Spectrum and Relevance of Incidental Bowel Findings on Computed Tomography

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KEYWORDS

• CT • Gastrointestinal tract • Bowel • Incidental findings

KEY POINTS

- Incidental bowel findings commonly are discovered on computed tomography (CT); most are benign and require no further work-up or management; however, some are clinically relevant. In particular, bowel wall thickening may reflect underlying neoplasm and should be brought to the attention of the referring clinician.
- There are a wide variety of causes of pneumatosis intestinalis, with clinical presentations ranging from asymptomatic to life-threatening bowel ischemia.
- Bowel dilatation most often is due to mechanical obstruction; however, the radiologist should be aware of the causes of acute and chronic nonobstructive bowel dilatation.
- Bowel intussusception in an adult should raise suspicion for a neoplasm acting as the lead point; however, a transient self-resolving intussusception can be suggested in the setting of a short segment intussusception with no upstream bowel dilatation or visible lead point.
- The fat halo sign can be a CT sign of inflammatory bowel disease; however, it probably is seen more frequently as an incidental and clinically insignificant finding.

INTRODUCTION

Incidental findings in the bowel commonly are encountered on CT examinations and encompass a diverse array of pathology, reflective of the unique spectrum of disease encountered in each segment of the intestine. Similar to incidental findings in other organ systems, most of these findings are benign and require no further work-up. Examples of benign disease covered in this chapter include diverticulosis, most cases of intramural fat, asymptomatic pneumatosis, nonobstructive bowel dilatation, and transient intussusception. A minority of incidental findings are clinically relevant or initially indeterminate, requiring further patient management and often necessitating additional imaging examinations and interventions. For example, malignant tumors of the gastrointestinal (GI) tract may have a long latency period before becoming symptomatic and frequently are detected on CT as incidental findings. Determination of the clinical relevance and optimal management of incidental findings often poses a dilemma for the radiologist. In recent years, there has been a proliferation of studies reviewing incidental findings on CT as well as position papers from the American College of Radiology written for the purpose of providing guidelines for management. Unfortunately, many of these articles do not include discussions or data regarding incidental bowel

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findings nor is there yet an American College of Radiology white paper dedicated to management of bowel findings. The goal of this article is to review the various incidental findings that can be detected on CT and MR imaging, discuss their clinical implications, and give examples from the literature in order to provide a perspective on management.

WALL THICKENING

Incidental bowel wall thickening (IBWT) is a relatively frequent finding and can be focal or regional. Although IBWT may be inflammatory, infectious, ischemic, or neoplastic in etiology, its clinical relevance when detected incidentally remains unclear, particularly when identified on CT (or occasionally on MR imaging or ultrasound [US]) performed for apparently unrelated reasons.[1] Furthermore, there is no consensus in the literature, to the authors' knowledge, on how to approach this finding.[2]

The first challenge for radiologists is to determine to the best of their ability whether the suspected wall thickening is truly pathologic, or spurious, due to under-distention. Trends toward decreased use of positive oral contrast at many centers can make evaluation of the bowel difficult, especially when under-distended (**Figs. 1–3**), and CT examinations performed without intravenous contrast do not allow for analysis of mural enhancement. Additionally, false-positive and false-negative results for an intestinal mass can result from stool or other intraluminal contents either obscuring or mimicking a mass.

The thickness of the wall of the GI tract varies between small bowel and large bowel and also is affected by multiple factors, including the degree of luminal distention.[2–4] Normal small bowel wall is thin, measuring between 1 mm and 2 mm, when the lumen is well distended.[4] When the bowel is partially collapsed, it can measure between 2 mm and 3 mm in thickness, which frequently is used as the upper limit of normal.[3–6] The jejunum commonly appears falsely thickened when under-distended due to a greater fold density than the ileum. The normal wall of the colon is very thin—often barely perceptible—and when distended should measure less than 3 mm.[4,7] The wall generally is considered abnormal if there is thickening greater than 5 mm.[3] Normal bowel wall also enhances predictably following intravenous contrast administration. Enhancement typically is uniform and symmetric and also usually is more pronounced in the mucosal layer.[4]

When bowel wall thickening is detected, additional CT findings need to be analyzed for complete assessment and to formulate an effective differential diagnosis. Salient features include degree of thickening, symmetry, length of affected segment, mural attenuation, and any associated perienteric abnormalities.[4,8]

The primary entity of concern in a patient with a short segment of thickened bowel is neoplasia, which is uncommonly but not rarely detected as a purely incidental finding on CT. For example, in a study of 1175 emergency department patients in whom abdominal/pelvic CT was performed, incidental findings were detected in 700, including 15 patients with colonic wall thickening, which yielded 4 colon cancers and 5 colorectal polyps. Additionally, 11 gastric lesions were detected, which yielded 1 gastric cancer.[9]

In studies that have investigated the significance of IBWT diagnosed on CT, there is a high

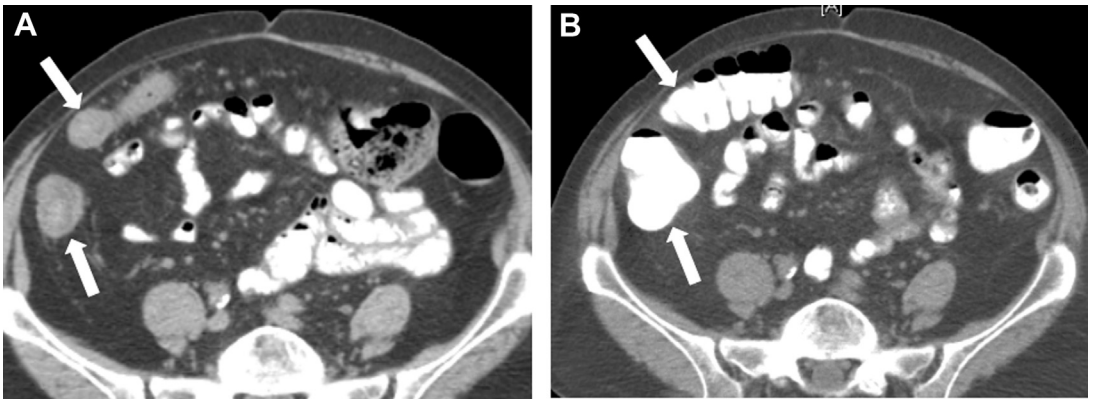

Fig. 1. Under-distended colon mimicking colitis. A 72-year-old woman with generalized abdominal pain. Axial CT image (*A*) shows apparent wall thickening of the under-distended right colon (*arrows*), which could erroneously raise concern for colitis. Image from repeat CT performed 1 hour later (*B*), however, demonstrates oral contrast progression into the right colon, which now is well opacified and with normal wall thickness (*arrows*).

