



Abdominal Ultrasound
Chapter 8

THE GASTROINTESTINAL TRACT



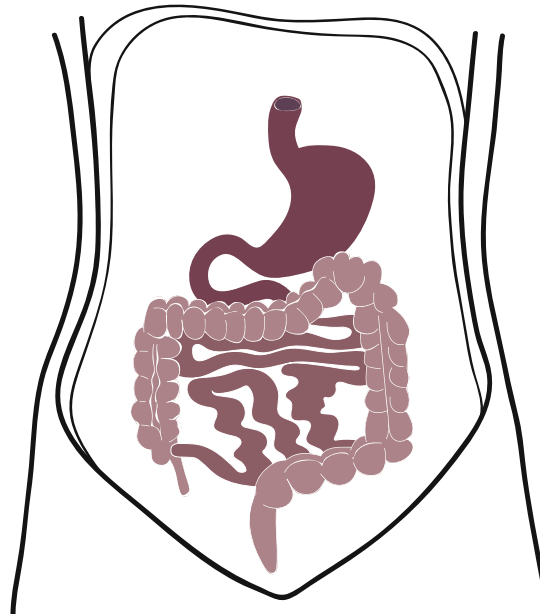
Niko Mayr

The Gastrointestinal Tract

MASTERING ULTRASOUND ANATOMY

The abdominal components of the gastrointestinal tract include the stomach, the small bowel (duodenum, jejunum, ileum), and the large bowel (cecum with its appendix vermiformis, the ascending, transverse, descending, and sigmoid colons, as well as the rectum and anal canal).

All the components of the gastrointestinal tract have fairly similar wall architecture, while the mucosal lining tends to be higher in the small bowel (surface enlargement) and lower in the more distal regions (large bowel).



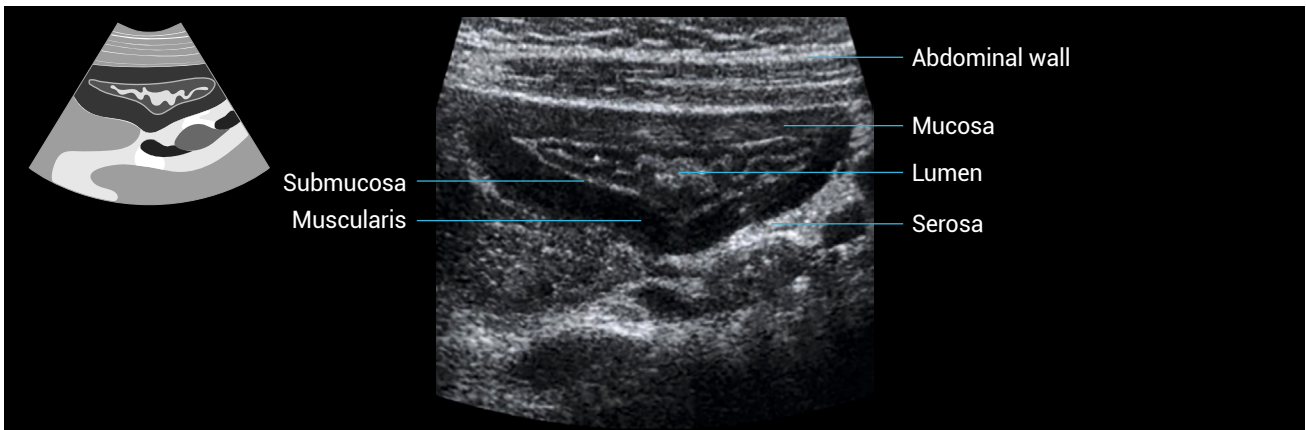
Stomach

The wall of the stomach is composed of four layers.

- **Mucosa:** the internal layer of epithelium, the lamina propria (loose connective tissue and gastric glandular tissue) and the muscularis mucosae. This layer is hyperechoic.
- **Submucosa:** a fibrous layer of connective tissue under the mucosa. This layer is hyperechoic.
- **Muscularis:** the muscular layer, which consists of an inner circular layer and an outer longitudinal layer. The stomach differs from the other GI organs as the muscularis consists of

three layers—inner oblique, middle circular and outer longitudinal. The muscularis layers are hypoechoic.

