The Mesenteric Organ? - New concepts and a novel radiological perspective on its disease

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Authors: H. R. F. Dalla Pria¹, F. Velloni¹, R. A. Santiago¹, M. S. Zacarias¹, L. F. D. Silva¹, F. Tamamoto¹, A. C. Von Atzingen², U. S. Torres¹, G. D'Ippolito¹; ¹São Paulo/BR, ²Pouso Alegre/BR
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Learning objectives

- To discuss basic topics of embryology and anatomical contemporary classification of the mesentery.
- To expose differences between the traditional and the new proposal of mesenteric anatomy.
- To illustrate main patterns of mesenteric pathologies, which can be divided into primary or secondary diseases.
- To provide tips for the correct diagnostic investigation of such pathologies and exclusion of the main differential diagnoses.

Basic topics of embryology and anatomical contemporary classification of the mesentery and the main differences between the traditional and the new proposal of mesenteric anatomy

Although recent data have revolutionized the concepts about the mesenteric anatomy, anatomical and embryologic books and publications continue to present classic anatomical descriptions. Thus, our focus will not be on the classical concepts: we will be addressing the proposed new concepts.

Recent data suggest a change in the formerly known anatomical model of mesentery, now proving its continuity and defending his new classification as an organ due to its uniqueness, function and role in disease.

The classic concept of mesenteric fragmentation was overcome: it was previously believed that the mesentery of the ascending and descending colon region (right and left mesocolon) did not exist in the adult due to regression or resorption mechanism. Today, it is known that the mesentery is a continuous structure from distal to the duodenojejunal flexure to the mesorectal level, including the normal presence of the right and left mesocolon.

Important concepts about the embryology of the mesentery:

Embryology - The classic concepts and the new model
**Classic concepts**

The classic model of mesenteric embryology was based on the anatomical concept of mesenteric discontinuity. According to this model, the small bowel mesentery, as well as that of the transverse colon and sigmoid, persists into adulthood. However, the right and left mesocolon regress, which would make mesentery discontinuous and fragmented. Theories were developed to try explain right and left mesenteric involution, but none of them were widely accepted. Despite the mesenteric fragmentation theory, the start and end points for each mesenteric region have never been identified, which corroborates the lack of consistency of this observation. Nowadays we know such points do not exist, since the mesentery has been proven as a continuous structure.

**New model**

Once mesenteric continuity has been proven, its anatomical structure in the adult is much simpler than previously thought. Although the new model simplifies its anatomy, the embryological development of the mesentery, peritoneal reflection and fascia needs to be systematically studied, as it no longer fit the previously described model.

The intestine develops from the endodermal germ layer, while the mesentery derives from the mesodermal germ layer.

**Mesentery:** Relatively little is known regarding the cellular events involved in mesenteric development. It is suggested that rotation, anchorage, elongation, and attachment are important and interrelated processes. The mesenteric embryology process can be simplified in a set of key processes:

- suspension at points of vascular connectivity;
- differential elongation of regions of the intestine and mesentery with a resultant counter-clockwise rotation of both;
- mesenteric flattening against the posterior abdominal wall;
- development of Toldt’s fascia and the peritoneal membrane to maintain attachment in this conformation.

It is important to define the terms "attachment" and "suspension."

- "Attachment" refers to the flattening of the mesentery against the posterior abdominal wall so that it becomes apposed to the retroperitoneum. There is no "insertion" into the posterior abdominal wall in any location.
"Suspension" refers to the suspension of the mesentery to the posterior abdominal wall at vascular pedicles. The mesentery fans out from the "root region" where the superior mesenteric artery suspends it to the posterior abdominal wall. From this point, the mesentery expands, being mobile in some regions while in others it is attached to the posterior abdominal wall. The continuous mesentery spans the intestine from duodenojejunal to anorectal junction.

Peritoneum: The embryological development of peritoneal reflections is also little elucidated. It is suggested that the peritoneal reflection develops after the development and final positioning of the gastromesenteric complex and that it serves to secure the gastromesenteric complex in position. A secondary benefit is that it limits the spread of diseases.

Important concepts about the anatomy of the mesentery:

Anatomy - The classic concepts

According to the classical anatomical model, mesentery would be a fragmented structure. It was previously considered to be a double layer of peritoneum that encloses the intestines and attaches them to the posterior abdominal wall. Its main fragments were:

- small bowel mesentery (mesentery proper) suspends the jejunum and the ileum
- greater omentum: connects the stomach to the colon
- lesser omentum: connects the stomach to the liver
- mesoappendix: peritoneum of the vermiform appendix
- transverse mesocolon: peritoneum of the transverse colon
- sigmoid mesocolon: peritoneum of the sigmoid colon

Anatomy - New Model

Mesentery: The current concept is that it is a continuous structure from distal to the duodenojejunal flexure to the mesorectal level. However, it can be subdivided into the following regions for didactic purposes:

- Mesenteric root
- Small bowel mesentery
- Ileocolic pedicle territory
• Right mesocolon
• Transverse mesocolon
• Left mesocolon
• Mesosigmoid
• Mesorectum

**Fig. 1:** The new mesentery

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

**Peritoneum:** The peritoneal reflections develop to bridge any space between the intestine, mesentery, and abdominal wall. The following peritoneal reflections are highlighted:

• Hepatocolic peritoneal reflection
• Splenocolic peritoneal reflection
• Small bowel peritoneal reflection
• Ileocaecal peritoneal reflection
• Right peritoneal reflection
• Left peritoneal reflection
• Mesosigmoidal peritoneal reflection
• Pararectal peritoneal reflection

*Toldt's fascia:* Toldt's fascia is the connective tissue layer that occurs between attached regions of mesentery and retroperitoneum (or pelvis). It occupies a potential space between the mesentery and retroperitoneum. The peritoneal reflection is the anatomic limit between this space and the fascia. Whenever two mesothelial surfaces come into direct and prolonged contact, Toldt's fascia develops between and bridges both.
**Fig. 1:** The new mesentery

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**Fig. 2:** Mesenteric root (orange). The small bowel mesentery has a "mesenteric root" at the origin of the superior mesenteric artery (SMA): the small bowel mesentery then fans out from the root region, where the SMA (red arrow) suspends it in the posterior abdominal wall to terminal ileum.

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**Fig. 3:** Small bowel mesentery (purple) with the superior mesenteric branches (vascular markings)

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Fig. 4: Ileocolic pedicle territory: confluence between small bowel mesentery (purple) and right mesocolon (yellow), and the ileocolic vessels (vascular marking - arrows).

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**Fig. 5:** Right mesocolon (yellow), vascular marking (arrow) and hepatic flexure mesenteric confluence between right and transverse mesocolon (red).

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Fig. 6: Transverse mesocolon (red) and vascular marking (arrows)

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**Fig. 7:** Left mesocolon (blue) and its confluence with the transverse mesocolon (red). Small bowel mesentery (purple) and vascular markings of small bowel mesentery (purple arrow) and left mesocolon (blue arrow).

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Fig. 8: Mesosigmoid (green) and its confluence with the left mesocolon (blue). The vascular markings (arrow).

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Fig. 9: Mesorectum (pink) and its confluence with the mesosigmoid (green) - rectosigmoid junction. Mesosigmoidal vascular markings (arrows).

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**Fig. 10:** Overview: 1) Yellow line: right lateral peritoneal fold; 2) Red line: Toldt's fascia (also known as anterior pararenal fascia) - Toldt's fascia is difficult to visualize, unless thickened within a pathological context. It is more easily visualized in the region where it was previously known as the anterior pararenal fascia, but it must be remembered that it occurs in every region of contact between peritoneum and retroperitoneum (even if it is not seen on imaging); 3) Purple region: small bowel mesentery; 4) Red region: transverse mesocolon; 5) Pink region: greater omentum - The transverse mesocolon and colon overlie the small bowel mesentery, and the greater omentum overlies the upper surface of the transverse mesocolon. Extensive adhesions occur between the under surface of the greater omentum and the upper surface of the transverse mesocolon; 6) Yellow region: right mesocolon; 7) Blue region: left mesocolon; 8) Orange region: retroperitoneum.

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Background

Why nominate the mesentery as an organ?

The definition of an organ is vague, so that listing and classifying human organs is problematic. In one of the most accepted definitions, an organ is defined as an independent part of the body that carries a special function.

After the new anatomical and functional understanding of the mesentery, it was then suggested that it should be redesignated as an organ itself. The criteria observed for this designation were in short, its size, its continuity and distinct functions.

How does the mesentery meet the criteria to be designated as an organ and what are its distinct functions?

- Among its unique functions, its role in the intestinal suspension is highlighted, preventing the pelvic collapse of the intestines in the orthostatic position. Also, intestinal transit would probably be slowed or possibly even cease without these suspension and attachment functions. Mesenteric attachment facilitates suspension of the colon, allowing it to adopt the spiral conformation. Its suspension, as well, allows for intestinal motility and peristalsis.

- It plays an important role in body physiology, serving as a bridge for signals exchanged between the body and the intestine. It plays a role mediating local or systemic responses, either through the interaction of mesenteric lymph node chains or in the production of inflammatory factors. An important example is that the mesentery production of C-reactive protein is responsible for an important amount of the serum levels of this protein. C-reactive protein regulates glycemic and lipid metabolism. Data also suggest that mesenteric events contribute to the regulation of systemic fibrinolytic, inflammatory, and coagulation cascades.

- It plays a role in the development of systemic diseases associated with increased visceral fat, such as the development of atherosclerosis, diabetes mellitus, metabolic syndrome, dyslipidemia and hypertension.

- It is an indispensable structure in the embryological development of the other abdominal organs, since its development is closely related.
New paths

This clarification of the mesenteric anatomy is crucial to the systematic study of this structure. New advances in surgical techniques and the understanding of mesenteric and intestinal diseases are expected. Little data is available on approaches to mesenteric and related diseases using this new concept of mesenteric contiguity. However, recent paths are beginning to develop technologies and clinical approaches to explored the mesentery.

