Peritoneal cavity anatomy in CT Peritoneography: a comprehensive description.

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Learning objectives

- To know CT Peritoneography indications and technique.
- To review the normal peritoneal cavity anatomy by CT Peritoneography.
Background

Peritoneal cavity anatomy is complex and its understanding may be difficult. CT peritoneography can help for a better understanding of the normal peritoneal cavity anatomy. CT Peritoneography, because of its excellent tissue characterization and multiplanar abilities, is a powerful tool for anatomic delineation of the peritoneal cavity.

Continuous ambulatory peritoneal dialysis (CAPD) is an established treatment option used to treat end-stage renal failure. This technique is preferred over hemodialysis for patients in whom vascular access is difficult or for those with diabetes mellitus or cardiovascular disease. In addition, many patients choose CAPD because it allows more independence and mobility. In CAPD the dialysate is infused into the peritoneum using a catheter placed with the tip positioned in the pelvis. The peritoneal membrane serves as the dialyzer because it is a natural semipermeable membrane.

Abdominal CT in conjunction with intraperitoneal infusion of contrast material has been used to assess the dynamics of intraperitoneal fluid. CT Peritoneography is the standard imaging technique for the evaluation of complications related to continuous ambulatory peritoneal dialysis.

At our institution, the contrast material-dialysate mixture is instilled into the peritoneal cavity with sterile techniques by trained staff of the Department of Nephrology. These procedures include drainage of the dialysate, followed by a infusion of a mixture of 2 L dialysate with approximately 150 mL of a non-ionic contrast medium containing 300 mgI/mL. Patient ambulation and changes in position are necessary to achieve good distribution of the contrast medium throughout the peritoneal cavity.
Findings and procedure details

What is the peritoneum?

The peritoneum is a serous sac consisting of a thin mesothelial membrane, composed of a unique layer of mesothelial cells and a connective tissue layer, which lines the abdominopelvic cavity and covers most of the abdominal organs contained therein. Although the peritoneum is a single continuous membrane, it is divided arbitrarily into two sheets, the parietal peritoneum and the visceral peritoneum. The parietal peritoneum covers the abdominal and pelvic cavities and the visceral peritoneum covers the external surface of most abdominal organs. Between the parietal and visceral layers of peritoneum there is a potential space, so-called the peritoneal cavity, with a thin film of serous fluid that lubricates peritoneal surfaces.

Mesentery, omentum and ligaments: What do these terms refer to?

They define several folds of peritoneum that connect organs with other organs or to the abdominal wall. They consist of a double layer of peritoneum that supports a structure within the peritoneal cavity and content blood vessels, lymph nodes, nerves, and fat.

- **Mesentery**: peritoneal fold that suspends the small and large bowel from the posterior peritoneal wall.

  - **Small Bowel mesentery**: it attaches the small bowel to the retroperitoneum and extends from the ligament of Treitz to the ileocecal valve. It contains the superior mesenteric vessels and their branches. It has an oblique position, from top to bottom and from left to right. Fig. 1 on page 8 Fig. 2 on page 8 Fig. 3 on page 9

  - **Transverse colon mesentery or transverse mesocolon**: a peritoneal fold that attaches the transverse colon to the retroperitoneum edge of the pancreas. The mesocolon forms the posteroinferior border of the lesser sac and contains the middle colic vessels. Fig. 1 on page 8 Fig. 2 on page 8 Fig. 3 on page 9. It divides the peritoneal cavity in two great compartments:

    - Supermesocolic compartment.
    - Inframesocolic compartment.

  - **Sigmoid mesocolon**: it is a peritoneal ligament that attaches the sigmoid colon to the posterior pelvic wall and contains the hemorrhoidal and sigmoid vessels. Fig. 2 on page 8 Fig. 3 on page 9
- **Omentum**: mesentery or double layer of peritoneum that extends from the stomach and duodenal bulb to adjacent organs. The lesser and greater omenta extend from the lesser and greater curvatures of the stomach respectively. Fig. 2 on page 8 Fig. 3 on page 9

  • The **lesser omentum** is the double layer of peritoneum that extends from the liver to the lesser curvature of the stomach and the first part of the duodenum. It is made of two contiguous components called the gastrohepatic and hepatoduodenal ligaments:
    1. The gastrohepatic ligament connects the liver to the lesser curvature of the stomach. It contains the gastric arteries and veins.
    2. The hepatoduodenal ligament connects the liver to the first part of the duodenum and contains the portal vein, the hepatic artery and the common bile duct.

