MODERN RADIOLOGY eBook

# Large Bowel

ESR EUROPEAN SOCIETY OF RADIOLOGY

# Preface

*Modern Radiology* is a free educational resource for radiology published online by the European Society of Radiology (ESR). The title of this second, rebranded version reflects the novel didactic concept of the *ESR eBook* with its unique blend of text, images, and schematics in the form of succinct pages, supplemented by clinical imaging cases, Q&A sections and hyperlinks allowing to switch quickly between the different sections of organ-based and more technical chapters, summaries and references.

Its chapters are based on the contributions of over 100 recognised European experts, referring to both general technical and organ-based clinical imaging topics. The new graphical look showing Asklepios with fashionable glasses, symbolises the combination of classical medical teaching with contemporary style education.

Although the initial version of the *ESR eBook* was created to provide basic knowledge for medical students and teachers of undergraduate courses, it has gradually expanded its scope to include more advanced knowledge for readers who wish to 'dig deeper'. As a result, *Modern Radiology* covers also topics of the postgraduate levels of the *European Training Curriculum for Radiology*, thus addressing postgraduate educational needs of residents. In addition, it reflects feedback from medical professionals worldwide who wish to update their knowledge in specific areas of medical imaging and who have already appreciated the depth and clarity of the *ESR eBook* across the basic and more advanced educational levels.

I would like to express my heartfelt thanks to all authors who contributed their time and expertise to this voluntary, non-profit endeavour as well as Carlo Catalano, Andrea Laghi and András Palkó, who had the initial idea to create an *ESR eBook*, and - finally - to the ESR Office for their technical and administrative support.

*Modern Radiology* embodies a collaborative spirit and unwavering commitment to this fascinating medical discipline which is indispensable for modern patient care. I hope that this *educational* tool may encourage curiosity and critical thinking, contributing to the appreciation of the art and science of radiology across Europe and beyond.

**Minerva Becker,** Editor
Professor of Radiology, University of Geneva, Switzerland

## Large Bowel

**CHAPTER OUTLINE:**

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**CHAPTER OUTLINE:**

# Signage


**CORE KNOWLEDGE**


**FURTHER KNOWLEDGE**


**ATTENTION**


**COMPARE**


**QUESTIONS**


**HYPERLINKS**


**REFERENCES**

## Large **Bowel**

**CHAPTER OUTLINE:**

MODERN RADIOLOGY eBook

Based on the ESR Curriculum for Radiological Education

# Large Bowel

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**CHAPTER OUTLINE:**

# Chapter Outline

- Radiological Anatomy
- Radiological Investigations
- Acute Conditions
  - Perforation
  - Diverticulitis
  - Epiploic Appendagitis
  - Appendicitis
  - Volvulus
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  - Neutropenic Colitis
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  - Difficulty Initiating Evacuation
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- Take-Home Messages
- References and Further Reading
- Test Your Knowledge



**CHAPTER OUTLINE:**

# Radiological Anatomy

## Large Bowel

CHAPTER OUTLINE:

# / Anatomy

The **large bowel** is a muscular tube that is divided into the:

- caecum and appendix
- ascending colon
- hepatic flexure
- transverse colon
- splenic flexure
- descending colon
- sigmoid colon
- rectum
- anus

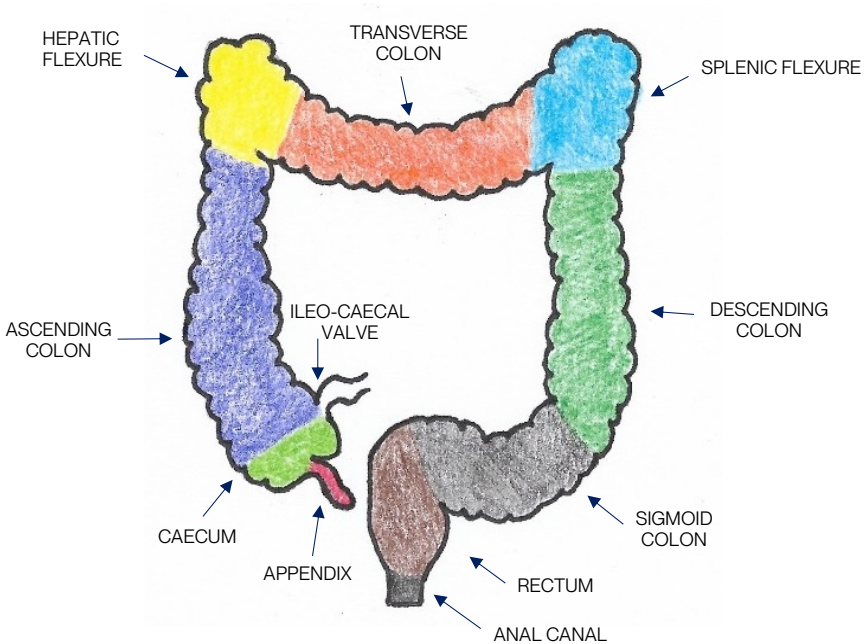



**FIGURE 1**

Schematic illustration of the large bowel.



**CHAPTER OUTLINE:**

The peritoneum is a continuous membrane that lines the abdominal cavity and abdominal organs. It consists of two layers that are continuous with each other: **the parietal and visceral peritoneum**.

The parietal peritoneum lines the inner surface of the abdominopelvic wall. The visceral peritoneum covers the majority of the abdominal viscera.

The **peritoneal cavity** is a potential space between the parietal and visceral peritoneum.

Intraperitoneal organs are lined by visceral peritoneum both anteriorly and posteriorly. The **caecum, appendix, transverse colon and sigmoid colon are intraperitoneal structures**.

Retroperitoneal organs lie posterior to the peritoneum and are only covered only by peritoneum anteriorly – **the ascending and descending colon are retroperitoneal structures and the rectum is extra-peritoneal**.

**Mesenteries** are double layers of peritoneum which attach the intestine to the posterior abdominal wall and allow blood vessels, nerve and lymphatics to supply the intestine. **The transverse and sigmoid colon** have mesenteries called the **transverse mesocolon** and **sigmoid mesocolon**.

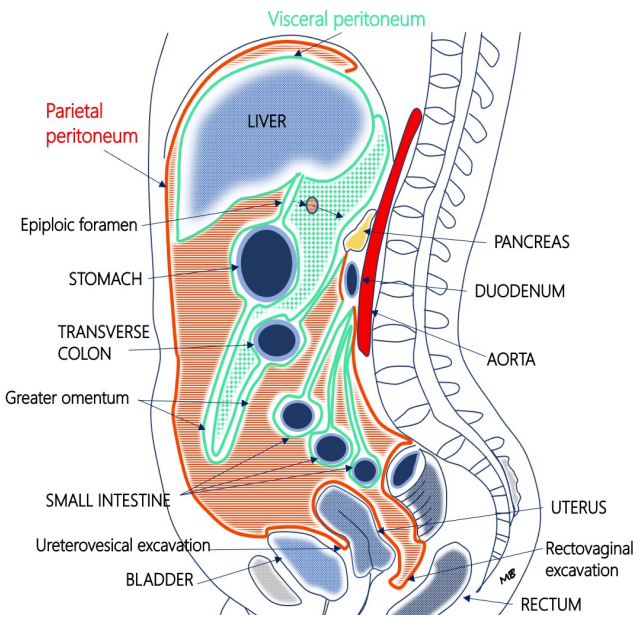



**FIGURE 2**

Schematic illustration of the peritoneum. Visceral peritoneum (**green**), parietal peritoneum (**red**). Main cavity (**red texture**), omental bursa (**green texture**).

## Large Bowel

**CHAPTER OUTLINE:**

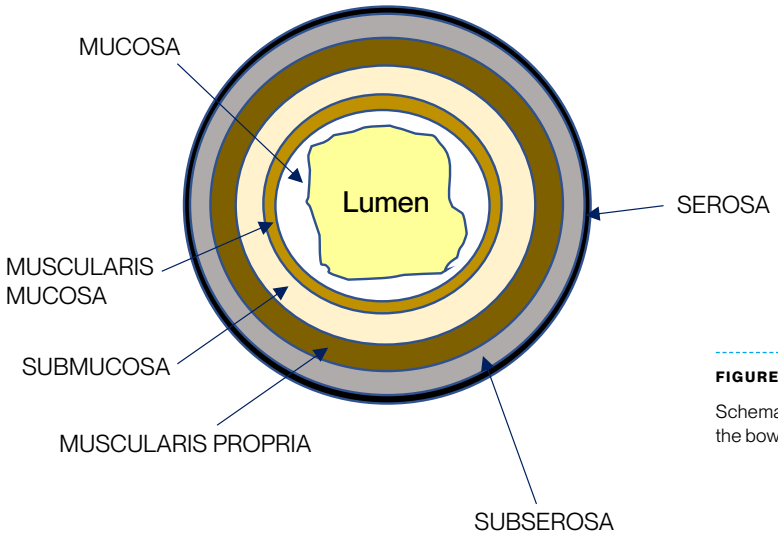



**FIGURE 3**

Schematic illustration of the bowel wall layers.

The **layers of bowel wall** are illustrated in the schematic diagram above.

The **mucosa** consists of epithelium, intestinal glands, the lamina propria and muscularis mucosa.

The **submucosa** consists of nerves, blood vessels and elastic fibers with collagen.

The **muscularis propria** consists of inner circular and outer longitudinal smooth muscle layers, with the myenteric (Auberbach) nerve plexus in between.

The outermost layer is the **serosa**. The serosa is a synonym for the **visceral peritoneum** and covers the intra-peritoneal transverse and sigmoid colon. The ascending and descending colon are retroperitoneal and the outer layer on their posterior surface is the **adventitia**.

The **superior mesenteric artery** supplies the colon proximal to the splenic flexure via the **ileocolic, right and mid-colic branches**. The distal colon is supplied by the **inferior mesenteric artery via the left colic, sigmoid and superior rectal artery branches**. The mid and inferior rectum are supplied via the **internal iliac artery**.

The **marginal artery of Drummond** is a vascular arcade running along the mesocolonic border formed by the terminal branches of the superior and inferior mesenteric arteries.

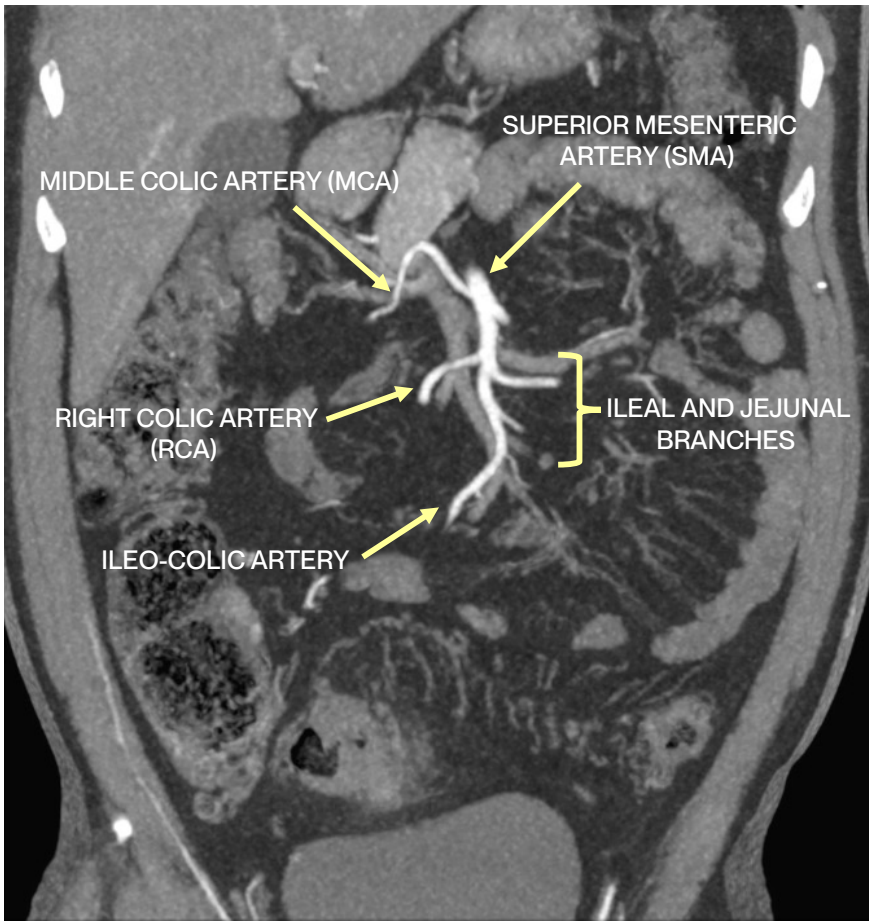



**FIGURE 4**

Coronal maximum intensity projection (MIP) image of a CT angiogram demonstrating the branches of the superior mesenteric artery.



**CHAPTER OUTLINE:**

The veins follow the arteries with the right colon draining into **the superior mesenteric vein** and the left colon into the **inferior mesenteric vein** which drains into **the portal vein**, via the splenic vein. The middle and inferior rectal veins drain into the **internal iliac vein**.

The **lymphatic drainage** of the colon also follows the course of the arteries, draining ultimately into the **coeliac nodes**. From the proximal rectum, lymph drains superiorly via superior rectal artery nodes to the inferior mesenteric chain, posteriorly by nodes around the median sacral artery and laterally around the middle rectal artery to the internal iliac chain.

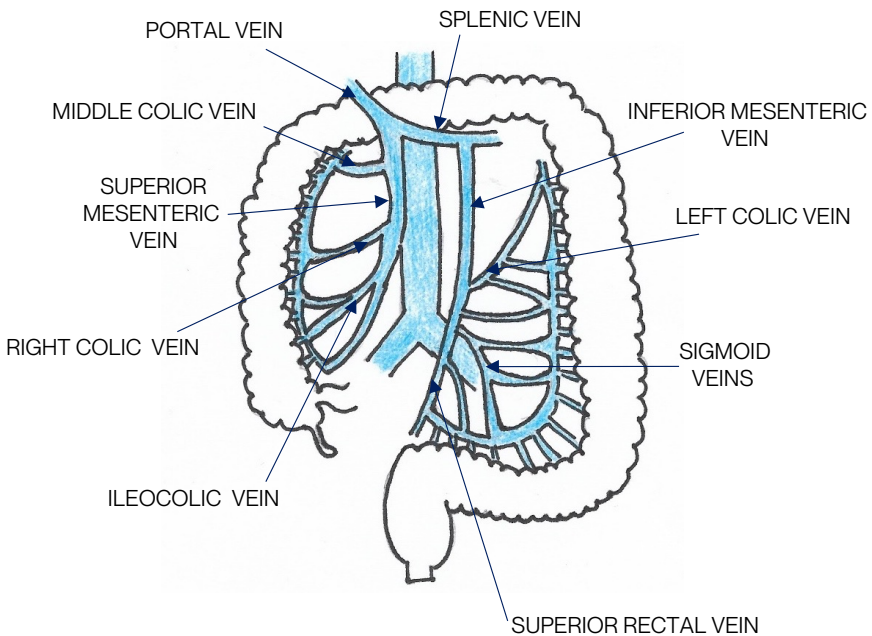



**FIGURE 5**

Schematic illustration of the venous drainage of the large bowel.



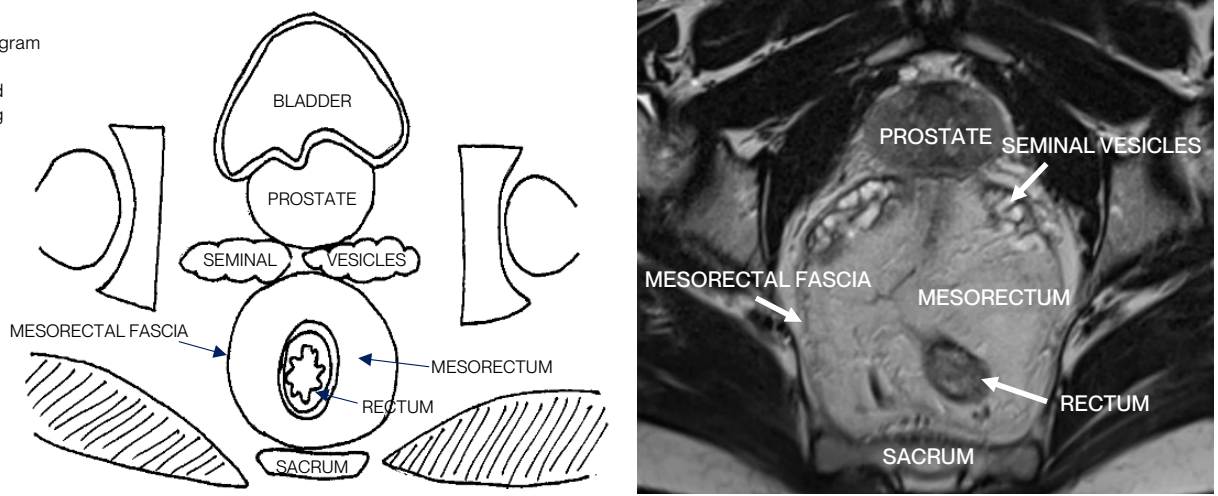
**CHAPTER OUTLINE:**

The **rectum** is defined as the distal 15 cm of large bowel proximal to the anus. Anteriorly the rectum is covered by peritoneum to the level of the junction of the upper two-thirds and lower one-third.

