

Chapter 6: The lower gastrointestinal tract

This chapter covers:

Common conditions

- Appendicitis
- Colonic obstruction
- Diverticular disease
- Neoplasia: polyp, carcinoma
- Sepsis
- Colitis
- Volvulus

Common presentations in which imaging can help

- Altered bowel habit: obstruction, carcinoma, diverticular disease
- Acute abdominal distension: obstruction
- Acute abdominal pain: obstruction, colitis, diverticulitis
- Rectal bleeding: carcinoma, diverticular disease, colitis

Look for hepatomegaly or an abdominal mass on clinical examination.

Patients should undergo perianal and rectal examination at presentation. This task is often delegated to the house officer. If you are unsure, ask for help from a senior colleague.

Imaging strategy

Initial imaging in acute presentations usually involves a supine AXR and an erect CXR. CXR may demonstrate free intraperitoneal air beneath the diaphragm (see Chapter 5), and many patients who are acutely ill may have evidence of chest sepsis or cardiac failure

also. Supine AXR will give information concerning small and large bowel gas pattern, free intraperitoneal air, soft tissues and bony structures.

Once initial clinical assessment has been made and a working diagnosis formulated, many patients will require further imaging. Discuss the case with the radiologist to identify the best way (including endoscopy) to reach a diagnosis.

US

US in colorectal disease can be helpful for initial assessment of:

- Possible bowel-related mass
- Free fluid or abscess formation
- Solid organs.

By their nature, many pathologies of the colon are associated with significant bowel gas and when combined with an elderly, immobile or obese patient the use of US may be limited.

CT

CT can provide significant additional diagnostic information in patients with bowel-related masses and suspected inflammatory disease or malignancy. CT is increasingly being used as an early investigation in the elderly and frail to avoid rectal contrast studies.

Contrast enema

This is an essential tool for evaluation of

the rectum and colon (combined with endoscopy).

Unprepared contrast enema, usually using water-soluble iodinated contrast, may be used to exclude an obstructing lesion in patients with large bowel obstruction. Mucosal detail is poor and, if the study is negative, follow-up barium enema or colonoscopy is often needed.

Contrast enema should not be performed in patients at risk of perforation (e.g. toxic megacolon). Barium causes peritonitis if it extravasates outside the bowel and should not be used in patients who may have perforation or where recent deep biopsies have been performed. Water-soluble contrast should be used.

Maximum diagnostic information is obtained using the double-contrast technique (air and barium) with good bowel preparation. However, a significant number of elderly patients cannot retain air and/or barium and may be immobile. In some of these patients, CT may be used to exclude a gross mass lesion.

MR

MR has a role in staging colorectal carcinoma, but its use is currently limited otherwise.

NM

This has a limited role, but it can be used to assess the extent of inflammatory colitis.

Appendicitis

This is the most common surgical emergency, with a peak incidence in the second and third decades.

The classic signs of appendicitis are absent in up to one-third of patients and there is a significant rate of clinical misdiagnosis.

Imaging may be particularly helpful in:

- The elderly, where symptoms and signs may be minimal
- Children, where history and examination are often difficult
- Young women who may have a gynaecological cause for pain.

Accurate and appropriate imaging reduces the number of normal laparotomies and will help to exclude other causes of appendix-type pain. However, imaging is often not needed following clinical assessment.

AXR

Look for:

- Laminated calcified appendicolith (10–15% of patients)
- Evidence of ileus, often localized to the right iliac fossa
- Distortion of psoas margin
- Bubbles of air in associated appendix abscess.

US

This represents a non-invasive modality for assessment of atypical patients. US is most accurate in children and young and/or pregnant women, where the appendix is not obscured by gas. US features of appendicitis include identification of the appendix as an abnormal, thick-walled and non-compressible structure with a distended lumen (Fig. 6.1). An appendicolith or associated abscess formation may also be seen.



Fig. 6.1 Transverse ultrasound section of the appendix in a patient with appendicitis. The appendix has a thickened wall (callipers) with a dilated lumen (arrow) and a target appearance.

CT

CT is highly accurate in the evaluation of appendix inflammation and local extent. It is the technique of choice in the elderly, obese or very tender patients or where US has been unhelpful and clinical concern persists.

Barium studies

Barium studies of small or large bowel may be helpful in some patients where initial US or CT have indicated bowel pathology not clearly related to the appendix.

