

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: Radiologic Management of Mesenteric Ischemia

Variant 1: Patient with recent onset abdominal pain, no peritoneal signs, known atrial fibrillation. CTA shows filling defect in proximal SMA consistent with embolus.

Treatment/Procedure	Rating	Comments
Systemic anticoagulation	8	This procedure may be sole therapy depending on status of the patient but will more often serve as a bridge to transcatheter or surgical evaluation of clot.
Surgical embolectomy	5	Surgical embolectomy may be a first-line treatment option over thrombolytic therapy based on physician preference and clinical presentation.
Transcatheter thrombolysis	7	This procedure depends on the burden of thrombus seen distally at the time of angiography. Organized thrombus in the setting of atrial fibrillation may not respond to thrombolysis.
Angiography and aspiration embolectomy	7	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Variant 2: Patient with recent onset abdominal pain, no peritoneal signs, known atrial fibrillation. CTA shows calcified atherosclerotic plaque involving the aorta and its major branches, as well as proximal short-segment occlusion of the proximal SMA.

Treatment/Procedure	Rating	Comments
Systemic anticoagulation	8	This procedure is used as an adjunct to surgical or transcatheter treatment.
Surgical endarterectomy or bypass	6	This procedure is used if an endovascular approach with thrombolysis, angioplasty, and stenting is not technically feasible.
Angiography and transcatheter thrombolysis followed by percutaneous transluminal angioplasty and stent placement	8	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Variant 3: Hospitalized patient with cardiac disease causing low cardiac output who developed abdominal pain but without peritoneal signs. CT angiogram shows patent origins and proximal portions of celiac artery, SMA, and IMA, with diffuse irregular narrowing of SMA branches.

Treatment/Procedure	Rating	Comments
Angiography with infusion of vasodilator	8	This procedure may lead to hypotension.
Systemic infusion of prostaglandin E1	7	This procedure may lead to hypotension.
Systemic anticoagulation	7	
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Clinical Condition: Radiologic Management of Mesenteric Ischemia

Variant 4: Patient with history of abdominal pain after meals for the past few months and weight loss. CTA shows aortic atherosclerotic disease and suggests SMA-origin stenosis with occlusion of celiac origin and an occluded IMA.

Treatment/Procedure	Rating	Comments
Angiography with possible percutaneous transluminal angioplasty and stent placement	8	
Surgical bypass or endarterectomy	7	
Systemic anticoagulation	5	This procedure may be complementary to other treatments but is generally not done alone.
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Variant 5: Patient with pain after meals and CTA showing widely patent origins of SMA and IMA, with possible compression of the celiac origin by the median arcuate ligament.

Treatment/Procedure	Rating	Comments
Mesenteric angiography in lateral projection during both inspiration and expiration	7	CTA or MRA should be performed prior to catheter angiography.
Surgery with median arcuate ligament release, with or without bypass	8	This procedure is performed once diagnosis is confirmed by angiography.
Supportive measures only (analgesics)	7	Median arcuate ligament syndrome diagnosis is controversial but surgical therapy may be appropriate depending on the clinical situation.
Systemic anticoagulation	2	
Percutaneous transluminal angioplasty with stent placement	4	This procedure is the second-line intervention in patients with recurrent or persistent symptoms despite surgical decompression and where there is evidence of celiac artery narrowing.
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

Variant 6: Previously healthy patient with worsening diffuse abdominal pain for 2 weeks. CTA shows occlusion of the superior mesenteric vein and its major tributaries. Small bowel appears normal.

Treatment/Procedure	Rating	Comments
Systemic anticoagulation	9	This procedure may be either primary therapy or adjunctive to thrombolysis depending on age and condition of patient.
Transhepatic superior mesenteric vein catheterization and thrombolytic infusion	7	This procedure depends on severity of symptoms, condition of patient, and response to systemic anticoagulation. Adjunct TIPS creation may be considered for outflow improvement.
SMA angiography followed by thrombolytic infusion	4	This procedure has minimal proven efficacy in the literature.
Surgical thrombectomy	3	This procedure has a low rating because the thrombus typically involves multiple branches.
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate		

RADIOLOGIC MANAGEMENT OF MESENTERIC ISCHEMIA

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Summary of Literature Review

Introduction/Background

Mesenteric vascular insufficiency is a serious medical condition that may lead to bowel infarction, morbidity, and mortality that may approach 50% [1]. The most common symptom is abdominal pain, which may be acute and severe or insidious in onset and vague. Postprandial pain is common. On physical examination, patients may exhibit pain out of proportion to physical examination [2]. Causes of mesenteric ischemia may be arterial (eg, thromboembolism, atherosclerosis, dissection, and vasculitis), mesenteric venous thrombosis, and hypoperfusion (eg, hypovolemia, shock). The purpose of imaging evaluation is to determine the underlying cause of bowel ischemia, which then helps direct treatment decisions.

