BMJ Best Practice

# Evaluation of nausea and vomiting in children

Straight to the point of care


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# Summary

Nausea and vomiting are very common symptoms in the pediatric population. Whether presenting in the emergency department or in an outpatient clinic, they are a frequent reason for parents and caregivers to seek medical attention.

## Definitions

Nausea is the subjective unpleasant sensation of imminent vomiting. It is frequently accompanied by autonomic symptoms such as dizziness, pallor, and sweating.

According to the Rome foundation, chronic nausea is defined as bothersome nausea occurring several times per week, not usually associated with vomiting, in the absence of endoscopic or metabolic disease. These criteria must be fulfilled for the last 3 months, with the symptom onset at least 6 months prior to diagnosis.[1] In the latest Rome IV consensus, a specific definition of chronic nausea for young children or adolescents was not included.[1] [2]

Nausea is not always followed by vomiting, as in conditions such as chronic functional nausea, postural nausea, and functional dyspepsia.

Vomiting is defined as the vigorous oral expulsion of the gastric or intestinal contents associated with increased intra-abdominal pressure. Oral regurgitation refers to the effortless, usually postprandial, emesis of food content.

Vomiting is usually preceded by nausea; the only exceptions are rumination syndrome, in which oral regurgitation is not preceded by nausea, and possibly gastroesophageal reflux disease.

## Etiology

There are various established mechanisms that are known to cause nausea and vomiting, including:[3]

- Stimulation of chemoreceptors situated in the area postrema (medullary structure located in the fourth ventricle of the brain)
- Movement-induced stimulation of the labyrinth
- Irritation or over-distension of the mechanically sensitive vagal afferents in the gastrointestinal tract

The etiology of nausea and vomiting is often age-dependent, with a wide spectrum of gastrointestinal, nongastrointestinal, and environmental causes, including:

- Inflammatory changes causing infection of the gastrointestinal system or other body systems
- Anatomical abnormalities resulting in bowel obstruction
- Functional disorders or malignancy of the gastrointestinal tract
- Neurologic, which can be one of the most ominous causes, particularly in the presence of increased intracranial hypertension or central nervous system infection
- Metabolic or endocrine abnormalities such as diabetic ketoacidosis, adrenal insufficiency, and protein or carbohydrate metabolism disorders
- Urologic/gynecologic or renal, such as gonadal torsion
- Renal, such as hemolytic uremic syndrome and nephrolithiasis
- Psychiatric, such as eating disorders, rumination, or factitious disorder
- Toxic ingestions and adverse effects associated with the use of medications or illicit drugs

OVERVIEW

## Diagnosis

A complete history and meticulous physical examination is essential and provides the clues for appropriate diagnosis and management. Diagnostic testing should be directed by the clinical picture.[4]

Urgent considerations, particularly neurologic compromise, need to be addressed first and may prompt more immediate therapeutic management.

Red-flag symptoms that may require urgent management include: lethargy, fever, volume depletion, weight loss, bilious vomiting, hematemesis, papilledema, abdominal tenderness, or the presence of a mass.

# Etiology

Nausea and vomiting are common symptoms in children. The etiology of these symptoms is often age-dependent, with a wide spectrum of gastrointestinal, nongastrointestinal, and environmental causes.

## Gastroenteritis

Gastroenteritis is a very common cause of nausea, vomiting, diarrhea, and abdominal pain.

Children ages <5 years may experience as many as 1-5 episodes of acute diarrhea each year.[5] According to the Global Health Data Exchange in 2016, gastroenteritis manifesting as diarrhea was the eighth leading cause of death worldwide among all ages (1.65 million deaths), and the fifth leading cause of death among children younger than 5 years (446,000 deaths).[6]

For pediatric patients in the US, around 1% of cases require hospitalization, often due to dehydration.[7] Thus, when feasible, the initial emphasis should be on the provision of oral rehydration for mild to moderate dehydration, and intravenous fluids for more severe cases.

- Viral gastroenteritis: highly contagious infection that may present as an epidemic in a particular region and makes up 50% to 70% of cases of acute gastroenteritis. In most cases, the infection is self-limiting and resolves on its own, necessitating supportive measures only. The most common causative viral agents are norovirus, rotavirus, enteric adenovirus (types 40 and 41), astrovirus, coronavirus, and some picornaviruses.[8]
- Bacterial gastroenteritis: infection generally produces more severe and prolonged symptoms. An estimated 15% to 20% of acute gastroenteritis episodes are thought to be caused by bacterial infection in the US, but stool studies are positive in only 1.5% to 5.6% of cases.[8] [9] The most common causative bacteria are *Salmonella*, *Shigella*, *Campylobacter*, *Escherichia coli*, *Vibrio*, *Yersinia*, and *Clostridium difficile*.[8]
- Parasitic gastroenteritis: parasitic infections are typically more prolonged and make up an estimated 10% to 15% of cases of acute gastroenteritis.[8] Giardiasis, an enteric infection caused by the protozoan parasite *Giardia lamblia*, is the most common parasitic infection and can be spread by ingestion of contaminated food or water, or person-to-person spread via the fecal-oral route. Other parasitic agents include *Amoebas*, *Cryptosporidium*, *Isospora*, *Cyclospora*, and *Microsporidium*.

## Neurologic

Neurologic causes of nausea or vomiting are always concerning and often demand prompt evaluation and treatment.

- Meningitis: a medical emergency. Frequently, the etiology is viral (e.g., enterovirus, arbovirus, herpes virus, influenza virus, and possibly mumps virus); bacterial meningitis (e.g., group B *streptococcus*, *E coli*, *Listeria monocytogenes*, *Haemophilus influenzae* type b, *Streptococcus pneumoniae*, and *Neisseria meningitidis*) is a rare, but more serious etiology.[10] [11] [12]
- Functional neurologic syndromes: migraine, motion/travel sickness, and vertigo are very common. Pediatric migraines frequently lead to nausea and vomiting. The prevalence of migraine increases with age and has been estimated to be 8% to 23% between the ages of 10 and 20 years.[13]

- Brain tumors: the second most common cause of malignancy in children, with a mortality rate varying from <10% to >90% depending on the lesion.[14] Etiology is variable; however, they can be associated with conditions such as neurofibromatosis or familial adenomatous polyposis.[15]
- Intracranial hypertension: must be diagnosed and treated promptly; may be due to a brain tumor, pseudotumor cerebri (benign intracranial hypertension), hydrocephalus, infection, liver dysfunction, or ventriculoperitoneal shunt malfunction.[16]
- Concussion (mild traumatic brain injury): relatively common during early childhood; nausea is frequently observed postconcussion.[17] [18] Data from one large prospective observational cohort study indicate that approximately 13% of children (<18 years) experience vomiting following minor blunt head trauma.[19] Note that recurrent vomiting following mild head injury may predict intracranial injury.[20][21] In adolescents, concussion is frequently associated with blunt trauma due to athletic activities such as bicycling, football, basketball, and soccer.

## Gastroenterologic: obstructive

Gastrointestinal obstruction is a common and very concerning cause of nausea and vomiting in children. The etiology is mostly age-dependent, but may also be contingent on pre-existing abdominal surgery.

- Pyloric stenosis: incidence is around 2 per 1000 live births, with males having a 4- to 5-times increased risk compared with females.[22] [23] Usually presents between 2 and 12 weeks of age.[22] [24] [25] A family history of a parent having the condition is common.[26] [27]
- Small bowel atresia: commonly associated with polyhydramnios and diagnosed prenatally. Presentation occurs soon after birth with abdominal distention and vomiting.
- Intestinal malrotation: a spectrum of rotational and fixation disturbances that can occur during embryonic development. Has an incidence of 1 per 6000 live births and is considered as a surgical emergency. Can lead to a midgut volvulus with a high risk of intestinal necrosis.
- Intussusception: the most common cause of intestinal obstruction in children ages 6-36 months old, with an incidence of 36 cases per 100,000 infant years in the US.[28] It is always considered an emergency. While usually idiopathic in etiology, viral diseases have been associated with triggering an acute episode.[29]
- Superior mesenteric artery syndrome: an uncommon cause of small bowel obstruction. In this condition, a functional compression exists of the third portion of the duodenum by the superior mesenteric artery and the aorta. It is commonly associated with a slim body habitus, a recent and marked history of weight loss, or a history of spinal surgery.[30]

## Gastroenterologic: functional

- Gastroesophageal reflux disease: simple regurgitation occurs in almost 50% of infants. In 90% of these infants, symptoms are limited to oral regurgitations and resolve by the age of 1 year in most.[31]
- Cyclic vomiting: defined as a pattern of intermittent and often paroxysmal vomiting, alternating with asymptomatic periods without vomiting.[32] It is a diagnosis of exclusion and can only be diagnosed in patients after the exclusion of inflammatory, metabolic, or neoplastic causes. It is frequently seen in children, particularly adolescents and females, with an estimated prevalence of approximately 2% in

school-aged children.[32] [33] Initially, episodes may be confused for a prolonged viral gastroenteritis. Suspicion should arise when the stereotypical pattern is established.[34]

- Dysautonomia (e.g., postural orthostatic tachycardia syndrome and orthostatic hypotension): while primary dysautonomic syndromes are extremely rare, the presence of nausea and vomiting in these syndromes is common in adolescents; up to 87% of pediatric patients with orthostatic intolerance report gastrointestinal symptoms.[35]
- Gastroparesis: defined as delayed gastric emptying and associated with nausea and vomiting. It is an uncommon cause of vomiting in children. It frequently occurs after a viral infection (i.e., postviral gastroparesis), but may be seen in association with mitochondrial, neuromuscular, and autoimmune disorders.
- Hirschsprung disease: a congenital condition, affecting the distal segments of the colon, caused by absence of ganglion cells in the myenteric and submucosal plexus. This creates a functional obstruction. It occurs in 1 in 5000 live births and is generally associated with frequent episodes of enterocolitis.[36]
- Constipation: prevalence of 0.7% to 29.6% worldwide in children.[37] [38] Rarely, it can lead to symptoms suggesting bowel obstruction, particularly in the presence of marked impaction of stool in the rectum. However, it is better recognized as a "functional" versus "true" mechanical obstruction, despite the relative similarity in presentation.
- Functional dyspepsia: presence of epigastric pain or discomfort associated with early satiety, nausea, or vomiting. It occurs in the absence of inflammatory or metabolic disease or malignancy that would otherwise explain the symptoms. Symptoms may in part be explained by abnormalities in antroduodenal motility, gastric emptying, gastric sensation, and accommodation.

## Gastroenterologic: inflammatory

- Peptic ulcer disease: common in certain pediatric populations. *Helicobacter pylori* is a frequent cause and is often associated with a family history of infection, low socioeconomic status, or crowded living conditions.[39] It is also common in the setting of an acute illness (e.g., patients in intensive care units).
- Acute appendicitis: usually caused by an obstruction (e.g., lymphoid hyperplasia, fecalith) of the lumen of the appendix.
- Acute pancreatitis: the most common causes in children include mutations in genes encoding proteases, congenital anomalies affecting the pancreas, gallstones, and drugs (e.g., valproic acid, glucocorticoids).[40]
- Hepatitis A: infection caused by the hepatitis A virus, an RNA virus, spread via close contact with an infected person (including fecal-oral contact) or contaminated food or water.

## Gastroenterologic: allergic

- Food allergies: the incidence of food allergies is approximately 10% at 1 year of age, falling to 3% to 4% by the age of 2 years.[41] Some children demonstrate persistent symptoms with associated respiratory and dermatologic complaints. Milk/dairy (lactose), wheat, soy, peanuts, eggs, and shellfish are the most frequently involved foods.

- Eosinophilic esophagitis: defined as the presence of ≥15 eosinophils per high-power field in an esophageal biopsy with presence of esophageal dysfunction, in the absence of other causes of esophageal eosinophilia.[42] [43] [44] Prevalence has increased over time.[45] Food allergies seem to play a major role in the pathogenesis of the disease; however, the etiology is not clearly defined.

## Gastroenterologic: malignancy

- Small bowel lymphoma: predisposing factors such as low socioeconomic status, poor sanitation, and genetic factors have been associated with the development of immune-proliferative small intestine disease. Celiac disease and ulcerative enteritis are more closely linked to enteropathy-associated T-cell lymphoma.[46]

## Metabolic/endocrine

- Diabetic ketoacidosis: more common in children <5 years of age and girls, and is more frequently the initial presentation for type 1 (versus type 2) diabetes.[47] [48]
- Adrenal insufficiency: rare in children. Nausea and vomiting are common presenting symptoms.[49] Adrenal insufficiency has been linked to syndromes such as congenital adrenal hyperplasia, triple A syndrome (achalasia, addisonianism, and alacrima), autoimmune adrenal failure, and paroxysmal disorders.
- Inborn errors of metabolism: uncommon disorders that generally present at birth and may be devastating if unrecognized. Protein metabolism disorders include aminoaciduria, organic acidemias, and urea cycle disorders, and are associated with poor feeding, vomiting, and lethargy. They can also be associated with metabolic decompensation including acidosis, hyperammonemia, or hypoglycemia. If not treated, disease progression including neurologic compromise and death may occur. Carbohydrate metabolism disorders include galactosemia, fructosemia, and some glycogen storage diseases, and can result in poor feeding, vomiting, liver dysfunction, and hypoglycemia.[50]

## Urologic/gynecologic and renal

Nausea and vomiting are frequent symptoms of renal, urologic, and gynecologic diseases.

- Gonadal torsion: testicular or ovarian torsion are considered surgical emergencies. Testicular torsion is more common between the ages of 12 and 18 years; however, it can occur in young infants and neonates as well.[51] It can be due to trauma. Ovarian torsion generally occurs just before menarche, but may also occur in younger girls. Approximately 25% of patients have normal ovaries; however, more commonly, the condition is associated with ovarian cysts or benign masses.[52]
- Urinary tract infection (UTI): estimated prevalence in children is approximately 7%.[53] Occurs most frequently in females. Bacterial infection is the most common cause. Risk factors include chronic constipation, bladder dysfunction (e.g., neurogenic bladder), and vesicoureteral reflux.
- Hemolytic uremic syndrome: a common cause of kidney failure in children, which is commonly associated with O157 H7 toxigenic *E coli* and *Shigella* infection. Genetic and medication-related causes also exist.[54] Mortality can reach 5%, and chronic renal failure can occur in 20% of patients.[55]

- Nephrolithiasis: incidence is increasing in children. More frequently seen in white boys, with most patients aged 13 years or younger.[56] Risk factors include: environmental factors; metabolic conditions; systemic disorders; structural abnormalities of the kidneys, ureters, or bladder; and a history of UTIs. The most frequent composition is calcium oxalate and phosphate.[57]
- Ureteropelvic junction obstruction: an obstruction of the flow of urine from the renal pelvis to the proximal ureter, which is frequently diagnosed prenatally. Causes include congenital abnormalities, previous surgery, or disorders that cause inflammation of the upper urinary tract.

## Psychiatric

- Eating disorders: the lifetime prevalence of bulimia nervosa (DSM criteria) has been estimated to be up to 4.6% for females and 1.3% for males, and up to 3.6% and 0.3%, respectively, for anorexia nervosa (DSM criteria).[58] [59] Eating disorders have an associated mortality of 2% to 6%, with adolescents being at increased risk.[60] [61] It is commonly associated with depression and other psychiatric comorbidities.
- Rumination syndrome: defined as the presence of repeated oral regurgitation of small amounts of food from the stomach, which is often then re-swallowed. This usually occurs during or immediately after the patient eats. It is found in approximately 5% of the pediatric population and is frequently associated with psychiatric disorders such as bulimia nervosa.[62] [63] [64] It occurs more commonly in children with developmental delays.[65]
- Factitious disorder (medical abuse): should be suspected when symptoms seem fabricated or out of proportion to the examination. Often, routine diagnostic workup does not explain the nature of the symptoms. Nausea and vomiting are common in this disorder. It occurs frequently in children ages <5 years. The perpetrator is often one of the child's parents or caretakers. It can be devastating if not recognized early.[66]

## Environmental

- Toxic ingestions: approximately 1.17 million toxic exposures in children (<20 years) were reported by poison control centers in the US in 2021.[67] Among the most common exposures in children age ≤5 years were cosmetics, cleaning substances, analgesics, pesticides, cough and cold preparations, cardiovascular drugs, stimulants and street drugs, and essential oils.[67]
- Medication adverse effects: the most common include chemotherapy drugs (induce stimulation of the area postrema in the hypothalamus and may produce severe symptoms), opioid analgesics (due to their effect on reducing gastrointestinal motility), and anticholinergic medications such as antidepressants or antispasmodics (due to reducing gastrointestinal motility). Nonsteroidal anti-inflammatory drugs can cause nausea and vomiting secondary to gastrointestinal inflammation. Others include anesthetics and antibiotics.
- Cannabis hyperemesis syndrome: a rare cause of intractable vomiting associated with the use of cannabis.[68] [69] Other symptoms include compulsive bathing, abdominal pain, and polydipsia. Vomiting usually ceases with discontinuation of the drug.[70]

## Respiratory/ear, nose, and throat

- Otitis media: defined as the presence of fluid and inflammation in the middle ear. Very common in the pediatric population, with 1 in 4 children having at least 1 episode of acute otitis media by the age of 10 years.[71] The most common pathogens associated with acute otitis media are bacteria such as *S pneumoniae* , *H influenza* , and *Moraxella catarrhalis* ; however, viruses have also been implicated.
- Pneumonia: a very common cause of morbidity in children. It is more frequent in boys aged <5 years, particularly in association with a low socioeconomic status. Both viruses (e.g., influenza virus) and bacteria (e.g., *S pneumonia* , *Mycoplasma pneumoniae* ) have been implicated.

