Lower gastrointestinal (LGI) bleeding in the pediatric patient 5 years of age or younger is an uncommon ED presentation that causes anxiety and concern both in the child’s family and in the clinician. A report from Boston Children’s Hospital in the early 1990s showed that rectal bleeding was a presenting complaint in 0.3% of pediatric patients who visited the emergency department (ED) within a 1-year period. The emergency clinician may find this presentation daunting, since the differential diagnosis of LGI bleeding includes numerous age-specific disorders not found in the adult population, ranging from self-limited anal fissures to surgical emergencies. The time to diagnosis and reduction will influence morbidity and mortality in these patients; hence, the emergency clinician should have a high index of suspicion as well as knowledge of current evidence for diagnosis and treatment. This issue of Pediatric Emergency Medicine Practice reviews the common differential diagnoses of LGI bleeding in children younger than 5 years of age, relying on the best available evidence from the literature. Readers will be able to apply clinically appropriate guidelines regarding diagnosis and treatment in an effective and patient-specific manner. In particular, this article focuses on the challenge of evaluating and managing the pediatric patient with intussusception.

CME Objectives

Upon completion of this article, you should be able to:

1. Identify an appropriate differential diagnosis for LGI bleeding based on the patient’s age.
2. Describe key features of the history and physical examination that may identify intussusception in children who present with LGI bleeding.
3. Determine appropriate indications for imaging modalities in LGI bleeding and intussusception.

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Medium: Print and Online
Method of participation: Print or online answer form and evaluation
Prior to beginning this activity, see "Physician CME Information" on the back page.
Case Presentation

A 3-year-old female presents to your ED with the chief complaint of diffuse abdominal pain and nonbloody, nonbilious vomiting over the past 2 days. Her mother tells you that, after vomiting, the child becomes “lethargic and lies still in pain.” These events are self-limited, lasting a few minutes. The patient is otherwise healthy and has been afebrile without diarrhea. On physical examination, the child appears well and is interactive but is somewhat listless. She has no fever and, except for a heart rate of up to 115 beats per minute, her vital signs are within normal limits. Auscultation of her abdomen indicates normoactive bowel sounds. Her abdomen is soft and distended, with mild diffuse tenderness. A fecal occult blood test comes back positive. Her intermittent abdominal pain raises your suspicion for possible intussusception, which is suggested by the presence of occult blood in the stool. With many imaging modalities available, as well as consultants on hand, you suspect you’ll be able to confirm or confidently rule out this diagnosis.

Introduction

The possibility of bleeding from the LGI tract in a young child causes anxiety for the child’s family. The general emergency clinician may find this presentation daunting, since the differential diagnosis of LGI bleeding includes numerous age-specific disorders not found in the adult population. Many emergency clinicians do not feel comfortable discharging the pediatric patient with recent LGI bleeding, and disposition can present a challenge. By assessing for age-specific pathologies and obtaining a thorough clinical history and examination, the emergency clinician will narrow diagnostic choices, thereby optimizing management and further care of the pediatric patient with LGI bleeding.

This issue of Pediatric Emergency Medicine Practice will review the common differential diagnoses of LGI bleeding in children younger than 5 years of age, relying on the best available evidence from the literature. In particular, it will focus on the challenge of evaluating and managing the pediatric patient with intussusception. The emergency clinician will be able to apply clinically appropriate guidelines regarding diagnosis and treatment in an effective and patient-specific manner.

Critical Appraisal Of The Literature

A large number of articles have been published regarding outcomes in patients with intussusception who were treated with various modalities; specifically, hydrostatic and pneumostatic reduction and surgery. Much of this research involved retrospective cohort studies. This review focuses on these findings in detail.

An extensive search of the literature on pediatric LGI bleeding and intussusception between 1970 and 2011 using Ovid MEDLINE® and PubMed was conducted. Keywords included pediatric GI bleeding, intussusception, Meckel diverticulum, bowel malrotation, milk-protein sensitivity, milk-protein allergy, pediatric GI hemorrhage, blood per rectum, inflammatory bowel disease, necrotizing enterocolitis, GI arteriovenous malformation, and pediatric rectal/anal trauma. The search was limited to studies involving persons between 0 and 18 years of age.

Epidemiology And Etiology

Lower Gastrointestinal Bleeding

Lower gastrointestinal bleeding refers to blood loss that occurs in locations distal to the ligament of Treitz in the duodenum. A report from Boston Children’s Hospital in the early 1990s showed that rectal bleeding was a presenting complaint in 0.3% of pediatric patients who visited the ED within a 1-year period. 1

The causes of LGI bleeding in children are best categorized according to age at presentation, although these groupings do overlap. Common etiologies of LGI bleeding are shown in Table 1. Causes of LGI bleeding in developed countries differ from those seen worldwide because of variations in the prevalence of infectious diseases.

In children 5 years of age or younger, LGI bleeding is caused by infectious agents, venous and other anatomic malformations, trauma, colitis, Meckel diverticulum, or intussusception. (See Table 1.) The most common cause of LGI bleeding in children 5 years of age and younger is anal fissures, which are identified on physical examination. 2

Malrotation is a congenital anomaly that occurs due to incomplete rotation and fixation of the gut during intrauterine development. It is found in 1 in 500 live births. 3 This congenital abnormality should be considered when LGI bleeding occurs in the child with volvulus accompanied by obstruction and bowel necrosis. Forty percent of children with malrotation will present during the first week of life, and up to 80% present before they reach 1 year of age. 4

In the newborn, milk-protein allergy is a common cause of allergic proctocolitis with rectal bleeding. The median age of onset in cow’s milk-protein-sensitive enteropathy is 3.5 months. 5 Allergic proctocolitis may present with hematemesis; mucoid, bloody diarrhea; and/or chronic, watery diarrhea. Given the allergic nature of this disease process, infants who are solely breast-fed will present with symptoms later than formula-fed infants. 5 When a massively bloody stool is evident, other serious etiologies such as necrotizing enterocolitis or malrotation should be investigated. 6
Infectious causes of LGI bleeding include *Campylobacter*, *Shigella*, enteroinvasive and enterohemorrhagic *Escherichia coli*, *Salmonella*, *Yersinia*, *Clostridium difficile*, and *Entamoeba histolytica*. These pathogens cause direct injury by attaching to and invading the epithelium and mucosa, with subsequent stimulation of the leukocyte inflammatory response. *C. difficile* is known to give rise to pseudomembranous colitis. Allergic proctocolitis due to milk-protein sensitivity occurs via an IgE-mediated inflammatory response.

