

Peritoneal ligaments and spaces: a comprehensive review

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Learning objectives

- 1.To provide an overview of peritoneal ligaments as studied by computed tomography (CT) including normal and abnormal findings.
- 2.To review the normal anatomy of the peritoneal spaces and to provide an overview of the multiple pathologic processes that may affect these compartments, with emphasis on the role of CT.

Background

Disease processes commonly spread either transperitoneally or subperitoneally. In transperitoneal spread, disease commonly penetrates through the peritoneal layer and disseminates into the peritoneal cavity. Subperitoneal spread occurs when disease processes spread along the subperitoneal space of the peritoneal ligaments between the two layers of the peritoneum. The subperitoneal space is a large, interconnecting potential space that extends from the retroperitoneum into the peritoneal cavity. It thus represents a significant conduit for the spread of disease within the peritoneal cavity.

Overview

The peritoneum is a serous sac consisting of a thin mesothelial membrane that lines the abdominal and pelvic cavities and covers most of the abdominal organs contained therein.

It is divided arbitrarily into 2 types:

- the visceral peritoneum (3)
- and the parietal peritoneum (4)

Figure 1: abdominal viscera (1); peritoneal cavity (2); visceral peritoneum (3); parietal peritoneum (4); peritoneal reflection (5)

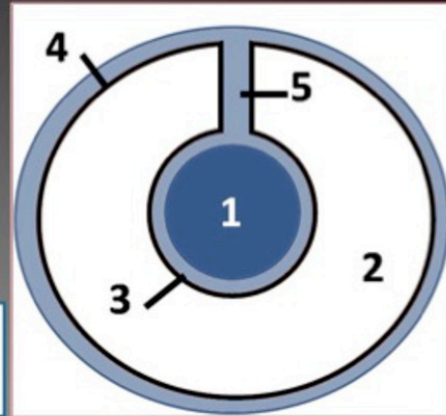


Fig. 1: Overview

References: J. F. Costa; Coimbra, PORTUGAL

Overview

1. The small and large intestines are suspended from the posterior aspect of the peritoneal cavity by the mesentery, which serves as a conduit for the blood vessels, nerves, and lymphatic vessels going to and from the abdominal organs.
2. The omentum is a double-layer extension of visceral peritoneum that extends from the stomach.
3. Other peritoneal ligaments, such as the gastrosplenic ligament and splenorenal ligament, are also formed by fused double layers of peritoneum.

Fig. 2: Overview

References: J. F. Costa; Coimbra, PORTUGAL

Imaging findings OR Procedure details

This exhibit describes and illustrates the complex anatomy of the peritoneum. We present a comprehensive review of the peritoneal reflections (falciform, coronary and phrenocolic ligaments; lesser and greater omenta, transverse and sigmoid mesocolon; small bowel mesentery) and peritoneal spaces.

Peritoneal reflections

These peritoneal reflections are generally recognizable on CT scans as fat-containing structures, either by their location or by their major constituent vessels:

1. Gastrohepatic ligament
2. Hepatoduodenal ligament
3. Gastrosplenic ligament
4. Splenorenal ligament
5. Gastrocolic ligament
6. Transverse mesocolon
7. Sigmoid mesocolon
8. Small bowel mesentery
9. Other ligaments
 - a) Falciform
 - b) Coronary and triangular
 - c) Phrenicocolic
 - d) Duodenocolic

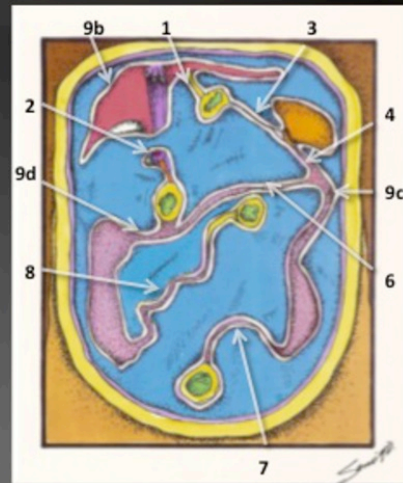


Fig. 4: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Gastrohepatic ligament

1. Definition

- Lesser omentum
- Extends from the fissure for the ligamentum venosum to the lesser curvature of the stomach

2. Landmarks

- Left and right gastric arteries, coronary vein and left gastric lymph nodes

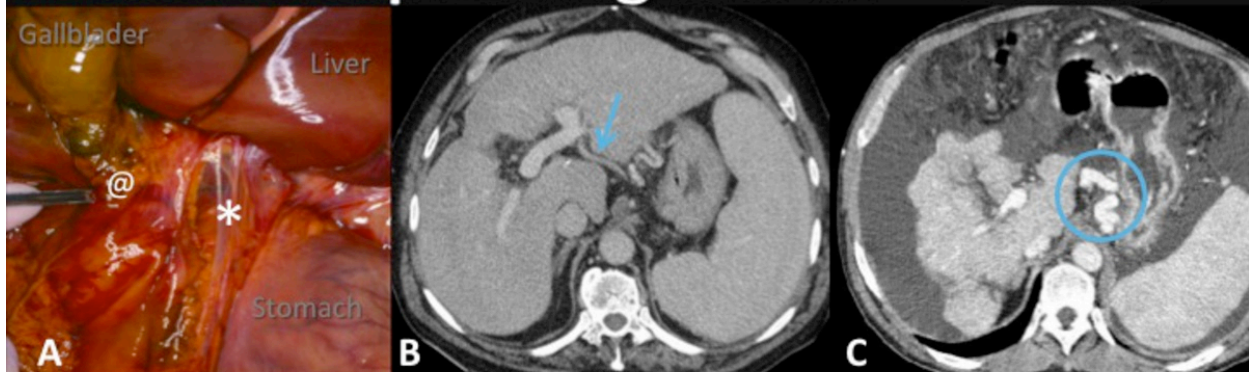
3. Common pathology

- Pathway for bidirectional spread of disease between the stomach and the left hepatic lobe
- Varices
- Nodal metastases (nodes are abnormal when >8mm)