According to the concept of mesenteric continuity, the development of volvulus is no longer attributed to the presence of an anomalous mesentery, but to a mesenteric twist around the attachment areas. Thus, its treatment can be performed through the fixation of mesenteric regions. Recent data suggest that Crohn's disease would be a primary mesenteric disease. It has also been shown that the inclusion of mesenteric resection in the treatment of Crohn's disease reduces recurrence rates. The field of colorectal surgery, especially in the oncological scope is also changing. The recent advances in our understanding of mesenteric anatomy and surgical terminology will facilitate the standardization process.

In the field of radiology, an anatomical-radiological review was done using data from the Visible Human Project to identify mesenteric regions. CT appearances were correlated with cadaveric and histological appearances at corresponding levels. The percentages of identification of each mesenteric anatomic region on the tomography were quantified, as well as the possibility of identification of the flexural contiguity. The anatomical limits on imaging were also defined. This enabled re-evaluation of CT images of the mesentery, in which contiguous flexural and non-flexural mesenteric regions were repeatedly identifiable. A mesenteric-based atlas of abdominal imaging was recently developed, using mainly vascular markers for the correct identification of the mesenteric regions. Thus, we have an updated anatomical and radiological version which radiologists can now use to better interpret, diagnose or stage intra-abdominal diseases.

The use of the new anatomic-radiological model goes beyond the didactic role and the possibility of a correct description of the mesenteric regions. From the best knowledge of the normality of the mesenteric anatomy, it is possible to perform an accurate study of the pathological processes, as well as the planning of surgical or interventional radiologic procedures.

For the first time, we fully understand the shape of the mesentery, and by understanding its shape, we can seek to elucidate its functions, physiology and role in diseases.
The mesentery in radiology

Adapted from: Coffey JC, Eur Radiol. 2016 Mar 18;26(3):714-21

We can use **vascular markings** for better identification of the mesenteric regions.

**Fig. 2:** Mesenteric root (orange). The small bowel mesentery has a "mesenteric root" at the origin of the superior mesenteric artery (SMA): the small bowel mesentery then fans out from the root region, where the SMA (red arrow) suspends it in the posterior abdominal wall to terminal ileum.

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Findings and procedure details

Now that we have reviewed the key concepts about the anatomy and radiologic anatomy of the mesentery, we can approach the mesentery pathologies by dividing them into primary and secondary.

Table 1: Table of contents

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

Primary

- Internal Herniation
Internal Herniation

Fig. 11: Left internal paraduodenal hernia

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Sac-like appearance (D - red circle); The left colic artery - branch of the inferior mesenteric artery (arrow in E) and at the time of surgery: hernia sac without signs of strangulation (F)

**Fig. 12:** Same case as Fig. 11: Left internal paraduodenal hernia
**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Internal Herniation**

**Case:** A 69-year-old woman with diffuse abdominal pain, nausea and vomiting.

**Epidemiology:** Internal hernias account for approximately 0.5–5.8% of all cases of intestinal obstruction and are associated with a high mortality—up to 50%. About this case, left paraduodenal hernias have incidence of approximately 40% of all internal hernias. They occur when small bowel loops prolapases through a potential space, called the Landzert fossa, which is present in about 2% of the population.

**Clinical presentation:** Nonspecific symptoms are common: nausea, vomiting, pain, distension. It is a difficult diagnosis, which increases the importance of imaging methods, such as computed tomography.

**Location:** It depends on the site of herniation: the internal hernias that may have congenital etiology are: left paraduodenal, right paraduodenal, pericecal, foramen of Winslow, intersigmoid, transmesenteric. Intersigmoid, transmesenteric hernias can also be secondary (acquired). There is also retroanastomotic hernia, which is necessarily acquired after a surgical procedure.

**Image key points:** Sac-like appearance of the intestinal loops; clustered bowel loops in atypical location. Mesenteric vessel abnormalities: engorgement, crowding, twisting, and stretching of these vessels.

**Fig. 13:** Internal Herniation

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Malrotation**
Intestinal transit study of a 4-year-old boy presenting with oral malformation and malnutrition. Supine frontal radiograph (A) shows cecum displaced in the superomedial aspect (arrow). B- Lateral view: cecum displaced superiorly.

Fig. 14: Malrotation: Case 1.

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
2nd Case - Malrotation at MRI: colon predominantly on left abdomen (arrows)

**Fig. 15:** Malrotation Case 2.

**References:** Fleury Medicina Diagnóstica, São Paulo, Brazil
**Malrotation**

**Definition:** The concept of intestinal rotation explains the final position of the right colon and its mesocolon on the right flank, as well as the final position of the small intestine and its mesentery in the adult. It may be found non-rotation (complete) or malrotation - intermediate position between non-rotation and correct intestinal placement. In non-rotation the small bowel is located on the right side within the peritoneal cavity and the colon is located on the left side. Several degrees of malrotation of the small or large bowel may occur, and the positions of the duodenojejunal junction and colon depend on the stage of embryological development in which the rotation process failed.

**Epidemiology:** Malrotation occurs in approximately 1: 500 births and is widely related to genetic syndromes and other abnormalities, especially those of the gastrointestinal tract.

**Clinical presentation:** In newborns and young infants, bilious vomiting, abdominal distension, obstruction or midgut volvulus may occur. It may be asymptomatic in adults but potentially related to complications.

**Image key points:** Displaced position of the intestinal loops (jejunum flexor duodenum, colon, cecum). Vascular displacement: in most patients with malrotation (the SMA and SMV will assume a vertical relationship or show left-right inversion).

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**Fig. 16:** Malrotation

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Volvulus**
Sigmoid Volvulus
93-year-old man presenting with symptoms of constipation
A-B: Enhanced-CT (venous phase) MIP coronal reconstruction 4mm: occlusion point (arrows).
C: Coronal Enhanced-CT (venous phase) show large gas-filled loop, forming a closed-loop obstruction (*)
D: CT scout image

Fig. 17: Sigmoid Volvulus
References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Fig. 18: Same case as Fig. 17: Sigmoid Volvulus Video - specific CT sign for volvulus is the whirl sign: vessels twisted like a whirlwind in the center of the bowel twist.

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Volvulus**

**Case:** 93-year-old man presenting with symptoms of constipation.

**Definition:** Volvulus is defined as a twisting of the intestine upon itself that causes obstruction.

**Epidemiology:** Acute colonic volvulus accounts for approximately 10%-15% of large bowel obstruction. Sigmoid volvulus (~70% - occurs more in the elderly); Cecal volvulus (~25%). Volvulus of the transverse colon and splenic flexure is rare.

**Clinical presentation:** Usually elderly, with insidious symptoms of obstruction: abdominal pain, constipation or obstipation, and abdominal distension.

**Image key points:** marked distension of large bowel, bird beak sign, whirl sign, the coffee bean (sigmoid) and inverted U sign (sigmoid);

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**Fig. 19:** Volvulus

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Vascular - Mesenteric bleeding/hematoma**
Fig. 20: Vascular - Mesenteric bleeding/hematoma

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Case:** Mesenteric hematoma with active bleeding. A 56-year-old woman with multiple myeloma with chronic kidney disease on hemodialysis had mental confusion, hypokalemia, hypovolemic shock, and acute onset of abdominal pain and distension.

**Epidemiology:** Rare and a diagnostic challenge.

**Clinical presentation:** It varies according to the cause, size and location of the hematoma. It may present as a palpable mass and promote extrinsic compression in the gastrointestinal tract, leading to obstruction.

**Differential diagnosis:** If there is no history of trauma and other obvious conditions, such as pancreatitis or gastric ulcer, one should proceed with CT-scan to investigate other causes, such as aneurysms, pseudo-aneurysms and tumors. Image key points: Hematoma, active bleeding, and depending on the size of the hematoma, signs of obstruction.

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**Fig. 21:** Vascular - Mesenteric bleeding/hematoma

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Vascular - Mesenteric ischemia**
Fig. 22: Vascular - Mesenteric ischemia

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

Venous phase intravenous and oral contrast enhanced CT scan: Acute superior mesenteric vein thrombosis (arrowheads).
A: MIP coronal reconstruction 4mm
B-C: MIP coronal reconstruction 4mm
D-E: Axial. In D, jejunum with wall thickening (arrow)
**Definition:** Mesenteric ischemia is a primary vascular disorder of the mesentery and has three main causes: mesenteric arterial embolus and thrombus, mesenteric venous thrombus, and non-occlusive mesenteric ischemia.

**Epidemiology:** Arterial occlusion (60–70%), venous occlusion (5–10%)

**Clinical presentation:** Arterial occlusion: acute presentation, abdominal pain out of proportion with clinical findings. As the acute ischemic event progresses, metabolic abnormalities occur that progress to multiple organ dysfunction; Venous occlusion: subacute presentation, vague symptoms of acute abdomen with gradual worsening, diffuse abdominal pain and distension.

**Radiographic features:** CT findings vary widely depending on the cause and underlying pathophysiology

**Image key points:** Arterial: Defect or defects in arteries, arterial occlusion, SMA > SMV. Venous occlusion: Defect or defects in veins, venous engorgement.

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**Fig. 23:** Vascular - Mesenteric ischemia

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Mesenteric cyst**
A homogeneous and unenhanced cyst, CT (arrow in A) in the inframesocolic region of the mesenteric root. Hypointense and homogeneous in the T1-WI(B) with fine septations (arrowheads in D – T2WI). In the coronal plane (D) it is observed its relation with a segment of small bowel.

