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Learning objectives

To recognize jejunal mesenteric panniculitis (JMP), an incidental finding on MDCT examinations performed for other clinical reasons, and to investigate its phisiopatological meaning and relation with lymphoproliferative disorders. To distinguish this segmental pattern of mesenteric involvement from diffuse mesenteric thickening, associated with different pathological conditions, well known and described in the literature as "misty mesentery" (MM).

In this poster we will analyze the role of imaging in JMP detection and classification, according to a grading score based on the presence/absence of key radiological signs, partly coinciding with those described in MM.

Our aim is to make radiologists aware of the importance of a correct identification and grading of JMP, as well as searching a correlation with clinical and immunological status in Patients with no evident cause of such alteration. This in order to carry out identification of Patients at risk of developing mesenteric lymphoma.
Background

The mesentery is a reflection of the peritoneum on the bowel surface. It is a space lined by two parallel layers within which mesenteric vessels, lymphatics, nodes, nerves are immersed into a variable amount of fat [1]. All this vessels converge toward a precise point, represented by the spleno-mesenteric confluence.

The term "misty mesentery", first used by Mindelzun et al. in 1996 [2], refers to a complex of signs, mainly consisting in increased attenuation at MDCT of mesenteric fat, whose density is in normal condition similar to that of retroperitoneal or subcutaneous tissue, ranging between -100 and -160 HU. When mesentery is infiltrated by fluids, inflammatory cells, neoplasms or fibrosis, normal density values variably increase to -40/-60 HU at least.

MM is frequently observed during daily clinical practice and may be caused by various pathological conditions, including edema, inflammation, haemorrhage or neoplastic infiltration. In patients suffering from acute abdominal disease, MM may be considered a feature of an underlying disorder, selectively affecting the corresponding tract of mesentery, such as acute pancreatitis or liver cirrhosis.

MM grossly presents itself with a segmental or nonsegmental appearance. Nonsegmental mesenteric involvement most commonly occurs in patients with inflammatory bowel diseases or who have experienced a previous trauma with mesenteric and/or major bowel injuries. In such cases, primary lesions are often found in the nearby of MM.

Alternatively, segmental MM commonly results from edematous changes secondary to vascular disorders or neoplastic infiltration. The primary pathologic process can also exist at sites distant from involved mesentery, as it happens in liver cirrhosis.

In this context, jejunal mesentery is described to be involved more frequently than the ileal segment (76% versus 24% according to Bo Kyoung Seo et al. [1]). Although there is no exact explanation for this observation, some differences in vascular anatomy between jejunum and ileum have been proposed: there are relatively fewer mesenteric vascular branches in the jejunum than in the ileum, so that the jejunal tract of bowel is more likely to feel the effect of hydrostatic pressure. Another reason for this observation may be that most of underlying diseases in oncologic patients are localized in the upper part of abdomen, involving the liver, stomach, pancreas, and proximal descending colon.

MM microscopically consists of an infiltration by inflammatory cells, namely myofibroblasts and foamy macrophages. Vessels traversing the lesion are often inflamed and sometimes thrombosed [3].
Although nonsegmental MM is a common feature of many pathological conditions, occasionally a segmental pattern of mesenteric involvement can be observed. JMP, although similar to MM, specifically affects the mesentery of jejune, that is the first tract of absorbing intestine. It could be an incidental finding on MDCT examinations performed for other clinical reasons, more frequently than usually believed. Yet our case material hints the hypothesis that it can represent the indicator of an immunologically mediated chronic inflammation affecting this bowel tract, the first absorbing one. The chronic stimulation by an allergic stimulus on the local lymphatic system open, in predisposed Patient, a possible evolution to some lymphoproliferative disorder, particularly follicular lymphoma.
Imaging findings OR Procedure details

MM is defined as a visually perceptible area of increased attenuation of the adipose tissue around mesenteric vessels and nodes, relative to that of subcutaneous or retroperitoneal fat. This appearance frequently associates with a segmental distribution of changes along the branches of mesenteric vessels, namely jejunal.

The hallmark of JMP is segmental increased density of jejunal fat, without displacement of mesenteric vessels, almost always inscribed in a clear hypertrophy of mesenteric fat. Sometimes small bowel loops may be locally displaced by thickened mesentery. Since it extends along the root of jejunal mesentery, JMP typically has a leftward orientation.