Fig. 5: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Gastrohepatic ligament



A) **Human cadaveric dissection of the abdomen.** The lesser sac and the greater peritoneal cavity communicate through the epiploic foramen of Winslow. This foramen is located anterior to the inferior vena cava and posterior to the hepatoduodenal ligament (@). The anterior limit of the lesser sac corresponds to the gastrohepatic ligament (*). B) **Replaced left hepatic artery.** The image shows a contrast enhanced vessel (→) extending the entire length of the fissure for the ligamentum venosum. Normally, there should be no identifiable structures in the fissure for the ligamentum venosum. One common normal variant is to see an artery arising from the left gastric artery that extends into this fissure and supplies the left lobe of the liver. C) Dilatation of a vascular structure, adjacent to the lesser curvature of the stomach, corresponding to a **right gastric varix** (circle).

Fig. 6: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Hepatoduodenal ligament

1. Definition

- Free margin of the lesser omentum
- From the flexure between 1st and 2nd portion of the duodenum to the porta hepatis

2. Landmarks

- Portal vein (PV), hepatic artery (HA), bile duct (CBD)
- Nodes can be normal up to 2cm in width and 1,5cm in height

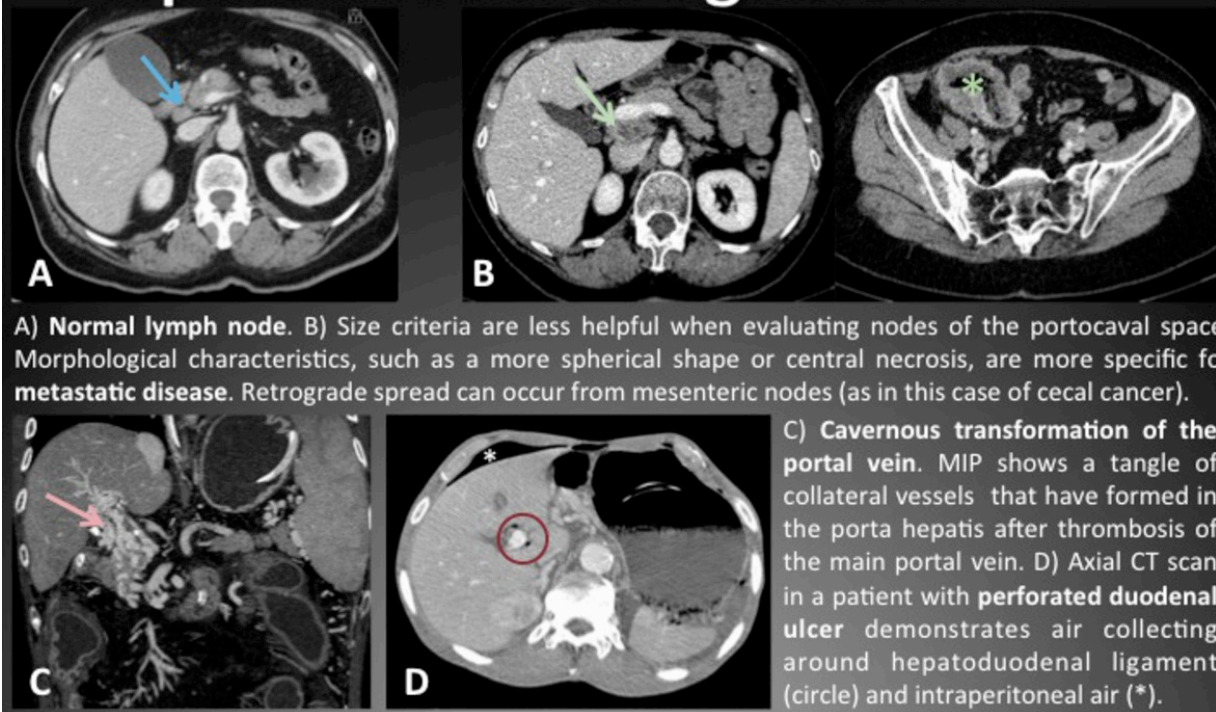
3. Common pathology

- Lymphadenopathy
- Direct spread of adjacent disease (namely, pancreaticobiliary)
- Pathology involving PV, HA and CBD

Fig. 7: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Hepatoduodenal ligament



A) Normal lymph node. B) Size criteria are less helpful when evaluating nodes of the portocaval space. Morphological characteristics, such as a more spherical shape or central necrosis, are more specific for metastatic disease. Retrograde spread can occur from mesenteric nodes (as in this case of cecal cancer).

C) Cavernous transformation of the portal vein. MIP shows a tangle of collateral vessels that have formed in the porta hepatis after thrombosis of the main portal vein. D) Axial CT scan in a patient with perforated duodenal ulcer demonstrates air collecting around hepatoduodenal ligament (circle) and intraperitoneal air (*).