Trauma can cause LGI bleeding in the pediatric population. Blunt and penetrating injuries to the abdomen can present with hematochezia. Sexual abuse must be considered in a young patient with evidence of anal trauma. Trauma to the bowel wall upon straining or during passage of a hard stool or with the introduction of a foreign body can result in rectal bleeding. Even the seemingly innocuous insertion of thermometers or enemas can cause rectal perforation in the newborn. In addition, structures such as polyps or venous malformations may bleed spontaneously upon trauma by passing stool.

Inflammatory bowel disease (IBD), such as Crohn disease or ulcerative colitis, is rare in young children but can result in LGI bleeding. The incidence of IBD in children is reported to range from 1.1 to 2.4 per 100,000 and appears to be increasing. Fifteen percent of all diagnoses of IBD are made in children younger than 6 years of age. The majority of pediatric patients with IBD (56%) are diagnosed with Crohn disease. Defective host mucosal immune cells incite an inappropriate response to microbial antigens, leading to inflammation and ulceration. In ulcerative colitis, the inflammation and ulceration are limited to the colonic mucosa, almost always involve the rectum, and might extend proximally. Crohn disease can occur anywhere in the gastrointestinal (GI) tract, with transmural ulceration and granuloma formation, and is known to skip bowel segments, resulting in patchy areas of disease.

### Intussusception

Intussusception is an important cause of occult or gross LGI bleeding in the pediatric patient. Eighty percent of children who present with intussusception are 2 years old or younger, with the majority of cases occurring in infants between 5 and 10 months of age. The incidence of childhood intussusception is estimated to be 1 in 2000 live births in the United States, and a study from Australia cites an incidence of 1 out of 1450 pediatric ED visits. The ratio of occurrence in males to females is 3:2. There is no consensus regarding the seasonality of this disorder.

Intussusception is the leading cause of intestinal obstruction in children 5 months to 3 years of age. It is also one of the most common causes of acute abdominal emergency in young children. Morbidity and mortality are associated with the time to diagnosis and the efficacy of management. In 2007, Kaiser et al noted that symptoms lasting longer than 24 hours, as compared with those of shorter duration, were associated with a greater need for surgery (73% vs 45%; *P* < 0.001) and bowel resection (39% vs 17%; *P* = 0.001). In the United States, mortality due to intussusception is approximately 1% among children who received an early diagnosis, fluid resuscitation, and therapy. Parashar et al reported that intussusception-associated infant mortality rates were 2.3 per 1,000,000 live births during 1995-1997, with a greater risk of dying among infants whose mothers were younger than 20 years of age, nonwhite, and unmarried, with an education level below grade 12.

Intussusception is rare in adults, accounting for only 5% to 16% of reported cases. The causes of intussusception, both known and postulated, are varied. Up to 90% of cases, particularly in young children, are idiopathic, and a clearly identifiable origin or specific disease process cannot be detected. The most common cause of intussusception is thought to be hyperplasia of ileal lymphoid tissue (Peyer patches), which leads to telescoping of the intestine. Such enlargement may be due to a previous infection or may be a reaction to the intussusception itself. Ileal lymphoid hyperplasia has also been associated with milk-protein allergy.

In most children older than 5 years of age with intussusception, a precipitating factor can be identified. Similarly, in infants younger than 3 months of age, congenital anomalies such as Meckel diverticulum are often the cause. In all pediatric age groups, Meckel diverticulum and polyps are the most

### Table 1. Common Causes Of Lower Gastrointestinal Bleeding By Age

<table>
<thead>
<tr>
<th>Etiology</th>
<th>0 to 2 Months</th>
<th>&gt; 2 Months to &lt; 2 Years</th>
<th>2 Years to 5 Years</th>
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<tr>
<td>Anal fissures</td>
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<tr>
<td>Acute gastroenteritis</td>
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<tr>
<td>Intussusception</td>
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<tr>
<td>Necrotizing enterocolitis</td>
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<tr>
<td>Trauma</td>
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<td>Coagulopathy</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Hemorrhagic disease of the newborn</td>
<td>x</td>
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<tr>
<td>Milk-protein allergy</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Swallowed blood</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Arteriovenous malformations</td>
<td>x</td>
<td>x</td>
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</tr>
<tr>
<td>Meckel diverticulum</td>
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<td>Polyps</td>
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common pathologic lead points to cause intussuscep-
tion.\textsuperscript{30} Both these conditions are also among the lengthy differential diagnoses to be considered when a child presents to the ED with LGI bleeding.

**Pathophysiology**

**Lower Gastrointestinal Bleeding**

The pathophysiologic basis of all cases of LGI bleed-
ing is mucosal insult via direct trauma, infectious in-
sult, immunologic insult, or malformation. Mucosal
lesions are the most common cause of LGI bleeding
pathology, occurring due to irritation and inflamma-
tion of the intestine.

**Risk Factors For Lower Gastrointestinal Bleeding**

The risk factors for LGI bleeding in young children
are directly related to the potential etiologies. Most
obvious among these are coagulopathies or anatomic
anomalies of the GI tract that would predispose to
disease. See Table 2 for risk factors for LGI bleeding.