The lateral and posterior aspects of the upper rectum and all the lower one-third are surrounded by the **mesorectum**, which is composed of loose adipose connective tissue containing the small perirectal lymph nodes and the superior rectal vessels. The mesorectum itself is enclosed by the mesorectal fascia. Posteriorly the **mesorectal fascia** is separated from the presacral fascia by the thin retrorectal space; anteriorly it blends with the rectovesical (Denonvillier) fascia; superiorly it is contiguous with the sigmoid mesentery; and inferiorly it terminates close to the anus in the parietal fascia covering the levator ani.

**FIGURE 6**

Schematic diagram of the male pelvis (left) and corresponding T2-weighted MRI image (right) in the axial plane.




## Large Bowel

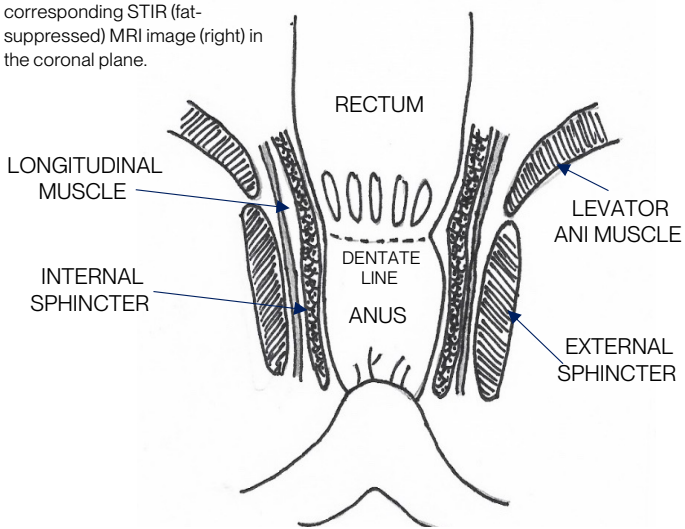
**CHAPTER OUTLINE:**

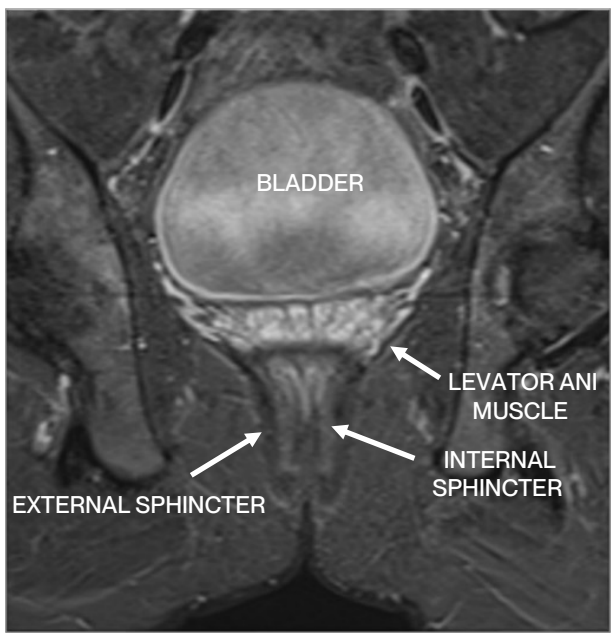
The anus has a complex sphincter arrangement with an **internal sphincter** comprised of smooth muscle (a continuation of the circular muscle of the distal rectum) and an **external sphincter** of striated muscle.

**Longitudinal muscle** lies between the internal and external sphincters, consisting of striated and smooth muscle with extensive fibroelastic tissue, which anchors the anus in position.

**FIGURE 7**

Schematic diagram of the anal sphincter anatomy (left) and corresponding STIR (fat-suppressed) MRI image (right) in the coronal plane.

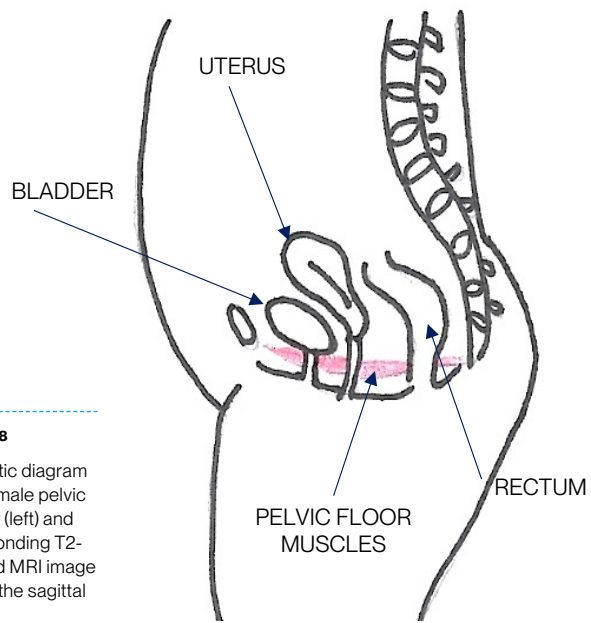





CHAPTER OUTLINE:

The **pelvic floor** consists of muscle and connective tissue that forms a 'sling' across the base of the pelvis. It consists of three contiguous supporting layers – the **endopelvic fascia**, the **muscular pelvic diaphragm** and the **urogenital diaphragm**. These support the pelvic floor organs and assist in urinary and faecal continence. The muscular pelvic floor consists mainly of the **levator ani complex** along with the **coccygeus** and **puborectalis** muscles.



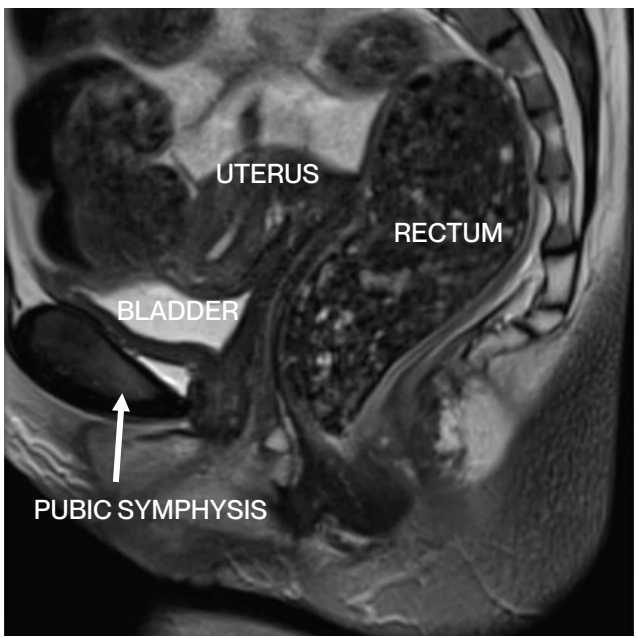




**FIGURE 8**

Schematic diagram of the female pelvic anatomy (left) and corresponding T2-weighted MRI image (right) in the sagittal plane.

## Large Bowel

**CHAPTER OUTLINE:**

On **normal plain radiographs**, the large bowel tends to be peripheral whereas the small bowel tends to be central. The large bowel has a larger caliber than the small bowel.

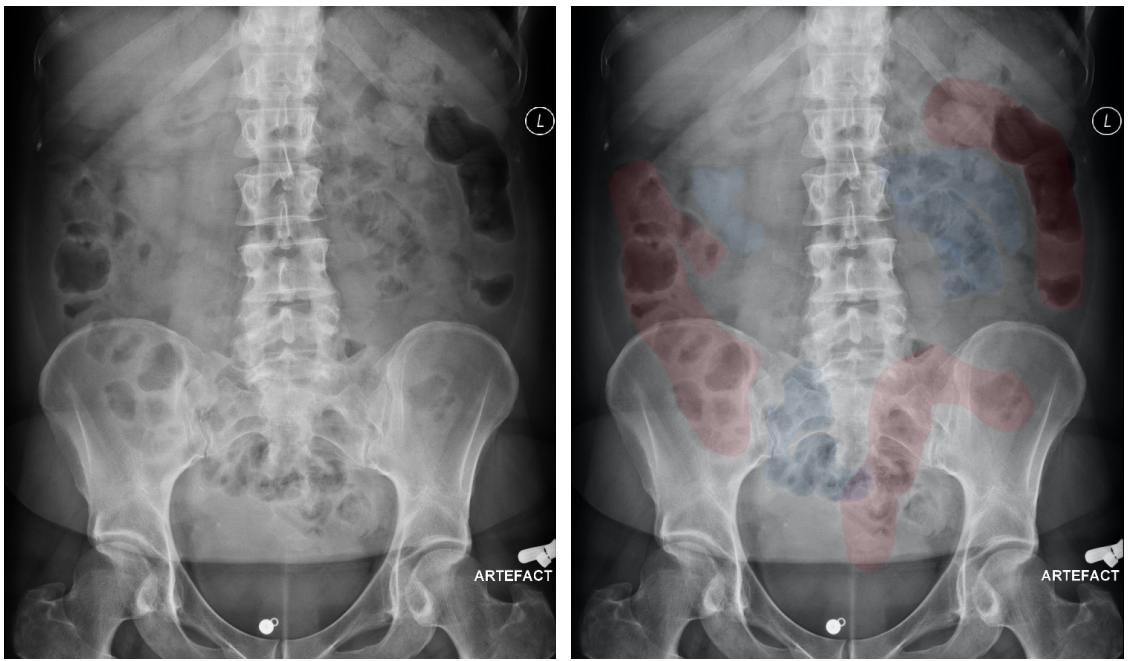



**FIGURE 9**

Normal bowel gas pattern as seen on an abdominal plain radiograph. Most often gas shadows are not continuous. The course of the large bowel (**red**) and of the small bowel (**blue**) is shown on the annotated image.

*Case courtesy of Dr Jeremy Jones, Radiopaedia.org, rID: 34068*

# Large Bowel

**CHAPTER OUTLINE:**

# Radiological Investigations

CHAPTER OUTLINE:

# / Imaging Modalities

**Plain radiographs** are quick and easily **accessible** and they have a modest radiation dose. They have a **limited role** in colonic disease due to their low sensitivity and low specificity. However, plain radiographs may be used as a first-line investigation in the context of volvulus, bowel obstruction and toxic megacolon.

The **standard projection** is the anterior-posterior (AP) supine view. The posterior-anterior (PA) erect view is additionally used to assess free gas in the abdomen, as well as gas-fluid levels in suspected bowel obstruction.

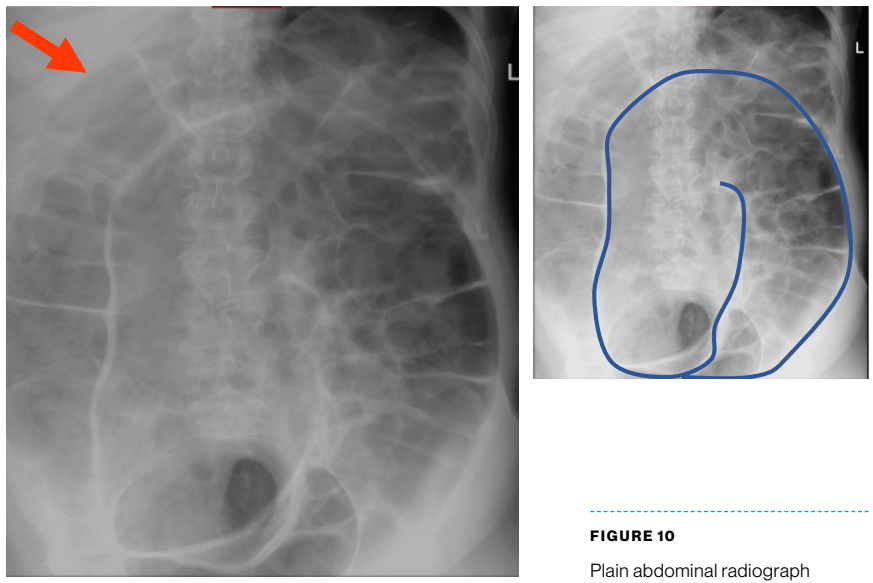


**FIGURE 10**

Plain abdominal radiograph shows a volvulus of the sigmoid colon with a classic coffee-bean sign (**blue outline**). The apex of the volvulus points to the right upper quadrant and there are loops of dilated large bowel seen proximally (**arrow**). See for comparison Figure 9 (normal abdominal plain radiograph).

Cross-sectional imaging techniques consist mainly of **computed tomography (CT)**, **magnetic resonance imaging (MRI)** and **ultrasound (US).** These have increasingly become the **mainstay of colonic imaging**.

In the **emergency setting, CT is often the first line imaging test** for assessing acute or life-threatening conditions such as bowel obstruction, bowel ischaemia, volvulus, intussception, the post-operative abdomen and the acute complications of inflammatory bowel disease for example (please see subsequent section on 'Acute Conditions').

A **CT of the abdomen and pelvis with portal venous contrast** (acquired at 60 seconds post-intravenous contrast injection) is the standard imaging acquisition although this will vary according to the clinical question – for example, if bowel ischaemia is suspected, an arterial phase (at 30 seconds) will also be required to assess the arterial vessels for acute thrombus.

**FIGURE 11**

Coronal reformat of a portal venous phase CT abdomen/pelvis demonstrates acute large bowel obstruction secondary to a large prostatic mass (**star**) compressing on the distal colon (**arrowhead**). The large bowel should not measure more than 6 cm (9 cm at the caecum). The ascending colon on this image measures up to 7.5 cm.

# / Large **Bowel**

**CHAPTER OUTLINE:**

**Fluoroscopic contrast studies** are less commonly performed today but remain useful for problem solving in complex cases, e.g., for assessing post-operative intestinal integrity, diagnosing leaks and delineating colonic fistulae.

A water-soluble contrast enema uses a contrast agent such as diluted Gastrografin, which is instilled into the rectum via a Foley catheter and allows real-time dynamic evaluation of colonic anatomy, using X-rays.

Double-contrast barium enemas are now obsolete tests and have been replaced by cross-sectional imaging. They involved the use of bowel insufflation with either carbon dioxide or air for luminal distension and a smooth-muscle relaxant given intravenously. These were previously commonly used for the diagnosis of tumours and assessment of inflammatory bowel disease.

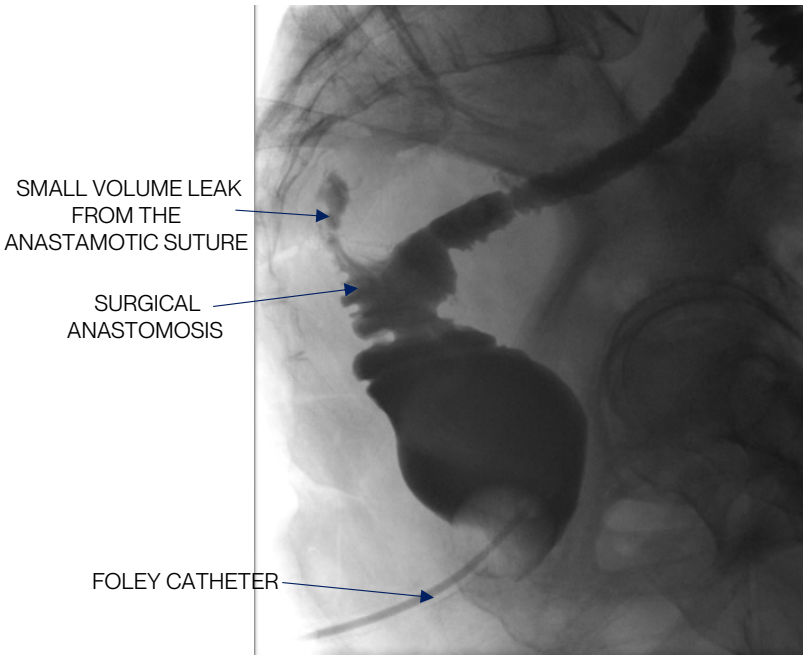



**FIGURE 12**

Single sagittal image from an iodinated contrast enema in a patient post anterior resection for a rectosigmoid tumour. There is a small volume leak from the posterior aspect of the lower anastomotic suture line.