- **Serosa:** the outermost layer of the wall, consisting of connective tissue. In the duodenal bulb, jejunum, ileum, cecum, and transverse and sigmoid colon, this layer is continuous with the peritoneum. In other regions (duodenum, and ascending and descending colon) it is adhered to the fatty tissue of the retroperitoneum. This layer is isoechoic.

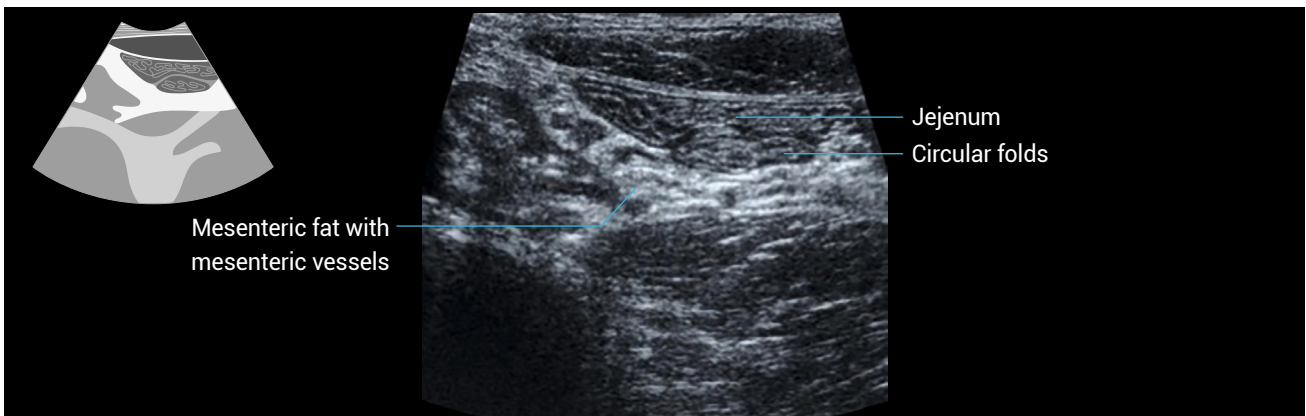


Small bowel

The image below shows the jejunum in the left middle abdomen without any distention of the lumen. You can see the typical high mucosal folds.

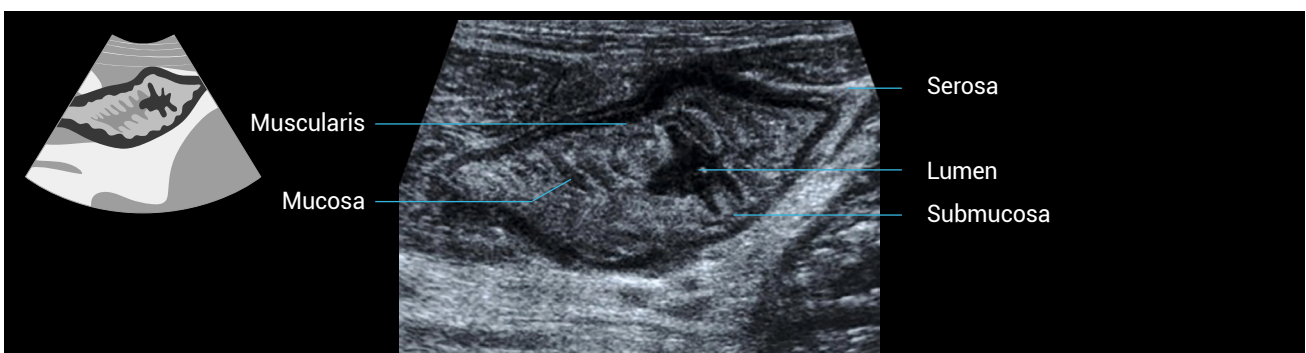
The following features can be used to differentiate jejunum and ileum:

- Jejunum is slightly wider (< 3 cm) than ileum (< 2 cm).
- Jejunum folds are thicker (2–3 mm) than ileum folds (1–2 mm).
- Jejunum folds are more numerous and deeper than ileum folds.