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Fig. 2. Sigmoid colon cancer. A 69-year-old man with back pain and suspected abdominal aortic aneurysm. Axial image from a CT performed without oral or intravenous contrast. There is wall thickening of the sigmoid (*arrows*), which potentially could be difficult to detect due to bowel under-distention and lack of oral and intravenous contrast. The patient also had a liver metastasis visualized on this CT (not shown).

rate of disease found on endoscopic examination. A meta-analysis evaluating incidental colonic wall thickening on CT, and which included 9 studies and 1252 patients, found that 73% of patients had abnormalities at colonoscopy, with a cancer rate that ranged from 14% to 27%.[10] Eskaros and colleagues[11] found that 64% of patients with incidental colonic wall thickening on CT had a corresponding abnormality on colonoscopy. Colitis was the diagnosis in a majority of cases; however, in a subset of patients in which a mass was suspected on CT, this was confirmed in 100% (12/12) of cases. Uzzaman and colleagues[12] found abnormalities on optical colonoscopy at the exact site of IBWT seen on CT in 58% of patients; in 36/95 of these patients, the abnormality was a malignancy. Documentation of the characteristics of the wall thickening would help in assessing the clinical relevance of IBWT in predicting the presence of a colonic neoplasm. Shorter segment of wall thickening, irregular or eccentric thickening, and greater degree of wall thickness all are factors that favor a neoplastic process; however, such analysis is lacking in most studies. Note that routine abdominal CT has been shown to be moderately sensitive for detection of colorectal neoplasia. Ozel and colleagues[13] found routine abdominal CT to be 72% sensitive and 84% specific in diagnosing invasive colorectal cancer.

There are fewer studies in the literature that have looked at the significance of esophageal or gastric wall thickening compared with colonic wall thickening on CT, to the authors' knowledge. Cai and colleagues[14] found endoscopic abnormalities in 22/27 patients with distal esophageal wall thickening on abdominal CT, with esophagitis, varices, and hiatal hernia diagnosed in approximately equal frequency. Tellez-Avila and colleagues[15] found abnormalities on endoscopy in 6/19 patients with incidental gastric wall thickening, all of which were adenocarcinomas.

The appendix also can be a site of incidental tumors, such as a neuroendocrine tumor (NET) (the appendix is the most common site in the GI tract for NET), mucinous tumor, or adenocarcinoma (**Fig. 4**).[16]

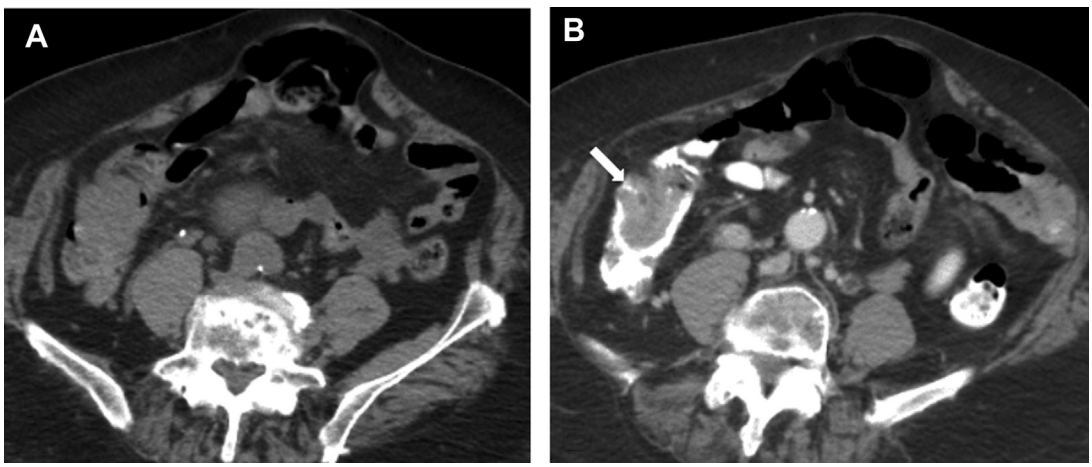

Fig. 3. Cecal cancer. An 81-year-old woman with failure to thrive. Axial image (*A*) from a CT performed without oral or intravenous contrast shows no detectable colonic abnormality. Image (*B*) from repeat CT examination performed a few days later with oral and intravenous contrast clearly shows a large cecal mass (*arrow*), confirmed to be adenocarcinoma on colonoscopy.

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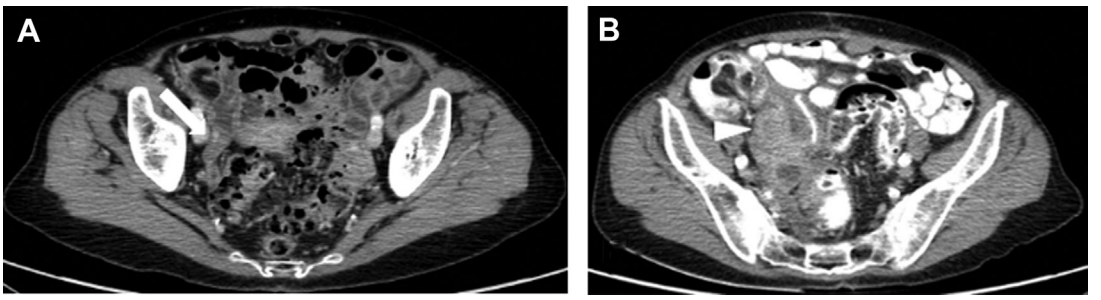

Fig. 4. Incidental appendiceal cancer. A 69-year-old woman with weight loss. Axial intravenous contrast-enhanced CT image (*A*) of the abdomen and pelvis demonstrates a subtle mass at the base of the appendix, which was overlooked by the interpreting radiologist (*arrow*). Two years later, the mass has increased in size (*B* [*arrowhead*]). The patient underwent right hemicolectomy with pathology revealing adenocarcinoma.