**Fig. 24:** Mesenteric cyst

**References:** Fleury Medicina Diagnóstica, São Paulo, Brazil
Mesenteric cyst

**Case:** diffuse abdominal pain, nausea and vomiting.

**Definition:** The rare form of primary mesenteropathy, mesenteric cysts occur most commonly on the mesentery of the small bowel or right colon. While the etiology is unknown, developmental abnormalities of mesenteric lymphatics may play a role.

**Epidemiology:** Mesenteric cysts are rare: incidence of 0.5-1 : 100,000 admissions.

**Clinical presentation:** asymptomatic increased abdominal girth, chronic abdominal pain or as an acute abdomen secondary to torsion, infection, or hemorrhage into the cyst itself.

**Radiographic features:** cystic mesenteric lesions that can be further characterized on the wall thickness (thin or thick walled) and their loculation (unilocular or multilocular).

**Differential diagnosis:** pancreatic pseudocyst, ovarian cyst, urachal cyst, hydrometrocolpos, peritoneal hydatidosis.

Image key points: Its relationship with the mesentery and exclusion of differential diagnoses

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**Fig. 25:** Mesenteric cyst

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Hemangiomatosis**
Enhanced CT (A-D), and non enhanced CT (E): ill-defined mass of similar attenuation to muscle (arrows) with phleboliths (arrowheads).

**Fig. 26:** Hemangiomatosis

**References:** Diagnósticos da América S.A. DASA. São Paulo, SP, Brazil
Definition: Vascular malformations are similar to hemangiomas in that they are composed of abnormal vascular channels lined with a single layer of dysplastic endothelium. Vascular malformations are congenital. These malformations are named after the vascular element they most closely resemble: capillary, venous, and lymphatic malformations. When these lesions are very large or numerous, the term hemangiomatosis may be applied.

Radiographic features: On unenhanced CT, it may appear as an ill-defined mass of similar attenuation to muscle. CT may also show the presence of associated phleboliths.

Image key points: The presence of phleboliths suggests the possibility of this pathology.

Fig. 27: Hemangiomatosis

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

• Crohn's Disease
A-C Enhanced CT (venous phase): 23-year-old woman with Crohn's disease, presenting concentric parietal thickening of the right colon, ileocecal valve and ileal loops (*), with densification of the adipose planes and vascular engorgement of the adjacent mesentery (comb sign - arrowheads). D-E: Enhanced CT (venous phase): 8-year-old girl with Crohn’s disease, presenting complication of the disease, with fistula between the ileum and the bladder (arrows).

Fig. 28: Crohn's Disease

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Crohn’s Disease**

**Definition:** Recent findings challenge the classic notion that Crohn's disease arises from the mucosa of the intestine. It is feasible that Crohn's disease represents a true primary mesenteropathy. The classic model of Crohn's disease holds inflammation commences at the mucosa and outward spreads (becoming transmural) and thereafter affects the adjacent mesentery. However, recent findings support that Crohn's disease represents true primary mesenteropathy, i.e., the disease actually begins in the mesentery. Although the source of production of inflammatory factors, most notably the production of C-reactive protein, the mesenteric role of Crohn's disease is reinforced by its role in the recurrence and need for surgical reassessment of the disease. There is a direct correlation between the circumferential involvement of mesenteric fat and the risk of future surgery by the disease. Emerging data indicate that the mesenteric disease scores correlate with the Crohn's disease activity index, as well as with increasing levels of mucosal disease. Mesenteric disease manifestations are directly associated with local mucosal and systemic manifestations in Crohn's disease. At present, both etiology and pathobiology of Crohn's disease remain under investigation. Although the origin of this pathology has not yet been fully clarified, we have chosen to describe it among primary mesenteropathies, according to the most recent scientific data.

**Epidemiology:** is common in northern Europe, North America, and Japan, affects both sexes equally and has its peak of development between 15 and 25 years of age.

**Radiographic features:** thickened bowel wall with marked contrast material enhancement, mural stratification, pericolic or perienteric hypervascularity (comb sign), hyperintensity of the bowel wall on T2-weighted images, fibro-fatty proliferation (creeping fat), lymph node enlargement, and extramural complications such as phlegmon, abscess, strictures and fistulae.

**Fig. 29:** Crohn's Disease

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

**Primary Neoplasms**

Tumors with primary manifestation in the peritoneum in the absence of a visceral site of origin.

They arise from mesothelial cells, submesothelial mesenchymal cells, and uncommitted stem cells.

Because the origins of some primary peritoneal tumors are obscure, these lesions are difficult to classify precisely.

**Mesothelial tumors:** peritoneal malignant mesothelioma, well-differentiated papillary mesothelioma, multicystic mesothelioma and adenomatoid tumor.
Epithelial tumors: primary peritoneal serous carcinoma and primary peritoneal serous borderline tumor.

Smooth muscle tumor: leiomyomatosis peritonealis disseminata.

Tumors of uncertain origin: desmoplastic small round cell tumor and solitary fibrous tumor.

• **Peritoneal Malignant Mesothelioma**

![Peritoneal Malignant Mesothelioma](image)

Non-enhanced CT: Diffuse peritoneal malignant mesothelioma - Fluid widely distributed through the abdominal cavity. Punctiform and sparse nodular calcifications are observed (arrowheads).

**Fig. 30: Mesothelioma**

**References:** Fleury Medicina Diagnóstica, São Paulo, Brazil
Ax T2WI MRI (E-F); Cor T2WI (G) and Ax T1WI Gad (H): free fluid at the pelvic excavation, with septa (arrowhead) and smooth and diffuse thickening of the peritoneum (arrows).

**Fig. 31:** Same case as Fig. 30: Mesothelioma

**References:** Fleury Medicina Diagnóstica, São Paulo, Brazil
**Peritoneal Malignant Mesothelioma**

**Definition:** Malignant mesothelioma is a rare neoplasm that arises from mesothelial cells or multipotential subserosal mesenchymal cells of the pleura, peritoneum, pericardium, or tunica vaginalis of the testis. Peritoneal primary mesotheliomas account for 6% -10% of malignant mesotheliomas.

**Epidemiology:** Three types: diffuse malignant mesothelioma, well-differentiated papillary mesothelioma and multicystic mesothelioma. Diffuse malignant mesotheliomas are aggressive aggressive tumors and the risk factors are asbestos exposure, radiotherapy and chronic peritonitis. Multicystic Mesothelioma occurs in young or middle-aged women and the risk factors are previous surgeries, repetitive pelvic inflammatory disease.

**Clinical presentation:** Abdominal pain, abdominal distention, nausea, anorexia, and weight loss. Complications such as bowel obstruction may occur with advanced disease.

**Differential diagnosis:** Diffuse Peritoneal Malignant Mesothelioma: carcinomatosis, lymphomatosis and peritoneal infections. Multicystic Mesothelioma: Pseudomyxoma peritonei.

**Image key points:** Diffuse peritoneal malignant mesothelioma - two patterns: 1- diffuse involvement of the peritoneal cavity and 2- focal intraperitoneal masses. Multicystic Mesothelioma: multiseptated, cystic structures that have an intimate anatomic association with the uterus and ovaries.

**Fig. 32:** Peritoneal Malignant Mesothelioma

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Desmoplastic Small Round Cell Tumor**
Fig. 33: Desmoplastic Small Round Cell Tumor

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Fig. 34: Same case as Fig. 33: Desmoplastic Small Round Cell Tumor

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Desmoplastic Small Round Cell Tumor**

**Definition:** Rare malignancy of unknown histogenesis that occurs predominantly in adolescent and young adult males. It is a distinctive clinicopathologic entity in the family of primitive pediatric tumors that are composed of small, round, blue cells, a group that includes Wilms tumor, Ewing sarcoma, peripheral primitive neuroectodermal tumor.

**Epidemiology:** young men with a mean age of 19 years

**Clinical presentation:** abdominal pain

**Radiographic features:** Peritoneal thickening, nodules, and masses. But it can present as a solitary peritoneal mass. The masses are characteristically heterogeneous (reflecting intratumoral necrosis or hemorrhage). The masses may contain small, punctate calcifications. Malignant ascites is common.

**Differential diagnosis:** Peritoneal carcinomatosis and lymphomatosis.

**Image key points:** Presence of a single or multiple dominant masses within the diffuse process is more characteristic of desmoplastic small round cell tumor compared with the other lesions. Imaging evidence heterogeneity or calcification is also suggestive of desmoplastic small round cell tumor.

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**Fig. 35:** Desmoplastic Small Round Cell Tumor

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

**Primary- Inflammatory**

- *Sclerosing mesenteritis - mesenteric panniculitis*
Sclerosing mesenteritis – mesenteric panniculitis

Non-enhanced CT: subtle increased attenuation within the mesentery (arrowheads).

Fig. 36: Sclerosing mesenteritis - mesenteric panniculitis

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Sclerosing mesenteritis – mesenteric panniculitis

**Definition:** Sclerosing Mesenteritis (panniculitis) is an uncommon idiopathic disorder characterized by chronic non-specific inflammation involving the adipose tissue of the bowel mesentery. Although sclerosing mesenteritis is often associated with other idiopathic inflammatory disorders its exact cause is unknown. The evolution of this entity has been described in three stages. **Stage 1: mesenteric lipodystrophy:** degeneration of mesenteric fat, frequently asymptomatic. **Stage 2: mesenteric panniculitis:** inflammatory changes and lymphatic distension with early fibrosis - may have a symptomatic presentation. **Stage 3: retractile mesenteritis:** collagen deposition and fibrosis thickens and shortens the mesentery.

**Epidemiology:** male predilection, with the average age around 60 years.

**Clinical presentation:** Patients may present with abdominal pain, intestinal obstruction or ischemia, a mass, or diarrhea.

**Radiographic features:** From subtle increased attenuation in the mesentery to a soft tissue mass. The process usually involves the mesentery of the small bowel, especially at its root, but occasionally involves the mesocolon. The mass may envelop the mesenteric vessels, where the preservation of fat halo around the mesenteric vessels (fat ring sign) can be observed. This finding may help distinguish sclerosing mesenteritis from other mesenteric processes such as lymphoma, carcinoid tumor, or carcinomatosis.

