The value of multi-detector row CT in the diagnosis of intra and retroperitoneal mass

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Learning objectives

To emphasize the value of multidetector row CT in the diagnosis of intra and retroperitoneal lesions based on some cases illustrating CT imaging findings

Background

- The peritoneum lines the abdominal walls and confines a wide and complex cavity, the peritoneal cavity. It is composed of two parts: the parietal and visceral peritoneum. The parietal peritoneum lines the inner wall of abdominopelvic cavity above, on the sides and anteriorly. Below it covers the urinary bladder, the seminal vesicles (in men), the uterus and ovaries (in women) and the rectum. Posteriorly it adheres to the anterior renal fascia. However, it moves away from the fascia at various levels to cover the second and third duodenal portions, the pancreas, and to give rise to the mesenteries and ligaments, limiting the spaces where the vasculonervous structures extend (subperitoneal spaces).

- The retroperitoneal space, bounded anteriorly by the posterior parietal peritoneum and posteriorly by the transversalis fascia, extends from the diaphragm superiorly to the pelvis inferiorly. It contains both digestive and urinary structures and vessels. The retroperitoneum is one of the parts of the body least accessible to conventional investigation.

- Nowadays, it becomes possible with the introduction of the multidetector row CT and three-dimensional imaging, to perform detailed CT-examination of both intra and retroperitoneal radioanatomy and positive diagnosis of lesions.

Imaging findings OR Procedure details

The abdominal cavity contains 2 main spaces:
- the peritoneal cavity
- the retroperitoneal spaces
I. The value of multidetector row CT-scanner in radioanatomy of peritoneum and in lesions of the peritoneal cavity:

A- Anatomy of parietal and visceral peritoneum

- The peritoneal serous lamina lines the walls of abdominopelvic cavity (parietal peritoneum) and external surface of viscera (visceral peritoneum)

- In the absence of pathologic conditions, both parietal and visceral layers, very thin, are not individualized in imaging investigations; however, it can be detected in case of thickening or calcifications, or whenever it is outlined by fluid.

The visceral peritoneum originates from the parietal peritoneal inflexions towards the abdominal cavity. It surrounds the hollow viscera and parenchymatous organs, connecting the organs to the abdominal wall and to one another.

These connections assume different names according to the structures they join:

- Mesenteries = areas of visceral peritoneum inflexion containing organ vascularization

- Ligaments = folds of peritoneum connecting organs to one another or to the abdominal wall.

- Omenta = folds of peritoneum connecting the stomach with other organs.

These inflexions give rise to secondary cavities.

B- Radioanatomy of peritoneum cavities and intraperitoneal lesions in row CT-scanner

1) Supramesocolic cavity:

- Limited by the diaphragm above and the transverse colon below.

- Divided in four main spaces: right subphrenic space; right subhepatic space; left subphrenic space; and the lesser sac.

- Ligaments that divide the various spaces of the supramesocolic cavity:

- Falciform ligament: double fold of peritoneum that extends from the anterior abdominal wall to the liver (fig 1 on page 11, 6) on page 15
- Coronary ligaments surrounding the bare area of the liver, which is not covered by the peritoneum

1-1 Right subphrenic space (fig1, on page 112) on page 12:

- Located between the right hepatic lobe and the diaphragm.
- Separated from the left subphrenic space by the falciform ligament.
- Communicates with the right subhepatic space except on the posterior portion, where they are separated by the right coronary and triangular ligaments.
- This space may be the site of fluid accumulation, abscesses and metastatic disease.

1-2 Right subhepatic space (fig3 on page 12,4) on page 13

- Surrounds the lower half of the right lobe of the liver.
- Has two recesses: anterior and posterior.
- Anterior recess continues above with the right subphrenic space and is closed below by the transverse mesocolon, except in the lateral portion where it communicates with the right paracolic gutter.
- The posterior (or Morrison's) recess penetrates between the posterior wall of the liver and the superior portion of the right kidney, up to the right inferior coronary ligament, which separates this recess from the right subphrenic space.

1-3 Left subphrenic space (fig1 on page 11,2) on page 12

This is a wide space limited above by the diaphragm and below by the transverse mesocolon and phrenocolic ligament. This space is made up of four communicating recesses.

1-3 -a) The immediate subphrenic space:

- Located between the diaphragm and the gastric fundus
- Is a common location for fluid accumulation, gastric processes and abscesses.

1-3 -b) The perisplenic recess (fig5) on page 14

- Surrounds the spleen and is limited inferiorly by the phrenocolic ligament, which inhibits the spread of pathologic processes to the left paracolic gutter.
- Is a common location for fluid, abscesses and hemoperitoneum after splenic trauma.

