

1. d. Common causes of lower GI bleeding in the well-appearing infant include dietary protein allergy, anal fissures, and infectious colitis. The most likely cause of bleeding in this child is a dietary protein allergy. The most common cause of a dietary protein allergy is cow's milk protein, but infants can also develop allergies to soy protein or to breast milk (most likely in response to an allergen in the maternal diet). This is treated by eliminating the offending protein from the diet, and children should be switched to casein containing formulae (e.g., Nutramigen® or Alimentum®). Hematochezia should resolve within a few days. Adjunctive tests may be helpful. A CBC will help assess this child's hematologic status and while not a sensitive marker, the presence of eosinophilia suggests an allergic colitis. Fecal leukocytes are found in both allergic and infectious colitis. Stool culture is important in detecting the presence of a bacterial colitis. Left untreated, bacterial gastroenteritis is more likely to lead to serious sequelae in infants. A contrast enema is the diagnostic study of choice for suspected intussusception. Intussusception can lead to bloody stools; however, children who have blood in their stools are usually symptomatic, and intussusception in this young an infant would be unusual.
2. b. The child has a presentation that is consistent with constipation. He is afebrile, has poorly localized pain, and an unimpressive physical examination. Common causes of constipation in an otherwise well appearing child include anal fissures, dietary causes, and functional constipation. Much less common, but obviously more serious, causes of constipation include Hirschsprung's disease, bowel obstruction, and infantile botulism. A rectal examination is important in detecting an anal fissures or a dermatitis that may lead to painful defecation and retention of stool. The presence of hard or large stools in the rectal vault supports the diagnosis of constipation. Laboratory tests and CT may be considered if the child's presentation is atypical for constipation, but they should be performed only after a rectal examination. An oral challenge is unhelpful in making a specific diagnosis in this child.
3. a. This patient most likely has biliary atresia, characterized by failure of bile secretion with resultant jaundice, hepatomegaly, and direct hyperbilirubinemia. Typically, these patients have gradually worsening symptoms. Sepsis can cause direct hyperbilirubinemia, but usually these children are not otherwise asymptomatic. While acetaminophen toxicity can lead to liver failure and direct hyperbilirubinemia, this would be a highly unusual presentation in a young infant without any other signs or symptoms. In contrast with adults, cholecystitis is an unusual cause of direct hyperbilirubinemia in children. Notable exceptions include patients with hemolytic anemias, most commonly sickle cell disease.
4. d. Intussusception is the most common cause of intestinal obstruction in young children. Most commonly, these patients present between 1-2 years of age with paroxysmal abdominal pain and vomiting. Early in the course of intussusception, the child may look well in between these episodes of pain, but as the intussusception progresses, these patients typically look more ill. As the intestinal mucosa becomes ischemic because of the intussusception, the sloughed, bloody mucosa becomes mixed in with the stool, resulting in the classic "currant jelly" appearance. However, this is a late and insensitive finding. Some children have a relative lack of abdominal complaints, and instead present with lethargy. Younger children typically have idiopathic intussusception, while older children often have an identifiable "lead point" for

their intussusception (e.g., polyp, intestinal purpura from Henoch-Schonlein purpura). Plain x-rays may be of diagnostic benefit. These films may demonstrate findings consistent with obstruction, and occasionally, the intussusceptum may be visible as a soft-tissue mass on the radiographs. However, the plain films may also be normal.

