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## A Story About Mesenteric Ischemia

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### ABSTRACT:

**Audience:** This interactive module is designed for implementation within an emergency medicine residency program. The target audience is first through fourth year (PGY 1 to PGY 4) residents, medical students, physician assistant fellows, physician assistant students, physician assistants and attending physicians.

**Introduction:** Although mesenteric ischemia accounts for only 1% of emergency department visits, it carries a high mortality rate.<sup>1-3</sup> The overall mortality associated with mesenteric ischemia is between 60% to 90% and climbs exponentially once bowel wall infarction occurs.<sup>2,3</sup> Acute arterial occlusion is the most familiar form of mesenteric ischemia. However, there are other forms of mesenteric ischemia that are not as well recognized or well known that still carry significant mortality rates. Early recognition, diagnosis and treatment are the mainstays in reducing the mortality of this condition.<sup>1</sup> Knowing all forms of mesenteric ischemia is essential for an emergency medicine clinician.

This module utilizes a combination of a traditional flipped classroom model with a novel approach of narrative medicine. Learners will read assigned articles and complete a question sheet in preparation. In didactics, the group will divide into small groups to create a narrative about a patient who presents with one of the four forms of mesenteric ischemia. This modality utilizes active learning, discussion and synthesis.

**Objectives:** After participation in this module, learners will be able to: 1) List the types of mesenteric ischemia, 2) identify risk factors and historical components that differentiate each type of mesenteric ischemia, 3) provide the diagnostic modality of choice, and 4) describe the appropriate treatment in each type of mesenteric ischemia.

**Methods:** This module utilizes the flipped classroom model of education for independent learning along with small group discussion. Learners will independently complete pre-assigned readings and questions based on the readings. In didactics sessions, learners will then create a narrative of a patient presenting with one of the types of mesenteric ischemia. Each of the narratives will be shared with the entire group in the final 30 minutes of the didactic session. If programs choose, the type of mesenteric ischemia may be revealed at the end, allowing for participants to select the form they suspect is being presented.

**Topics:** Mesenteric ischemia, abdominal pain, flipped classroom, small group.



# USER GUIDE

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## Learner Audience:

Medical students, interns, junior Residents, senior residents, physician assistant trainees

## Time Required for Implementation:

1-1.5 hours

**Recommended Number of Learners per Instructor:** One instructor can facilitate four groups with up to fifteen participants in each group.

## Topics:

Mesenteric ischemia, abdominal pain, flipped classroom, small groups.

## Objectives:

After participation in this module, learners will be able to:

1. List the types of mesenteric ischemia
2. Identify risk factors and historical components that differentiate each type of mesenteric ischemia
3. Provide the diagnostic modality of choice
4. Describe the appropriate treatment in each type of mesenteric ischemia

## Linked objectives and methods:

Traditionally, didactics have been delivered via an hour-long lecture format. There is little data to support this as the standard form of information delivery.<sup>4</sup> In the lecture format, learners are in a passive state receiving information. For this session, we desired to have learners engaged in active learning and discussion. In order to achieve this, we utilized a flipped classroom with small groups format. Learners were assigned preselected readings and a list of open-ended questions to answer based on the assigned readings. On the didactic day, learners were divided into four different groups based on level of training with the goal of evenly distributed experience across each group.

Once divided into groups, each group was assigned one of the four types of mesenteric ischemia. Group members were assigned with writing a narrative about a patient presenting to the emergency department with the assigned diagnosis. The narratives were required to include salient information such as risk factors, presenting signs and symptoms, diagnostic testing,

treatment, and complications. Groups were given forty-five minutes to complete the narrative portion of the didactic. The remaining time was utilized for sharing the narrative with the group and for facilitator wrap up.

When considering mesenteric ischemia, many learners immediately recall acute arterial occlusive mesenteric ischemia, since this is the most common form and carries the highest mortality. However, there are other forms of mesenteric ischemia, each with significant mortality rates. This session utilizes a social constructivist framework<sup>5,6</sup> to incorporate what the learner already knows, adds knowledge to his/her existing knowledge through readings and answering open questions, and then provides a social environment for collaboration and reflection in the narrative writing process.