In contrast to the more infiltrative appearance of wall thickening commonly encountered with gastric or colonic adenocarcinoma, an incidentally found circumscribed masslike focal process suggests an alternative diagnosis on CT, such as a NET, or GI stromal tumor (GIST), which arises most commonly in the stomach (**Fig. 5**), followed by the small bowel.

Lipomas are benign submucosal tumors found throughout the GI tract, most commonly in the colon, and easily are diagnosed on CT as fat attenuation intramural or intraluminal masses. Although these generally can be ignored, lipomas occasionally can be the cause of complications, such as intussusception or bleeding. Tumors greater than 2 cm are more likely to ulcerate, leading to acute or chronic anemia.[17]

Fig. 5. GIST. A 52-year-old man with chest pain and dyspnea. Axial image from CT angiography performed to evaluate for pulmonary embolism incidentally shows an exophytic mass emanating from the posterior gastric fundus (*arrow*), which was strongly suggestive of a GIST. Patient underwent endoscopic ultrasound and biopsy with pathology confirming the diagnosis of GIST.

Non-neoplastic entities also can be the cause of an incidental mass or wall thickening in the GI tract. Bowel wall thickening from chronic diverticulosis is a common finding, particularly in the sigmoid colon on CT, and usually can be distinguished from cancer by the longer length of involvement and presence of diverticulosis. Wall thickening in the setting of cirrhosis can be due to portal hypertensive colopathy, a benign condition with no clinical relevance in and of itself. CT shows wall thickening, usually involving the right colon, indistinguishable from a colitis; diagnosis can be made based on the presence of findings indicative of cirrhosis and portal hypertension and lack of symptomatology.[18]

Heterotopic pancreas can occur in the stomach, duodenum, or jejunum and usually is discovered as an incidental small nodule or mass on CT or MR imaging, although rarely it can be the cause of acute pancreatitis (**Fig. 6**).[19]

In an estimated 12% to 37% of cases of endometriosis, endometriotic implants can involve the bowel, usually bowel segments in the dependent pelvis, involving in decreasing order of frequency, the rectosigmoid, appendix, cecum, and terminal ileum.[20] These implants appear as serosal masses and may be large enough to be visualized on cross-sectional imaging (**Fig. 7**). A diagnosis can be suggested when there is involvement of pelvic bowel loops and in the setting of a known history of endometriosis, although primary GI tract tumor and metastatic disease are in the differential diagnosis. Concurrent findings of endometriosis, such as complex adnexal cyst(s) or hydrosalpinx, if present, can assist the radiologist in arriving at the correct diagnosis.

Splenosis, a condition defined by heterotopic autotransplantation of splenic tissue due to traumatic or iatrogenic cause, can mimic a primary intestinal tumor in cases of an implant detected along the serosal surface of the bowel.[21]

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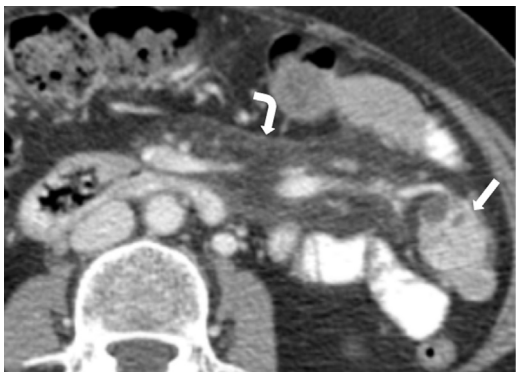

Fig. 6. Heterotopic pancreas. A 69-year-old woman with abdominal pain and bloating; clinical concern was for ovarian cancer. Axial CT image from a CT performed with oral and intravenous contrast demonstrates a circumscribed mass along the serosal surface of a jejunal loop (*arrow*), predominantly solid, but also containing a few cysts. Findings were thought to be most likely due to a GIST; however, intraoperative and pathologic findings revealed heterotopic pancreas, which was causing acute pancreatitis. Note fat stranding of the small bowel mesentery from acute inflammation (*curved arrow*).

PNEUMATOSIS INTESTINALIS

Pneumatosis intestinalis (PI) is a radiological finding that refers to gas in the subserosal or submucosal layers of the GI tract.[22,23] The etiology commonly is associated with serious underlying pathology, which may require immediate surgical intervention but also can be seen with benign conditions requiring no intervention.[24] With the widespread increase of imaging, the prevalence of PI, in particular benign pneumatosis, is higher than previously thought.[25] Given that incidental findings can prompt additional diagnostic and therapeutic intervention in some cases, which can be harmful to the patient, it is important to understand the differential diagnosis and associated clinical significance of PI.[25] Identifying which patients can be managed conservatively and which require urgent intervention requires an understanding of the various etiologies of PI, assessment of the clinical context, and the recognition of associated radiological findings.

Fig. 7. Endometriosis of the bowel. A 38-year-old woman with a history of endometriosis, scanned for rectal bleeding. Axial coronal image from a CT performed with oral and intravenous contrast demonstrates a spiculated serosal soft-tissue mass involving the sigmoid colon (*arrow*), representing an endometriotic implant.