## Large Bowel

**CHAPTER OUTLINE:**

**Computed tomography colonography (CTC)** has replaced barium enema for the **detection of colorectal cancer and polyps** and refers to CT of the gas-filled colon. It is commonly performed in patients who are unsuitable for or have failed colonoscopy.

The patient is given a laxative preparation prior to the study and asked to drink an oral contrast agent to coat (or 'tag') any residual faecal contents remaining. CTC can be performed without laxative (with only a tagging agent) if required. Colonic distension is performed using carbon dioxide, typically via an automated insufflation device and is improved by the additional use of an intravenous anti-spasmodic agent, e.g., hyoscine butylbromide. CT images are acquired in at least two views – prone and supine with additional decubitus images obtained if additional views are needed.

Interpretation is performed using a combination of 2D axial and multiplanar reconstructions and 3D reconstructions.

Intravenous contrast is also administered for evaluation of extra-colonic disease.

**FIGURE 13**

Prone axial CT reformat of a CTC showing C02 distended loops of bowel (**white arrowhead**) and 'tagged' faecal residue (**white arrow**).

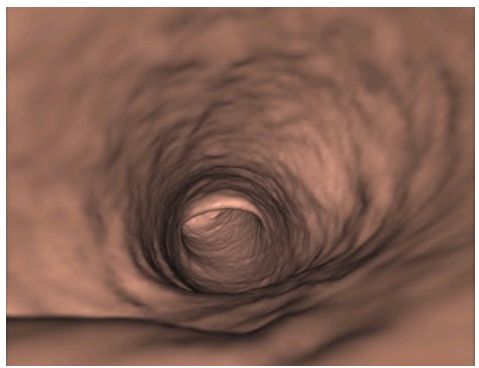


**FIGURE 14**

3D endoluminal reconstruction of the well-insufflated colon that has been cleansed with a laxative preparation.



**CHAPTER OUTLINE:**

**Magnetic Resonance Imaging (MRI)** remains the cross-sectional radiological technique of choice for pelvic imaging. It is accurate for local staging of rectal malignancy in addition to assessing benign disease such as anal fistulae and pelvic floor dysfunction.

**MR Colonography (MRC)** follows similar principles to CTC, requiring bowel cleansing and colonic distension. It can be used to evaluate the colonic lumen, colon wall and extra-luminal tissues. However, endoscopy remains the test of choice for evaluation of the colon in the assessment of inflammatory bowel disease. **MRI with oral contrast**, whilst mainly used to evaluate the small bowel, may have a role to play in evaluating colitis.

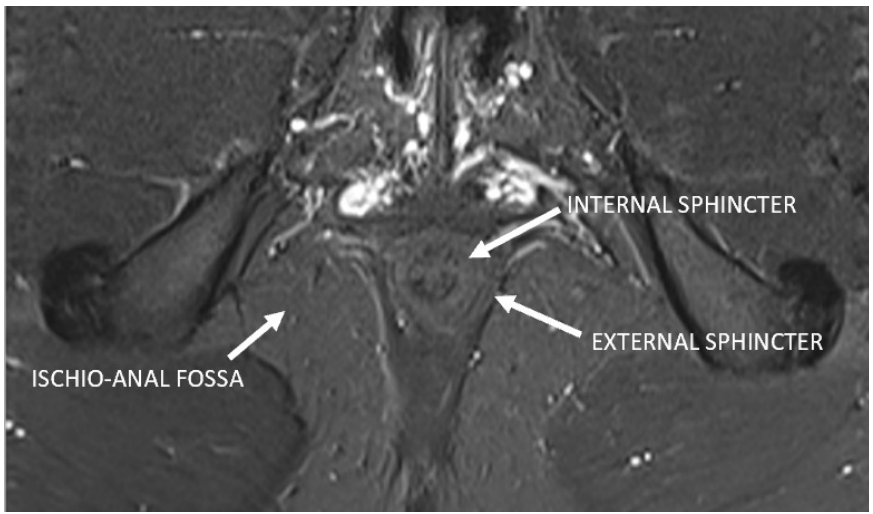



**FIGURE 15**

Axial STIR (Short T1 Inversion Recovery) sequence from a MR fistula study showing the normal anatomy of the anal sphincters.

**Evacuation proctography** is a study of the dynamics of rectal evacuation. Conventionally the procedure has been performed using X-ray fluoroscopy, but MRI proctography is now more commonly used.

The rectum is distended using air or ultrasound jelly and evacuation is captured using a rapid dynamic MRI sequence.

Proctography may be viewed in three stages: Rest, evacuation and recovery. At rest, the anorectal junction is normally just above the plane of the ischial tuberosities. Evacuation is initiated by descent of the pelvic floor, widening of the anorectal angle, and relaxation of the anal sphincters.

During MRI proctography, organ prolapse is conventionally measured with respect to the **pubococcygeal line** which provides a convenient, reproducible point of reference.

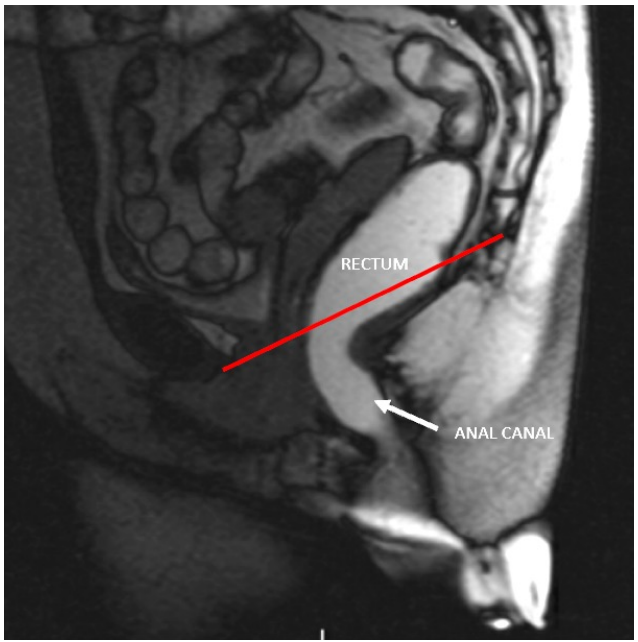



**FIGURE 16**

Sagittal image from a MR defecating proctogram showing the rectum distended with jelly. The red line is the pubococcygeal line which is defined as the line that joins the inferior border of the pubic symphysis to the last coccygeal joint.



**CHAPTER OUTLINE:**

**High frequency ultrasound** provides detailed imaging of the colon wall and has a valuable role for assessing extent and activity of inflammatory bowel disease, the diagnosis of appendicitis and for assessment of the anal sphincters.

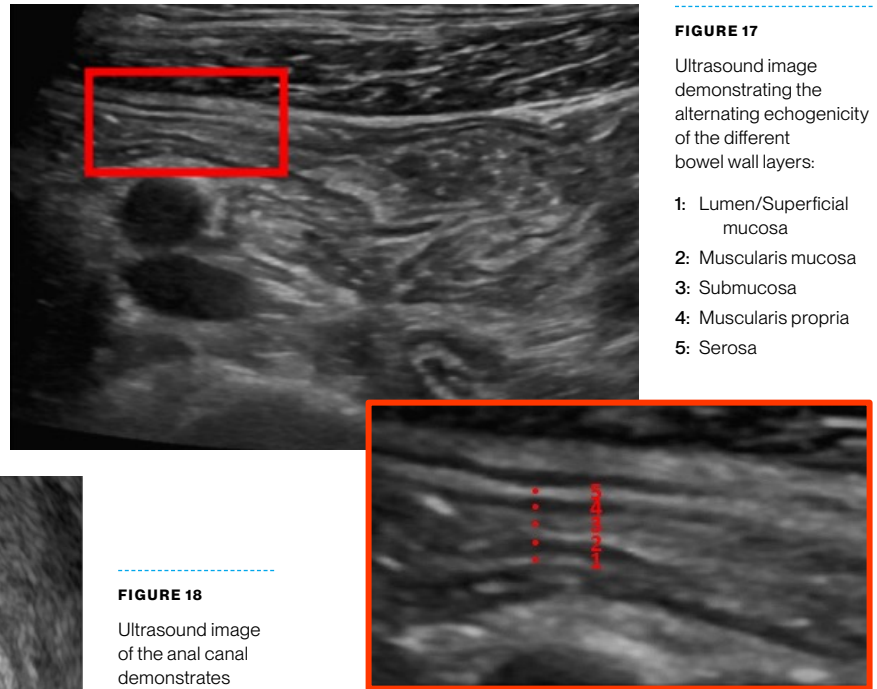


**FIGURE 17**

Ultrasound image demonstrating the alternating echogenicity of the different bowel wall layers:

1: Lumen/Superficial mucosa
2: Muscularis mucosa
3: Submucosa
4: Muscularis propria
5: Serosa

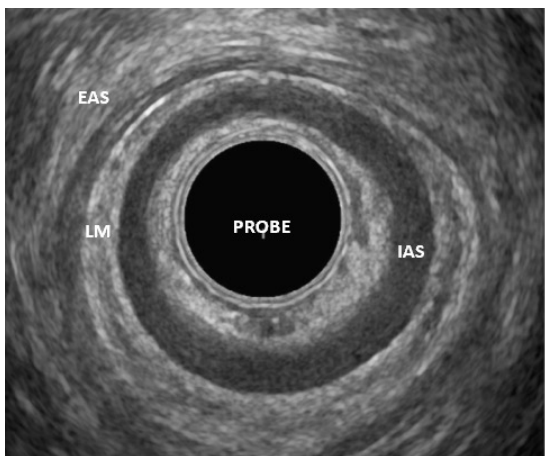



**FIGURE 18**

Ultrasound image of the anal canal demonstrates the hypoechoic internal anal sphincter (IAS), the longitudinal muscle in the intersphincteric plane (LM) and the echogenic external anal sphincter (EAS).

## Large Bowel

**CHAPTER OUTLINE:**

**PET** (Positron emission tomography) is a nuclear medicine scan usually combined with CT (PET-CT) or MRI (PET-MRI) which has a role to play in the staging of metastatic or recurrent colon cancer. It uses an isotope tracer (18-fluoride) combined with a radiopharmaceutical (fluorodeoxyglucose) to highlight sites of metabolically active disease. They are useful for the assessment of extraluminal disease and distant metastases.

Colonic cancer and adenomatous polyps are often 18-FDG avid and may be found incidentally during PET scans performed for other indications.

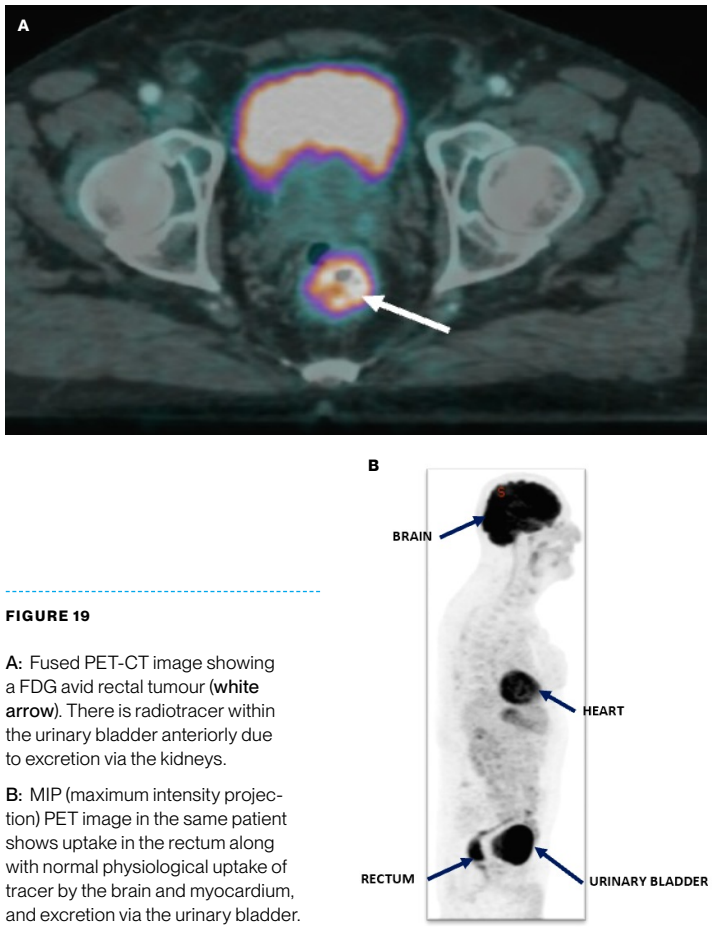



**FIGURE 19**

**A:** Fused PET-CT image showing a FDG avid rectal tumour (**white arrow**). There is radiotracer within the urinary bladder anteriorly due to excretion via the kidneys.

**B:** MIP (maximum intensity projection) PET image in the same patient shows uptake in the rectum along with normal physiological uptake of tracer by the brain and myocardium, and excretion via the urinary bladder.

# Acute Conditions

CHAPTER OUTLINE:

# / Perforation

**Colonic perforation** is an acute surgical emergency. It may result from infection and inflammation, trauma including instrumentation, ischaemia, malignancy, and bowel obstruction. Shown on this page are examples of colonic perforation.

**FIGURE 20**

Coronal CT image demonstrates an example of sigmoid colonic perforation with locules of gas outside the bowel (**red arrows**) secondary to the pressure effect of hard impacted faeces that forms a more solid mass (**white arrow**). This causes ischaemic necrosis of the colonic wall and ultimately perforation, known as stercoral perforation.



**FIGURE 21**

Axial CT image, taken in the portal venous phase, demonstrates a small perforation of the sigmoid colon with small locules of gas outside the bowel (**red arrows**) secondary to acute inflammation. There is also a small fluid collection (**arrowhead**) seen adjacent to the sigmoid colon. The patient had evidence of skip lesions (non-contiguous segments of inflamed bowel) and suspected undiagnosed Crohn's disease.

## / Large Bowel

**CHAPTER OUTLINE:**

# / Diverticulitis

**Diverticulae** are outpouchings of the muscular colonic wall. Diverticular disease denotes the presence of diverticulae, very commonly seen in elderly patients and most commonly in the sigmoid colon. **Diverticulitis** refers to the presence of inflammation, thought to be secondary to retention of faecal material in the diverticulum which leads to ischaemic necrosis and microperforation.

Differentiation of acute diverticulitis from a tumour can sometimes be difficult with overlapping imaging features. Cancer can present with a short segment of mass-like colonic mural thickening whilst diverticulitis often affects a longer segment of colon and is associated with mesenteric engorgement and fluid.

**FIGURE 22**

CT is the **most accurate imaging modality** for the assessment of acute diverticulitis. Hallmark changes include colonic wall thickening (**white arrow**) and associated inflammatory change and oedema in the pericolic fat.

**Complications of acute diverticulitis** include localised perforation, abscess and fistula formation. An abscess may perforate directly into the abdominal cavity causing faecal peritonitis. Rarely pseudocysts can form from expansion of a wall-off subserosal perforation. Abscesses less than 3 cm are usually treated with antibiotics whilst those more than 4 cm often benefit from image-guided drainage.

**>=< FURTHER KNOWLEDGE**

Fistula formation commonly involves the bladder resulting in a **colovesical fistula**. The fistulous tract may not always be seen but the presence of gas within the bladder (in the absence of catheterisation or recent instrumentation) is highly suggestive.


**FIGURE 23**

Coronal (**A** and **B**) and axial (**C**) CT images showing a thick-walled gas-containing abscess (**white arrow**) in the pelvis as a result of severe acute diverticulitis. There is a direct fistulous tract (**yellow arrow**) between the urinary bladder and adjacent inflamed sigmoid colon with resulting dependent gas within the urinary bladder (**star**).