## Recommended pre-reading for facilitator:

- Oldenburg WA, Lau LL, Rodenberg TJ, Edmonds HJ, Burger CD. Acute mesenteric ischemia: a clinical review. *Arch Intern Med.* 2004;164(10):1054-1062. doi: 10.1001/archinte.164.10.1054
- Sise MJ. Acute mesenteric ischemia. *Surg Clin North Am.* 2014;94(1):165-181. doi: 10.1016/j.suc.2013.10.012
- O'Keefe KP, Sanson TG. Mesenteric Ischemia. In: Adams JG, Barton ED, Collings JL, DeBlieux PM, Gisondi MA, Nadel ES, eds. *Emergency Medicine: Clinical Essentials.* 2nd ed. Philadelphia, PA: Elsevier; 2013:292-298.
- Oliva IB, Davarpanah AH, Rybicki FJ, et al. ACR Appropriateness Criteria® imaging of mesenteric ischemia. *Abdom Imaging.* 2013;38(4):714-719. doi: 10.1007/s00261-012-9975-2

## Learner responsible content (LRC):

- Oldenburg WA, Lau LL, Rodenberg TJ, Edmonds HJ, Burger CD. Acute mesenteric ischemia: a clinical review. *Arch Intern Med.* 2004;164(10):1054-1062. doi: 10.1001/archinte.164.10.1054
- Sise MJ. Acute mesenteric ischemia. *Surg Clin North Am.* 2014;94(1):165-181. doi: 10.1016/j.suc.2013.10.012
- O'Keefe KP, Sanson TG. Mesenteric Ischemia. In: Adams JG, Barton ED, Collings JL, DeBlieux PM, Gisondi MA, Nadel ES, eds. *Emergency Medicine: Clinical Essentials.* 2nd ed. Philadelphia, PA: Elsevier; 2013:292-298.
- Oliva IB, Davarpanah AH, Rybicki FJ, et al. ACR Appropriateness Criteria® imaging of mesenteric ischemia. *Abdom Imaging.* 2013;38(4):714-719. doi: 10.1007/s00261-012-9975-2
- Pre-didactic Questions (attached)



# USER GUIDE

## Stations:

Stations were divided equally by post-graduate year into four groups. Once divided into groups, each group was assigned one of the four types of mesenteric ischemia. Group members were assigned with writing a narrative about a patient presenting to the emergency department with the assigned diagnosis. The narratives were required to include salient information such as risk factors, presenting signs and symptoms, diagnostic testing, treatment, and complications. Groups were given forty-five minutes to complete the narrative portion of the didactic.

## Brief wrap-up:

Wrap-up involves facilitator highlighting answers to the pre-didactic questions.

## Results and tips for successful implementation:

One week prior to our weekly emergency medicine conference, learners were assigned readings and questions for completion. On conference day, twenty-five learners were present and were divided into four groups of varying post-graduate year levels. Effectiveness of the module was evaluated two weeks post-conference through the use of a quiz and a qualitative feedback evaluation tool that was distributed to all trainees. Answers from those who did not participate in the narrative writing exercise were used as a control group and compared with the answers provided by learners who did participate in the narrative writing exercise.

The evaluation tool addressed qualitative questions such as, "Do you feel that after this learning module, you have a better understanding of the disease processes of mesenteric ischemia?" Binary answer options of "Yes" and "No" were provided for these questions. Quiz questions were a combination of multiple-choice questions and open-ended questions similar to those of the initial pre-didactic questionnaire. Quantitatively, evaluations revealed a trend towards retention of the learning materials at the two-week mark; however, only eleven evaluation tools were returned. Qualitatively, learners felt they will provide better care as a result of the learning module. Our evaluation tool did reveal one area for improvement which is for the facilitator to stress during the wrap-up that there are no lab markers, such as lactate, that can confirm or rule out the diagnosis of mesenteric ischemia.