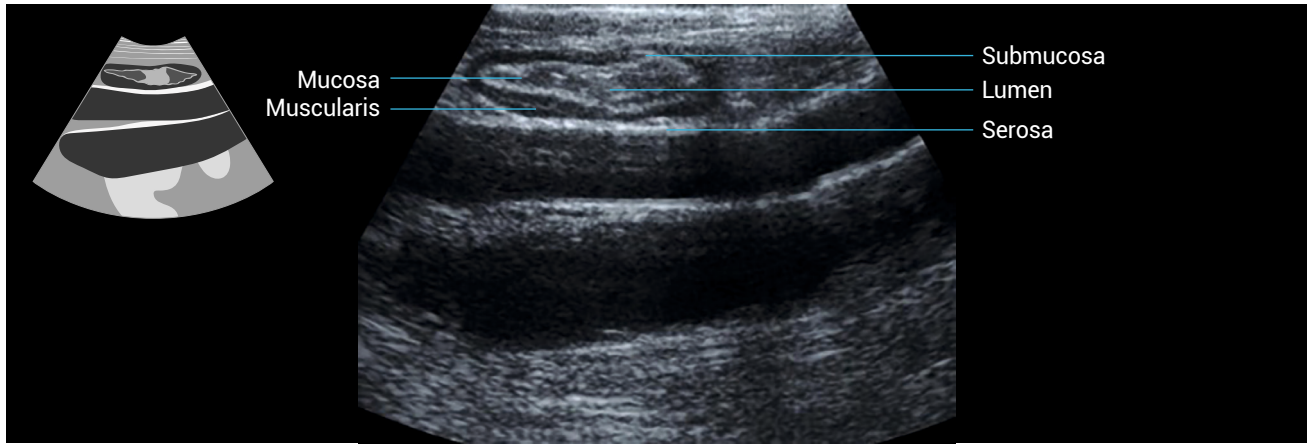
Jejunum folds

In the image below, the deep jejunum folds are visible and the different layers of the wall can be distinguished.



Large bowel

The large bowel has few mucosal folds and can be distinguished from the small bowel by its location, as it represents the colonic frame in the abdomen. When the large bowel is filled with stool and air, the wall is barely visible.



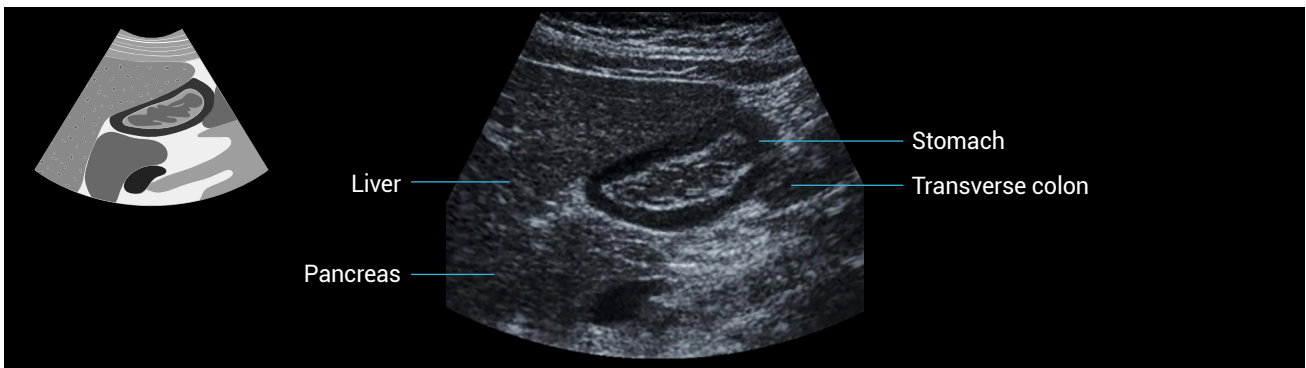
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RECOGNIZING THE LANDMARKS