Fig. 8: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Gastrosplenic ligament

1. Definition

- Left lateral extension of the greater omentum connecting the greater curvature of the stomach with the spleen.
- It forms the lateral boundary of the lesser sac

2. Landmarks

- Short gastric vessels, left gastroepiploic vessels

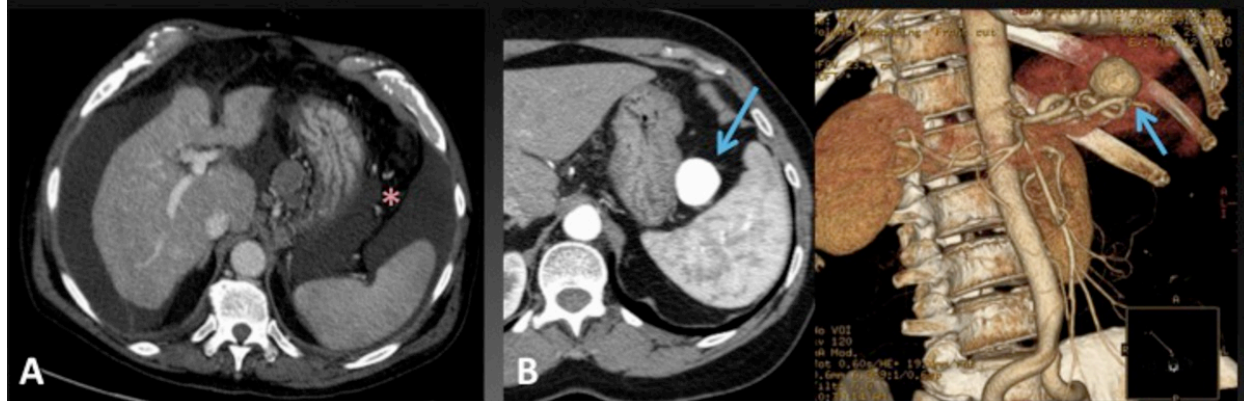
3. Common pathology

- Conduit for the spread of disease between the pancreatic tail (via the splenorenal ligament), spleen, and stomach

Fig. 9: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Gastrosplenic ligament



A) The **gastrosplenic ligament** is identified as the fat tissue (*), surrounded by ascites, between the greater curvature of the stomach and the splenic hilum. It contains the left gastroepiploic vessels; B and C) Arterial phase contrast-enhanced CT scan and corresponding VRT show distal **splenic artery aneurysm** located near splenic hilum.

Fig. 10: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Splenorenal ligament

1. Definition

- Surrounds a region of the pancreatic tail and extends to the left anterior pararenal space

2. Landmarks

- Splenic artery and vein

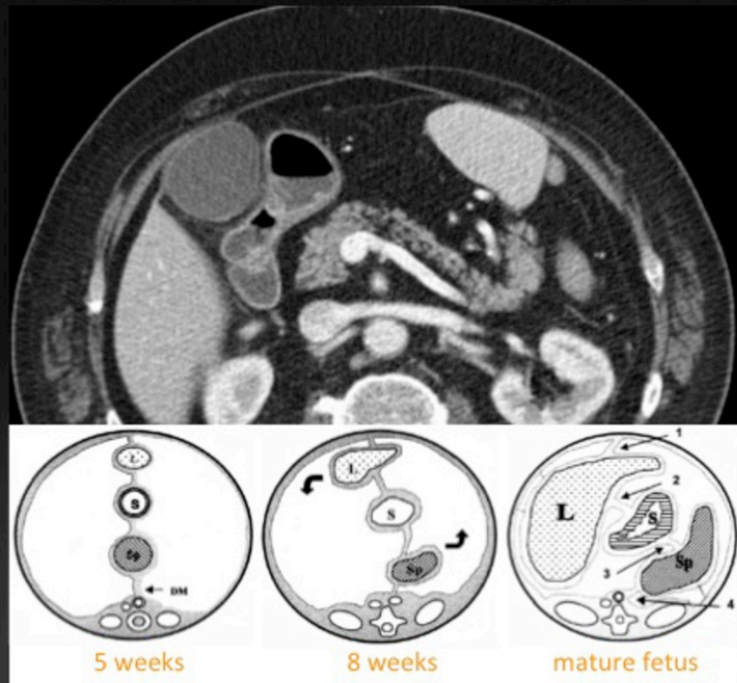
3. Common pathology

- Most commonly represents a conduit of disease from the pancreas to the retroperitoneum, splenic hilum and stomach (via gastrosplenic ligament)
- Varices

Fig. 11: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Splenorenal ligament



The spleen and dorsal portion of the pancreas appear by the fifth gestational week between the folds of the dorsal mesogastrium, which contains the splenic vessels and accompanying nerves.

The mesentery of the pancreas fuses with the posterior parietal peritoneum, leaving the spleen suspended by the splenorenal ligament and gastrosplenic ligament. Incomplete fusion can create a potential intraperitoneal space posterior to the pancreatic tail. In the case presented here, one can see an ectopic spleen accompanied by anterior deviation of the pancreatic tail.

Fig. 12: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Gastrocolic ligament

1. Definition

- Greater omentum; joins the greater curvature of the stomach to the transverse colon
- Formed by the fusion of four layers of peritoneum that extend from the stomach and drape over the colon and loops of small bowel extending into the pelvis

2. Landmarks

- Right and left gastroepiploic vessels, gastrocolic trunk

3. Common pathology

- “Abdominal policeman”
- Direct spread of disease between stomach, transverse colon and pancreas

Fig. 13: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Gastrocolic ligament



A) Human cadaveric dissection of the abdomen shows the greater omentum composed mainly of fatty tissue. The greater omentum hangs down like an apron from the greater curvature of the stomach and the proximal part of the duodenum, covering most of the small bowel loops. B) Omental cake (*). The protective role of the greater omentum is related to its ability to phagocytize inflammatory processes, contain bowel wall injuries, and become involved in metastatic disease of the peritoneal cavity; C) Dilated veins (→) within this ligament represent dilated gastroepiploic collaterals resulting from splenic venous compromise, in the setting of complicated pancreatitis.