**Intussusception**

Intussusception is an invagination, or telescoping, of a
segment of proximal bowel (the intussusceptum) into
an adjacent bowel segment (intussusciptens). Abnor-
malities in the continuity of the gut mucosa, termed
lead point, create an area of traction in the bowel al-
lowing for telescoping to occur and hindering synchro-
nous peristalsis.\textsuperscript{31} Such discontinuity can be intramu-
al, intraluminal, or extraluminal. The most frequent
site of intussusception is the terminal ileum.\textsuperscript{32}

When the mesentery of the intussusceptum is
confined and compressed within the intussucripe-
s, resulting venous congestion leads to edema
and ischemia. This edema can result in partial to
complete obstruction, perforation, and peritonitis.
Intussusception is the most common cause of small-
bowel obstruction in children 3 months to 6 years of
age.\textsuperscript{19,20,33} Such insult to the mucosa can manifest as
LGI bleeding. Studies have shown that hematoche-
zia is a presenting symptom in two-thirds of patients
with intussusception.\textsuperscript{23}

Classically, the stool contains blood and mucus,
resembling “redcurrant jelly.”\textsuperscript{34} In 1997, Yamamoto
et al reported that 59% of children with intussuscep-
tion had hematochezia and 13% had redcurrant jelly
stool.\textsuperscript{34} Historically, redcurrant jelly stool is consid-
ered to be pathognomonic of intussusception; how-
ever, hematochezia and occult bleeding are much
more common.

**Risk Factors For Intussusception**

Although 90% of cases of intussusception in young
children are idiopathic, many risk factors can predis-
pose to this disorder. Risk factors include:

- **Young age:** Children between the ages of 6
  months and 3 years are at much higher risk for
  intussusception than adults. There is no familial
  risk for this disorder. Intussusception in adults is
  rare.
- **Previous disease:** Children in whom intussus-
  cepation was previously treated with surgical re-
  duction are at risk for recurrence. Among those
  treated with nonsurgical types of reduction, there
  is a 10% recurrence rate.\textsuperscript{32}
- **Viral illness:** Children with a recent viral illness,
such as adenovirus or rotavirus infection, are at
  a greater risk for intussusception, possibly due
to lymphoid hyperplasia in the GI tract. MeSen-
teric lymphadenitis is also a precipitating factor.
- **GI infection:** Infection with parasites such as
  *Ascaris lumbricoides* can lead to intussusception
to heavy worm-loads.\textsuperscript{35}
- **Vaccination status:** Prior to the availability of the
  Rotateq\textsuperscript{®} vaccine, children who received
  the rhesus rotavirus tetravalent vaccine (RRTV,
  Rotashield\textsuperscript{®}) were at greater risk for intus-
susception. Moreover, the patients affected
  were younger and had higher rates of surgical
  intervention than patients with intussusception
  who did not receive the vaccination.\textsuperscript{1,36} A
  case-control analysis showed an attributable risk
  of 1 in 9474 infants vaccinated.\textsuperscript{37,38} In July 1999,
  less than 1 year after the license for this vaccine
  was approved, the Centers for Disease Control
  and Prevention and the American Academy of
  Pediatrics suspended their recommendations to
  administer this vaccine. In a 2006 study pub-
lished in the *New England Journal of Medicine*,
the current pentavalent human bovine reassortment
rotavirus vaccine was shown to pose a risk of in-
tussusception similar to that posed by placebo.\textsuperscript{39}
- **Henoch-Schönlein purpura (HSP):** Children
  with HSP are at higher risk for intussusception
  because of the formation of small-bowel hema-
tomas. Major GI complications ensue in 5% of
  pediatric patients with HSP, with intussuscep-
tion being the most common.\textsuperscript{40}
- **Cystic fibrosis:** Patients with cystic fibrosis are
  at higher risk for intussusception because inspis-
sated stool with ileus can function as a lead
  point/pathologic apex.\textsuperscript{41}
- **Physical anomalies:** Malrotation, intestinal

<table>
<thead>
<tr>
<th>Table 2. Risk Factors For Lower Gastrointestinal Bleeding</th>
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<tr>
<td>- Anticoagulant use</td>
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<tr>
<td>- Arteriovenous malformation</td>
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<tr>
<td>- Polyps</td>
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<tr>
<td>- Constipation</td>
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<tr>
<td>- Coagulopathy</td>
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<tr>
<td>- Prematurity</td>
</tr>
</tbody>
</table>
polyps, Meckel diverticulum, duplication cysts, inverted appendiceal stumps, and colon cancer can cause intussusception.42

- **Iatrogenic factors**: As part of clinical care, gastrojejunostomy, feeding tubes, and abdominal adhesions from previous operations may become iatrogenic causes of intussusception.50
- **Malignancy**: The presence of leukemia or lymphoma increases the risk for intussusception because of possible lymphoid hyperplasia.

**Differential Diagnosis**

**Lower Gastrointestinal Bleeding**

The differential diagnoses in LGI bleeding in the pediatric patient have been discussed in the Epidemiology and Etiology section, page 2. Nonetheless, it is important to consider in the differential diagnosis causes unrelated to the GI tract, such as coagulopathy, vasculitis, trauma, the presence of a foreign body, and the ingestion of substances that mimic the appearance of blood. In young patients, coagulopathy may be the initial presentation in cases of LGI bleeding.43-45

- Vitamin K deficiency associated with hemorrhagic disease of the newborn is an early and dramatic example of LGI bleeding unrelated to the GI tract.
- Idiopathic thrombocytopenic purpura can present with bruising and ecchymosis in addition to GI bleeding.46
- Patients with hemophilia are more likely to present with hemarthrosis, and GI bleeding is also a possible presentation.47-49 In hemophilia A and B, correction of factor deficiencies may be initiated in the ED.
- Vasculitides, such as polyarteritis nodosa and Sjögren syndrome, may present as GI hemorrhage due to mesenteric ischemia.50-52 In a study that evaluated systemic vasculitis, 16% of patients presented with GI bleeding.53
- The use of certain medications and ingested substances can mimic the findings in rectal bleeding. For example, bismuth-containing medications and charcoal ingestion may be mistaken for melena.
- Red foods, vaginal bleeding, gross hematuria, and lesions of the buttocks can falsely present as hematochezia, especially on a diaper.
- The ingestion of red meat, turnips, horseradish, or vitamin C may be responsible for a false-positive result on the fecal occult blood test.

