Chapter

Imaging of Constipation and Its Complications

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Abstract

Radiology is an important tool in the diagnosis and treatment of patients with constipation. Imaging provides both vital anatomic and functional information that may facilitate arriving at an accurate diagnosis, assessing for serious complications, and delivering the appropriate therapy in a timely fashion. In this chapter, we discuss how each imaging modality is used to image patients with constipation. Within this discussion, we review what information is provided by each modality and we detail complete imaging protocols and technical parameters for each test. Finally, we highlight key findings with illustrative images from radiography, fluoroscopy, CT, and MR imaging.

Keywords: imaging, radiology, stercoral colitis, computed tomography, CT, magnetic resonance imaging, MRI

1. Introduction

Radiology plays a pivotal role in the detection of constipation, identification of underlying etiologies, and revealing associated complications. Imaging evaluation of constipation has evolved from radiography and contrast enemas to advanced cross-sectional and functional imaging. A dilemma that physicians of medical and surgical specialties encounter when confronted with a patient with constipation is the decision of if or when radiology is indicated. The clinical presentation of the patient and what information is desired will ultimately govern if imaging is warranted and then what is the most appropriate exam to order. If the patient presents in the acute setting with a potential surgical emergency, fast and widely available imaging exams, such as radiography or computed tomography (CT), are the most appropriate exams to order. If the patient has a chronic issue or data regarding colorectal function is desired, a colorectal transit time exam with Sitz markers or defecography with fluoroscopy or magnetic resonance (MR) imaging are the exams of choice. With a diverse range of anatomic and functional imaging tests available, radiology has developed into an invaluable mechanism in the assessment of patients with constipation.

2. Radiography

Radiography, also known as plain film or X-ray, is a widely available, inexpensive, and easily obtained imaging test to assess for constipation. While the reported diagnostic sensitivity of radiography for the detection of constipation is 84%, the reported specificity is 72% [1]. Despite its relatively low sensitivity and specificity,

radiographs serve as a basis for triage for further imaging work-up and assist in the therapeutic decision-making process. Inherent pitfalls in radiography of patients whom are constipated are other causes of colonic dilation, particularly adynamic ileus and colonic pseudo-obstruction [1].

Radiography is commonly used to image pediatric patients with constipation, particularly in the acute setting. However there is a unified consensus throughout the medical community to reduce non-essential and unnecessary radiation exposure to the pediatric population [2]. The latest consensus guidelines from the North American and European Societies of Pediatric Gastroenterology, Hepatology, and Nutrition advocate that constipation should be diagnosed clinically in pediatric patients because there is no reliable system to diagnose constipation and, instead, this modality may lead to misdiagnosis of more acute pathology [2]. Expert consensus also advocates that radiography has no role in imaging of children with functional constipation, which is best diagnosed with careful clinical assessment and physical examination [2].

2.1 Radiography technique

Anteroposterior (AP) images of the abdomen and pelvis in the supine position are performed to visualize and qualify the burden of feces, visualize the size of the colon, and assess for colonic obstruction. Erect and lateral decubitus images of the abdomen and pelvis to may be added if there is concern for complications of constipation such as free air from a perforation [1].

2.2 Key findings on radiography

The key radiographic findings of constipation are the presence of large fecal burden throughout the colon, luminal fecalomas, and a relative paucity or absence of luminal gas [3]. Feces appear as soft tissue opacities with internal mottled air (**Figures 1** and **2**) [3].

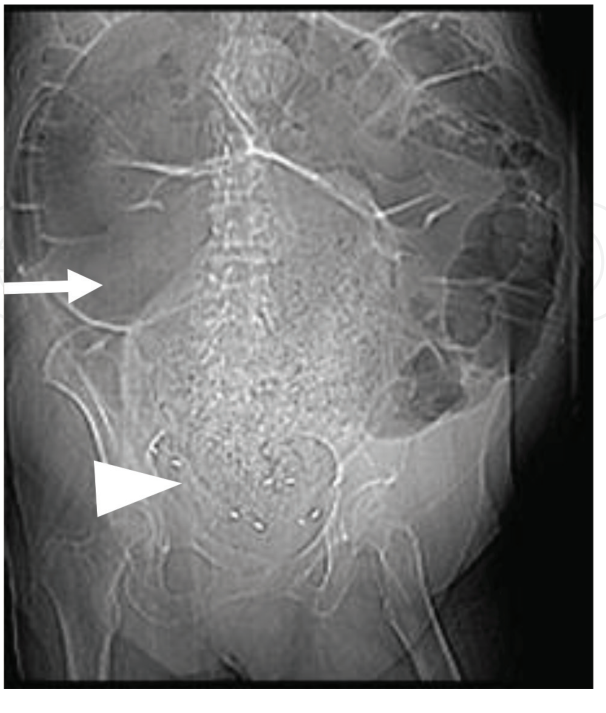


Figure 1.
AP radiograph of the abdomen and pelvis in a patient with constipation displays diffuse dilation of the colon (arrow) with an abrupt transition in luminal caliber by a large soft tissue opacity, which contains internal mottled air, indicative of feces (arrowhead).

Figure 2.
AP radiograph of the abdomen and pelvis of patient with constipation shows a dilated colon with a transition in caliber due to a soft tissue opacity, which contains internal mottled air, characteristic of feces (arrow).

Radiography is helpful to assess for the presence of complications associated with constipation. Non-dependent images of the abdomen in the upright or left lateral decubitus positions may also be used for assessment of free air [1]. Bowel ischemia and infarction may be manifested on radiographs as pneumatosis, or air within the bowel wall, and/or portal venous gas, which projects over the silhouette of the liver [1]. Pneumoperitoneum from bowel perforation can be detected on radiography by air external to the bowel wall, air along the peritoneal ligaments, and air in the right upper abdominal quadrant [1]. If a surgical emergency is suspected on radiography, emergent surgical consultation is recommended. However, if surgery is not imminently planned or other treatment options are being considered, assessment of the severity and cause of the constipation with cross-sectional imaging becomes a priority. CT is the preferred imaging modality because of its superior sensitivity and specificity and it can potentially modify treatment.

Two entities that mimic mechanical causes of constipation are adynamic paralytic ileus and acute colonic pseudo-obstruction. Adynamic paralytic ileus is commonly due to medications, metabolic abnormalities, and recent surgery. Acute colonic pseudo-obstruction, also known as Ogilvie's Syndrome, is due to altered autonomic innervation of the colon and may also be caused by medications and metabolic disturbances [1].

Assessment of the small bowel and colon in pediatric patients may be challenging because the appearances, fold pattern, and location of the small bowel and colon overlap more so than in adult patients. There is also no established system to diagnose constipation in pediatric patients. Therefore radiography may be misleading in the assessment of pediatric patients it may result in missed diagnoses; this modality should be used in children in a limited fashion.