Our population consists of 194 Patients (mean age 69.1 years; range between 30 and 91 years), undergone from November 2005 to June 2011 abdominal contrast enhanced MDCT examination at our institution for different reasons. All patients were characterized by the presence of JMP on radiological images, either justified by an underlying clinical condition or presenting itself as an occasional finding without any known motivation.

MDCT scanning protocol employed consisted in:

- Brilliance 64 channel MDCT scanner (Philips Healthcare, Amsterdam, Netherlands)
- Single scout from diaphragm to femoral diaphisis
- Scan volume from the dome of diaphragm to small trochanters
- Helical scan; slice thickness: 1 mm; pitch: 1.5; mean dose per patient: 12 mS
- 18-20 G iv cannula placed in a distal arm vein
- 120 ml iodinated contrast medium (350 mgI/ml) @ 3.0 ml/s + 60 ml @ 3.0 ml/s saline chase
- Dynamic scanning with a bolus tracking timing for arterial and portal phase images

MDCT reformat images, including MPR and coronal thick slab MIP reconstructions were obtained in order to show most important radiological signs associated with MM.

Radiological key signs of MM, on axial MDCT images consist in [4]:

- **Increased thickness of involved mesentery** (Fig. 1)

Maximum thickness of jejunal mesenteric leaflets can be measured on MDCT axial sections. Normally it does not exceed 2-3 cm. If greater, it should be considered a
hallmark of mesenteric involvement and is to be interpreted as a reaction of fat to chronic inflammation.

- **Increased fat density (GGO mesentery)** (Figg. 1, 2)

Normal mesenteric fat appears as a homogeneous area of low attenuation (-100 to -160 HU), similar to that of subcutaneous tissues or retroperitoneum. When mesentery is infiltrated by cells (inflammatory or neoplastic), fluids (edema, lymph or blood) or collagen (fibrosis), normal density values increase to -40/-60 HU at least. Applying a semeiology similar to that of chest CT, we named this abnormality as GGO mesentery, when increased fat density non obscuring the vessels was present.

- **Enlarged lymph nodes** (Fig. 3)

Advent of new MDCT machines allows the depiction of normal nodes within mesenteric reflections more often concentrated in the terminal mesentery around ileo-colic vessels. These nodes are considered to be enlarged when greater than 1 mm in axial diameter [5, 6], but some variations can be introduced, regarding specific pathological conditions.

- **Halo sign** (Fig. 2)

"Fat ring sign" or "fatty halo" stands for the preservation of normal fat densitometric values close to nodes in the context of a hyperdense mesentery (probably effect of lymphatic drainage by nodes) [8, 9].

- **Pseudocapsule** (Fig. 1b)

"Pseudocapsule", described as a sign of MM, consists of a peripheral band limiting the inflammatory mesenteric mass from surrounding normal folds, identifying mesentery with limited inflammatory activity. This aspect represents the thickening of peripheral envelope of mesentery or the presence of a subtle fluid component. In the retractile form, fibrosis predominates and the disease manifests itself as large masses of soft-tissue attenuation that may arrive to encompass vessels and contain calcifications. Retractile mesenteritis cannot be distinguished from mesenteric tumors (carcinoid or lymphoma) without extensive histological sampling, because it represent an end stage chronic phlogistic condition.

- **Status of mesenteric vessels** (Fig. 3)

Mesenteric vessels are considered to be dilated or engorged when larger than 3 mm in caliber or increased in number [5, 7]. In equivocal cases, diameter of vessels within affected mesentery should be compared with that of uninvolved segments at a similar level. Venous dilatation mainly results from increased hydrostatic pressure due to portal hypertension or extrinsic compression of mesenteric veins. Otherwise arterial dilatation may be caused by either inflammatory hyperemia in patients with phlogistic conditions or increased blood supply in cases with malignant neoplasms. Both arterial and venous
dilatation lays for a more extensive mesenteric involvement than single arterial or venous enlargement. When present, they determine an alteration of the whole mesenteric ligament. This aspect is practically absent in JMP.

- **Presence or absence of bowel wall changes**

Either ileal or colonic loops can be involved. Bowel wall is considered to be thickened when it exceeds 4 mm [5, 7]. It is often associated with a possible involvement of corresponding tracts of mesentery.