# / Epiploic Appendagitis

**Epiploic appendages** are protrusions of subserosal fat, lined by peritoneum, that arise from the surface of the colon. There are around 50-100 of them in the colon, most commonly at the rectosigmoid junction.

**Epiploic appendagitis** is a self-limiting inflammatory/ischaemic process involving the appendix epiploica. The pathogenesis is thought to be due to torsion of a large pedunculated appendage or thrombosis of the venous outflow. Along with omental infarction, epiploic appendigitis falls under the broader group of intraperitoneal focal fat infarction.

The condition is self-limiting and is managed conservatively.

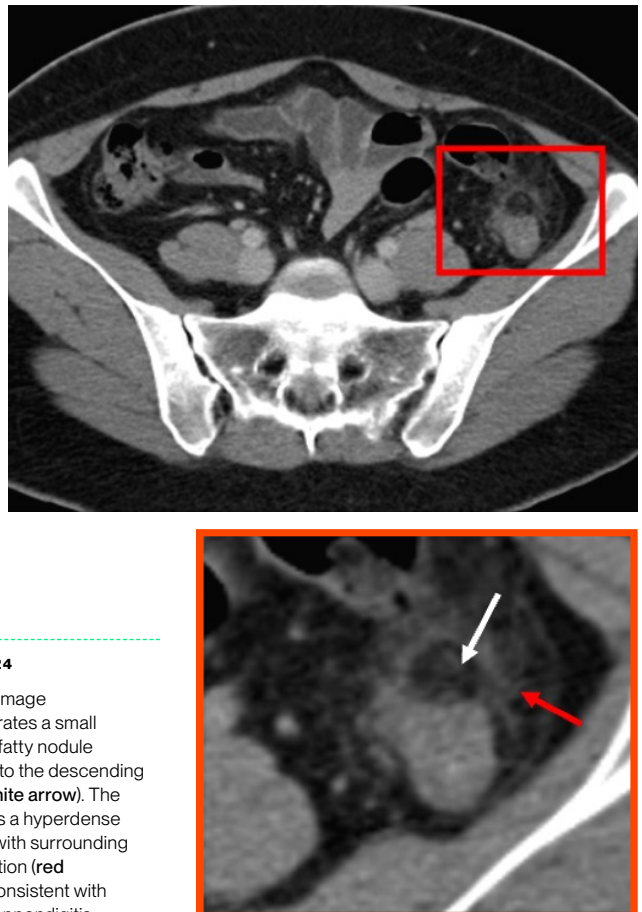


**FIGURE 24**

Axial CT image demonstrates a small rounded fatty nodule adjacent to the descending colon (**white arrow**). The lesion has a hyperdense capsule with surrounding inflammation (**red arrow**), consistent with epiploic appendigitis.

<!> ATTENTION

# / Appendicitis

This is the one of the most common abdominal pathologies. Imaging is used to support clinical evaluation to make the diagnosis, exclude other pathologies or to look for complications.

CT scans are very sensitive but care must be taken in younger patients given the associated radiation exposure. Ultrasound is a very useful alternative. Although highly specific, its sensitivity is limited. MRIs are also useful in pregnant women and paediatric populations.

On ultrasound, imaging findings are a **dilated (> 6 mm), fluid-filled, non-compressible** appendix with **increased echogenicity of the surrounding fat** suggesting peri-appendiceal inflammation. On colour Doppler images, there is increased vascularity of the appendix wall.

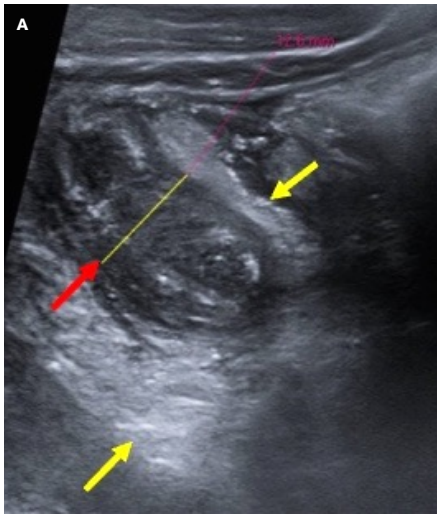



**FIGURE 25**

**A:** Ultrasound image (longitudinal plane) of a dilated oedematous appendix (**red arrow**). Note the increased echogenicity of the surrounding fat (**yellow arrows**). The transverse diameter of the appendix measures 12.6 mm.

**B:** Increased vascularity demonstrated on colour Doppler assessment (transverse imaging plane).

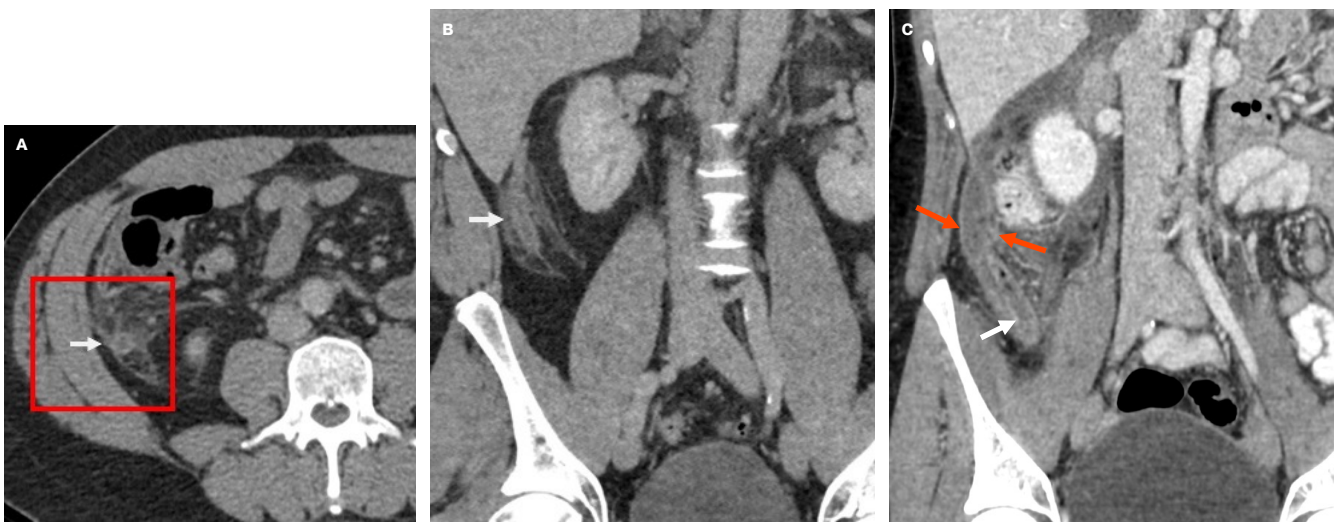
<!> ATTENTION

**CT is superior to ultrasound** not only for the diagnosis of appendicitis but also for assessing for the presence of complications such as perforation or abscess formation. Low-dose CT has replaced standard CT in many institutions as it offers significant radiation dose reduction while having a similar diagnostic accuracy.

**FIGURE 26**

**A and B:** Axial and coronal CT images showing an inflamed appendix (**white arrow**) with inflammation of the surrounding fat (streaky, reticulated aspect).

**C:** Coronal CT image in a different patient showing the inflamed appendix (**white arrow**), inflammation of the surrounding fat and abscess formation (**red arrows**).



# / Volvulus

Volvulus is an uncommon cause of acute abdominal pain. It occurs when a **segment of bowel twists arounds its own axis or around its mesentery**. The **sigmoid colon is the most common site** of occurrence **followed by the caecum**. Volvulus can also occur (although less commonly) in the transverse colon and splenic flexure.

On an abdominal X-ray, findings are a **bean-shaped** dilated loop of large bowel (see also Figure 10). CT demonstrates a "**whirl sign**" which denotes twisting of the mesenteric vessels. Complications include obstruction and perforation and these can be investigated on CT.

A volvulus is usually caused by a redundant segment of bowel (i.e. a very mobile segment of bowel not firmly attached to the mesentery). **Occasionally, the cause of a volvulus is an obstructing lesion** and as such in patients with intermittent episodes of volvulus, colonoscopy or CT colonography (CTC) should be done afterwards to exclude a tumour.

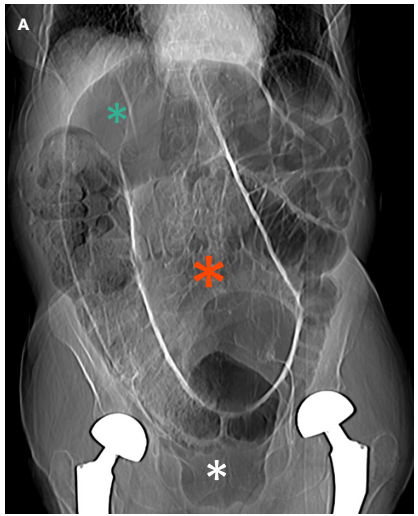



**FIGURE 27**

CT topogram (**A**) and axial CT image (**B**) showing the characteristic aspect of a sigmoid volvulus. The large dilated loop of the sigmoid colon (**red asterisk**) has a wall without haustra and the lower end points towards the pelvis. There is no rectal gas (**white asterisk**). The liver overlap sign can be seen, i.e. the sigmoid volvulus ascends to the right upper quadrant and projects over the liver (**green asterisk**). There is major large bowel dilatation due to obstruction. Case courtesy: Pierre Alexandre Poletti, MD, Geneva University Hospitals.

# / Intussusception

This is when **one segment of bowel telescopes into another segment of bowel**. The segment of bowel on the outside is called the *intussusceptum* and the bowel that telescopes into it is called the *intussuscipiens*.

Intusussception is more common in children and often occurs and resolves intermittently. It can sometimes get stuck, leading to oedema and subsequently obstruction of the intussusceptum. Timely reduction to avoid bowel necrosis is essential.

In adults, **colonic intussusception is almost always due to a tumour**, which serves a lead point.

Ultrasound is very useful for diagnosis in children however in adults, CT is preferable. Imaging shows a typical "**target**" appearance.

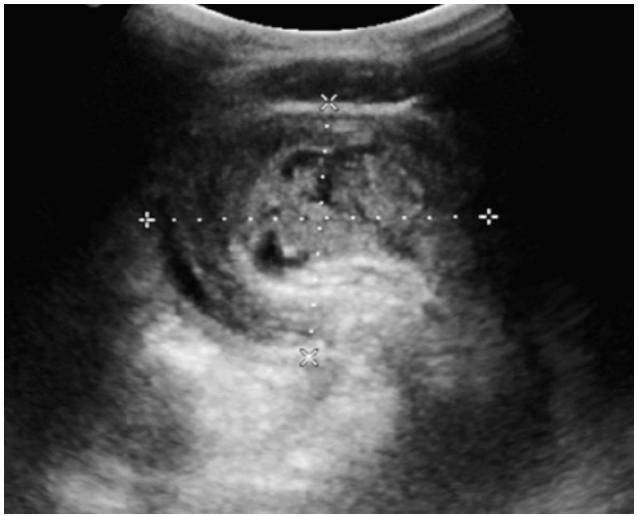


**FIGURE 28**

Ultrasound scan in a case of ileo-colic intussusception showing a target appearance of bowel within bowel. This appearance is caused by alternating concentric hypoechoic and hyperechoic bands. The hyperechoic bands correspond to the mucosa and muscularis, whereas the hypoechoic bands correspond to the submucosa.

# Tumours



CHAPTER OUTLINE:

# / Tumours – **Polyps**

**Polyps** are elevated mucosal lesions which can be classified according to their morphology (Paris classification) or histological types.

The most clinically significant polyps are **adenomas** which have the potential to become dysplastic and develop into a cancer. Adenomas can be histologically classified as tubular, villous or tubulovillous. **Villous adenomas** are more likely to become malignant. Other risk factors are adenomas > 1 cm in size or those containing high grade dysplasia.

Benign histological subtypes include hamartomatous and inflammatory polyps.

The detection of polyps is therefore important to remove or reduce the risk of developing colorectal cancer. Endoscopy and CT colonography form the mainstay of polyp detection.

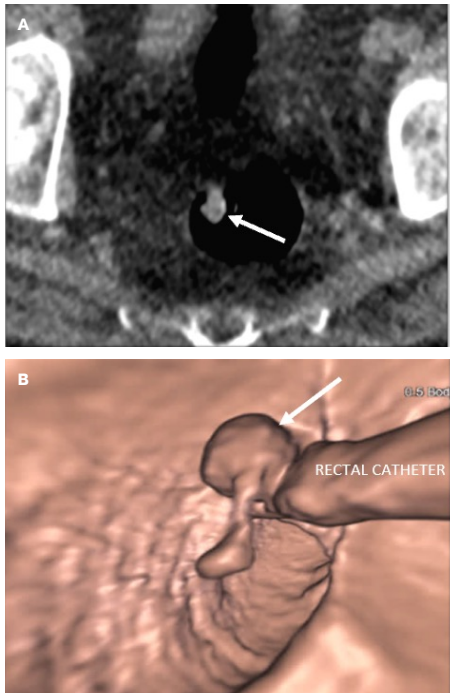



**FIGURE 29**

2D image from a CTC (**A**) and 3D reconstruction (**B**) of a rectal polyp (**white arrows**). Note the rectal catheter used for $CO_2$ insufflation seen directly adjacent to the polyp.

The morphology of polyps can be described according to the **Paris classification**.

Pedunculated polyps (Paris Ip) have a stalk and are more likely to contain high-grade dysplasia. However, because the stalk provides distance between the polyp and bowel wall, they are often considered cured once resected.

Sessile polyps (Paris Is) have a broad base and a higher risk of invasive malignancy.

Subpedunculated polyps (Paris Isp) are intermediate in risk and appearance between pedunculated and sessile polyps.

Flat lesions (Paris 0-II group) is defined as being less than 3 mm in height above the mucosal surface.

Paris 0-IIa are slightly elevated, Paris 0-IIb are completely flat and Paris 0-IIc are depressed rather relative to the mucosal surface. The latter have a higher risk of invasive cancer.

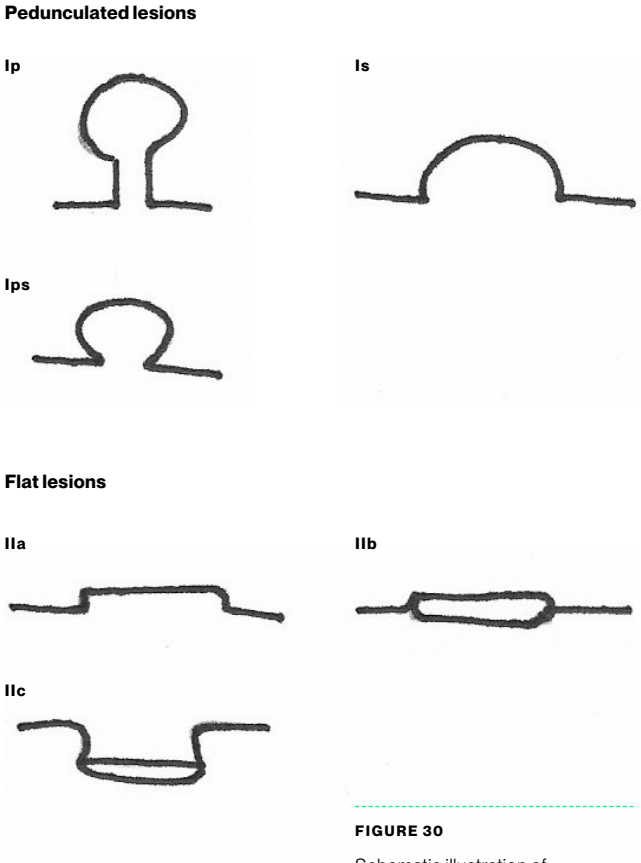



**FIGURE 30**

Schematic illustration of the Paris classification.