Fig. 14: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Small bowel mesentery

1. Definition

- Fan-shaped structure extending obliquely from the duodenojejunal junction to the ileocecal valve

2. Landmarks

- Mesenteric vessels and fat

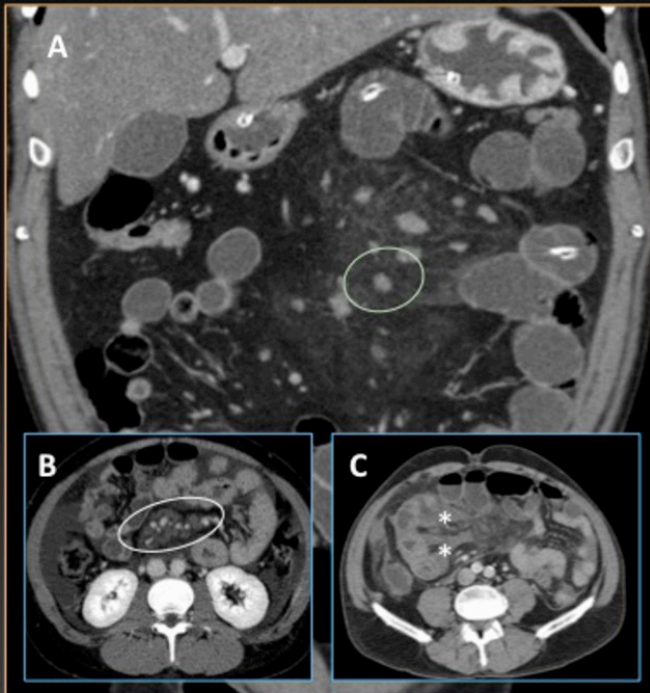
3. Common pathology

- Mesenteric pathology appears as:
 - rounded or 'cake-like' masses,
 - ill-defined masses,
 - stellate appearance.

Fig. 15: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Small bowel mesentery



The term “**misty mesentery**” describes the CT appearance of mesenteric fat infiltrated by inflammatory cells, fluid (edema, lymph, and blood), tumor, and fibrosis. With infiltration of the mesentery by fluid or cells, the mean density of this fat increases to -40 to -60 UH. Depending on the nature and extent of the infiltration, mesenteric vessels may be either completely or partially effaced.

- A) Mesenteric panniculitis causes misty mesentery. Mild adenopathy is seen in mesentery. Note halo of fat around mesenteric nodes.
- B) Small-bowel vasculitis secondary to systemic lupus erythematosus.
- C) Trauma. High-density fluid is noted within mesentery.

Fig. 16: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Small bowel mesentery



A) **Carcinoid tumor.** CT scan shows a fibrotic spiculated mesenteric mass (→). Calcifications were seen on contiguous scans. These features overlap with those of retractile mesenteritis in addition to several other entities. B) **Mesenteric cyst.** Routine CT scan of the abdomen shows a fluid-filled mass (*) in the root of the mesentery. C) **Intraabdominal desmoid (fibromatosis)** in a 49-year-old man with no history of familial adenomatous polyposis syndrome. Axial contrast-enhanced CT image shows a solitary mesenteric mass with a smooth border (→).

Fig. 17: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Mesocolon

- The dorsal mesocolon undergoes extensive posterior fusion.
- The ascending and descending portions of the dorsal mesocolon lie in their lateral positions and fuse with the parietal peritoneum, as does the mesorectum.
- The appendix cecum, transverse mesocolon and sigmoid mesocolon persist.

Fig. 18: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Transverse mesocolon

1. Definition

- Extends from the pancreas to invest the region of the transverse colon inferiorly
- On the right, it is in continuity with the duodenocolic ligament and, on the left, the phrenicocolic ligament and SRL. This structure also has continuity with the GCL representing the greater omentum and extending to the inferior aspect of the stomach. In the middle it is continuous with the small bowel mesentery.

2. Landmarks

- Middle colic vessels

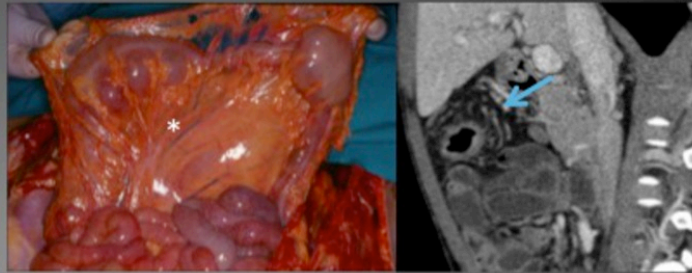
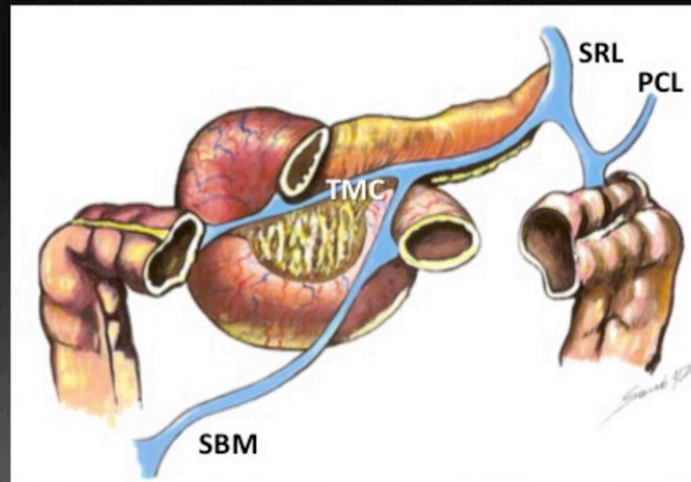