**Differential diagnosis:** lymphoma, carcinoid tumor, carcinomatosis, primary mesenteric mesothelioma, and mesenteric edema

**Image key points:** Sclerosing mesenteritis mesenteric panniculitis type: mesentery appear to have increased attenuation with small nodes but without evidence of a discrete soft-tissue mass.

**Fig. 37:** Sclerosing mesenteritis - mesenteric panniculitis

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Sclerosing mesenteritis - retractile mesenteritis IgG4 related**
IgG₄-related mesenteric fibrosis presented as infiltrative, heterogeneous and enhancing tissue with retractable effect involving mesenteric root (arrows).

Fig. 38: Sclerosing mesenteritis - Retractile mesenteritis IgG₄ related

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Definition:** IgG₄-related disease (IgG₄-RD) represents an inflammatory and fibrosing disease process of unknown etiology. Recently, a close relationship has been reported between IgG₄-RD and multifocal fibrosclerosis. The disease often responds well to steroid therapy. The relationship between sclerosing mesenteritis and IgG₄-RD has not been studied well. There is debate about the association between systemic inflammatory conditions and mesenteric panniculitis. The causes are not completely delimited.

**Epidemiology:** male predilection, with the average age around 60 years.

**Radiographic features:** retractile mesenteritis presentation of sclerosing mesenteritis. - the final stage of sclerosing mesenteritis, when fibrosis is established.

**Differential diagnosis:** The differential diagnosis of sclerosing mesenteritis may include various inflammatory and neoplastic diseases.

**Image key points:** retractile mesenteritis type-mesenteric mass with fibrosis signs and retractable effect on imaging.

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**Fig. 39:** Sclerosing mesenteritis - retractile mesenteritis IgG₄ related

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Abdominal cocoon**
Enhanced CT (A-D): Gastric and duodenal distention due to obstruction in the level of duodenojejunal flexure. (arrowhead in B and C). It is possible to identify a cluster of jejunal intestinal loops surrounded by a thin membrane, forming a cocoon-like appearance (arrow heads in A-D). E-F: Intraoperative aspect.

**Fig. 40:** Abdominal cocoon

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Abdominal cocoon

Case: A 27-year-old man with diffuse abdominal pain, bilious vomiting and 25-lb weight loss over one month.

Definition: Abdominal cocoon syndrome (also known as sclerosing encapsulating peritonitis) is characterized by small bowel encapsulation by a fibrocollagenous membrane or "cocoon". It is a rare cause of intestinal obstruction. It has 2 types: primary (idiopathic) and secondary. The secondary type is seen in patients with peritoneal dialysis, peritonitis, previous abdominal surgery, sarcoidosis, and tuberculosis.

Epidemiology: The idiopathic type primarily affects young females from tropical and subtropical countries.

Clinical presentation: Acute or chronic symptoms of small bowel obstruction.

Differential diagnosis: CT findings of a membrane enveloping loops of small bowel were seen in some paraduodenal hernias.

Image key points: Small bowel loops congregation in the center of abdomen with a non-enhancement fibrous membrane surrounding the bowel loops.

Fig. 41: Abdominal cocoon

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

Secondary Neoplasms

• Pseudomyxoma
Pseudomyxoma peritonei presented as a low density, cystic implants along the surfaces of the liver (arrows), small and large bowel mesentery (*) and peritoneal surface (arrowheads).

**Fig. 42:** Pseudomyxoma

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Pseudomyxoma

Case: A 44-year-old man with pain and increased abdominal volume and weight loss for 2 years.

Definition: Pseudomyxoma peritonei describes the finding of thick mucinous or gelatinous material on the surfaces of the peritoneal cavity. It is accepted that the majority of cases of classic pseudomyxoma peritonei develops from low-grade mucinous carcinomas that penetrate or rupture into the peritoneal cavity.

Epidemiology: 1: 1.000.000/year. It occurs more in women, in their 50s.

Clinical presentation: Progressive abdominal pain, increasing abdominal girth, and weight loss.

Radiographic features: At sonography, might be suspected when ascitic fluid is echogenic, a finding that suggests that the fluid is gelatinous. Scalloping of the hepatic and splenic margins may also be present. Mucin within the peritoneum is usually low in CT attenuation, but areas of soft-tissue attenuation may be present that represent solid tumor elements, fibrosis, or compression of the mesentery.

Differential diagnosis: Mucinous carcinomatosis.

Image key points: Scalloping of the visceral surfaces of the intra-peritoneal organs (indentations that occur on the capsular margins) helps differentiate pseudomyxoma from simple ascites.

Fig. 43: Pseudomyxoma

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- Lymphomatosis x Carcinomatosis x Sarcomatosis

Conditions with overlapping characteristics:

Carcinomatosis: Peritoneal and omental seeding are known sites of dissemination of metastatic carcinoma, most commonly arising from the ovary, colon and stomach. Lymphadenopathy is usually located around the primary tumor. Ascites is usually marked.

Lymphomatosis: omental caking with homogeneous bulky masses, in addition to a diffuse distribution of enlarged lymph nodes.

Sarcomatosis: may present bulky masses, but they are frequently heterogeneous, hypervascular and may be associated with hemoperitoneum. Lymphnode enlargement is rare.
• **Lymphomatosis**

**Lymphomatosis**

A: prominent straightened vessels secondary to lymphomatous infiltration of the mesentery causing a "stellate appearance" (arrowheads). There is also homogeneous soft tissue in the greater omentum a.k.a omental-caking (*).  
B-E: bulky homogeneous intraperitoneal masses (arrows), associated with free fluid in D-E.

**Fig. 44:** Lymphomatosis  
**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Lymphomatosis**

**Definition:** Peritoneal lymphomatosis is a rare manifestation of lymphoma, most frequently seen with non-Hodgkin lymphoma and is defined as the intraperitoneal spread of lymphoma.

**Radiographic features:** The pattern most commonly found in peritoneal lymphomatosis is omental caking with bulky homogeneous masses. Other characteristics found are: a homogeneous smooth thickening, diffusely infiltrating the peritoneum and the leaves of the mesentery; small omental nodules associated with fine infiltration of the omental fat (smudged appearance); stellate appearance of the mesentery in an infiltrating process, causing thickening and rigidity of the mesentery.

**Differential diagnosis:** peritoneal carcinomatosis and peritoneal sarcomatosis.

**Image key points:** bulky homogeneous masses or smooth peritoneal soft tissue thickening, diffuse lymphadenopathy, in addition to imaging features of variable extranodal lymphomatous involvement

**Fig. 45:** Lymphomatosis

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Carcinomatosis**
Carcinomatosis

A-C Peritoneal thickening (arrowheads) and marked ascites. D-E: loculated ascites (*). F- tumor implants with one of the nodules showing calcification (arrow).

Fig. 46: Carcinomatosis

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Carcinomatosis

**Definition:** Carcinomatosis is the intraperitoneal dissemination of any tumor that does not originate from the peritoneum itself. It is the most common diffuse peritoneal disease.

**Radiographic features:** Ascites, free or loculated, greater omentum involvement (omentum cake), invasion of the mesentery, increased mesenteric fat density, mesenteric mass/nodules, tumor implants in the peritoneal serous membrane.

**Differential diagnosis:** Pseudomyxoma peritonei, Malignant peritoneal mesothelioma, Peritoneal lymphomatosis, Peritoneal tuberculosis, Tuberculosis, Splenosis implants, Diffuse peritoneal leiomyomatosis.

**Fig. 47:** Carcinomatosis

*References:* Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- **Sarcomatosis**
Fig. 48: Sarcomatosis

38-year-old female presenting with peritoneal sarcomatosis. A-D: MRI show nodular peritoneal implants from sarcoma (arrows).

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Definition: disseminated intraperitoneal spread of sarcoma in the absence of significant extra abdominal sites of disease.

Epidemiology: rare entity. Sarcomatosis may arise from recurrent intraabdominal sarcomas or may be metastatic from extremity sarcomas. The most frequent tumors that give rise to peritoneal sarcomatosis are gastrointestinal stromal tumors (GISTs), liposarcomas, and leiomyosarcomas.

Radiographic features: All peritoneal surface malignancies share similar radiologic features (carcinomatosis and lymphomatosis), with seeding of soft-tissue implants along the peritoneum and omentum.

Differential diagnosis: carcinomatosis and lymphomatosis

Image key points: tumor implants from sarcomas are usually spherical and deforming, hypervascular and with minimal associated ascites. Carcinomatosis implants are either flat or ovoid according to the adjacent structure and generally have a marked ascites associated.

Fig. 49: Sarcomatosis

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- Peritoneal GIST
Multiple nodular and heterogeneous peritoneal implants (arrows in A and B) secondary from gastric GIST, which presents as exophytic and necrotic mass originated from gastric fundus and body (* in C).

Fig. 50: Peritoneal GIST

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Peritoneal GIST

Case: A 49-year-old man with pain, increased abdominal volume and weight loss. Gastric GIST (primary) with peritoneal spread.

Definition: Gastrointestinal stromal tumors (GIST) are a group of smooth muscle mesenchymal tumors of variable malignancy. They account for 0.1 to 3% of all gastrointestinal neoplasms.

Epidemiology: approximately 5000–30,000 people/year. Middle-aged and older patients.

Clinical presentation: The clinical findings vary depending on the location and size of the tumor at presentation. Lesions in the stomach, small bowel, or colon may present with gastrointestinal bleed and there may be abdominal pain, nausea, and vomiting.

Radiographic features: most of these tumors are submucosal in location, usually attaining a large size without causing bowel obstruction by the time of diagnosis. Many of these tumors have an exophytic component. The enhancement pattern can vary from homogenously enhancing to heterogeneously enhancing, with or without ulceration. Ulceration is as a common feature of GIST. Metastases from GIST commonly occur to the liver and peritoneal cavity via hematogenous spread and peritoneal seeding.