5. d. This patient has hemolytic uremic syndrome (HUS) characterized by the triad of microangiopathic hemolytic anemia, thrombocytopenia, and acute renal failure. The underlying pathophysiology is thought to be a thrombotic microangiopathy, and the most commonly identified precipitant is infection with *E. coli* O157:H7. Patients develop bloody diarrhea, vomiting, and abdominal pain because of injury to the gastrointestinal vasculature. Patients develop an anemia because of destruction of red blood cells in the circulation, and intravascular clumping results in thrombocytopenia. Renal failure results from microvascular injury to the renal microvasculature, and HUS is the most common cause of acute renal failure requiring dialysis in children. Similarly, microvascular injury can lead to variable neurologic symptoms. Steroids do not improve the prognosis in these patients; while most patients improve with supportive care, the mortality rate with this illness is 5-10%.
6. d. Inflammatory bowel disease (IBD) is a general term used to describe ulcerative colitis and Crohn's disease. Ulcerative colitis causes inflammation and ulceration of the mucosa and submucosa of the colon, while Crohn's disease is a transmural inflammation associated with granulomas that affect any part of the gastrointestinal tract. Both of these diseases can present with similar symptoms. IBD usually presents insidiously, associated with abdominal pain, fever, diarrhea, and poor growth. Extraintestinal manifestations, such as uveitis, arthritis, and erythema nodosum are more common with Crohn's disease. Patients with IBD can present to the ED with life-threatening complications. Toxic megacolon is a dramatic complication of IBD; this likely results from extension of the inflammatory process through all layers of the intestinal wall, resulting in loss of colonic tone, ileus and perforation with resultant peritonitis and sepsis. While rectal bleeding associated with IBD is usually occult, occasionally patients can present with significant rectal bleeding. Ongoing intestinal inflammation and injury may lead to stricture formation and obstruction. Not uncommonly, patients with IBD have undergone surgery; these patients are at risk for obstruction from surgical adhesions.
7. a. Pyloric stenosis is typically found in infants in the first few weeks of life and is more common in males. Typically, babies have emesis that becomes more forceful, characteristically described as projectile vomiting. This vomiting is *not bilious*, as the level of obstruction is proximal to the insertion of the common bile duct. Patients appear hungry and want to feed despite vomiting. The hypertrophied pylorus, sometimes described as an "olive" because of its similar shape and size, may be felt on physical examination. These patients are often dehydrated, and their frequent emesis results in a hypochloremic, hypokalemic metabolic alkalosis. Diagnosis can be confirmed by ultrasonography or an upper GI series. The upper GI will produce a "string sign," a thin ribbon of contrast passing through the narrow, elongated pyloric channel. Patients are treated by pyloromyotomy.
8. b. This patient has Henoch-Schonlein purpura, a vasculitis characterized by a purpuric rash (predominantly on the lower extremities), arthralgias, nephritis, and abdominal pain. The abdominal pain is caused by edema and hemorrhage in the gastrointestinal mucosa. Purpura in the intestinal mucosa may serve as a lead point for intussusception, and patients can develop either occult or frank gastrointestinal bleeding. Renal involvement is common, but patients *rarely* develop renal failure. Treatment is primarily supportive, but patients with more severe symptoms frequently benefit from steroid therapy.

9. c. Sudden-onset of bilious emesis in an ill-appearing neonate should prompt consideration of malrotation and midgut volvulus. Malrotated bowel and mesentery is predisposed to undergo volvulus, resulting in compromise of the vascular supply to the bowel causing ischemia and infarction. This is a catastrophic event, since bowel necrosis can occur within a few hours. An upper GI series is the imaging study of choice to confirm this diagnosis (a contrast enema would be more appropriate in a patient with suspected intussusception), but this is a patient whose clinical signs and symptoms are highly suggestive of malrotation with signs of ongoing ischemia. Immediate pediatric surgical consultation is warranted and surgical intervention must not be delayed.
10. d. Pancreatitis in children occurs less commonly than in adults and typically presents with vomiting and epigastric abdominal pain. Pancreatitis occurs because of blunt abdominal trauma or infections (e.g., coxsackievirus, mumps, hepatitis A and B). A significant number of children have idiopathic pancreatitis. Biliary disease is a relatively uncommon cause of pancreatitis in children.
11. c. Patients with Shigella typically have a relatively low WBC (<10,000 cells/mm³) with a left shift. Although many patients with Shigella have mild, clinically nonspecific gastroenteritis, the classic gastrointestinal manifestations of this illness is bacillary dysentery, associated with fever, crampy abdominal pain, bloody and/or mucoid stool, and tenesmus. Bacteremia is seen much less commonly than in patients with Salmonella gastroenteritis, and intestinal perforation is a rare complication. In patients with Shigella gastroenteritis, antibiotic therapy is felt to be beneficial because therapy shortens the duration of diarrhea and eradicates the organism from the stool. Trimethoprim-sulfamethoxazole is the antibiotic of choice.
12. a. Young children can develop both primary and secondary gastric and duodenal ulcers. While children can present with upper gastrointestinal bleeding, more commonly, children complain of feeding difficulties, vomiting, and abdominal pain. Most children with upper gastrointestinal bleeding present with small flecks of blood from mucosal lesions (e.g., gastritis, peptic ulcer disease, small Mallory-Weiss tears from repetitive or forceful vomiting). In the absence of significant bleeding, abdominal pain, hemodynamic instability or other worrisome historical or physical exam findings, most children do not need nasogastric tube placement. Esophageal varices are an uncommon cause of upper GI bleeding and are seen in patients with portal hypertension resulting from extrahepatic obstruction or diseases of the liver parenchyma. While a neonate may have serious underlying problems causing hematemesis (e.g., vascular malformations, vitamin K deficiency or hematologic disorder, stress ulcers), hematemesis in the newborn is most commonly a result of swallowed maternal blood from either the delivery or bleeding from the mother's nipples in a breast-fed infant.
13. c. Many medications can cause hepatotoxicity, and 15-20% of children with fulminant liver failure have toxin-induced liver failure. The most common medication causing hepatotoxicity is acetaminophen, and the most common brand name for acetaminophen is Tylenol®. However, acetaminophen is a component of many pain medication combinations, including Vicodin® (acetaminophen/hydrocodone), and it is important to treat patients who have overdosed on these medications for both opiate and acetaminophen toxicity. Iron overdose can also lead to hepatocellular injury. Opiates and synthetic opiates, such as OxyContin®, are not associated with liver toxicity.
14. c. Appendicitis is one of the most common conditions requiring surgical intervention in children. Most children with appendicitis have poorly localized midabdominal pain, frequently associated with anorexia, vomiting, and fever. When this constellation of