# Urgent considerations

(See Differentials for more details)
Red-flag symptoms that may require urgent management include lethargy, fever, volume depletion, weight loss, bilious vomiting, hematemesis, papilledema, abdominal tenderness, and/or the presence of a mass.

Children are at increased risk of volume depletion, and they should be specifically assessed for this feature when there is a history of vomiting, diarrhea, or poor oral intake. Signs of volume depletion include depressed anterior fontanel (in infants), sunken eyes, dry mucosal membranes, sticky saliva, loss of skin turgor, and slow capillary refill. Oral or nasogastric fluids should be started in order to avoid shock. If this is not possible, or if the child does not respond, intravenous hydration is needed.

Antiemetics are generally not recommended in infants and children with a suspected obstruction or increased intracranial pressure, especially if the cause of the vomiting is unknown. They may be useful in patients with gastroenteritis to help decrease fluid loss. Adverse effects of antiemetics include sedation and neurological symptoms.



## Neonates

Intestinal malrotation:

- Should be suspected in newborns with bilious vomiting.
- Patient may require urgent upper gastrointestinal series and surgery.
- Ladd procedure may be indicated to prevent midgut volvulus and intestinal necrosis.

Hirschsprung disease:

- Should be suspected in a newborn baby who has failed to pass meconium within 48 hours of birth and has bilious vomiting, explosive diarrhea, or abdominal distension.
- Initial treatment is bowel irrigation, followed by definitive surgical treatment.

Metabolic disorders:

- Should be suspected in infants with lethargy, hepatomegaly, and absence of fever.
- Electrolytes, venous pH, blood glucose level, ammonia level, and liver function tests (LFTs) should be obtained.
- Patient may require hospital admission for metabolic decompensation.

## Infants or toddlers

Intussusception:

- Should be suspected in infants or toddlers with cramps, intermittent abdominal pain, lethargy, and bloody stools.
- Patient should be sent to the emergency department for evaluation.
- Abdominal ultrasound and possible hydraulic or pneumatic reduction should be performed.

Failure to thrive:

- Enteropathy, milk protein allergy, and pancreatic insufficiency should be suspected in infants with poor weight gain and diarrhea.

- Appropriate referral for pancreatic function studies and possible endoscopy may be indicated.

Toxic ingestions:

- Should be suspected in infants or toddlers with lethargy, seizures, and ataxia. Access to a medication or toxin should be queried.
- Patient should be sent to the emergency department for evaluation.
- Electrolytes, blood gases, urine, and blood for toxic substances should be obtained.

Hemolytic uremic syndrome:

- Should be considered in children with abdominal pain, bloody diarrhea, and absence of fever. Characterized by microangiopathic hemolytic anemia, thrombocytopenia, and nephropathy.
- If suspected, patient should be hospitalized. A complete blood count (CBC), peripheral blood smear, and renal function test should be ordered initially.
- Treatment is mainly supportive.



## Older children or adolescents

Nephrolithiasis:

- Should be suspected in children with abdominal/back pain and hematuria.
- Appropriate imaging includes abdominal ultrasound and possibly a computed tomographic (CT) urogram.

Jaundice:

- Hepatitis should be suspected in children or adolescents with jaundice and abdominal pain.
- Abdominal ultrasound, LFTs, and hepatitis viral panel (including Epstein-Barr virus) are the most appropriate initial tests.

Constipation/fecal impaction:

- Should be suspected in older children (and toddlers) with abdominal distension, soiling, and the presence of a mass in the abdomen.
- Rectal exam may be considered in difficult or atypical cases, but there is limited evidence to support its use in the diagnosis of functional constipation.[72] [73] Rectal exam should only be undertaken by healthcare professionals competent to interpret features of anatomic abnormalities or Hirschsprung disease.[74]
- Abdominal x-ray may serve as an adjunct to the diagnosis , or as an alternative to rectal exam when it is not feasible.[73] [75]

Peptic ulcer disease:

- Should be suspected in children and adolescents with epigastric abdominal pain, melena, or hematemesis.
- May require referral for upper gastrointestinal endoscopy and initiation of acid suppression therapy.

Gonadal torsion:

- Should be considered in males with acute onset of testicular/scrotal pain (testicular torsion) and in females with severe sharp lower abdominal pain and a palpable adnexal mass (ovarian torsion).
- Considered a surgical emergency. A high index of suspicion is important to ensure timely diagnosis and management.

## All ages

Bacterial meningitis:

- Should be suspected in infants with lethargy, fever, and tense fontanel, or children and adolescents with headache, fever, or nuchal rigidity.
- Patient requires urgent admission and workup with blood, urine, and cerebrospinal fluid cultures.
- Antibiotics should be given immediately to prevent neurologic sequelae.[76] [77]

Pneumonia:

- Should be considered in patients with fever, cough, dyspnea, chest pain, crackles/rales on auscultation, or signs of respiratory distress.
- Chest x-ray and blood/sputum cultures should be ordered.
- Empiric antibiotic therapy should be started as soon as possible.[78] Whether the patient is treated as an inpatient or outpatient will depend on specific patient factors (e.g., severity of symptoms, presence of comorbidities, likelihood of drug resistance).

Increased intracranial pressure:

- Should be suspected in patients with headache and vomiting early in the morning with or without papilledema and ataxia.
- Immediate brain CT or magnetic resonance imaging (MRI) is indicated to help determine etiology (e.g., brain tumor, pseudotumor cerebri [benign intracranial hypertension], hydrocephalus, infection, concussion, or ventriculoperitoneal shunt malfunction).

Acute abdomen:

- Differential diagnosis includes appendicitis, intussusception, intestinal volvulus, pancreatitis, and renal calculi.
- If suspected, abdominal/pelvic CT imaging with contrast should be ordered. If renal calculi are strongly suspected, obtain CT without contrast first.

Small bowel lymphoma:

- Should be suspected in patients with abdominal pain, diarrhea, weight loss, fever, presence of mass, or organomegaly.
- CT or MRI of the abdomen should be ordered to confirm the presence of a mass or obstruction.
- Considered a surgical emergency if obstruction is present.

Eosinophilic disease:



- Should be suspected in patients with dysphagia, choking, food impaction, rhinitis, or asthma (eosinophilic esophagitis), or in patients with diarrhea, hematochezia, or failure to thrive (eosinophilic gastroenteritis).
- Peripheral eosinophilia is seen on a CBC.

Diabetic ketoacidosis (DKA):

- Should be considered in patients with type 1 diabetes or in patients with polyuria, polydipsia, polyphagia, weight loss, drowsiness, lethargy, anorexia, and abdominal pain for whom DKA may be the first manifestation of diabetes.
- Urinalysis (for glucose and ketones) and ABG should be performed, and blood samples taken for glucose, ketones, and electrolytes.
- Can cause severe complications or even death if untreated.

# Approach

Nausea and vomiting are common in children and are due to a diverse range of conditions. Despite there being many complex tests available, diagnosis primarily relies on a thorough history and physical exam.

Red-flag symptoms that should always be assessed, as they may require urgent management, include lethargy, fever, volume depletion, weight loss, bilious vomiting, hematemesis, papilledema, abdominal tenderness, or the presence of a mass.

## History

Nausea is characterized by the subjective unpleasant sensation of imminent vomiting. Often, the feeling can be localized in the stomach or throat, and is frequently accompanied by autonomic symptoms such as dizziness, pallor, and sweating. Vomiting is defined as the vigorous oral expulsion of the gastric or intestinal contents associated with contraction of the abdominal and chest muscles.

Nausea and vomiting frequently occur simultaneously in multiple conditions. Vomiting is usually preceded by nausea; the only exceptions are rumination syndrome, in which oral regurgitation is not preceded by nausea, and possibly gastroesophageal reflux disease (GERD).

Nausea is not always followed by vomiting, as in conditions such as chronic functional nausea, postural nausea, and functional dyspepsia.

The following history should be elicited from the patient, parent, or caregiver.

- Travel, food or fresh water intake, sick contacts: may indicate an infection.
- Travel with passive movement: may indicate motion/travel sickness.
- Previous trauma: may indicate concussion.
- Ingestion of toxin(s) or use of medication(s): may indicate an environmental cause. Among the most common exposures in children ages ≤5 years are cosmetics, cleaning substances, analgesics, pesticides, cough and cold preparations, cardiovascular drugs, stimulants and street drugs, and essential oils.[67] Drug adverse effects: most commonly implicated include chemotherapy drugs, opioid analgesics, and anticholinergic drugs such as antidepressants or antispasmodics. Nonsteroidal anti-inflammatory drugs can cause nausea and vomiting secondary to gastrointestinal inflammation. Others include anesthetics and antibiotics.
- Family history: may indicate a chronic inflammatory condition, genetic conditions (e.g., metabolism disorders), or liver disorders.
- Relation of symptoms to types of food: may indicate a food allergy.

The etiology of the symptoms is often age-dependent and the following conditions present most commonly in each of the following age groups.



| | | |
|---|---|---|
| Any age | • Addison disease<br>• Benign paroxysmal positional vertigo<br>• Brain tumor<br>• Eosinophilic disease<br>• Gastroparesis<br>• Giardiasis<br>• Hepatitis A<br>• Hydrocephalus<br>• Labyrinthitis | • Medication adverse effects<br>• Meningitis<br>• Motion/travel sickness<br>• Otitis media<br>• Pseudotumor cerebri<br>• Small bowel lymphoma<br>• Superior mesenteric artery syndrome<br>• Ureteropelvic junction obstruction<br>• Urinary tract infection<br>• Viral/bacterial gastroenteritis |
| Neonates | • Congenital adrenal hyperplasia<br>• Hirschsprung disease<br>• Intestinal malrotation | • Metabolic disorders<br>• Pyloric stenosis<br>• Small bowel atresia |
| Infants | • Constipation<br>• Diabetic ketoacidosis<br>• Food allergies<br>• Gastroesophageal reflux disorder<br>• Hemolytic uremic syndrome | • Intussusception<br>• Metabolic disorders<br>• Munchausen by proxy<br>• Pneumonia<br>• Toxic ingestions |
| Children | • Constipation<br>• Cyclic vomiting<br>• Diabetic ketoacidosis<br>• Functional dyspepsia<br>• Hemolytic uremic syndrome<br>• Medication adverse effects<br>• Migraine | • Munchausen by proxy<br>• Nephrolithiasis<br>• Peptic ulcer disease<br>• Pneumonia<br>• Rumination<br>• Toxic ingestions |
| Adolescents | • Acute appendicitis<br>• Acute pancreatitis<br>• Bulimia nervosa<br>• Cannabis hyperemesis syndrome<br>• Concussion<br>• Cyclic vomiting<br>• Functional dyspepsia<br>• Medication adverse effects | • Migraine<br>• Nephrolithiasis<br>• Ovarian torsion<br>• Peptic ulcer disease<br>• Postural orthostatic tachycardia<br>• Rumination<br>• Testicular torsion<br>• Toxic ingestions |

*Etiology of nausea and vomiting in children and adolescents grouped according to age*

*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*

It is important for the clinician to differentiate between acute and chronic symptoms.

- The etiology of chronic nausea is often difficult to define, and in order to better classify it, a consensus statement has been released by the Rome foundation. According to the Rome foundation, chronic

nausea is defined as bothersome nausea occurring several times per week, not usually associated with vomiting, in the absence of endoscopic or metabolic disease. These criteria must be fulfilled for the last 3 months, with the symptom onset at least 6 months prior to diagnosis.[1] In the latest Rome IV consensus, a specific definition of chronic nausea for young children or adolescents was not included.[1] [2]

- Most cases seen in primary care are acute with symptoms that occur for less than one week. In this context, the severity of the symptoms and impact on the patient's health should be evaluated as the first priority. Specifically, the number and duration of episodes and ability to maintain hydration or adequate nutrition may need to be addressed before attempting to determine the cause.
- Chronic symptoms may be associated with structural, inflammatory, malignant, or functional gastrointestinal or nongastrointestinal disorders; therefore, a careful evaluation and referral should always be considered.

It is important for the clinician to be aware of the timing of a patient's symptoms: day or night; during sleep; or before, during, or after meals. This is particularly important with recurrent or chronic nausea and vomiting.

- Frequency of the episodes can be classified as either cyclical (i.e., when asymptomatic periods occur, such as in cyclic vomiting) or continuous.
- If symptoms occur during the morning and are associated with changes in posture (e.g., standing up), dysautonomia, postural nausea, and orthostatic tachycardia should be suspected.
- If symptoms occur immediately after the patient eats, rumination should be suspected, particularly in the context of regurgitation without nausea. It appears to be more common in developmentally delayed children.
- If symptoms occur later in the day or after meals/feeds with undigested food in the vomitus, gastroparesis should be considered. A delay in gastric emptying can be a common occurrence after a viral infection (postviral gastroparesis).
- If symptoms occur during the night and wake the patient up, or occur on waking, this may suggest more serious conditions such as intracranial hypertension, particularly when associated with severe headaches. Intracranial hypertension may be due to a brain tumor, pseudotumor cerebri (benign intracranial hypertension), hydrocephalus, infection, or ventriculoperitoneal shunt malfunction.
- In the case of GERD, it is important to differentiate effortless regurgitation versus vomiting. Regurgitation generally occurs shortly after meals and can be associated with heartburn.

The characteristics of the vomitus, when present, are relevant to the diagnosis.

- Vomitus may be digested food contents from the stomach, yellow in color, bilious, or in some cases blood-tinged or frankly bloody.
- Bilious vomiting is common in cases of intestinal obstruction like intestinal malrotation and small bowel atresia. It may also be present in Hirschsprung disease.
- Projectile vomiting (postprandial, nonbilious) is specific to pyloric stenosis.
- Hematemesis is common in GERD, peptic ulcer disease (PUD), and bulimia nervosa.
- It is not uncommon to see the vomitus evolve during multiple consecutive episodes: for example, changing from food content to bilious and then to bloody. Hematemesis under these circumstances may be due to ensuing Mallory-Weiss tears (mucosal tears at the gastroesophageal junction) due to retching or gastritis.

The presence of associated symptoms may help direct the clinician toward a diagnosis.

- Diarrhea (especially bloody, watery, or foul-smelling), abdominal pain, and fever are common presenting symptoms of gastroenteritis. Diarrhea and abdominal pain may also indicate small bowel



lymphoma.[30] If diarrhea is explosive, it may indicate Hirschsprung disease. Bloody diarrhea may also indicate hemolytic uremic syndrome. Hematochezia may indicate intussusception (may be described as currant jelly stool) or intestinal malrotation. Melena may indicate peptic ulcer disease.

- Fever, headache, photophobia, confusion, and nuchal rigidity may indicate meningitis. Nuchal rigidity is uncommon in children <2 years of age, but its absence does not exclude meningitis.
- Fever may also indicate other infectious causes. Otalgia is characteristic of otitis media. Dysuria, urinary frequency, or flank pain may indicate a urinary tract infection or, if pain is severe, nephrolithiasis. Upper respiratory tract symptoms (e.g., cough, dyspnea) may indicate pneumonia.
- Headache, photophobia, and the absence of fever may suggest migraine as a precipitating factor. Symptoms may be preceded by an aura.
- A baby being very hungry immediately after feeding (seems to be "starving to death") is characteristic of pyloric stenosis.
- Acute onset of severe testicular/scrotal or sharp abdominal pain may indicate testicular or ovarian torsion, respectively. Midepigastric pain that radiates through to the back may indicate acute pancreatitis.
- Polyuria, polydipsia, and polyphagia can indicate diabetic ketoacidosis.
- Dysphagia including choking, food impaction, as well as odynophagia may indicate eosinophilic esophagitis (EoE); 50% to 60% of patients also have rhinitis or asthma.[45]
- Failure to pass meconium within 48 hours of birth: may indicate Hirschsprung disease or small bowel atresia.

Location of nausea can be very helpful in defining potential causes.

- Nausea in the epigastric region can be linked to dyspepsia.
- Patients who point to their neck/throat may have symptomatic GERD.

## Physical examination

A complete physical examination is always warranted; however, patients often have no specific findings on exam. Every body system should be examined carefully.