Colonic obstruction

The major causes of large bowel obstruction are carcinoma, diverticular disease and volvulus. Carcinoma, most commonly within the sigmoid, accounts for >50% of cases. Symptoms are of abdominal distension and pain with associated vomiting. A mass may be palpable.

The integrity of the ileocaecal valve is important. If it is competent, this prevents passage of air into the small bowel if the large bowel is obstructed, leading to rapid and pronounced colonic and caecal dilatation, with the risk of ischaemia and perforation. An incompetent ileocaecal valve allows colonic decompression, with passage of air into

the small bowel. Onset of symptoms may then be more gradual.

AXR

On supine AXR, look for:

- Dilated gas-filled colon proximal to the site of obstruction (Fig. 6.2)
- Paucity of gas in collapsed colon distal to the obstruction
- Haustral pattern to differentiate from small bowel



Fig. 6.2 Supine AXR in a patient with large bowel obstruction secondary to sigmoid carcinoma. There is gaseous distension of the large bowel down to the level of obstruction (arrow).

- Small bowel dilatation also if ileocaecal valve incompetent
- Evidence of perforation.

If large bowel obstruction is diagnosed, rectal and sigmoidoscopic examination should be performed to exclude a low obstructing lesion. If negative, the patient should be considered for contrast enema examination of the large bowel.

CXR

On erect CXR, look for evidence of free intraperitoneal air, lung metastases and other pathology.

Contrast enema

Although barium is the ideal agent, it can cause problems. It is contraindicated in patients at risk of perforation and can cause impaction if no obstruction is present, as well as interfering with future colonoscopy and CT (see Chapter 2). Iodinated contrast (water-soluble) is often used and will exclude gross obstruction (Fig. 6.3).

CT

This can be useful in assessing bowel and adjacent structures, particularly if patients are elderly or frail and cannot tolerate a contrast enema.

Pseudo-obstruction

Marked dilatation of the large bowel may occur in elderly, bedridden patients or those with neurological or psychiatric disorders. Gaseous distension often involves the rectum also, and faecal loading may be present. Sigmoidoscopy and contrast enema are often needed to

exclude a mechanical obstruction in patients who do not settle with conservative treatment.

Diverticular disease of the colon

This is the most common colonic disease in the West, with diverticula present in up to 50% of people of 50 years of age, with the sigmoid colon most frequently involved. Diverticula are out-pouchings of colonic mucosa and submucosa that penetrate between circular muscle fibres. Circular muscle hypertrophy and muscular spasm are common. Diverticular disease is generally diagnosed during barium enema examination, often as an incidental finding (Fig. 6.4). Complications of diverticular disease include diverticulitis, fistula formation and haemorrhage.

Diverticulitis

Diverticulitis is the most common complication of diverticular disease, occurring in up to 25% of patients. It occurs secondary to mucosal abrasion by faecal matter within a diverticulum, causing local perforation, inflammation and abscess formation. Patients present with left iliac fossa pain, fever and often an inflammatory mass.

AXR

AXR may demonstrate air within an abscess or secondary ileus. Chronic inflammation and stricturing with large bowel obstruction is unusual.

