Learning objectives

The purposes of this exhibit are to summarize the key aspects of the anatomy of peritoneum and to highlight its importance, by showing elucidative examples of pathologies that place and spread through the peritoneum on CT examinations.

Background

The abdominal cavity is divided into the peritoneal cavity and the retroperitoneal space by the peritoneum, a thin serous membrane. [1]

The peritoneal cavity is a potential space between the parietal peritoneum that lines the abdominal wall and the visceral peritoneum, which envelopes the abdominal organs. [2]

Ligaments, mesentery and omentum divide the peritoneal cavity into two compartments: the largest, called the greater sac, and a diverticulum, named omental bursa or lesser sac. [3] Peritoneal ligaments are constituted by two folds of peritoneum and support a structure within the peritoneal cavity. They may contain lymph nodes, vascular structures and ducts. [1] An omentum is a double layer of peritoneum that extends from the stomach and duodenal bulb to the adjacent organs. [2] The greater omentum is composed mainly of fatty tissue and some thin gastroepiploic vessels. At CT, it looks like a band of fatty tissue with a variable width, behind the anterior abdominal wall and anterior to the stomach, transverse colon, and small bowel. The lesser omentum is constituted by a combination of the gastrohepatic and hepatoduodenal ligaments, connects the lesser curvature of the stomach and proximal duodenum with the liver and covers the lesser sac anteriorly. [3] A mesentery is a double layer of peritoneum that connects a portion of bowel to the retroperitoneum. [1] The mesenteric contents include blood vessels, lymph nodes, nerves, and fat. The most mobile parts of the intestine have a mesentery.

Diseases may undergo subperitoneal spread, which consists of the spread of fluid or tumor from its site of origin along the peritoneal ligaments. Fluid may also undergo interfascial spread within the layers of the retroperitoneal fascia, which constitutes an important way of spread of disease across the midline within the retroperitoneum and from abdomen to pelvis along the retromesenteric, retrorenal and interfascial planes. [2]

Findings and procedure details
The peritoneal cavity is divided into supramesocolic and inframesocolic compartments by the transverse mesocolon. The transverse mesocolon is a peritoneal fold that attaches the transverse colon to the retroperitoneum and contains the middle colic vessels. (Fig. 1 on page 5 and Fig. 2 on page 6) In patients with pancreatic head cancer, it is an extremely important source of extension to search, since it determines the inoperability of it, because of its numerous vessels. [2]

The supramesocolic space consists of the right and left subphrenic spaces, right and left subhepatic spaces, the peri-splenic space and the lesser sac. [1] Left and right supramesocolic spaces usually communicate freely. [2] The falciform ligament, a double fold of peritoneum that connects the liver with the anterior abdominal wall and diaphragm and contains the paraumbilical vein, incompletely separates left and right subphrenic spaces (Fig. 3 on page 7). [4] Thus, it constitutes an incomplete barrier to the transfer of fluid between them. Subperitoneal tumor spread in this ligament may mimic liver metastasis. The falciform ligament and the triangular ligaments constitute the suspensory ligaments of the liver. The triangular ligaments outline the bare area of the liver. The left triangular ligament is short and does not compartmentalize the left subphrenic space. The right triangular ligament is long and separates the right subphrenic space from the right subhepatic space. [2]

The lesser omentum, as already discussed, is constituted by the gastrohepatic and hepatoduodenal ligaments. It connects the lesser curve of the stomach and proximal duodenum with the liver and covers the lesser sac anteriorly. The gastrohepatic ligament attaches the lesser curve of the stomach to the liver and contains the left gastric vessels and left gastric lymph nodes. (Fig. 4 on page 8) The hepatoduodenal ligament attaches the duodenum to the liver (Fig. 5 on page 9) and contains the portal vein, hepatic artery, common hepatic ducts and part of the cystic duct. [3] The head of the pancreas communicate with the liver and the lesser curvature of the stomach via the hepatoduodenal and gastrohepatic ligaments. [5] They constitute a route of spread of pancreatic disease to the porta hepatis and liver.[2]

The lesser sac is a posterior compartment of the supra-mesocolic space [6] that communicates with the great peritoneal cavity through the epiploic foramen at the inferior border of the hepatoduodenal ligament. It is constituted by three recesses: superior, splenic and inferior. The superior recess surrounds the medial aspect of the caudate lobe, the splenic recess extends to the splenic hilum and the inferior recess extends between the stomach, pancreas and transverse mesocolon [1]. The superior and inferior recesses are separated by the gastrohepatic ligament. [2] Without pathology, the lesser sac is empty and collapsed. However, when there is important ascites, such as in patients with hepatic failure, it can flow to the lesser sac through the epiploic foramen (Fig. 6 on page 10). [3] An isolated fluid collection in the lesser sac is suggestive for a pancreatitis (Fig. 7 on page 11) or a perforated gastric or duodenal ulcer. [1]
The **gastrosplenic ligament** extends between the great curvature of the stomach and the spleen (Fig. 8 on page 13). [2] It constitutes a frequent route for subperitoneal spread of pancreatitis-related fluid to the greater curvature of the stomach. [5] The fluid within it may mimic a lesser sac collection, although it is not connected to the peritoneal cavity. [2] The **splenorenal ligament** contains the pancreatic tail and communicates it with the hilum of the spleen. (Fig. 9 on page 13) [5] It also contains splenorenal collateral vessels in patients with portal hypertension (Fig. 10 on page 14). [2]