## Pearls:

The key learning points of the case are the answers to the pre-didactic questions that are covered at the end of the session. A print out of the answers can be provided to the learners

## References/suggestions for further reading:

1. Sise MJ. Acute mesenteric ischemia. *Surg Clin North Am.* 2014;94(1):165-181. doi: 10.1016/j.suc.2013.10.012
2. O'Keefe KP, Sanson TG. Mesenteric Ischemia. In: Adams JG, Barton ED, Collings JL, DeBlieux PM, Gisondi MA, Nadel ES, eds. *Emergency Medicine: Clinical Essentials.* 2nd ed. Philadelphia, PA: Elsevier; 2013:292-298.
3. Oliva IB, Davarpanah AH, Rybicki FJ, et al. ACR Appropriateness Criteria® imaging of mesenteric ischemia. *Abdom Imaging.* 2013;38(4):714-719. doi: 10.1007/s00261-012-9975-2.



## LEARNER MATERIALS

# A Story about Mesenteric Ischemia

Learner Responsible Content

Pre-didactic Questions

1. What are the four main types of mesenteric ischemia?
2. Which form of mesenteric ischemia carries the highest mortality?
3. What are the risk factors for the various types of mesenteric ischemia?
4. What is the pathophysiology associated with mesenteric ischemia?
5. Which vessel is the most commonly occluded in acute mesenteric ischemia?
6. What is the hallmark physical exam finding associated with mesenteric ischemia?
7. What are clinical presenting signs and symptoms of the different types of mesenteric ischemia?
8. What is “intestinal angina?”





## LEARNER MATERIALS

# A Story about Mesenteric Ischemia

Didactic Case Narrative

### Acute Mesenteric Ischemia

Please write a narrative on a patient with the above diagnosis. Please include salient information such as risk factors, presenting signs and symptoms, diagnostic testing, treatment, and complications.



## LEARNER MATERIALS

# A Story about Mesenteric Ischemia

Didactic Case Narrative

### Chronic Mesenteric Ischemia

Please write a narrative on a patient with the above diagnosis. Please include salient information such as risk factors, presenting signs and symptoms, diagnostic testing, treatment, and complications.





## LEARNER MATERIALS

# A Story about Mesenteric Ischemia

Didactic Case Narrative

### Mesenteric Venous Thrombosis (MVT)

Please write a narrative on a patient with the above diagnosis. Please include salient information such as risk factors, presenting signs and symptoms, diagnostic testing, treatment, and complications.



## LEARNER MATERIALS

# A Story about Mesenteric Ischemia

Didactic Case Narrative

### Nonocclusive Mesenteric Ischemia (NOMI)

Please write a narrative on a patient with the above diagnosis. Please include salient information such as risk factors, presenting signs and symptoms, diagnostic testing, treatment, and complications.



# INSTRUCTOR MATERIALS

## A Story about Mesenteric Ischemia

### Pre-didactic Question Answer Key

1. What are the four main types of mesenteric ischemia?
  - a. Acute mesenteric ischemia
    - i. Superior mesenteric artery embolism
    - ii. Superior mesenteric artery thrombus
  - b. Mesenteric venous thrombosis (MVT)
  - c. Nonocclusive mesenteric ischemia (NOMI)
  - d. Chronic mesenteric ischemia
2. Which form of mesenteric ischemia carries the highest mortality?
  - a. Acute mesenteric ischemia, mortality nearly 90%
3. What are the risk factors associated with the different types of mesenteric ischemia?
  - a. Superior mesenteric artery (SMA) embolism/thrombosis
    - i. Age greater than 50
    - ii. Cardiac sources: myocardial infarction (MI), congestive heart failure (CHF), ventricular aneurysm, arrhythmia, atrial fibrillation, dilated cardiomyopathy, valvular heart disease
    - iii. Atherosclerosis, aortic aneurysms, iatrogenic sources
  - b. Mesenteric vein thrombosis
    - i. Hypercoagulable states
    - ii. Vasculitis
    - iii. Intrabdominal malignancy/infection
    - iv. Intrabdominal trauma/surgery
    - v. Pancreatitis
    - vi. Inflammatory bowel disease
    - vii. Cirrhosis
    - viii. Congestive heart failure
    - ix. Hypersplenism
    - x. Oral contraceptives
    - xi. Smoking
    - xii. Obesity
  - c. Nonocclusive mesenteric ischemia (NOMI)
    - i. Vasoconstricting medications: vasopressin, phenylephrine, norepinephrine, ergots, amphetamines, cocaine, digitalis, beta blockers
    - ii. Renal or hepatic disease
    - iii. Cardiac surgery
    - iv. Extreme exercise
    - v. Hypotensive states
    - vi. Dehydration
    - vii. Enteral nutrition