Differential diagnosis: adenocarcinoma, lymphoma, peritoneal carcinomatosis, carcinoid, metastases, and other mesenchymal neoplasm.

Image key points: Peritoneal GIST is most often seen in the large discrete masses that are often necrotic with heterogeneous enhancement and less commonly the diffuse hypervascular omental and peritoneal caking. Necrosis within the masses may lead to fistulization and, owing to tumor hypervascularization, may present gastrointestinal bleeding and hemoperitoneum.

Fig. 51: Peritoneal GIST

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- Omental cake
A-C: Enhanced CT (venous phase) from a 72-year-old male with carcinomatosis. D-E: Enhanced CT (venous phase) from a 60 year old man with lymphomatosis. In both cases there is a mass of the anterior greater omentum or omental "cake" (arrowheads).

**Fig. 52:** Omental cake

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Definition:** Omental caking is the most characteristic imaging presentation of secondary peritoneal malignancy: it may present as fine nodular, soft tissue studding or large confluent soft tissue masses within the omentum.

**Epidemiology:** This pattern of involvement is associated with several malignancies of mesenteric dissemination, but is more common first in carcinomatosis after lymphomatosis, and is less commonly found in others such as sarcomatosis and peritoneal GIST.

**Radiographic features:** there is invasion of the greater omentum, sometimes accompanied by small nodulations. With progression, the omental fat is replaced by a solid mass, the omental caking itself.

**Image key points:** Invasion of the fat of the greater omentum with nodules in later forms

**Fig. 53:** Omental cake

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

**Secondary - Infectious**

- **Tuberculosis**

**Fig. 54:** Tuberculosis

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Epidemiology:** Tuberculosis is responsible for about 1.7 million deaths annually. It has increased its incidence due to HIV infection and use of immunosuppressive drugs.

**Radiographic features:** Peritoneal tuberculosis is the most common presentation of abdominal tuberculosis and may involve the peritoneum, mesenterium and omentum. It is classically classified into three types: dry, wet and fibrous types. **Wet type:** free or loculated ascites, associated or not with diffuse and smooth peritoneal thickening; **Dry type:** predominance of peritoneal and mesenteric thickening with caseous nodules, lymph nodes enlargement and fibrinous adhesions; **Fibrous type:** remarkable omental thickening and entanglement of bowel loops clinically resembling a mass, occasionally with loculated ascites and that may be similar to peritoneal carcinomatosis.

**Differential diagnosis:** carcinomatosis, lymphoma, Crohn's disease, amebiasis, adenocarcinoma.

**Image key points:** smooth peritoneal thickening with marked enhancement after intravenous contrast injection; lymph node enlargement with areas of central necrosis. Fat-fluid level in association with necrotic lymph nodes is highly specific for tuberculous ascites.

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**Fig. 55:** Tuberculosis

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- Atypical Mycobacteriosis
Fig. 56: Atypical Mycobacteriosis
References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Atypical Mycobacteriosis**

**Case:** 28-year-old HIV positive man with abdominal mycobacteriosis.

**Definition:** Mycobacterium avium-intracellulare complex consists of two species of acid-fast mycobacteria: *Mycobacterium avium* and *Mycobacterium intracellulare*. They are referred to collectively as MACs. Mycobacterial infections do not usually involve the gastrointestinal tract in patients with intact immune systems. Immunocompromised patients may develop disseminated MAC infections.

**Epidemiology:** In the developed world, extrapulmonary MAC infection was one of the most frequent opportunistic infections in AIDS patients.

**Clinical presentation:** weight loss, abdominal pain, and vomiting, fever, night sweats, malabsorption, and diarrhea.

**Radiographic features:** at barium studies, small bowel presents diffusely thickened, irregular small bowel folds with mucosal nodularities. At CT: small bowel presents segmental or diffuse wall thickening with mucosal hyperenhancement associated with mesenteric lymph nodes, which may be increased in number and enlarged.

**Image key points:** MAC infections present smaller lymph nodes compared to those of Mycobacterium tuberculosis infections. However, it may present lymph nodes with central necrosis.

**Fig. 57: Atypical Mycobacteriosis**

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- *Actinomycosis Infection*
A-B: AxT2WI: Bilateral tubo-ovarian abscesses (*), and peritoneal implants (arrows). C (DWI and D (ADC): intense restriction of abscesses. E-G: Enhanced CT (venous phase): it is possible to see the abdominal dispersion of actinomycosis, presenting hepatic abscess (dotted circle), and pelvic involvement, with peritoneal implants (arrow), pelvic abscess (*) and densification of the adjacent mesentery.

**Fig. 58**: Actinomycosis Infection

**References**: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Actinomyces Infection

Case: A 54-year-old woman with abdominal pain and vomiting. She was in use of an intrauterine device (IUD).

Epidemiology: The greatest occurrence is in women using IUDs. It is also described after an episode of perforation of an abdominal viscus owing to inflammatory or neoplastic disease, surgery, or trauma. Among the affections caused by actinomycosis, only 20% occur in an abdominopelvic form.

Clinical presentation: Lower abdominal pain, cachexia, fever and leukocytosis.

Radiographic features: With the disease progression, there is the formation of tubo-ovarian abscess. Intraabdominal extension occurs through contiguous spread, and it crosses normal anatomical barriers and results in abscesses, sinus tracts, and fistulas surrounded. Hematogenous spread is also possible. Various abdominal organs may be involved in abdominopelvic actinomycosis and include the gastrointestinal tract, ovaries, liver, gallbladder, and pancreas. In the intestine, it may be found principally mural invasion with stricture formation, mass effect with tapered narrowing of the lumen, and thickened mucosal folds. The most important CT feature for the correct diagnosis is a large mass adjacent to the involved bowel, predominantly cystic or solid with marked contrast enhancement. Anal fistula can occur. There is also occurrence of a large heterogeneous mass at the greater omentum and bowel wall thickening of the adjacent transverse colon.

Differential diagnosis: Crohn disease, intestinal tuberculosis, and excavated malignant tumors.

Image key points: Mass or an abscess is found in the pelvis in patients with an IUD, fever, and laboratory tests suggesting infection.

Fig. 59: Actinomycosis Infection

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

- Hydatidosis
A 68-year-old man from an indigenous village with nonspecific symptoms.
Enhanced CT (venous phase). A (axial); B-C (coronal): Calcified hepatic cysts associated with perfusional disorder of the adjacent parenchyma (arrowheads). Two abdominal cysts, with parietal calcifications (arrows).

**Fig. 60: Hydatidosis**

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
Hydatidosis

Case: A 68-year-old man from an indigenous village with nonspecific symptoms.

Definition: Hydatid disease is a worldwide zoonosis produced by the larval stage of the Echinococcus tapeworm.

Epidemiology: The two main types of hydatid disease are caused by *E. granulosus* and *E. multilocularis*. The former is commonly seen in the Mediterranean region, Africa, South America, the Middle East, Australia, and New Zealand - and is the most frequently encountered type of hydatid disease in humans. Peritoneal hydatidosis is usually secondary to liver disease, occurring in approximately 13% of cases, and is usually only detected when the cysts are large enough to produce symptoms.

Clinical presentation: specific and depend on the location of the disease.

Radiographic features: In the liver, the site most affected by the disease is the right lobe, and the findings depend on the stage of the disease: unilocular cyst, containing daughter vesicles, containing daughter cysts, partially calcified, or completely calcified (dead). Abdominal and pelvic hydatid cysts arise from primary liver cysts. The peritoneal surfaces provide an excellent bed for implantation and growth of these secondary cysts. Cysts may be multiple and located anywhere in the peritoneal cavity.

Image key points: similar to those in hepatic disease. Peritoneal hydatid disease may grow and occupy the entire peritoneal cavity, simulating a multiloculated mass. Cyst fluid usually has water attenuation. They may have calcification of their walls or internal septa. The cyst wall typically has a high-attenuation at unenhanced CT even without calcification. Detachment of the laminated membrane from the pericyst can be visualized as linear areas of increased attenuation within the cyst. Daughter vesicles manifest as round structures located peripherally within the mother cyst.

Fig. 61: Hydatidosis

References: Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR

Secondary - Miscellany

- Splenosis
Enhanced CT: Widespread peritoneal splenosis (arrows) following splenic rupture and splenectomy.

**Fig. 62: Splenosis**

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
**Splenosis**

**Definition:** is the benign acquired condition of heterotopic autotransplantation of splenic tissue in another anatomic compartment of the body after splenic rupture.

**Epidemiology:** Splenosis in the abdominal or pelvic cavity occurs in approximately 65% of cases of splenic rupture. The most common sites of implantation are: greater omentum, small-bowel serosa, parietal peritoneum, and undersurface of the diaphragm.

**Clinical presentation:** Although abdominal splenosis is frequently asymptomatic, it can present with hemorrhage, pain secondary to infarction or torsion, or obstruction of the intestinal or urinary tract.

**Differential diagnosis:** polysplenia, accessory spleens, endometriosis, primary malignancy or metastatic disease.

**Image key points:** On unenhanced and enhanced CT, the masses are similar in attenuation to the expected appearance of otherwise normal splenic tissue. On MRI, the intensity and enhancement of the splenic nodules resemble that of normal splenic tissue. Nuclear scintigraphy using heat-damaged RBCs tagged with technetium-99 is currently the diagnostic tool of choice and can noninvasively confirm the diagnosis of splenosis if suspected on cross-sectional imaging.