**Intussusception**

The differential diagnosis of intussusception is similar to those described for LGI and inclusive to all the etiologies of LGI bleeding. See Table 1, page 3 for causes of LGI bleeding in children, by age.

**Prehospital Treatment**

Prehospital treatment of LGI bleeding begins with the initial evaluation of airway, breathing, and circulation. If a patient has lost a significant amount of blood, he will show signs of shock such as tachycardia or hypotension. Intravenous (IV) fluid resuscitation should be started in cases in which the patient is hypotensive, especially if ongoing blood loss is suspected. Prior to arrival in the ED, emergency medical services (EMS) staff and community physicians must monitor blood pressure and heart rate while the patient is being resuscitated. An assessment of shock severity will aid in the resuscitative effort and indicate whether intensive care unit (ICU) admission will be required. Prehospital providers must communicate with the accepting medical facility before transfer to confirm whether the facility can provide pediatric intensive care, especially if hemorrhagic shock is suspected.

**Emergency Department Evaluation**

Although LGI bleeding is a relatively uncommon occurrence in children, presentations to the ED require expertise in its management. In a cornerstone study of almost 600 children by Bruce et al in 1987, 37% had blood in their stool at the time of presentation.56

Intussusception should be suspected in the young child who is lethargic with colicky abdominal pain, vomiting, and LGI bleeding. The clinical triad of intermittent abdominal pain, abdominal mass, and redcurrant jelly stool at presentation is evident in less than 50% of cases of intussusception.30,53 The third sign of this triad – redcurrant jelly stool – will be found in 100% of untreated cases as the bowel becomes more edematous and intraluminal pressure is increased.1,34

**History**

Obtaining details regarding the duration and frequency of observed bleeding will differentiate chronic from acute bleeding. The emergency clinician should ask about the quality and quantity of stools and bowel movements. The number of bloody bowel movements per day is important in order to assess ongoing blood loss and the potential for anemia. Hard stools or constipation suggests anal fissure, bleeding hemorrhoids, or polyps. Gastrointestinal bleeding can also occur with fecal impaction and subsequent obstruction. Bloody, mucoid diarrhea may be seen with acute gastroenteritis due to infection with Campylobacter, Salmonella, Shigella, or some strains of E coli.

The presence or absence of abdominal pain associated with LGI bleeding aids in diagnosis. Colicky abdominal pain occurs in intussusception in 50% to 80% of cases,54-56 and 70% of these patients present...
with gross or occult GI bleeding. Painful bleeding is common in IBD, necrotizing enterocolitis, intussusception, and anal fissures. In general, bleeding will be painless in the case of polyps, swallowed blood, arteriovenous malformations, and milk-protein allergy. Meckel diverticulum can present with voluminous blood loss in the absence of pain. Painless bleeding is not likely to be infectious in origin.

The quality of the abdominal pain is also important to assess. It is useful to ask the patient or parents to describe the pain. Pain that resolves upon defecation is more common with IBD, whereas pain that increases with bowel movements may be due to hemorrhoids or anal fissures.

The location of abdominal pain can lend to specific diagnosis as well. Epigastric pain is typical of gastritis and esophagitis.

It is important to quantify and qualify any history of vomiting. Vomiting is a common occurrence in any GI disorder that results in partial or complete obstruction. Bilious vomiting is suggestive of an upper GI obstruction, such as one occurring at the Ligament of Treitz. Acute and protracted vomiting may be seen in children with acute gastroenteritis.

Fever is suggestive of infectious or inflammatory processes such as acute gastroenteritis, IBD, or necrotizing enterocolitis.

A history of medication use must be reviewed since some of the effects of certain medications may mimic melena or hematochezia once the drug is digested. For example, the ingestion of ampicillin, iron supplements, and bismuth subssaliclyate may give a false impression of melena. Medications such as anticoagulants and nonsteroidal anti-inflammatory drugs (NSAIDs) can also pose a risk for GI hemorrhage. Similarly, with the ingestion of dark-colored or brightly colored foods such as beets, chocolate, gelatins, or beverages, the stool may appear to contain blood on gross examination.

A history of weight loss or failure to thrive suggests chronic underlying disease. Weight loss my indicate malignancy, IBD, cystic fibrosis, or Hirschsprung disease. Acute onset of fatigue, near syncope, or syncope may signal an acute blood loss.

The age of the child at presentation can help clarify the diagnosis. For example, a newborn that is breastfeeding from a mother with mastitis may have swallowed maternal blood, or a newborn who was born at home may not have received vitamin K at birth.

**Physical Examination**

A thorough physical examination, including the requisite evaluation of airway, breathing, and circulation, will indicate the child’s hemodynamic status. Signs of poor perfusion, such as weak peripheral pulses with cool extremities, slow capillary refill, and tachycardia suggest diminished intravascular volume due to dehydration and bleeding. According to the American Heart Association and the Pediatric Advanced Life Support Guidelines, children will manifest hypotension with an intravascular volume loss of 30%.

Hypovolemic pediatric patients can maintain normal blood pressure through increases in systemic vascular resistance, cardiac contractility, and heart rate. These compensatory mechanisms may make it very difficult for the clinician to identify a patient in compensated shock due to blood loss until a significant blood volume has been lost.