Overview of Diagnostic Imaging Modalities

Detection of proximal mesenteric arterial occlusive disease is possible with contrast-enhanced computed tomographic angiography (CTA), magnetic resonance angiography (MRA), and ultrasound (US). Ostial lesions are reliably evaluated with all 3 modalities. Both US and MRA have been directly compared with angiography. Multidetector CT scanners, particularly with sagittal reformatting, are capable of demonstrating the proximal mesenteric vessels very well. CTA relies on administration of iodinated contrast but does not entail the risks of catheter angiography [3-8].

In patients with renal insufficiency or a history of severe reaction to iodinated contrast, noncontrast MRA or US of the mesenteric vessel origins is preferred over CTA. Results vary considerably with operator expertise, patient body habitus, and presence of bowel gas, but accuracy in detecting ostial abnormalities has been reported to be >90% [9]. The more peripheral mesenteric vessels are not as well demonstrated with US or CTA, and angiography has remained the best method to evaluate these vessels. Therefore, if clinical suspicion of mesenteric ischemia is high, a negative CTA or US examination should not preclude selective mesenteric angiography, particularly if distal disease is a consideration.

Mesenteric venous occlusion can be adequately assessed by contrast-enhanced CT or MRI. In cases where these noninvasive diagnostic modalities do not provide a definitive answer, CT arterial portography may be helpful in delineating mesenteric venous anatomy [10].

Overview of Therapeutic Modalities

Treatments for mesenteric ischemia attempt to reverse the underlying cause, with the goal of prevention of bowel infarction. Treatment choice depends on the underlying etiology of ischemia. For patients with mesenteric arterial occlusive disease there has been a shift away from surgical treatment (eg, embolectomy, endarterectomy, and arterial bypass) towards endovascular approaches including thrombolysis and clot retrieval in cases of acute embolus (if peritoneal signs are absent), percutaneous transluminal angioplasty (PTA), and stent placement for patients with chronic arterial occlusive disease. Acute nonocclusive mesenteric ischemia (NOMI) can be managed by intra-arterial administration of vasodilators, such as nitroglycerin or papaverine, or by high-dose intravenous prostaglandin E1. First-line treatment for venous mesenteric ischemia is systemic anticoagulation.

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Discussion by Variant

Variants 1 and 2: Acute Occlusive Mesenteric Ischemia

Surgery has been the standard of care for acute occlusive mesenteric ischemia over the past decades [11]. Several endovascular techniques have been described in the literature, including aspiration embolectomy [12] and thrombolysis [13] for embolic occlusion of the superior mesenteric artery (SMA), as well as percutaneous transarterial PTA with or without stent placement (PTA/S) for thrombotic occlusions in patients with underlying atherosclerotic disease. Recent literature suggests that in current practice, endovascular techniques are commonly attempted first, and traditional surgical approaches are resorted to when endovascular treatment fails or is not feasible [14-16]. Use of endovascular approaches has been associated with a decrease in the amount of bowel resected [14-16], lower incidence of concomitant renal or respiratory failure [14], lower subsequent incidence of short bowel syndrome [15], and lower mortality [16]. However, if symptoms and signs of bowel infarction are present (peritoneal symptoms, pneumoperitoneum, or intramural air on CT), urgent surgery rather than thrombolysis is advised [13]. The inability to confidently exclude bowel infarction in many patients with mesenteric ischemia has limited the widespread use of thrombolysis. Due to the presence of vasospasm associated with occlusive mesenteric ischemia, catheter-directed vasodilator infusion may also be of benefit in some patients with occlusive mesenteric ischemia, especially prior to more definitive therapy. Treatment of underlying stenotic or occlusive lesions using PTA/S can be achieved at the same setting as diagnosis, sometimes after removal of a thrombotic clot by aspiration or thrombolysis [11].

Variant 3: Acute Nonocclusive Mesenteric Ischemia

In a patient with signs and symptoms of acute mesenteric ischemia, narrowing of peripheral mesenteric vessels or a pattern of alternating dilatation and narrowing suggests NOMI. This diagnosis is best made with conventional angiography, which would also enable initiation of catheter-directed vasodilator infusion therapy. Angiography can provide superior anatomic detail not available from CTA or US [17]. However, recent data suggest that if a patient is not clinically stable enough to undergo angiography, multidetector contrast-enhanced CT may provide adequate information to make a diagnosis of NOMI [18,19]. Vasoconstriction may lead to bowel ischemia and necrosis with a mortality rate that has been reported to be up to 70%. Early diagnosis and treatment are critically important in acute mesenteric ischemia to avoid bowel infarction. Typically therapy consists of intra-arterial administration of vasodilators, such as nitroglycerin, papaverine, or glucagon [20]. Administration of high-dose intravenous prostaglandin E1 may be equally effective [18].