The **greater omentum** or gastrocolic ligament extends inferiorly from the great curvature of the stomach and the proximal part of duodenum, covering the small bowel. It has a considerable mobility and moves around the peritoneal cavity. The CT appearances of abnormalities that involve the great omentum include: multifocal, ill-defined infiltrative lesions, including peritoneal carcinomatosis (Fig. 11 on page 15), tuberculous peritonitis, malignant peritoneal mesothelioma, pseudomyxoma peritonei, lymphomatosis, and the conditions of cirrhosis and portal hypertension; solid or cystic masses including primary and secondary neoplasms and infectious processes; other conditions as omental infarction, foreign-body granuloma, hematoma and hernia (Fig. 12 on page 16). [3]

The right and left inframesocolic spaces are separated from the supramesocolic spaces by the transverse mesocolon and from the paracolic gutter by the ascending or descending colon. The **right inframesocolic space** is smaller and limited inferiorly by the attachment of the small bowel mesentery to the cecum. This fact explains why collections in this space do not generally extend to the pelvis. However, the larger **left inframesocolic space** communicates freely with the pelvis (Fig. 13 on page 17). [2]

The **mesentery root** extends obliquely from the horizontal portion of the duodenum to the ileocecal valve (Fig. 14 on page 18). [1] Because of that location, among the peritoneal structures, it is one of the most susceptible to be involved by metastatic processes, directly or by the neurovascular plexus and lymphatic vessels within it. [2] It constitutes a frequent pathway for spread of lymphoma, carcinoid, pancreatic and colon cancer. [6] Rotational and fusion abnormalities of the mesentery may lead to volvulus or internal hernia (Fig. 15 on page 19).

The **sigmoid mesocolon** attaches the sigmoid colon to the posterior pelvic wall (Fig. 16 on page 20). The most common pathologic processes involving it are acute diverticulitis (Fig. 17 on page 21), perforated colon carcinoma and Crohn's disease. [1]

The paracolic gutters can be seen laterally to the peritoneal reflections of the left and right sides of the colon. The **right paracolic gutter** is larger and communicates freely
with the right subphrenic space. The **phrenicocolic ligament** constitutes an incomplete barrier to the spread of pathologic processes from the **left paracolic gutter** to the left subphrenic space (Fig. 18 on page 22). Right and left paracolic gutters communicate with the pelvic spaces. [2]

The deepest part of the peritoneal cavity locates posteriorly to the bladder, constituting the **pelvic cavity**. In women, the uterus subdivides this space into the vesico-uterine pouch anteriorly and the recto-uterine pouch posteriorly [1]. The latter constitutes the most gravidity-dependent site for fluid accumulation (Fig. 19 on page 23). [2] In men, there is only the rectovesical pouch, between the rectum and the bladder (Fig. 20 on page 24). [1] Anteriorly, the medial umbilical folds that contain the obliterated umbilical arteries divide the pelvic spaces into lateral and medial. On each side, the inferior epigastric artery divides the lateral compartment into lateral and medial inguinal fossae. Those constitute the sites of indirect and direct hernias, respectively (Fig. 21 on page 25). [2]

The **retroperitoneum** is the region of the abdomen that is located posteriorly to the peritoneal cavity, from the diaphragm to the pelvic inlet. [7] It is continuous inferiorly with the subperitoneal space of the pelvis and anteriorly with the preperitoneal space and establishes connections with the intra-abdominal organs through the mesenteric root and the sites of attachment of various organs (pancreas, liver, duodenum and descending and ascending colon). [1] It is divided into three compartments: the anterior pararenal space, the perirenal space and the posterior pararenal space. These spaces are defined by the anterior renal fascia, the posterior renal fascia and the lateroconal fascia (Fig. 22 on page 26). [7] The **anterior pararenal space** contains the pancreas. The **retromesenteric plane** constitutes a potentially expansible plane between the anterior pararenal space and the perirenal space and constitutes a route of spread of fluid in patients with pancreatitis (Fig. 23 on page 27). [2] The presence of retroperitoneal air should alert for the possibility of a perforated retroperitoneal viscera. Isolated pneumoretroperitoneum in the anterior pararenal space adjacent to the duodenum is suggestive of a duodenal perforation (Fig. 24 on page 28). [7] The **great vessel space** is localized around the aorta and inferior vena cava. It is limited laterally by the perirenal spaces and ureters and extends superiorly into the posterior mediastinum. Retroperitoneal fibrosis is usually confined to this space (Fig. 25 on page 29). [2]