The following findings on physical examination will help narrow the diagnosis in LGI bleeding:

- **Nose and oral cavity**: Inspect the nostrils for dried blood suggestive of epistaxis from trauma, coagulopathy, or spontaneous bleeding. Look for oral lesions that may be associated with mucositis or polyposis syndromes such as Peutz-Jeghers syndrome.
- **Neck**: Lymphadenopathy can be present in cases of infection or malignancy.
- **Skin**: Purpura and extensive bruising may indicate coagulopathy, sepsis, or trauma. Pallor can reflect chronic blood loss.
- **Abdomen**: A distended, tender abdomen can reflect obstruction, perforation, trauma, or peritonitis. Organomegaly or an abdominal mass may represent intussusception, hepatitis, or malignancy. Splenomegaly would raise the possibility of variceal hemorrhage from portal hypertension.
- **Genitourinary tract and rectum**: Be thorough and sensitive with respect to examining these sites in the pediatric patient. A parent or guardian as well as a nurse should be present during the examination. The patient should be examined in both the supine and prone positions to allow adequate visualization of the genitalia and anus. A careful examination may reveal frank fissures or hemorrhoids and can help confirm urinary or vaginal lesions, rather than the GI tract, as the source of blood noted on a diaper. Increased rectal tone might suggest Hirschsprung disease, which can present as enterocolitis. If there is a suspicion of sexual abuse, a more specialized examination is warranted.

**Intussusception**

Intussusception is not a likely diagnosis in children over 3 years of age and is rare in children older than age 5. In 10% to 20% of children who do have intussusception, diarrhea will be present, and vomiting occurs 60% to 80% of the time. Children with intussusception may also have a fever, the causes of which are varied and include Henoch-Schönlein purpura, viral infections, and possible bowel perforation and/or bowel necrosis.
Diagnostic Studies

Laboratory Tests

Laboratory tests provide a tool to aid in patient stabilization and in distinguishing potential etiologies. Most laboratory tests do not allow a definitive diagnosis, however, and management decisions should therefore be based on clinical examination and diagnostic imaging.

The white blood cell count can show leukocytosis with infection as well as inflammatory processes, and it is therefore nonspecific. Anemia occurs as a result of chronic blood loss. Hematocrit may remain stable in the setting of acute bleeding, but it is valuable as a baseline for serial measurements when blood loss persists. Thrombocytopenia is seen in Henoch-Schönlein purpura, which can be a cause of intussusception. Coagulopathies themselves can be the cause of GI bleeding. Eosinophilia may be present and represents an allergic component to disease such as with milk-protein sensitivity. Likewise, serum IgE may be elevated. Nonetheless, both these findings are nonspecific.

Blood urea nitrogen (BUN) is elevated in cases of dehydration and may also be elevated with GI bleeding owing to the breakdown of red blood cells in the digestive tract. A fecal occult blood test will differentiate real from factitious bleeding and is useful in patients with a history of hematochezia or suspected GI bleeding. Stool culture will identify common bacterial infections that contribute to hemorrhagic gastroenteritis, which is part of the differential diagnosis for intussusception.

Lower Gastrointestinal Bleeding Imaging Studies

A variety of diagnostic studies can aid in determining the cause of suspected LGI bleeding in the pediatric patient. By selecting appropriate imaging modalities, the emergency clinician will minimize exposure to radiation and effectively make the diagnosis. See Table 3, page 8 for a complete guide to the preferred imaging procedures.

The abdominal radiograph is a common imaging modality that clinicians often order in the evaluation of pediatric LGI bleeding. It is useful in the diagnosis of necrotizing enterocolitis by identifying pneumatosis intestinalis and thickened bowel loops. However, obstructions that may be seen on an x-ray do not generally cause sudden GI bleeding, and plain films are of limited value in the evaluation of bleeding.

An upper GI series can be useful in the diagnosis of malrotation, duodenal atresia, and suspected obstruction; however, it is not helpful for detecting intussusception. A few reports have shown rectosigmoid and duodenojejunal narrowing to be associated with milk-protein allergy and associated allergic enterocolitis.

Computed tomography (CT) can be useful for identifying abscesses or fistulae associated with IBD. Magnetic resonance imaging (MRI) is not applicable in the setting of acute GI bleed because it is not as easily obtained emergently, nor is it therapeutic.

Tissue biopsy is used to assess the patient’s immune response and to identify infectious organisms, nerve plexuses, and smooth-muscle distribution. In allergic proctocolitis due to milk-protein allergy, the biopsy will show eosinophilic infiltration. This information would not be accessible in a timely fashion to the emergency clinician and is more useful in the inpatient setting to definitively identify proctocolitis or Hirschsprung disease.

Endoscopy can localize the site(s) of bleeding and identify lesions, growths, and malformations. It can also be therapeutic in the case of polyps or arteriovenous malformations. The findings on colonoscopy that are associated with milk-protein allergy include friable mucosa with erythema and erosions.

Intussusception Imaging Studies

Ultrasonography is an excellent imaging modality for diagnosing and assessing intussusception because of its high sensitivity (97%-100%) and high specificity (88%-100%) in detecting this disorder. Many institutions currently use ultrasound as a first-line evaluation of LGI bleeding. A 7-year retrospective evaluation of ultrasound in patients with intussusception showed a positive predictive value of 86.6% and a negative predictive value of 99.7%.

Ultrasound imaging allows for the visualization of lead points that would make intussusception more likely. The typical appearance of intussusception on ultrasound is the “target sign” (also described as a “bull’s eye” or “coiled spring”). This sign reflects bowel loop invagination. However, a similar “donut sign” may persist after therapeutic reduction, which can make the diagnosis problematic. Donut signs are smaller than target signs and have a single hypechoic rim that is hypothesized to represent edema of the ileocecal valve. These suspicious intestinal structures resolve within 5 days after reduction of intussusception.

The use of enemas in conjunction with ultrasound for identifying intussusception as a cause of LGI bleeding can also be used as therapy for this disorder. (For specific information about the use of ultrasonographic imaging during treatment, see the section on Treatment of Intussusception, page 9.) This diagnostic test is contraindicated if perforation is suspected.

Abdominal radiographs can be an adjunct to diagnosis in intussusception, although with a sensitivity of 45%, they are not as sensitive as ultrasonography. Radiographs are useful for detecting the absence of bowel gas in the right upper quadrant as
well as the presence of a crescentic air pocket, which represents the negative space between intussusceptum and intussuscipiens. The University of Montreal recently studied radiographs in patients with intussusception by pediatric emergency clinicians. The study showed that abdominal radiography supplemented the clinical suspicion for intussusception in 48% of actual cases (low sensitivity) and in 21% of negative cases (low specificity); 41% of cases of con-

firmed intussusception were deemed equivocal, and 11% were incorrectly interpreted as being reassuring.