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**Fig. 63:** Splenosis

**References:** Universidade Federal de São Paulo, Hospital São Paulo - São Paulo/BR
### Imaging Findings or Procedure details

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**Table 1:** Table of contents

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Fig. 11: Left internal paraduodenal hernia

A 69-year-old woman with diffuse abdominal pain, nausea and vomiting. CT: The third portion of the duodenum is tapered (afferent loop — arrow in A) and the jejunum is tapered too (efferent loop — arrow in B). Convergence of mesenteric vessels (arrow in C) and sac-like appearance (C - dotted circle)
Fig. 12: Same case as Fig. 11: Left internal paraduodenal hernia

Sac-like appearance (D- red circle); The left colic artery - branch of the inferior mesenteric artery (arrow in E) and at the time of surgery: hernia sac without signs of strangulation (F)
Intestinal transit study of a 4-year-old boy presenting with oral malformation and malnutrition. Supine frontal radiograph (A) shows cecum displaced in the superomedial aspect (arrow). B: Lateral view: cecum displaced superiorly.

**Fig. 14:** Malrotation: Case 1.

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Fig. 15: Malrotation Case 2.

© Fleury Medicina Diagnóstica, São Paulo, Brazil
Sigmoid Volvulus

93-year-old man presenting with symptoms of constipation
A-B: Enhanced-CT (venous phase) MIP coronal reconstruction 4mm: occlusion point (arrows).
C: Coronal Enhanced-CT (venous phase) show large gas-filled loop, forming a closed-loop obstruction (*)
D: CT scout image

Fig. 17: Sigmoid Volvulus

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**Fig. 18**: Same case as Fig. 17: Sigmoid Volvulus Video - specific CT sign for volvulus is the whirl sign: vessels twisted like a whirlwind in the center of the bowel twist.

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A-E: thickening with absent mural enhancement in a segment of transverse colon (*). The transverse colon is compressed by hematoma in the mesotransverse. B-E: hematoma (arrows) with active bleeding (arrowheads) in the mesotransverse.

**Fig. 20: Vascular - Mesenteric bleeding/hematoma**

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Fig. 22: Vascular - Mesenteric ischemia

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A homogeneous and unenhanced cyst, CT (arrow in A) in the inframesocolic region of the mesenteric root. Hypointense and homogeneous in the T1-WI (B) with fine septations (arrowheads in D – T2WI). In the coronal plane (D) it is observed its relation with a segment of small bowel.

**Fig. 24:** Mesenteric cyst

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Fig. 26: Hemangiomatosis

Enhanced CT (A-D), and non enhanced CT (E): ill-defined mass of similar attenuation to muscle (arrows) with phleboliths (arrowheads).

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A-C Enhanced CT (venous phase): 23-year-old woman with Crohn's disease, presenting concentric parietal thickening of the right colon, ileocecal valve and ileal loops (*), with densification of the adipose planes and vascular engorgement of the adjacent mesentery (comb sign - arrowheads). D-E: Enhanced CT (venous phase): 8-year-old girl with Crohn's disease, presenting complication of the disease, with fistula between the ileum and the bladder (arrows).

Fig. 28: Crohn's Disease

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Non-enhanced CT: Diffuse peritoneal malignant mesothelioma- Fluid widely distributed through the abdominal cavity. Punctiform and sparse nodular calcifications are observed (arrowheads).

**Fig. 30: Mesothelioma**

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Fig. 31: Same case as Fig. 30: Mesothelioma

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A-D: Enhanced CT show multiple solid masses with heterogeneous enhancement (arrowheads), malignant ascites (*) and peritoneal thickening. (arrow in A)

**Fig. 33:** Desmoplastic Small Round Cell Tumor

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Fig. 34: Same case as Fig. 33: Desmoplastic Small Round Cell Tumor

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Non-enhanced CT: subtle increased attenuation within the mesentery (arrowheads).

**Fig. 36:** Sclerosing mesenteritis - mesenteric panniculitis

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Fig. 38: Sclerosing mesenteritis - Retractile mesenteritis IgG4 related

IgG4-related mesenteric fibrosis presented as infiltrative, heterogeneous and enhancing tissue with retractable effect involving mesenteric root (arrows).

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Enhanced CT (A-D): Gastric and duodenal distention due to obstruction in the level of duodenojejunal flexure. (arrowhead in B and C). It is possible to identify a cluster of jejunal intestinal loops surrounded by a thin membrane, forming a cocoon-like appearance (arrow heads in A-D). E-F: intraoperative aspect.

**Fig. 40:** Abdominal cocoon

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Pseudomyxoma peritonei presented as a low density, cystic implants along the surfaces of the liver (arrows), small and large bowel mesentery (*) and peritoneal surface (arrowheads).

**Fig. 42:** Pseudomyxoma

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Lymphomatosis

A: prominent straightened vessels secondary to lymphomatous infiltration of the mesentery causing a “stellate appearance” (arrowheads). There is also homogeneous soft tissue in the greater omentum a.k.a omental-caking (*).
B-E: bulky homogeneous intraperitoneal masses (arrows), associated with free fluid in D-E.

Fig. 44: Lymphomatosis

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**Fig. 46: Carcinomatosis**

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38-year-old female presenting with peritoneal sarcomatosis. A-D: MRI show nodular peritoneal implants from sarcoma (arrows).

**Fig. 48: Sarcomatosis**

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Multiple nodular and heterogeneous peritoneal implants (arrows in A and B) secondary from gastric GIST, which presents as exophytic and necrotic mass originated from gastric fundus and body (* in C).

**Fig. 50:** Peritoneal GIST

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Fig. 52: Omental cake

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**Fig. 54: Tuberculosis**

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Fig. 56: Atypical Mycobacteriosis

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Fig. 58: Actinomycosis Infection

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A 68-year-old man from an indigenous village with nonspecific symptoms.
Enhanced CT (venous phase). A (axial); B-C (coronal): Calcified hepatic cysts associated with perfusional disorder of the adjacent parenchyma (arrowheads). Two abdominal cysts, with parietal calcifications (arrows).

Fig. 60: Hydatidosis

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Enhanced CT: Widespread peritoneal splenosis (arrows) following splenic rupture and splenectomy.

**Fig. 62: Splenosis**

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Internal Herniation

Case: A 69-year-old woman with diffuse abdominal pain, nausea and vomiting.

Epidemiology: Internal hernias account for approximately 0.5-0.8% of all cases of intestinal obstruction and are associated with a high mortality- up to 50%. About this case, left paradaudenal hernias have incidence of approximately 40% of all internal hernias. They occur when small bowel loops prolapses through a potential space, called the Landzert fossa, which is present in about 2% of the population.

Clinical presentation: Nonspecific symptoms are common: nausea, vomiting, pain, distension. It is a difficult diagnosis, which increases the importance of imaging methods, such as computed tomography.

Location: It depends on the site of herniation: the internal hernias that may have congenital etiology are: left paradaudenal, right paradaudenal, pericecal, foramen of Winslow, intersigmoid, transmesenteric. Intersigmoid, transmesenteric hernias can also be secondary (acquired). There is also retroanastomotic hernia, which is necessarily acquired after a surgical procedure.

Image key points: Sac-like appearance of the intestinal loops; clustered bowel loops in atypical location. Mesenteric vessel abnormalities: engorgement, crowding, twisting, and stretching of these vessels.

Fig. 13: Internal Herniation

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Malrotation

Definition: The concept of intestinal rotation explains the final position of the right colon and its mesocolon on the right flank, as well as the final position of the small intestine and its mesentery in the adult. It may be found non-rotation (complete) or malrotation - intermediate position between non-rotation and correct intestinal placement. In non-rotation the small bowel is located on the right side within the peritoneal cavity and the colon is located on the left side. Several degrees of malrotation of the small or large bowel may occur, and the positions of the duodenojejunal junction and colon depend on the stage of embryological development in which the rotation process failed.

Epidemiology: Malrotation occurs in approximately 1: 500 births and is widely related to genetic syndromes and other abnormalities, especially those of the gastrointestinal tract.

Clinical presentation: In newborns and young infants, bilious vomiting, abdominal distension, obstruction or midgut volvulus may occur. It may be asymptomatic in adults but potentially related to complications.

Image key points: Displaced position of the intestinal loops (jejunum flexor duodenum, colon, cecum). Vascular displacement: in most patients with malrotation (the SMA and SMV will assume a vertical relationship or show left-right inversion).

Fig. 16: Malrotation

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**Case:** 93-year-old man presenting with symptoms of constipation.

**Definition:** Volvulus is defined as a twisting of the intestine upon itself that causes obstruction.

**Epidemiology:** Acute colonic volvulus accounts for approximately 10%–15% of large bowel obstruction.
Sigmoid volvulus (~70% - occurs more in the elderly);
Cecal volvulus (~25%).
Volvulus of the transverse colon and splenic flexure is rare

**Clinical presentation:** Usually elderly, with insidious symptoms of obstruction: abdominal pain, constipation or obstipation, and abdominal distension

**Image key points:** marked distension of large bowel, bird beak sign, whirl sign, the coffee bean (sigmoid) and inverted U sign (sigmoid);

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**Fig. 19: Volvulus**

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Case: Mesenteric hematoma with active bleeding. A 56-year-old woman with multiple myeloma with chronic kidney disease on hemodialysis had mental confusion, hypokalemia, hypovolemic shock, and acute onset of abdominal pain and distension.

Epidemiology: Rare and a diagnostic challenge.

Clinical presentation: It varies according to the cause, size and location of the hematoma. It may present as a palpable mass and promote extrinsic compression in the gastrointestinal tract, leading to obstruction.

Differential diagnosis: If there is no history of trauma and other obvious conditions, such as pancreatitis or gastric ulcer, one should proceed with CT-scan to investigate other causes, such as aneurysms, pseudo-aneurysms and tumors. Image key points: Hematoma, active bleeding, and depending on the size of the hematoma, signs of obstruction.

Fig. 21: Vascular - Mesenteric bleeding/hematoma

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**Definition:** Mesenteric ischemia is a primary vascular disorder of the mesentery and has three main causes: mesenteric arterial embolus and thrombus, mesenteric venous thrombus, and non-occlusive mesenteric ischemia.