2.3 Radiography for colonic transit time: Sitz marker exam

A radiographic test that is used to estimate transit time of the colon is a Sitz marker exam [4]. In patients with constipation, this study may help discriminate between delayed colonic transit and defecation disorders.

2.3.1 Sitz marker exam

Patients are instructed to discontinue laxatives or any pro-motility medications. Otherwise no preparation is needed. The most common technique used is the ingestion of 20 or 24 Sitz markers in a single dose with a meal. Sitz markers are

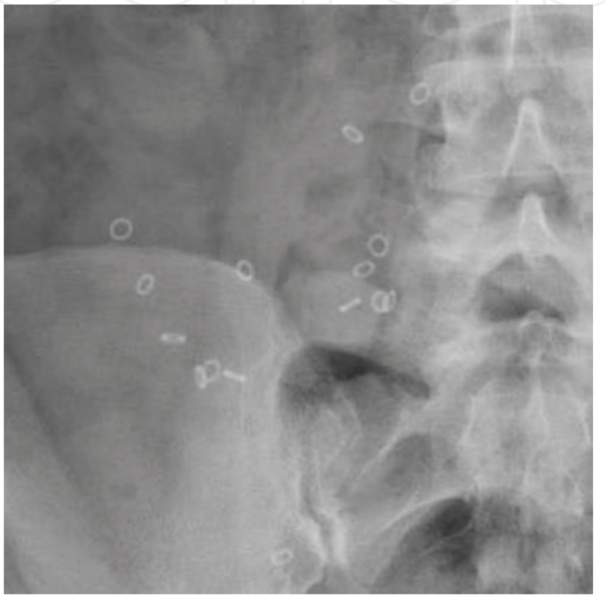


Figure 3.
Magnified AP radiograph of the pelvis shows Sitz markers.

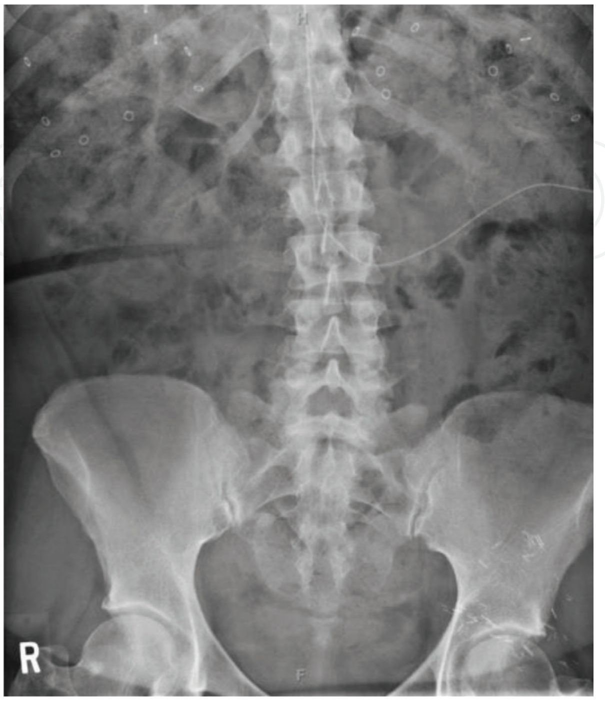


Figure 4.
AP radiograph of the abdomen and pelvis in this patient on day 3 of a Sitz marker exam, 18 of 20 Sitz markers are present and indicate that colonic transit will be delayed at 5 days.

Day	Sitz markers
1	≤16
2	≤8
3	≤4
4	≤2
5	≤1

Table 1.
Anticipated schedule of the number of retained Sitz markers on serial daily abdominal radiographs in a 20 Sitz marker exam. Day number is in the left column and retained Sitz marker number is in the right column.

small, plastic rings that contain radio-opaque material so they may be visible on radiographs (**Figure 3**) [4]. Then serial anteroposterior radiographic images of the abdomen and pelvis are obtained to monitor the clearance of the Sitz markers from the colon (**Figure 4**). A normal colonic transit time ranges between 24 and 56 h. Most patients will clear all of the Sitz markers in 4–5 days [4].

2.3.2 Key findings on Sitz marker exam

A normal colonic transit time, which is between 24 and 56 hours, corresponds to retention of less than 20% of the original Sitz markers at 5 days [4]. In a Sitz marker exam that used 20 Sitz markers, the anticipated schedule of the number of retained Sitz markers on serial daily abdominal radiographs is as follows (**Table 1**).

3. Fluoroscopy

Fluoroscopy employs the administration of contrast with real-time, moving radiographs to image both anatomy and function. Two fluoroscopic imaging techniques used to evaluate patients with constipation are contrast enema and evacuation proctography exams.

3.1 Contrast enema

Contrast enema may be valuable in the initial imaging assessment of patients with constipation because of it allows delineation of mechanical causes of constipation by displaying the luminal size of the colon and rectum, site(s) of transition in luminal caliber, and the length of involvement [5]. This exam is unique because it may be both diagnostic and therapeutic: the instillation of contrast material into the colon and rectum may relieve fecal impaction [5].

3.1.1 Contrast enema technique

Prior to the exam, patients undergo a bowel cleanse preparation with an oral laxative, such as magnesium citrate or polyethylene glycol. Contrast enema exams are performed with fluoroscopy and may be performed with either single contrast: barium or water-soluble contrast only or double contrast: barium or water-soluble contrast with the insufflation of air or carbon dioxide.

Pre-procedural radiographic anteroposterior images of the abdomen and pelvis and a left lateral radiographic view of pelvis are obtained. The patient then lies in the left lateral decubitus position on the fluoroscopy table. A digital rectal exam in performed. Then a thin, small-gauge, flexible catheter is placed into the rectum. This catheter is typically paired with a small, balloon that is inflated to

ensure that the catheter does not back out of the rectum. If double contrast is performed, air or carbon dioxide is gently insufflated by hand pump to patient tolerance. The contrast is then instilled into the rectum and colon by gravity. During contrast administration, fluoroscopic-guided spot radiographic left and right lateral and left and right posterior oblique images of the rectum, rectosigmoid junction, sigmoid colon, descending colon and splenic flexure are obtained. Then an anteroposterior view of the transverse colon and a left posterior oblique view of hepatic flexure are obtained. Finally anteroposterior and posterior oblique images of the ascending colon, cecum, ileocecal valve, and the terminal ileum, are obtained. At the end of the exam, the contrast is emptied out of the colon by gravity and a post evacuation anteroposterior radiographic view of the abdomen and pelvis is obtained.

3.1.2 Key findings on contrast enema

Contrast enema exams can depict filling defects in the colon and rectum from feces and fecalomas from constipation or an obstructive mass, such as malignancy (**Figure 5**) [5].