PI is classified into primary PI and secondary PI. Primary PI, or pneumatosis cystoides intestinalis (pneumatosis coli), is less common (15%), is idiopathic, and has the morphology of well-circumscribed cysts or bubbles within the walls of the bowel. It has an incidence of approximately 0.03%.[26] A majority of cases (approximately 85%) of PI are secondary to an underlying disease process, including mesenteric ischemia, bowel necrosis, trauma, inflammatory bowel disease (IBD), malignancy, autoimmune conditions (scleroderma, dermatomyositis), infection (*Clostridium difficile*, human immunodeficiency virus, or cytomegalovirus), chronic obstructive pulmonary disease, postoperative changes (laparotomy, laparoscopy, peritoneal dialysis, and so forth), or medications (corticosteroids, immunosuppressants, and chemotherapeutic agents).[25,27,28] The pathogenesis of PI is not fully understood but likely is multifactorial and involves the disruption of mucosal integrity and the migration of gas either via direct dissection into the wall or through translocation of gas-producing bacteria from the lumen into the submucosal space, and/or increased thoracic pressure, causing alveolar rupture and gas diffusion via perivascular or perilymphatic routes.[24,27]

Benign PI appears as intramural cystic/bubble-like gas collections on CT (**Fig. 8**) is often and asymptomatic. Studies have shown that benign PI often is confined to the right colon. As a result, patients with PI confined to the right colon, without signs of peritonitis or sepsis, in the appropriate clinical context, and in the absence of worrisome imaging findings (discussed later) can be treated with supportive care.[24] A theory proposes that immunosuppressive or steroid therapies may induce lymphoid depletion in Peyer patches, which impairs the GI defense mechanism, reduces peristalsis, and compromises the intestinal wall integrity resulting in PI.[29,30] An association with tapering and discontinuation of steroids has been associated with improvement of PI.[29]

Worrisome features indicative of fulminant PI include linear or circumferential morphology of

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intramural gas (**Fig. 9**), bowel dilatation, bowel wall thickening, mesenteric stranding, hemorrhagic ascites, small bowel involvement, obstruction, ischemia, visceral infarction, portomesenteric venous gas, and perforation.[27,28,31,32]

To summarize, the finding of PI demands a multidisciplinary approach to identify its clinical relevance, and thoughtful assimilation of clinical, radiologic, and laboratory findings to determine appropriate management. This is best accomplished through direct communication between the radiologist and clinical provider(s).

DIVERTICULA

Diverticula of the GI tract are extremely common incidental imaging findings. Although radiologists are most familiar with colonic diverticulosis due to its very high incidence in the Western world, and the common occurrence of symptomatic colonic diverticulitis, diverticulosis frequently is found in other sites of the digestive tract, occurring in decreasing order of frequency in the colon, duodenum, esophagus, stomach, jejunum, and ileum.[33] Kelly and colleagues[9] found colonic diverticulosis to be the most commonly reported

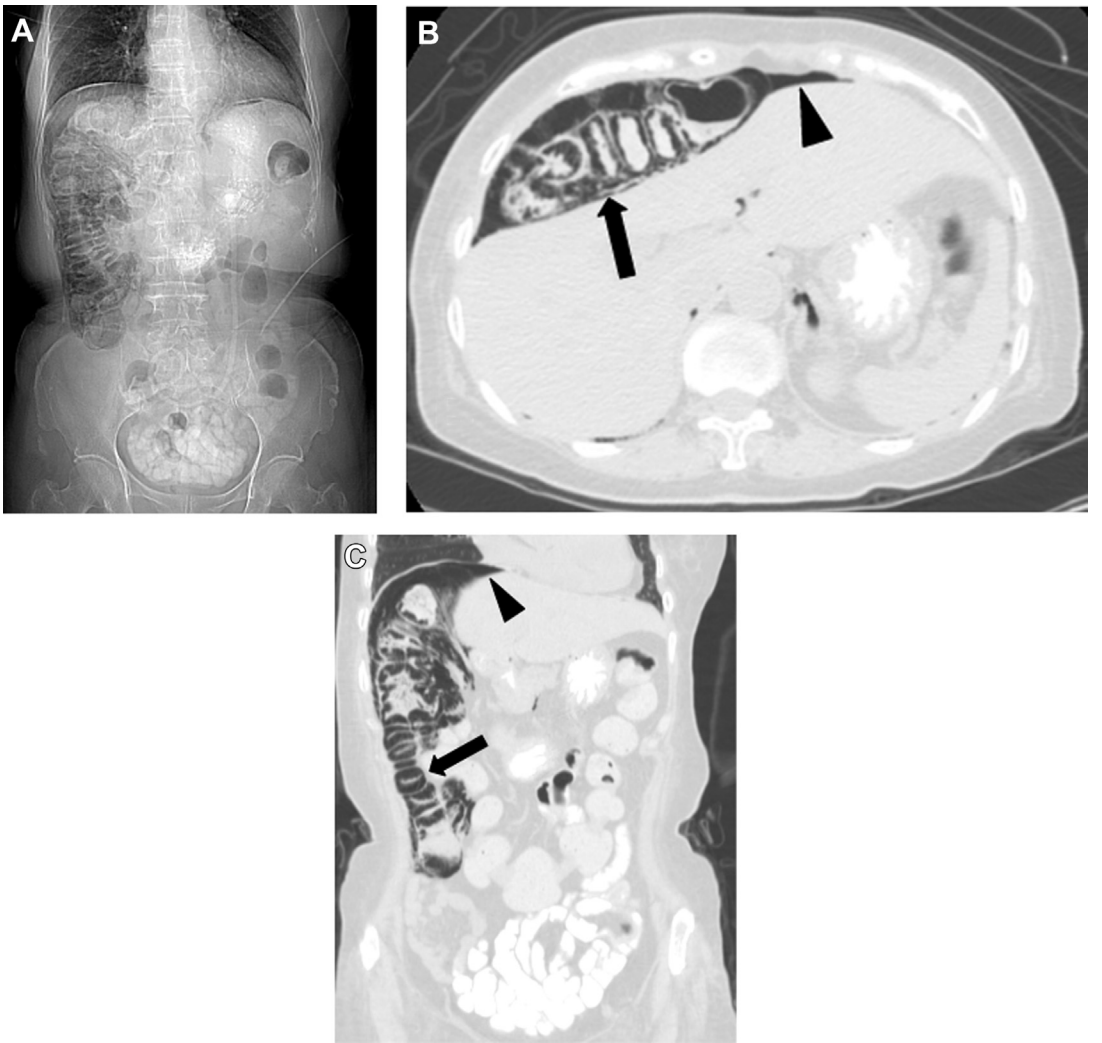

Fig. 8. Pneumatosis cystoides coli. A 66-year-old man with abdominal distention. Scout (*A*) and nonenhanced axial (*B*) and coronal (*C*) CT images performed for evaluation of intraperitoneal free air seen on radiographs. There is extensive pneumatosis along the wall of the ascending colon (*arrows*), which demonstrates cystic/bubble-like morphology, an appearance which supports a benign process. Lucency under the right diaphragm represents a combination of pneumatosis and pneumoperitoneum (*arrowheads*). The pneumoperitoneum likely is secondary to escaped intramural air.