Stomach antrum

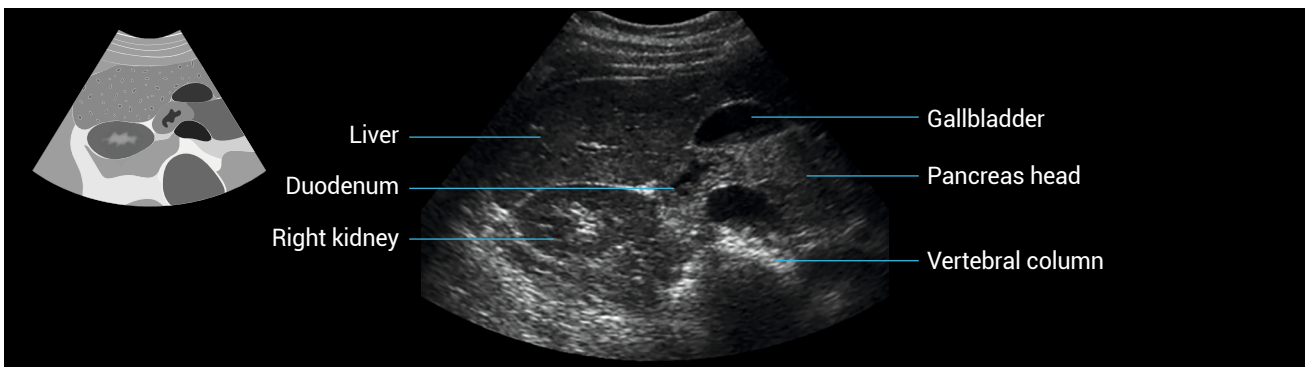
The stomach lies superficial to the pancreas and borders the transverse colon cranially.

The stomach and transverse colon are bound by the gastrocolic ligament.



Duodenum

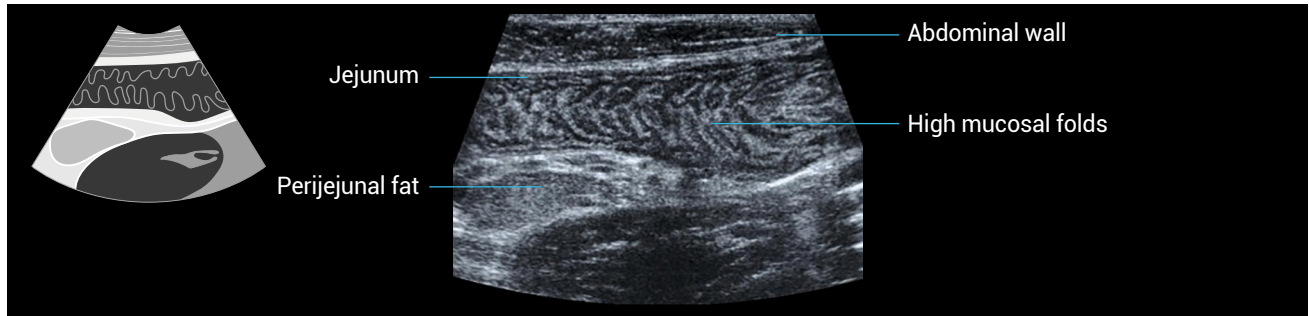
The duodenum circles the pancreatic head and borders the right liver lobe and the gallbladder caudally.



Jejunum

The small intestine is located in the left middle abdomen and borders the descending colon on the left within the colonic frame. The jejunum can

be easily distinguished since it shows the highest mucosal folds in the GI tract.



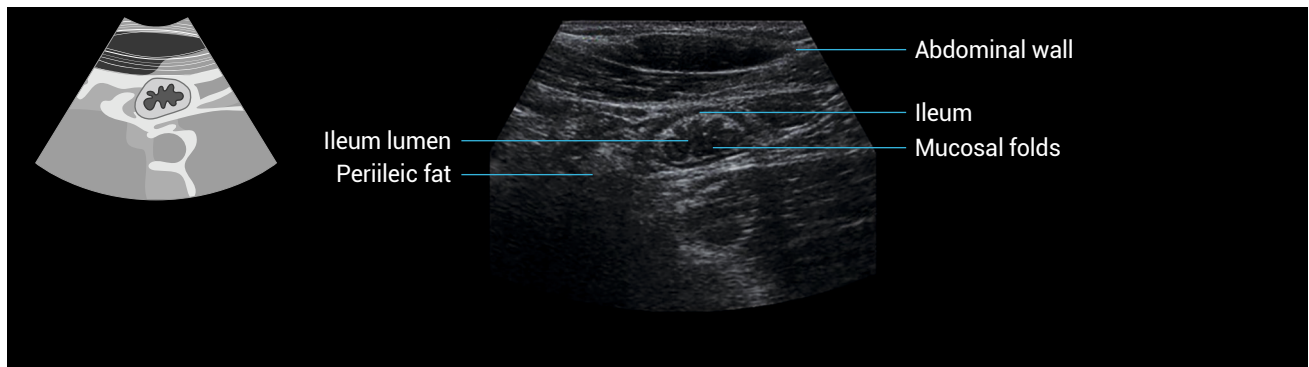
Ileum

The border between the jejunum and ileum is not distinctive.

appear lower than those of the jejunum.

