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A Listless Infant with Vomiting

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CASE PRESENTATION

History

A 6-month-old male infant was referred by his pediatrician to the emergency department (ED) because of persistent vomiting and dehydration. On the first day of symptoms, he had a few episodes of nonbloody and nonbilious emesis, a temperature of 37.8°C (100°F), and stools streaked with blood. As his vomiting episodes persisted during the next 2 days, his emesis was yellow-green tinged, his oral intake and urine output decreased, and his bowel movements ceased. He became increasingly listless and seemed to experience episodes of abdominal pain. On examination in his pediatrician's office, his weight had decreased 0.6 kg compared with a measurement taken 1 month previously. Two weeks before his presentation to the ED, the infant was diagnosed with acute otitis media and had completed a course of cefdinir. He had no recent history of upper respiratory symptoms, cough, or rashes. He had a normal birth history and weighed 3.6 kg at delivery. He had no history of hospitalization or surgery, took no daily medications, and had no drug allergies.

Key Point

Vomiting that is persistent, becomes bilious, and is associated with an absence of bowel movements suggests a small bowel obstruction beyond the second part of the duodenum. The other symptoms (ie, poor oral intake, decreased urine output, weight loss, listlessness) suggest moderate to severe dehydration and possible shock. Infants presenting with these symptoms require intravenous (IV) fluid resuscitation and a diagnostic work-up. In addition to its association with severe dehydration, listlessness also can denote a serious central nervous system (CNS) disorder or disseminated infection and is itself a symptom of high concern.

Physical Examination

On physical examination, the infant was listless and appeared ill, but he made occasional eye contact. His vital signs were as follows: tympanic temperature, 36.5°C (97.7°F); heart rate, 148 bpm; respiratory rate, 36 breaths/min; systolic blood pressure, 90 mm Hg. His weight was 6.9 kg (15th percentile for age, an acute drop from the 30th percentile 1 month previously). Although not measured, the infant's height and head circumference appeared within the normal range. He had no dysmorphic features, a small flat anterior fontanelle, normal tympanic membranes, a supple neck, and no nasal discharge. His lungs were clear, and he had no increased work of breathing. His heart sounds had a regular pitch and rhythm, his pulses were slightly decreased in his extremities, and his peripheral capillary refill time was 2 to 3 seconds. Abdominal examination revealed normal bowel sounds and a nondistended abdomen that was soft but diffusely tender with moderately deep palpation; there was no palpable liver, spleen, or mass. Rectal examination revealed normal sphincter tone, flecks of soft brown stool that tested positive for occult blood, and no palpable masses. The infant had bilaterally descended testicles and no evidence of inguinal hernias. His musculoskeletal and neurologic examinations showed normal results, and skin examination revealed decreased turgor and coolness of peripheral extremities, with no rashes, bruising, or petechiae.

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Table 1. Differential Diagnosis of Abdominal Pain in Infants Younger Than 2 Years

More common

Gastroenteritis

Incarcerated hernia

Intussusception

Urinary tract infection

Less common

Aerophagia

Hirschsprung's disease

Intestinal obstruction

Malrotation with volvulus

Pneumonitis (lower lobe)

Spontaneous bacterial peritonitis

Trauma (eg, abuse)

Adapted with permission from Kliegman RM, Nieder ML, Super DM. Practical strategies in pediatric diagnosis and therapy. Philadelphia: WB Saunders; 1996:260.

Table 2. Differential Diagnosis for Infantile Vomiting

Common

Anatomic obstruction

Gastroenteritis

Gastroesophageal reflux

Overfeeding

Systemic infection

Rare

Adrenogenital syndrome

Brain tumor (increased intracranial pressure)

Food poisoning

Inborn error of metabolism

Renal tubular acidosis

Rumination

Subdural hemorrhage

Adapted with permission from Nelson WE, Behrman RE, Kliegman RM, Arvin AM, editors. Nelson textbook of pediatrics. 15th ed. Philadelphia: WB Saunders; 1996:1033.

| Key Point |

The results of the infant's physical examination suggest an abdominal process. The findings of listlessness, decreased pulses, delayed capillary refill time, and normal blood pressure indicate shock and confirm the need for IV fluid resuscitation. Although the patient is still technically in a compensated form of shock (decreased perfusion but normal blood pressure), great care is required. Children—and infants in particular—who are inadequately treated may have a precipitous deterioration into an uncompensated form of shock that is very difficult to resuscitate. Aggressive fluid resuscitation with 20-mL/kg body weight boluses of normal saline infused over 15 to 20 minutes and frequent reassessments are mandatory.