- Volume depletion: a decrease of more than 5% of the previous weight should raise concern about the possibility of volume depletion. The presence of tachycardia and hypotension with weight loss >10% to 15% is associated with a more pronounced hypovolemia and the need for appropriate fluid resuscitation. Other signs of volume depletion include the presence of a sunken anterior fontanel (in infants) or eyes, dry mucosal membranes, sticky saliva, loss of skin turgor, and slow capillary refill. Volume depletion may be associated with infections, an obstruction, or metabolic disorders.
- Fever, pallor, and lethargy: typical signs of infection.
- Wheezing or rales: may be revealed on chest exam and may indicate pneumonia.
- Skin changes: jaundice, petechiae, or a purpuric rash may suggest an infectious process. Jaundice may also be seen in infants with pyloric stenosis, hepatitis A, or metabolism disorders. Hyperpigmentation of mucosa suggests Addison disease. Loss of skin turgor suggests volume depletion, and pallor suggests anemia.
- Neurologic signs: seizures, confusion/altered mental status, behavioral changes, nuchal rigidity, papilledema, abnormal gait, vision dysfunction, cranial nerve paralysis, or retinal hemorrhages may be suggestive of trauma or intracranial hypertension. A bulging fontanel in infants may also suggest intracranial hypertension. Amnesia may follow traumatic brain injury.

- Acetone breath: specific for diabetic ketoacidosis. Other signs include tachycardia, hypotension, hyperventilation, and altered mental status.
- Failure to thrive: a nonspecific sign that can occur in metabolic disorders, obstruction, food allergies, and functional gastrointestinal disorders.
- Unexplained symptoms may indicate factitious disorder. Symptoms that do not respond to medical management also support a diagnosis of the latter, or possibly cannabis hyperemesis syndrome.

The abdominal examination often gives multiple clues for the diagnosis.

- Absence of bowel sounds and presence of abdominal distension: may suggest gastrointestinal obstruction.
- Tenderness or pain on palpation: should alert the examiner to a possible acute abdominal inflammatory process such as enteritis or appendicitis.
- Epigastric mass or visible peristalsis: can suggest pyloric stenosis in infants. A palpable mass may also indicate some other type of obstruction, or possibly gonadal torsion or nephrolithiasis, depending on the location of the mass.
- Hepatomegaly: often seen in the context of metabolic conditions such as fructose intolerance or hepatitis A.
- Right upper quadrant tenderness: suggests viral hepatitis or a toxic insult to the liver.
- Costovertebral tenderness: present in teenagers with urinary tract infections, or patients with nephrolithiasis.
- Bloating or distension may indicate gastroenteritis or an obstruction.

Rectal exam may be considered in difficult or atypical cases, but there is limited evidence to support its use in the diagnosis of functional constipation.[72] [73] Rectal exam should only be undertaken by healthcare professionals competent to interpret features of anatomic abnormalities or Hirschsprung disease.[74]

Otoscopy should be performed if otitis media is suspected (e.g., older children with otalgia or younger children who are seen to be pulling their ears). A bulging tympanic membrane and myringitis are diagnostic for otitis media.

## Initial laboratory investigations

A complete medical history and physical examination guides which diagnostic tests should follow. Most cases do not require an extensive evaluation. Diagnostic testing should be directed by the clinical picture.[4]

A complete blood count, blood urea nitrogen and serum creatinine, liver function tests (LFTs), pancreatic enzymes, blood glucose level, serum ketones, arterial blood gas, urine culture, and urinalysis should be considered in all patients initially, particularly if the patient appears ill. Serum electrolytes should be ordered in patients with volume depletion in whom intravenous fluids may be needed. Lumbar puncture should be performed if meningitis or pseudotumor cerebri is suspected. Hepatitis A antibodies should be ordered if viral hepatitis is suspected. A positive fecal occult blood test raises concerns for gastrointestinal inflammatory conditions. Stool studies are useful if the patient has diarrhea. Blood (or sputum) cultures may be ordered to confirm the presence of an infection. Drug urine/serum screens should be ordered if a toxic ingestion is suspected.

The presence of acidosis, ketosis, and hyperglycemia suggests diabetic ketoacidosis. Hemolytic uremic syndrome is characterized by the presence of microangiopathic anemia, thrombocytopenia, and renal insufficiency. Anemia can also occur in severe gastroenteritis, peptic ulcer disease, and eating disorders. Derangement of serum electrolytes can occur in many conditions including metabolic or endocrine disorders,



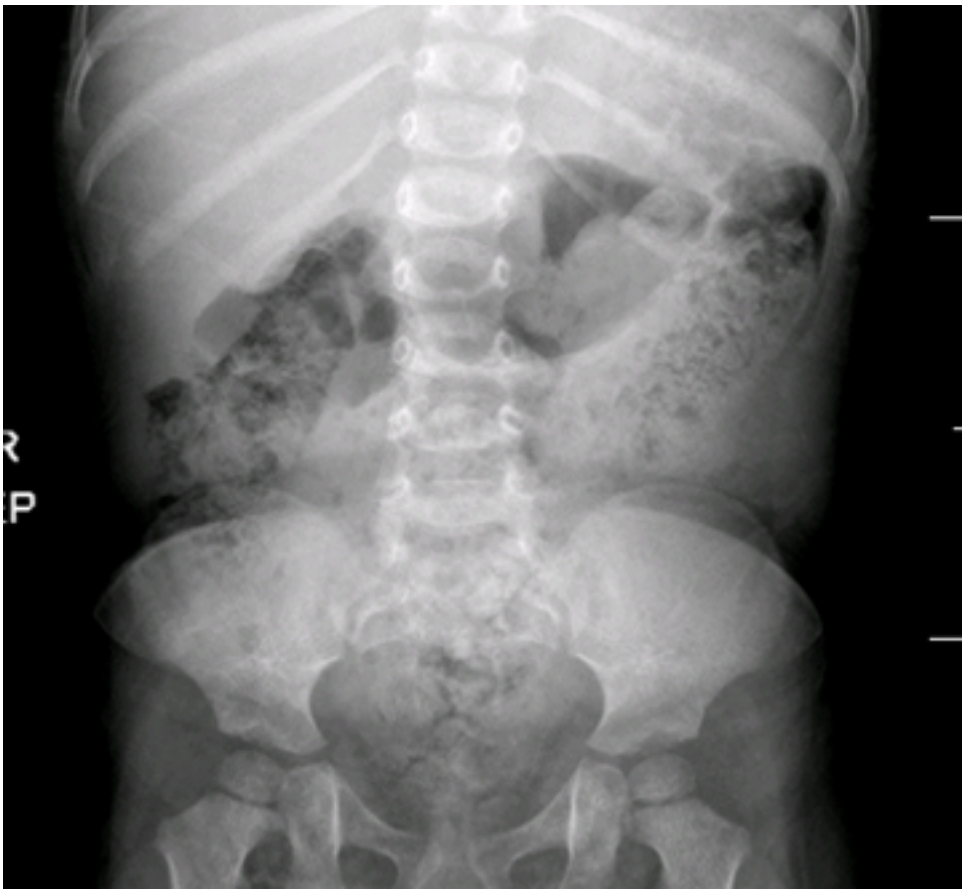
eating disorders, toxin/medication ingestions, and any condition associated with volume depletion. White blood cell (WBC) count is usually elevated in infections, and peripheral eosinophilia indicates eosinophilic disease. Elevated LFTs may indicate hepatitis A, especially in the context of a positive test for hepatitis A virus immunoglobulins.

## Initial imaging investigations

Frequently, no imaging is necessary, especially if the clinical presentation can be explained by the history and physical exam.

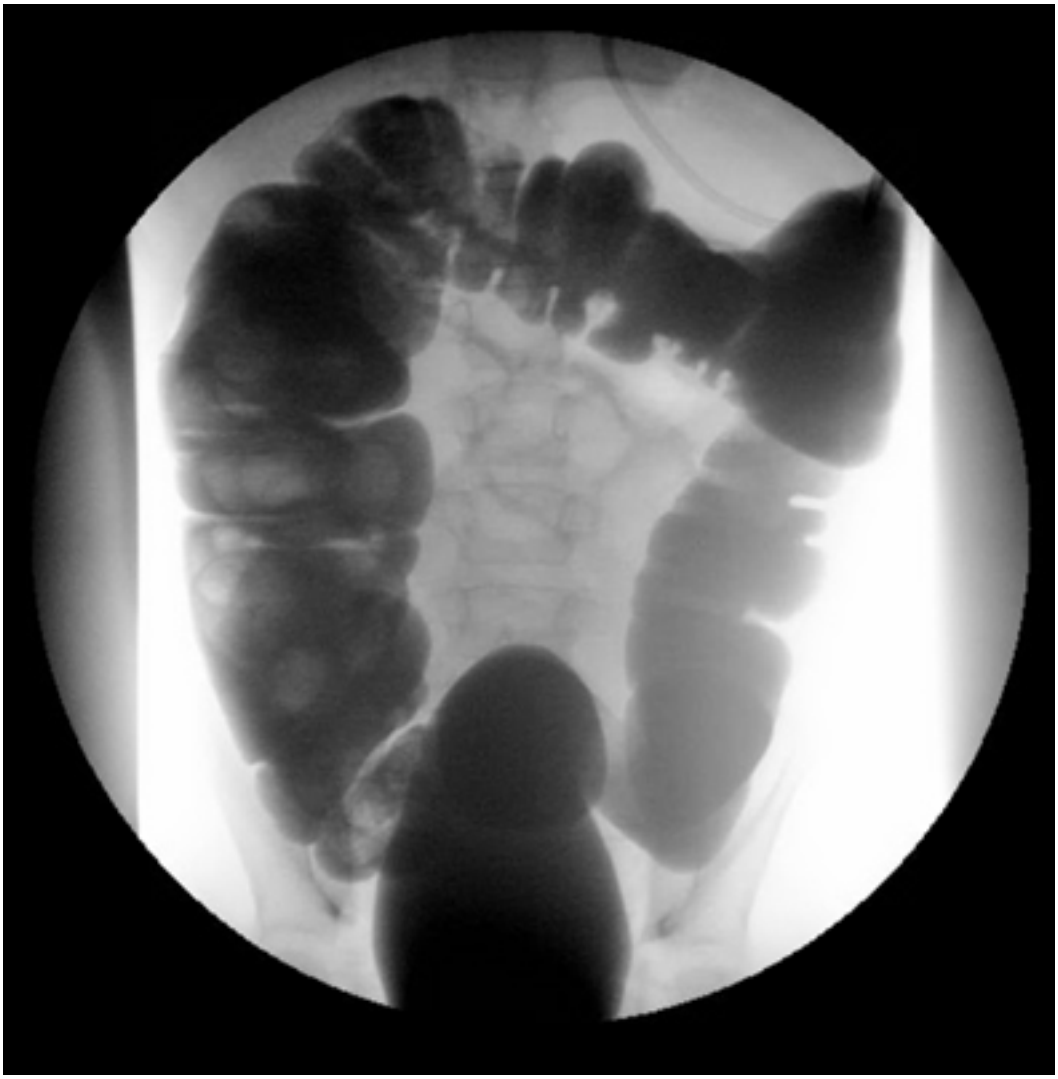
Relevant imaging studies include the following.

- Plain abdominal x-rays (including an upright or cross-table lateral view): should be obtained if a bowel obstruction is suspected.



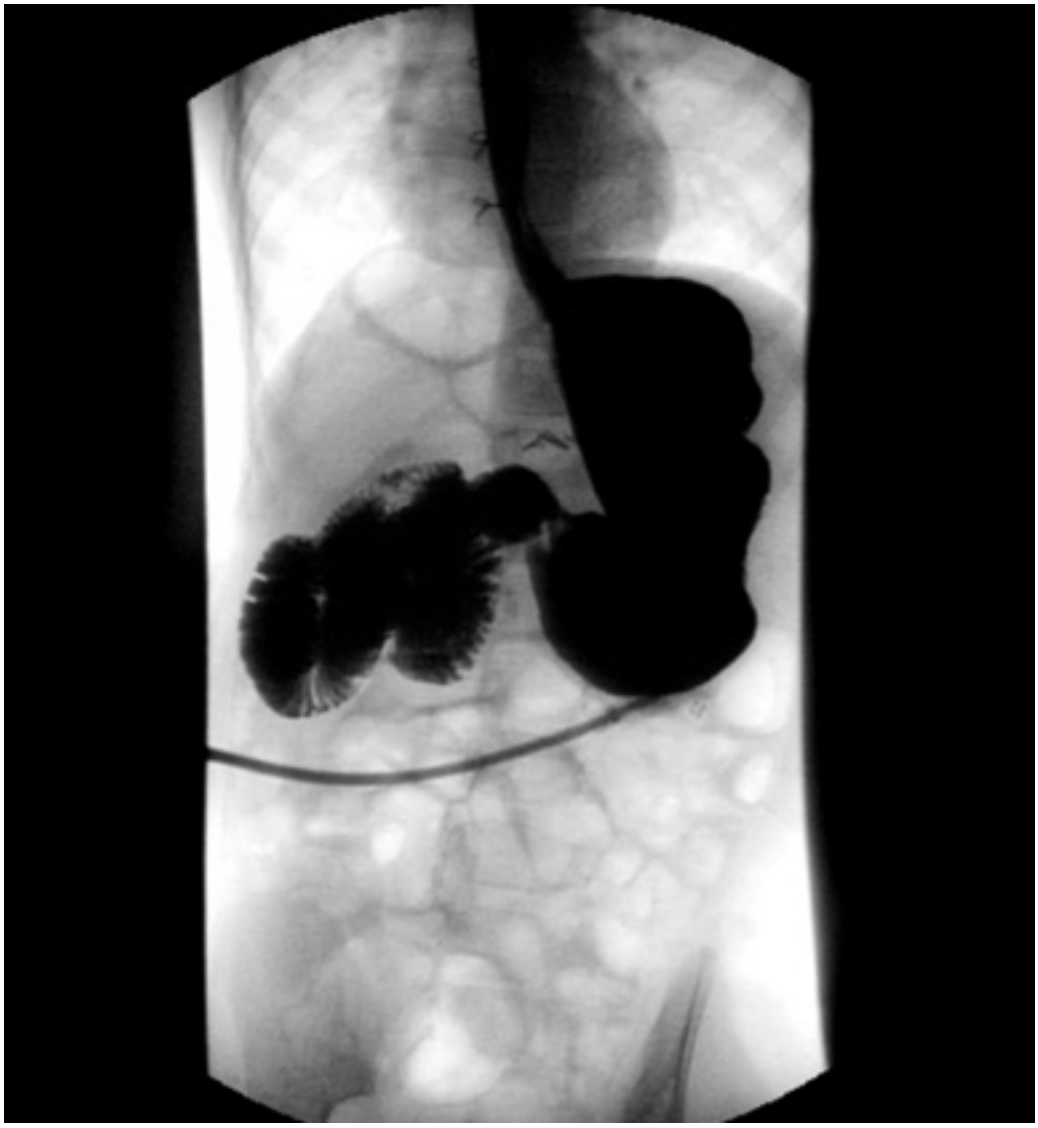
*Abdominal x-ray showing fecal impaction in a patient with constipation*

*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*



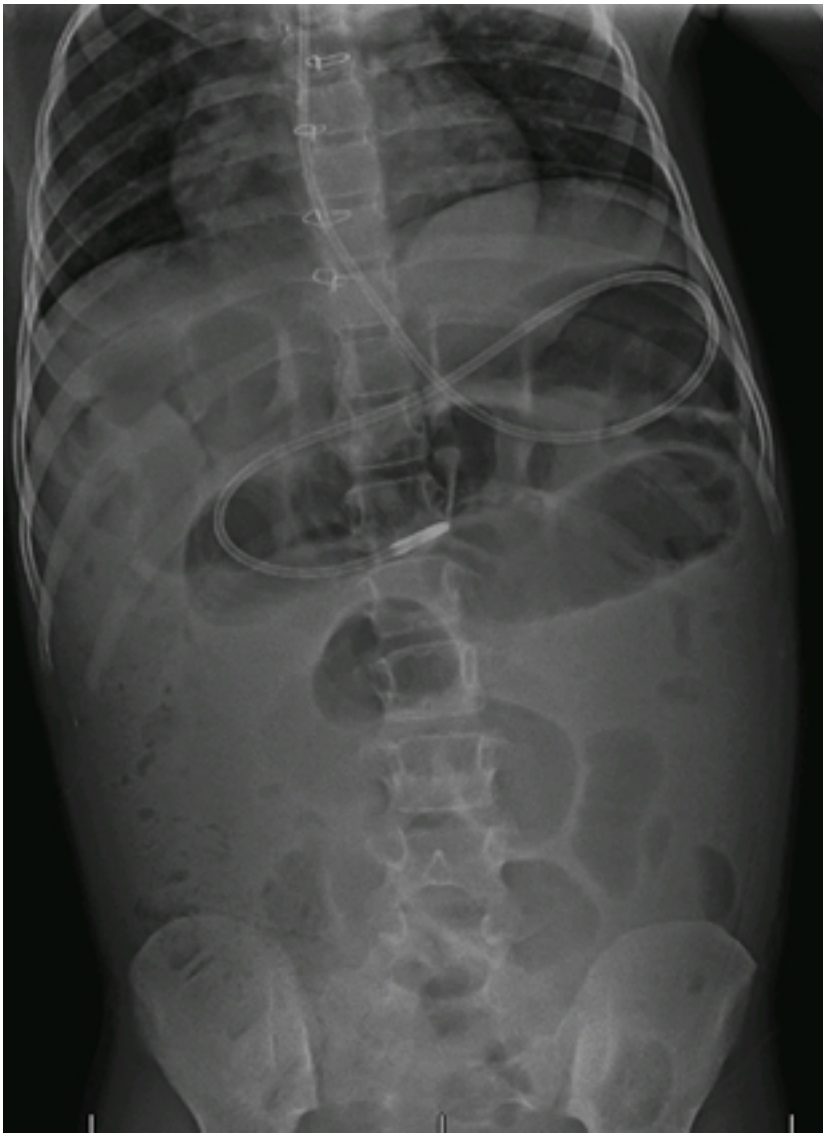
*Abdominal x-ray showing filled right colon and empty left colon and rectum in a patient with intussusception*