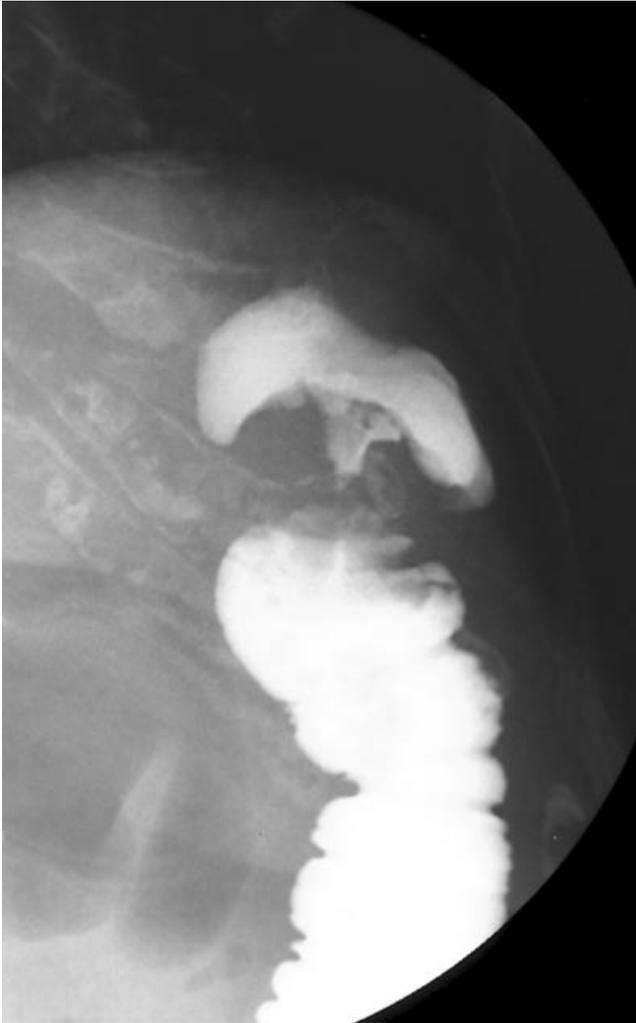


Fig. 6.3 Water-soluble contrast enema film from splenic flexure region shows an obstructing carcinoma. Note 'apple core' appearance of stricture with shouldering.



Fig. 6.4 Film from double-contrast barium enema series showing florid sigmoid diverticular disease. Note diverticula and circular muscle hypertrophy. The sigmoid colon is tortuous and is an area of weakness for barium enema—mucosal lesions can easily be overlooked. Another problem here is the presence of significant small bowel reflux of barium, which partially obscures the sigmoid region.

Barium enema

This is excellent at demonstrating diverticular colonic muscular hypertrophy and spasm, and local contrast extravasation into walled-off pericolic abscess. Patients often do not tolerate barium enema during an acute episode, and enema does not delineate pericolic inflammation.

US

US is often requested as a first-line

investigation for patients with left iliac fossa pain and may demonstrate bowel-wall thickening, a mass or fluid collection in diverticulitis. However, US is often non-diagnostic.

CT

Patients often proceed to CT, which accurately delineates diverticula, bowel-wall thickening, pericolic inflammatory change and abscess formation (Fig. 6.5), and will guide aspiration or drainage of abscess.



Fig. 6.5 Post-contrast CT demonstrates a sigmoid colon diverticular abscess. There is an irregular mass containing fluid and air (long arrow). Thick-walled sigmoid colon abuts the abscess (short arrow).

Note:

It is important to remember that perforated carcinoma can mimic diverticulitis, and once the acute episode has settled, patients should undergo endoscopic examination.

Fistula formation

A fistula is a communication between two surfaces lined by epithelium. A colovesical fistula is the commonest type of indiverticular disease and is secondary to recurrent inflammation—these patients present with pneumaturia. Air in the bladder may be apparent on AXR. The fistula can be demarcated during barium enema. CT is very sensitive at detecting air in the bladder, with

associated changes in the sigmoid colon. Coloenteric (Fig. 6.6), colovaginal and colcutaneous fistulae may also occur.

Remember that fistula formation also occurs with malignancy and this should be excluded.

Haemorrhage

This is not related to diverticulitis. It occurs in 30–50% of patients with diverticular disease and may be life-threatening. Haemorrhage is usually self-limiting, but re-bleeding is common.

Barium enema or colonoscopy is indicated if bleeding is to be investigated as an outpatient. Catastrophic haemorrhage may require angiography to iden-

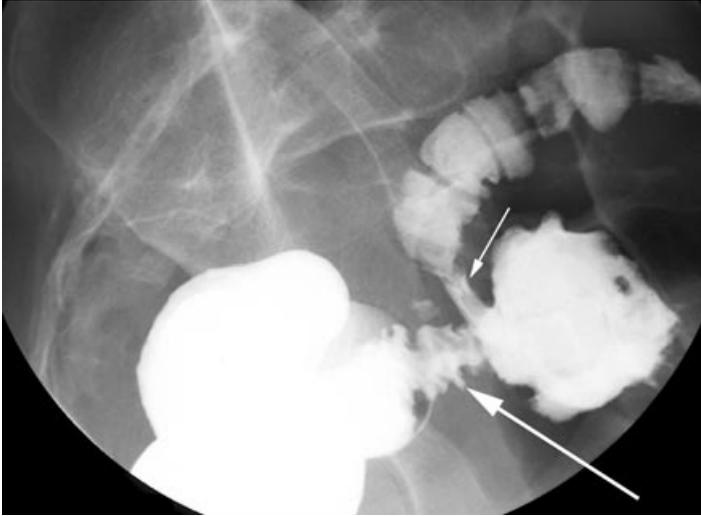


Fig. 6.6 Film from a single-contrast barium enema in the sigmoid region. There is irregular narrowing in the mid-sigmoid region (long arrow) with adjacent diverticular disease. Contrast passes via a fistula (short arrow) to communicate with small bowel. This was secondary to diverticular disease, but exclusion of malignancy is essential.

tify the site and to allow potential embolization of the bleeding vessel.