- **What is the differential diagnosis for a listless infant with vomiting, abdominal pain, and gastrointestinal (GI) bleeding?**

DIFFERENTIAL DIAGNOSIS

In diagnosing an infant with this presentation (listlessness, vomiting, abdominal pain, and bloody stools), one must consider systemic conditions as well as primary GI pathology (**Tables 1–4**). Many parts of the differential diagnosis for this child seem unlikely. His age and medical history are inconsistent with gastroesophageal reflux (GER), rumination, or overfeeding.

GER is common among infants and is often treated with frequent burping, upright positioning during and after feeding, and thickened formula. The disorder begins early in life (usually in the first month of life) and gradually resolves over time as the infant grows. GER associated with weight loss or failure to thrive is classified as gastroesophageal reflux disease and is usually treated with medication or surgery (gastrostomy and fundoplication).

Although gastroenteritis with dehydration is a possible diagnosis, the characteristics of the patient's pain make this diagnosis unlikely because the pain associated with gastroenteritis is often less severe and the child continues to appear ill between painful episodes.[1] He has no symptoms or findings that support pneumonia or trauma, although nonaccidental trauma without external evidence should always be considered. Spontaneous bacterial peritonitis is unlikely because it most often occurs in children with pre-existing nephrotic syndrome or cirrhosis and is usually associated with diarrhea.[1] With regard to GI bleeding, the infant has no history of a coagulation disorder and is beyond the usual age for necrotizing enterocolitis or swallowed maternal blood. Milk protein allergy is unlikely without prior symptoms, and gastric ulcers are uncommon in this age group.

The differential diagnosis for this particular child, a listless infant with vomiting, includes 5 major categories: vital sign abnormalities, metabolic derangements, GI

Table 3. Differential Diagnosis of Gastrointestinal Bleeding in Infants

Common

Anal fissure

Bacterial enteritis

Intussusception

Lymphonodular hyperplasia

Milk protein allergy

Swallowed maternal blood

Rare

Coagulation disorder

Meckel's diverticulum

Necrotizing enterocolitis

Stress ulcer, stomach

Volvulus

Adapted with permission from Nelson WE, Behrman RE, Kliegman RM, Arvin AM, editors. Nelson textbook of pediatrics. 15th ed. Philadelphia: WB Saunders; 1996:1037.

Table 4. Differential Considerations for a Listless Infant* with Vomiting

Vital signs

Bradycardia/tachycardia

Dehydration/shock

Infectious diseases

Meningitis

Sepsis

Metabolic conditions

Adrenogenital syndrome

Hypoglycemia/hyperglycemia

Inborn error of metabolism

Structural gastrointestinal conditions

Hirschsprung's disease with toxic megacolon

Intussusception

Malrotation with midgut volvulus

Other bowel obstruction (eg, adhesions, hernia)

Central nervous system conditions

Increased intracranial pressure

Intracranial hemorrhage

Mass lesion

*Child younger than 2 years.

structural causes, CNS impairment, and infectious causes (Table 4). Laboratory results are shown in **Table 5**. Although sepsis is often the initial concern, the normal leukocyte count and lack of fever make an infectious process less likely. Normal electrolyte and glucose levels do not support metabolic causes such as adrenogenital syndrome or an inborn error of metabolism, and normal results on neurologic examination decrease the likelihood of an intracranial process. This child appears to have symptoms and examination findings that suggest a primary GI process with possible obstruction. The most likely causes of obstruction in an infant include intussusception, malrotation with volvulus, and Hirschsprung's disease. The presence of blood in the stool strongly suggests intussusception.