Some exemplificative images of radiological signs described, taken from our series, are given alongside (Figg. 1-5):

When radiological abnormalities described above selectively affect the jejunum, the term "JMP" can be introduced. As regards signs described in MM, it is to be noticed that not all of them are present in JMP. In particular, congestion of vessels and thickening of bowel loops are absent.

Abdominal pain, sense of heaviness, food intolerance and diarrhea are among clinical findings occasionally described. Yet most Patients presenting this condition are asymptomatic. Immunological dysregulation, with chronic stimulation of local lymphatic system, is proposed to determine these alterations, otherwise idiopathic.

Our case material showed higher prevalence of enlarged lymph nodes within jejunal mesentery over 2 cm in patients developing follicular lymphoma than in those presenting JMP without such nodes enlargement. Thus, when drawing up a JMP grading score, it should be taken into account that differences in prevalence of MDCT signs correlate with different causes of JMP. This to say that enlarged lymph nodes are a particularly relevant radiologic finding in Patients prone to develope linfoproliferative disorders.

In conclusion, when segmental MM shows above mentioned MDCT features and no underlying disease is detected, mesenteric panniculitis should be considered in jejunal tract, particularly in presence of fat hypertrophy. JMP may be a nonspecific response to some hidden chronic stimulation [10, 11]. Therefore, close clinical and imaging follow-up, also in search of specific gastroenterological laboratory findings, is advisable in these subjects, since at risk of developing follicular lymphoma. This has been observed in four cases of our series, of which some exemplificative images are reported alongside (Figg. 6, 7a, b).

When this diagnosis is suspected, pathological confirmation is required (Fig. 7c).
Fig. 1: MDCT axial images showing jejunal mesenteric thickening measuring 5.6 cm (a) and surrounded by a subtle tumoral pseudocapsule (arrowheads in b).

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Fig. 2: MDCT axial image (a) and coronal MPR (b) showing fat ring sign around a lymph node (arrowheads in a) and mesenteric GGO (arrow in b) in a case of JMP.

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**Fig. 3:** MDCT coronal MIP reconstructions showing several enlarged lymph nodes along dilated superior mesenteric vessels, distributed throughout the whole mesentery.

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**Fig. 4:** MDCT axial images showing tumoral pseudocapsule surrounding an iperplastic jejunal mesentery.

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**Fig. 5:** Axial MDCT sections showing enlarged inferior mesenteric artery (arrow in a) and vein (arrow in b) in a patient with liver cirrhosis.

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**Fig. 6:** MDCT coronal (a, b) and oblique (c, d) MPR showing another case of mesenteric lymphoma of our series before (a, c) and after (b, d) spread of disease one year later, when mediastinal enlarged lymph nodes were also present (e).

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Fig. 7: Follicular lymphoma. MDCT axial image (a) and coronal MIP reconstruction (b) showing one case of follicular lymphoma of our series with large lymphadenopathies within jejunal mesentery. Macroscopic appearance (intraoperative color picture) of mesenteric follicular lymphoma after diagnostic laparotomy (c): enlarged lymph nodes within jejunal peritoneal layers are visible. Difference in color between loops affected (less bright, white arrow) and spared by cellular infiltration is also to be noticed.

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**Conclusion**

MM is a group of radiological findings that can be associated with several pathological conditions of the abdomen, such as neoplastic, phlogistic or vascular alterations. Anyway many patients presenting signs of MM on MDCT examinations performed for other reasons, have elective segmental jejunal involvement without any demonstrable underlying cause in surrounding bowel loops, better defined as JMP. This condition, JMP, is to be considered a distinct disease, related to an abnormal reaction of jejunal lymphatic system to pathological stimuli selectively affecting the jejunum, that is the first absorbing tract of bowel.

Thus radiological evidence of JMP can be detected by radiologists; it is important to stage the jejunal involvement and correlate it with clinical and immunological status of the Patient. Prevalence of lymphadenopathies over 2 cm in size within JMP appears to be the main risk factor for developing follicular lymphoma. In these cases, close follow-up through MDCT scans is warranted to predict possible evolution to follicular lymphoma and eventually laparoscopic or open biopsy may be indicated, as demonstrated in four cases of our series.

Further studies will better clarify causes, pathophysiology and clinical significance of this chronic mesenteric inflammation.
Personal Information

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