**Epidemiology:** Arterial occlusion (60–70%), venous occlusion (5–10%)

**Clinical presentation:** Arterial occlusion: acute presentation, abdominal pain out of proportion with clinical findings. As the acute ischemic event progresses, metabolic abnormalities occur that progress to multiple organ dysfunction; Venous occlusion: subacute presentation, vague symptoms of acute abdomen with gradual worsening, diffuse abdominal pain and distension.

**Radiographic features:** CT findings vary widely depending on the cause and underlying pathophysiology.

**Image key points:** Arterial: Defect or defects in arteries, arterial occlusion, SMA > SMV. Venous occlusion: Defect or defects in veins, venous engorgement.

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**Fig. 23:** Vascular - Mesenteric ischemia

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Mesenteric cyst

**Case:** diffuse abdominal pain, nausea and vomiting.

**Definition:** The rare form of primary mesenteropathy, mesenteric cysts occur most commonly on the mesentery of the small bowel or right colon. While the etiology is unknown, developmental abnormalities of mesenteric lymphatics may play a role.

**Epidemiology:** Mesenteric cysts are rare: incidence of 0.5-1 : 100,000 admissions.

**Clinical presentation:** asymptomatic increased abdominal girth, chronic abdominal pain or as an acute abdomen secondary to torsion, infection, or hemorrhage into the cyst itself.

**Radiographic features:** cystic mesenteric lesions that can be further characterized on the wall thickness (thin or thick walled) and their loculation (unilocular or multilocular).

**Differential diagnosis:** pancreatic pseudocyst, ovarian cyst, urachal cyst, hydrometrocolpos, peritoneal hydatidosis. Image key points: Its relationship with the mesentery and exclusion of differential diagnoses

**Fig. 25:** Mesenteric cyst

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**Definition:** Vascular malformations are similar to hemangiomas in that they are composed of abnormal vascular channels lined with a single layer of dysplastic endothelium. Vascular malformations are congenital. These malformations are named after the vascular element they most closely resemble: capillary, venous, and lymphatic malformations. When these lesions are very large or numerous, the term hemangiomatosis may be applied.

**Radiographic features:** On unenhanced CT, it may appear as an ill-defined mass of similar attenuation to muscle. CT may also show the presence of associated phleboliths.

**Image key points:** The presence of phleboliths suggests the possibility of this pathology.

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**Fig. 27:** Hemangiomatosis

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**Crohn’s Disease**

**Definition:** Recent findings challenge the classic notion that Crohn's disease arises from the mucosa of the intestine. It is feasible that Crohn's disease represents a true primary mesenteropathy. The classic model of Crohn's disease holds inflammation commences at the mucosa and outward spreads (becoming transmural) and thereafter affects the adjacent mesentery. However, recent findings support that Crohn's disease represents true primary mesenteropathy, i.e., the disease actually begins in the mesentery. Although the source of production of inflammatory factors, most notably the production of C-reactive protein, the mesenteric role of Crohn's disease is reinforced by its role in the recurrence and need for surgical reassessment of the disease. There is a direct correlation between the circumferential involvement of mesenteric fat and the risk of future surgery by the disease. Emerging data indicate that the mesenteric disease scores correlate with the Crohn's disease activity index, as well as with increasing levels of mucosal disease. Mesenteric disease manifestations are directly associated with local mucosal and systemic manifestations in Crohn's disease. At present, both etiology and pathobiology of Crohn's disease remain under investigation. Although the origin of this pathology has not yet been fully clarified, we have chosen to describe it among primary mesenteropathies, according to the most recent scientific data.

**Epidemiology:** is common in northern Europe, North America, and Japan, affects both sexes equally and has its peak of development between 15 and 25 years of age.

**Radiographic features:** thickened bowel wall with marked contrast material enhancement, mural stratification, pericolic or perienteric hypervascularity (comb sign), hyperintensity of the bowel wall on T2-weighted images, fibro-fatty proliferation (creeping fat), lymph node enlargement, and extramural complications such as phlegmon, abscess, strictures and fistulae.

**Fig. 29: Crohn’s Disease**

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**Definition:** Malignant mesothelioma is a rare neoplasm that arises from mesothelial cells or multipotential subserosal mesenchymal cells of the pleura, peritoneum, pericardium, or tunica vaginalis of the testis. Peritoneal primary mesotheliomas account for 6% -10% of malignant mesotheliomas.

**Epidemiology:** Three types- diffuse malignant mesothelioma, well-differentiated papillary mesothelioma and multicystic mesothelioma. Diffuse malignant mesotheliomas are aggressive aggressive tumors and the risk factors are asbestos exposure, radiotherapy and chronic peritonitis. Multicystic Mesothelioma occurs in young or middle-aged women and the risk factors are previous surgeries, repetitive pelvic inflammatory disease

**Clinical presentation:** Abdominal pain, abdominal distention, nausea, anorexia, and weight loss. Complications such as bowel obstruction may occur with advanced disease

**Differential diagnosis:** Diffuse Peritoneal Malignant Mesothelioma: carcinomatosis, lymphomatosis and peritoneal infections. Multicystic Mesothelioma: Pseudomyxoma peritonei.

**Image key points:** Diffuse peritoneal malignant mesothelioma - two patterns: 1- diffuse involvement of the peritoneal cavity and 2- focal intraperitoneal masses. Multicystic Mesothelioma: multiseptated, cystic structures that have an intimate anatomic association with the uterus and ovaries

**Fig. 32:** Peritoneal Malignant Mesothelioma

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**Definition:** Rare malignancy of unknown histogenesis that occurs predominantly in adolescent and young adult males. It is a distinctive clinicopathologic entity in the family of primitive pediatric tumors that are composed of small, round, blue cells, a group that includes Wilms tumor, Ewing sarcoma, peripheral primitive neuroectodermal tumor.

**Epidemiology:** young men with a mean age of 19 years

**Clinical presentation:** abdominal pain

**Radiographic features:** Peritoneal thickening, nodules, and masses. But it can present as a solitary peritoneal mass. The masses are characteristically heterogeneous (reflecting intratumoral necrosis or hemorrhage). The masses may contain small, punctate calcifications. Malignant ascites is common.

**Differential diagnosis:** Peritoneal carcinomatosis and lymphomatosis.

**Image key points:** Presence of a single or multiple dominant masses within the diffuse process is more characteristic of desmoplastic small round cell tumor compared with the other lesions. Imaging evidence heterogeneity or calcification is also suggestive of desmoplastic small round cell tumor.

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**Fig. 35:** Desmoplastic Small Round Cell Tumor

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**Sclerosing mesenteritis – mesenteric panniculitis**

**Definition:** Sclerosing Mesenteritis (panniculitis) is an uncommon idiopathic disorder characterized by chronic non-specific inflammation involving the adipose tissue of the bowel mesentery. Although sclerosing mesenteritis is often associated with other idiopathic inflammatory disorders its exact cause is unknown. The evolution of this entity has been described in three stages. **Stage 1 mesenteric lipodystrophy:** degeneration of mesenteric fat, frequently asymptomatic. **Stage 2 mesenteric panniculitis:** inflammatory changes and lymphatic distension with early fibrosis - may have a symptomatic presentation. **Stage 3 retractile mesenteritis:** collagen deposition and fibrosis thickens and shortens the mesentery.

**Epidemiology:** male predilection, with the average age around 60 years.

**Clinical presentation:** Patients may present with abdominal pain, intestinal obstruction or ischemia, a mass, or diarrhea.

**Radiographic features:** From subtle increased attenuation in the mesentery to a soft tissue mass. The process usually involves the mesentery of the small bowel, especially at its root, but occasionally involves the mesocolon. The mass may envelop the mesenteric vessels, where the preservation of fat halo around the mesenteric vessels (fat ring sign) can be observed. This finding may help distinguish sclerosing mesenteritis from other mesenteric processes such as lymphoma, carcinoid tumor, or carcinomatosis.

**Differential diagnosis:** lymphoma, carcinoid tumor, carcinomatosis, primary mesenteric mesothelioma, and mesenteric edema

**Image key points:** Sclerosing mesenteritis mesenteric panniculitis type: mesentery appear to have increased attenuation with small nodes but without evidence of a discrete soft-tissue mass.

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**Fig. 37: Sclerosing mesenteritis - mesenteric panniculitis**

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Definition: IgG4-related disease (IgG4-RD) represents an inflammatory and fibrosing disease process of unknown etiology. Recently, a close relationship has been reported between IgG4-RD and multifocal fibrosclerosis. The disease often responds well to steroid therapy. The relationship between sclerosing mesenteritis and IgG4-RD has not been studied well. There is debate about the association between systemic inflammatory conditions and mesenteric panniculitis. The causes are not completely delimited.

Epidemiology: male predominance, with the average age around 60 years.

Radiographic features: retractile mesenteritis presentation of sclerosing mesenteritis. - the final stage of sclerosing mesenteritis, when fibrosis is established.

Differential diagnosis: The differential diagnosis of sclerosing mesenteritis may include various inflammatory and neoplastic diseases.

Image key points: retractile mesenteritis type-mesenteric mass with fibrosis signs and retractable effect on imaging.

Fig. 39: Sclerosing mesenteritis - retractile mesenteritis IgG4 related

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Abdominal cocoon

**Case:** A 27-year-old man with diffuse abdominal pain, bilious vomiting and 25-lb weight loss over one month.

**Definition:** Abdominal cocoon syndrome (also known as sclerosing encapsulating peritonitis) is characterized by small bowel encapsulation by a fibrocollagenous membrane or "cocoon". It is a rare cause of intestinal obstruction. It has 2 types: primary (idiopathic) and secondary. The secondary type is seen in patients with peritoneal dialysis, peritonitis, previous abdominal surgery, sarcoidosis, and tuberculosis.

