatric enema is sufficient.[12] To avoid hyperphosphatemia, phosphate enemas should not be used in dehydrated children.

In the absence of anatomic defects or medical conditions, functional constipation should be managed with both dietary and behavioral modifications. Appropriate recommendations include increasing fiber and fluid intake, administering nonstimulant laxatives and lubricants such as mineral oil, and encouraging regular toileting through positive reinforcement. All patients with constipation need careful follow-up with their primary care provider. □

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