*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*



*Abdominal x-ray showing intestinal malrotation; note the small bowel is located to the right side of the midline*

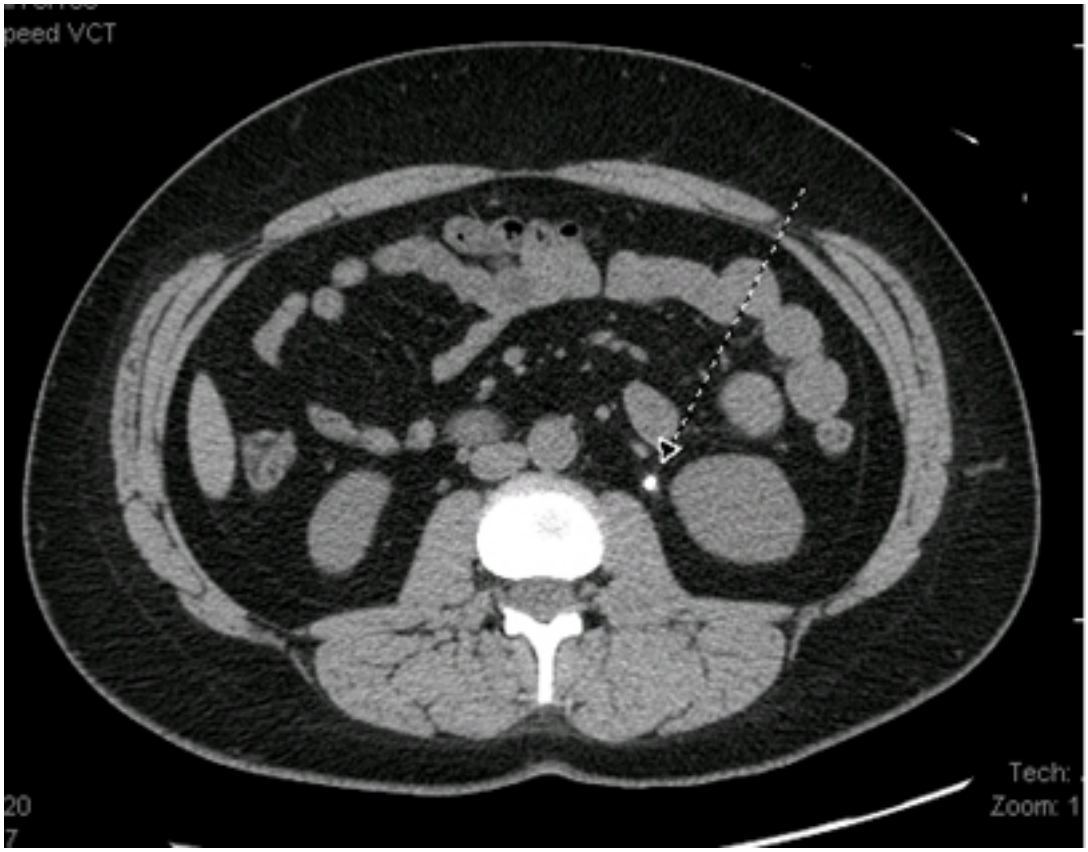
*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*



*Abdominal x-ray showing small bowel volvulus, a common cause of bilious vomiting*

*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*

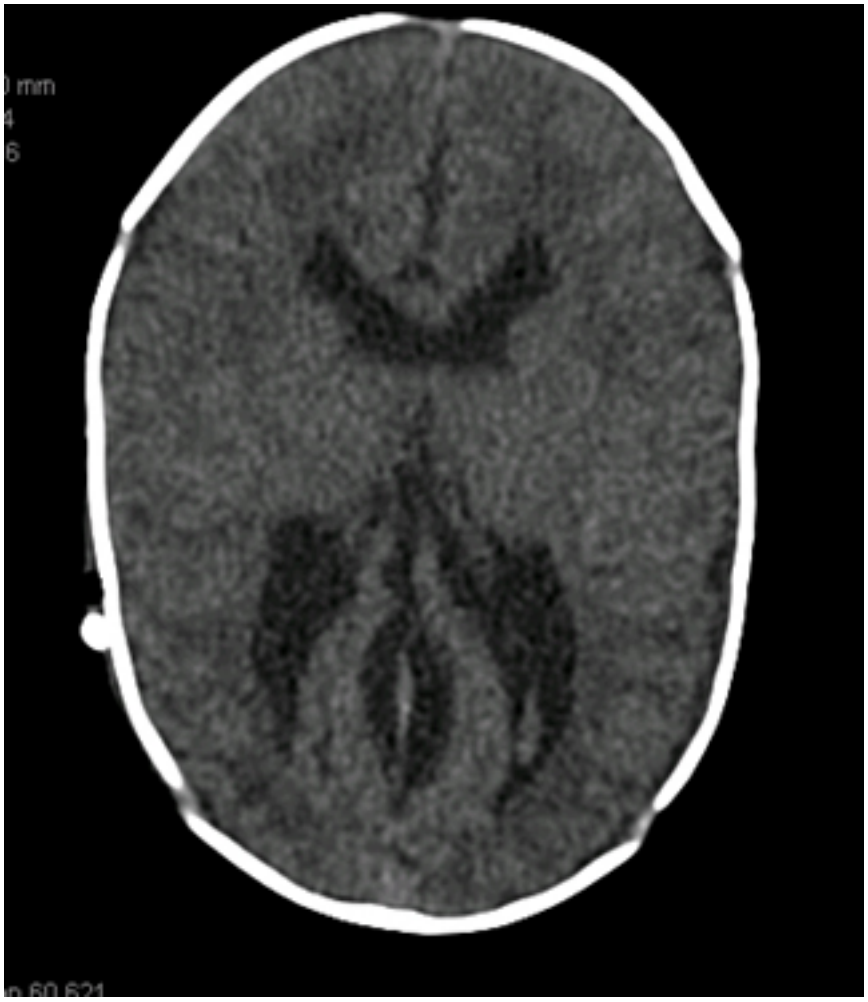
- Ultrasound: in many centers, ultrasound is considered the test of choice in children before CT in order to avoid radiation exposure. Should be performed by an operator with experience in performing ultrasound in children. Useful in diagnosing hydrocephalus, pyloric stenosis, intussusception, appendicitis, nephrolithiasis, and gonadal torsion.
- Computed tomography (CT) abdomen: may be obtained if an abdominal inflammatory condition is suspected (e.g., appendicitis, pancreatitis), particularly when supported by laboratory testing such as an elevated WBC count or elevated pancreatic enzymes.[79] It may also be ordered if obstruction, ovarian torsion, malignancy, or nephrolithiasis is suspected. In cases of suspected nephrolithiasis, intravenous contrast should not be used.




*CT abdomen showing small calcification in area of the left ureteral space, which corresponds to the presence of a kidney stone*

*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*

- CT/magnetic resonance imaging (MRI) head: must be obtained if there is suspicion for intracranial hypertension, particularly if severe headaches accompany the symptoms.

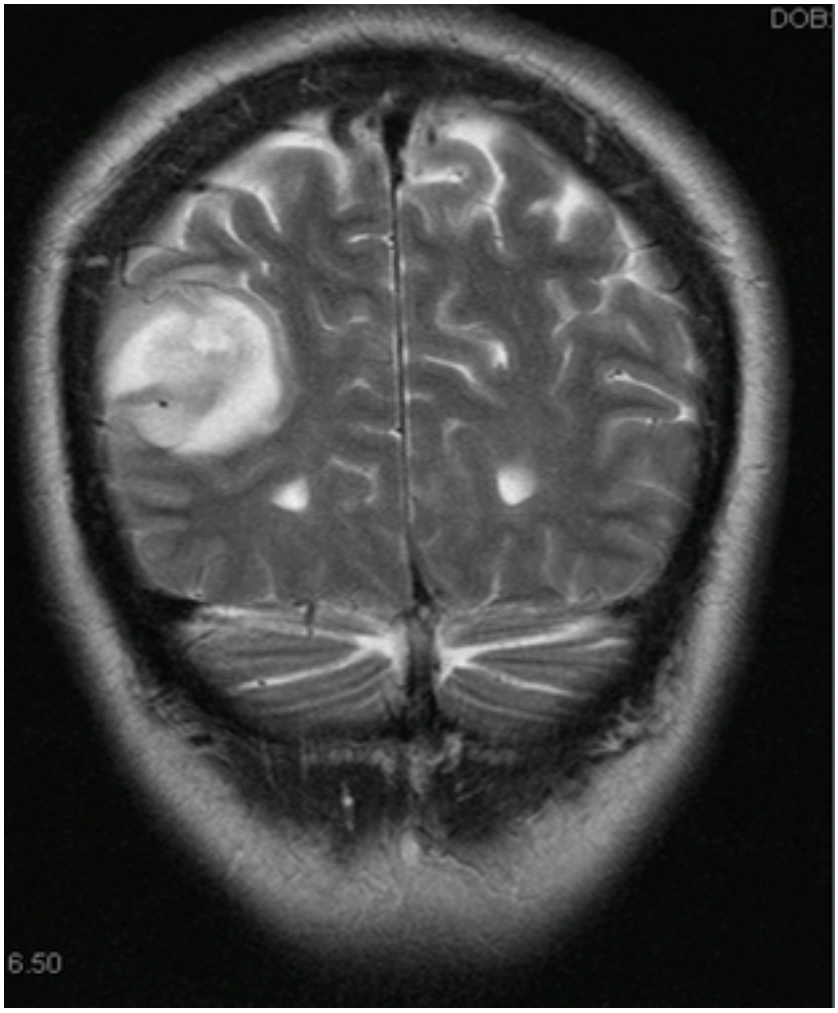


*CT showing increased volume of lateral ventricles secondary to noncommunicating hydrocephalus*

*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*






*CT head showing right parietotemporal brain tumor*

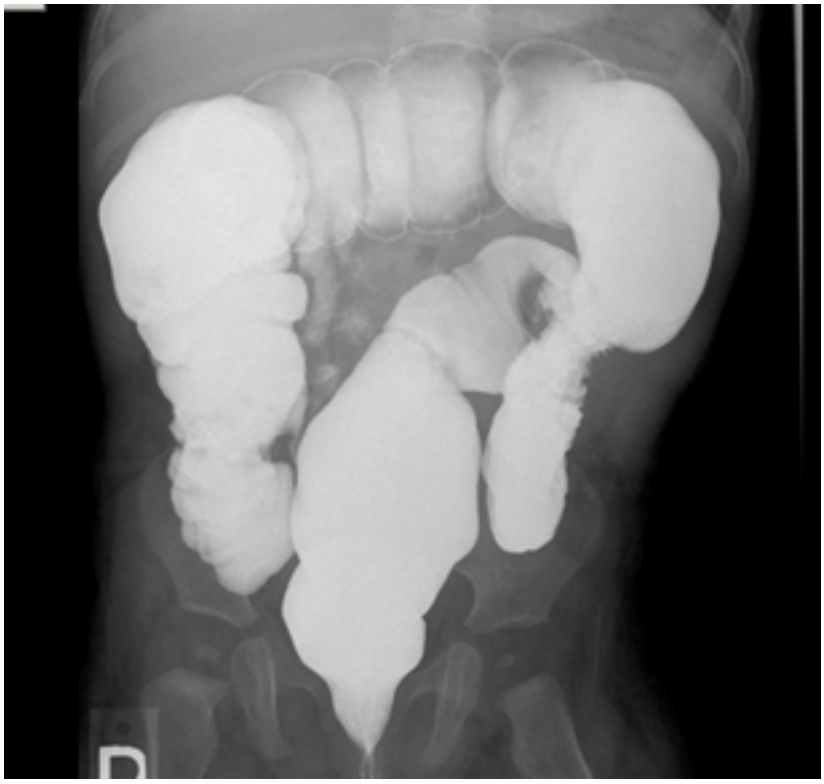
*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*

- Chest x-ray: if pneumonia is suspected.

## Subsequent investigations

The laboratory and imaging studies above are usually sufficient to address several common diagnoses; however, further testing may be required and may include the following.

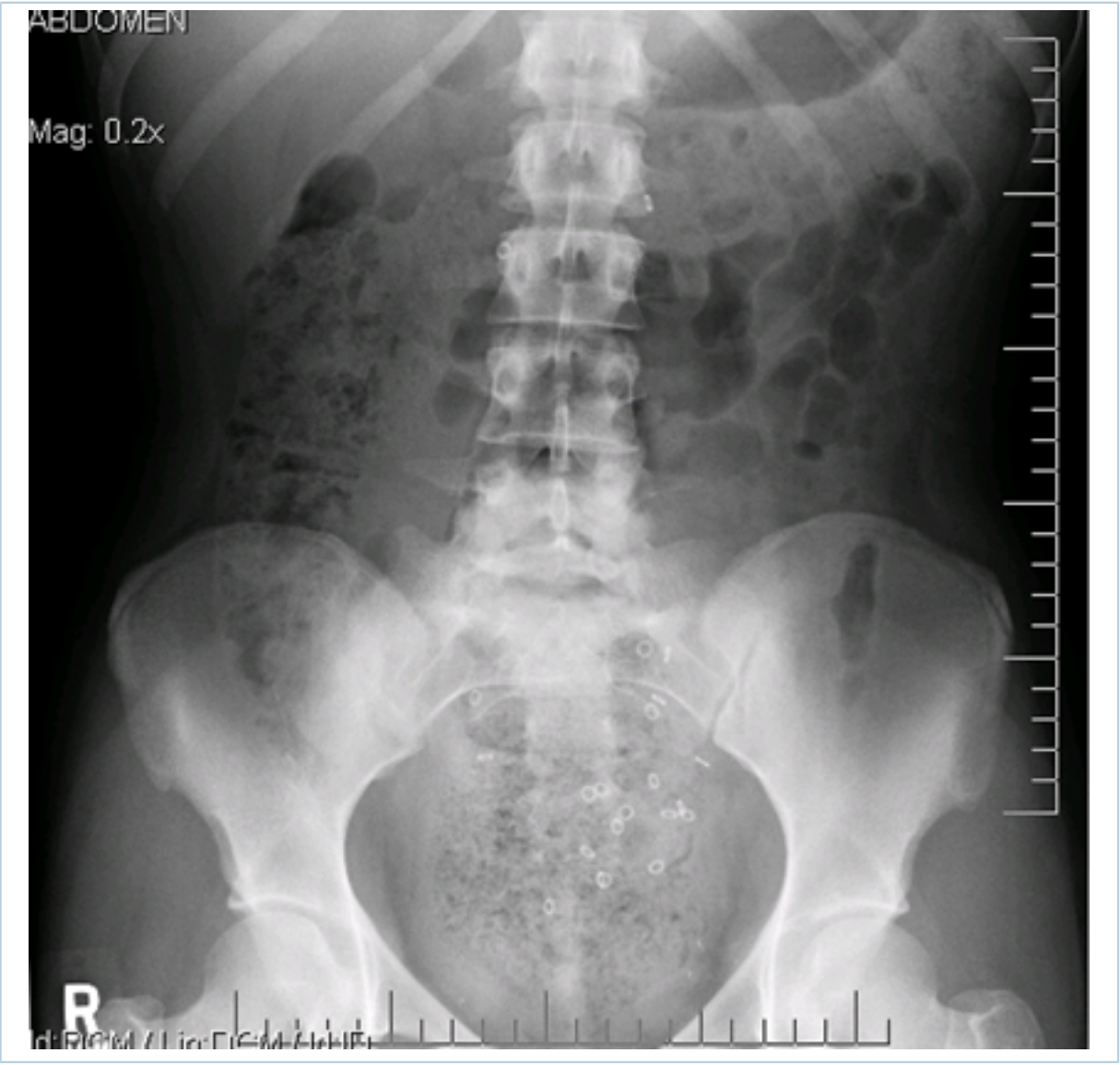
- Upper gastrointestinal series or abdominal CT or MRI enterography (useful for anatomical problems including intermittent or partial bowel obstruction: for example, intestinal malrotation, pyloric stenosis, superior mesenteric artery syndrome).
- Esophagogastroduodenoscopy or colonoscopy: useful to visualize bowel mucosa and obtain tissue samples for pathologic analysis when inflammatory conditions are suspected.
- Gastric emptying scintigraphy, electrogastrograms, or manometry: may be useful for conditions such as refractory gastroparesis or chronic unexplained nausea.
- Enema: a barium enema is useful in diagnosing small bowel atresia or Hirschsprung disease; a diagnostic enema may be used to aid diagnosis of intussusception and also act as a therapeutic intervention.



*Barium enema showing transition zones in patient with Hirschsprung disease*

*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*

- Sitz marker test: useful for refractory or chronic cases of constipation.