  • The **greater omentum** is attached to the stomach and hangs like an apron from the transverse colon and is usually located anterior to the small bowel. It is made of three components called the gastrocolic, gastrosplenic and gastrophrenic ligaments. The portion of the greater omentum that hangs from the transverse colon becomes redundant and its two layers fuse with one another so the inferior recess of the lesser sac is obliterated, and is therefore composed of four layers of peritoneum.

- **Ligament**: it supports an organ within the peritoneal cavity or connects two organs. It is named according to the structures it connects.

**Peritoneal spaces.**

Although the peritoneal cavity is unique, it consists of several communicating spaces.

The peritoneal cavity can be divided into the **greater** and **lesser peritoneal sacs**.

  • The **greater sac** constitutes the majority of the peritoneal cavity.
  • The **lesser sac**, also known as the omental bursa, is smaller and lies posterior to the stomach and lesser omentum.

Transverse mesocolon divides the peritoneal cavity into supramesocolic and inframesocolic compartments.

- **Supramesocolic compartment** lies above the transverse mesocolon and includes:
  • **Right and left subphrenic spaces**, separated by the falciform ligament. The falciform ligament attaches the ventral surface of the liver to the anterior
abdominal wall and contains the obliterated umbilical vein (*ligamentum teres*). Fig. 4 on page 10

- **Right perihepatic space** is contiguous to the right subphrenic space and surrounds the liver on the right to falciform ligament. The **left perihepatic space** is contiguous to the left subphrenic space and surrounds the liver on the left to falciform ligament. Fig. 5 on page 11

- **Right and left subhepatic spaces**. The right subhepatic space is so-called the Morison pouch or hepatorenal fossa. The bare area of the liver is devoid of peritoneum and lies between the reflections of the peritoneum at right and left coronary ligaments. This bare area is continuous with the right anterior pararenal space. Fig. 6 on page 12 Fig. 7 on page 12

- **Perisplenic space**: It is contiguous to left subphrenic space and surrounds the spleen. It is bounded inferiorly by the phrenocolic ligament, which serves to support the spleen and attaches the left flexure of the colon to the left hemidiaphragm, and it separates, but not completely, the left subphrenic space from the left paracolic gutter. Fig. 5 on page 11 Fig. 6 on page 12 Fig. 8 on page 13

- **Lesser sac**: the lesser sac is embryologically formed from an infolding of the greater omentum. It is located posterior to the stomach and the greater omentum and communicates with the remainder of the peritoneal spaces through the omental foramen (foramen of Winslow). It is surrounded by the liver, lesser omentum, stomach, transverse mesocolon, greater omentum (gastrocolic ligament) and gastrosplenic ligament Fig. 9 on page 14 Fig. 10 on page 16. It contains three recesses Fig. 11 on page 15 Fig. 12 on page 15:
  - Superior recess, which surrounds the medial aspect of the caudate lobe.
  - Splenic recess. It extends across the midline to the splenic hilum.
  - Inferior recess, which separates the stomach from the pancreas and transverse mesocolon.

- The **inframesocolic compartment** lies below the transverse mesocolon and includes:
  - **Right paracolic gutter**: peritoneal recess on the posterior abdominal wall lying alongside the ascending colon. It is lateral to the ascending colon and continuous with the right perihepatic space Fig. 13 on page 17.
  - **Left paracolic gutter**: peritoneal recess on the posterior abdominal wall lying alongside the descending colon. It is lateral to the descending colon Fig. 13 on page 17. Gutters depth is highly variable Fig. 14 on page 18. The phrenicocolic ligament is a relative but incomplete impediment to the spread of pathologic processes from the left paracolic gutter to the left
subphrenic space Fig. 15 on page 18. Both the right and left paracolic gutters communicate with the pelvic space. These gutters are clinically important because they allow a passage for infectious fluids or blood from different compartments of the abdomen.

- **Abdominal central space**: it is located caudal to the transverse mesocolon and between ascending and descending colon. It contains the small bowel and communicates with the pelvic space. Fig. 16 on page 19.

- **Pelvic cavity**: It is the most gravity-dependent site for fluid accumulation. In men it is the rectovesical space, and in women it is the rectouterine space, so called the pouch of Douglas. Both gutters and the abdominal central space communicates with the pelvic space Fig. 17 on page 20 Fig. 18 on page 20.
Fig. 1: CT Peritoneography. Coronal views. Transverse mesocolon and small bowel mesentery.

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Fig. 2: CT Peritoneography. Sagital view. Transverse mesocolon, small bowel mesentery and sigmoid mesocolon. Greater omentum and lesser omentum. Sto-Stomach, Liv-Liver, TrCol-Transverse colon, Sig-Sigmoid.