The ileum is located in the lower right abdomen and when the lumen is filled with fluid the folds tend to

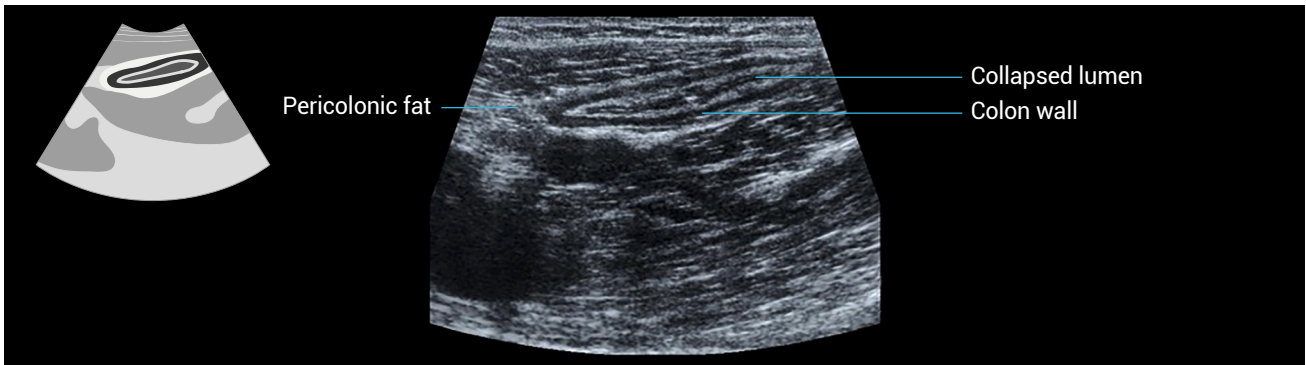
The terminal ileum is located at the cecal pouch and ends at the valve of Bauhin.



Colon—empty and distended

The colon begins at the valve of Bauhin and ends at the anal canal. The cecum is located in the right iliac fossa and is followed by the ascending, transverse, descending, and sigmoid colons, which form a frame

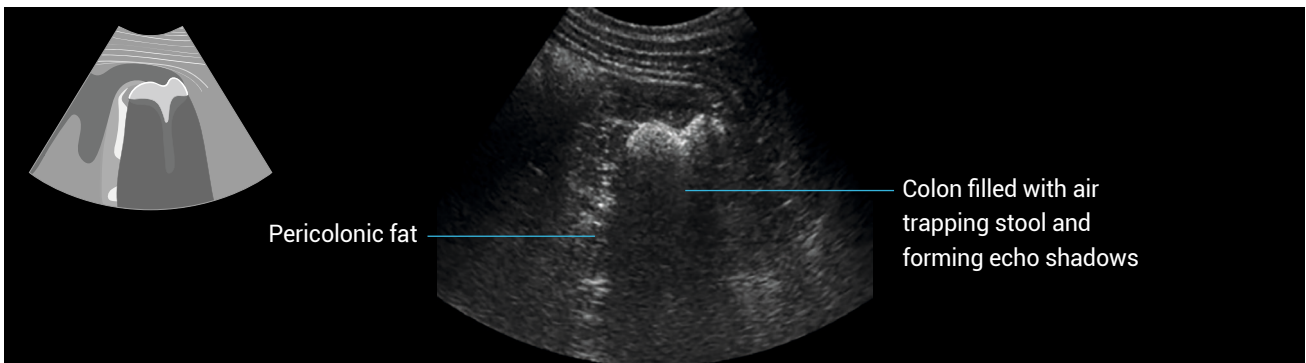
around the outside of the small bowel. The colonic wall can be easily visualized in the image below since it does not have high mucosal folds.