Variant 4: Chronic Mesenteric Ischemia

Chronic mesenteric ischemia most commonly occurs due to atherosclerotic occlusive disease of the mesenteric arteries (celiac axis, SMA, inferior mesenteric artery [IMA]). Signs and symptoms of chronic mesenteric ischemia include weight loss, sitophobia (food fear), and postprandial abdominal pain. Given the relatively rich collateral supply to the bowel, signs and symptoms of ischemia typically occur when at least 2 arteries (and often all 3) are affected. Endovascular therapy, particularly PTA and stent placement, has supplanted open surgical repair as the preferred therapy for mesenteric-origin stenoses in patients without bowel infarction. Mortality and morbidity are believed to be lower for endovascular interventions compared to open repair; however, more patients develop recurrent symptoms and require reintervention following endovascular treatment than after open repair [21,22]. Complications of endovascular treatment include distal mesenteric embolization, branch perforation, dissection, stent dislodgement, and stent thrombosis [23].

Variant 5: Median Arcuate Ligament Syndrome

The median arcuate ligament is a fibrous band connecting the right and left hemidiaphragms that is present in everyone and results in celiac axis narrowing in 20% of the population. The incidence and even existence of abdominal symptoms due to compression of the celiac artery by the median arcuate ligament are debatable. The compression has been postulated to limit blood flow to the bowel, with resulting ischemic symptoms, or to irritate the celiac ganglion, which results in abdominal pain. Compression of the celiac artery may be a normal finding in asymptomatic patients and is well characterized [24]. Therefore, supportive treatment with analgesics and continued diagnostic evaluation for alternate causes of abdominal pain might be reasonable first steps in patients with suspected median arcuate ligament syndrome.

Patients with imaging evidence of celiac axis compression have been treated with best results in patients who had both celiac decompression (surgical division of the ligament) and some form of celiac artery revascularization. Predictors of successful outcome in 1 study were “postprandial pain pattern (81% cured), age between 40 and 60

(77% cured), and weight loss of 20 pounds or more (67% cured)” [25]. There is no evidence supporting the use of stent placement in this entity, and endovascular dilation may be contraindicated unless ligament release has been performed first [26].

Variant 6: Venous Mesenteric Ischemia

Mesenteric venous thrombosis accounts for 5%–15% of all cases of mesenteric ischemia. Patients may have abdominal pain, nausea, or vomiting. However, clinical diagnosis is often difficult because abdominal symptoms are nonspecific [27,28]. Diagnosis can be established by noninvasive means, such as multidetector CT and MR venography [29]. The mainstay of therapy is systemic anticoagulation. Generally, patients maintained on systemic anticoagulation have higher chances of recanalization of the occluded veins and lower odds of recurrence. Long-term systemic anticoagulation is usually required. Bleeding in the necrotic bowel may result, but this possibility should not delay systemic anticoagulation, and bleeding has to be treated if it occurs [30,31]. Thrombolysis with or without mechanical thrombectomy may re-establish splanchnic venous flow and prevent bowel infarction in the setting of an acute or a subacute venous thrombosis [26,32,33]. The rate of blood flow restoration by thrombolytic administration into the SMA appears to be lower than that of direct thrombolytic administration into the splanchnic veins [26].

Summary of Recommendations

- Recommended therapy for acute mesenteric ischemia includes aspiration embolectomy, transcatheter thrombolysis, and angioplasty with or without stenting for the treatment of underlying arterial stenosis. Systemic anticoagulation can be the sole therapy depending on the status of the patient but more often serves as a bridge to transcatheter or surgical evaluation of the thrombus. NOMI may respond to transarterial infusion of vasodilators such as nitroglycerin, papaverine, glucagon, and prostaglandin E1. Side effects of vasodilator therapy include hypotension.
- Recommended therapy for chronic mesenteric ischemia includes angioplasty with or without stent placement and, if an endovascular approach is not possible, surgical bypass or endarterectomy. Systemic anticoagulation can be complementary to the invasive procedures but is typically not offered as monotherapy.
- The diagnosis of median arcuate ligament syndrome is controversial, but surgical release may be appropriate depending on the clinical situation.
- Venous mesenteric ischemia may respond to systemic anticoagulation alone. Transhepatic or transjugular superior mesenteric vein catheterization and thrombolytic infusion can be offered depending on the severity of symptoms, condition of the patient, and response to systemic anticoagulation. Adjunct transjugular intrahepatic portosystemic shunt (TIPS) creation can be considered for outflow improvement.

Summary of Evidence

Of the 33 references cited in the *ACR Appropriateness Criteria® Radiologic Management of Mesenteric Ischemia* document, 19 are categorized as therapeutic references including 6 good quality studies. Additionally, 13 references are categorized as diagnostic references including 3 good quality studies, and 4 quality studies that may have design limitations. There are 19 references that may not be useful as primary evidence. There is 1 reference that is a meta-analysis study.

The 33 references cited in the *ACR Appropriateness Criteria® Radiologic Management of Mesenteric Ischemia* document were published from 1985-2014.

While there are references that report on studies with design limitations, 9 good quality studies provide good evidence.

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac/.

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.