Fig. 19: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Transverse mesocolon



The pancreas is centrally located within the subperitoneal space and in continuity with the abdominal organs via their mesenteric attachments. Neoplasms and inflammation can spread from the pancreas directly to the spleen via the splenorenal ligament (SRL), to the colon via the transverse mesocolon (TMC), to the liver via the hepatoduodenal ligament, and into the small bowel mesentery (SBM) along the superior mesenteric vessels. (PCL: phrenicocolic ligament)

Fig. 20: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Transverse mesocolon

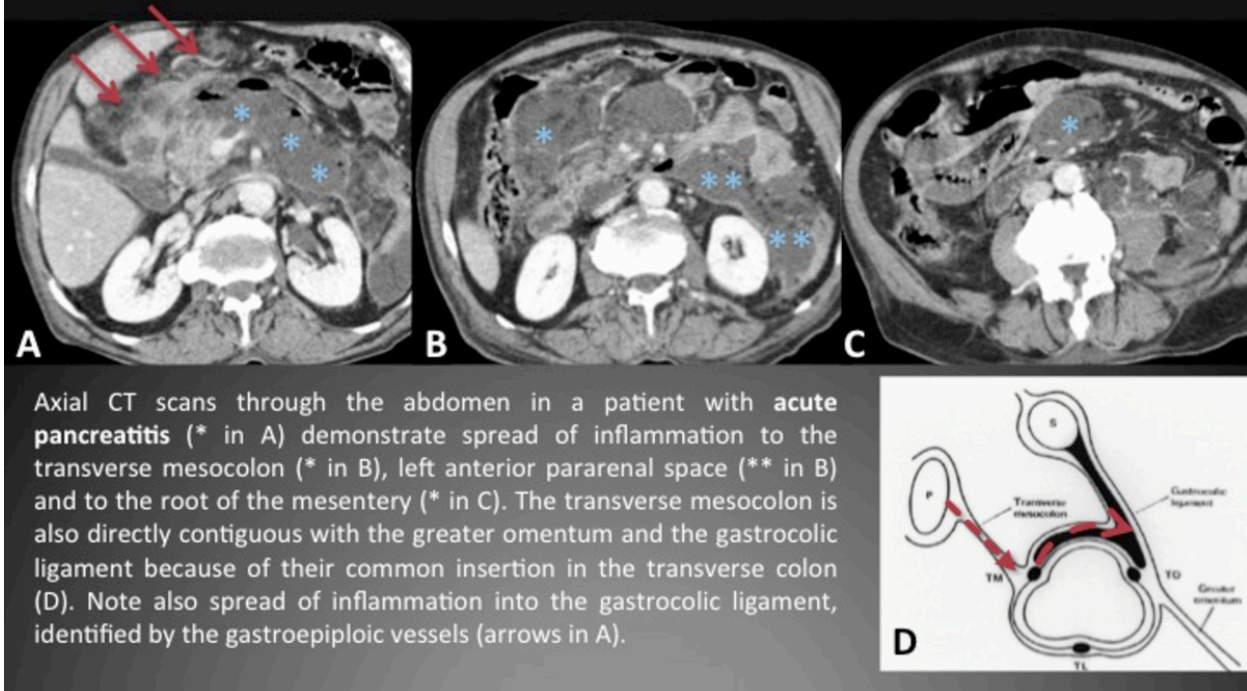


Fig. 21: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Sigmoid mesocolon

1. Definition

- Peritoneal fold attaching the sigmoid colon to the pelvic wall

2. Landmarks

- Sigmoid vessels

3. Common pathology

- Various processes involving the sigmoid colon including diverticulitis and colonic malignancy can involve this structure.
- It also may be involved with metastatic disease from pelvic malignancies, especially ovarian carcinoma.
- Sigmoid mesocolon hernias account for 6% of all internal hernias.