**Epidemiology:** The idiopathic type primarily affects young females from tropical and subtropical countries.

**Clinical presentation:** Acute or chronic symptoms of small bowel obstruction.

**Differential diagnosis:** CT findings of a membrane enveloping loops of small bowel were seen in some paraduodenal hernias.

**Image key points:** Small bowel loops congregation in the center of abdomen with a non-enhancement fibrous membrane surrounding the bowel loops.

**Fig. 41:** Abdominal cocoon

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Pseudomyxoma

Case: A 44-year-old man with pain and increased abdominal volume and weight loss for 2 years.

Definition: Pseudomyxoma peritonei describes the finding of thick mucinous or gelatinous material on the surfaces of the peritoneal cavity. It is accepted that the majority of cases of classic pseudomyxoma peritonei develops from low-grade mucinous carcinomas that penetrate or rupture into the peritoneal cavity.

Epidemiology: 1: 1,000,000/year. It occurs more in women, in their 50s.

Clinical presentation: Progressive abdominal pain, increasing abdominal girth, and weight loss.

Radiographic features: At sonography, might be suspected when ascitic fluid is echogenic, a finding that suggests that the fluid is gelatinous. Scalloping of the hepatic and splenic margins may also be present. Mucin within the peritoneum is usually low in CT attenuation, but areas of soft-tissue attenuation may be present that represent solid tumor elements, fibrosis, or compression of the mesentery.

Differential diagnosis: Mucinous carcinomatosis.

Image key points: Scalloping of the visceral surfaces of the intra-peritoneal organs (indentations that occur on the capsular margins) helps differentiate pseudomyxoma from simple ascites.

Fig. 43: Pseudomyxoma

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**Definition**: Peritoneal lymphomatosis is a rare manifestation of lymphoma, most frequently seen with non-Hodgkin lymphoma and is defined as the intraperitoneal spread of lymphoma.

**Radiographic features**: The pattern most commonly found in peritoneal lymphomatosis is omental caking with bulky homogeneous masses. Other characteristics found are: a homogeneous smooth thickening, diffusely infiltrating the peritoneum and the leaves of the mesentery; small omental nodules associated with fine infiltration of the omental fat (smudged appearance); stellate appearance of the mesentery in an infiltrating process, causing thickening and rigidity of the mesentery.

**Differential diagnosis**: peritoneal carcinomatosis and peritoneal sarcomatosis.

**Image key points**: bulky homogeneous masses or smooth peritoneal soft tissue thickening, diffuse lymphadenopathy, in addition to imaging features of variable extranodal lymphomatous involvement

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**Fig. 45: Lymphomatosis**

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**Definition:** carcinomatosis is the intraperitoneal dissemination of any tumor that does not originate from the peritoneum itself. It is the most common diffuse peritoneal disease.

**Radiographic features:** Ascites, free or loculated, greater omentum involvement (omentum cake), invasion of the mesentery, increased mesenteric fat density, mesenteric mass/nodules, tumor implants in the peritoneal serous membrane.

**Differential diagnosis:** Pseudomyxoma peritonei, Malignant peritoneal mesothelioma, Peritoneal lymphomatosis, Peritoneal tuberculosis, Tuberculosis, Splenosis implants, Diffuse peritoneal leiomyomatosis.

**Fig. 47:** Carcinomatosis

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**Definition:** disseminated intraperitoneal spread of sarcoma in the absence of significant extra abdominal sites of disease.

**Epidemiology:** rare entity. Sarcomatosis may arise from recurrent intraabdominal sarcomas or may be metastatic from extremity sarcomas. The most frequent tumors that give rise to peritoneal sarcomatosis are gastrointestinal stromal tumors (GISTs), liposarcomas, and leiomyosarcomas.

**Radiographic features:** All peritoneal surface malignancies share similar radiologic features (carcinomatosis and lymphomatosis), with seeding of soft-tissue implants along the peritoneum and omentum.

**Differential diagnosis:** carcinomatosis and lymphomatosis

**Image key points:** tumor implants from sarcomas are usually spherical and deforming, hypervascular and with minimal associated ascites. Carcinomatosis implants are either flat or ovoid according to the adjacent structure and generally have a marked ascites associated.

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**Fig. 49: Sarcomatosis**

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Case: A 49-year-old man with pain, increased abdominal volume and weight loss. Gastric GIST (primary) with peritoneal spread.

Definition: Gastrointestinal stromal tumors (GIST) are a group of smooth muscle mesenchymal tumors of variable malignancy. They account for 0.1 to 3% of all gastrointestinal neoplasms.

Epidemiology: approximately 5000–30,000 people/year. Middle-aged and older patients.

Clinical presentation: The clinical findings vary depending on the location and size of the tumor at presentation. Lesions in the stomach, small bowel, or colon may present with gastrointestinal bleed and there may be abdominal pain, nausea, and vomiting.

Radiographic features: most of these tumors are submucosal in location, usually attaining a large size without causing bowel obstruction by the time of diagnosis. Many of these tumors have an exophytic component. The enhancement pattern can vary from homogenously enhancing to heterogeneously enhancing, with or without ulceration. Ulceration is as a common feature of GIST. Metastases from GIST commonly occur to the liver and peritoneal cavity via hematogenous spread and peritoneal seeding.

Differential diagnosis: adenocarcinoma, lymphoma, peritoneal carcinomatosis, carcinoid, metastases, and other mesenchymal neoplasm.

Image key points: Peritoneal GIST is most often seen in the large discrete masses that are often necrotic with heterogeneous enhancement and less commonly the diffuse hypervascular omental and peritoneal caking. Necrosis within the masses may lead to fistulization and, owing to tumor hypervascularization, may present gastrointestinal bleeding and hematoperitoneum.

Fig. 51: Peritoneal GIST

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**Definition:** Omental caking is the most characteristic imaging presentation of secondary peritoneal malignancy: it may present as fine nodular, soft tissue studding or large confluent soft tissue masses within the omentum.

**Epidemiology:** This pattern of involvement is associated with several malignancies of mesenteric dissemination, but is more common first in carcinomatosis after lymphomatosis, and is less commonly found in others such as sarcomatosis and peritoneal GIST.

**Radiographic features:** there is invasion of the greater omentum, sometimes accompanied by small nodulations. With progression, the omental fat is replaced by a solid mass, the omental caking itself.

**Image key points:** Invasion of the fat of the greater omentum with nodules in later forms

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**Fig. 53:** Omental cake

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**Tuberculosis**

**Epidemiology:** Tuberculosis is responsible for about 1.7 million deaths annually. It has increased its incidence due to HIV infection and use of immunosuppressive drugs.

**Radiographic features:** Peritoneal tuberculosis is the most common presentation of abdominal tuberculosis and may involve the peritoneum, mesenterium and omentum. It is classically classified into three types: dry, wet and fibrous types. **Wet type:** free or loculated ascites, associated or not with diffuse and smooth peritoneal thickening; **Dry type:** predominance of peritoneal and mesenteric thickening with caseous nodules, lymph nodes enlargement and fibrinous adhesions; **Fibrous type:** remarkable omental thickening and entanglement of bowel loops clinically resembling a mass, occasionally with loculated ascites and that may be similar to peritoneal carcinomatosis.

**Differential diagnosis:** carcinomatosis, lymphoma, Crohn's disease, amebiasis, adenocarcinoma.

**Image key points:** smooth peritoneal thickening with marked enhancement after intravenous contrast injection; lymph node enlargement with areas of central necrosis. Fat-fluid level in association with necrotic lymph nodes is highly specific for tuberculous ascites.

**Fig. 55:** Tuberculosis

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Conclusion

The question of the mesentery being designated as an organ has not yet been widely defined or accepted by the scientific community. This is an anatomical concept and the criteria presented may not be sufficient for this designation.

Organ or not, the mesentery has gained space as a noble, continuous structure with specific functions and also being the origin and spread of specific diseases. Thus, the mesentery must have a new approach by the scientific community in the future.

Currently, the new concepts regarding the mesenteric continuity with special functions brings a fresh look to primary and secondary mesenteric pathologies, from radiological diagnosis to therapeutic management and is an open door to the systematic radiological investigation of this anatomical structure now properly detailed.
Personal information

Contact details:

Hanna R. F. Dalla Pria

Department of Imaging, Universidade Federal de São Paulo
Rua Napoleão de Barros, 800 - Vila Clementino
CEP 04024-002 - São Paulo/SP, Brazil.
Email: hannarafa@msn.com

Author Information

Hanna R. F. Dalla Pria (Department of Imaging, Universidade Federal de São Paulo, São Paulo, Brazil).

Fernanda Velloni (Department of Imaging, Universidade Federal de São Paulo, São Paulo, Brazil; Diagnósticos da América S.A. DASA. São Paulo, SP, Brazil).

Rafael A. Santiago (Department of Imaging, Universidade Federal de São Paulo, São Paulo, Brazil; Diagnósticos da América S.A. DASA. São Paulo, SP, Brazil).

Marina S. Zacarias (Department of Imaging, Universidade Federal de São Paulo, São Paulo, Brazil).

Luís F. D. Silva (Department of Imaging, Universidade Federal de São Paulo, São Paulo, Brazil).

Fernando Tamamoto (Department of Imaging, Universidade Federal de São Paulo, São Paulo, Brazil).
Augusto C. Von Atzingen (Department of Imaging, Universidade Federal de São Paulo, São Paulo, Brazil; Universidade do Vale do Sapucaí (Univás), Pouso Alegre, MG, Brazil).

Ulysses S. Torres (Fleury Medicina Diagnóstica, São Paulo, Brazil).

Giuseppe D'Ippolito (Department of Imaging, Universidade Federal de São Paulo, São Paulo, Brazil; Fleury Medicina Diagnóstica, São Paulo, Brazil).
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