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incidental finding on abdominal CT. This study did not include data on diverticula in other regions of the bowel. Other than including the presence of a diverticulum or diverticulosis in the radiology report, there usually is no need for any further work-up or management of the patient, because only a minority manifest with any symptomatology. Common complications of diverticula include infection, perforation, abscess, obstruction, and hemorrhage. Typical signs of acute diverticular infection on CT are well known to the practicing radiologist and include focal wall thickening of the involved segment of bowel, stranding of the adjacent fat, and, in complicated cases, localized abscess formation.

Esophageal diverticula are classified as either pulsion or traction diverticula, with pulsion diverticula much more common and usually located in the mid to distal esophagus, whereas traction diverticula usually are found in the mid-esophagus. Epiphrenic diverticula are located within 10 cm of the gastroesophageal junction. These diverticula can grow to a large size and cause dysphagia due to compression of the true lumen of the esophagus. Regurgitation of contents of the diverticulum can lead to reflux symptoms and aspiration. Due to their location near the gastroesophageal junction, epiphrenic diverticula may be confused with a hiatal hernia on radiographs or on CT (**Fig. 10**).[34] Visualization of the entire stomach below the diaphragm and lack of gastric folds extending through the esophageal hiatus can help in making a correct diagnosis.

Gastric diverticula are uncommon and occur most frequently along the posterior wall of the fundus (**Fig. 11**). Their significance to the radiologist is for the potential to be misdiagnosed as a left adrenal nodule or exophytic gastric mass on CT, especially if there is no air in the lumen of the diverticulum.

Duodenal diverticula are found in up to 22% of patients in autopsy studies and usually are asymptomatic. Most arise along the medial wall of the second portion of the duodenum, within 2.5 cm of the ampulla of Vater. Infection of a duodenal diverticulum is an infrequent occurrence in comparison to diverticula of the colon, a fact attributed to their larger size and relatively sterile and liquid contents of the duodenum.[35] Periampullary diverticula can be the cause of recurrent pancreatitis, cholangitis, and common duct calculi due to obstruction of the ampulla. The abnormal anatomy created by the diverticulum can make it technically difficult for the endoscopist to perform a sphincterotomy, and it may be appropriate to state the presence of a periampullary diverticulum in the impression of the radiology report, if the patient is being considered for such a procedure.[36] A potential pitfall is for a periampullary diverticulum to be mistaken for a pancreatic mass, whether a cystic process if its lumen is entirely fluid-filled, or a solid mass if the lumen is collapsed (**Fig. 12**).

Diverticulosis of the mesenteric small bowel is uncommon, occurring in 0.6% to 2.3% of the population. The jejunum is involved more often than the ileum. Diverticula often are multiple rather than solitary, and most are discovered incidentally during radiologic investigations. Bacterial overgrowth in jejunoileal diverticula can be symptomatic, although imaging findings may be absent. Use of multiplanar CT reformations, especially in the coronal plane, often facilitates visualization of jejunoileal diverticula.[37]

Meckel diverticulum is the most common congenital bowel anomaly, with a prevalence of 1% to 4% in autopsy studies. Most are asymptomatic, but a Meckel diverticulum can cause complications, including GI bleeding, obstruction, perforation, intussusception, and neoplasm. On CT, a Meckel diverticulum appears as a cystic or blind-ending tubular mass of variable size connected to the ileum. Wall thickening, intraluminal gas and fluid, and localized inflammatory changes may be present in the setting of Meckel diverticulitis.[38,39]

Fig. 9. Small bowel pneumatosis secondary to ischemic bowel. An 81-year-old man with severe abdominal pain and elevated serum lactate. Coronal image from CT performed without oral or intravenous contrast demonstrates linear submucosal gas collections (*arrows*) within the wall of right lower quadrant small bowel loops, representing pneumatosis from bowel ischemia. Note portal venous gas (*arrowhead*).

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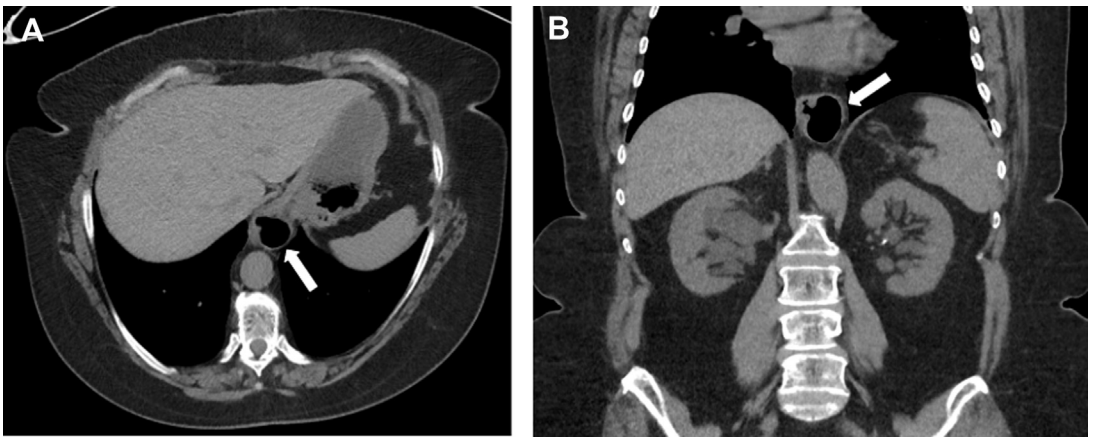

Fig. 10. Epiphrenic esophageal diverticulum. A 57-year-old man with suspected renal/ureteral calculi. Axial (*A*) and coronal (*B*) images from CT performed without oral or intravenous contrast shows an epiphrenic pulsion diverticulum of the distal esophagus (*arrows*). Although the imaging appearance can be similar, the finding should not be misinterpreted as a hiatal hernia.