When the colon is filled with stool, the colonic wall is very thin and can only be faintly visualized.

In this case, the dorsal wall is not visible, since it lies in the shadows of the intraluminal air.

In most patients, the colon is filled with stool and air without motility throughout the colonic frame.



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HOW DO I DO IT?

Suggested algorithm for the ultrasound of the biliary system

1. Stomach: place your probe in the left hypochondriac region in cross section to find the stomach (alternatively, you can use the splenic window to find the large curvature of the stomach).
2. Duodenum: position your probe in cross-section following a C form around the pancreas head in the upper middle abdomen to examine the duodenum.
3. Jejunum: position your probe in the left middle abdomen.
4. Ileum: position your probe in the right lower abdomen.
5. Colon: follow the colon in cross section from the right lower abdomen to the right upper abdomen, rotate the probe 90° and follow the transverse colon to the left upper abdomen, rotate the probe another 90° and then follow the colon in cross section from the left upper to left lower abdomen and to the center of the pelvis.
6. Landmarks: pancreas head, jejunal folds, ileal folds, colonic texture in the right and left middle abdomen



Important:
Always follow the same sequence!

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IMAGING BOWEL OBSTRUCTION

Small bowel obstruction

Small bowel obstruction accounts for 80% of all mechanical intestinal obstructions, with the remaining 20% resulting from large bowel obstruction.



In developed countries, adhesions are by far the most common cause of small bowel obstructions, accounting for ~ 75% of obstructions, while in

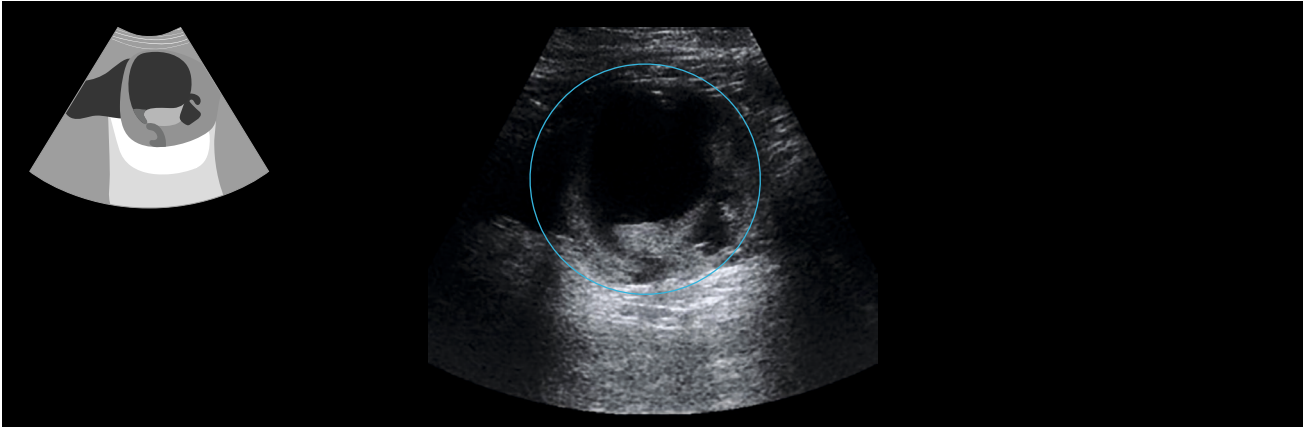
developing countries incarcerated hernias are much more common, accounting for 80% of obstructions.

Signs of bowel obstruction

- Dilated bowel loop (diameter > 2.5 cm)
- Decreased bowel peristalsis

Findings suggestive of bowel ischemia / infarction, which require urgent surgical evaluation

- Fluid-filled distended bowel with extra-luminal free fluid between bowel loops
- No peristalsis
- Bowel wall thickening > 3mm



Closed loop obstruction is a specific type of small bowel obstruction in which two points along the course of a bowel are obstructed at a single location, thus forming a closed loop. The closed loop usually rotates around its axis, forming a small intestinal volvulus.

Colon obstruction usually occurs secondary to adhesions, a twist in the mesentery, or herniation.

A similar related pathology is the large bowel volvulus (in either sigmoid or cecum).