Abdominal CT can also be used to diagnose intussusception. Diagnosis of intussusception by CT is often incidental when such imaging was obtained to evaluate for other causes of abdominal pain. Computed tomography is not the test of choice to diagnose intussusception because of its associated radiation and lack of therapeutic functionality.

<table>
<thead>
<tr>
<th>Imaging Modality</th>
<th>Uses</th>
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<tbody>
<tr>
<td>Abdominal radiographs</td>
<td>Useful in</td>
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<tr>
<td></td>
<td>• Pneumatosis intestinalis</td>
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<td></td>
<td>• Obstruction</td>
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<td></td>
<td>• Free air</td>
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<td></td>
<td>Limited in</td>
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<tr>
<td></td>
<td>• Identification or quantification of bleeding</td>
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<td></td>
<td>• Diagnosis of intussusception — not sensitive (45%)67 but may show absence of bowel in the right upper quadrant or a crescentic air pocket suggestive of the negative space between intussusceptum and intussuscipiens68</td>
</tr>
<tr>
<td>Upper gastrointestinal series</td>
<td>Useful in</td>
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<td>• Milk-protein allergy</td>
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<td>• Enterocolitis</td>
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<td>• Duodenal atresia</td>
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<td>• Obstruction</td>
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<tr>
<td></td>
<td>Limited in intussusception</td>
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<tr>
<td>Barium or hydrostatic enema</td>
<td>Useful in both diagnosis and therapy of intussusception</td>
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<tr>
<td></td>
<td>Barium enema</td>
</tr>
<tr>
<td></td>
<td>• Requires x-ray fluoroscopy</td>
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<td>• Poses risk of barium peritonitis and adhesions with perforation68</td>
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<tr>
<td></td>
<td>Hydrostatic enema</td>
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<tr>
<td></td>
<td>• Uses a water-soluble medium or saline</td>
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<td>• Accompanies ultrasound</td>
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<td></td>
<td>• Causes fluid and electrolyte shifts, with perforation</td>
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<tr>
<td>Air-contrast enema</td>
<td>• Poses lower radiation exposure</td>
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<td></td>
<td>• Results in fewer complications from perforation70,71</td>
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<tr>
<td></td>
<td>• May cause tension pneumoperitoneum</td>
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<tr>
<td>Ultrasonography</td>
<td>• Useful in diagnosing intussusception</td>
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<tr>
<td></td>
<td>• Reveals “target sign”</td>
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<td></td>
<td>• Modality of choice for therapeutic reduction</td>
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<tr>
<td>Computed tomography</td>
<td>Useful in</td>
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<tr>
<td></td>
<td>• Abscesses or fistulae</td>
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<tr>
<td></td>
<td>• Intussusception (although not the test of choice)</td>
</tr>
<tr>
<td></td>
<td>Limited by radiation exposure</td>
</tr>
<tr>
<td>Magnetic resonance imaging</td>
<td>• Not applicable in the setting of acute gastrointestinal bleeding</td>
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<tr>
<td></td>
<td>• Not easily obtained</td>
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<tr>
<td></td>
<td>• Not therapeutic</td>
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<tr>
<td>Mucosal biopsy</td>
<td>Useful in</td>
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<td>• Detecting immune response</td>
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<td></td>
<td>• Detecting infection</td>
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<td></td>
<td>• Identifying nerve plexus for underlying disorders such as Hirschsprung disease</td>
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<td>Endoscopy/colonoscopy</td>
<td>Useful in</td>
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<td></td>
<td>• Bleeding</td>
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<td></td>
<td>• Localizing lesions, growths, and malformations</td>
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<td>• Therapy</td>
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**Radiation**

Radiation exposure is lower with pneumatic air-contrast enema than with barium enema. The rates of complications and sequelae due to perforation with use of air-contrast enema are also lower when compared with other reduction media. Tension pneumoperitoneum is a rare, but significant, complication that must be kept in mind if air-contrast reduction is selected.

Numerous studies have been conducted to evaluate and compare the benefits of various reducing agents. Hydrostatic reduction has been associated with a more constant colonic pressure when compared with air reduction, suggesting that pneumatic reduction may result in a lower reported risk of perforation. However, del-Pozo suggests that the differences in perforation rates between these 2 types of enemas may be related to perforations that occurred prior to reduction therapy and subsequent increased pressure in the colon rather than to the type of enema used. Overall perforation rates after hydrostatic or air-contrast enemas have been reported to be 1% or less.

An important consideration in pediatric patients is the need to limit or avoid radiation exposure. Radiation exposure is lower with air-contrast enema reduction than with barium enema reduction and is absent in ultrasound-guided enema reduction. Although intussusception having a lead point is not likely to be reduced by means of an enema, the responsible lesion may be seen on fluoroscopy or ultrasonography, thus aiding further management.

The rates of intussusception recurrence with all types of nonsurgical reduction range between 5% and 20%. According to Bajaj, recurrence rates of enema-reduced intussusception are approximately 10%. Fifty percent of all recurrences occur within 48 hours of the initial reduction. Multiple recurrences occurred in approximately one-third of these patients. In a study by González-Spinola and del-Pozo, the rate of intussusception recurrence after ultrasound-guided hydrostatic enema was 9.7%; however, a delayed repeat attempt at reduction after a period of rest increased the likelihood of success without increasing the risk for perforation. Recurrence rates with barium enema were 11%, as compared with 8% with air-contrast enema. In 2007, Ko reported that, unlike surgery, enema reduction is not contraindicated when there are multiple recurrences. In fact, surgery is recommended only when recurrence of intussusception is irreducible or when a pathologic lead point is identified. Surgery would also be the treatment of choice in cases of perforation and peritonitis. The current literature indicates a strong consensus for attempting enema reduction even for intussusception recurrence in straightforward cases before resorting to surgical correction.
1. “The 6-month-old patient had a vague history of colicky abdominal pain, but he appeared well in the ED. This looked like a milk-protein allergy.”
Intussusception classically presents with colicky abdominal pain, and the patient may appear well between painful episodes. A positive fecal occult blood test can support a suspicion of intussusception, although it may also be positive in the child with milk-protein allergy. History is an important tool in narrowing the differential diagnosis. Milk-protein allergy is not likely to begin acutely in this older patient. Ultrasound should be used to diagnose intussusception. Observation in the ED may also be warranted if ultrasound is unavailable, and it may be helpful in deciding whether to obtain a CT scan, which would expose the patient to radiation.