Diverticular disease is the most common colonic disease in the Western world, present in 5% of the population before the age of 40% and in 33% to 50% of the population after the age of 50. This contrasts sharply with the low prevalence of diverticulosis (0.2%) in Asia and Africa. The sigmoid colon is involved in 95% of cases. Diverticula appear as small rounded outpouchings projecting from the colonic wall, typically measuring between 0.5 cm and 1.0 cm. Diverticulitis occurs in approximately 4% of patients with colonic diverticula.[40]

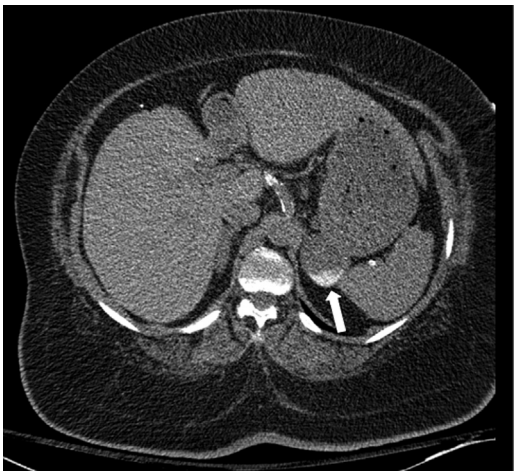

Fig. 11. Gastric diverticulum. A 49-year-old man with shortness of breath. Axial image from chest CT performed without intravenous contrast reveals a gastric diverticulum (*arrow*) emanating from the posterior gastric fundus, a typical location for a gastric diverticulum. Layering hyperdense debris helps to distinguish the finding from other entities, such as an exophytic gastric mass.

NON-OBSTRUCTIVE BOWEL DILATATION

Abnormally dilated bowel is an infrequent incidental finding on CT. Mechanical obstruction is far and away the most common cause of bowel dilatation and usually is symptomatic. Nonobstructive causes of bowel dilatation are neuromuscular dysfunction and are classified as adynamic ileus. Acute causes, which most often are symptomatic and not incidental, include recent laparotomy, intraperitoneal infection, ischemia, electrolyte imbalance and colonic pseudoobstruction (Ogilvie syndrome). Chronically dilated small bowel and/or large bowel can be caused by various etiologies, including medications (eg, narcotics), endocrine disorders, such as diabetes and hypothyroidism, scleroderma, celiac disease, amyloidosis, lymphangiectasia, Parkinson disease, and Chagas disease.[41–44]

Classifying bowel dilatation as obstructive or nonobstructive is the most essential task of the radiologist in the setting of bowel dilatation on CT. Fundamental in making the diagnosis of a bowel obstruction is the detection of a transition point, or change in caliber of the bowel at the site of obstruction, whether in the small or large bowel. Chou and colleagues[45] found 4 criteria, which were statistically significant in the diagnosis of small bowel obstruction—continuous dilatation of proximal bowel, greater amount of fluid in bowel loops proximal to the obstruction, abrupt transition, and less intraluminal content in the colon. Prior abdominal radiographs or CT scans, if

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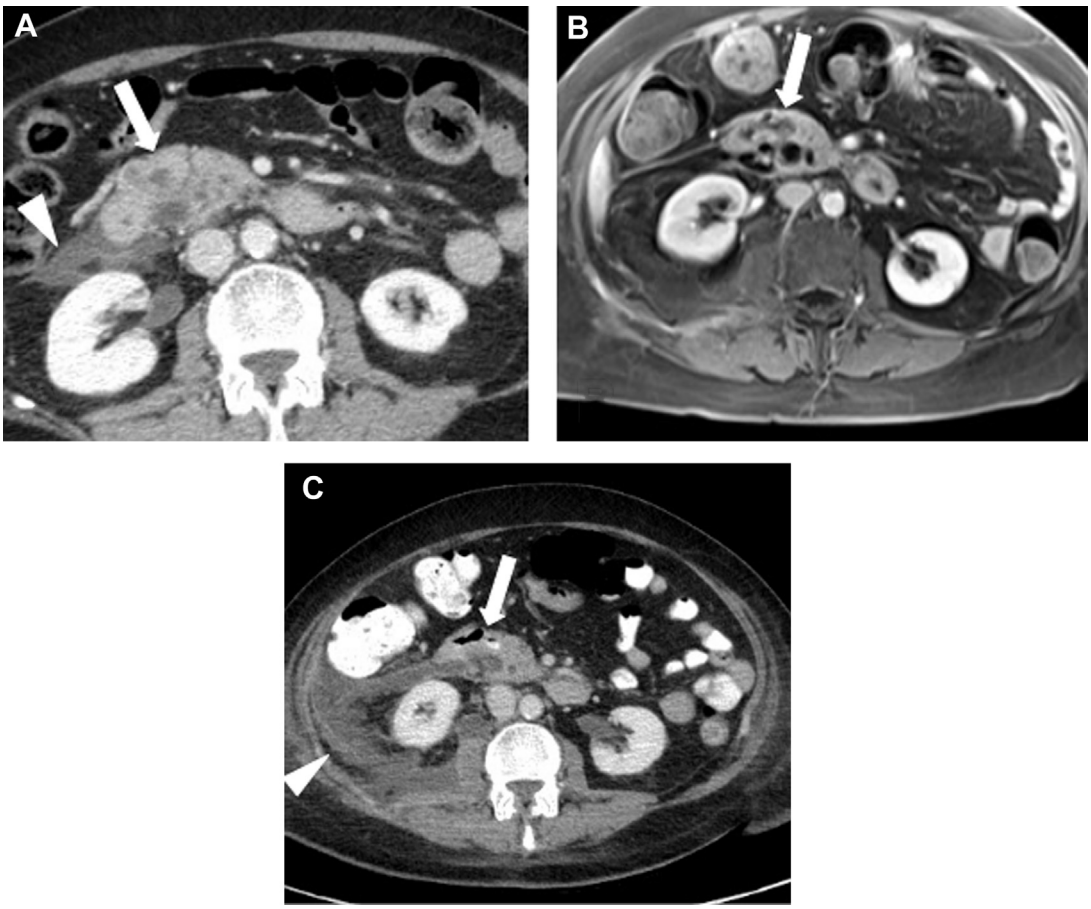

Fig. 12. Periampullary duodenal diverticulum. A 70-year-old woman with elevated liver function tests. Axial CT (*A*) and MR (*B*) images, both performed with intravenous contrast, demonstrate a heterogeneous focus adjacent to the pancreas head (*arrows*) which was mistaken for a mass. (*C*) Image from subsequent oral and intravenous contrast-enhanced CT shows air and oral contrast at the same site (*arrow*), diagnostic of a duodenal diverticulum. Peripancreatic and right-sided retroperitoneal fluid (*A, C* [*arrowheads*]) is secondary to acute pancreatitis.

available, may help in suggesting the diagnosis of chronic nonobstructive dilatation.