CLINICAL COURSE
Initial Management

Based on his initial history and physical examination, the infant was presumed to have an intestinal obstruction and moderate to severe dehydration. He was given a 20-mL/kg IV fluid bolus of normal saline, blood was sent to the laboratory (results in Table 5), and a surgical consultation was obtained. Abdominal radiographs revealed dilated loops of small bowel, a paucity of rectosigmoid gas, air fluid levels, and no evidence of perforation (**Figure 1**). With symptoms of vomiting, abdominal pain, obstruction, and heme-positive stool, intussusception was considered the most likely diagnosis. A water-soluble

enema was ordered. Because of his degree of dehydration and hypernatremia, the patient was given 2 more 20-mL/kg normal saline boluses prior to undergoing the enema study. After receiving these fluid boluses, the infant's blood pressure remained within the normal range, and his capillary refill time decreased to less than 2 seconds.

The enema study was performed with the pediatric surgical team present and demonstrated an ileocolic intussusception that was completely reduced with hydrostatic pressure (**Figure 2**). A small amount of bloody stool with mucous was expelled, but no perforation was evident during the study. The patient tolerated the procedure well with no hypotension or respiratory compromise. He was admitted to the hospital for continued rehydration, correction of hypernatremia, and observation in case of recurrent obstruction.

- **What are the most important factors to know about the diagnosis and clinical course of intussusception?**
- **What are the components of the preoperative, operative, and postoperative management of a child with intussusception?**

Table 5. Laboratory Values of Case Patient*

Variable	Result
Leukocyte count	$13.8 \times 10^3/mm^3$
Differential count	
Segmented neutrophils	69%
Lymphocytes	23%
Atypical lymphocytes	1%
Monocytes	6%
Eosinophils	1%
Platelet count	$598 \times 10^3/mm^3$
Hemoglobin	10.9 g/dL
Serum electrolytes	
Sodium	155 mEq/L
Potassium	4.6 mEq/L
Chloride	117 mEq/L
Bicarbonate	16 mEq/L
Blood urea nitrogen	24 mg/dL
Serum creatinine	0.4 mg/dL
Serum glucose	96 mg/dL

*The laboratory results show hypernatremia and an elevated ratio of blood urea nitrogen to creatinine, suggesting prerenal azotemia most likely caused by hypovolemia from vomiting and dehydration.

INTUSSUSCEPTION

Definition

Intussusception occurs when one segment of bowel telescopes into another adjacent segment, causing obstruction. Although this obstruction may occur at any point along the GI tract, ileocolic intussusceptions are most common.[1]

Epidemiology

Intussusception is the most common cause of intestinal obstruction in children younger than 2 years, occurring with the highest frequency between 5 and 12 months of age.[2–4] The age range of children affected by intussusception is between 3 months and 6 years, with 15% of cases occurring between 2 and 3 years of age and 10% occurring beyond 3 years of age.[5] The male-to-female ratio for the disorder is 4:1.[1] With treatment, the mortality rate is 1% to 3%, but intussusception is uniformly fatal within 2 to 5 days without treatment.[6]

Etiology

Although the exact etiology of intussusception is unclear, many authors suggest that a lead point in the intestine allows a bowel segment (intussusceptum) with

Figure 1. Abdominal radiograph of the case patient, revealing dilated loops of small bowel, obstruction of the liver edge, and a paucity of rectosigmoid gas. There is no evidence of perforation.

its mesentery to telescope into its adjacent distal segment (intussuscipiens), forming the obstruction. The mesentery of the intussusceptum becomes constricted, impairing venous return and causing edema. As the telescoping continues, edema worsens, and the bowel segments can become strangulated and ischemic.[1] Once the segments are strangulated, mucosal bleeding can occur, producing the "currant-jelly" stools.