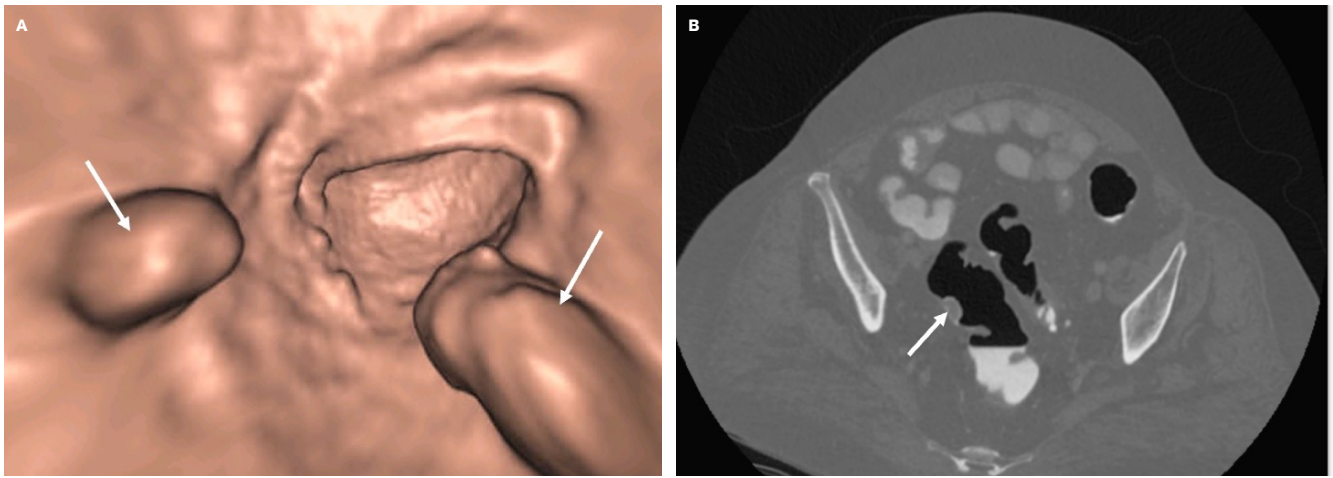



**FIGURE 31**

Case example of a 3D endoluminal reconstruction (**A**) which demonstrates two polyps in the sigmoid colon (**white arrows**). The larger polyp of the two is also demonstrated on the 2D axial CTC image (**B**) which shows a predominantly raised flat polyp (Paris IIa).

**CHAPTER OUTLINE:**

# / Tumours – **Inherited Polyposis Syndromes**

There are a number of **inherited polyposis syndromes** which carry an increased risk of developing colorectal cancer (CRC).

### FAMILIAL ADENOMATOUS POLYPOSIS (FAP)

- Autosomal dominant inheritance
- Typically, have > 100 adenomatous polyps
- All patients eventually develop CRC
- Preventative proctocolectomy is therefore recommended
- Extra-intestinal manifestations include skull osteomas, abnormal dentition and desmoid tumours
- Gardner syndrome is a variant of FAP with prominent skeletal and skin manifestations

### HEREDITARY NON-POLYPOSIS COLORECTAL CANCER (HNPCC)

- Autosomal dominant inheritance
- Increased risk of endometrial, small bowel and transitional cell carcinoma
- 70% of colorectal cancers occur in the proximal colon

### PEUTZ-JEGHERS SYNDROME

- Autosomal dominant inheritance
- Small bowel hamartomas. Large bowel polyps are less common
- Mucocutaneous pigmentation

### TURCOT SYNDROME

- Rare polyposis syndrome
- Colonic adenomatous polyps and CNS tumours, e.g., medulloblastomas

### COWDEN SYNDROME

- Hamartomatous polyps
- Mucocutaneous lesions, thyroid abnormalities, fibrocystic disease of the breast

### CRONKHITE-CANADA SYNDROME

- Multiple or large serrated colonic polyps
- Alopecia, nail atrophy and skin hyperpigmentation

Patients with Familial Adenomatous Polyposis (FAP) are at risk of developing extra-colonic adenomas, particularly in the stomach and duodenum. In addition, desmoid tumours (benign locally infiltrative fibroblastic tumours) have a known association with FAP. The development of desmoid tumors is often precipitated by trauma or surgery.

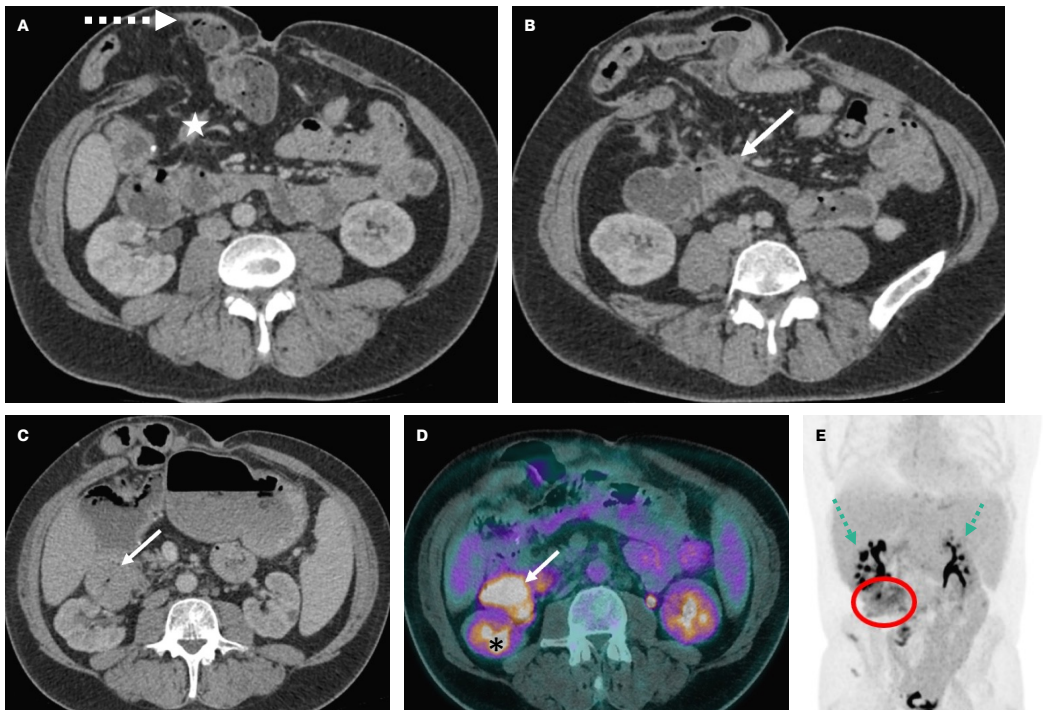



**FIGURE 32**

Case example of a patient with known FAP and previous colectomy. There is an end-ileostomy with an incidental para-stomal hernia (**dashed arrow in A**). The patient developed a desmoid tumour in the small bowel mesentery (**star**) with associated retraction and nodularity of the mesentery (**arrow in B**) and tethering of the small bowel. A number of years later, the same patient went on to develop a mass at the junction of the second and third parts of the duodenum (**arrows in C and D**) which was confirmed to be avid on FDG-PET CT (**D** and **E**), highly suspicious for the development of an adenocarcinoma. Normal FDG uptake is also demonstrated in the kidneys (**asterisks in D, dashed arrows in E**).



**CHAPTER OUTLINE:**

<!> ATTENTION

# / Tumours – **Colorectal Cancer (CRC)**

- Primary colorectal cancer is the second most common cause of cancer mortality in both men and women in Europe. 5-year survival is around 50%.
- Over **half of cases** occur in the **sigmoid** and **rectum**, with one third alone occurring in the rectum.
- Prognostic factors include local tumour invasion, vascular or lymphatic involvement, preoperative elevation of carcinoembryonic antigen (CEA) and tumour differentiation.
- The traditional **Duke's staging system** has been largely **replaced by the TNM** (tumour, nodes, metastases) system.
- CT estimates the T stage but is less able to distinguish between early T stages (T1 and T2). Ultrasound is better than CT at differentiating between T1 and T2 tumours. **MRI** is used to locally **stage rectal cancers**.
- Adverse prognostic factors are T3 or T4 tumours, and tumours with extra-mural venous invasion which is suspected by the expansion of draining veins.
- Poor-prognostic rectal tumours are likely to receive neoadjuvant chemotherapy prior to surgical resection.

| TNM | TUMOUR EXTENT | DUKES |
|---|---|---|
| Stage I | Invasion into submucosa T1<br>Invasion into muscularis propria T2 | A |
| Stage II | Invasion outside muscularis propria T3<br>Invasion of visceral peritoneum T4a<br>Invasion of other organs T4b | B |
| Stage III | 1-3 lymph nodes involved N1<br>≥ 4 lymph nodes N2 | C |
| Stage IV | Distant metastasis in one organ M1a<br>Distant metastasis in > 1 organ or to the peritoneum M1b<br>Peritoneal metastases M1c | D |

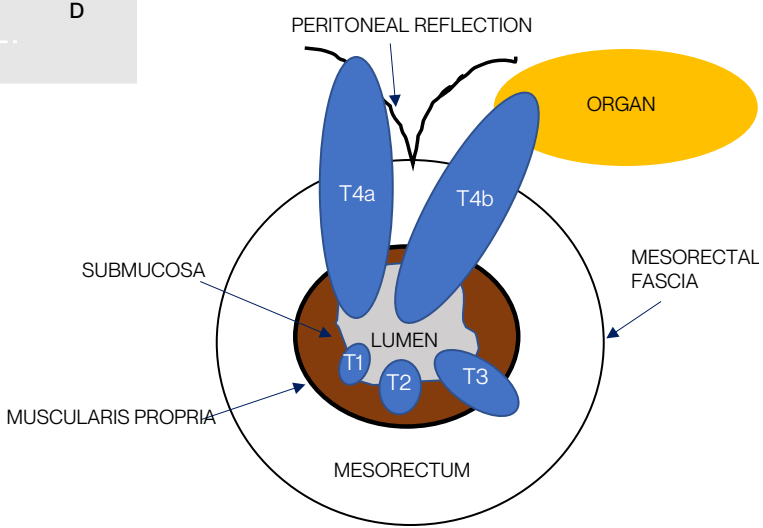



**FIGURE 33**

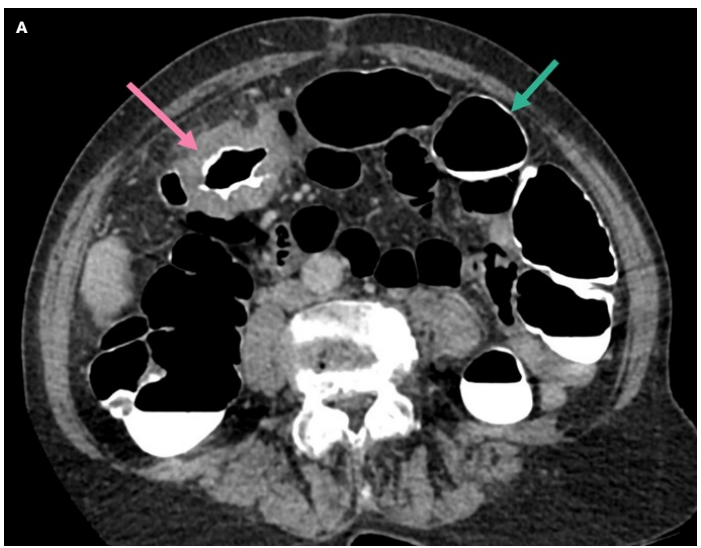
8th Edition TNM staging of colorectal cancer (CRC).

## Large Bowel

**CHAPTER OUTLINE:**

CTC has an equivalent sensitivity to colonoscopy for detecting CRC and readily depicts colonic masses. On conventional CT, tumours are seen as **a focal area of wall thickening**. Conventional CT has a modest sensitivity for colon cancer compared to CTC with bowel cleansing and colonic distension. Nodal staging accuracy is also modest on cross-sectional imaging.

>=< FURTHER KNOWLEDGE



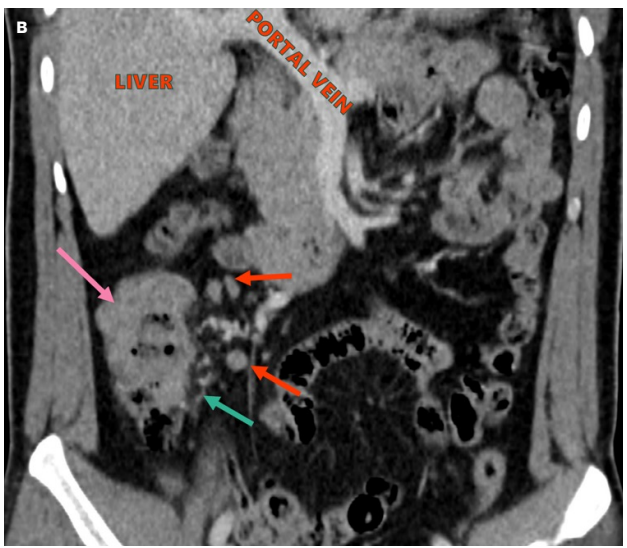




**FIGURE 34**

The axial CTC image (**A**) demonstrates a circumferential mass at the hepatic flexure (**pink arrow**) which is causing luminal narrowing. Compare this with the remainder of the colon which has a paper-thin wall (**turquoise arrow**). The coronal CT image (**B**) demonstrates thickening of the caecum (**pink arrow**), which proved to be an adenocarcinoma on biopsy taken at the time of colonoscopy. There is also evidence of tumour extension into the pericolic fat (**turquoise arrow**) and multiple adjacent regional lymph nodes (**red arrows**). The T and N staging is therefore T4a N2.

MRI is imaging investigation of choice for the local staging of **rectal cancer**.

The surgical treatment of rectal cancer involves a **total mesorectal excision** (TME) which is a total resection of the tumour, rectum and mesorectum. The dissection plane along the mesorectal fascia is known as the **circumferential resection margin** (CRM).

The mesorectal fascia (MRF) is considered involved if there is direct invasion of the MRF by the primary tumor or a margin of ≤ 1 mm between the primary tumor and MRF. These tumours will require down-staging with neoadjuvant chemoradiotherapy prior to surgery to increase the likelihood of curative surgery.

Local nodes and extra-mural vascular invasion can also be assessed on MRI. Morphological features such as an irregular contour and heterogeneous signal intensity of lymph nodes confer a high likelihood of disease involvement.

>=< FURTHER KNOWLEDGE

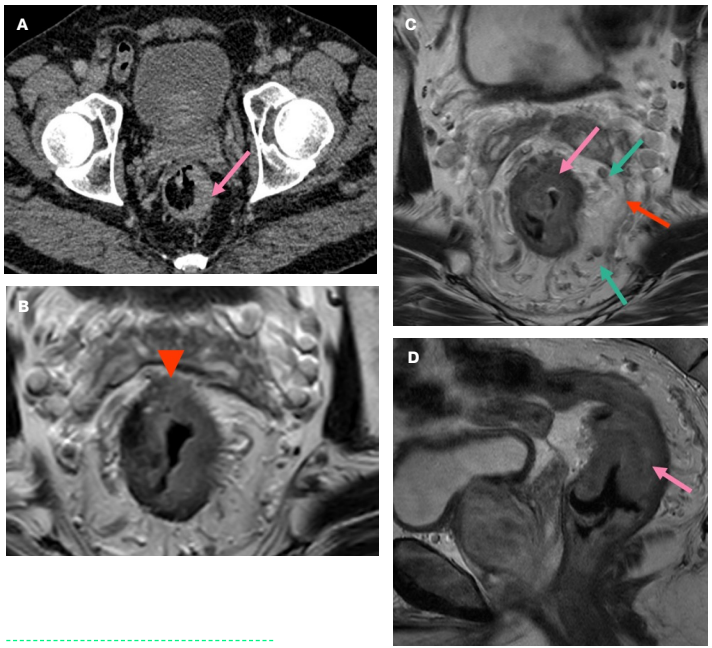



**FIGURE 35**

Pelvic CT (**A**) shows a semi-annular tumour within the mid-rectum which has rolled edges (**pink arrow**). The same lesion is shown on a small-field of view axial MRI sequence (**B**). There is clear evidence of tumour extension beyond the muscularis propria (**dark black outline**) and into the perirectal fat (**arrowhead**). On **C**, the tumour extends from the 10 – 6 o'clock position. There are small lymph nodes (**turquoise arrows**). The more anterior of these lie approximately 1 mm from the circumferential resection margin (**orange arrow**). The mid-rectal tumour as seen on the sagittal MRI sequence (**D**).

MRI also has an important role to play in the evaluation of tumour response after chemoradiotherapy. **Diffusion-weighted sequences may be** helpful for assessing if there is any residual tumour present.

The presence of a **dense fibrotic scar** with no evidence of tumour signal denotes a complete radiological response. In some centers, such patients may undergo close 'watch and wait' surveillance rather than straight to surgery.