Fig. 22: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Sigmoid mesocolon

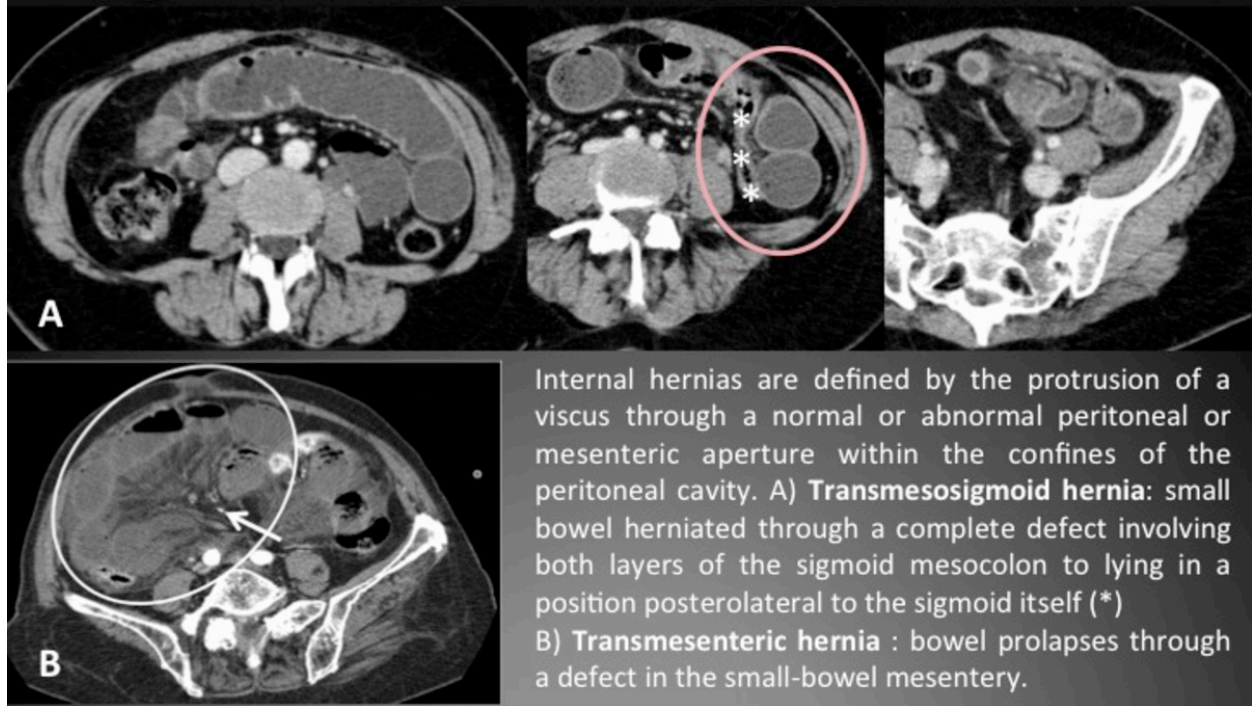


Fig. 23: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Other ligaments

1. Falciform ligament

- Extends from fissure for the ligamentum venosum to the anterior abdominal wall (arrows).
- The falciform ligament contains the ligamentum teres that corresponds to the obliterated paraumbilical vein (*).
- Provides a potential conduit for transmission of inflammation or hemorrhage from remote organs such as the pancreas (via gastrohepatic ligament) to the anterior abdominal wall

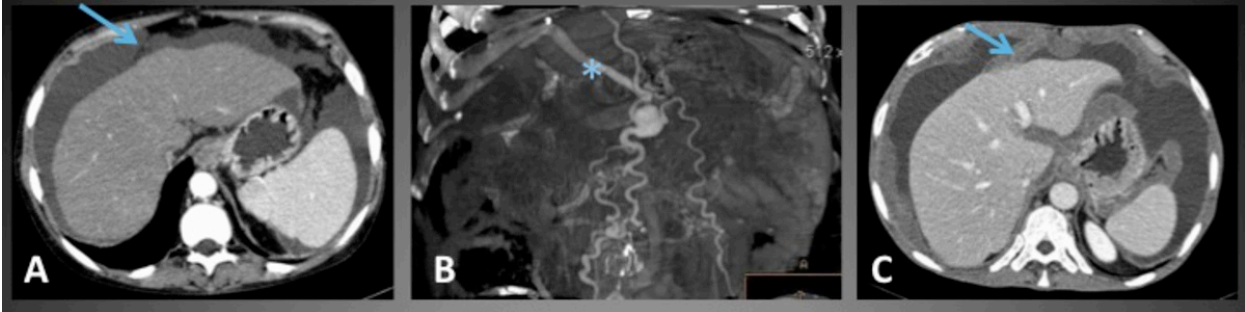


Fig. 24: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Other ligaments

2. Coronary and triangular ligaments

- The bare area of the liver is formed by the peritoneal reflection over the posterior portion of the liver embedded in the diaphragm (A).
- The bare area is delineated by the coronary ligament (central), and the right and left triangular ligaments (lateral).
- In patients with sufficient ascites (* in B), the bare area is identified as the area along the posterior surface of the liver adjacent to the diaphragm that is spared by the fluid (→ in B).

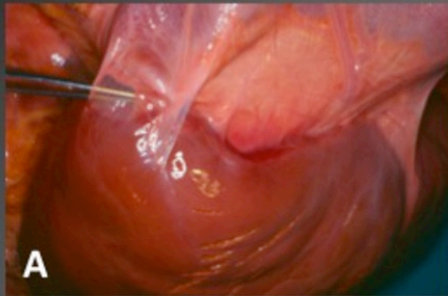


Fig. 25: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Other ligaments

3. Phrenicocolic ligament

- Corresponds to the left lateral extension of the root of the transverse mesocolon; it is a suspensory ligament of the spleen
- Acts as a conduit among the pancreas, colon, spleen, and left retroperitoneum for the spread of disease.