*Sitz marker test showing retention of ingested markers in the rectosigmoid region in a patient with constipation*

*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*

- Small bowel biopsy: recommended in patients with chronic symptoms associated with vomiting (e.g., diarrhea, abdominal pain). Can lead to the diagnosis of small bowel inflammation or infectious causes including giardiasis. May also be useful for diagnosing lactose intolerance.
- Autonomic testing (including tilt table): useful when symptoms suggest dysautonomia as a primary mechanism for symptoms.
- Food allergy tests (e.g., skin prick test) are indicated when a food allergy is suspected.
- ECG or echocardiogram: useful in eating disorders for detection of arrhythmias.

For cyclic vomiting syndrome, additional diagnostic testing is contingent on a patient's presentation and obtained for the purposes of ruling out other conditions.

# Differentials overview

| Common |
| --- |
| Viral gastroenteritis |
| Bacterial gastroenteritis |
| Giardiasis |
| Migraine |
| Motion/travel sickness |
| Labyrinthitis |
| Concussion (mild traumatic brain injury) |
| Meningitis |
| Brain tumor |
| Hydrocephalus |
| Pyloric stenosis |
| Intussusception |
| Intestinal malrotation |
| Small bowel atresia |
| Diabetic ketoacidosis |
| Gastroesophageal reflux disease (GERD) |
| Cyclic vomiting |
| Gastroparesis |
| Constipation |
| Functional dyspepsia |
| Testicular torsion |

## Common

- Urinary tract infection
- Nephrolithiasis
- Peptic ulcer disease
- Acute appendicitis
- Acute pancreatitis
- Hepatitis A
- Lactose intolerance
- Food allergy
- Eosinophilic disease
- Bulimia nervosa
- Toxic ingestion
- Medication adverse effects

## Uncommon

- Benign paroxysmal positional vertigo
- Pseudotumor cerebri (benign intracranial hypertension)
- Superior mesenteric artery syndrome
- Addison disease (primary adrenal insufficiency)
- Congenital adrenal hyperplasia
- Protein metabolism disorders
- Carbohydrate metabolism disorders
- Postural orthostatic tachycardia syndrome
- Hirschsprung disease

| Uncommon |
| --- |
| Ovarian torsion |
| Hemolytic uremic syndrome |
| Ureteropelvic junction obstruction |
| Small bowel lymphoma |
| Rumination |
| Factitious disorder |
| Cannabis hyperemesis syndrome |
| Otitis media |
| Pneumonia |

# Differentials

## Common

### ◊ Viral gastroenteritis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| characterized by foul-smelling watery diarrhea, fever, multiple episodes of vomiting, and abdominal pain; usually self-limited but significant volume depletion and malnutrition can occur | signs of volume depletion (i.e., depressed anterior fontanel in infants, sunken eyes, dry mucosal membranes, sticky saliva, loss of skin turgor, slow capillary refill) may be present; mild abdominal tenderness, hyperactive bowel sounds | »**clinical exam:** usually diagnosed by clinical assessment | »**serum electrolytes:** abnormal if severe volume depletion present<br>»**stool culture:** negative<br>Indicated in post-transplant, oncology, and immunocompromised patients.<br>Most common causative viral agents are rotavirus, norovirus, astrovirus, adenovirus, and enterovirus.<br>»**stool electron microscopy:** may show viral particle<br>Indicated in post-transplant, oncology, and immunocompromised patients. |

### Bacterial gastroenteritis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| history of contaminated water/food, diarrhea (may be bloody or mixed with mucus), abdominal pain, fever, and multiple episodes of vomiting | abdominal distension and tenderness, signs of volume depletion (i.e., depressed anterior fontanel in infants, sunken eyes, dry mucosal membranes, sticky saliva, loss of skin turgor, slow capillary refill) may be present | »**stool culture:** positive for causative bacteria in some cases<br>Most common causative bacteria are *Escherichia coli* , *Salmonella* , *Shigella* , and *Campylobacter* . | »**stool serotyping/ polymerase chain reaction (PCR):** positive for causative bacteria<br>Most common causative bacteria are *Escherichia coli* , *Salmonella* , *Shigella* , and *Campylobacter* . |

## Common

### Bacterial gastroenteritis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | | »**stool microscopy:** presence of red blood cells and neutrophils | PCR is highly specific. |

### ◊ Giardiasis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| history of travel, contaminated water/ food, IgA deficiency, foul-smelling watery/ fatty stools, abdominal pain, bloating, or weight loss | usually unremarkable in acute disease but abdominal distension, pallor, edema, or growth retardation can occur in chronic disease | »**stool microscopy:** presence of cysts and trophozoites<br>»**stool antigen detection:** positive for cyst wall<br>By enzyme-linked immunosorbent assay or direct fluorescent antibody. | »**duodenal aspirates and biopsies:** presence of cysts and trophozoites |

### ◊ Migraine

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| headache (paroxysmal episodes that can be unilateral or bilateral), photophobia; these symptoms may be preceded by an aura | usually normal | »**clinical exam:** usually diagnosed by clinical assessment | »**MRI head:** almost always normal, rules out intracranial lesion<br>Recommended if focal neurologic signs present, rapid increase in frequency of headache, or pain that wakes patient from sleep. |

### ◊ Motion/travel sickness

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| history of passive movement (can be visual), dizziness, eructation, increased salivation, and malaise | often normal but pallor, diaphoresis, unsteadiness, and lack of coordination can be seen | »**clinical exam:** usually diagnosed by clinical assessment | |

## Common

### ◊ Labyrinthitis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| history of vertigo, dizziness, hearing loss, tinnitus, otalgia, and flu-like symptoms; irritation of the vestibular system can be secondary to trauma, central nervous system, ear infection, or vestibular neuritis | nystagmus or signs of infection in the ear | »**clinical exam:** usually diagnosed by clinical assessment | »**audiogram:** sensorineural hearing loss<br>»**MRI head:** normal or evidence of enhancement in the inner ear<br>Recommended if focal neurologic signs are present. |

### Concussion (mild traumatic brain injury)

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| history of head trauma or participation in contact sport; symptoms include headache, altered mental status, confusion, amnesia, and behavioral changes; loss of consciousness does not always occur | altered mental and cognitive status, confusion, altered coordination, normal neurologic exam | »**clinical exam:** usually diagnosed by clinical assessment | »**CT/MRI head:** normal<br>Recommended if focal neurologic signs are present. Clinical decision rules and algorithms can inform decision-making.[80] [81]<br>MRI recommended if suspicion of intracerebral structural lesion or hematoma, and CT scan is negative. |

### Meningitis

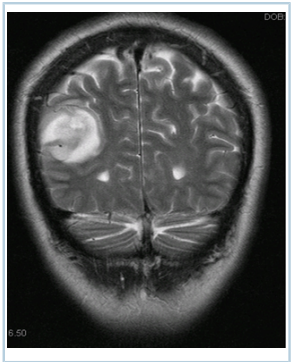
| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| headache, nuchal rigidity, photophobia, fever, altered mental status, confusion, history of previous infection; with infants, irritability, lethargy, and poor feeding | bulging fontanel indicates increased intracranial pressure (infants); seizures, petechial or purpuric rash, nuchal rigidity (uncommon in children <2 years | »**cerebrospinal fluid cell count:** elevated WBC count<br>»**cerebrospinal fluid protein:** elevated (bacterial); elevated or normal (viral) | »**blood culture:** may be positive<br>»**CBC:** may be elevated WBC count, left shift, low platelets |

## Common

### Meningitis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | of age; absence does not exclude meningitis), and Kernig or Brudzinski signs can occur; some children may not exhibit meningeal signs | »**cerebrospinal fluid glucose:** may be low<br>»**cerebrospinal fluid Gram stain:** may be positive (bacterial)<br>»**cerebrospinal fluid culture:** may be positive | |

### Brain tumor

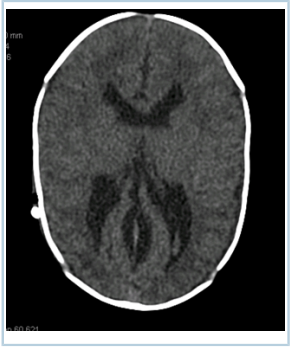
| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| irritability and lethargy in infants; headache or nausea/vomiting on waking, abnormal gait, seizures, and behavioral changes in older children | bulging fontanel and macrocephaly in infants; papilledema, focal neurologic signs, and cranial nerve paralysis in older children | »**CT/MRI head:** presence of mass, empty sella, flattening of the globe; posterior fossa, leptomeningeal, or subarachnoid spread MRI is preferred; however CT scan may be used initially to rule out other diagnoses or if MRI is not available.<br>  <br>*CT head showing right parietotemporal brain tumor*<br>*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission* | |



## Common

### Hydrocephalus

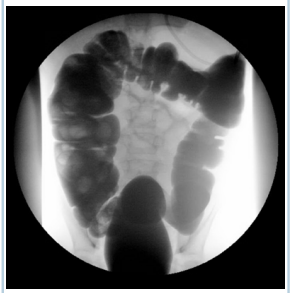
| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| irritability and lethargy in infants; headache or nausea/vomiting on waking and behavioral changes in older children; associated with prematurity, meningocele, and genetic syndromes | bulging fontanel, macrocephaly, dilated scalp veins, frontal bossing, and spasticity in infants; papilledema and cranial nerve paralysis in older children; may result in brain injury if not treated | »**ultrasound head (neonates):** ventricular dilatation<br>Test of choice in newborns and small infants.<br><br>»**CT/MRI head:** establishes site of obstruction, negative intracranial and intraorbital pathology, empty sella, flattening of the globe<br>Recommended in toddlers, children, and adolescents.<br>  <br>*CT showing increased volume of lateral ventricles secondary to noncommunicating hydrocephalus*<br>*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*<br><br>CT is preferred if patient is unlikely to tolerate MRI. | |

## Common

### Pyloric stenosis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| family history, more common in males, symptoms usually presents between 2 and 12 weeks of age, postprandial nonbilious projectile vomiting (usually contains ingested formula content), lack of weight gain or weight loss | undernourished infant, presence of mobile epigastric mass (rarely detected), visible peristalsis; signs of volume depletion may be present; jaundice may occur | »**ultrasound abdomen:** pylorus muscle thickness >4 mm, pyloric canal length >17 mm<br>False positive result if pyloric spasms. | |

### Intussusception

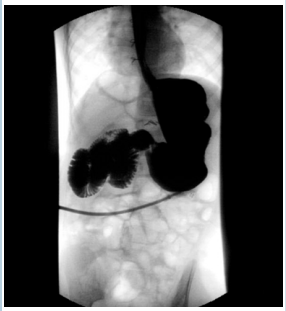
| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| usual age 3-6 months (up to 5 years), abdominal pain alternating with periods of exhaustion, hematochezia (may be described as currant jelly stool) | abdominal distension and abdominal mass may be present; may cause intestinal necrosis, acute abdomen, or obstruction | »**plain abdominal x-ray:** may be normal but "target sign", visible abdominal mass, or obstruction possible<br>May show filled right colon and empty left colon.<br>  <br>*Abdominal x-ray showing filled right colon and empty left colon and rectum in a patient with intussusception*<br>*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission* | »**diagnostic/ therapeutic air or contrast enema:** meniscus sign, coiled spring sign<br>Also a therapeutic intervention. |

# Common

## Intussusception

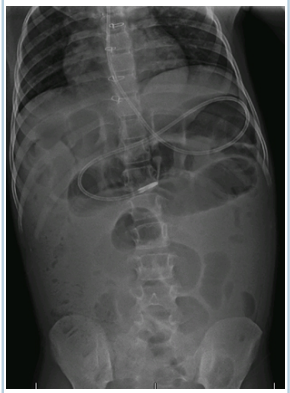
| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | | »**ultrasound abdomen:** hypoechoic ring with hyperechoic center | |

## Intestinal malrotation

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| onset <1 month age with bilious vomiting; more concerning symptoms include hematochezia, abdominal distension, and shock; for older children, presents as chronic vomiting and poor weight gain | exam initially normal but may demonstrate rapid progression to acute abdomen secondary to bowel necrosis; there is a high risk of midgut volvulus and intestinal necrosis | »**plain abdominal x-ray:** obstruction: dilatation of the stomach and duodenum Recommended if considered a surgical emergency.  *Abdominal x-ray showing intestinal malrotation; note the small bowel is located to the right side of the midline* *From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission* | »**CT abdomen (with oral and intravenous contrast):** no oral contrast beyond duodenum (volvulus); no contrast in the distal superior mesenteric artery (volvulus with ischemia); twirling of the superior mesenteric artery and vein (volvulus); transposition of superior mesenteric artery and vein (malrotation); a transition point in bowel caliber, right-sided duodenum; duodenum courses anterior or to right of superior mesenteric artery |

# Common

## Intestinal malrotation

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | |  <br>*Abdominal x-ray showing small bowel volvulus, a common cause of bilious vomiting*<br>*From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission*<br><br>»**upper gastrointestinal series:** corkscrew duodenum, small bowel to the right of midline<br>Gold standard test. | |

## Small bowel atresia

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| history of polyhydramnios or Down syndrome with symptoms of feeding intolerance and vomiting appearing soon after birth | abdominal distension (absent in proximal atresia, severe with visible loops in distal compromise, tenderness indicates peritonitis, mass indicates meconium peritonitis), possible failure to pass meconium, signs of | »**plain abdominal x-ray:** double bubble sign, proximal presence of gas with distal absence | »**upper gastrointestinal series:** confirms presence of atresia<br>Also rules out intestinal malrotation.<br><br>»**barium enema:** distal atresia microcolon |



## Common

### Small bowel atresia

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | volume depletion may be present | | Recommended if x-ray shows distal air but proximal absence. |

### Diabetic ketoacidosis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| poorly controlled diabetes type 1 is typical; may be first manifestation of diabetes with polyuria, polydipsia, polyphagia, weight loss, drowsiness, lethargy, anorexia, and abdominal pain | altered mental status, acetone breath, tachycardia, hypotension, hyperventilation, and signs of volume depletion can be present; can cause severe complications or even death if untreated | »**blood glucose level:** elevated<br>»**urinalysis:** positive for glucose and ketones<br>»**serum electrolytes:** sodium (low); potassium (elevated); chloride (low); magnesium (low); calcium (low); phosphate (normal or elevated)<br>»**anion gap:** elevated anion gap<br>»**ABG:** pH varies from 7.00 to 7.30, arterial bicarbonate ranges from <10 mEq/L to >15 mEq/L<br>»**serum ketones:** positive | |

### ◊ Gastroesophageal reflux disease (GERD)

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| regurgitation is present in 50% of infants with no other symptoms; symptoms include feeding refusal, irritability, hematemesis, failure to thrive (infants), laryngitis (children), and heartburn/ | usually normal, pallor (due to anemia in severe cases) | »**clinical exam:** usually diagnosed by clinical assessment but may vary widely by age; obtain a detailed history from from the patient, parent, or caregiver | »**pH study:** pH <4 more than 4% of the time is abnormal<br>»**esophageal impedance study:** positive association with symptoms with abnormal reflux indexes Can serve as a single technique for the |

## Common

### ◊ Gastroesophageal reflux disease (GERD)

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| acid regurgitation (adolescents) | | | diagnosis of GERD in infants and children. Recommended when atypical symptoms (e.g., respiratory, laryngeal, chest pain), are present. Recommended to differentiate patients with nonerosive reflux disease, hypersensitive esophagus, and functional heartburn with normal endoscopy. Determines efficacy of acid suppression therapy and clarifies role of acid and non-acid reflux in the context of esophagitis.<br><br>»**esophagogastroduodenos plus biopsy:** vertical red lines in distal esophagus, rare Barrett stricture Recommended when chest pain or red flag symptoms (such as hematemesis, anemia, or dysphagia) are present. |

### ◊ Cyclic vomiting

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| family history of migraine, stereotypical episodes of vomiting for hours or days, episodes alternate with normal periods of health; lethargy, headache, | usually normal, absence of red flags (e.g., weight loss, neurologic findings, papilledema, anemia, abdominal mass | »**clinical exam:** usually diagnosed by clinical assessment | »**upper gastrointestinal series:** normal Excludes other causes.<br><br>»**ultrasound abdomen:** normal |



## Common

### ◊ Cyclic vomiting

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| and diarrhea may be present | tenderness, positive fecal occult blood) | | Excludes other causes.<br>»**fecal occult blood:** negative<br>»**CBC:** normal<br>»**complete metabolic profile:** normal<br>»**erythrocyte sedimentation rate (ESR):** normal |

### ◊ Gastroparesis

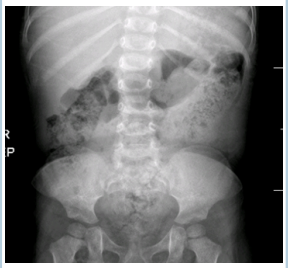
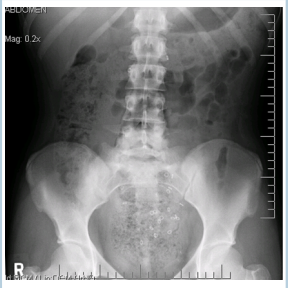
| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| may occur after a viral disease or be associated with systemic conditions; symptoms include postprandial vomiting of food contents 1-4 hours after meals, poor appetite, early satiety, and abdominal pain | usually normal but abdominal distension may be present | »**gastric emptying scintigraphy:** gastric retention of >90%, 60%, and 10% at the end of 1, 2, and 4 hours, respectively; liquid phase contrast in infants and solid phase in children | »**esophagogastroduodenoscopy:** no obstruction, retained food in stomach after overnight fast<br>Not necessary for diagnosis, but rules out obstruction.<br>»**antroduodenal manometry:** antral or duodenal hypomotility<br>Aids with management. |