In closed loop obstruction, there is a high risk of strangulation and bowel infarction (10–35%). The image above shows a cross-section through a small bowel with perifocal free fluid, suggesting mechanical obstruction resulting from vascular problems (closed loop obstruction).

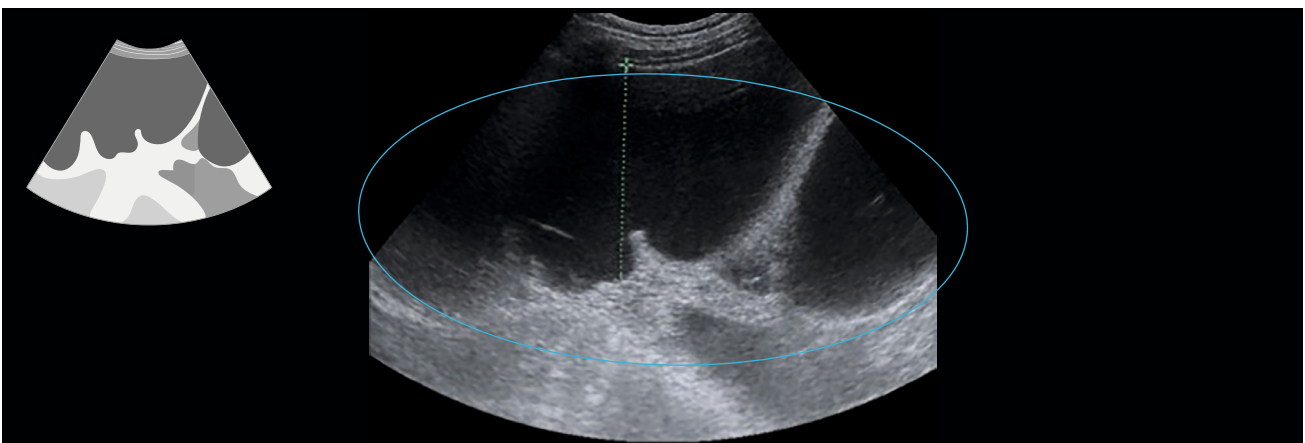
Large bowel obstruction

Large bowel obstruction occurs when there is mechanical obstruction of the large bowel, and is often impressive on imaging since the large bowel tends to become massively distended.

Large bowel obstruction requires prompt diagnosis and treatment. Colon cancer is the most common cause, contributing to approximately 40–60% of cases.

The image below illustrates the wide dilatation of the colon, which is filled with fluid. This is a typical finding in colon obstruction.

Following the colonic frame with the linear array probe, from the coecal pole to the rectum, can assist in locating the volvulus or the obstructing tumor.



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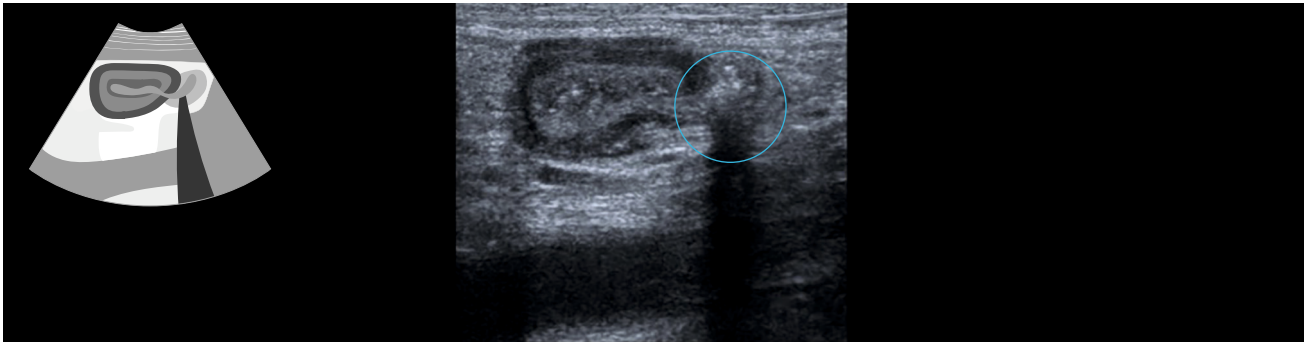
DIAGNOSING DIVERTICULITIS

Diverticulitis

Colonic diverticula are almost all false diverticula, which are characterized by mucosa herniating through a defect in the muscularis and being covered by overlying serosa (where present).