# INSTRUCTOR MATERIALS

- d. Chronic mesenteric ischemia
  - i. Vascular stenosis of mesenteric arteries
  - ii. Atherosclerosis
  - iii. Vasculitis
  - iv. Female gender
  
4. What is the pathophysiology associated with mesenteric ischemia?
  - a. For each, it is the eventual hypoperfusion of the bowel that can lead to necrosis and translocation of bacteria. If untreated, it will lead to septic shock.
  - b. For SMA embolism/thrombosis, it is the acute obstruction of blood flow in the mesenteric vessels leading to necrosis.
  - c. For mesenteric venous thrombosis, it is the acute obstruction of the venous system leading to edema and arterial hypoperfusion.
  - d. For nonocclusive and chronic mesenteric ischemia, it is the transient hypoperfusive states leading to tissue necrosis.
  
5. Which vessel is the most commonly occluded in acute mesenteric ischemia?
  - a. Superior mesenteric artery (SMA).
  
6. What is the hallmark physical exam finding associated with mesenteric ischemia?
  - a. Severe abdominal pain out of proportion to the physical exam.
  
7. What are clinical presenting signs and symptoms of the different types of mesenteric ischemia?
  - a. Acute mesenteric ischemia
    - i. Superior mesenteric artery (SMA) embolism – acute abdominal pain followed by rapid, forceful bowel evacuation.
    - ii. Superior mesenteric artery (SMA) thrombosis – history of chronic abdominal pain for weeks or months followed by an acute event.
  - b. Mesenteric venous thrombosis (MVT) – less acute presentation than arterial forms since the occlusion evolves over several days.
  - c. Nonocclusive mesenteric ischemia (NOMI) – unexplained abdominal distension increasing in patients after cardiac surgery or dialysis.
  - d. Chronic mesenteric ischemia – unexplained weight loss and repeated post prandial pain.
  
8. What is “intestinal angina?”
  - a. Abdominal pain occurring after eating due to increased intestinal demand.
  
9. What is the differential diagnosis for ischemic bowel disease?
  - a. Abdominal aortic aneurysm: rupture or expansion
  - b. Perforated ulcer or viscus
  - c. Ruptured ectopic pregnancy (woman of childbearing age)
  - d. Incarcerated or strangulated hernia
  - e. Septic shock



## INSTRUCTOR MATERIALS

- f. Intussusception
- g. Volvulus
- h. Salpingitis or tubo-ovarian abscess
- i. Torsion of the ovary or testicle
- j. Appendicitis
- k. Pelvic mass or torsion
- l. Pancreatitis
- m. Diverticulitis
- n. Ruptured ovarian cyst
- o. Renal colic
- p. Biliary colic
- q. Also consider atypical manifestations of:
  - i. Inferior wall myocardial infarction
  - ii. Pulmonary embolism
  - iii. Pneumonia
  - iv. Diabetic ketoacidosis
  - v. Acute glaucoma

10. What are red flags associated with mesenteric ischemia?

- a. Pain out of proportion to the findings on physical examination
- b. Presence of one or more risk factors
- c. Pain not responsive to narcotics
- d. Rectal bleeding

11. What is the imaging modality of choice to diagnose mesenteric ischemia?

- a. Computed tomography angiography (CTA) of the abdomen and pelvis is the image modality of choice.

