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The EM Educator Series

The EM Educator Series: Mesenteric Ischemia

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Case 1:
A 63-year-old female with a history of atrial fibrillation presents with abdominal pain that began suddenly. She also has had severe nausea with several episodes of non-blood vomiting and diarrhea. She is tachycardic but afebrile. She does not have tenderness on abdominal exam, but she is writing in pain.

Case 2:
A 75-year-old male is hypotensive and in severe heart failure. He is on norepinephrine and epinephrine. On your reevaluation, he has worsening abdominal pain and diarrhea.

Case 3:
A 30-year-old female presents with abdominal pain. This is her fourth visit in 3 weeks. She has experienced intermittent abdominal pain and nausea for these last 3 weeks. She is on oral contraceptives.

Questions for Learners:

1. What are the four types of mesenteric ischemia?
2. What are the major risk factors for mesenteric ischemia?
3. How can this disease present, and how does it relate to the pathophysiology of each type?
4. What are pitfalls with laboratory evaluation?
5. What imaging is recommended, and what are pitfalls?
6. What is the ED management?
7. What specialists should be consulted?

Suggested Resources:

- Articles
    - emDOCs - Improving the diagnosis of mesenteric ischemia
    - emDOCs – Power Review
    - EP Monthly – The Dangerous Miss
- Journal Articles
    - EM Clinics of NA – Mesenteric Ischemia
    - EM Clinics of NA – Geriatric abdominal pain
    - EM Clinics of NA – Avoiding misdiagnosis
    - Br J Hosp Med – Pitfalls: pain out of proportion

Answers for Learners:

1. **What are the four types of mesenteric ischemia?**
2. **What are the major risk factors for mesenteric ischemia?**
3. **How can this disease present, and how does it relate to the pathophysiology of each type?**

Table 1. Acute mesenteric ischemia risk factors, symptoms, treatments, and mortality[1,5–7]

	ARTERIAL			VENOUS
	Occlusive		Nonocclusive (15%)	
	Embolic (60%)	Thrombotic (20%)		
Risk Factors	Atrial fibrillation MI CHF prior embolism (⅓)	CAD PAD tobacco use	ESRD CHF vasopressors	Prior DVT or PE (50%) Recent surgery Hypercoagulable
Symptoms	Acute-onset Hematochezia	Progressive worsening Chronic mesenteric ischemia symptoms (20-65%) - food fear, postprandial pain, early satiety, weight loss	Critically ill patient Hypotension Altered mental status	Insidious onset Asymptomatic
Treatments	Revascularization (endovascular or open surgery), laparotomy as indicated	Revascularization (endovascular or open surgery), laparotomy as indicated	Treat underlying cause, stop vasopressors, vasodilators, laparotomy as indicated	Anticoagulation, laparotomy as indicated
Mortality	18-88%	27-100%	50-83%, varies with underlying disease	25-69%

Abbreviations: CAD, coronary artery disease; CHF, congestive heart failure; DVT, deep venous thrombosis; ESRD, end stage renal disease; MI, myocardial infarction; PAD, peripheral artery disease; PE, pulmonary embolism

- **Arterial embolism** accounts for the majority of cases of mesenteric ischemia with half occurring at the superior mesenteric artery (SMA) supplying the midgut (distal duodenum to the splenic flexure). Less frequently, emboli may occlude the celiac artery supplying the foregut (distal esophagus to proximal duodenum) or the inferior mesenteric artery (IMA) supplying the hindgut (splenic flexure to distal sigmoid). Patients with arterial embolism commonly have atrial fibrillation and present more acutely with the classic “pain out of proportion”.

- **Arterial thrombosis** in the setting of chronic atherosclerosis may present with similar acuity or a more progressive onset depending on the preexisting vessel disease and collateral flow. Patients with chronic mesenteric ischemia almost always report a prior history of postprandial abdominal pain. This pain represents intestinal angina which develops when the demand for blood flow for digestion exceeds the capacity of obstructed mesenteric arteries to supply the intestinal mucosa. Total mesenteric blood flow represents 20% of resting cardiac output and can increase up to two times postprandially. Chronic ischemia frequently results in weight loss, nausea, and vomiting.

- **Nonocclusive arterial mesenteric ischemia** results from inadequate supply of blood due to an underlying critical illness and most commonly affects the descending or sigmoid colon. Bowel can tolerate a 75% reduction in blood flow for up to 12 hours through multiple adaptations: increasing oxygen extraction (up to 90%), autoregulation of arterial resistance, and capillary recruitment (bowel utilizes only 25% of intestinal capillaries at rest). Colonic ischemia may present as bleeding, pain, or perforation with peritonitis. The diagnosis may be complicated by

limited history due to critical illness or mechanical ventilation. The literature has distinguished between mesenteric ischemia and ischemic colitis in reference to ischemia of the small bowel (SMA) versus colon (IMA), respectively. Recent reviews differentiate mesenteric ischemia by etiology (e.g. occlusive versus nonocclusive) rather than region of ischemia. Additionally, SMA supply of the colon and variations in vascular anatomy may render this distinction less clinically useful.