symptoms is followed by radiation of pain to the right lower quadrant, appendicitis is a strong diagnostic consideration. However, the diagnosis of appendicitis is rarely this obvious. The signs and symptoms of appendicitis overlap with many other conditions. Clinicians often misdiagnose appendicitis as gastroenteritis because of the presence of diarrhea; however, up to one-third of patients with appendicitis have diarrhea because of appendiceal irritation of the sigmoid colon. Because of the difficulties in making this diagnosis, perforation is a more common complication in younger children. The omentum is responsible for walling off a perforated appendix, but because this is not as well developed in younger children, they are more prone to developing generalized peritonitis. The presence of a fecalith on an abdominal x-ray is highly suggestive of appendicitis, but this finding is present on less than 10% of radiographs in patients with appendicitis. Both ultrasound and CT scanning are highly sensitive and specific when interpreted by experienced radiologists.

15. a. This patient is most likely to have bleeding from a Meckel's diverticulum. A Meckel's diverticulum is a remnant of the embryonic yolk sac and represents the most common congenital gastrointestinal malformation. The diverticulum frequently contains ectopic gastric mucosa, and bleeding (often painless) is caused by erosion at the junction of the gastric mucosa and the normal ileal mucosa. This is often associated with the "Rule of 2's"; 2% of the population has a Meckel's diverticulum, the diverticulum is located 2 feet proximal to the ileocecal valve, the diverticulum is typically 2 inches long, and only 2% of patients with Meckel's have any complications. Clinically, children typically present with painless rectal bleeding. Diagnosis is usually made by nuclear imaging studies ("Meckel's scan"), and the treatment for this is surgical removal. Inflammatory bowel disease and bacterial gastroenteritis can both cause rectal bleeding, but this bleeding typically occurs along with other symptoms. While allergic colitis can cause painless rectal bleeding, this is usually seen in neonates and infants.
16. a. GERD is a very common gastrointestinal problem in children. Younger children frequently present with spitting up or vomiting, but they may only have non-specific findings such as refusal to eat, failure to thrive, irritability, and sleep disturbances. In older children, patients complain of retrosternal, burning discomfort. While most children with GERD have a relatively benign course, GERD can be associated with laryngospasm and apnea in infants and is probably responsible for some deaths misclassified as deaths from sudden infant death syndrome. Treatment for GERD is addressed in a stepwise fashion. Initially, patients are treated conservatively (eg, thickening of feedings, smaller but more frequent feedings, avoidance of feedings before bedtime). If this is ineffective, then children are put on prokinetic and H₂-blocking agents. Patients who fail these measures are potential candidates for fundoplication.
17. b. Chronic constipation in an infant is worrisome. Functional constipation, a common cause of chronic constipation in older children, is rare in infants. Constipation can be caused by infant botulism, but this is usually accompanied by progressive hypotonicity and lethargy. Congenital hypothyroidism can cause chronic constipation, but this is usually detected by universal newborn screening programs. Infants usually have other findings (e.g., hypothermia and hypoactivity, coarse facies, large tongue) as well. This boy's history is most consistent with Hirschsprung's disease, also known as aganglionic megacolon. This is caused by the absence of parasympathetic ganglion cells in segments of the colon, leading to unopposed sympathetic stimulation. This, in turn, causes increased intestinal tone and loss of peristalsis. Clinical features include constipation, vomiting, and abdominal distension (this can mimic acute intestinal obstruction in neonates). Palpable stool on abdominal examination with an

absence of stool in the rectal vault is characteristic. The diagnostic gold standard is rectal biopsy, and treatment involves surgical correction.

18. b. This girl most likely has hepatitis A. This is an acute, self-limited illness and frequently does not come to medical attention. Approximately 30% of children less than 6 years of age develop symptomatic hepatitis, and only a small percentage of these patients develop jaundice. Although prolonged disease (as long as 6 months) can occur, fulminant hepatitis is rare, and patients do not develop chronic infection. Because this is transmitted via a fecal-oral route, hepatitis A is frequently seen in the context of community-wide infections such as in day care or custodial care institutions. Hepatitis A vaccines can be used for prophylaxis and are frequently administered to high-risk groups (e.g., people traveling to or living in areas with high endemic rates of infection).
19. e. It is important to emphasize that abdominal pain is a very common complaint in children and may be the manifestation of many extra-abdominal pathologic processes. Children with abdominal pain should undergo a complete physical examination.