Colorectal carcinoma

Colorectal carcinoma is the second most common cause of cancer death. Risk factors include family history, adenomatous polyposis syndromes, chronic ulcerative colitis and Crohn's disease. The vast majority of colorectal carcinomas begin as benign adenomas, which grow over time and undergo malignant transformation. Adenomas of >1 cm are at risk and >2 cm malignancy is likely

(50%). Fifty per cent of carcinomas are in the rectum or sigmoid and in range of the flexible sigmoidoscope.

Patients with a colorectal carcinoma are at risk of synchronous (carcinoma elsewhere in large bowel) and metachronous (colonic carcinoma at a later date) lesions and it is important to evaluate the entire colon at the time of diagnosis.

Polyp detection

Clearly, polyp detection and removal prior to malignant change is essential for prevention of colorectal carcinoma, although large-scale population screening

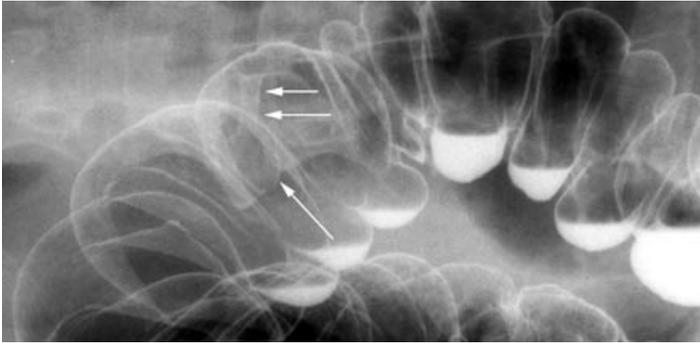


Fig. 6.7 Decubitus spot film of the hepatic flexure from a double-contrast barium enema series demonstrates a pedunculated polyp on a stalk (arrows). Note gravitational pooling of barium.

is still under investigation. Several imaging modalities are available; all have strengths and weaknesses. Colonoscopy is often preferred.

Barium enema

Double-contrast barium enema is highly accurate and comparable to colonoscopy in the identification of polyps >1 cm. This accuracy falls off <1 cm in size. Completion rate to the caecum is better with barium enema. Diagnostic accuracy is impaired:

- With poor bowel preparation
- If patients cannot retain air or barium
- With tortuosity of the bowel, especially in the sigmoid
- With extensive associated diverticular disease
- The lower rectum is often not well seen, particularly if a balloon catheter is used.

Adenomatous polyps may be:

- *Pedunculated* (on a stalk): where risk of malignancy is low (Fig. 6.7)
- *Sessile* (flat): villous change and malignancy is more likely (Fig. 6.8).

Colonoscopy

Endoscopic assessment of the colon allows identification and also removal of polyps. This modality is theoretically the ideal, but does have the complications of sedation and perforation, and technical failure is common, for similar reasons, to barium enema.

CT colonography

This three-dimensional virtual-reality CT technique, following air insufflation of the colon, has shown initial promising results.