Colonic and rectal luminal size and the presence, degree, and length of strictures are all displayed and can be assessed on contrast enemas [5, 6]. Strictures, which are due to fibrosis from repeated inflammation or de-vascularization, may be caused by diverticulitis (**Figure 6**), ischemia, prior radiation or surgery (**Figure 7**), and inflammatory bowel disease (**Figure 8**) [5, 6].

Contrast enema is a dynamic imaging modality in the assessment of pediatric patients with constipation [7]. Contrast enemas are invaluable in both the diagnosis and extent of involvement for Hirschsprung's disease, an entity that results in constipation due aganglionosis, or absence of the ganglion cells, in the distal colon and rectum [7]. The denervated distal colon or rectum is small in luminal size with proximal dilation [7]. Early filling views of the sigmoid colon and rectum allow for detection of an abnormal sigmoid colon to rectum size ratio and fasciculation or saw-tooth irregularity of the denervated segment [7].

While contrast enema can reliably display these causes of constipation, computed tomography (CT) may characterize these entities with greater spatial and

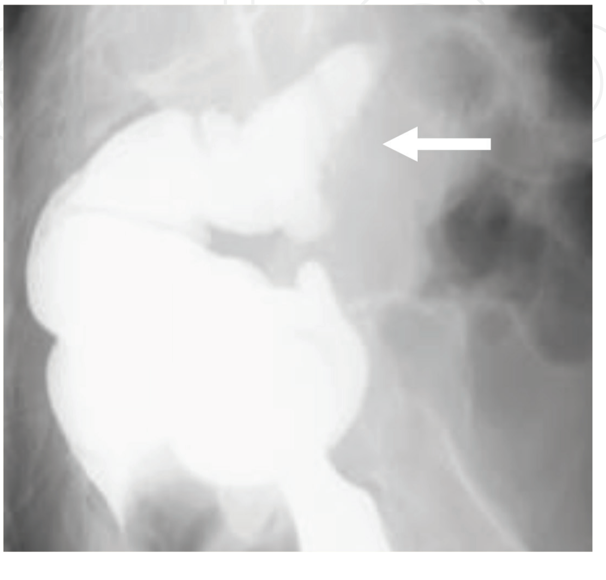


Figure 5.
Contrast enema image of the sigmoid colon in a patient with constipation and irregular bowel movements shows an abrupt transition (arrow) with obstruction of passage of contrast. The patient was referred for a colonoscopy and then surgery for resection of an adenocarcinoma.

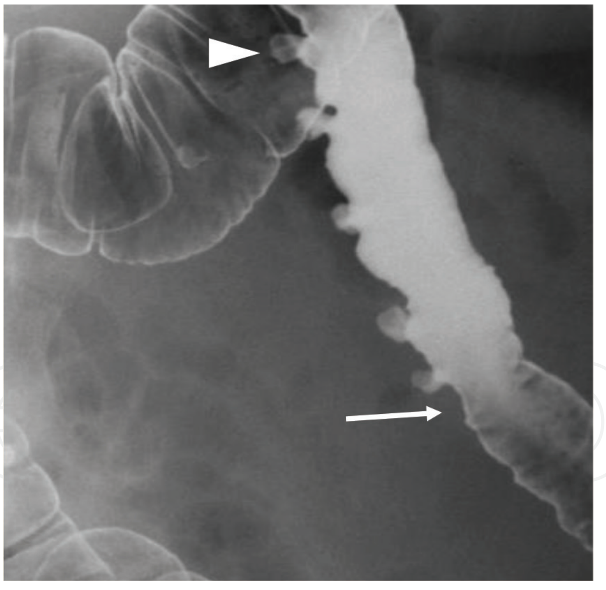


Figure 6.
A patient with abnormal and irregular bowel movements and constipation following an episode of acute diverticulitis underwent a contrast enema. Adjacent to multiple diverticula (arrowhead) in the descending colon, there is focal, short-segment, low-grade stricture (arrow) from prior diverticulitis.

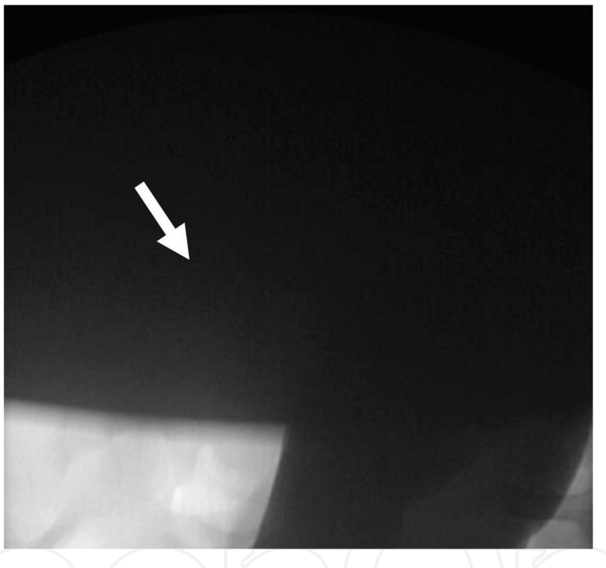


Figure 7.
Contrast enema image of a patient with constipation and decreased bowel movements; she has a history of cervical cancer that was treated with radiation therapy. There is a short-segment, high-grade stricture (arrow) in the sigmoid colon due to prior radiation therapy.

temporal resolution, in a shorter time, with improved patient comfort, and that is more available, particularly in the emergent setting [8]. CT also permits visualization of extra-colorectal structures [8]. Therefore these causes of constipation are discussed in further depth in the CT section of this chapter.

3.2 Fluoroscopic defecography

Defecography is a fluoroscopic exam that provides valuable data for patients with constipation that is caused by both anatomic and functional disorders, which range from pelvic floor dysfunction to spastic pelvic floor syndrome. This exam is typically performed in adult and adolescent patients whom may follow instructions for the dynamic portion of the exam.

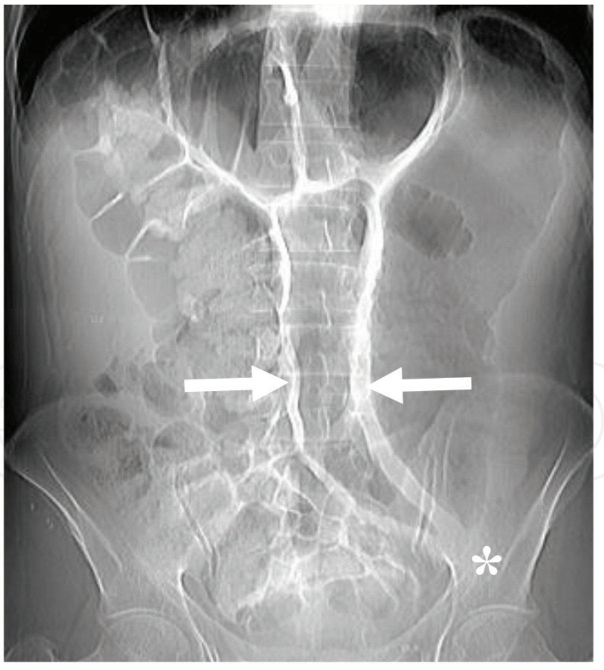


Figure 8.
A patient with ulcerative colitis underwent a contrast enema. AP image after evacuation of contrast shows contrast outlining diffuse colonic wall thickening (arrows) and dilatation with smooth tapering in the sigmoid colon (asterisk).