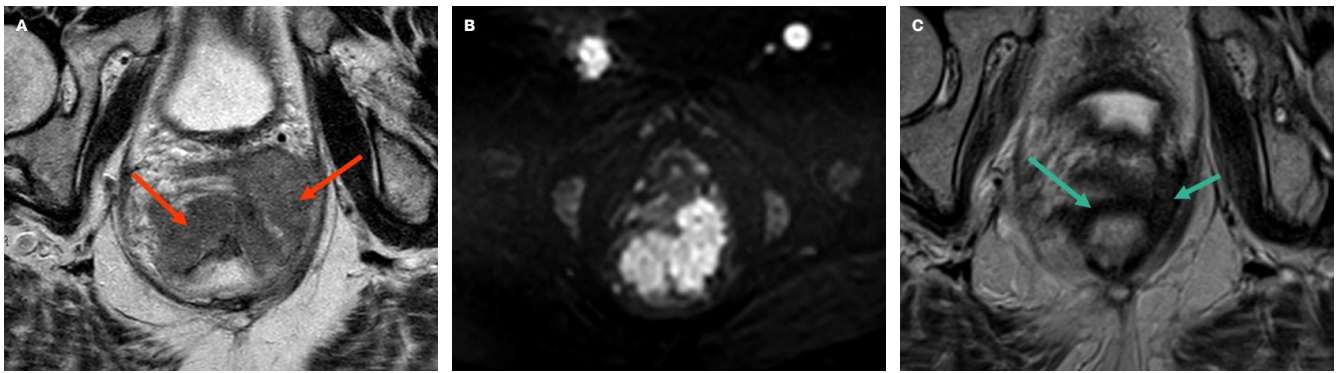



**FIGURE 36**

Axial MRI shows a bulky tumour in the anterior lower rectum (**A**, **orange arrows**) infiltrating into the vagina on the left. The corresponding DWI sequence (**B**) shows high signal consistent with the presence of restricted diffusion. MRI following chemoradiotherapy (**C**) shows a very good response to treatment. The bulky mass has been replaced with low signal fibrosis (**turquoise arrows**). On the corresponding DWI images, there was no associated residual high signal (not shown).

## / Large Bowel

**CHAPTER OUTLINE:**

# / Tumours – **Anal Cancer**

**Anal cancers** are relatively uncommon and account for less than 2% of large bowel malignancies. They are defined as originating between the anorectal junction above and the anal verge below. **MRI** is the modality of choice for staging anal cancers.

The majority are squamous cell cancers and have a high association with HPV (human papilloma virus).

>=< FURTHER KNOWLEDGE

They are staged differently to rectal tumours as follows:

| TNM | TUMOUR EXTENT |
|---|---|
| Stage I | Tumour 2 cm or less in greatest dimension T1 |
| Stage IIa | Tumour > 2 cm but < 5 cm in greatest dimension T2 |
| Stage IIb | Tumour > 5 cm in greatest dimension T3 |
| Stage IIIa | T1 or T2 |
| | Metastases in inguinal, mesorectal and/or internal iliac lymph nodes N1a |
| | Metastases in external iliac lymph nodes N1b |
| | Metastases in external iliac and N1a nodes N1c |
| Stage IIIb | Tumour of any size that invades adjacent organs T4 |
| Stage IIIc | T3 + N1 + M0 (no distant metastases) |
| Stage IV | Any T stage + Any N stage + M1 (distant metastases) |

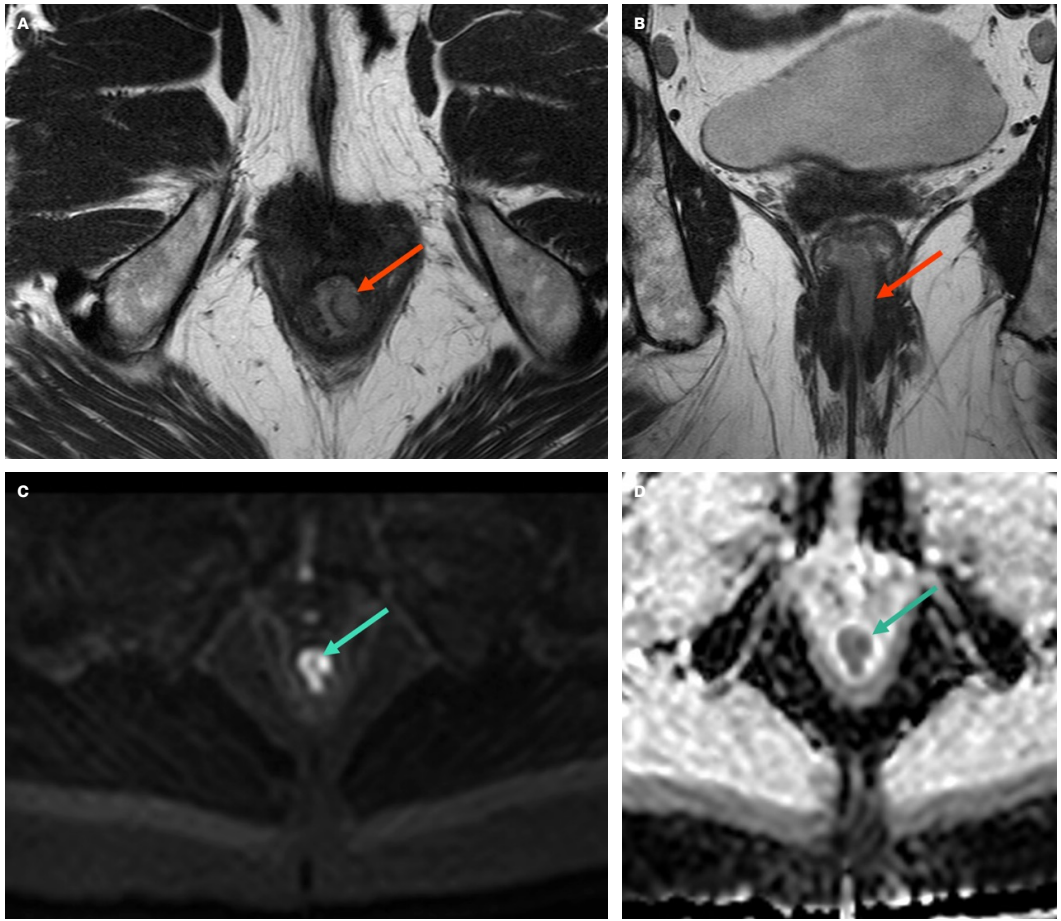



**FIGURE 37**

Axial (**A**) and coronal (**B**) T2-weighted MRI images show an intraluminal mass in the rectum (**orange arrows**) consistent with an anal tumour. The tumour measured 2.7 cm and is therefore staged as T2. DWI image (**C**) shows corresponding high signal and ADC (apparent diffusion coefficient) map (**D**) shows corresponding low signal (**turquoise arrows**) consistent with the presence of diffusion restriction. Diffusion restriction in this case indicates a tumour with increased cellularity.

/ Large **Bowel**

**CHAPTER OUTLINE:**

# / Tumours – **Appendix**

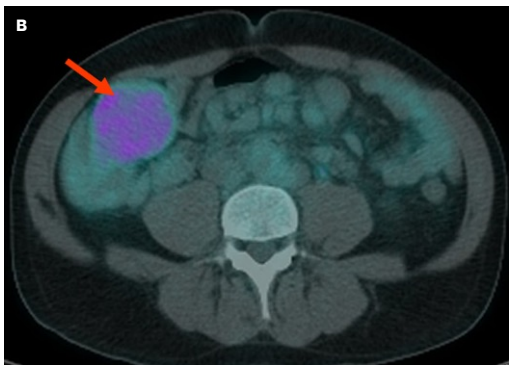
There are a number of neoplasms which can involve the appendix, most commonly **neuroendocrine tumours or mucinous neoplasms**. Mucinous neoplasms of the appendix range from more benign mucoceles to more malignant cystadenocarcinomas. They are the most common cause of pseudomyxoma peritonei which is the intraperitoneal accumulation of mucinous ascites related to a mucin-producing neoplasm.

**FIGURE 38**

Coronal CT reformat demonstrates a cystic tubular mass arising from the caecum (**asterisk**). No soft tissue component to the mass. Histology post surgical resection confirmed a low grade appendiceal mucinous neoplasm.

# / Tumours – **Lymphoma**

Lymphoma of the large bowel is uncommon. There will often be marked bowel wall thickening or aneurysmal dilatation without obstruction.

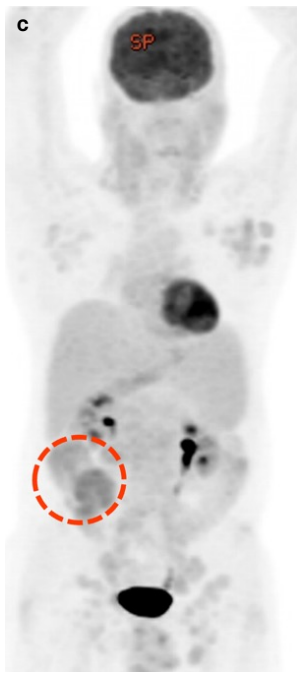




**FIGURE 39**

Coronal CT reformat (**A**) demonstrates a large intraluminal mass within the caecum (**star**). Biopsy confirmed this to be mantle cell lymphoma with involvement of the caecum. CT also demonstrates bulky mesenteric (**pink arrow**) and inguinal lymphadenopathy (**turquoise arrows**). Fused images (**B**) and planar 2D image (**C**) from PET-CT show uptake of the FDG tracer at the site of the caecum, consistent with lymphoma (**orange arrow** and **circle**).

**FIGURE 40**

The same patient as in Figure 38 went on to develop ileo-colic intussusception **secondary to the lymphoma mass acting as a lead point**. Intussusception is where the bowel invaginates on itself and is pulled into a neighbouring loop of bowel (see Acute conditions). The intussusceptum is in this case the terminal ileum (**turquoise arrow**) and the intussuscipiens is in this case the caecum, (**pink arrow**). As on the previous CT (Figure 39), there is evidence of widespread bulky lymphadenopathy (**orange arrows**).

## Large Bowel

**CHAPTER OUTLINE:**

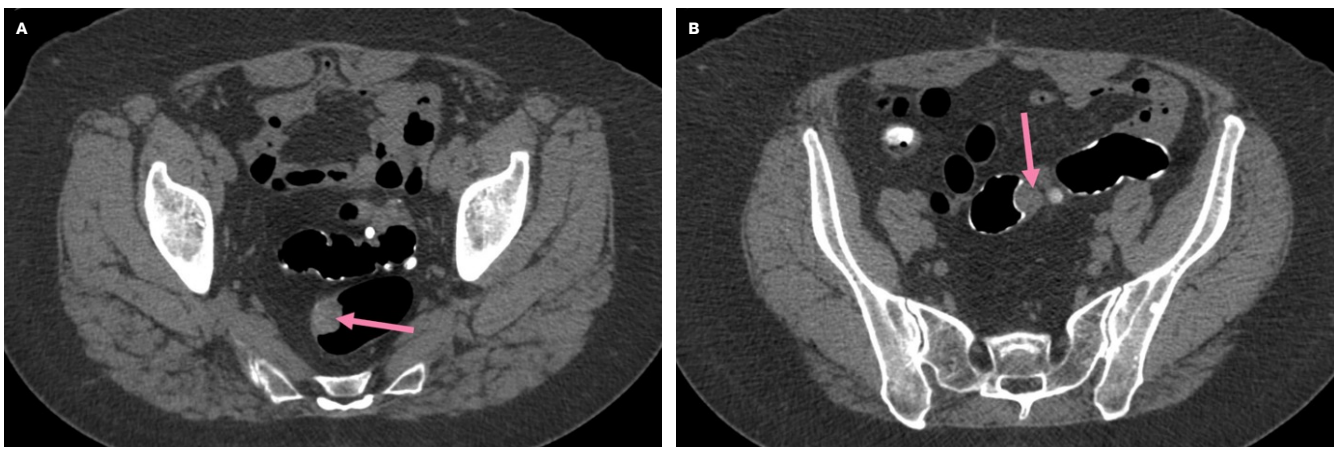
# / Tumours – **Secondary Cancers**

The colon may be secondarily involved by direct invasion, lymphatic permeation, intraperitoneal seeding or haematogenous spread. Gastric cancer spreading via the gastrocolic ligament or pancreatic cancer spreading via the transverse mesocolon are typical.

Serosal tumour spread can cause tethering and contraction of the bowel wall secondary to a desmoplastic response. Occasionally, haematological spread may produce a more diffuse 'linitis plastica' appearance.

**FIGURE 41**

Axial CT slices from the same patient show serosally-based nodules (**arrows**) in the rectosigmoid colon (**A**) and mid-proximal sigmoid colon (**B**) in a patient with a history of previously treated ovarian cancer. The metastatic lesions are consistent with recurrence of the patient's cancer.



# Colitis



CHAPTER OUTLINE:

# / Colitis

Colitis refers to inflammation of the large bowel. It can occur as a result of **infection**, **inflammation** and sometimes, **ischaemia**. Colitis is often evaluated using cross sectional imaging, primarily CT and MRI. Ultrasound can be used particularly in patients with inflammatory bowel disease who require regular imaging. Given the multiple potential causes, imaging features can be non-specific.

The main diagnostic criteria for colitis is **a wall thickness of > 4 mm**. Depending on the cause, other signs may be present such as:

- Distension
- Increased or decreased enhancement
- Changes in the surrounding fat – "fat stranding"

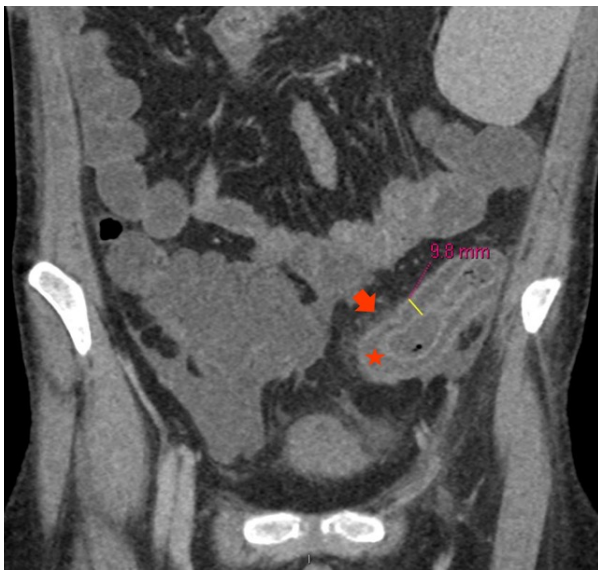



**FIGURE 42**

Coronal CT showing in a patient with colitis showing gross oedema and thickening of the bowel wall measuring approximately 10 mm (**orange star**), increased mucosal and serosal enhancement and mild surrounding fat stranding (**orange arrow**).



**CHAPTER OUTLINE:**

# / Cause of Colitis and Common Sites of Involvement

**DIFFUSE**

- / Cytomeglovirus
- / Pseudomembranous colitis
- / Ulcerative colitis

**RIGHT-SIDED**

- / Tuberculosis
- / Crohn's
- / Salmonella
- / Neutropenic colitis
- / Ischaemic colitis (hypo-perfusional)

**LEFT-SIDED**

- / Ischaemic (watershed)
- / Shigella
- / Gonorrhoea
- / Ulcerative colitis
- / Radiation colitis

# / Inflammatory Bowel Disease

This is a term used to denote two main conditions – **Ulcerative Colitis** and **Crohn's Disease**.

## / Ulcerative Colitis

Ulcerative disease affects **only** the **colon** and **rectum** (the small bowel is not involved). Inflammation is **confined to the mucosa** and usually starts at the rectum and progresses proximally to include the rest of the colon in a continuous manner.

