



Multidetector CT for the Diagnosis of Acute Mesenteric Ischemia

- Acute mesenteric ischemia is a life-threatening condition that requires prompt diagnosis and emergent management to minimize morbidity and mortality.
- CT angiography which is comprised of noncontrast, arterial phase, and venous phase multidetector CT acquisition has a sensitivity of about 94% for the diagnosis of mesenteric ischemia

Acute mesenteric ischemia is a life-threatening emergency that represents about 1% of all cases of acute abdomen and approximately 0.1% of hospital admissions. Because the mortality rate is over 50%, acute mesenteric ischemia is responsible for about 5% of deaths in the USA.

Acute bowel ischemia is caused by a variety of causes (Table 1), including arterial emboli, arterial or venous thrombosis, or non-occlusive disease that typically result from low cardiac output combined with vasoconstriction. The median age of patients with acute mesenteric ischemia is about 70 years and about two-thirds are women. Clinically, the signs and symptoms of acute mesenteric ischemia can be similar to other intra-abdominal pathologies including; pancreatitis, acute diverticulitis, small bowel obstruction, or acute cholecystitis. However, acute mesenteric ischemia classically presents with the severity of patient's symptoms out of proportion to findings on the physical examination.

If mesenteric ischemia is from an embolism to the superior mesenteric artery, the onset of symptoms is dramatic with severe unrelenting abdominal pain, nausea, vomiting, and urgent bowel evacuation. Acute mesenteric ischemia should be particularly considered in patients presenting with these symptoms who are over age 60 and have a history of atrial fibrillation, recent myocardial infarction, congestive heart failure, arterial emboli, or postprandial abdominal pain and weight loss.

Table 1. Causes of Acute Mesenteric Ischemia*

Superior mesenteric artery emboli	40-50%
Mesenteric artery thrombosis	20-30%
Mesenteric and portal venous thrombosis	5-15%
Non-occlusive mesenteric ischemia	25%
Aortic dissection	5% of dissections

*Data from (Shih, Hagspiel, 2007)



Figure 1. Axial sections from a contrast-enhanced CT scan show thickening of the ascending colon (arrow) and multiple loops of dilated small bowel with air fluid levels found to represent transmural small bowel necrosis on surgery.

Diagnosis of Mesenteric Ischemia

Prompt diagnosis of mesenteric ischemia is essential because the mortality rate doubles if surgery is performed after the bowel becomes infarcted. Laboratory blood tests, such as elevated lactate level, can suggest but are not specific for mesenteric ischemia. Plain film radiographs are usually not contributory in detecting acute mesenteric ischemia. In the past, angiography was considered to be the gold standard of reference for establishing the diagnosis. However with the advances in multidetector CT (MDCT) technology, this invasive time consuming, and expensive procedure is now reserved for select therapeutic indications.

Historically, CT examination was of limited utility in diagnosing mesenteric ischemia. However, modern MDCT scanners are faster, which virtually eliminates

artifacts due to patient/bowel motion and respiration, and provide superior resolution and three-dimensional display of mesenteric vascular arcade and anatomic details. In addition, it is now recognized that intravenous contrast enhancement with no oral contrast, or low-density oral contrast improves the diagnostic accuracy of detecting mesenteric ischemia because it allows improved assessment of the bowel wall. The frequency of radiological findings for mesenteric ischemia are shown in Table 2, with an estimate of sensitivity and specificity of each finding,

and are illustrated in Figures 1-6. The optimal calculated sensitivity and specificity of biphasic contrast CT examination, with data collected in the arterial and then the portal phase, has been reported to be 94% and 96%, respectively. Experimental studies in pigs have also demonstrated that the measured change in enhancement in the bowel wall is another method of reliably detecting mesenteric ischemia and in predicting reversible changes in the bowel wall from an irreversible insult/bowel infarction.

Radiologic Finding	% of Cases* (n = 120)	Sensitivity† (%) (n = 62)	Specificity† (%) (n = 62)
Bowel Wall Thickening	95.8	85	72
Fat Stranding	72.5	88	61
Ascites	30.8	73	33
Bowel Dilatation	22.5	65	83
Pneumatosis	12.5	42	100
Arterial Occlusion	10.0	31	100
Portal Venous Gas	9.2	12	100
Organ Infarct	9.2	15	94
Venous Occlusion	5.0	15	94

*Data courtesy of Essmaeel H. Abdel-Dayem, M.D.; 120 CT examinations on 111 patients with pathologically proven bowel ischemia. †Data from Kirkpatrick et al., 2003; 62 patients, 26 of whom had pathologically confirmed mesenteric ischemia.