2. “The 10-year-old patient had colicky abdominal pain, but she was too old to have intussusception.”
Although intussusception is most common in younger patients, it can occur at any age. The incidence of intussusception associated with a pathologic lead point increases with age.

3. “Intussusception in the 3-year-old patient was successfully reduced, and though she appeared well, I decided to admit her for observation, since 50% of recurrences occur in the first 48 hours.”
Hospital admission is not indicated in the easily and successfully reduced case of idiopathic intussusception if, after a period of observation in the ED, the patient returns to baseline status and tolerates oral intake without vomiting or pain. Hospital admission to monitor for recurrence after a simple reduction in the well-appearing patient is not warranted and imposes significant costs on the healthcare system. Family counseling must be given, as well as clear discharge instructions regarding returning to the ED in the event of abdominal pain, vomiting, or bloody stools.

4. “The patient had frank hematochezia, but it didn’t resemble redcurrant jelly stools, so intussusception was lower on my differential.”
Although it is considered the “classic” presentation, intussusception does not commonly present with redcurrant jelly stools. Frank hematochezia is a presenting sign in about 60% of cases of intussusception.

5. “Though this patient appeared well, the stools were grossly bloody, which warranted an in-depth work-up.”
Many food products and medications may give the false appearance of bloody stools. The presence of blood should be confirmed with a fecal occult blood test prior to initiating further evaluation in the stable patient.

6. “I thought my patient had intussusception, but her abdomen was tender and it was more efficient to obtain a CT scan to rule out other possible GI pathologies, like appendicitis.”
Ultrasonography is a sensitive and specific imaging modality for intussusception. If available, an ultrasound examination will spare the patient exposure to the radiation from a CT scan. If the ultrasound result is negative or inconclusive, CT would be the next option.

7. “It was the middle of the night and the ultrasound technician wouldn’t be available for another 4 hours. Although I thought the patient had intussusception, he appeared well, so I waited until the tech arrived.”
Ultrasonography is the best imaging choice for diagnosing intussusception and will avoid unnecessary radiation exposure from CT. However, a delay in diagnosis and therapeutic reduction can increase the risk for complications. If ultrasound is unavailable and you suspect intussusception, a CT scan should be obtained.
Henoch-Schönlein purpura is a form of vasculitis that can directly contribute to LGI bleeding. It may also indirectly cause LGI bleeding when hematomas form in the wall of the small bowel, acting as lead points for intussusception and subsequent bleeding. Intussusception associated with HSP typically occurs after the resolution of HSP-associated abdominal pain. In some circumstances, bleeding can be massive and constitutes the main presenting sign of this disorder.80-81

The pediatric oncology patient is at risk for chemotherapy-induced mucositis, steroid- and stress-induced bleeding ulcers, and chemotherapy- or cancer-related liver damage— all of which predisposes to bleeding esophageal varices. Immunosuppression with coexisting coagulopathies will further contribute to bleeding. For these reasons, admission and close monitoring of the child with cancer who presents with LGI bleeding is recommended.82

Child abuse is a serious concern in the pediatric population and can cause LGI bleeding. Unreported or unevaluated blunt abdominal trauma that occurred several days prior to presentation should raise concern about possible hematoma formation. Penetrating injuries should be considered, and a thorough physical examination is in order for any child with rectal pain or bleeding.83

Premature infants may have immature gut colonization, poor feeding tolerance, and aberrant GI motility. They are also at higher risk for necrotizing enterocolitis, which can result in significant morbidity and mortality.84

Children born at home are at risk for hemorrhagic disease of the newborn if they have not been given vitamin K postpartum. This condition may present as GI hemorrhage.85

There are circumstances that may lead to a false diagnosis of LGI bleeding. Examples include the use of medications or the ingestion of certain foods that can cause the stool to appear bloody. brisk upper GI bleeding can present as rectal bleeding. Ingestion of blood from epistaxis or swallowed maternal blood during the birthing process can cause fecal-occult-positive stools. A common scenario in the pediatric ED involves an otherwise healthy 3-day-old infant born by vaginal delivery presenting with a history of bloody stools or bloody emesis. Once it is determined that the child is hemodynamically stable with normal findings on abdominal and rectal examinations, a positive fecal occult blood test is confirmed. To distinguish whether the occult blood is, in fact, the infant’s rather than swallowed maternal blood, the Apt-Downey test may be employed; however, the history and clinical examination should be sufficient if there is no other reason to suspect GI bleeding.81

Pediatric patients can return home from the ED after a straightforward and successful reduction of intussusception if they meet discharge criteria. Several studies have evaluated postreduction complications. In one report, children with an uncomplicated course prior to reduction in whom intussusception was hydrostatistically reduced by barium enema and who had a normal postreduction examination and successful oral feeding had a low risk of complications during the 24-hour period after the procedure.82 In a large retrospective study of uncomplicated intussusception reductions in healthy children, recurrence rates were not affected by observation in the ED or hospital. There were no adverse outcomes reported, and 50% of recurrences occurred within the first 24 hours, whereas the remainder occurred within the next 10 months.83 Previous studies have shown that 30% of recurrences occur within the first 48 hours. With supportive studies, the emergency clinician can feel confident about discharging pediatric patients after successful, uncomplicated reductions if the patient meets discharge criteria (see the Disposition section), has reliable family support, and lives within close proximity to a hospital.83

In the majority of ED visits by pediatric patients with LGI bleeding, the cause is benign (eg, anal fissures, swallowed maternal blood, or milk-protein allergy).1 Most of these patients can be discharged home for observation by their primary care physician and can be given instructions about changes in diet once other, more concerning, differential diagnoses have been ruled out. Lower gastrointestinal bleeding in children is typically not life-threatening. If a stable GI lesion is suspected, consultation with a gastroenterologist and appropriate follow-up are prudent measures.1 Notably, 10% to 20% of referrals to pediatric gastroenterologists are for complaints of

Figure 1. Sample Discharge Instruction

Discharge Instructions

Your child was evaluated in the emergency department for lower gastrointestinal bleeding.