A specific lead point in the intestine is not found in more than 90% of cases.[6] However, when this point is present, it can take many forms. Most often, it is the result of enlarged lymphoid tissue (Peyer's patches) from a recent viral infection.[7–10] Other lead points occur because of Henoch-Schönlein purpura vasculitis, the appendix, a Meckel's diverticulum, an intestinal polyp, an intestinal duplication, celiac disease, or lymphosarcoma. Although intussusception is less common in children older than 5 years, a specific lead point is found more often in these older children.[11–13] Intussusception also may occur in dehydrated children with cystic fibrosis.[1]

Clinical Presentation

History. Two clinical presentations are associated with intussusception. The classic triad of symptoms consists of abdominal pain, vomiting, and bloody stools.[1] However, fewer than 33% of patients with intussusception have all
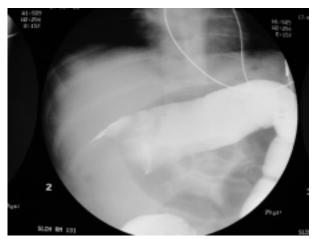
Figure 2. Contrast enema study of the case patient reveals an acute cut-off of contrast material consistent with an ileocolic intussusception that has extended into the ascending colon.

3 of these symptoms; 75% will have at least 2, and approximately 13% will have only 1.[14] Consequently, the lack of 1 or 2 of the symptoms does not necessarily rule out the diagnosis of intussusception. In fact, the child may be lethargic with none of the classic symptoms, sometimes called the *neurologic presentation* of intussusception.[15] With regard to the classic symptoms, abdominal pain typically precedes the vomiting, begins suddenly, and follows a paroxysmal pattern.[1] These painful episodes may occur every 15 to 30 minutes and last 10 to 15 minutes; during that time, the child is inconsolable and draws his legs to his abdomen. Between painful episodes, the child may be lethargic. Diarrhea with or without blood may be present, and vomiting is a nonspecific symptom that may be absent.[5]

Physical examination. On examination, the child may appear lethargic with signs of dehydration and hypovolemia. Results of the examination may be normal, except for the abdominal examination. Early in the disease course, the abdomen may be normal, but with progression, it may become distended and tender. Palpation may reveal a vertically oriented, sausage-shaped mass in the right upper quadrant; this mass may be more readily located during bimanual rectal and abdominal examination.[1] Dance's sign is the empty space in the right lower quadrant associated with a palpable mass in the right upper quadrant; it represents the displacement of the cecum from its normal position.[16] No abdominal mass is palpable in 50% of patients with intussusception. When the stool contains blood and mucous, it is described as appearing like currant jelly. However, the frequency of currant-

jelly stools associated with intussusception is highly variable (15%–85%), and there is no standard definition to describe their color and consistency.[5] Even if no gross blood is seen, up to 75% of patients with intussusception will have occult blood in the stool.[6] Rarely, the intussusception has progressed to an extent that its tip has prolapsed through the anus.[16] The patient may have a low-grade fever, but high fever is uncommon unless the late finding of enteric sepsis has occurred.[6]

Diagnosis

Laboratory examination. No laboratory studies are routinely used to diagnose intussusception, but they may be necessary to rule out differential considerations or assess for clinically significant electrolyte abnormalities caused by persistent vomiting and dehydration.

Imaging studies. Initial screening abdominal radiographs are indicated to evaluate patients for signs of obstruction, perforation, masses, or findings suggestive of intussusception. At least 2 views should be obtained, usually a supine anteroposterior view and either a left lateral decubitus or upright view. Obstruction is suggested by dilated bowel loops, loss of haustra or plications, lack of distal gas, and air-fluid levels.[17] Perforation is suggested by free air or air within the bowel wall (pneumatosis intestinalis).