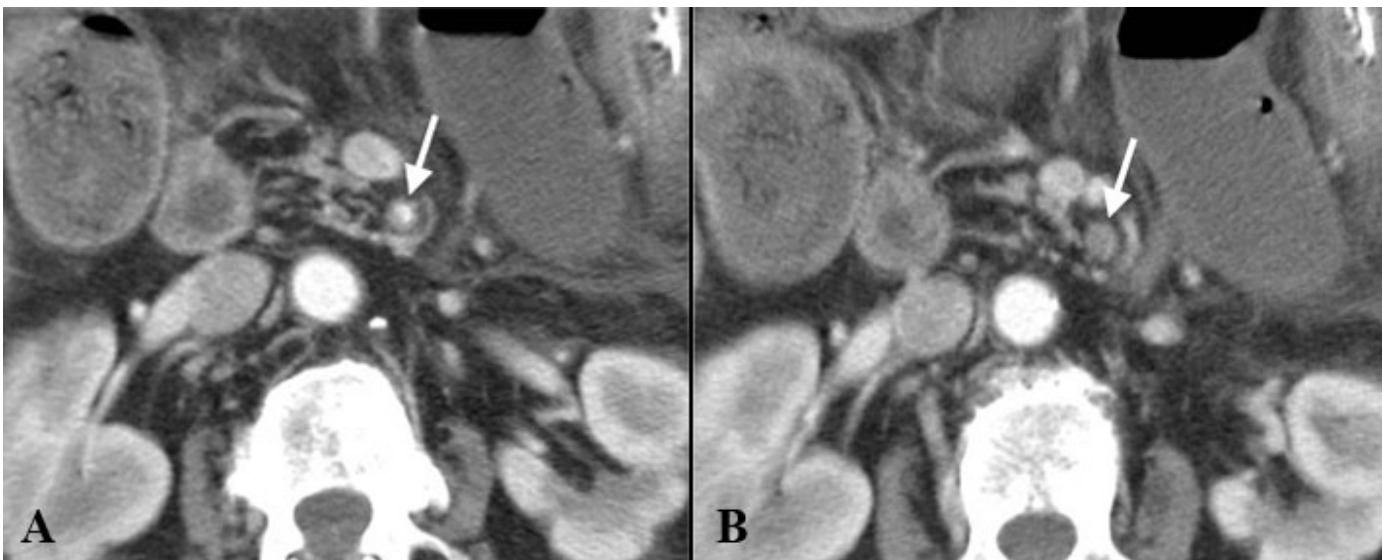


Figure 2. IV contrast-enhanced CT shows the superior mesenteric artery patent (arrow) proximally (A) and occluded (arrow) distally (B) consistent with thrombus.

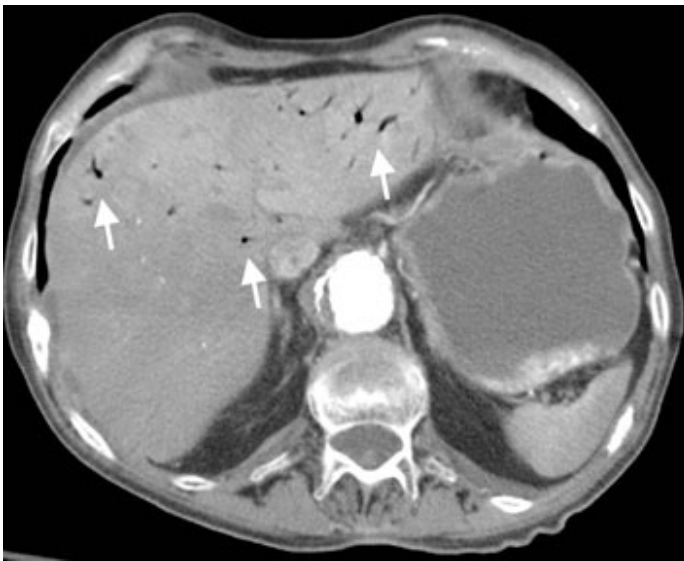


Figure 3. IV contrast-enhanced CT scan in a patient with acute transmural mesenteric infarction demonstrating pronounced intrahepatic portal venous gas (arrows).

