The “Misty Mesentery”: Mesenteric Panniculitis and Its Mimics

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The “Misty Mesentery”:

1. The term “misty mesentery” was coined by Mindelzun et al. in 1996 to describe a regional increase in mesenteric fat density that is seen frequently at abdominopelvic CT.
2. Mesenteric panniculitis (MP) is one of the broad range of disorders that may result in the imaging finding of a misty mesentery on CT.
3. MP cannot be diagnosed on CT without the exclusion of many other possible causes of a misty mesentery including disorders that result in mesenteric edema, lymphedema, hemorrhage, and infiltration with inflammatory or neoplastic cells.
4. Retractile mesenteritis results in irregular fibrotic mesenteric masses that simulate a number of neoplastic conditions of the mesentery and peritoneum such as carcinoid tumors, desmoid tumors, and peritoneal carcinomatosis.

The term “misty mesentery” was coined by Mindelzun et al. [1] in 1996 to describe a regional increase in mesenteric fat density at abdominopelvic CT. This imaging finding is commonly encountered during review of abdominal CT scans [2]; when a misty mesentery is observed, the radiologist must consider many pathologic entities involving the mesenteric fat and adjacent organs that may result in the infiltration of these tissues by fluid, fibrous tissue, or inflammatory or neoplastic cells.

Mesenteric panniculitis (MP) is one of the broad range of disorders that may result in the imaging finding of a misty mesentery on CT. MP is pathologically characterized by inflammation and variable amounts of fibrosis and fat necrosis of the mesentery. Although MP is an important potential cause for a misty mesentery on CT, MP is a diagnosis that requires the exclusion of a range of important diseases and ultimately may require histologic confirmation [3].

In this article, we describe the key CT findings associated with MP. We outline the imaging features of MP and of a wider spectrum of related disorders belonging to the parent group sclerosing mesenteritis. A misty mesentery can be seen in association with a range of pathologic entities other than MP. Imaging findings in conditions known to mimic MP are also described in an attempt to provide the radiologist with a basis for rational differential diagnosis.

Pathophysiology

MP belongs to a continuum of idiopathic disorders of the mesentery and peritoneum referred to as “sclerosing mesenteritis” [4]. Pathologically, sclerosing mesenteritis can be divided into three stages. The first stage is mesenteric lipodystrophy in which a layer of foamy macrophages replaces the mesenteric fat [4]. The second stage is MP in which there is an infiltrate of plasma cells, polymorphonuclear leukocytes, and foamy macrophages [4, 5]. The final stage is retractile mesenteritis, which is characterized by collagen deposition, fat necrosis, and fibrosis that leads to tissue retraction [4, 5].

The cause of sclerosing mesenteritis remains unclear, although several possible causes have been proposed in the literature including previous abdominal surgery, abdominal trauma, autoimmunity, vasculitis, and infection [6]. Sclerosing mesenteritis has been associated in a number of case studies with a variety of intraabdominal and extraabdominal malignant diseases including lymphoma, colorectal carcinoma, gastric carcinoma, renal cell carcinoma, melanoma, myeloma, chronic lymphocytic leukemia, and carcinoid tumors [6]. Currently, there is no clear answer to the question of how strongly sclerosing mesenteritis is associated with underlying malignancy. Kipfer et al. [7] reported that 30% of patients with sclerosing mesenteritis had an underlying malignancy, whereas Daskalogiannaki et al. [6] reported a higher rate of 69% of sclerosing mesenteritis patients with coexisting malignancy. Other investigators have found that
the coexistence of malignancy and sclerosing mesenteritis is not significantly different than in patients undergoing routine abdominopelvic CT without findings suggesting sclerosing mesenteritis [8]. The possibility that sclerosing mesenteritis may represent a nonspecific paraneoplastic response has been suggested, but available data are limited and the exact relationship between sclerosing mesenteritis and malignancy remains unclear. There is, however, an established association between sclerosing mesenteritis and other idiopathic inflammatory disorders such as orbital pseudotumor, retroperitoneal fibrosis, sclerosing cholangitis, and Reidel thyroiditis [3].