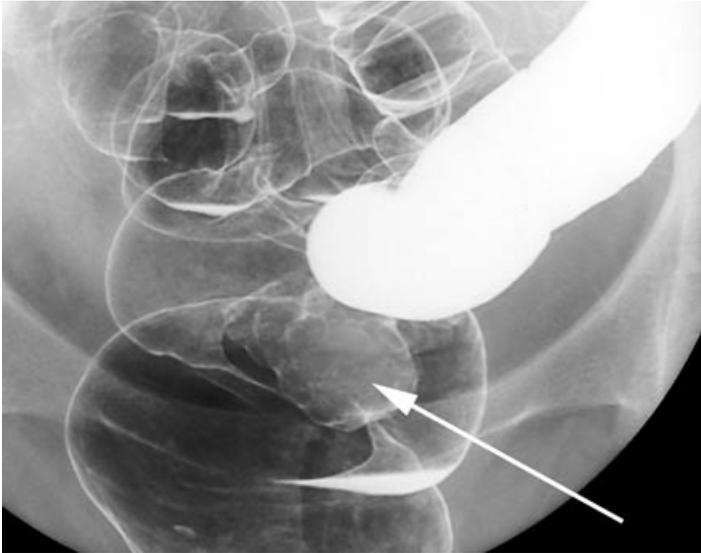


Fig. 6.8 Film from double-contrast barium enema demonstrates a large sessile polyp in the upper rectum (arrow). The surface of the polyp is irregular and, when combined with the size, malignancy is likely.

Adenocarcinoma

This may be diagnosed by the three modalities outlined above—again, colonoscopy offers the opportunity for histological examination.

Barium enema

Look for:

- Fungating, polypoid lesion
- Annular, ulcerating—‘apple core’ with shouldering (Fig. 6.9)
- Scirrhus lesion (uncommon).

CT

CT is useful for identifying primary tumour and is the most reliable method for staging:

- Luminal mass and bowel wall thickening (Fig. 6.10)
- Stranding and nodularity of adjacent fat—may indicate local invasion
- Invasion of local structures
- Presence of mesenteric disease, ascites, significant adenopathy
- Liver and lung metastases.



Fig. 6.9 Film from double-contrast barium enema in a patient with a large transverse colon carcinoma (large arrow). There is irregular stricturing of the bowel with shouldering apparent. Note lung metastases at lung bases (small arrows).

US

Transabdominal US can identify bowel-related masses and will assess the liver parenchyma for metastases.

Transrectal US and MRI accurately delineate the layers of the rectal wall and are useful for local staging of disease. Bulky and locally invasive rectal carcinomas will receive local radiotherapy prior to surgery.

Local complications of colorectal carcinoma

- *Obstruction*: this is common (see earlier). In patients unfit for immediate

surgery, radiological insertion of an expanding metallic stent over a guidewire can relieve obstruction, giving palliation. Surgery can be considered when the patient's condition has improved.

- *Fistula formation* (see earlier)
- *Perforation*: patients may go straight to theatre for surgery.

Follow-up of treated colorectal cancer

Residual large bowel post-resection is followed-up regularly, either endoscopically or by barium enema.

CT is the modality currently of choice for identifying extraluminal local recur-



Fig. 6.10 Post-contrast CT in a patient with caecal carcinoma. There is marked thickening of the caecal wall (arrows).

rence or metastatic disease and is also used to monitor patients with known metastatic disease undergoing treatment.

Hepatic metastases may be considered for ablation or resection (see Chapter 7).

Abdominal sepsis

Sepsis in the abdomen is a very important cause of patient mortality, morbidity and increased length of hospital stay. Cases are often complex and great benefit may be obtained through direct discussion with a radiologist.

This section concentrates on intraperitoneal, subphrenic, psoas and pelvic abscess formation. Diverticular,

pancreatic and hepatic abscesses are covered elsewhere.

Intraperitoneal abscess

Usually results from secondary infection of collections of blood, bile or ascites and may arise in patients who have undergone bowel or hepatobiliary surgery. If patients have pyrexia or a raised white cell count only, with no significant abdominal symptoms, make sure there is no evidence of chest, urinary or skin sepsis (e.g. infected cannula) prior to further investigations.

AXR

AXR may show an ileus or mottled

gas densities within an intraperitoneal abscess and is worth arranging if there are abdominal symptoms.

US

US is the next investigation of choice for the identification of abdominal and pelvic fluid collections. Bandaging, suturing, pain, obesity and gas often degrade US; CT would then be recommended.

Percutaneous drainage under US or CT guidance can be performed in post-operative abscess formation.

Subphrenic abscess

This usually follows bowel surgery or appendectomy.

AXR

AXR may show mottled gas densities in abscess but air–fluid level and sympathetic pleural effusion is best appreciated on erect CXR (Fig. 6.11).

US and CT

US or CT will confirm diagnosis if necessary.



Fig. 6.11 Erect CXR demonstrates a large right subphrenic abscess post-cholecystectomy. Note air–fluid level (arrows) and right basal pleural effusion.