**Images for this section:**
Fig. 1: Abdominopelvic CT (coronal plane) of a patient with ascites, showing the transverse mesocolon, with numerous vessels, separating the supramesocolic and inframesocolic compartments.
**Fig. 2:** In the same patient of the Fig. 1, the transverse mesocolon is seen in a sagittal plane.
Fig. 3: Abdominopelvic CT of a patient with important ascites, that allows the visualization of the falciform ligament.
Fig. 4: Abdominopelvic CT of a patient with ascites showing the gastrohepatic ligament.
Fig. 5: In the same patient as Fig. 4, the hepatoduodenal ligament is also visible, due to ascites. D: duodenum; PH: pancreatic head.
**Fig. 6:** Abdominopelvic CT showing ascitic fluid in the lesser sac, in a patient with chronic hepatic disease.
Fig. 7: Example of a pathology that can manifest in the lesser sac: Abdominopelvic CT of a patient with acute pancreatitis, showing an isolated fluid collection in the lesser sac (arrow).

Fig. 8: Abdominopelvic CT of a patient with ascites, where the gastrosplenic ligament is visible.
Fig. 9: Abdominopelvic CT of a patient with ascites, showing the splenorenal ligament, containing the pancreatic tail (PT).
**Fig. 10:** Example of a pathology that can manifest in the splenorenal ligament: Abdominopelvic CT of a patient with portal hypertension, showing splenorenal collateral vessels inside it (arrow).
Fig. 11: Example of a pathology that can affect the greater omentum: Abdominopelvic CT of a patient with adenocarcinoma of the ovary, showing nodular thickening of the peritoneum and ascites (arrow), which traduces peritoneal carcinomatosis.
**Fig. 12:** Example of another pathology that can affect the greater omentum: Abdominopelvic CT of a patient with hepatic chronic disease, where we can see an epiploic umbilical hernia that contains collateral vessels (arrow).
**Fig. 13:** Abdominopelvic CT of a patient with ascites showing that the attachment of the small bowel to the cecum (arrow) delimitates inferiorly the right inframesocolic space. Differently, the larger left communicates freely with the pelvis.
Fig. 14: Abdominopelvic CT of a patient with ascites showing the mesentery root extending obliquely from the horizontal portion of the duodenum to the ileocecal valve (blue circle).
Fig. 15: Example of a pathology that can manifest in the mesentery: Abdominopelvic CT showing a closed loop and densification of the mesentery fat within it (arrow) in a patient with dilatation of the small bowel. These aspects suggest the presence of an internal hernia.
Fig. 16: Abdominopelvic CT of a patient with ascites showing sigmoid mesocolon.
Fig. 17: Example of a pathology that can manifest in the sigmoid mesocolon: Abdominopelvic CT of a patient with abdominal pain, showing multiple diverticula (blue arrows) and densification of the sigmoid mesocolon (white arrow). These aspects are suggestive of acute diverticulitis.
**Fig. 18:** Abdominopelvic CT of a patient with ascites, showing the phrenicocolic ligament, which constitutes an incomplete barrier between the left paracolic gutter (PG) and the left subphrenic space.
Fig. 19: Abdominopelvic CT of a female patient showing the location of the vesico-uterine and the recto-uterine pouches.
Fig. 20: Abdominopelvic CT of a male patient with ascitic fluid in the rectovesical pouch.
**Fig. 21:** Example of a pathology that can arise from the pelvic space: Abdominopelvic CT of a patient with bilateral direct inguinal hernia (medial to inferior epigastric artery). The left hernia contains ascitic fluid (arrow).
Fig. 22: Abdominopelvic CT of a patient with renal lithiasis, showing thickened fascial planes of the retroperitoneum. ARF: anterior renal fascia; PRF: posterior renal fascia; LCF: lateroconal fascia.
**Fig. 23:** Example of a pathology that can affect the anterior pararenal and perirenal spaces: Abdominopelvic CT of a patient with acute pancreatitis, showing fluid collections in the anterior pararenal space (APS) and in the perirenal space (PS).
**Fig. 24:** Example of a condition that can be limited to the retroperitoneum: Abdominopelvic CT showing retroperitoneal air, mostly in the anterior pararenal space (arrow), which results from duodenal perforation. Aerobilia is also present.
Fig. 25: Example of another pathology that can affect the retroperitoneum: Abdominopelvic CT showing retroperitoneal fibrosis in the great vessel space (blue circle).
Conclusion

The peritoneum has a complex anatomy that can explain the way of spread of many diseases, of which we saw some examples. In fact, in the presence of a pathologic process in a specific peritoneal space or ligament, the knowledge of the peritoneal anatomy (with its folds and connections) can raise the most probable diagnostic hypotheses. This is the reason why it is so important for the radiologist to know it.

Personal information

References