Clinical Characteristics
Sclerosing mesenteritis is reported across a large age range, typically extending from the third to the ninth decades. Cases of sclerosing mesenteritis in the pediatric age range are rare but have been documented as case reports in the literature [9]. The most commonly reported mean age of presentation lies in the seventh decade and a male preponderance is accepted [4, 7].

Very rarely patients with MP may present with acute abdominal symptoms including abdominal pain, bloating, nausea, or weight loss [5], and an abdominal mass may be palpated in up to 50% of this subgroup [7]. In this subgroup of acutely symptomatic patients, treatment with steroids or a combination of steroids and other drugs such as tamoxifen has been shown to be beneficial [10]. An increasing proportion of asymptomatic patients continue to be identified when undergoing modern cross-sectional imaging; Daskalogiannaki et al. [6] reported imaging findings consistent with MP in 0.6% of 6620 consecutive patients undergoing routine abdominopelvic CT.

Imaging Findings in Mesenteric Panniculitis
MP results in a masslike area of heterogeneously increased fat attenuation on CT that may displacelocal bowel loops but typically does not displace the surrounding mesenteric vascular structures [2] (Fig. 1). Ultrasound may show a well-defined hyperechoic mass with small central hypoechoic areas or a heterogeneous but predominantly hyperechoic mass [11]. On MRI, a mesenteric mass is seen with intermediate signal intensity on T1-weighted images and with slightly higher signal intensity on T2-weighted images [12]. Mesenteric lymph nodes are often seen within the region of segmental mesenteric stranding and nodes may be enlarged to greater than 1 cm in a small percentage of cases [13]. Approximately 90% of cases involve the small-bowel mesentery [10] and changes are more commonly centered to the left of the midline corresponding with the jejunal mesentery [14] (Fig. 2).

Important imaging signs of MP include the “tumoral pseudocapsule” sign (Fig. 3), which refers to the presence of a peripheral curvilinear band of soft-tissue attenuation limiting the heterogeneous mesenteric mass from the surrounding normal mesentery, and the “fat halo” sign (Fig. 4), which refers to the preservation of normal fat density in the fatty tissue surrounding the mesenteric vessels. The thickness of the tumoral pseudocapsule band of soft tissue is typically not greater than 3 mm [6]. The sensitivities of the fat halo and tumoral pseudocapsule signs were reported as 75% and 50%, respectively, in a series of 17 pathologically confirmed cases [13]. The specificity of these signs has not yet been defined to our knowledge, but radiologists should be aware that the fat halo sign may also be present in patients with mesenteric lymphoma [15, 16] and the tumoral pseudocapsule sign may also be found in cases of benign and malignant mesenteric lipomatous tumors [2].

Mimics of Mesenteric Panniculitis
When a misty mesentery is observed on CT, it is incumbent on the radiologist to consider and, if possible, exclude alternative causes of a regional increase in mesenteric fat density such as edema (Fig. 5), hemorrhage, lymphedema, inflammation (Fig. 6), and neoplasia (Fig. 7) before suggesting a diagnosis of MP [1].

Mesenteric Edema
Mesenteric edema may be caused by systemic diseases such as hypoproteinemia or hepatic, cardiac, or renal failure or may be related to local vascular diseases such as portal hypertension and hepatic, portal, or mesenteric vein thrombosis. Ascites and fluid in the subcutaneous adipose tissues are not associated with MP; when these findings are present, the radiologist should suspect mesenteric edema due to a systemic disease rather than MP. A misty mesentery was identified in 86% of patients with hepatic cirrhosis undergoing abdominal CT [17]; a large number of those patients had evidence of edema in other adipose compartments but more than one third of cirrhotic patients may have evidence of only a misty mesentery.

The pattern of mesenteric edema secondary to mesenteric vein thrombosis tends to be focal and is typically in continuity with segmental bowel wall thickening, which may indicate the presence of small-bowel ischemia.

Mesenteric Inflammation
Pancreatitis is the most common process associated with inflammation of the small-bowel mesentery but virtually all other inflammatory diseases of the gastrointestinal tract including cholecystitis, appendicitis, diverticulitis, inflammatory bowel disease, and infective peritonitis may also result in inflammatory changes in the adjacent mesentery [3]. Tuberculous peritonitis should be suspected when the following signs are observed in association with a misty mesentery [18]: lymphadenopathy with central hypodensity due to caseous necrosis; nodularity of the mesenteric fat; smooth thickening of the peritoneum typically with pronounced enhancement; and high-density ascites, which is proposed to be caused by high protein content.