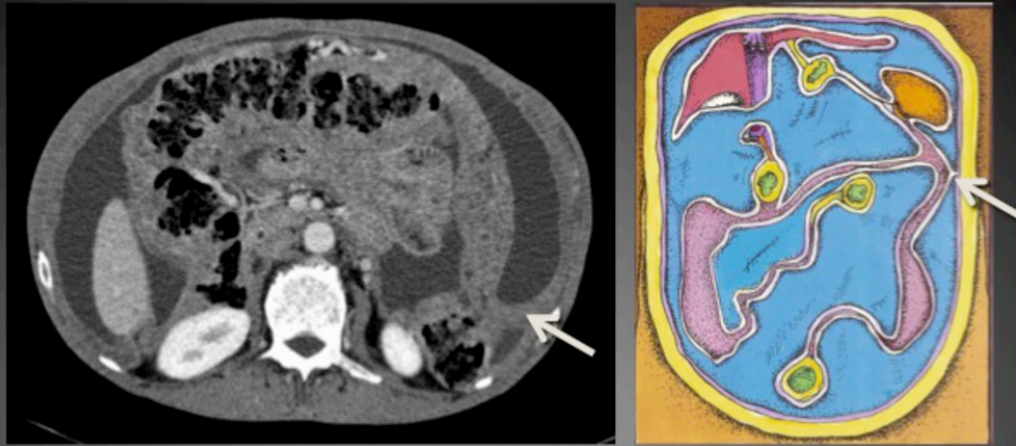


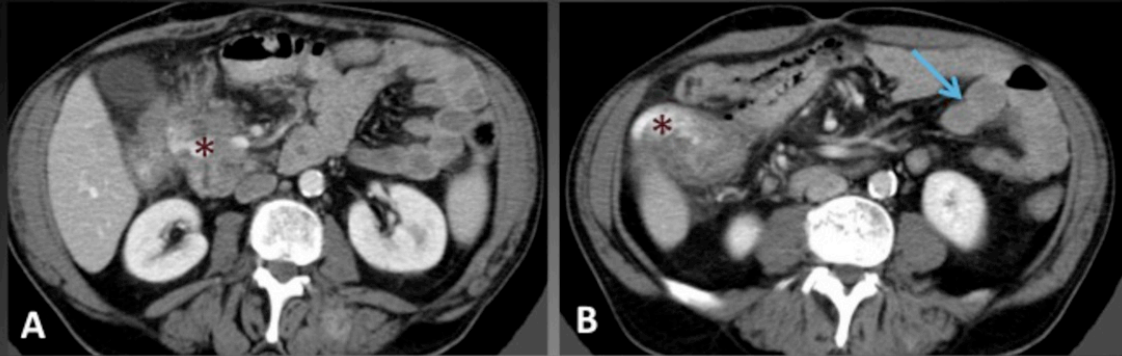
Fig. 26: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Other ligaments

4. Duodenocolic ligament

- A potential route of spread exists between the right colon and the duodenum via the rightward aspect of the transverse mesocolon (duodenocolic ligament).



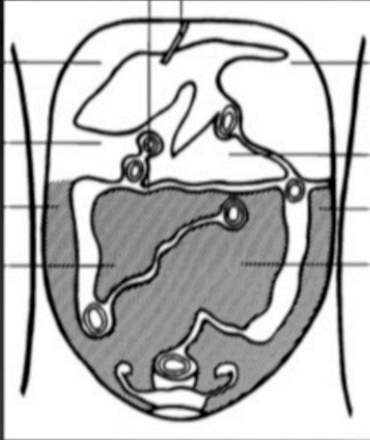
Contrast-enhanced CT shows (A) a poorly defined mass apparently including the duodenum and the colon. A small amount of positive oral contrast agent (*) is present within the mass. An image obtained caudally (B) shows oral contrast agent in the colon (*) without evidence of contrast in the jejunum (arrow), a feature related to colo-duodenal fistula.

Fig. 27: Peritoneal reflections

References: J. F. Costa; Coimbra, PORTUGAL

Peritoneal spaces

The peritoneal compartments and recesses are potential spaces within the abdominal cavity formed by the posterior and anterior parietal attachments of the membranes and ligaments discussed earlier.



The root of the transverse mesocolon is the central dorsal attachment that divides the abdominal cavity into the supramesocolic and inframesocolic compartments.

Healy JC, Reznek RH. The peritoneum, mesenteries and omenta: normal anatomy and pathological processes. Eur Radiol. 1998;8(6):886-900

Fig. 28: Peritoneal spaces

References: J. F. Costa; Coimbra, PORTUGAL

Supramesocolic region

The more complex supramesocolic space is divided into right and left sides which are further subdivided by upper abdominal organs, ligaments and mesenteries.

1. Right peritoneal spaces

- Lesser sac
- Right anterior perihepatic space
- Right posterior perihepatic space (Morison's pouch)

2. Left peritoneal spaces

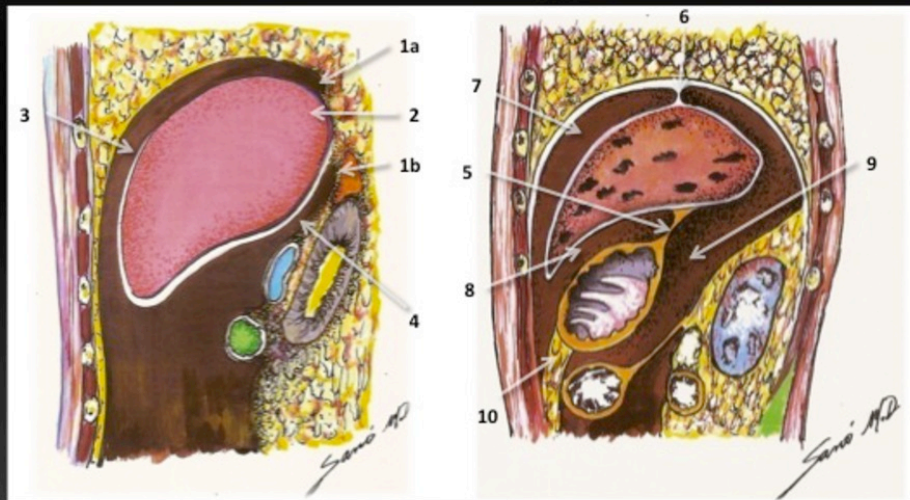
- Left anterior perihepatic space
- Left posterior perihepatic space (gastrohepatic recess)
- Left anterior subphrenic space
- Perisplenic space