3.2.1 Fluoroscopic defecography technique

Pre-procedural bowel preparation consists of a bowel cleanse preparation with an oral laxative, such as magnesium citrate or polyethylene glycol. Barium may be administered in the vagina (5 mL barium instillation) and small bowel (500 mL barium oral ingestion) to simultaneously assess these structures in relation to the colon and rectum.

The patient is placed on the fluoroscopy table in left lateral decubitus position. 120–240 mL of barium paste is introduced into the rectum with a large-bore, soft catheter. Then spot lateral radiographic images of the patient at rest in the left lateral decubitus position with knees flexed to recreate the seated position. The patient is then positioned in a special defecography chair. Continuous and spot right lateral images of the seated patient are obtained at rest at rest, during strain (Valsalva maneuver), and then during defecation. A post-evacuation image during strain is obtained to assess for retained barium paste.

3.2.2 Key findings on fluoroscopic defecography

Defecography is a highly sensitive modality for the detection and classification of rectocele and rectal prolapse [9, 10]. A rectocele is the abnormal bulging or protrusion of the rectal wall due to a fascial or ligamentous defect [10]. A rectocele may cause inhibit defecation due to weakening of the vector force during strain [9, 10]. Feces may become entrapped in rectoceles that in turn results in incomplete evacuation [9, 10]. The presence of an anterior rectocele (**Figure 9**) is indicative of a defect in the rectovaginal fascia whereas the presence of a posterior rectocele indicates a defect in the anococcygeal ligament [9, 10]. Rectal prolapse may cause constipation by infolding of the rectum that is caused by repetitive straining and fascial disruption [9, 10].

Rectoceles are measured and classified on the basis of distance of the anterior or posterior rectal wall from the anal canal axis [9, 11, 12]. Rectal prolapses are classified by mucosa-only or full wall-thickness involvement and intra-rectal, internal

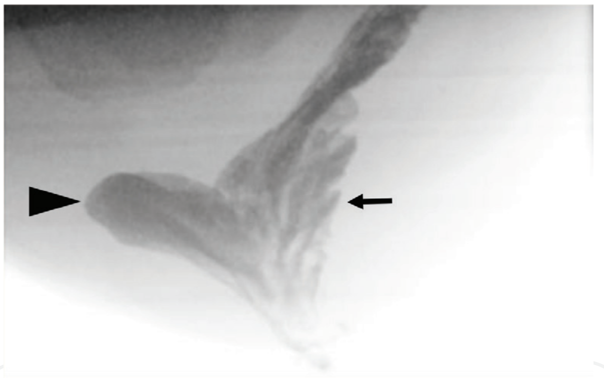


Figure 9.
Evacuation image from a fluoroscopic defecography in a patient with difficult evacuation and constipation shows a mucosal, intra-rectal prolapse (arrow) and an anterior rectocele (arrowhead), which incompletely empties.

intra-anal, or external location (**Figure 9**) [9, 11, 12]. While fluoroscopic defecography has been shown to be highly sensitive for rectal prolapse detection, MR defecography allows for similarly reliable and accurate classification of rectocele and rectal prolapse type due to superior tissue resolution [12].

4. Magnetic resonance (MR) defecography

As an analogue to fluoroscopic defecography, MR defecography plays a vital role in the management of patients with constipation that is caused by both anatomic and functional disorders, which range from pelvic floor dysfunction to spastic pelvic floor syndrome [9, 11, 12]. High resolution and dynamic MR techniques provide detailed anatomic and physiologic information of the colon, rectum, and pelvic floor [9, 11, 12]. This data may then be used to discriminate patients that need surgery from those that need more conservative therapy [9, 11, 12]. For example, many patients with rectoceles from pelvic floor dysfunction will never improve without surgical repair whereas patients with functional constipation are treated with positive biologic feedback [9, 11, 12].

MR defecography is typically performed in adult and adolescent patients whom may tolerate confined space of the bore of the magnet and follow instructions for the dynamic portion of the exam. Challenges to MR imaging are pre-procedural preparation and scan times that are longer than radiography or CT exams. Also MR imaging exams may be limited in certain patients because of claustrophobia, as well as medical devices and orthopedic metallic hardware.

4.1 MR defecography technique

Prior to the exam, patients undergo a bowel cleanse preparation with an oral laxative, such as magnesium citrate or polyethylene glycol, and fast for 6 h. The patient is instructed to use one rectal enema the night before the examination and another up to 1 h before the exam. The patient lies in the right decubitus position on an absorbent, waterproof pad on the MR table and approximately 100–150 mL of warmed ultrasound gel is instilled in the rectum with a flexible tube. In female patients, 60 mL of ultrasound gel may be instilled into the vagina for to simultaneously assess the vagina and cervix in relation to the colon and rectum.

Simple and clear communication is important to establish with the patient during the examination to ensure direct instructions are followed that will in turn yield the best possible images. A phased-array torso coil is used to acquire sagittal,

coronal, and axial T2-weighted steady-state fast spin echo (SSFSE) MR images: 24–30 cm field of view (FOV), 6 mm thickness, 512 × 256 matrix, repetition time (TR) = 5170 ms, echo time (TE) = 137 ms, from the superior border of the pubic symphysis to the lower end of the anal canal. Are then obtained of the entire pelvis. T2-weighted MR images are helpful in assessing for wall edema or masses and accentuate mucosal features against a bright background created by rectal ultrasound gel contrast. The high-resolution images provide superb soft tissue detail for hernias and muscular or fascial defects.

Dynamic fast imaging employing steady-state acquisition is then performed. The FOV is centered at the rectum and then imaging is performed at rest, during strain (Valsalva maneuver), and then during defecation. Serial, single-section mid-sagittal SSFSE MR images (30 cm FOV, 8 mm thickness, 256 × 256 matrix, TR = 3840 ms, TE = 1670 ms) are acquired every 2 s and repeated 15–20 times and viewed as a cine loop. Gradient echo imaging may also be used for the dynamic sequences. Imaging is also performed of the patient while performing squeeze maneuver to evaluate puborectalis muscle contraction. The use of these dynamic sequences allows real-time functional imaging.