Psoas abscess

Psoas abscess often relates to adjacent vertebral, bowel or renal sepsis. Look for evidence clinically of psoas irritation and painful hip flexion.

AXR

AXR may show psoas enlargement and abnormal gas densities. Look carefully for renal tract calcification and vertebral body abnormality (tuberculous or metastatic bony involvement).

US and CT

US is often limited in evaluation of the retroperitoneum and CT is the ideal modality for psoas assessment and abscess drainage (Fig. 6.12).

Colitis

The three most common forms of colitis are dealt with here: ulcerative, Crohn's and ischaemic.

Ulcerative colitis

This is a common inflammatory disease of the colon and rectum of uncertain aetiology, which initially involves the bowel mucosa but extends to involve deeper layers. The disease usually commences in the rectum and extends proximally, with the diagnosis made on sigmoidoscopic biopsy. The terminal ileum may be involved ('backwash ileitis').

Ulcerative colitis runs a variable clinical course—usually with periods of



Fig. 6.12 CT of left psoas abscess secondary to renal calculus disease. A large septated fluid collection involves the left psoas and iliacus muscles (long arrow). Note normal right psoas muscle (short arrow).

relapse and remission, although an acute and fulminant illness may occur. Extracolonic manifestations are recognised (e.g. arthritis, iritis, rash) in 10%.

AXR

Look for:

- Extent of faecal residue—where it is absent this is suggestive of colitic involvement
- Bowel wall thickening
- Colon diameter (>6 cm in transverse colon suspicious of toxic megacolon). Colon narrows in chronic disease
- Loss of haustration or mural thickening
- Evidence of perforation.

Barium enema

This is a useful investigation in ulcerative colitis. It is used to assess disease extent, to differentiate ulcerative colitis from other forms of colitis and to detect disease complications (e.g. malignancy).

Barium enema features of ulcerative colitis

Acute changes

Granular mucosa pattern
 ‘Collar-stud’ ulcers (shallow ulceration underlying mucosa)
 Haustral thickening (‘thumb-printing’)
 Inflammatory polyps

Chronic changes (Fig. 6.13)

Haustral loss
 Colon shortening
 Luminal narrowing (‘lead-pipe’ colon)

Postinflammatory polyps Terminal ileitis

Complications of ulcerative colitis

- *Toxic megacolon*: an acute fulminant illness with colonic dilatation (>6 cm) and high risk of perforation. It carries a high mortality. Toxic megacolon can be diagnosed on AXR (Fig. 6.14). Contrast enema should not be performed because of the risk of perforation.
- *Colonic adenocarcinoma*: annual incidence of 10% after first decade of the disease. Carcinomas are often multiple and flat, and scirrhous in nature (Fig. 6.13). Patients with ulcerative colitis should undergo regular colonoscopic screening with random biopsies to detect dysplasia.

Crohn’s colitis (see Chapter 5)

This is a granulomatous colitis particularly involving the right colon, with sparing of rectum and sigmoid colon. However, perianal disease (abscess, fistula, ulceration) is strongly suggestive of Crohn’s.

AXR

Look for:

- Extent of faecal residue, bowel-wall thickening, haustral loss or thickening (Fig. 6.15)
- Also look for gallstones, sacroiliitis and avascular necrosis (femoral heads), which are associated with Crohn’s (and ulcerative colitis).



Fig. 6.13 Films from double-contrast barium enema in a patient with long-standing ulcerative colitis involving the colon around to the hepatic flexure. Note granular mucosa with colon lumen narrowed and haustral pattern absent. A complicating carcinoma is seen at the splenic flexure (arrow). Note normal haustral pattern in the right colon.