1-3-c) **The left subhepatic (or gastrohepatic) recess (fig6) on page 15** Located between the left hepatic lobe and the stomach.

- Is usually affected by processes that involve the left hepatic lobe, lesser curvature of the stomach, duodenal bulb and the gallbladder.

1-4) **Lesser sac (omentum bursa) (fig7) on page 16**

- Posterior recess of the supramesocolic cavity
- Virtual space (in the lack of pathologic condition)
- Lesser sac lesions may be confidently diagnosed by the characteristic location between the stomach and pancreas.
- Divided in three recesses:

1-4-a) **Superior recess:**
- Above the pancreas and to the right of the midline on transverse sections
- Extends upwards along the posteromedial face of the liver to the level of the diaphragm.

1-4-b) **Spleenic recess:**
- Extends across the midline to the splenic hilum.
- Limited by the gastrohepatic ligament in the front, the gastrospenic ligament laterally and the splenopancreatic ligament behind.

1-4-c) **Inferior recess:**
- Separates the stomach from the pancreas and transverse mesocolon.
- Larger recess, and is located to the left of the midline.

2) **Submesocolic Cavity**

- Space confined between the transverse mesocolon above and the sigmoid mesocolon below.
- Divided in right and left inframesocolic compartments by the mesenteric root partially separated by the ascending and descending colon in the right and left paracolic gutters (fig8) on page 17
2-1) **Right inframesocolic compartment:**

Contents:

2-1-a) The right paracolic gutter communicates above with the lateral portion of the right subhepatic space *(fig9)* on page 18

2-1-b) The ileocecal recesses are located above and below the terminal ileum and can harbour metastatic implants or being involved by inflammatory processes (e.g. appendicitis, Crohn's disease)

2-1-c) The right parasigmoidal space (inferior extension), which communicates with the pelvic cavity

Common site of fluid accumulation and metastatic deposition.

2-2) **Left inframesocolic compartment**

-Contents:

2-1-a) The left paracolic gutter: closed above by the phrenocolic ligament *(fig1)* on page 11

2-1-b) The left parasigmoidal space which communicates with the pelvic cavity.

-Common site of fluid accumulation and metastatic deposition

3) **Pelvic cavity**

-Extension of the submesocolic cavity to the pelvis, with which it widely communicates.

- Is limited by parietal peritoneum that lines the abdominopelvic wall and reflects to cover the bladder, genital organs and rectum.

- The deepest part of the peritoneal cavity lies posterior to the bladder and differs between man and women:

**In females:**

The uterus subdivides this deep recess into the vesicouterine recess anteriorly, and the rectouterine recess (also called cul-de-sac or pouch of Douglas) posteriorly *(fig10)*. on page 19

The rectouterine recess is bounded anteriorly by the round ligaments and the uterus and posteriorly by the rectum, and is the most dependent portion of pelvis. It is a common location for fluid, drop metastases, primary pelvic malignancies and abscesses.
In men:
The various communicating recesses between the bladder and rectum are combined to form a single space, called rectovesical space.

II-The value of multi-detector row CT in Retroperitoneum: Radioanatomy and retroperitoneal lesions

A)Limits of retroperitoneum:
-It is an anatomic space extended from the diaphragm superiorly to the pelvis inferiorly.
-It is bounded: anteriorly by the posterior parietal peritoneum
posteriorly by the transversalis fascia.

B)Compartments: (fig11) on page 20
The retroperitoneum is divided by
-the anterior renal fascia (Gerota's Fascia or Toldt's Fascia)
-the posterior renal fascia(Zuckerkandl's Fascia)
-the latero conal fascia
-the parietal peritoneum
in :
-anterior pararenal compartement
-perirenal compartement
-posterior pararenal compartement

A Fourth compartment, called the retroperitoneal vascular compartment is considered by some authors(the aorta, the inferior vena cava).

These spaces are continuous inferiorly with the inferorenal space, a large retroperitoneal compartment that lies below the cone of renal fascia.

The layers of renal fascia can be detected and identified on CT scans when they are bordered on both sides by fatty tissue. on page
The multidetector CT help to show better the different fasciae and retroperitoneal spaces thanks to multiplanar reconstruction(fig12).

The posterior renal fascia, consists of two major laminae;
- the thinner anterior lamina extends anteriorly to become the anterior renal fascia,
- the thicker posterior lamina becomes the lateroconal fascia, which then continues anterolaterally, behind the colon to blend with the parietal peritoneum(fig13).