Mesenteric Hemorrhage
Acute hemorrhage into the small-bowel mesentery typically displays high CT attenuation values in the range of 40–60 HU. A history of trauma, anticoagulation therapy, blood dyscrasia, or mesenteric ischemia may be present.

Mesenteric Lymphedema
Primary mesenteric lymphedema, or small intestinal lymphangiectasia, is a rare disorder first described in 1961 by Waldmann et al. [19]. Mesenteric lymphedema is associated with diffuse nodular thickening of the small-bowel wall resulting from dilated lymphatic channels within the small-bowel villi. The changes may be segmental, ascites is usually present, and small-bowel thickening may assume a stratified appearance due to mucosal or submucosal edema [20]. Paraortic and mesenteric lymph nodes are not usually visible, which may allow differentiation of mesenteric lymphedema from other conditions, such as lymphoma, Whipple disease, celiac disease, and tuberculosis, all of which can produce diffuse small intestinal wall thickening [21].

Mesenteric Neoplasia
Perhaps the most challenging differential diagnosis to exclude when a misty mesentery is encountered is early-stage Hodgkin and non-Hodgkin lymphoma; lymphoma is the most common tumor involving the mesentery. Late stage disease usually presents little diagnostic difficulty because of the typically bulky mesenteric lymphadenopathy, but early stage disease can produce mildly enlarged nodes; a misty mesentery; and, as previously stated, even the
The mesenteric mass is often easily identified in 70% of these lesions and they are often indistinguishable from MP [8] despite an improvement in or even resolution of the mesenteric lymphadenopathy.

Primary mesenteric neoplasms, such as neurinomas, lipomas, and mesenteric liposarcomas, can mimic MP and may also display a curvilinear rim of soft tissue surrounding their peripheral margins mimicking the previously described tumor pseudocapsule sign [2]. An imaging finding that can help in distinguishing these rare neoplasms from MP and other benign pathologic processes is visible mass effect on adjacent mesenteric vessels [8]. Mass effect is not a feature of MP, and in such cases, imaging-guided percutaneous biopsy or laparoscopy and biopsy should be considered.

**Imaging Findings in Retractile Mesenteritis**

Retractile mesenteritis represents the more chronic and fulminant subgroup of sclerosing mesenteritis [4]. Its imaging characteristics differ greatly from those of the MP subgroup and are typified by the presence of one or more irregular fibrotic soft-tissue mesenteric masses (Fig. 8). Calcification may be seen within the soft-tissue mass, most likely reflecting a sequela of fat necrosis, and there may be encasement of the adjacent bowel loops and vascular structures, leading to signs of obstruction and occasionally to hollow visceral ischemia [13, 22].

** Mimics of Retractile Mesenteritis**

The imaging features of retractile mesenteritis overlap with numerous malignant conditions of the mesentery and peritoneum such as carcinoid tumors, desmoid tumors, and peritoneal carcinomatosis [2]. Because of the overlapping imaging findings in these conditions, retractile mesenteritis is also a diagnosis of exclusion and typically requires extensive histologic sampling and often resection to exclude neoplasia [3].

Gastrointestinal carcinoid tumors typically appear as a solid mass located in the mesentery with imaging features of a surrounding desmoplastic reaction resulting in stellate linear stranding of the adjacent mesenteric tissues [2] (Fig. 9). Calcifications are visible in up to 70% of these lesions and they are often indistinguishable from retractile mesenteritis on CT. The mesenteric mass is often easily identified on CT, but the primary carcinoid tumor, most commonly involving the ileum, may not be detectable on CT. Small-bowel investigations such as CT enterography, CT enterocolitis, or double-balloon and capsule endoscopy are frequently required to detect the small primary tumors [3]. Desmoid tumors constitute a benign proliferation of fibrous tissue and are seen in association with familial colorectal polyposis, otherwise known as Gardner syndrome, most commonly after laparotomy or in the postsurgical patient [2]. Most desmotic mesenteric tumors are isosattenuating relative to muscle. Mesenteric vessels are usually displaced but not encased by the mass [2].