Paul M Silverman; "The subperitoneal space: mechanisms of tumor spread in the peritoneal cavity, mesentery, and omentum"; *Cancer Imaging* (2003) 4, 25–29

Fig. 29: Peritoneal spaces

References: J. F. Costa; Coimbra, PORTUGAL

Supramesocolic region



1. Right coronary ligament: superior (a) and inferior (b) reflection; 2. Bare area of liver; 3. Right anterior perihepatic space; 4. Right posterior perihepatic space (Morison's pouch); 5. Lesser omentum; 6. Left triangular ligament; 7. Left anterior perihepatic space; 8. Left posterior perihepatic space (gastrohepatic recess); 9. Lesser sac; 10. Greater omentum

Fig. 30: Peritoneal spaces

References: J. F. Costa; Coimbra, PORTUGAL

Supramesocolic region

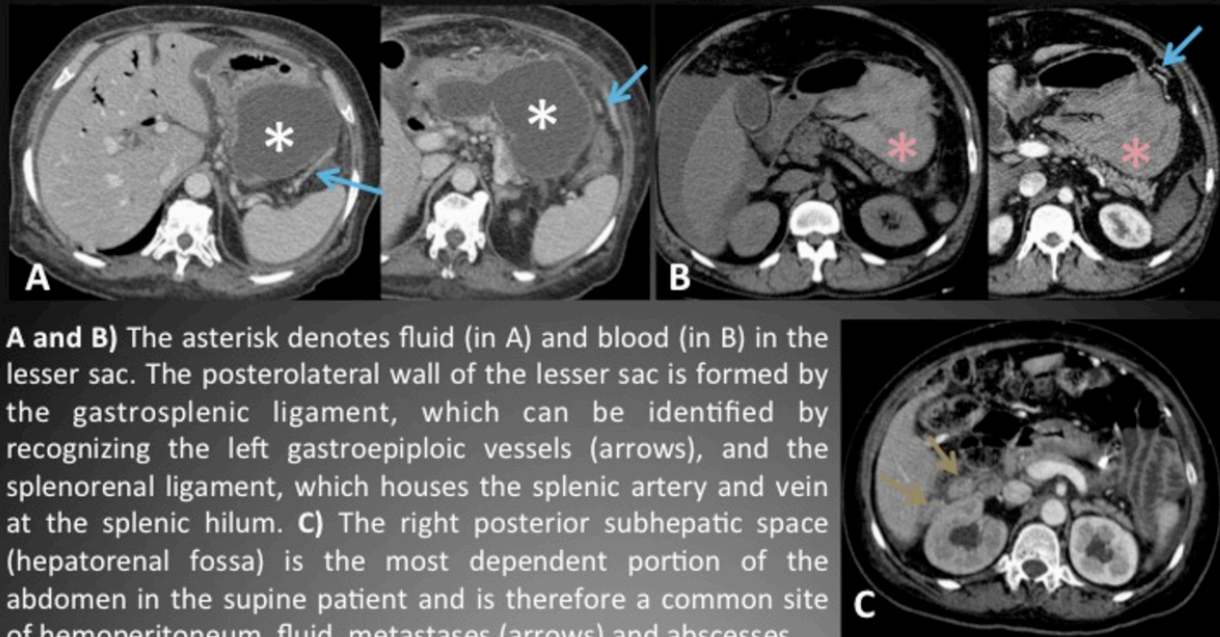


Fig. 31: Peritoneal spaces

References: J. F. Costa; Coimbra, PORTUGAL

Supramesocolic region

As a result of rotation and growth of the stomach during fetal development, the lesser sac is a unique peritoneal space that extends behind the stomach, anterior to the pancreas. Contains three recesses: superior, splenic and inferior.

- The superior recess of the lesser sac surrounds the caudate lobe of the liver and is separated from the splenic recess by the gastropancreatic fold (formed by the left gastric artery) (A).
- The lesser omentum separates the superior recess of the lesser sac (B) from the gastrohepatic recess (C), that is a portion of the left peritoneal space and does not extend posteriorly to the inferior vena cava (as the superior recess of the lesser sac).



* Wylie J. Dodds, W. Dennis Foley, Thomas L. Lawson, Edward T. Stewart, and Andrew Taylor; Anatomy and Imaging of the Lesser Peritoneal Sac; AJR (1985) 144:567-575

Fig. 32: Peritoneal spaces

References: J. F. Costa; Coimbra, PORTUGAL

Inframesocolic region

The attachment of the root of the small intestinal mesentery divides the inframesocolic compartment into the right and left inframesocolic recesses.

The lateral extensions of the inframesocolic recesses are the paracolic gutters.

- The left paracolic gutter is not in continuity with the supramesocolic recess because it is interrupted by the phrenicocolic ligament.
- The right paracolic gutter is larger than its counterpart on the left and is continuous superiorly with the right subhepatic and subphrenic spaces.
- Both paracolic gutters are in continuity with the pelvic peritoneal space.

Fig. 33: Peritoneal spaces

References: J. F. Costa; Coimbra, PORTUGAL

Conclusion

1. CT is an exquisite method for defining pathology involving the peritoneal cavity, mesentery, and omentum.
2. Their correct understanding can only be achieved with a thorough appreciation of the anatomy, including the ligaments and mesenteries, which subdivide the peritoneal cavity.
3. This exhibit will be a core learning tool for the residents and radiology physicians.

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Drawings by Luis Jose Sano M.D. (artistasano@hotmail.com)

Fig. 3: Personal information

References: J. F. Costa; Coimbra, PORTUGAL

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