4.2 Key findings on MR defecography

The excellent tissue resolution of MR imaging provides valuable information on anatomic abnormalities of the rectum and pelvic floor. The dynamic component of MR imaging enables assessment of function and physiology. MR imaging has a high sensitivity of the presence of rectoceles (**Figure 10**) and rectal prolapse (**Figure 10**) [9, 11]. Rectoceles are measured and classified on the basis of distance of the anterior or posterior rectal wall from the anal canal axis [9, 11]. A bulge of the rectum that measures less than 2 cm is normal; over 2 cm is abnormal and diagnostic of a rectocele [9, 11, 12]. Rectoceles that protrude up to 3 cm from the normal margin are a significant cause of constipation or incomplete defecation [9, 11, 12]. A rectocele of more than 4 cm is classified as large [9, 11, 12].

Rectal prolapse may cause constipation due to rectal wall infolding that is induced by chronic straining and fascial disruption [9, 11, 12]. Rectal prolapse can only involve the mucosa or the entire wall thickness [9, 11, 12]. Rectal prolapses

Figure 10.
Mid-sagittal SSFSE MR image of the pelvis during evacuation in a patient with constipation shows a large anterior rectocele (arrowhead) and internal intra-rectal prolapse (arrow).

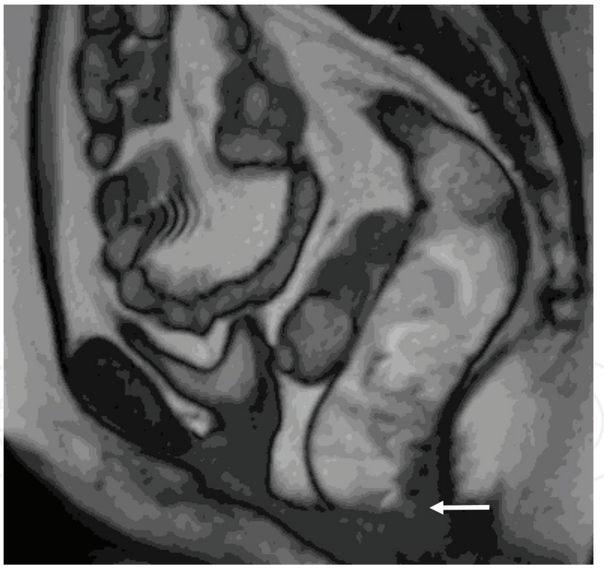


Figure 11.
Mid-sagittal gradient echo MR image of the pelvis during evacuation in a patient with chronic constipation show persistent puborectalis muscular contraction (arrow) without expulsion of intra-rectal gel.

may also be internal intra-rectal, internal intra-anal, or external [9, 11, 12]. Although fluoroscopy has been shown to be a highly sensitive modality for the detection of rectal prolapse relative to MR imaging, the superior resolution of MR imaging similarly provides accurate differentiation of mucosa-only prolapse from full-wall-thickness prolapse [9, 11, 12]. Thus MR imaging provides crucial anatomical and functional information for surgical planning and enables accurate discrimination between the subtypes of rectal prolapse [9, 11, 12].

Spastic pelvic floor syndrome, or anismus, is caused by paradoxical and involuntary contraction of the puborectalis muscle in the pelvic floor [9, 11]. It results in non-relaxation of the external anal sphincter complex and impairs normal defecation [9, 11]. This causes constipation with prolonged and incomplete defecation [9, 11]. Imaging findings include persistent puborectalis muscular contraction during the strain (Valsalva maneuver) and defecation phases, absence of pelvic floor descent, and an abnormally acute anorectal angle (**Figure 11**) [9, 11].

5. Computed tomography (CT)

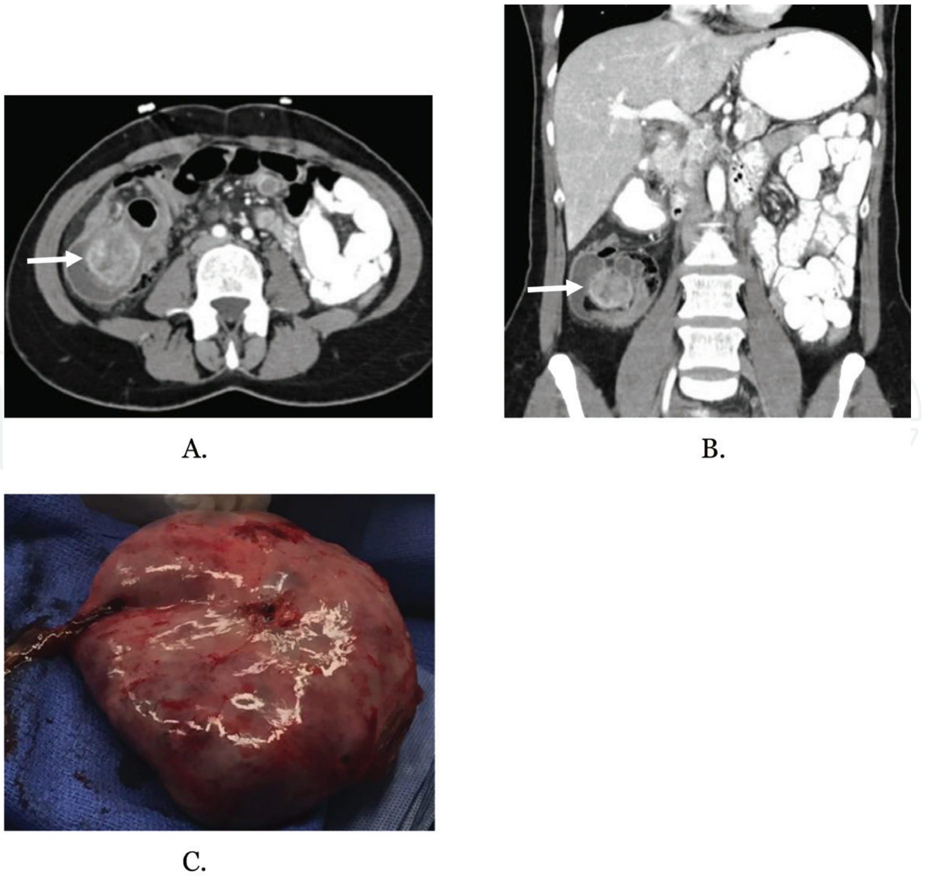
CT is the most important imaging modality in the evaluation of patients with known or suspected constipation. It is readily available, performed quickly, allows assessment for potential complications, and permits visualization of extra-colonic structures. The advent of multi-detector CT scanners with improved technical protocols has resulted in faster and more available imaging, particularly in the acute setting. Multi-planar and thin section reconstruction capability may allow for identification of sites of obstruction in the colon and rectum and delineation of colorectal morphology. CT has a reported sensitivity of 96% and specificity of 93% in the identification of constipation. Additional benefits of CT are visualization of complications associated with constipation, particularly stercoral colitis, ischemia, and perforation, and other organ systems for comorbid conditions that may cause constipation [1, 3, 13–15]. CT is widely used to image adult patients however it is used judiciously in pediatric patients to avoid radiation exposure. If, however, a pediatric patient has constipation that may be secondarily caused by another acute pathology, CT can be of vital importance to diagnosis and management. Radiation dose reduction and modulation may be performed to reduced exposure to pediatric patients.