### ◊ Constipation

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| usual age less than 1 year or 2-4 years with fewer than 3 bowel movements per week, withholding maneuvers, toilet avoidance, straining, large stools, and fecal incontinence | abdominal distension, fecal mass palpated in the abdomen | »**clinical exam:** usually diagnosed by clinical assessment<br>Rectal exam may be considered in difficult or atypical cases, but there is limited evidence to support its use in the diagnosis of functional constipation.[72] [73] If | »**plain abdominal x-ray:** fecal impaction<br>Fecal impaction may be seen on x-ray. |

## Common

### ◊ Constipation

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | | performed, presence of hard stool in the rectal vault. |  *Abdominal x-ray showing fecal impaction in a patient with constipation* *From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission* »**Sitz marker test:** differentiates slow transit versus outlet obstruction in the colon Good for refractory constipation.  *Sitz marker test showing retention of ingested markers in the rectosigmoid region in a patient with constipation* *From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission* |



## Common

### ◊ Constipation

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | | | »**anorectal manometry:** presence of recto-anal inhibitory reflex to rule out Hirschsprung disease |

### ◊ Functional dyspepsia

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| children and adolescents with epigastric abdominal pain, indigestion, early satiety, and absence of red flags (e.g., weight loss, blood in stool or urine, fever, vomiting, abnormal growth) | usually normal | »**clinical exam:** usually diagnosed by clinical assessment | »**fecal occult blood:** negative<br>»**CBC:** normal<br>»**complete metabolic profile:** normal<br>»**ESR:** normal<br>»**esophagogastroduodenoscopy:** normal<br>Recommended if no improvement to rule out other causes. |

### Testicular torsion

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| males with acute onset of testicular/scrotal pain and abdominal pain; nausea and vomiting occur in many patients | scrotal edema or erythema with scrotal tenderness to palpation | »**surgical exploration of the scrotum:** testicular torsion<br>If history and physical exam suggest testicular torsion, immediate surgical consult and exploration should take precedence over diagnostic tests.<br>A history and exam leading to an unclear diagnosis should still prompt urgent referral; however, in | »**scintigraphy:** decreased uptake of radioactive technetium-99m to the affected testicle<br>Rarely indicated due to the urgent nature of the condition, but may be useful to distinguish torsion from other nonsurgical causes of acute scrotum. |

## Common

### Testicular torsion

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | | this situation additional diagnostic tests may help avoid unnecessary surgery.<br><br>»**testicular workup for ischemia and suspected torsion (TWIST) score:** low risk (score 0-2), intermediate risk (3-4), or high risk (5-7)<br>A clinical risk score that can be used to support the assessment and management of a child or young person with testicular pain.<br>It is a 7-point score generated from five parameters.[82] [83]<br><br>»**ultrasound scrotum (with Doppler):** decreased blood flow to testicle | |

### ◊ Urinary tract infection

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| fever, irritability, lethargy, poor feeding, and failure to thrive in infants and toddlers; dysuria, urinary frequency, and flank pain in children and adolescents | usually normal; suprapubic tenderness in infants; costovertebral tenderness seen with pyelonephritis in children and adolescents | »**urinalysis:** positive leukocyte esterase and/or nitrites<br>»**urine culture:** catheter: urine specimens obtained by catheter: >10,000 colony-forming units (cfu)/mL in a symptomatic child<br>Thresholds vary between guidelines and collection methods, and results should be interpreted in the | |



## Common

### ◊ Urinary tract infection

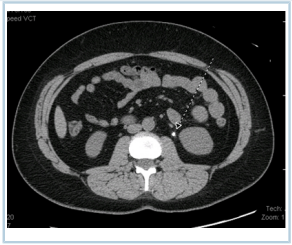
| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | | context of clinical presentation. The US guidelines suggest a 10,000 CFU/mL threshold for catheter specimens in symptomatic infants ages 8-60 days.[84] Data suggests that these thresholds are applicable in febrile infants ages up to 3 years.[85] European guidelines suggest a 1000-10,000 CFU/mL threshold for clean-catch, midstream, and catheter specimens.[86] Any counts following suprapubic aspiration should be considered to be significant.[86] [87] | |

### Nephrolithiasis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| positive family history, acute severe flank/abdominal pain, hematuria, dysuria, urgent nausea and vomiting | costovertebral angle tenderness | »**urinalysis:** may be normal or positive for blood<br>»**noncontrast CT abdomen:** calcification seen within urinary tract Imaging study of choice. | »**ultrasound renal:** calcification seen within urinary tract Misses stones <5 mm or ureteral stones. |

# Common

## Nephrolithiasis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | |  *CT abdomen showing small calcification in area of the left ureteral space, which corresponds to the presence of a kidney stone* *From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission* | |

## Peptic ulcer disease

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| risk factors include *Helicobacter pylori* infection, chronic nonsteroidal anti-inflammatory drug use, and stress; symptoms include irritability and feeding intolerance in infants and toddlers; dyspepsia, epigastric pain, hematemesis, and melena in children and adolescents | epigastric tenderness, pointing sign, and pallor in presence of anemia; can lead to bleeding, anemia, or stricture if diagnosis is missed | »**fecal occult blood:** occult blood may be present<br>»**esophagogastroduodenoscopy plus biopsy:** peptic ulcer; may also detect cause (e.g., *Helicobacter pylori* ) | |



## Common

### Acute appendicitis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| abdominal pain, anorexia, and fever | right lower quadrant tenderness, Rovsing sign, psoas sign, obturator sign, and diminished bowel sounds | »**CBC:** mild leukocytosis<br>»**ultrasound abdomen:** aperistaltic or noncompressible structure in region of appendix with outer diameter >6 mm | »**CT abdomen/ pelvis:** abnormal appendix (diameter >6 mm) identified or calcified appendicolith seen in association with periappendiceal inflammation |

### Acute pancreatitis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| midepigastric abdominal pain (may radiate to back), anorexia, and malaise | epigastric and periumbilical abdominal pain on palpation and signs of volume depletion may be present | »**serum lipase:** elevated (3 times the upper normal limit) Serum lipase and amylase have similar sensitivity and specificity, but lipase levels remain elevated for longer (up to 14 days after symptom onset vs. 5 days for amylase), providing a higher likelihood of picking up the diagnosis in patients with a delayed presentation.[88]<br>»**serum amylase:** elevated (3 times the upper normal limit) Serum lipase and amylase have similar sensitivity and specificity, but lipase levels remain elevated for longer (up to 14 days after symptom onset vs. 5 days for amylase), | »**abdominal ultrasound:** assess for obstructive gallstone |

## Common

### Acute pancreatitis

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | | providing a higher likelihood of picking up the diagnosis in patients with a delayed presentation.[88]<br><br>»**LFTs:** gamma-glutamyl transferase typically elevated if gallstone disease | |

### Hepatitis A

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| often asymptomatic but fever, malaise, jaundice, and abdominal pain may be present | usually normal; jaundice, hepatomegaly, and right upper quadrant abdominal tenderness can be present but are more common in adolescents | »**serum aminotransferases:** elevated<br><br>»**serum bilirubin:** elevated | »**IgM antihepatitis A virus:** positive Usually remains positive for up to 6 months.<br><br>»**IgG antihepatitis A virus:** positive Usually remains positive for years. |

### ◊ Lactose intolerance

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| frequent in Asian and African-American people; can be secondary to prematurity, gastroenteritis, or medications; family history, abdominal pain, flatulence, diarrhea, and symptoms after ingestion of dairy products | usually normal; may note abdominal distension after lactose ingestion and a perianal erythematous rash due to carbohydrate malabsorption | »**fecal pH:** reduced<br><br>»**lactose hydrogen breath test:** breath hydrogen >20 parts per million after lactose load and intolerance symptoms | »**small bowel biopsy:** normal or reduced intestinal lactase and/or other disaccharidases |



## Common

### ◊ Food allergy

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| onset generally <1 year of age with cough, rash, diarrhea or constipation, hematochezia, and failure to thrive; symptoms often associated with wheat, milk, soy, egg, peanut, or shellfish ingestion | eczema, rhinitis, wheezing, pallor, and abdominal distension | »**in vitro IgE-specific immunoassay:** depends on food allergen | »**skin prick testing:** wheal diameter 3 mm greater than control<br>»**atopy patch testing:** erythema and induration |

### Eosinophilic disease

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| dysphagia, choking with eating, food impaction, and atopy with eosinophilic esophagitis; diarrhea, hematochezia, and failure to thrive with eosinophilic gastroenteritis | usually normal but may note pallor, eczema, and abdominal distension | »**CBC:** possible peripheral eosinophilia<br>»**serum immunoglobulins:** IgE elevated | »**esophagogastroduodenoscopy plus biopsy:** furrowing stricture, whitish papules, ≥15 eosinophils/high-power field (eosinophilic esophagitis); >20-25 eosinophils/high-power field (eosinophilic gastroenteritis) |

### Bulimia nervosa

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| recurrent episodes of binge eating with self-induced vomiting, uncontrolled food intake, concern about weight gain/ body image, depression, anxiety, low self-esteem, and hematemesis | dental enamel erosion, pallor, signs of volume depletion may be present, and arrhythmia | »**clinical exam:** usually diagnosed by clinical assessment | »**CBC:** anemia<br>»**complete metabolic panel:** may show: hypokalemia, elevated creatinine, hypomagnesemia, elevated LFTs<br>»**ECG:** may be abnormal |

## Common

### Toxic ingestion

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| witnessed or deliberate ingestion or medication error; symptoms vary from mild and nonspecific to severe and depend on toxin ingested; examples of ingestions in children ages ≤5 years are cosmetics, cleaning substances, analgesics, pesticides, cough and cold preparations, cardiovascular drugs, stimulants and street drugs, and essential oils | symptoms range from normal to altered mental status, hypoxemia, seizures, hypotension, arrhythmias, respiratory depression, and possible death | »**clinical exam:** usually diagnosed by clinical assessment | »**ECG:** characteristic changes of causative agent, arrhythmias<br>»**serum electrolytes:** can be abnormal<br>»**ABG:** hypoxemia, metabolic acidosis, respiratory acidosis, respiratory alkalosis<br>»**comprehensive urine drug screen:** possible identification of toxin or drug<br>»**serum drug levels:** drug level detected Useful if specific drug(s) suspected. |

### ◊ Medication adverse effects

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| history of taking drug known to cause nausea and vomiting (e.g., chemotherapy, opioid analgesics, anticholinergic drugs such as antidepressants or antispasmodics, nonsteroidal anti-inflammatory drugs, antibiotics) | nonspecific | »**clinical exam:** usually diagnosed by clinical assessment | |

## Uncommon

### ◊ Benign paroxysmal positional vertigo

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| common cause of vertigo in children with intermittent episodes of vertigo | nystagmus during Dix-Hallpike maneuver with normal exam between episodes | »**clinical exam:** usually diagnosed by clinical assessment | |

## Uncommon

### ◊ Benign paroxysmal positional vertigo

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| alternating with normal periods, disequilibrium, diaphoresis, and specific provoking positions | | with nystagmus during Dix-Hallpike maneuver | |

### Pseudotumor cerebri (benign intracranial hypertension)

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| family history, visual field loss, diplopia, headache, tinnitus, obesity, and specific medication history (e.g., nalidixic acid, nitrofurantoin, indomethacin, isotretinoin, lithium, anabolic steroids) | papilledema, cranial nerve paralysis, and decreased visual function | »**MRI head:** negative intracranial and intraorbital pathology, empty sella, flattening of the globe | »**lumbar puncture:** elevated pressure: opening pressure >250 mm $H_2O$ Can be performed once intracranial pathology has been ruled out. |

### ◊ Superior mesenteric artery syndrome

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| recent weight loss, prolonged bed rest, or spinal surgery with intermittent nausea/vomiting and abdominal pain following eating; symptoms improve in left lateral or prone position | thin body habitus and low weight; upper abdominal distension not always present | »**upper gastrointestinal series:** stomach dilatation, cut-off sign, obstruction in the third portion of the duodenum with possible positional improvement | »**CT abdomen:** duodenal compression between aorta and superior mesenteric artery Recommended in cases where diagnosis is in doubt. |

### Addison disease (primary adrenal insufficiency)

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| secondary to autoimmune disorders, infectious diseases, or chronic use of corticosteroids; symptoms include lethargy, anorexia, | hypotension and oral hyperpigmentation; may result in shock if left untreated | »**serum electrolytes:** hyponatremia, hyperkalemia »**morning serum cortisol level:** cortisol <5 micrograms/dL Diagnosis is highly likely if the cortisol is | »**adrenal stimulation testing:** serum cortisol <18 micrograms/dL |

## Uncommon

### Addison disease (primary adrenal insufficiency)

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| weight loss, failure to thrive, and salt craving | | <5 micrograms/dL in combination with an adrenocorticotropic hormone plasma concentration elevated >2-fold above assay reference level. | |

### Congenital adrenal hyperplasia

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| failure to thrive, weight loss, poor feeding, irregular menses, and precocious puberty | hypotension, hyperpigmentation, hirsutism, and ambiguous genitalia in neonates | »**serum electrolytes:** hyponatremia, hyperkalemia, metabolic acidosis<br>»**serum 17-hydroxyprogesterone:** elevated for age | |

### Protein metabolism disorders

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| includes organic acidemias and urea cycle disorders; newborn or infant with possible family history, poor feeding, failure to thrive, and lethargy; metabolic crisis may be precipitated by illness or surgery | seizures, floppiness, and low muscular tone | »**venous pH $CO_2$:** acidosis (aminoaciduria), alkalosis (urea cycle disorders) | »**serum ammonia level:** elevated (aminoaciduria), markedly elevated (urea cycle disorders) May lead to acute metabolic decompensation, severe metabolic acidosis, hyperammonemia, or brain damage if not treated.<br>»**plasma amino acids/organic acids:** abnormal |

## Uncommon

### Carbohydrate metabolism disorders

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| includes galactosemia and fructosemia; newborn or infant with poor feeding, vomiting after feeds, lethargy, and bleeding; may lead to liver dysfunction, sepsis, or brain damage | septic appearance, jaundice, and hepatomegaly | »**LFTs:** elevated aminotransferases (galactosemia, fructosemia)<br>»**urine sugars/ reducing substances:** galactose (galactosemia), fructose (fructosemia) | »**blood enzyme determination:** abnormal |

### ◊ Postural orthostatic tachycardia syndrome

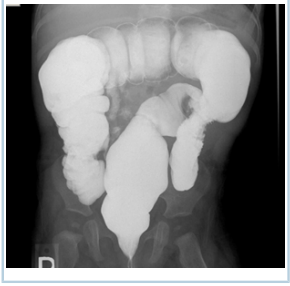
| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| occurs more frequently in adolescents and girls with symptoms usually occurring in the morning or with postural changes; nausea is commonly associated with orthostatic dizziness, anxiety, fainting/near-fainting episodes, abdominal pain, early satiety, bloating, and constipation | orthostatic hypotension, tachycardia, and skin color changes | »**orthostatic vital signs (screening):** heart rate increase >20 bpm or systolic BP decrease >20 mmHg when standing<br>»**tilt-table test (diagnosis):** orthostatic tachycardia with changing position | |

### Hirschsprung disease

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| passage of meconium greater than 48 hours after birth with explosive diarrhea, bilious vomiting, and failure to thrive | abdominal distension and absence of stool in rectal vault with possible production of large volume watery stool on rectal exam | »**contrast enema:** transition zone possible Used to establish the length of the aganglionic segment. | »**anorectal manometry:** absent rectoanal inhibitory reflex<br>»**rectal biopsy:** absence of ganglion cells, increased acetylcholinesterase stain |

## Uncommon

### Hirschsprung disease

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | |  *Barium enema showing transition zones in patient with Hirschsprung disease* *From the collections of Dr R.A. Gomez-Suarez and Dr J.E. Fortunato; used with permission* | |

### Ovarian torsion

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| adolescent females with severe sharp lower abdominal pain and fever; vaginal bleeding uncommon | abdominal distension, abdominal/pelvic tenderness, palpable adnexal mass, and tachycardia | »**ultrasound abdomen with Doppler:** solid, cystic, or complex adnexal mass with decreased blood flow to ovary Preferred in children over transvaginal ultrasound. | »**CT abdomen:** may show fallopian tube thickening, smooth wall thickening of the twisted adnexal cystic mass, ascites, and uterine deviation toward the twisted side Recommended if appendicitis is part of the differential. |

### Hemolytic uremic syndrome

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| children generally <5 years of age with abdominal pain and bloody diarrhea; fever | hypertension, pallor, petechiae, and peripheral edema | »**CBC:** anemia, thrombocytopenia | |