INTUSSUSCEPTION

Intussusception is a well-known medical condition characterized by the invagination of a bowel segment into an adjacent segment. Although a common entity in the pediatric population, only 5% of symptomatic intussusceptions occur in adults.[46] In the pediatric population, the cause of intussusception most frequently is idiopathic and thought to be the result of enlarged gut lymphoid tissue (Peyer patches) brought on by viral infection.[47] Classic symptoms in children have been described as abdominal pain, currant jelly stool, and a palpable sausage-like mass. Symptoms in adults, however, can be more nonspecific, if present at all, and can include abdominal pain, nausea, and vomiting.

In adults, an intussusception, particularly if it involves the colon, usually is a pathologic condition, with tumor serving as a lead point (**Fig. 13**). Neoplasm is the most common cause of adult intussusception.[48] Additional causes of intussusception in adults include benign tumors, feeding tubes, Meckel diverticulum, and foreign bodies. Symptoms of intussusception with a lead point include abdominal pain and nausea/vomiting. Intussusception can be divided into anatomic location: entero-enteric, colocolic, and ileocolic.

With the improving resolution and widespread adoption of CT, incidental entero-enteric transient intussusceptions have been detected with increasing frequency.[49] Transient intussusceptions usually are idiopathic and do not have a visible lead point. The mechanism of transient intermittent intussusceptions is not entirely established, to the authors' knowledge, but may involve dysrhythmic contractions that result in abnormal

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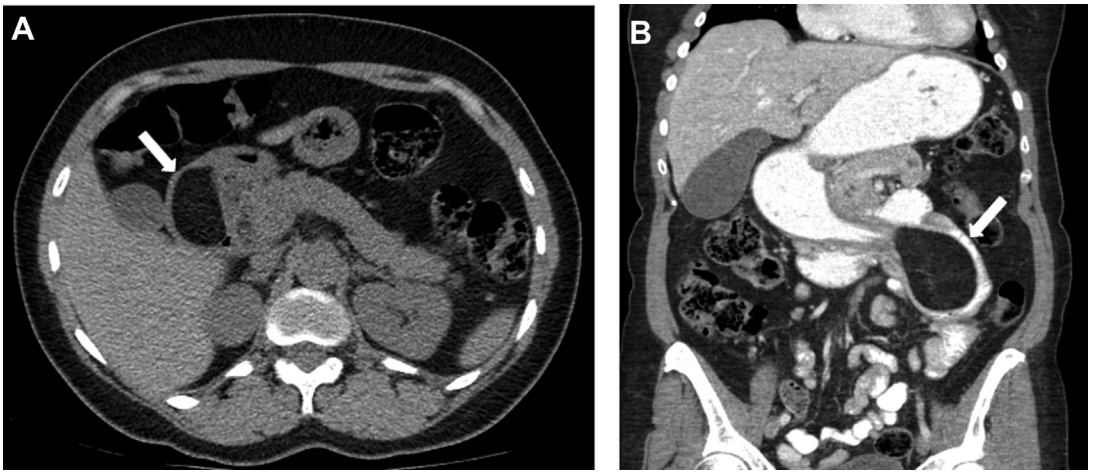

Fig. 13. Intussuscepting duodenal lipoma. A 63-year-old woman (on initial presentation). (*A*) Axial image from chest CT performed with intravenous contrast to evaluate for a possible lung mass demonstrates an incidental lipoma (*arrow*) within the duodenal bulb. (*B*) Coronal image from without intravenous contrast-enhanced abdominal CT 3 years later, after the patient presented with abdominal pain, now shows duodenal intussusception into the proximal jejunum with the lipoma increased in size, and now serving as lead point (*arrow*).

peristalsis.[49] The condition also has been described in patients with celiac disease and Crohn disease.[50] Unlike pathologic lead point cases, transient intussusceptions present without obstructive symptoms and may be asymptomatic.[51] Many studies have established that these cases can be treated with conservative management, even in the presence of GI symptoms.

In an extensive CT report search for cases of intussusception, Lvoff and colleagues[52] identified 37 patients with small bowel intussusception and found conservative management successful in 84% of cases. In another large review of CT reports, Rea and colleagues[53] identified 149 patients with entero-enteric intussusception and found fewer than 5% of those patients underwent operative intervention.

Intussusception is readily detectable on CT. The CT findings of intussusception are the classic targetoid bowel in bowel appearance. Predictive features of benign self-resolving intussusceptions include lack of visible lead point, absent