5.1 CT technique

CT has been particularly valuable in the determination of which patients would benefit from conservative medical management or immediate surgical intervention. CT imaging is typically performed using a 64 or 128-section multi-detector row scanner. Each exam is acquired during a single breath hold and in helical mode. Typical exposure settings are 120 kVp, automated tube current modulation with minimum tube current 100–150 mAs and beam pitch, 0.8–1.375. The administration of intravenous (IV) non-ionic contrast material is advised to assess for the presence of a colonic mass, or wall ischemia or inflammation. Exposure settings are set to 100 kVp and automated tube current modulation with minimum tube current is reduced to 80–100 mAs. If IV contrast is administered (contrast-enhanced), a single-phase technique is used with the acquisition of portal venous phase images 70 s after the IV administration of nonionic contrast material that is injected at a rate of 3–5 mL/s. Positive oral contrast material may or may not be used, depending on the indication and urgency or timing of the exam. Multi-planar reconstruction imaging in the coronal and sagittal planes, which are automatically created at the CT technologist's console, is routinely used. These images may be of great value in not only the diagnosis of constipation but also in the detection of the variety of common and uncommon causes and potential complications.

5.2 Key findings on CT

CT may have a substantial and significant impact on the clinical management of the patient by helping to answer major questions: is the patient constipated? Do feces



A. B.

C.

Figure 12.
(A and B) Axial and coronal images from a contrast-enhanced CT of the abdomen and pelvis of a patient with constipation and bloody bowel movements. There is an enhancing polypoid mass that arises in the cecum and extends into the lumen. (C) The patient then underwent colonoscopy and right colectomy for resection of a colonic adenocarcinoma.

impact the rectum? Are there associated complications of constipation, such as stercoral colitis, ischemia, or perforation? Is the colon obstructed? If the colon is obstructed, can the cause of the constipation be identified, as well as its exact site? CT is particularly useful in the detection of the variety of mechanical causes of constipation.

5.2.1 Malignancy

Primary colonic malignancy is one of the most common mechanical causes [1]. Colonic malignancy is shown on CT as an annular, semi-annular, polypoid, or ulcerated mass that arises from the colon and extends into the lumen or through the wall (**Figure 12A–C**) [16].

5.2.2 Strictures

Strictures are another mechanical cause of constipation. The pathophysiological mechanism for the development of a stricture is fibrosis from repeated inflammation or de-vascularization [17]. The main causes of strictures are diverticulitis, ischemia, inflammatory bowel disease, and prior medical therapy like surgery or radiation [17]. CT may display ancillary features of the primary cause of the stricture that may lead to an accurate diagnosis [17]. If the patient has colonic diverticular disease, repeated episodes of diverticulitis may cause a stricture (**Figure 13**) [15, 18].

Multiple and prolonged episodes of inflammation Crohn disease and ulcerative colitis are types of inflammatory bowel disease that may cause a fixed stricture (**Figure 14**) [15, 19]. Surgical and treatment history may reveal that the fixed stenosis is likely due to adhesive fibrosis from a surgical anastomosis or (**Figure 15A** and **B**) [15].

5.2.3 Stercoral colitis

CT plays an invaluable role in the detection of a significant and even fatal complication of constipation that is known as stercoral colitis. Elderly patients,

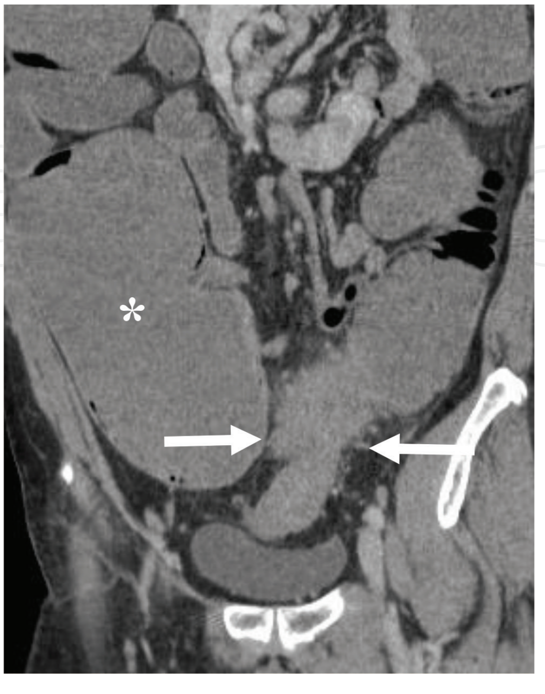


Figure 13.
A patient with several prior episodes of diverticulitis presented with pain and constipation. Coronal image from a contrast-enhanced CT shows a significant amount of feces and fluid in the dilated colon (asterisk) due to sigmoid colonic wall thickening and pericolonic fat stranding in the setting of diverticulosis, compatible with a diverticular stricture.

Figure 14.
Coronal image from a contrast-enhanced CT of a patient with Crohn disease displays a short-segment stricture in the mid-transverse colon (arrow) that results in a short-segment stricture (arrowhead) and upstream constipation.

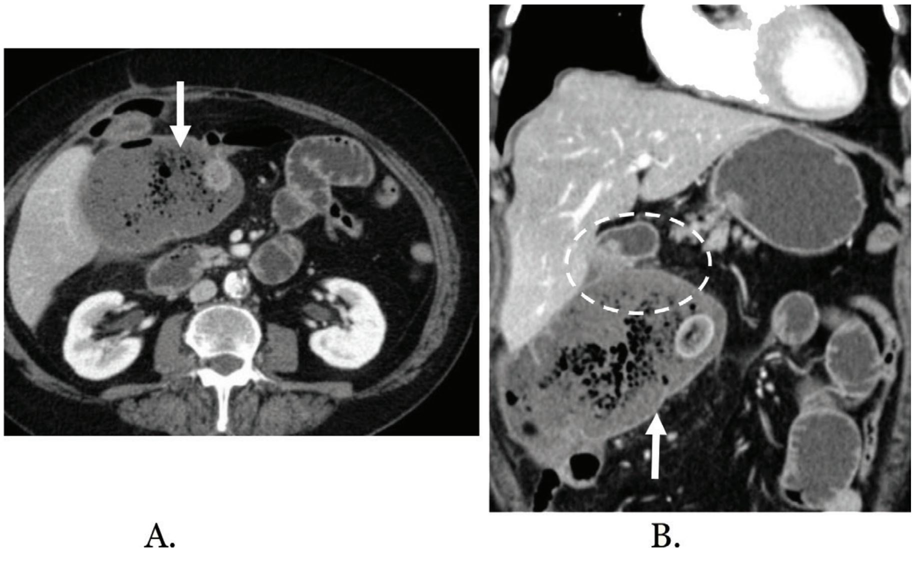


Figure 15.
(A and B) A patient presented with severe constipation and no bowel movements for over 1 week. Axial and coronal images from a contrast-enhanced CT show large feces that distend the cecum and ascending colon (arrow) due to a stricture at the hepatic flexure (circle). The stricture is due to post-surgical fibrosis that developed between the colon and the site of a prior cholecystectomy (circle).