- **Mesenteric vein thrombosis** presents more insidiously with vague abdominal pain usually for greater than 24 hours and even one month from onset. Risk factors include hypercoagulability as seen in malignancy, sepsis, liver disease, portal hypertension, sickle cell disease, and inherited thrombophilias. Anticoagulation with heparin and transition to oral medication is the mainstay of treatment rather than surgical or endovascular intervention.

Although a rare diagnosis overall, mesenteric ischemia appears significantly more commonly in the elderly. Incidence rate can be understood as the risk of developing a disease over a relevant time period. (The relevant time period includes the time during which a patient is 'at-risk' of developing the disease. If the patient develops the disease or dies, for example, they no longer contribute to the incidence rate calculation). In a retrospective, single-center analysis of a well-defined Finnish population, inhabitants older than 75 years had an incidence rate (cases/100,000 persons/year) of 51.2 for mesenteric ischemia compared to 40.2 for acute appendicitis. For point of reference, the incident rate of acute appendicitis among inhabitants 75 years or younger was 92.1.10 Figure 2 illustrates the exponential rise in incidence rate of acute mesenteric in the elderly compared to other acute abdominal pathologies.

4. What are pitfalls with laboratory evaluation?

No laboratory parameters have demonstrated adequate performance for the diagnosis of mesenteric ischemia. Biomarkers studied include those of oxidative stress (e.g. lactate), inflammation or infection (e.g. leukocytosis), and novel markers of wall damage (e.g. intestinal fatty acid binding protein [I-FABP]). Notably, D-dimer's high sensitivity may suggest its use as a rule-out test (sensitivity 0.94, specificity 0.40). Most studies have significant limitations including small study populations and heterogeneous methods and reference standards.

5. What imaging is recommended, and what are pitfalls?

CTA of the abdomen and pelvis is the preferred diagnostic imaging modality for suspected mesenteric ischemia due to its speed, noninvasiveness, and high accuracy (93-100% sensitivity and specificity).16 Imaging involves thin-section acquisition timed with arterial or venous enhancement and three dimensional rendering. A noncontrast phase, without intravenous or oral contrast enhancement, although not required, may help identify intramural hemorrhage, atherosclerotic calcifications, and establish baseline wall enhancement. CTA of the abdomen and pelvis can detect vascular and nonvascular signs of mesenteric ischemia as well as exclude alternate causes of abdominal pain. In one study of 959 patients suspected to have mesenteric ischemia, 19% of patients had the disease, 20% had no clear diagnosis, and 61% had specific alternate diagnoses; small bowel obstruction, infectious colitis, pneumonia, cholecystitis, and diverticulitis accounted for one-third of alternate diagnoses.

Clinicians must actively maintain suspicion so as not to overlook this rare but fatal diagnosis. The degree to which test results, such as CTA findings, changes the likelihood of a disease depends on a patient's pre-test probability. Pre-test probability depends on clinical suspicion and prevalence of a disease. If a

radiologist is not informed of clinical suspicion for mesenteric ischemia, they may not attribute clinical significance to subtle and nonspecific radiologic findings often seen in mesenteric ischemia (Tables 2 and 3). Furthermore, rate of successful diagnosis may improve if clinical suspicion is communicated in the radiology referral.

Table 2. CTA findings in acute mesenteric ischemia[10]

Specific	Nonspecific
• Thromboembolism of SMA • Mesenteric venous thrombosis • Unenhanced or poorly enhanced bowel wall • Intestinal pneumatosis • Portal venous gas	• Chronic calcified occlusion or hemodynamically significant SMA stenosis • Increased enhancement of bowel wall • Bowel lumen thickening • Lumen dilation • Mesenteric fat stranding • Ascites • Free gas • Solid organ infarction

Table 3. CTA findings in bowel ischemia with common mimickers[14]

Finding	Mimickers
Occlusion of vessels	Vasculitis
Bowel wall thickening	Inflammatory, infectious, or malignant process
Bowel wall enhancement	Inflammatory bowel disease, radiation, graft versus host disease, nutrition
Bowel dilation	Ileus, pseudo-obstruction
Pneumatosis and portal venous gas	Air trapped between the bowel wall and residual fluid, benign causes of pneumatosis (connective tissue disease, emphysema, asthma, intraabdominal procedures)

6. What is the ED management?

7. What specialists should be consulted?

Optimal treatment requires a multidisciplinary approach: general surgery, vascular surgery, and interventional radiology. Surgical intervention that can be initiated in less than six hours from symptom onset adds significant increase in survival. Three principles guide the surgical management of thromboembolic AMI: SMA revascularization, assessment of intestinal viability, and resection of necrotic bowel. Surgeons can utilize open or endovascular repair. If peritonitis is present, this obviates the need for further testing if you are considering AMI. Instead, speak with surgery about your findings and concern for transmural infarction.

What can emergency physicians do besides calling for help? Aggressive fluid resuscitation, electrolyte management, and broad-spectrum antibiotics are needed early in the course. Avoid oral intake, which can exacerbate ischemia. Patients may require 10-20 L of IV fluids within the first 24 hours due to extensive capillary leakage and third spacing. Begin anticoagulation in consultation with the treating surgeon, usually with unfractionated heparin. Vasospasm is common and can be treated with intra-arterial papaverine infusion, but this requires angiography. Another option is the vasodilator prostaglandin E1 (PGE1) which is administered intravenously.