1) Anterior pararenal space

1-1 limits:
- posterior parietal peritoneum anteriorly
- anterior renal and lateroconal fasciae posteriorly

1-2 content: (fig14) on page 23
- Most of the pancreas(fig15, on page 24) on page 25
- The retroperitoneal portions of the duodenum
- Ascending colon and descending colon
- Some little fat

1-3 anatomic relation:(fig17) on page 26
- This space is continuous across the midline
- It communicates with: the intraperitoneal space anteriorly(through the root of the small bowel mesentery);
- the perirenal and posterior pararenal spaces and with the prevesical space of the pelvic extraperitoneal spaces, inferiorly.

2) Posterior pararenal space(fig18) on page 26
2-1 Limits:
- the posterior renal and lateroconal fascia anteriorly
- the transversalis fascia posteriorly,

2-2 Content:
A moderate amount of fat.
Absence of organs in this space

Multidetector CT scan shows easier the limits of this space and allows to know some masses extension which might change the therapeutic approach(fig19). on page 27

2-3anatomic relations(fig20): on page 28

-The posterior pararenal space is continuous anteriorly with the properitoneal fat of the anterior abdominal wall.
-The posterior pararenal space also communicates, via the infrarenal space, with the anterior pararenal space, the perirenal space and the prevesical space.

3) Perirenal space:
3-1 limits:
The perirenal space, is located between the anterior and posterior layers of renal fascia(fig21). on page It is the largest of the three retroperitoneal compartments

3-2 content:
It contains the kidney,
adrenal gland,
renal vessels,
proximal collecting system,
proeminent amount of fat*.

*In the perirenal fat, bridging septa the Kunin’ Septa subdivide this space into multiple compartments(fig22) on page 30
Multidetector CT scan better shows perirenal space limits and so makes easier diagnosis(\textit{fig23}) on page 31.

\textbf{3-anatomic relation:}

\textbf{Superior extent of perirenal space:}

- The superior aspect of the perirenal space is open towards the upper abdominal extraperitoneal space, the bare area of the liver on the right, and the subphrenic extraperitoneal space on the left side.

Perirenal collections of blood, urine, pus or gas may extend superiorly into the bare area of the liver on the right.

- The perirenal space is also contiguous with the mediastinum along the upper margins of the psoas muscles, through splanchnic foramina of the diaphragmatic crura, or directly through small diaphragmatic perforations and lymphatics.

\textbf{Medial extent of perirenal space:}

- The perirenal spaces communicate across the midline, at and below the level of the renal hila or superior mesenteric artery. Above this level, there is no communication.

- The midline communication below renal hila, at the lower lumbar level (third to fifth lumbar vertebrae), occurs anterior to the aorta and vena cava, meaning that these vessels are not in the perirenal space.

\textbf{Lateral extent of perirenal space:}

- The lateral extent of the perirenal space is limited by the fusion of the anterior and posterior renal fasciae and lateroconal fascia.

\textbf{Inferior extent of perirenal space:}
Posterior and anterior renal fasciae gradually converge toward a point about 8 cm inferior to the lower pole of the kidney, where they blends loosely with the iliac fascia and periureteric connective tissues, and continues into the pelvis along a plane anterolateral to the psoas muscle.

In some persons, the inferior apex of perirenal space is open toward the iliac fossa and communicates with the extraperitoneal pelvic compartments(\textit{fig24}). on page 31
Superior extension of extraperitoneal pelvic collections into the perirenal spaces has also been reported.

The perirenal spaces are not contiguous with one another inferiorly.

4) **Infrarenal space:**

-The infrarenal space is a large retroperitoneal compartment, allowing communication between the pelvic extraperitoneal spaces (prevesical, perivesical and presacral (fig25) on page 32) and the perirenal, anterior and posterior pararenal spaces of the abdominal retroperitoneum.
-Infra renal spaces also communicate with one other across the midline.
-Fluid collections in the infrarenal space frequently extend into the ipsilateral aspect of the prevesical space. Additionally, extraperitoneal fluid collections arising in the pelvis can extend, via the prevesical space, superiorly into the retroperitoneal compartments of the abdomen.

5) **Another space is considered by some authors called the subperitoneal space:** it is both the space between the meso layers, containing vascular and nervous structures and the space below the parietal peritoneum.