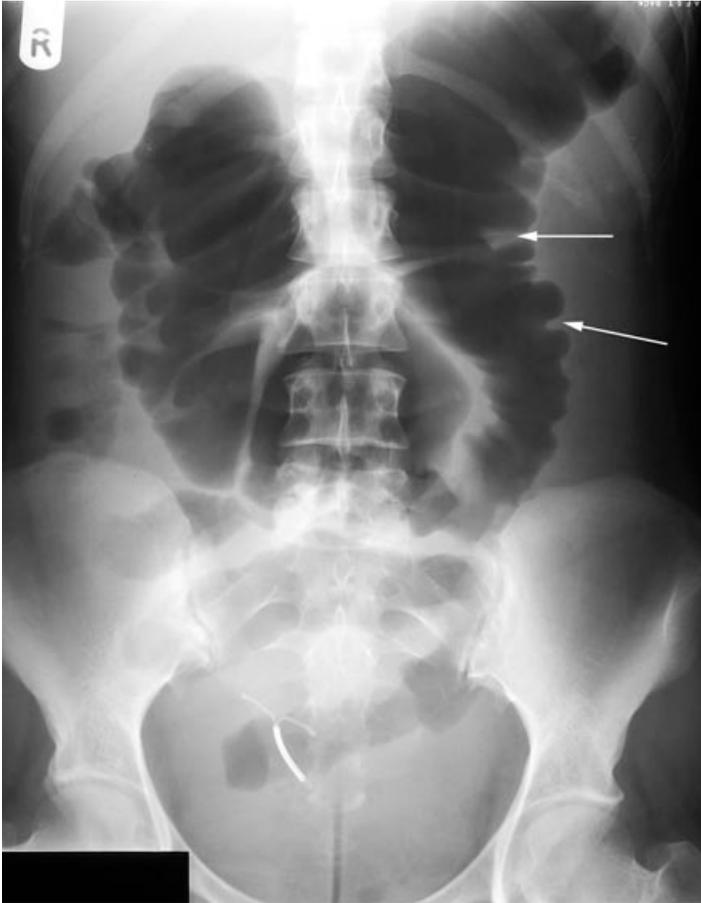


Fig. 6.14 AXR in a patient with ulcerative proctocolitis and toxic dilatation of the transverse colon. Note absence of faecal residue and thickening of haustra (arrows). There is a pelvic intrauterine contraceptive device (IUCD).



Fig. 6.15 AXR in a patient with Crohn's colitis. The transverse colon is narrowed and thumb-printing (mucosal oedema) is present (arrows).

Barium enema features of Crohn's colitis

Early

Nodular lymphoid hyperplasia
 Aphthous ulcers
 'Cobblestoning' resulting from longitudinal and transverse ulcers separated by oedema—ulcers are deep
 Thickened haustra
 Inflammatory pseudopolyps
 Discontinuous involvement ('skip lesions')

Late

Loss of haustration
 Strictures ('string' sign)
 Fistulae
 Pseudodiverticula

Complications of Crohn's colitis

- *Fistula*: enterocolic, enterocutaneous, perianal
- *Toxic megacolon*: less common than ulcerative colitis
- *Adenocarcinoma*: ileum and colon
- *Abscess formation*.

Ischaemic colitis

Patients present with acute abdominal pain and rectal bleeding, and ischaemic colitis tends to involve the splenic flexure and descending colon at the 'watershed' area of blood supply between superior and inferior mesenteric arteries. It is more common in the elderly with a history of cardiovascular disease.

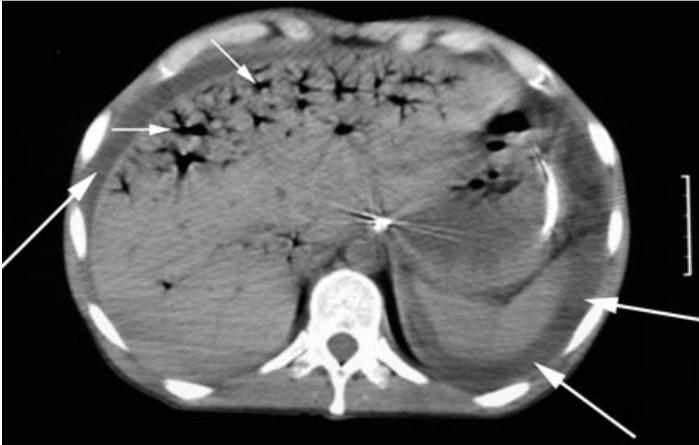


Fig. 6.16 Post-contrast CT in a severely ill patient with ischaemic colitis. Air is identified peripherally distributed within portal veins in the liver (small arrows). Ascites is present (large arrows).

AXR

AXR may show segmental mucosal oedema with thumb-printing. Diagnosis can be confirmed with barium enema.

CT

CT demonstrates segmental mural thickening, and also intramural and portal venous gas in severely ill patients (Fig. 6.16).

Caecal volvulus

Caecal volvulus accounts for 3% of colonic obstructions and is associated with malrotation of the right colon and a

long mesentery allowing the caecum to rotate so it lies in the mid-abdomen or, more commonly, the left upper quadrant.