12. Which serum marker reliably indicates a diagnosis of mesenteric ischemia?

- b. There are no reliable serum markers of any kind. At various phases of disease severity, patients may or may not have leukocytosis, acidosis, elevated lactate levels, elevated amylase levels or elevated d dimer.
- c. The absence of these values in no way eliminates mesenteric ischemia as a diagnosis.
- d. Diagnosis should not be delayed based on lab values.

13. What is the treatment?

- a. For acute mesenteric ischemia, revascularization is the priority. This can be achieved via immediate open surgery vs endovascular approach. Three factors contribute to the form of treatment. They are 1) the duration and severity of bowel ischemia, 2) the nature of the occlusive lesion and 3) availability of interventional radiology (IR) or vascular surgery. If bowel infarction or impending infarction are suspected in any form of mesenteric ischemia, immediate exploratory laparotomy is mandated. Patients should also receive aggressive resuscitation and antibiotics.



## INSTRUCTOR MATERIALS

- b. Embolic occlusion is usually secondary to a well-organized cardiac thrombus that is not amendable to thrombolytics. A risk of thrombolysis is also fragmenting embolic lesions that are not able to be retrieved via catheter thrombectomy. This form of mesenteric ischemia is usually managed through a combination of embolectomy and visual inspection of the bowel for evidence of necrosis.
- c. Acute thrombotic disease may be amendable to IR endovascular techniques and thrombolytic therapy.
- d. Mesenteric venous thrombosis is best treated nonoperatively with anticoagulation and adequate restoration of circulating blood volume. Surgical consultation should still be emergently placed as some patients may have experienced bowel infarction and may require resection of necrotic bowel.
- e. Mesenteric thrombosis requires surgical consultation and anticoagulation.
- f. Nonocclusive mesenteric ischemia (NOMI) often occurs in the setting of critical illness. Patients require maximal medical optimization such as fluid resuscitation, discontinuation of vasopressors if possible, and treatment of the underlying hypoperfusive state.
- g. Critical care admissions are recommended for all.

### 14. What are the complications of mesenteric ischemia?

- a. Recurrent ischemia secondary to recurrent embolism or incomplete embolectomy
- b. Stenosis at the arteriotomy site
- c. Progression of intestinal infarction
- d. Bleeding
- e. Bowel obstruction
- f. Anastomotic leak
- g. Cardiac complications
- h. Wound dehiscence
- i. Wound infection
- j. Prolonged ileus
- k. Pneumonia
- l. Renal failure
- m. Septic shock
- n. Recurrence secondary to graft occlusion
- o. Hernia
- p. Short bowel syndrome
- q. Small bowel obstruction secondary to adhesions or internal hernia

### References:

1. Sise MJ. Acute mesenteric ischemia. *Surg Clin North Am.* 2014;94(1):165-181. doi: 10.1016/j.suc.2013.10.012
2. O'Keefe KP, Sanson TG. Mesenteric Ischemia. In: Adams JG, Barton ED, Collings JL, DeBlieux PM, Gisondi MA, Nadel ES, eds. *Emergency Medicine: Clinical Essentials.* 2nd ed. Philadelphia, PA: Elsevier; 2013:292-298.
3. Oldenburg WA, Lau LL, Rodenberg TJ, Edmonds HJ, Burger CD. Acute mesenteric ischemia: a clinical review. *Archives of internal medicine.* 2004;164(10):1054-1062. doi: 10.1001/archinte.164.10.1054



## INSTRUCTOR MATERIALS

4. Carrero E, Gomar C, Penzo W, Rull M. Comparison between lecture-based approach and case/problem-based learning discussion for teaching pre-anaesthetic assessment. *Eur J Anaesthesiol.* 2007;24(12):1008-1015.
5. Taylor DC, Hamdy H. Adult learning theories: implications for learning and teaching in medical education: AMEE Guide No. 83. *Med Teach.* 2013;35(11):e1561-1572.
6. Kay D, Kibble J. Learning theories 101: application to everyday teaching and scholarship. *Adv Physiol Educ.* 2016;40(1):17-25.