Plain radiographic findings suggestive of intussusception include target sign, absence of the liver edge, crescent sign, and bowel obstruction. The target sign is found in the right upper quadrant and is visualized as a faint circle within a circle, similar to a doughnut.[18] The crescent sign represents the intussusceptum telescoping into a gas-filled intussuscipiens, resulting in a crescent-shaped gas bubble of varying size.[18] Both the target and the crescent signs are highly diagnostic for intussusception, but they are often difficult to detect.[18] The absence of the liver edge is not specific for intussusception, but it often accompanies the target sign.[18]

A completely normal series of abdominal radiographs allowing complete visualization of the colon (including the cecum) essentially rules out intussusception. However, radiographs are most often nonspecific, and further imaging is necessary. Ultrasonography is the imaging modality most commonly used to diagnose intussusception. It is noninvasive and quick. In addition to its high sensitivity for intussusception, ultrasonography can be used to detect alternative diagnoses when intussusception is absent.[19]

Contrast enemas can be both diagnostic and therapeutic. The standard diagnostic test for intussusception has traditionally been a barium enema. In addition to barium, air or water-soluble contrast may be used.

Because of the risk of perforation, consultation with a surgeon is recommended before attempting reduction using an enema.

Key Point

Intussusception is a diagnosis that must not be missed, because mortality is high without treatment. The child with intussusception may only appear lethargic or may have 1 or more of the classic triad symptoms (ie, abdominal pain, vomiting, blood in the stools). Plain radiographs are most often nonspecific, and further imaging with ultrasound or contrast enema is usually necessary. A contrast enema can be both diagnostic and therapeutic.

Treatment

The child with intussusception may present in shock, requiring IV fluid resuscitation. IV antibiotics are indicated in cases in which perforation or peritonitis is suspected. A nasogastric tube may be helpful if vomiting is persistent or bowel decompression is necessary. Definitive treatment is either nonsurgical, using a contrast enema, or surgical. Surgical reduction is indicated when contrast enema therapy fails to reduce the intussusception, causes perforation, or is contraindicated. The recurrence rates of intussusception are 5% to 10% after reduction with contrast enema and 1% to 4% after surgical reduction.[16]

Nonsurgical reduction. Reduction using a contrast enema is successful at rates varying from 50% to 95%.[20] Although air-contrast enemas often have been reported to have higher reduction rates compared to hydrostatic enemas, randomized controlled trials comparing the 2 types of enemas have failed to show any statistically significant differences.[21] The overall perforation rate in developed countries is 0% to 3%.[22] Absolute contraindications for contrast enemas include evidence of perforation or shock that is unresponsive to IV fluid resuscitation. Factors associated with a lower reduction rate and higher perforation rate include children younger than 3 months or older than 5 years, duration of symptoms exceeding 48 hours, bloody stools, presence of obstruction, and visualization of a long dissection sign during the enema therapy.[23–28]

Surgical reduction. Preoperatively, fluid resuscitation is continued until euvolemia is achieved, antibiotics are given, and a nasogastric tube is placed for bowel decompression.

During the procedure, the surgeon performs an exploratory laparotomy and reduces the intussusception manually. If there has been prolonged ischemia and necrosis of the bowel, resection may be necessary, but

this occurs in only 10% of surgical cases of intussusception.[16] Surgical exploration also may reveal a specific lead point and, if present, direct further treatment.

Postoperatively, the child is admitted for continued IV hydration and observation. Recurrence of obstruction following surgical reduction is uncommon, but it remains a possibility. The risk of a subsequent small bowel obstruction caused by adhesions is 7% after surgical reduction and 0% after nonsurgical reduction.[16]

CONCLUSION

Intussusception occurs when one segment of bowel telescopes into another adjacent segment, causing obstruction; it is the most common cause of intestinal obstruction in children younger than 2 years. The classic triad of symptoms consists of abdominal pain, vomiting, and bloody stools. Vomiting in infants that is persistent and becomes bilious is always abnormal and requires a thorough diagnostic evaluation. Even in the presence of a normal blood pressure, the findings of listlessness and delayed capillary refill time indicate shock and the need for IV fluid resuscitation. Definitive treatment of intussusception is either nonsurgical, using a contrast enema, or surgical. Intussusception is a diagnosis that cannot be missed, because mortality is high without treatment.   **HP**

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