AXR

AXR reveals a dilated gas-filled caecum in the left upper quadrant (Fig. 6.17). The medially placed ileocaecal valve may cause an indentation, giving a kidney or 'coffee-bean' appearance.

If the ileocaecal valve is incompetent, there will be coexisting small bowel dilatation. The normal caecal gas pattern is absent in the right iliac fossa.

A contrast enema is helpful if AXR is atypical, with the tapered end of the obstructed contrast column pointing toward the torsion.



Fig. 6.17 Supine AXR in a patient with caecal volvulus and an incompetent ileo-caecal valve. Note distended air-filled caecum in left upper quadrant (large arrow) and dilated small bowel loops (small arrows).

Sigmoid volvulus

This accounts for 1–2% of colonic obstructions and tends to occur in elderly or psychiatric patients with large redundant sigmoid colons.

Patients present with abdominal pain and distension.

AXR

On supine AXR, look for:

- Markedly dilated loop of sigmoid

colon extending into the upper abdomen, tapering to the left iliac fossa (Fig. 6.18)

- Often dilated large bowel proximally
- Absence of gas in the rectum.

A contrast enema may be required in some patients where radiographical findings are equivocal. This demonstrates a tapered narrowing of the contrast column at level of volvulus.

Once the diagnosis has been made, a flatus tube can be passed to decompress the sigmoid colon to allow patient stabilization prior to sigmoid colectomy.

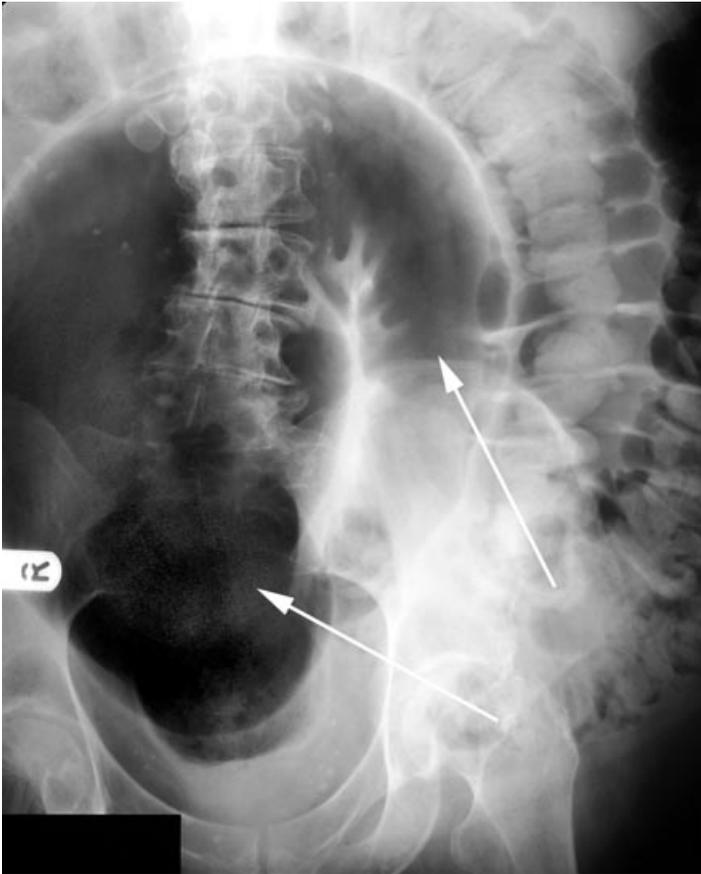


Fig. 6.18 Supine AXR in a patient with sigmoid volvulus. Note markedly dilated sigmoid colon (arrows) with 'inverted-U' configuration, converging to the left iliac fossa. Calcified gallstones are seen in the right upper quadrant.

Further reading

Gore RM, Levine MS, eds. *Textbook of Gastrointestinal Radiology*, 2nd edn. Philadelphia: Saunders, 2000.
Levine MS, Rubesin SE, Laufer I, eds.

Double Contrast Gastrointestinal Radiology, 3rd edn. Philadelphia: Saunders, 2000.
Miller FH, ed. *The Radiological Clinics of North America: Radiology of the Pancreas, Gall bladder and Biliary Tract*, Vol. 40. 2002.