## Uncommon

### Hemolytic uremic syndrome

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| can be absent; seizures can be present | | May develop hemolytic anemia or thrombocytopenia after 5-10 days.<br>»**peripheral blood smear:** presence of schistocytes<br>»**renal function:** elevated creatinine<br>May develop acute kidney injury. | |

### ◊ Ureteropelvic junction obstruction

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| frequently diagnosed prenatally; symptoms depend on age but can include hematuria and failure to thrive in infants, and recurrent abdominal or back pain with cyclic vomiting in older children | abdominal mass in infants | »**ultrasound renal:** hydronephrosis | »**diuretic renogram:** lack of excretion in the affected side |

### Small bowel lymphoma

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| higher incidence in celiac disease and certain gastrointestinal infections (e.g., *Campylobacter* ); abdominal pain, diarrhea, weight loss, fever, and bilious vomiting if obstruction present | pallor, abdominal distension, abdominal tenderness, presence of mass on palpation, organomegaly, ascites, clubbing, signs of obstruction or perforation | »**CT abdomen:** presence of mass or obstruction | »**upper gastrointestinal series plus small bowel follow-through:** mucosal fold thickening or obstruction |

## Uncommon

### ◊ Rumination

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| usually in developmentally delayed children but may also occur with normal development; presence of postprandial effortless oral regurgitations (contents may be re-swallowed) with absence of heartburn or nausea, and weight loss | usually normal but dental erosions can be present | »**clinical exam:** usually diagnosed by clinical assessment | »**esophageal impedance study:** episodes of bidirectional intra-esophageal flow preceded by belching Recommended if patient re-swallows regurgitation content.<br><br>»**antroduodenal manometry:** presence of simultaneous R-waves Recommended if increased intra-abdominal pressure. |

### ◊ Factitious disorder

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| perpetrator is frequently one parent, who may be involved in healthcare industry; presence of multiple unexplained symptoms, including nausea and vomiting, where symptoms do not improve despite medical management; may lead to severe iatrogenic surgery and even death if diagnosis missed | usually normal | »**clinical exam:** usually diagnosed by clinical assessment | »**cultures (e.g., blood or wound):** possible polymicrobial cultures or atypical organisms Indicated only for the specific presentation of suspected infection. Cultures may be positive when patients inject saliva or feces in order to cause infections in the blood or wounds.[89]<br><br>»**urine sulfonylureas:** ingestion of oral hypoglycemic agents: positive Indicated only in the specific presentation of hypoglycemia. |

## Uncommon

### ◊ Factitious disorder

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | | | »**stool test for laxative:** positive for laxative |

### ◊ Cannabis hyperemesis syndrome

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| frequent to daily cannabis use, intermittent nausea and vomiting, compulsory bathing behaviors that improve symptoms, insomnia, polydipsia, and abdominal pain; does not respond to treatment with medications | usually normal | »**urinary drug screen:** positive for cannabinoids | |

### ◊ Otitis media

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| fever, sleep disturbance, headache, diarrhea, irritability in infants, otalgia in older children, poor appetite | bulging, erythematous, or opaque tympanic membrane; myringitis | »**clinical exam:** usually diagnosed by clinical assessment | |

### Pneumonia

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| symptoms depend on age but can include fever, lethargy, cough, dyspnea, chest pain, poor oral intake, and abdominal pain | respiratory distress (tachypnea, cyanosis, retractions, decreased breath sounds and crackles, low oxygen saturation); sepsis and respiratory failure can occur if diagnosis missed | »**chest x-ray:** infiltration, consolidation, effusions, cavitation | »**CBC:** elevated neutrophil count<br>»**blood culture:** possibly positive for infecting organism Recommended in severe cases.<br>»**sputum culture:** possibly positive for infecting organism |

## Uncommon

### Pneumonia

| History | Exam | 1st Test | Other tests |
|---|---|---|---|
| | | | Recommended in severe cases. |

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# Images

| | | |
|---|---|---|
| Any age | • Addison disease<br>• Benign paroxysmal positional vertigo<br>• Brain tumor<br>• Eosinophilic disease<br>• Gastroparesis<br>• Giardiasis<br>• Hepatitis A<br>• Hydrocephalus<br>• Labyrinthitis | • Medication adverse effects<br>• Meningitis<br>• Motion/travel sickness<br>• Otitis media<br>• Pseudotumor cerebri<br>• Small bowel lymphoma<br>• Superior mesenteric artery syndrome<br>• Ureteropelvic junction obstruction<br>• Urinary tract infection<br>• Viral/bacterial gastroenteritis |
| Neonates | • Congenital adrenal hyperplasia<br>• Hirschsprung disease<br>• Intestinal malrotation | • Metabolic disorders<br>• Pyloric stenosis<br>• Small bowel atresia |
| Infants | • Constipation<br>• Diabetic ketoacidosis<br>• Food allergies<br>• Gastroesophageal reflux disorder<br>• Hemolytic uremic syndrome | • Intussusception<br>• Metabolic disorders<br>• Munchausen by proxy<br>• Pneumonia<br>• Toxic ingestions |
| Children | • Constipation<br>• Cyclic vomiting<br>• Diabetic ketoacidosis<br>• Functional dyspepsia<br>• Hemolytic uremic syndrome<br>• Medication adverse effects<br>• Migraine | • Munchausen by proxy<br>• Nephrolithiasis<br>• Peptic ulcer disease<br>• Pneumonia<br>• Rumination<br>• Toxic ingestions |
| Adolescents | • Acute appendicitis<br>• Acute pancreatitis<br>• Bulimia nervosa<br>• Cannabis hyperemesis syndrome<br>• Concussion<br>• Cyclic vomiting<br>• Functional dyspepsia<br>• Medication adverse effects | • Migraine<br>• Nephrolithiasis<br>• Ovarian torsion<br>• Peptic ulcer disease<br>• Postural orthostatic tachycardia<br>• Rumination<br>• Testicular torsion<br>• Toxic ingestions |

*Figure 1: Etiology of nausea and vomiting in children and adolescents grouped according to age*

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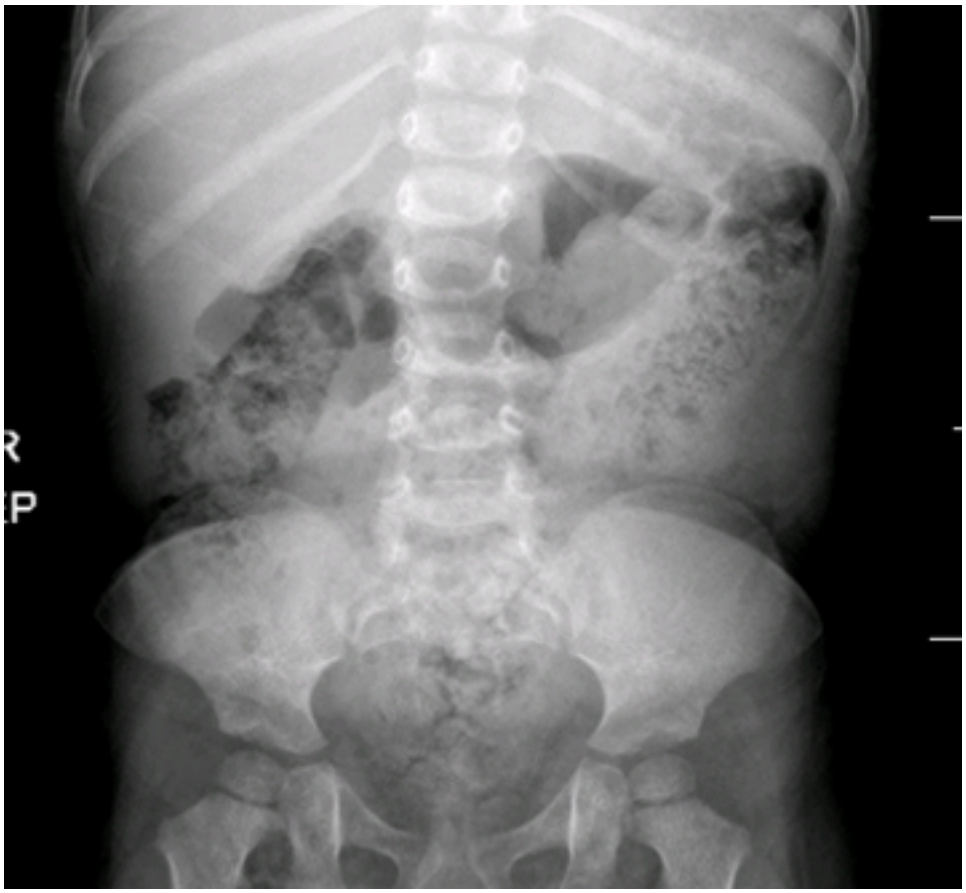

*Figure 2: Abdominal x-ray showing fecal impaction in a patient with constipation*

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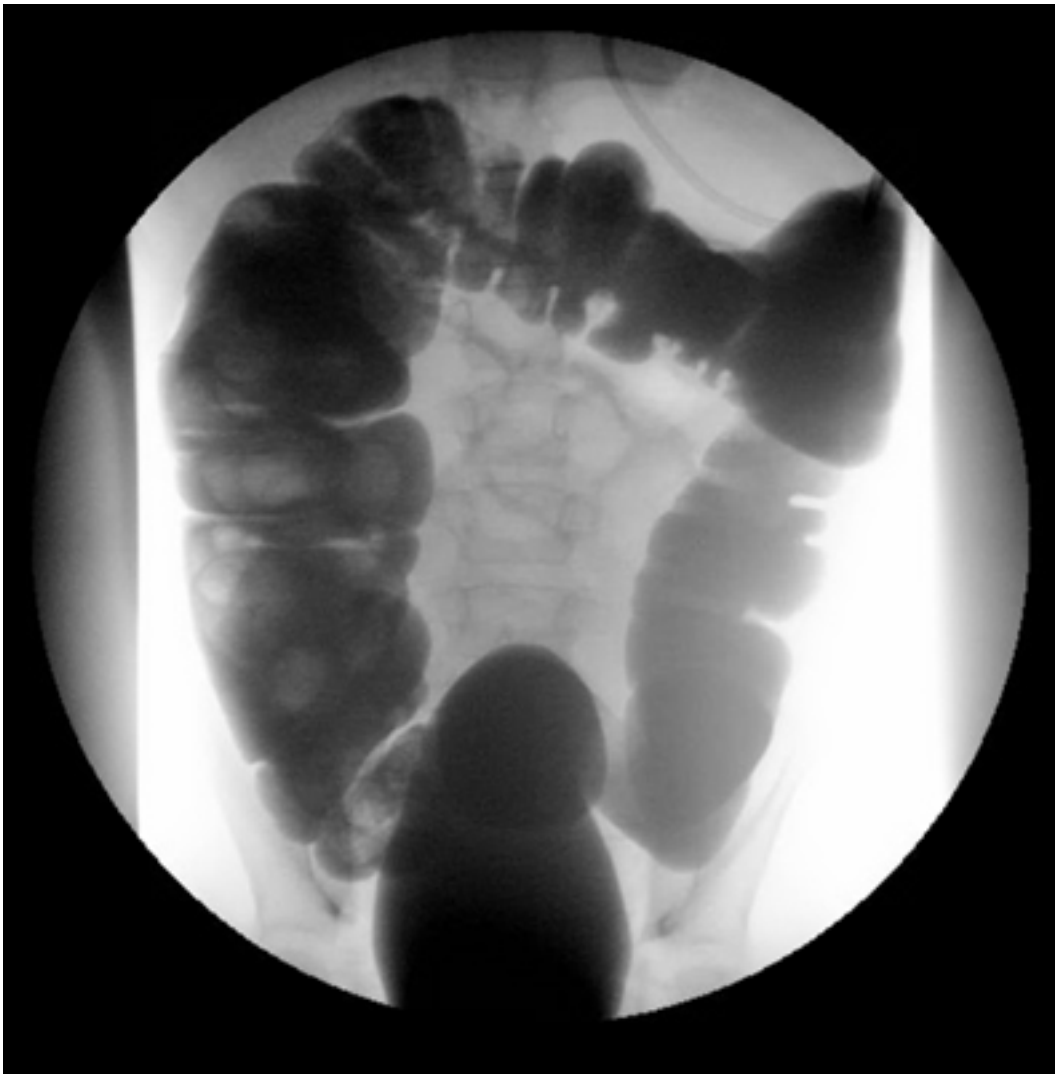

*Figure 3: Abdominal x-ray showing filled right colon and empty left colon and rectum in a patient with intussusception*

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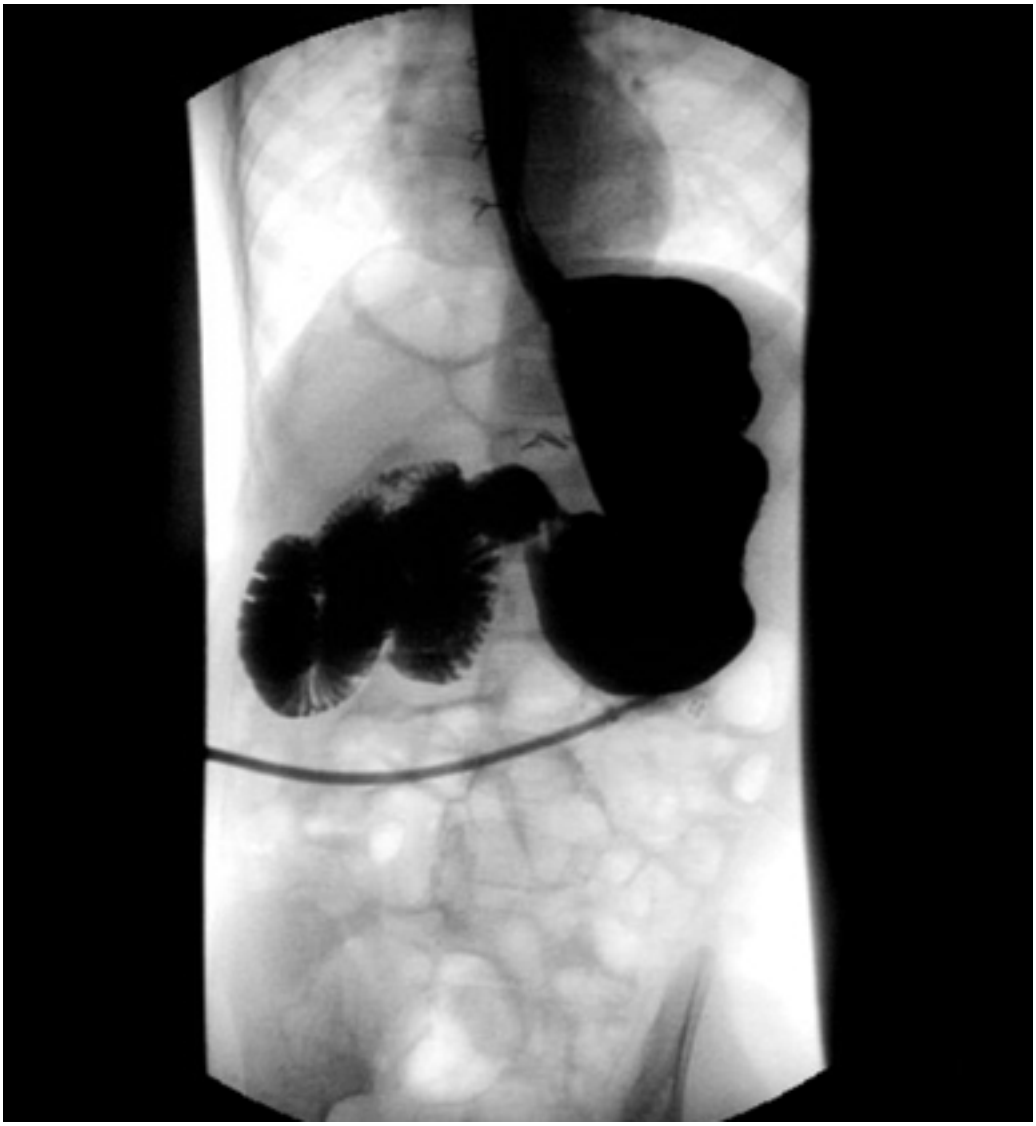

*Figure 4: Abdominal x-ray showing intestinal malrotation; note the small bowel is located to the right side of the midline*