While the entire colon can be affected by colonic diverticula, they are most common in the sigmoid colon and, to a lesser extent, in the descending colon.

This herniation typically occurs where nutrient arteries enter the colon, and is therefore more common on the mesenteric side of the colon.



Diverticulitis

Diverticulitis is the result of obstruction of the neck of the diverticulum, with subsequent inflammation, perforation, and infection. Initially, inflammation and infection are contained by inflammatory phlegmon. The infection may later progress to abscess formation and / or generalized peritonitis.

- Pericolic fat stranding, often disproportionately prominent compared to the amount of bowel wall thickening.
- Segmental thickening of the bowel wall.
- The affected diverticulum may show wall thickening and hypoechoic texture.
- The stool stone can sometimes be localized within the affected diverticulum neck.

The following ultrasound features are characteristic of diverticulitis:



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IDENTIFYING APPENDICITIS

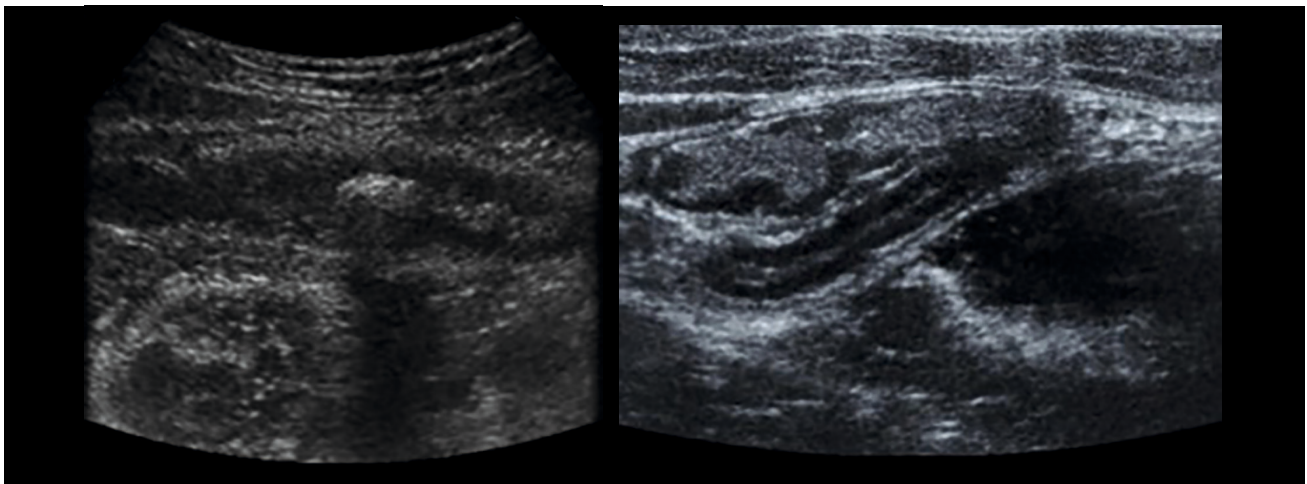
Appendicitis occurs when there is inflammation of the vermiform appendix. It is a very common condition in general radiology practice and is one of the main reasons for abdominal surgery in young patients.

Symptoms of appendicitis include

- Fever
- Localized pain and tenderness (right lower quadrant pain over appendix)
- Leukocytosis
- Nausea and vomiting

Ultrasound, with its lack of ionizing radiation, should be the investigation of choice in young patients. With a competent user, ultrasound is reliable at identifying abnormal appendices, especially in thin patients.

However, the identification of a normal appendix using ultrasound is more problematic, and in many instances appendicitis cannot be ruled out.



The left image shows a normally structured appendix next to a hypertrophic lymph node.

The right image shows an appendicolith with mural wall thickening.

The best way to locate the appendix using ultrasound is to single out the cecal pole in the right lower quadrant and then, using the linear ultrasound probe in a cross-section over the body, find the point at which the terminal ileum enters the colon.

Once this structure has been identified, the appendix root, which is normally located behind and caudally neighboring the terminal ileum, can be localized.