>▪< FURTHER KNOWLEDGE

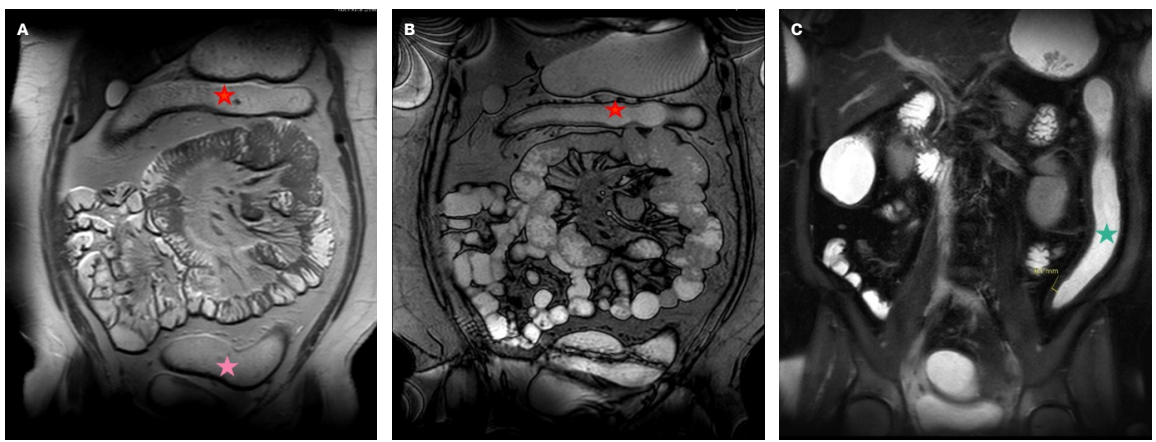



**FIGURE 43**

Coronal heavily T2 –weighted sequences (**A**, **B**, **C**) in a patient with long standing colonic inflammatory bowel disease. Notice the lack of normal colonic haustra (lead-pipe appearance) in the transverse (**red star**), descending (**turquoise star**) and sigmoid colon (**pink star**) and thickening of the descending colon.

# / Crohn's Disease

Crohn's disease on the other hand can affect **both small** and **large bowel**, rectum and **anus**. **The most common site of disease is the terminal ileum**. The inflammation in Crohn's is not continuous, and there can be segments of normal bowel interspersed between areas of inflammation. In addition, unlike ulcerative colitis, Crohn's disease **affects all the bowel layers** (i.e., it is transmural) and can therefore, lead to perforation, fistulation and abscess formation.

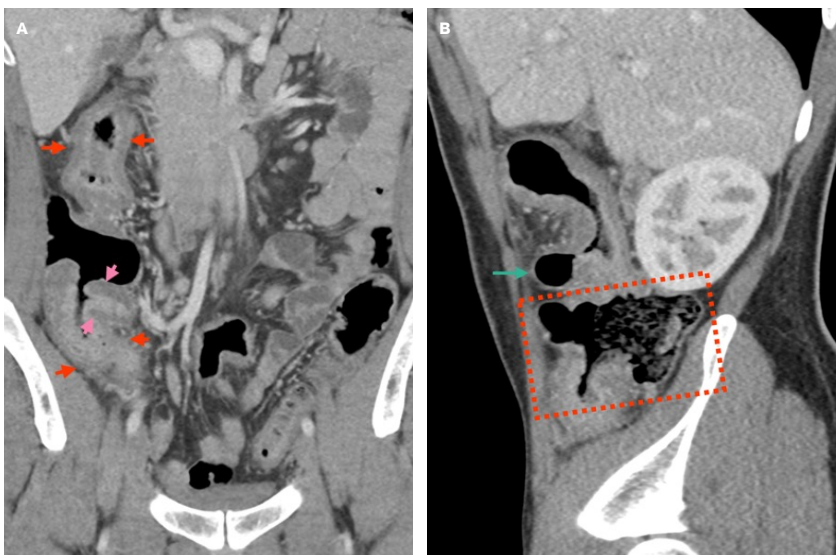



**FIGURE 44**

Coronal CT scan (**A**) showing right sided colitis (**orange arrows**) in a patient with Crohn's disease with involvement of the ileo-caecal junction (**pink arrows**). Sagittal CT scan (**B**) of the same case demonstrating normal bowel (**orange square**) between affected segments and pseudo-sacculation (**turquoise arrow**) due to stricturing.

**<!> ATTENTION**

Both diseases have overlapping presentations with **abdominal pain**, **weight loss** and **diarrhoea** (bloody diarrhoea in ulcerative colitis).

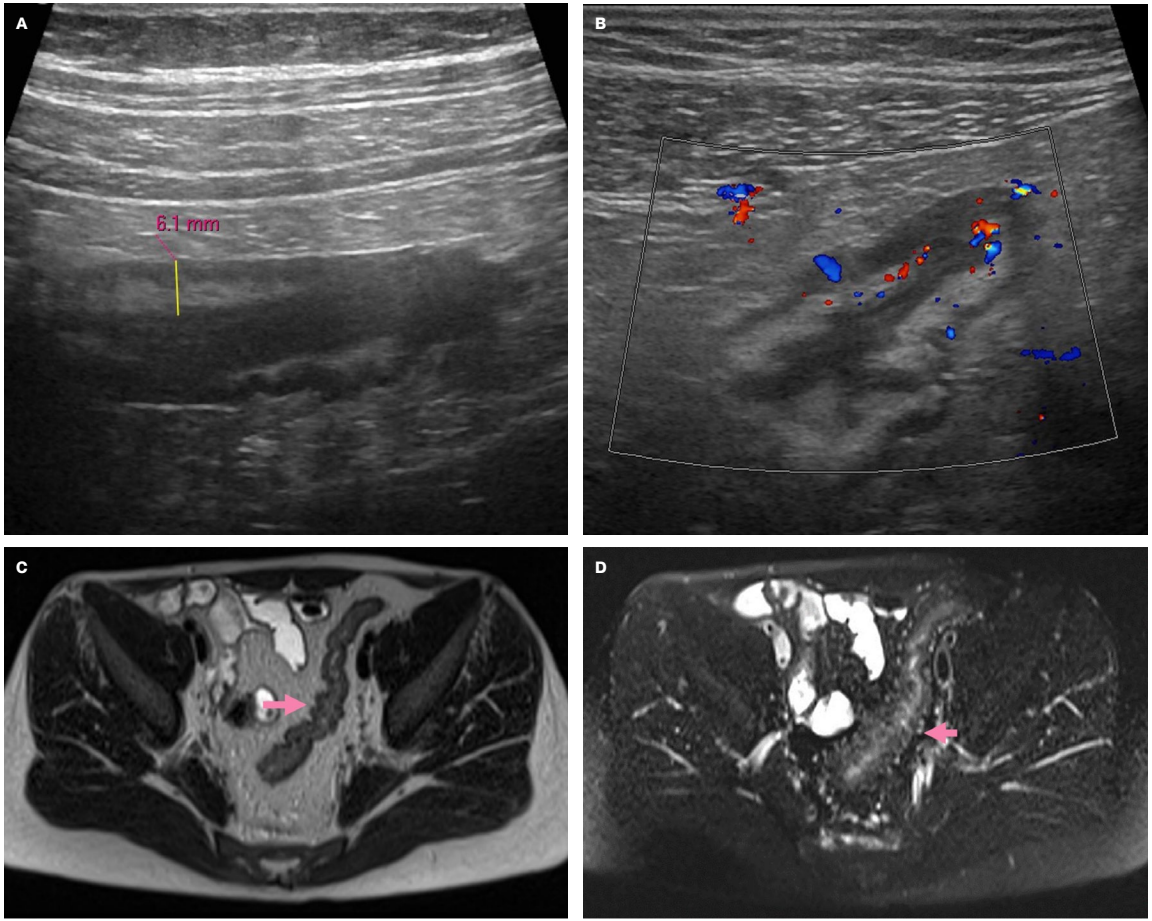



**FIGURE 45**

Ultrasound showing a thickened sigmoid colon (6.1 mm in **A**) with increased vascularity on colour Doppler assessment (**B**) in a case with left-sided colonic Crohn's disease. MRI scan of the same patient with axial T2 TRUFI (True Fast Imaging with Steady State Free Precession) and HASTE (Half fourier Single-shot Turbospin-Echo) fat saturated sequences (**C** and **D**) showing an inflamed thickened sigmoid colon with a narrowed lumen (**pink arrows**).

# Large Bowel

**CHAPTER OUTLINE:**

# / Ischaemic Colitis

This occurs when there is an **absence** or **reduction in blood flow** to the colon. It is mainly seen in people > 60 years but is sometimes present in younger patients with **hypercoagulable states, vasculitis, long distance athletes** and in cases of **drug use**. It is a **life-threatening condition** and may require urgent surgical intervention, although many cases resolve spontaneously.

## The causes include

- / Arterial or venous occlusion
- / Low flow states/hypoperfusion
- / Increased intracolonic pressure proximal to an area of obstruction


**FIGURE 46**

Coronal (**A**) and sagittal (**B**) slices of a patient with suspected ischaemic colitis affecting the splenic flexure and proximal descending colon. Note uniform and segmental bowel wall thickening with a low density linear band (submucosal oedema) between enhancing mucosa and serosa.

**<!> ATTENTION**

The splenic flexure is mostly affected (Figure 45) as it is a watershed area, i.e., lies between the superior mesenteric artery (SMA) and inferior mesenteric artery (IMA) vascular territories).

Venous ischaemia tends to present with more wall thickening than is seen in arterial ischaemia.

The degree of wall thickening does not correspond to the degree of transmural necrosis.

/ Large **Bowel**

**CHAPTER OUTLINE:**

On plain radiographs, signs include **thumbprinting** (which indicates mural oedema), **pneumoperitoneum** (indicating perforation) and **gas in the portal venous system** (indicating transmural necrosis). These are also seen on CT and effort should be made to look for would be sites arterial or venous occlusion.

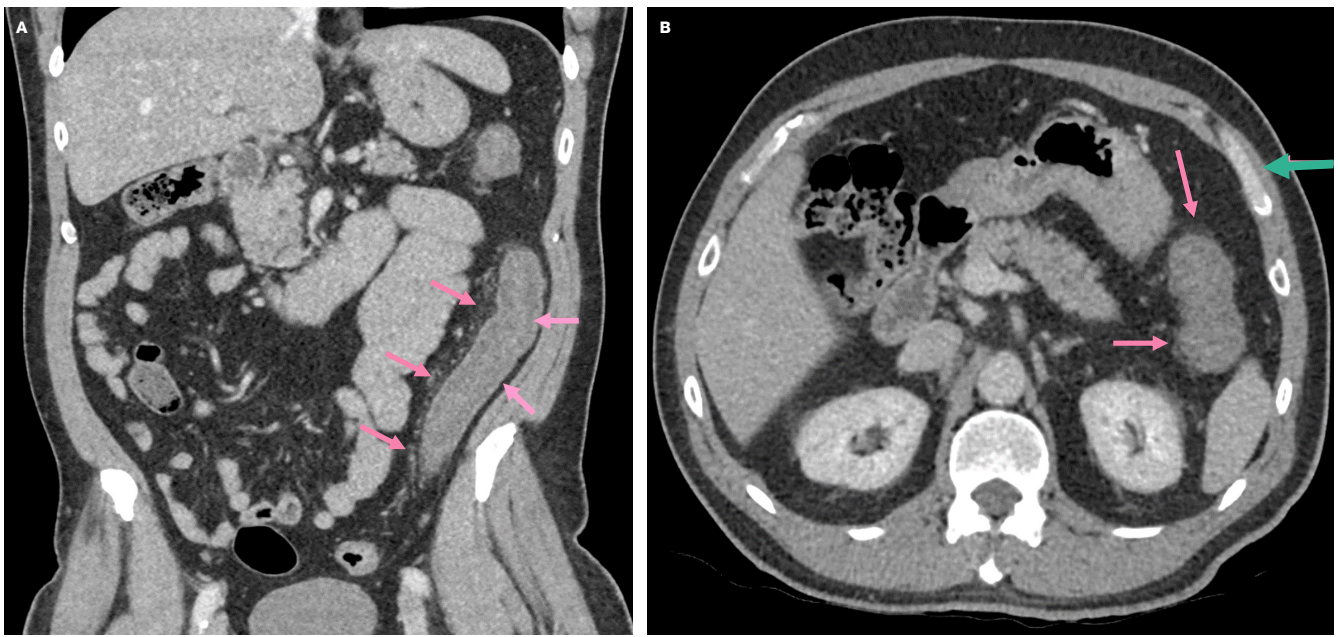



**FIGURE 47**

Coronal (**A**) and axial CT images (**B**) of a patient with ischaemic colitis affecting the descending colon and sigmoid (IMA territory). Signs are bowel wall thickening and surrounding fat stranding (**pink arrows**). Note for comparison normal fat aspect without stranding (**green arrow**).

/ Large **Bowel**

**CHAPTER OUTLINE:**

# / Infectious Colitis

## / Pseudomembranous Colitis

This is a form of infectious colitis caused by an **overgrowth of Clostridium difficile** bacteria, often as a result of broad spectrum antibiotic use. It usually presents with **fever**, **diarrhoea** and **a raised white cell count**. It can progress to a fulminant colitis which is characterised by **necrosis** and **perforation** and as such, can be a surgical emergency.

On CT MRI and US, there is marked bowel wall thickening, with submucosal hyperenhancement and submucosal oedema.

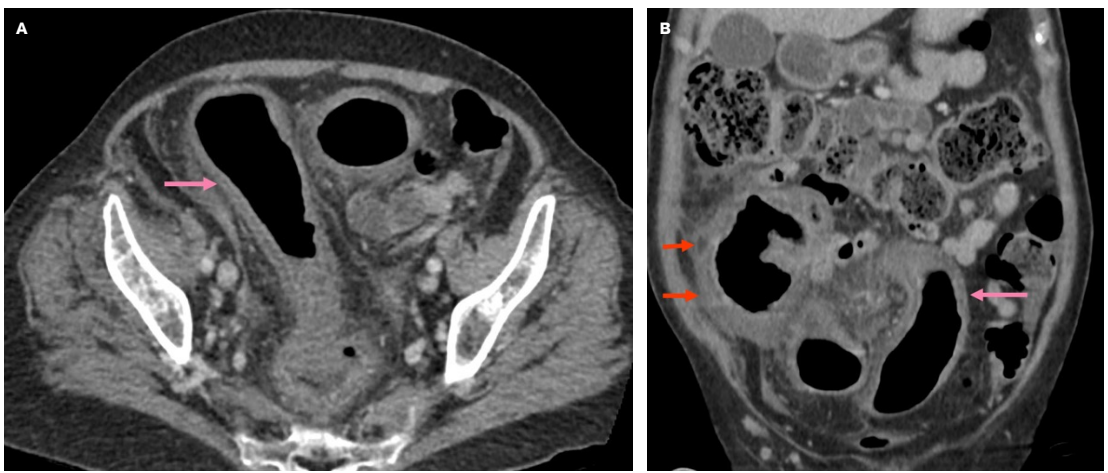



**FIGURE 48**

Axial (**A**) and coronal CT (**B**) images showing inflammation of the sigmoid colon (**pink arrow**) and the a caecum (**red arrow**) in a case of confirmed C-difficile infection.

# / Tuberculosis

This is another common infectious cause of colitis and should be considered in patients from areas where tuberculosis (TB) is endemic.

**<!> ATTENTION**

**It can affect any part of the bowel but is mostly seen in the terminal ileum and ileo-caecal region. When it affects the ileo-caecal region, it may be difficult to differentiate it from Crohn's disease.**


**FIGURE 49**

Coronal CT images of TB colitis affecting the right colon (**red arrows**). Note the presence of associated enlarged mesenteric nodes (**dotted circle**).

**>=< FURTHER KNOWLEDGE**

## Differentiating features include:

- / Ascites
- / Gross lymphadenopathy (particularly lymphadenopathy with caseous necrosis)
- / Peritoneal involvement
- / Conical contracted appearance of the caecum with a dilated terminal ileum.

# / Other organisms

Other organisms are also known to cause colonic inflammation including **Salmonella**, **shigella**, and **cytomegalovirus** (CMV).

**>=< FURTHER KNOWLEDGE**

Shigella causes mainly **left-sided colitis** and Salmonella mainly **right-sided colitis**. Left-sided colitis is also seen in patients with gonorrhoea. CMV causes a vasculitis leading to **diffuse colonic inflammation** with associated **mesenteric lymphadenopathy** and sometimes, **ascites**.

**FIGURE 50**

Coronal CT showing right-sided colitis (**orange arrow**) and enteritis affecting the distal and terminal ileum (**turquoise arrows**) in a case of confirmed shigella infection.

# / Radiation Colitis

This refers to inflammation as a **result of previous radiation therapy**. It is a **late complication** (often years after treatment) that can occur due to either **direct radiation treatment** (for example in patients with rectal cancer), or from radiation therapy to adjacent organs (such as the prostate and gynaecological organs).