Bleeding was likely caused by __________________. After careful evaluation and management in the ED, your child is clinically stable to be discharged home with close monitoring and follow-up by your primary care physician.

Please return to the ED if your child has worsening abdominal pain, persistent or severe vomiting, large amounts of bleeding, or weakness or is unable to tolerate fluids.
upper and lower GI bleeding.\textsuperscript{54}

Children with LGI bleeding due to intussusception can be discharged home contingent on several factors, as noted in the \textit{Controversies And Cutting Edge section}.

In general, the possibility of acute and persistent GI bleeding or acute hemodynamic instability warrants hospital admission. For example, a patient with a profusely bleeding Meckel diverticulum with tachycardia should be managed in the hospital. The patient with prolonged intussusception or difficult or unsuccessful reduction should also be admitted.

The following criteria for discharge home highlight important clinical requirements for any pediatric patient with intussusception and/or LGI bleeding (see Figure 1):

1. Hemodynamic stability, with the expectation that stability will be maintained.
2. Resolution of significant acute bleeding.
3. Resolution of or tolerable, mild abdominal pain.
4. Successful oral intake.
5. Reliability of follow-up with the primary care physician.
6. Family communication and understanding of discharge instructions, including reasons to return to the ED if signs or symptoms recur.

Pediatric patients with the following conditions will require admission for close monitoring or for further evaluation and possible treatment:

1. Hemodynamic instability, with pronounced tachycardia or hypotension.
2. Ongoing significant blood loss evidenced by continued tachycardia, hypoxia, or weakness.
3. Need for imminent surgery.
4. Inability to tolerate oral intake because of either refusal or frequent vomiting.

\textbf{Summary}

Lower gastrointestinal bleeding in the pediatric patient 5 years of age or younger is an uncommon ED presentation that causes anxiety and concern both in the child’s family and in the clinician. There are numerous causes of LGI bleeding in this age group, ranging from self-limited anal fissures to surgical emergencies. Age and presentation significantly narrow the large list of differential diagnoses in this patient population.

Intussusception is an important age-specific cause of obstruction and LGI bleeding in young pediatric patients. The time to diagnosis and reduction will influence morbidity and mortality in these patients; hence, the emergency clinician should have a high index of suspicion as well as knowledge of current evidence for diagnosis and treatment.

\textbf{Case Conclusion}

After determining that the patient was hemodynamically stable, you bypassed the abdominal x-ray and ultrasound studies and instead ordered imaging that is both diagnostic and therapeutic for suspected intussusception. You chose ultrasound-guided hydrostatic reduction, which posed no radiation risk and provided more constant pressure in the colon during administration. Her intussusception was reduced with relative ease in the ED. She remained clinically stable and was able to tolerate oral intake. Because of the uncomplicated reduction and her hemodynamic stability — as well as her reliable home environment — you discharged the patient to follow up with a gastroenterologist or primary medical doctor the next day.

\textbf{References}

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study, such as the type of study and the number of patients in the study, will be included in bold type following the reference, where available. In addition, the most informative references cited in this paper, as determined by the authors, will be noted by an asterisk (*) next to the number of the reference.

2. Stav K, Reif S. Gastrointestinal bleeding in children—etiolo
gy and diagnosis. Survey of patients in a Tel Aviv medical center, in the years 1990 to 1997. \textit{Harefuah}. 2000;138:534-538, 615. (Retrospective case series; 201 children)
involvement in leukocytoclastic vasculitis and polyarteritis nodosa. J Rheumatol. 1980;7:677-684. (Retrospective case series; 80 patients)


55. * Immordino PA. Intussusception in children: a review of 10 years’ experience in a community hospital. Conn Med. 1977;41:76-79. (Systematic review)


6. The emergency clinician should ask about the quality and quantity of stools and bowel movements in order to:
   a. Assess ongoing blood loss and the potential for anemia
   b. Gather information from the patient in regards to anal fissures, bleeding hemorrhoids, or polyps
   c. Both A and b
   d. None of the above

7. Abdominal radiographs are NOT useful in identifying:
   a. Obstruction
   b. Free air
   c. Bleeding
   d. Pneumatosis intestinalis

8. Ultrasound is an excellent diagnostic imaging modality for intussusception and, unlike CT, it does not carry the risk of radiation exposure.
   a. True
   b. False

9. Although both barium and hydrostatic enemas pose a low risk for complications in reduction, hydrostatic enema:
   a. Does not need to be performed under fluoroscopy, thus sparing the patient the radiation risk associated with the use of barium
   b. Uses a water-soluble medium or saline
   c. Causes fluid and electrolyte shifts, with perforation
   d. All of the above

10. Which of the following is not a criterion for discharge home for a pediatric patient with intussusception or LGI bleeding?
    a. Inability to tolerate oral intake because of either refusal or frequent vomiting
    b. Hemodynamic stability, with the expectation that stability will be maintained
    c. Resolution of significant acute bleeding
    d. Resolution of or tolerable, mild abdominal pain
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Goals: Upon reading Pediatric Emergency Medicine Practice, you should be able to: (1) demonstrate medical decision-making based on the strongest clinical evidence; (2) cost-effectively diagnose and treat the most critical ED presentations; and (3) describe the most common medicolegal pitfalls for each topic covered.

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