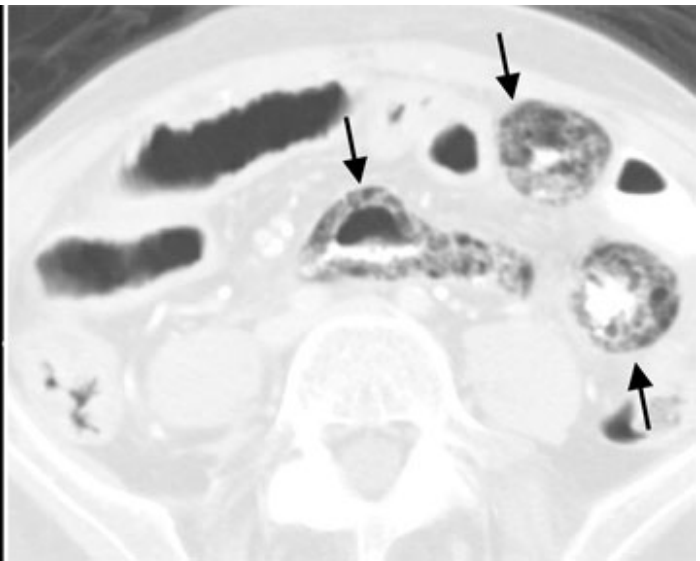


Figure 4. Contrast-enhanced CT scan in a patient with transmural small bowel infarction. Lung windows demonstrate multiple loops of small bowel with extensive gas within the bowel walls (pneumatosis).

CT Protocol for Suspected Mesenteric Ischemia

In the emergency room setting, patients with suspected mesenteric ischemia should be evaluated using a dedicated MDCT protocol. Because the CT protocol for suspected mesenteric ischemia differs from the usual abdominal CT protocol, it is advisable that all patients with suspected mesenteric ischemia be examined by a GI surgeon or specialist prior to MDCT imaging. Plain film radiography of the abdomen can be used to rule out more common conditions such as bowel obstruction, free air, or kidney stones.

Distension of the gastrointestinal tract can improve the visualization of bowel wall injury. Therefore, when tolerated by patients 900-1350 mL water or VoLumen® is administered orally. However, oral contrast administration is not mandatory.

The CT protocol starts with a non-contrast image of the abdomen to obtain baseline attenuation values and also for planning the range for acquiring arterial phase scanning. Then a bolus of contrast agent is rapidly injected intravenously through a peripherally placed intravenous cannula in the arm. The MDCT scanner software detects an increase in attenuation as the bolus enters the aorta and triggers a scan at the time of peak arterial enhancement. This is followed by a third scan timed to coincide with the venous phase of enhancement. The arterial phase images are typically post processed to create 2D and 3D displays of the mesenteric vascular anatomy to assess the patency of these vessels. When the changes of ischemia are significant, abnormal or reduced bowel wall enhancement can be detected at both the arterial and venous phase and the images are also examined for other signs of bowel ischemia (Table 2) and for other pathologies.

Although MRI offers superior soft tissue contrast resolution over MDCT, it is not typically considered first for diagnosing this condition as patients are usually too sick to cooperate for the entire MRI exam. However, in patients where CT is contraindicated due to renal insufficiency or contrast media allergy, dynamic contrast-enhanced MRI can be used to diagnose mesenteric ischemia. In such cases, the benefits of diagnosis will outweigh the extremely low but potential risk of nephrogenic systemic fibrosis that is associated with gadolinium usage.

Scheduling

Physicians who wish to refer patients for CT evaluation of suspected acute mesenteric ischemia should call 617-724-7246 (4-XRAY). The examination can be carried out in the on the main MGH campus in the Emergency Department or the Yawkey Center for Outpatient Care, Mass General Imaging in Chelsea, and Mass General Imaging West in Waltham.

Further Information

For further questions on CT diagnosis of mesenteric ischemia, please contact [Dushyant Sahani, M.D.](#), Abdominal Imaging and Intervention, MGH Department of Radiology, at 617-726-3937.

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