especially those with chronic diseases, are at the highest risk for development of stercoral colitis [3, 13–15]. Signs and symptoms of stercoral colitis are not specific; however, the most common complaints are constipation and pain [3, 13, 14]. Serologic tests and physical examination are also not specific [3, 13, 14].

The pathophysiology of stercoral colitis begins with constipation. Chronic constipation, without treatment or intervention, may lead to fecal impaction and fecaloma formation [3, 13, 14, 20]. A fecaloma is dehydrated, compacted feces. Impacted feces and fecalomas exert pressure upon the walls of the colon and rectum that in turn impairs vascular perfusion [3, 13, 14, 20]. Hypoperfusion leads to ischemia, infarction, and necrosis of the colon and rectum with consequent perforation [3, 13, 14]. The sigmoid colon is the most common site because: (1) it is the narrowest point in the colon, thereby impeding the transit of dehydrated feces and (2) the rectosigmoid vascular watershed region, known as Sudeck's point, is susceptible to ischemia [3, 13, 14].

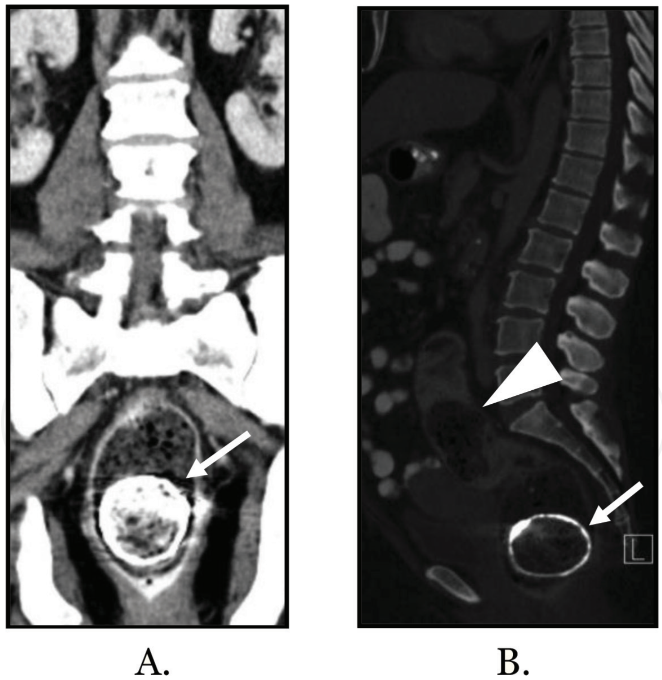


Figure 16.
(A and B) Coronal and sagittal contrast-enhanced CT images of a patient with constipation show fecal impaction in a dilated colon and rectum (arrowhead) with a large, rim-calcified fecaloma (arrow) that causes stercoral colitis.

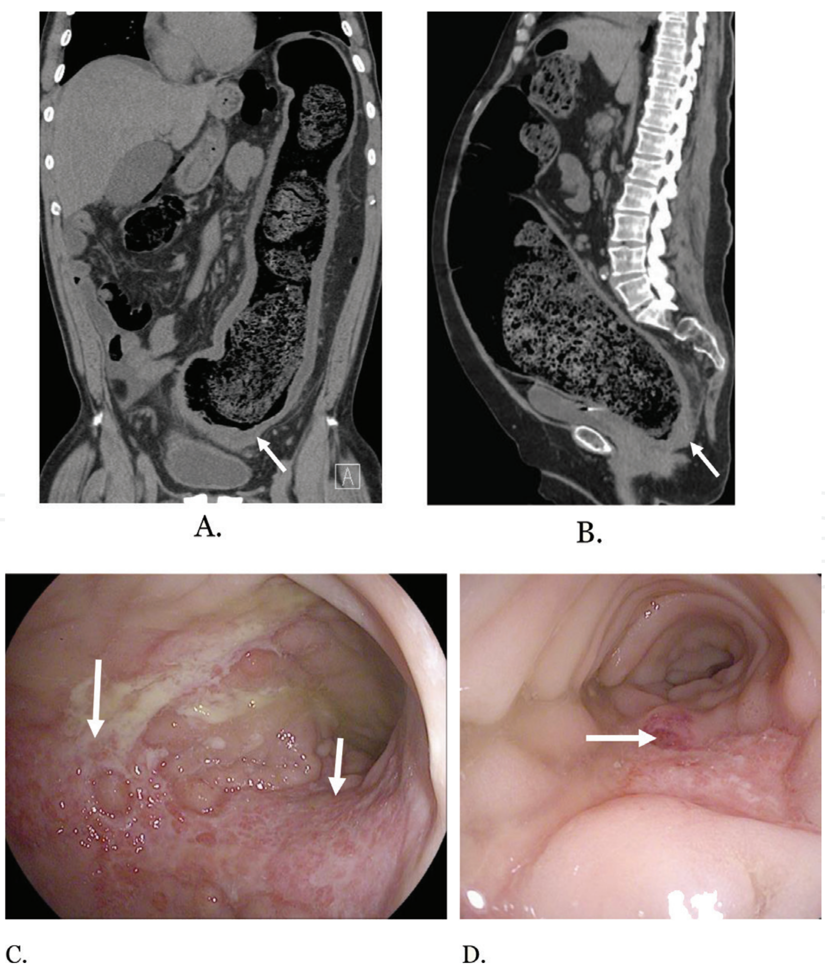
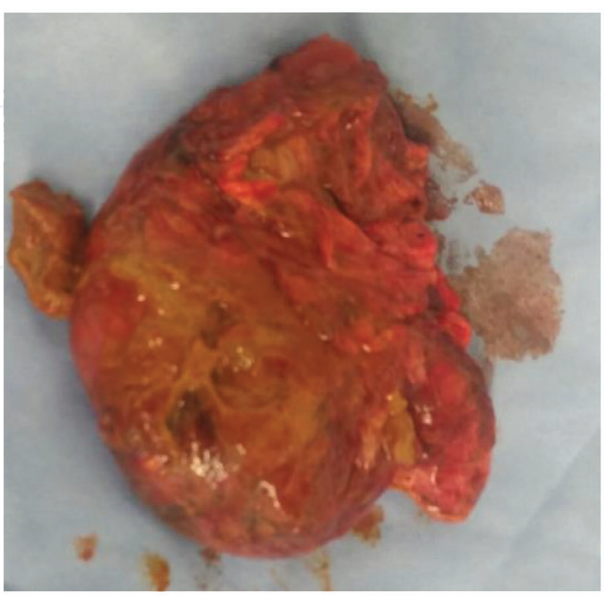