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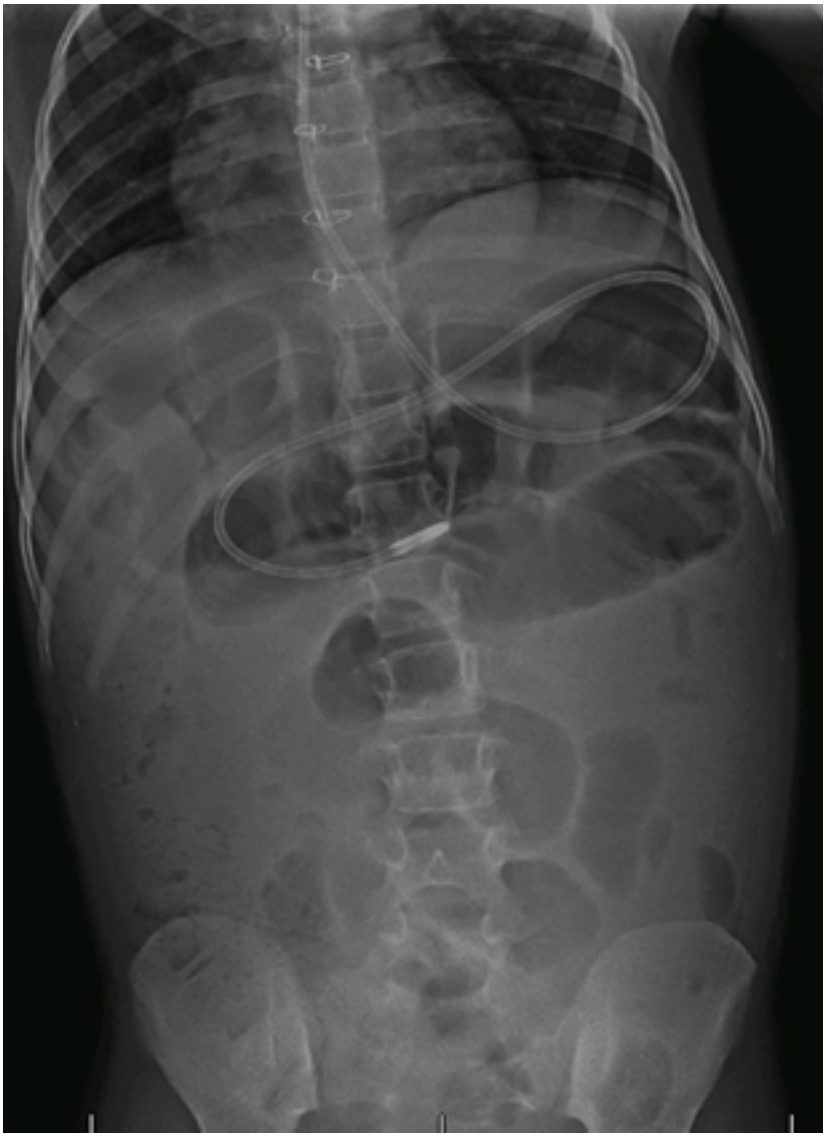

*Figure 5: Abdominal x-ray showing small bowel volvulus, a common cause of bilious vomiting*

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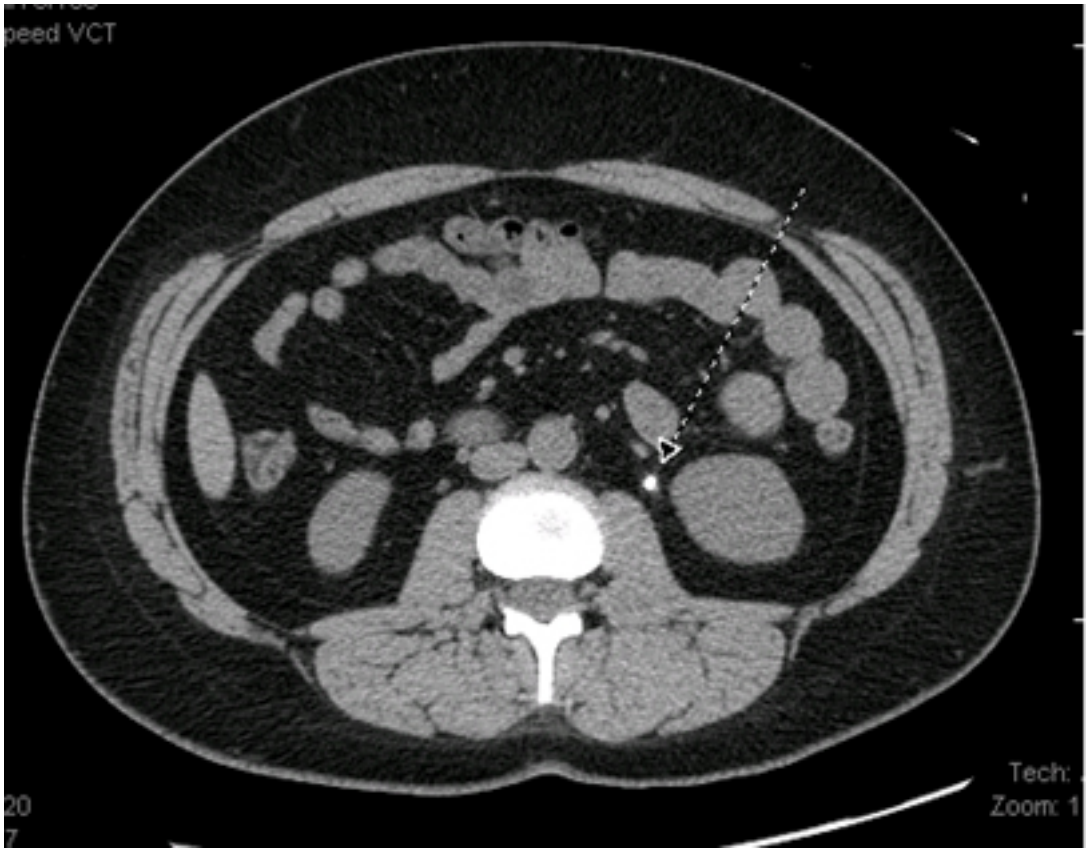


*Figure 6: CT abdomen showing small calcification in area of the left ureteral space, which corresponds to the presence of a kidney stone*

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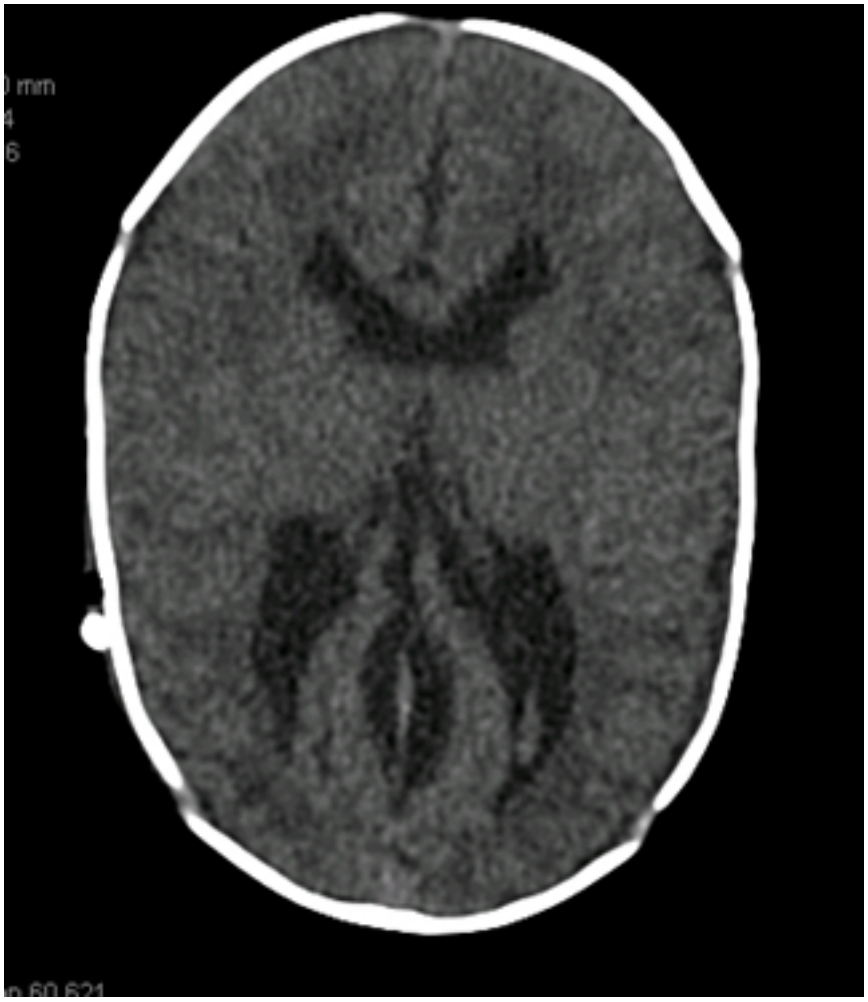

*Figure 7: CT showing increased volume of lateral ventricles secondary to noncommunicating hydrocephalus*

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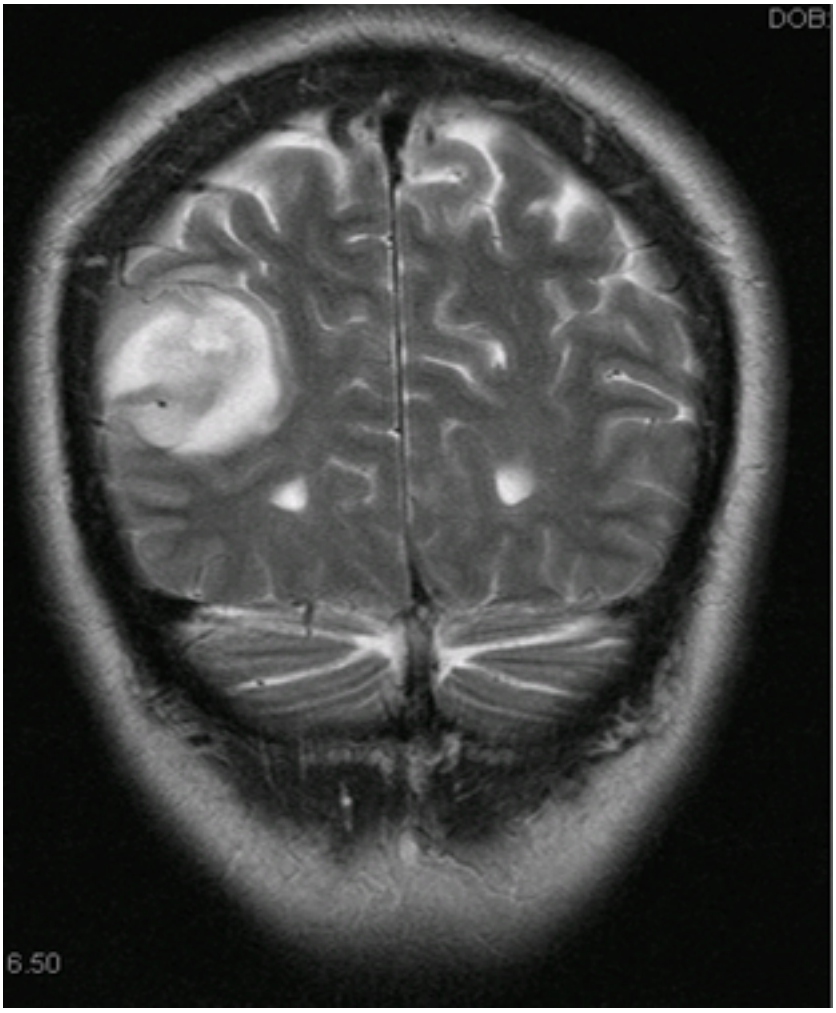


*Figure 8: CT head showing right parietotemporal brain tumor*

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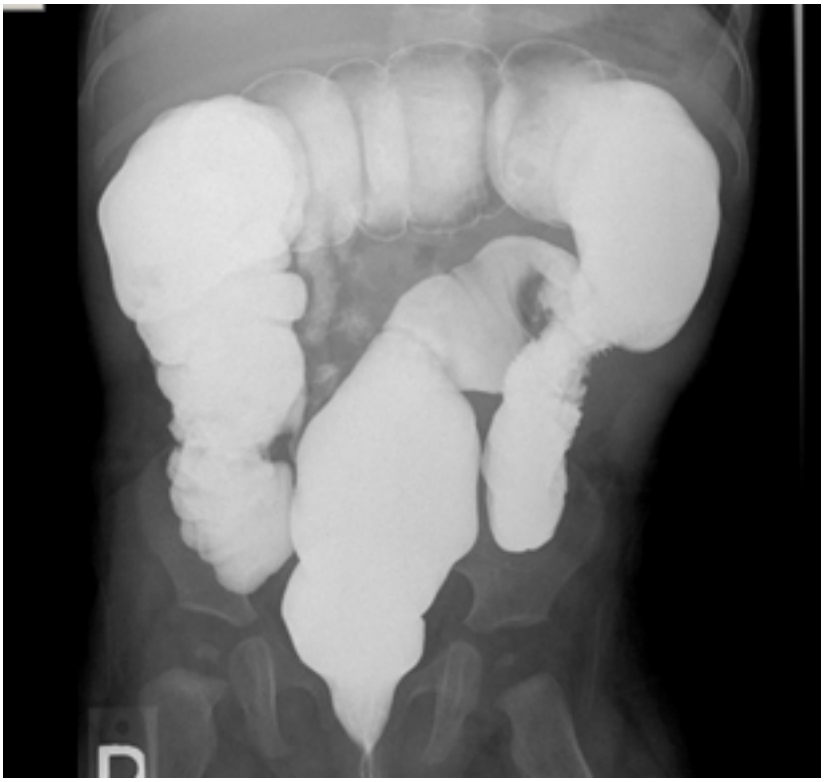

*Figure 9: Barium enema showing transition zones in patient with Hirschsprung disease*

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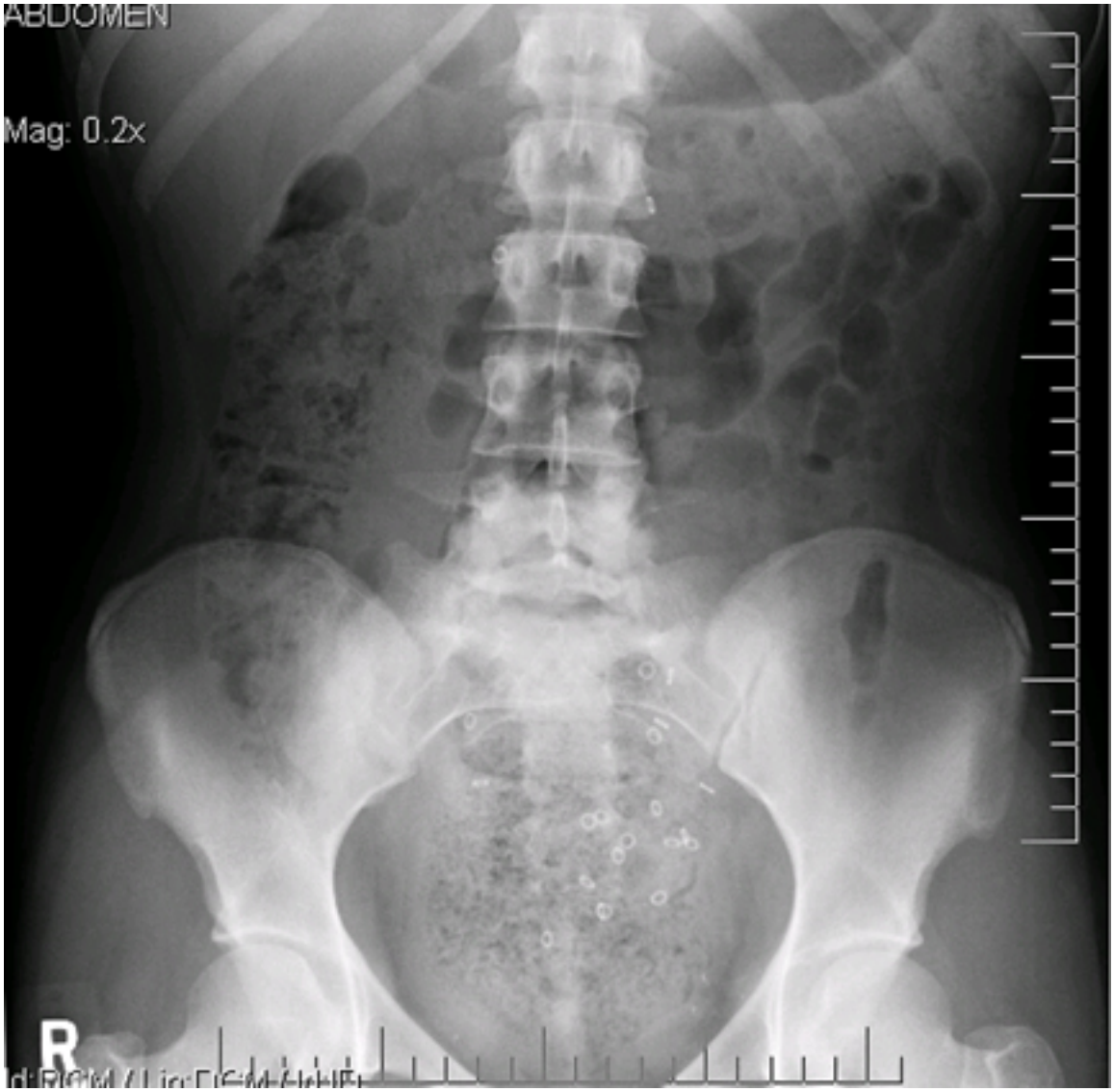


*Figure 10: Sitz marker test showing retention of ingested markers in the rectosigmoid region in a patient with constipation*

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This approach is in line with the guidance of the International Bureau of Weights and Measures Service.

**Figure 1 – BMJ Best Practice Numeral Style**



 

5-digit numerals: 10,000

4-digit numerals: 1000

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