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Fig. 3: CT Peritoneography. Sagital view. Transverse mesocolon, small bowel mesentery and sigmoid mesocolon. Greater omentum and lesser omentum. Sto-Stomach, Liv-Liver, TrCol-Transverse colon, Sig-Sigmoid.

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Fig. 4: CT Peritoneography. Axial and coronal views. Right and left subphrenic spaces, separated by the falciform ligament. Sto-Stomach, Liv-Liver, TrCol-Transverse colon.

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Fig. 5: CT Peritoneography. Axial view. Right and left perihepatic spaces, separated by the falciform ligament, and the perisplenic space. Sto-Stomach, Liv-Liver, Spl-Spleen.

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Fig. 6: CT Peritoneography. Axial views. Right perihepatic and subhepatic spaces. Perisplenic space. The bare area of the liver is devoid of peritoneum and lies between the reflections of the peritoneum at right and left coronary ligaments. Sto-Stomach, Liv-Liver, Spl-Spleen.

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Fig. 7: CT Peritoneography. Sagital view. The bare area of the liver is devoid of peritoneum. This bare area is continuous with the right anterior pararenal space. Liv-Liver, RKid-Right Kidney.

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Fig. 8: CT Peritoneography. Coronal view. The right subphrenic space communicates with the right perihepatic and subhepatic spaces. The left subphrenic space communicates with perisplenic space. The phrenocolic ligament separates, but not completely, the left subphrenic space from the left paracolic gutter. Sto-Stomach, Liv-Liver, Spl-Spleen.

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**Fig. 9:** CT Peritoneography. Coronal and axial views. Lesser sac. It is surrounded by the liver, lesser omentum, stomach, transverse mesocolon, greater omentum (gastrocolic ligament) and gastroepiploic ligament. It contains three recesses: superior, inferior and splenic recess. Sto-Stomach, Liv-Liver, Spl-Spleen, Pan-Pancreas.

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**Fig. 11:** CT Peritoneography. Axial views from cranial (A) to caudal (D). Lesser sac (red dot). The superior recess surrounds the medial aspect of the caudate lobe. The inferior recess separates the stomach from the pancreas and transverse mesocolon. The splenic recess extends across the midline to the splenic hilum.

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Fig. 12: CT Peritoneography. Coronal views from anterior(A) to posterior (D). Lesser sac (red dot). It is surrounded by the liver, lesser omentum, stomach, transverse mesocolon, greater omentum (gastrocolic ligament) and gastroplenic ligament. The mesocolon forms the inferior border of the lesser sac. The splenic recess extends across the midline towards the splenic hilum. Sto-Stomach, Liv-Liver, TrCol-Transverse Colon, Spl-Spleen.

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**Fig. 10:** CT Peritoneography. Sagital view. Lesser sac (red dot). It is surrounded by the liver, lesser omentum, stomach, transverse mesocolon, greater omentum (gastrocolic ligament) and gastrosplenic ligament. The mesocolon forms the inferior border of the lesser sac. Sto-Stomach, Liv-Liver, TrCol-Transverse Colon.

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Fig. 13: CT Peritoneography. Axial and sagittal views. Right and left gutters extend alongside the ascending and descending colon respectively. Both paracolic gutters communicate with the pelvic space. Col-Colon.

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Fig. 14: CT Peritoneography. Axial views. Gutters depth is highly variable. Col-Colon.

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**Fig. 15:** CT Peritoneography. Axial and coronal views. The right perihepatic space is continuous with the right paracolic gutter and the pelvic space. The phrenocolic ligament separates, but not completely, the left subphrenic space from the left paracolic gutter. Col-Colon, Spl-Spleen.

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**Fig. 16:** CT Peritoneography. Axial and coronal views. The abdominal central space (blue dot) is located caudal to the transverse mesocolon and between ascending and descending colon. It contains the small bowel and communicates with the pelvic space. Col-Colon, Bla-Bladder.

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**Fig. 17:** CT Peritoneography. Coronal and axial views. The pelvic space (green dot) is the most gravity-dependent site of the peritoneal cavity. Both the right and left paracolic gutters communicate with the pelvic space. Col-Colon, Bla-Bladder.

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Fig. 18: CT Peritoneography. Axial and coronal views. Pelvic space (green dot). The rectovesical recess, in male patients, and the rectouterine recess (the pouch of Douglas), in female patients, are the most gravity-dependent sites for fluid accumulation. Bla-Bladder, Rec-Rectum.

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Conclusion

- CT Peritoneography, because of its excellent tissue characterization and multiplanar abilities, is a powerful tool for anatomic delineation of the peritoneal cavity.

- Knowledge of the peritoneal spaces, ligaments and mesenteries are crucial for the understanding of the anatomy of the peritoneal cavity.
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References