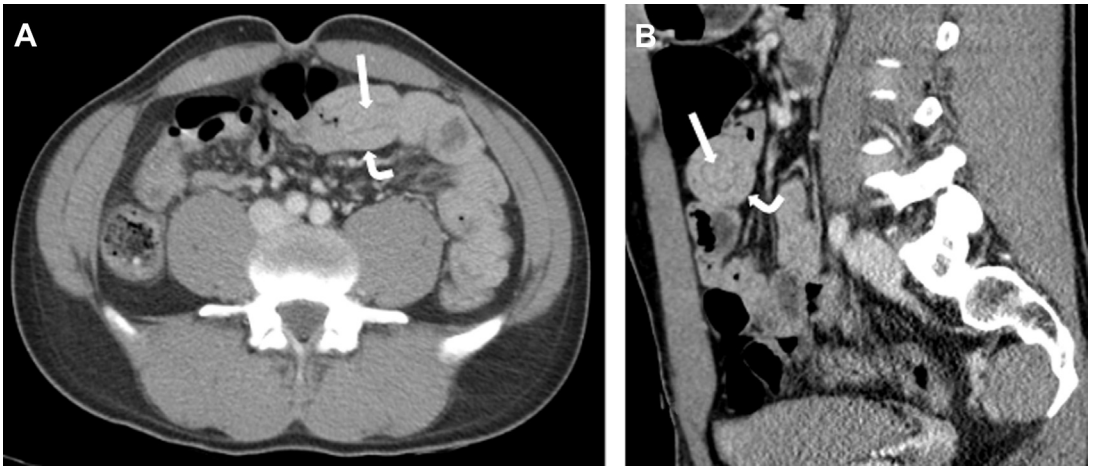

Fig. 14. Transient intussusception. A 32-year-old man with acute abdominal pain. Axial (*A*) and sagittal (*B*) images from CT performed with intravenous and without oral contrast, show an entero-enteric intussusception with the classic bowel in bowel appearance of the intussusceptum (*straight arrows*) within the receiving segment of small bowel, referred to as the intussuscipiens (*curved arrows*). This is a short segment intussusception without evidence of pathologic lead point, bowel obstruction, or inflammation. Therefore, findings are highly suggestive of a benign transient intussusception, a self-limiting condition. On follow-up CT 1 week later (not shown), the intussusception had resolved.

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obstruction, proximal small bowel location, and length less than 3.5 cm (**Fig. 14**).[52]

Benign entero-enteric intussusception is a condition that is being diagnosed with increasing frequency on CT. CT plays a critical role not only in detection but also stratifying cases that are likely to respond to conservative treatment.

SUBMUCOSAL FAT DEPOSITION

Submucosal fat deposition within the bowel, also known as the fat halo sign on CT, describes a middle layer of submucosal fat (low attenuation (below −10 HU)), surrounded by an inner layer (mucosa) and outer layer (muscularis propria and serosa) of soft tissue attenuation.[5,54,55] The fat halo sign initially was described in the setting of chronic IBD (Crohn disease and ulcerative colitis) and formerly was thought to be pathognomonic for IBD.[4,5,55,56] With the advent of improved CT technology, however, including the capability for routine rapid acquisition of thinner slices, and the increased utilization of imaging, the presence of this finding now is known to be more common than previously reported and has been associated with a broader differential, including obesity and chronic steroid use. In a patient without signs or symptoms related to bowel disease, this finding can be treated as purely incidental and of no clinical significance. Analysis of the distribution of submucosal fat, and correlating with associated findings and clinical history, can assist in determining clinical significance.

According to published data, the presence of the fat halo sign has been reported in 61% of patients with ulcerative colitis and in only 8% of patients with Crohn disease.[54,55] When submucosal fat is noted in both the small bowel and large bowel, the sign is considered as suggestive of Crohn disease. Additional findings typical for Crohn disease, including fistula or stricture formation, skip areas, and proliferation of mesenteric fat, when present, increase the likelihood of Crohn disease. When only the colon is affected, these findings as well as the degree and geographic distribution of bowel wall thickness sometimes can be used to distinguish ulcerative colitis from Crohn disease (**Fig 15**).[4,5,56] Isolated fat deposition in the duodenum or the proximal jejunum in the setting of fatty stools is suggestive of celiac disease. Other uncommon causes of the fat halo sign include acute presentations in patients receiving cytoreductive therapy or patients with graft-versus-host disease.[55,57]

The fat halo sign in patients without GI symptoms or clinical or radiological evidence of GI disease is considered a normal variant and may be linked with obesity. Harisinghani and colleagues[58] conducted a retrospective review and identified submucosal fat deposition in 21 of 100 patients who had computed tomographs (CTs) ordered for suspected urolithiasis. Of these 21 patients, none had any prior or subsequently recorded history of GI disease compatible with IBD.[58] The increased prevalence of fat in collapsed/underdistended bowel, thin caliber of the fatty layer, and disappearance of the fat halo sign with additional distention should favor a normal variant rather than a pathologic cause (**Fig. 16**). In addition, the presence of a normal haustral pattern can provide reassurance.[54,55,58]

Fig. 15. Fat halo sign secondary to IBD. A 53-year-old woman with nausea and vomiting. Axial image through the pelvis from CT performed with oral and intravenous contrast demonstrates the fat halo sign in the rectosigmoid colon (*arrows*) as well as marked mesocolic fat proliferation and dilated vasa recta (*arrowheads*), findings highly compatible with IBD.

Fig. 16. Incidentally found intramural colonic fat. A 48-year-old woman undergoing CT in the prone position without oral or intravenous contrast for renal colic. The fat halo sign is seen at the hepatic flexure and in the transverse colon (*arrows*). The patient was obese and had no history of IBD or bowel-related symptoms; therefore, this finding is likely of no clinical significance.

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SUMMARY

A variety of incidental findings in the bowel are seen with an overall relatively high frequency on CT. Typically, these scans are not performed to specifically optimize bowel visualization and characterization, for example, in the emergency setting. The role of the radiologist is to distinguish benign and clinically unimportant findings from findings needing further management. Knowledge pertaining to the specific CT appearances, pathophysiology, and clinical relevance associated with findings, including PI, diverticular disease, bowel dilatation, intussusception, and submucosal fat, can help the radiologist make the correct diagnosis. The radiologist also must be aware that neoplasms (both benign and malignant) of the GI tract occasionally can present as incidental findings, and conversely, that under-distention of the bowel, stool and other intraluminal contents, and the lack of intravenous contrast, can make accurate analysis of the bowel difficult, potentially obscuring or mimicking inflammatory or neoplastic disease.

CLINICS CARE POINTS

- Incidental bowel findings are commonly discovered on CT; most are benign and require no further workup or management, however some will be clinically significant. In particular, bowel wall thickening with suspicious features may reflect underlying neoplasm and should be brought to the attention of the referring physician.
- There are a wide variety of causes of pneumatosis intestinalis, with clinical presentation ranging from asymptomatic to life threatening bowel ischemia.
- Bowel dilatation is most often due to mechanical obstruction, however the radiologist should be aware of the causes of acute and chronic non obstructive bowel dilatation.
- Bowel intussusception in an adult should raise suspicion for a neoplasm acting as the lead point, however a transient self-resolving intussusception can be suggested in the setting of a short segment intussusception with no upstream bowel dilatation or visible lead point.
- The fat halo sign can be a CT sign of longstanding inflammatory bowel disease, however it is more frequently seen as an incidental and clinically insignificant finding.

DISCLOSURE

The authors have nothing to disclose.

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