When retractile mesenteritis involves the omentum or peripancreatic region, it may simulate widespread carcinomatosis; infection; or, rarely, pancreatic malignancy [23].

**Conclusion**

Radiologists should be aware that sclerosing mesenteritis has two imaging phenotypes—namely, MP and retractile mesenteritis. MP results in a segmental increase in mesenteric fat density termed the “misty mesentery”; however, this imaging finding is nonspecific and MP cannot be diagnosed on CT without the exclusion of a range of important diagnostic differences that can mimic MP on imaging studies, including causes of mesenteric edema, lymphedema, hemorrhage, or infiltration. Retractile mesenteritis results in irregular fibrotic mesenteric masses and therefore simulates neoplastic conditions of the mesentery and peritoneum such as carcinoid tumors, desmoid tumors, and peritoneal carcinomatosis.

**References**

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Fig. 1—47-year-old man with masslike region of heterogeneously increased fat attenuation consistent with mesenteric panniculitis. A and B, Axial contrast-enhanced CT images show fatty mass (arrow) displacing local bowel loops but not displacing surrounding mesenteric vascular structures. Bilateral extra renal pelves are also incidentally shown.

Fig. 2—75-year-old man with mesenteric panniculitis. A and B, Axial contrast-enhanced CT images show involvement of jejunal mesentery (arrow) that initially is located on left side of abdomen. C and D, Axial contrast-enhanced CT images acquired at later date show involvement of jejunal mesentery (arrow) persists but has moved in interim to right side of abdomen.
Fig. 3—60-year-old man with mesenteric panniculitis. A and B, Axial contrast-enhanced CT images show peripheral curvilinear band of soft-tissue attenuation (arrows), limiting heterogeneous mesenteric mass from surrounding normal mesentery. This finding is referred to as “tumoral pseudocapsule” sign.

Fig. 4—63-year-old man with mesenteric panniculitis. Axial contrast-enhanced CT image shows preservation of normal fat density in tissues surrounding mesenteric vessels (arrows), thereby creating “fat halo” sign.

Fig. 5—58-year-old man with acute superior mesenteric venous thrombosis. A and B, Axial CT images show filling defect (arrow, A) in superior mesenteric vein with associated regional increase in mesenteric fat density as result of edema. There also is moderate volume of ascites (arrowheads).
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Fig. 6—Mesenteric inflammation as mimic of mesenteric panniculitis (MP).

A and B, Axial (A) and coronal (B) contrast-enhanced CT images of 43-year-old man with acute pancreatitis show local increase in mesenteric fat density and mild adenopathy (arrow, A) secondary to inflammation. Pancreas appears normal on CT but presence of ascites (arrowheads, B) and retroperitoneal fluid is strongly suggestive of diagnosis other than MP.

C, Axial contrast-enhanced CT image of 28-year-old woman with acute appendicitis (arrow) shows local increase in mesenteric fat density secondary to inflammation.
Fig. 7—78-year-old man with non-Hodgkin lymphoma. A and B, Axial (A) and coronal (B) contrast-enhanced CT images acquired at initial diagnosis show multiple pathologically enlarged mesenteric lymph nodes (arrow). C and D, Axial (C) and coronal (D) contrast-enhanced CT images acquired after successful treatment with chemotherapy show previously enlarged mesenteric lymph nodes are now smaller; however, residual heterogeneously increased mesenteric fat attenuation (arrowhead) after therapy mimics appearance of mesenteric panniculitis.
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Fig. 9—58-year-old man with carcinoid tumor of distal ileum.
A, Axial contrast-enhanced CT image shows solid mesenteric mass (arrow) closely resembling appearance of retractile mesenteritis.
B, Coronal contrast-enhanced CT image shows solid mesenteric mass (arrow) closely resembling appearance of retractile mesenteritis.

Fig. 8—43-year-old woman with retractile mesenteritis.
A, Axial contrast-enhanced CT image shows irregular, poorly circumscribed mesenteric soft-tissue mass (arrow), which is inseparable from terminal ileum, and punctate foci of calcification likely representing internal fat necrosis.
B, Coronal contrast-enhanced CT image shows irregular, poorly circumscribed mesenteric soft-tissue mass (arrow).