Figure 17.
(A and B) Sagittal and axial non-contrast CT images of a patient with severe abdominal distention and constipation show a dilated colon with a large volume of feces and concentric wall thickening (arrows), indicative of stercoral colitis. (C and D) The majority of the fecaloma was removed in a piecemeal fashion with irrigation and retrieval devices. Images from the colonoscopy show friable, dusky, and erythematous mucosa (arrows), consistent with stercoral colitis and ischemia.

Radiography can detect fecal impaction and fecalomas in the colon and rectum however provides no sensitive or specific findings of stercoral colitis [3, 13, 14]. CT is diagnostic of stercoral colitis and its complications and can also exclude alternative causes of pain [3, 13–15]. The finding that is present in all patients with stercoral colitis is a fecaloma (**Figure 16A** and **B**) [3, 13–15]. Proximal to the fecaloma, the colon may or may not be dilated. The walls of the colon and rectum are asymmetrically thickened to greater than 0.3 cm and my have increased attenuation due to ischemic hemorrhage (**Figure 17A–D**) [3, 13, 14]. Extra-colorectal findings are inflammatory stranding of the fat that surrounds the colon and rectum and extra-luminal air, which is indicative of a perforation (**Figure 18A–C**) [3, 13]. Complications of stercoral colitis are perforation, abscess, peritonitis, sepsis, and death; mortality has been reported to approach nearly 50% [3, 13–15].

A.

B.



C.

Figure 18.
(A and B) Sagittal and axial contrast-enhanced CT images show fecal impaction of the cecum with asymmetric wall thickening (arrowheads) and extraluminal air (arrow) adjacent to a thinned segment of the cecal wall and throughout the peritoneum (arrow), consistent with a perforation. (C) Gross surgical specimen of the resected and perforated cecum, which is filled with feces.

6. Conclusions

The clinical presentation of a patient with constipation will help govern if imaging is warranted and what is the most appropriate exam to order. Identification of the specific etiologies and associated complications of constipation is facilitated by both anatomic and functional imaging which range from basic radiography to MR imaging. Understanding what information each imaging modality can provide is of paramount importance to order the appropriate test, make an accurate diagnosis, and guide the appropriate management.

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Conflict of interest

The author declares no conflict of interest.

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References

[1] Jaffe T, Thompson W. Large bowel obstruction in the adult: Classic radiographic and CT findings, etiology, and mimics. Radiology. 2015;**275**(3):651-663

[2] Ferguson CC, Gray MP, Diaz M, Boyd KP. Reducing unnecessary imaging for patients with constipation in the pediatric emergency department. Pediatrics. 2017;**140**(1):e1-e7

[3] Saksonov M, Bachar GN, Morgenstern S, et al. Stercoral colitis: A lethal disease-computed tomographic findings and clinical characteristic. Journal of Computer Assisted Tomography. 2014;**38**(5):721-726

[4] Lin HC, Prather C, Fisher RS, et al. Measurement of gastrointestinal transit. Digestive Diseases and Sciences. 2005;**50**(6):989-1004

[5] Sawai RS. Management of colonic obstruction: A review. Clinics of Colon and Rectal Surgery. 2012;**25**(4):200-203

[6] Drozdz W, Budzynski P. Change in mechanical bowel obstruction demographic and etiological patterns during the past century: Observations from one health care institution. Archives of Surgery. 2012;**147**(2):175-180

[7] O'Donovan AN, Habra G, Somers S, et al. Diagnosis of Hirschsprung's disease. AJR: American Journal of Roentgenology. 1996;**167**(2):517-520

[8] Taourel P, Kessler N, Lesnik A, et al. Helical CT of large bowel obstruction. Abdominal Imaging. 2003;**28**(2):267-275

[9] Hassan HH, Elnekiedy AM, Elshazly WG, Naguib NN. Modified MR defecography without rectal filling in obstructed defecation syndrome: Initial experience. European Journal of Radiology. 2016;**85**(9):1673-1681

[10] Karasick S, Karasick D, Karasick SR. Functional disorders of the anus and rectum: Findings on defecography. AJR: American Journal of Roentgenology. 1993;**160**(4):777-782

[11] Colaiacomo MC, Masselli G, Polettini E, et al. Dynamic MR imaging of the pelvic floor: A pictorial review. Radiographics. 2009;**29**(3):e35

[12] Law YM, Fielding JR. MRI of pelvic floor dysfunction: Review. AJR: American Journal of Roentgenology. 2008;**191**(6 Suppl):S45-S53

[13] Wu CH, Wang LJ, Wong YC, et al. Necrotic stercoral colitis: Importance of computed tomography findings. World Journal of Gastroenterology. 2011;**17**(3):379-384

[14] Heffernan C, Pachter HL, Megibow AJ, Macari M. Stercoral colitis leading to fatal peritonitis: CT findings. AJR: American Journal of Roentgenology. 2005;**184**(4):1189-1193

[15] Somwaru AS, Philips S. Imaging of uncommon causes of large-bowel obstruction. AJR: American Journal of Roentgenology. 2017;**209**(5):W277-W286

[16] Filippone A, Ambrosini R, Fuschi M, et al. Preoperative T and N staging of colorectal cancer: Accuracy of contrast-enhanced multi-detector row CT colonography-initial experience. Radiology. 2004;**231**(1):83-90

[17] Cappell MS, Batke M. Mechanical obstruction of the small bowel and colon. Medical Clinics of North America. 2008;**92**(3):575-597

[18] Gryspeerdt S, Lefere P. Chronic diverticulitis vs. colorectal cancer: Findings on CT colonography. Abdominal Imaging. 2012;**37**(6):1101-1109

[19] Punwani S, Rodriguez-Justo M, Bainbridge A, et al. Mural inflammation in Crohn disease: Location-matched histologic validation of MR imaging features. Radiology. 2009;**252**(3):712-720

[20] Fagelman D, Warhit JM, Reiter JD, Geiss AC. CT diagnosis of fecaloma. Journal of Computer Assisted Tomography. 1984;**8**(3):559-561