Exposure to radiation **above 45 Gy** leads to **inflammation of the end arteries** resulting in **ischaemia**, **inflammation** and subsequently **fibrosis** and **stricture formation**. In some cases, there may be fistulation with adjacent structures such as the bladder or the vagina. The rectum is most commonly involved.

**>=< FURTHER KNOWLEDGE**

On imaging, findings are **bowel wall thickening**, **mesenteric fat stranding** and **widening of the pre-sacral space** and **thickening of the mesorectal fascia**.

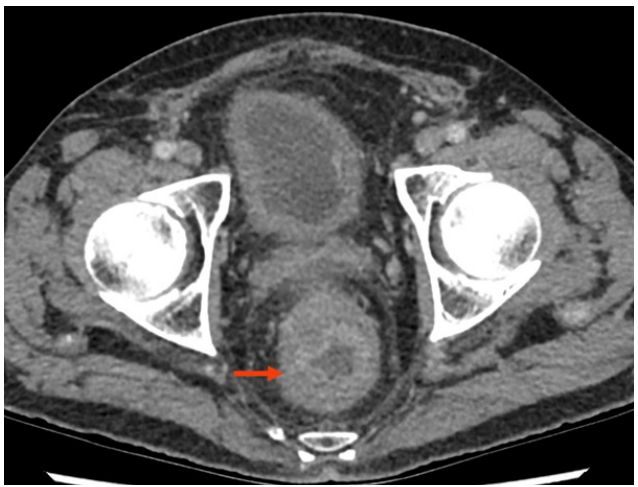


**FIGURE 51**

Axial CT showing a thickened inflamed rectum (proctitis) post radiotherapy treatment for prostate cancer (**red arrow**).

>=< FURTHER KNOWLEDGE

# / Neutropenic Colitis

This is a specific form of colonic inflammation seen in **immunosuppressed** individuals with **neutropenia**.

As with other causes of colitis, imaging findings are **wall thickening** and **oedema** (although less than seen in other infectious colitis) and signs of adjacent mesenteric inflammation (stranding).

The inflammation **usually affects the right colon** but can be confined to the caecum – a condition known as **typhlitis**.

# / Acute Fulminant Colitis

This is a late complication of colitis characterised by **transmural inflammation** and **neuromuscular degeneration** leading to gross colonic dilatation- **toxic megacolon**- and potentially, perforation.

The hallmark of fulminant colitis is a **dilated colon (> 5 cm)** with **absence of normal colonic haustra**. Fulminant colitis can be with all causes of colonic inflammation but is most commonly seen in cases of ulcerative colitis.

Abdominal X-rays are useful in assessing for colonic dilatation and particularly for monitoring. In the supine position, the transverse colon is the easiest site to observe findings as it is the least dependent part of the colon.

# Functional Disorders of the Anorectum

CHAPTER OUTLINE:

# / Functional Disorders of the Anorectum

These include **constipation**, **difficulty initiating defaecation**, to the **feeling of incomplete emptying** and needing rectal digitation to facilitate evacuation.

## / Constipation

This is a common presenting complaint and is usually as a result of slow transit of food. To assess colonic transit, several radiopaque markers with different shapes are ingested; 20 markers on day 1, 20 on day 2 and 20 on day 3. An abdominal radiograph is then obtained on Day 5 to evaluate the position of the markers. The presence of > 4 of day 1 markers, > 5 of day 2 markers and > 12 of day 3 markers is considered abnormal.

## / Dyssynergia (Anismus)

A functional inability to empty the rectum. Diagnosis can be made radiologically by **fluoroscopic** or **MR defaecating proctograms**.

**>=< FURTHER KNOWLEDGE**

Findings include:

- Delayed or incomplete evacuation (< 66% of the instilled rectal contents in 30 seconds)
- Failure of the pelvic floor and anal sphincter to relax on straining
- Co-existing anatomical findings are not infrequent
  - Anterior bulging of the rectal wall with retention within the rectocoele
  - Ancillary findings such as sigmoidocoeles/peritoneocoeles

# / Difficulty Initiating Evacuation

This is due to dyssynergia between straining and relaxation of the of the anorectal junction and is termed **anismus**.

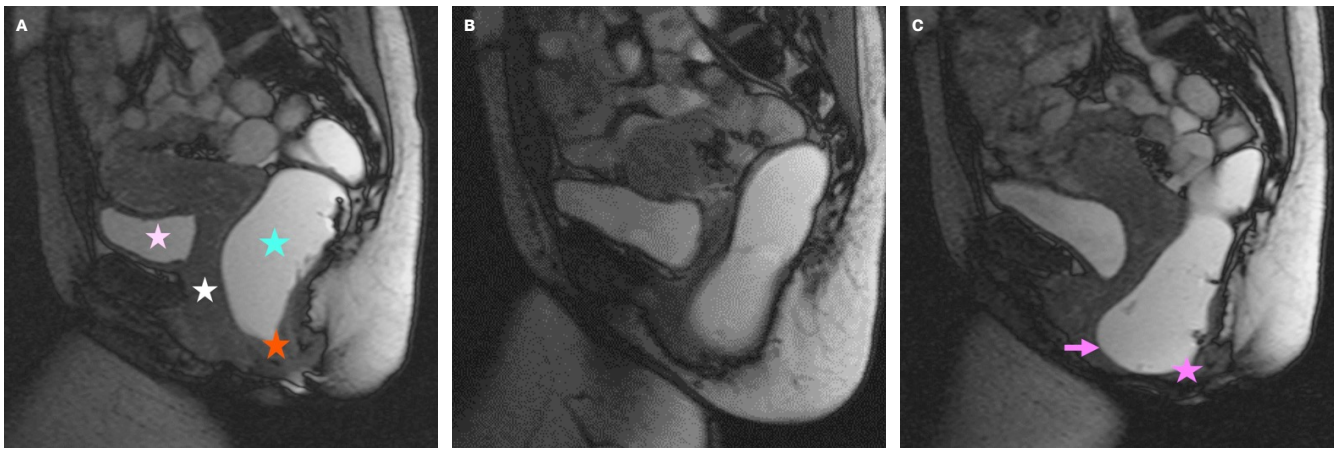



**FIGURE 52**

MR defaecating proctogram (A-C)

**A:** **Turquoise star** = rectum with instilled gel | **Pink star** = Bladder | **White star** = Vagina | **Orange star** = Anorectal junction

**B:** On straining, there is no evacuation despite relaxation of the pelvic floor evidenced by the descent of the bladder and anorectal junction

**C:** On maximum straining, there is still no evacuation of the rectal contents. This is a case of anismus. Note the anterior bulging of the rectal wall indicating a rectocoele (**purple arrow**). The **purple star** denotes the anorectal junction.

# / Incomplete Emptying

The feeling of incomplete emptying can be due to **rectocoeles** (bulging of the anterior wall of the rectum leading to pressure sensation and sometimes, faecal trapping) and **rectal intussusception**. Rectocoeles are often seen in multiparous women but are not always symptomatic.

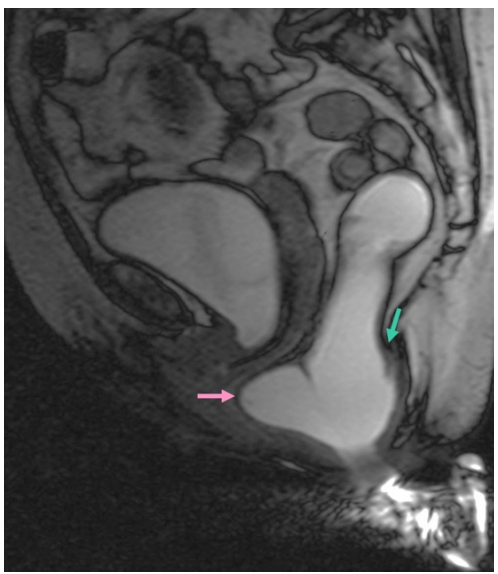


**FIGURE 53**

MR proctogram showing a rectocoele (**pink arrow**) and early rectal intussusception (**turquoise arrow**).

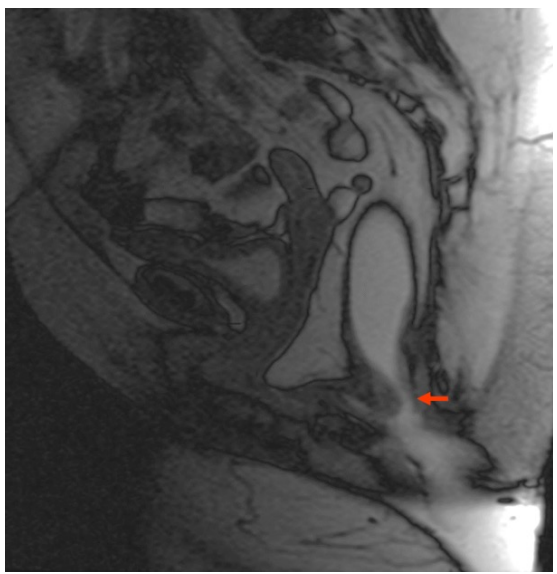


**FIGURE 54**

MR proctogram showing an obstructive rectal intussusception preventing complete evacuation. Note the narrowing of the rectum due to intussusception (**red arrow**).

# / Anal Fistula

This is an **abnormal connection between the anal canal** and the perineal skin surface via a tract. These commonly occur as a result of **cryptoglandular inflammation, or Crohn's disease**. They are often is divided into 4 types according to the Parks classification; intersphincteric, transphincteric, suprasphincteric and extrasphincteric.

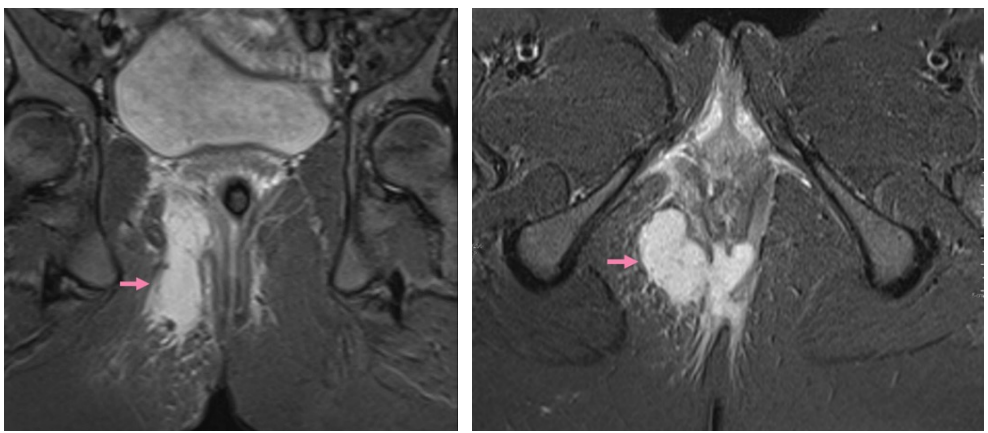


**FIGURE 55**

Coronal (**A**) and axial (**B**) MRI slices showing a perianal abscess (**pink arrows**) as a result of an anal fistula in Crohn's disease involving the puborectalis muscle.

**<!> ATTENTION**

MRI is the modality of choice for investigating anal fistulae. **T2** and **STIR** sequences show as **high signal** against the low signal of the sphincter complex and adjacent fat (on the fat supressed sequences).



**CHAPTER OUTLINE:**

# / Take-Home Messages

- / Cross-sectional imaging forms the mainstay for the imaging of colonic pathologies.
- / Abdominal radiographs have a role to play in specific situations, namely in suspected volvulus, bowel obstruction or toxic megacolon.
- / CT is the first-line imaging modality in acute or life-threatening conditions.
- / Ultrasound has a role to play in the assessment of acute appendicitis and inflammatory bowel disease.
- / MRI is mainly used for assessment of pelvic disease, namely primary staging of rectal and anal cancers, functional disorders of the anorectum and the imaging of perianal fistulas.

# / References and Further Reading

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# Test Your Knowledge

CHAPTER OUTLINE:

# / Test Your Knowledge

<?> QUESTION

1 What is the upper limit for the diameter of a normal appendix?

- ☐ 3 mm
- ☐ 4 mm
- ☐ 5 mm
- ☐ 6 mm
- ☐ 7 mm

# / Test Your Knowledge

<?> ANSWER

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- ☐ 3 mm
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- ☐ 5 mm
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- ☐ 7 mm

# / Test Your Knowledge

<?> QUESTION

## 2 How many layers does the bowel wall have on high resolution ultrasound?

- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7

# / Test Your Knowledge

<?> ANSWER

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- ☐ 3
- ☐ 4
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- ☐ 7

# / Test Your Knowledge

<?> QUESTION

## 3 Which sign is used to describe the appearance of sigmoid volvulus on an abdominal radiograph?

- ☐ Lead-pipe sign
- ☐ Comb's sign
- ☐ Target sign
- ☐ Coffee-bean sign
- ☐ Accordion sign

# / Test Your Knowledge

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# / Test Your Knowledge

<?> QUESTION

## 4 Which is the optimal imaging modality for the detection of colonic tumours and polyps?

- ☐ Abdominal radiograph
- ☐ CT colonography
- ☐ Portal-venous phase CT
- ☐ MR abdomen and pelvis
- ☐ PET-CT

# / Test Your Knowledge

<?> ANSWER

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- ☐ MR abdomen and pelvis
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# / Test Your Knowledge

<?> QUESTION

## 5 Which of the following are included in the imaging protocol for CT colonography?

- ☐ Intravenous contrast
- ☐ Faecal tagging
- ☐ Laxative preparation
- ☐ Anti-spasmolytic
- ☐ Two or more patient positions

# / Test Your Knowledge

<?> ANSWER

## 5 Which of the following are included in the imaging protocol for CT colonography?

- Intravenous contrast
- Faecal tagging
- Laxative preparation
- Anti-spasmolytic
- Two or more patient positions

# / Test Your Knowledge

<?> QUESTION

## 6 What is the gold-standard test for the local staging of rectal cancer?

- ☐ Colonoscopy
- ☐ Portal-venous phase CT
- ☐ Endoanal ultrasound
- ☐ PET-CT
- ☐ Rectal MRI

# / Test Your Knowledge

<?> ANSWER

## 6 What is the gold-standard test for the local staging of rectal cancer?

- ☐ Colonoscopy
- ☐ Portal-venous phase CT
- ☐ Endoanal ultrasound
- ☐ PET-CT
- ■ Rectal MRI

# / Test Your Knowledge



<?> QUESTION

7 In the context of rectal cancer, the circumferential resection margin (CRM) is considered involved on MRI if there is disease within what distance?

- ☐ 1 mm
- ☐ 2 mm
- ☐ 3 mm
- ☐ 4 mm
- ☐ 5 mm

# / Test Your Knowledge



<?> QUESTION

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- ■ 1 mm
- ☐ 2 mm
- ☐ 3 mm
- ☐ 4 mm
- ☐ 5 mm

# / Test Your Knowledge





<?> ANSWER

8 Familial adenomatous polyposis is one of the most common inherited polyposis syndromes. What is its inheritance pattern?

- ☐ Autosomal dominant
- ☐ Autosomal recessive
- ☐ X-lined dominant
- ☐ X-lined recessive
- ☐ Mitochondrial

# / Test Your Knowledge



<?> ANSWER

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- ☐ X-lined dominant
- ☐ X-lined recessive
- ☐ Mitochondrial

# / Test Your Knowledge



<?> QUESTION

## 9 Which of the following statements is INCORRECT?

- ☐ Ischaemic colitis most commonly involves the watershed territories.
- ☐ CT is the first-line imaging modality for the assessment of ischaemic bowel.
- ☐ Venous ischaemia tends to present with more bowel wall thickening than arterial ischaemia.
- ☐ The hepatic flexure is the most commonly affected segment in ischaemic colitis.

# / Test Your Knowledge



<?> ANSWER

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- ☐ Venous ischaemia tends to present with more bowel wall thickening than arterial ischaemia.
- ■ The hepatic flexure is the most commonly affected segment in ischaemic colitis.

# / Test Your Knowledge

<?> QUESTION

## 10 What is the first line investigation for the assessment of ulcerative colitis?

- ☐ CT
- ☐ MRI
- ☐ Ultrasound
- ☐ Colonoscopy

# / Test Your Knowledge

<?> ANSWER

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- ☐ MRI
- ☐ Ultrasound
- ■ Colonoscopy