**Images for this section:**

![Image of anatomical structures](image-url)
**Fig. 1:** Right and left subphrenic spaces. A) Axial and B) coronal reformatted contrastenhanced CT images showing the right (RSS) and left (LSS) subphrenic spaces filled with ascites. Note, the immediate subphrenic recess (IS) and the perisplenic recess (PS). Note falciform ligament (FL) dividing the left and right subphrenic spaces and phrenocolic ligament (PCL) dividing the LSS from the left paracolic gutter.

**Fig. 2:** Right subphrenic space. Axial contrast enhanced CT scan showing fluid accumulation in the right subphrenic space (RSS) as well as in the left subphrenic (LSS) and its the perisplenic recess (PSS)
Fig. 3: Right subhepatic space. A) Axial and B) sagittal reformated contrast enhanced CT images, showing the anterior subhepatic recess (ASR) and the posterior subhepatic recess (PSR), confined between the liver and the anterior renal fascia. Note anterior communication between the ASR and the right subphrenic space (RSS).
**Fig. 4:** Axial enhanced CT-scan showing hydatid cyst in the posterior subhepatic recess (Hepato-renal)
**Fig. 5:** Axial enhanced CT-scanner showing splenic contusion with a low amount of fluid in the perisplenic recess (arrow)
**Fig. 6:** Axial enhanced CT-scan showing mass of the left liver developing in contact with stomach lesser curvature in the gastrohepatic recess (GHR) of the left splenic space. Note: falciform ligament (FL)
Fig. 7: Axial enhanced abdominal CT-scanner showing peripancreatic collections (C) located in the lesser sac (complication of pancreatitis)
Fig. 8: Right and left inframesocolic (RIMC, LIMC) compartments filled with intraperitoneal fluid and separated by the mesentery root (MR). Also note the fluid accumulated in the left paracolic gutter (arrow) surrounding the descending left colon.
**Fig. 9:** Axial enhanced CT scan showing a nodule of carcinosis (arrow) located in the left paracolic gutter.
Fig. 10: Ovarian teratoma (arrow) located in the rectouterine recess of the pelvic cavity.
Fig. 11: Axial enhanced multidetector CT scan image showing the retroperitoneal compartments and fascia: -anterior renal fascia (ARF); lateroconal fascia (LCF); posterior renal fascia (PRF); transversalis fascia (TF) -anterior pararenal space (AP); posterior pararenal space (PPS); perirenal space (PR);
Fig. 12: 1 - anterior pararenal space; 2 - posterior pararenal space; 3 - perirenal space; 4 - infrarenal space.
Fig. 13: 1: anterior renal fascia, 2: lateroconal fascia, 3: posterior renal fascia.
Fig. 14: Axial unenhanced CT scan image showing the anterior pararenal space: most of the pancreas (P), the retroperitoneal portions of duodenum (D), and descending colon (DC)
**Fig. 15:** Axial enhanced CT image shows a pancreatic corporeo caudal adenocarcinoma; lesion in the anterior pararenal space(*).
**Fig. 16:** Axial enhanced CT image shows fat infiltration and nodules of carcinosis in the anterior pararenal space in a patient with a pancreatic metastatic adenocarcinoma.

**Fig. 17:** The anterior pararenal space is continuous across the midline; communicates with the intraperitoneal space anteriorly, through the root of the small bowel mesentery.
**Fig. 18:** Enhanced CT axial scan shows normal left posterior pararenal space, situated between posterior renal (PRF) and lateroconal fascia (LCF) anteriorly, and the transversalis fascia (TF) posteriorly.
Fig. 19: Axial Enhanced CT scan image shows a left kidney mass extending to the posterior pararenal space.
**Fig. 20:** The posterior pararenal space also communicates, via the infrarenal space, with the anterior pararenal space, the perirenal space and the prevesical space.
**Fig. 21**: Axial and sagittal multidetector CT scan images show the normal perirenal space (PRS). This space, located between the anterior and posterior layers of the renal fascia, is an inverted cone of tissue lateral to the lumbar spine.

**Fig. 22**: Axial enhanced multidetector CT scan image showing the Kunin'Septa
**Fig. 23:** Axial enhanced CT scan image shows a left kidney and adrenal masses posterior to the anterior pararenal fascia; located in the perirenal space.
Fig. 24: Axial enhanced CT scan image showing an abscess located in the extraperitoneal space, in the psoas muscle.
**Fig. 25:** Axial enhanced CT scan image showing pelvic extraperitoneal spaces; prevesical(∗r), perivesical(∗y) and presacral(∗g).
Conclusion

Multidetector row CT is a basic diagnostic investigative test that allows to define the location of intra and retroperitoneal lesions in the different compartments and their internal structures allowing positive diagnosis which is essential to define therapeutic approach.

Personal Information

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