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Mesenteric Ischemia

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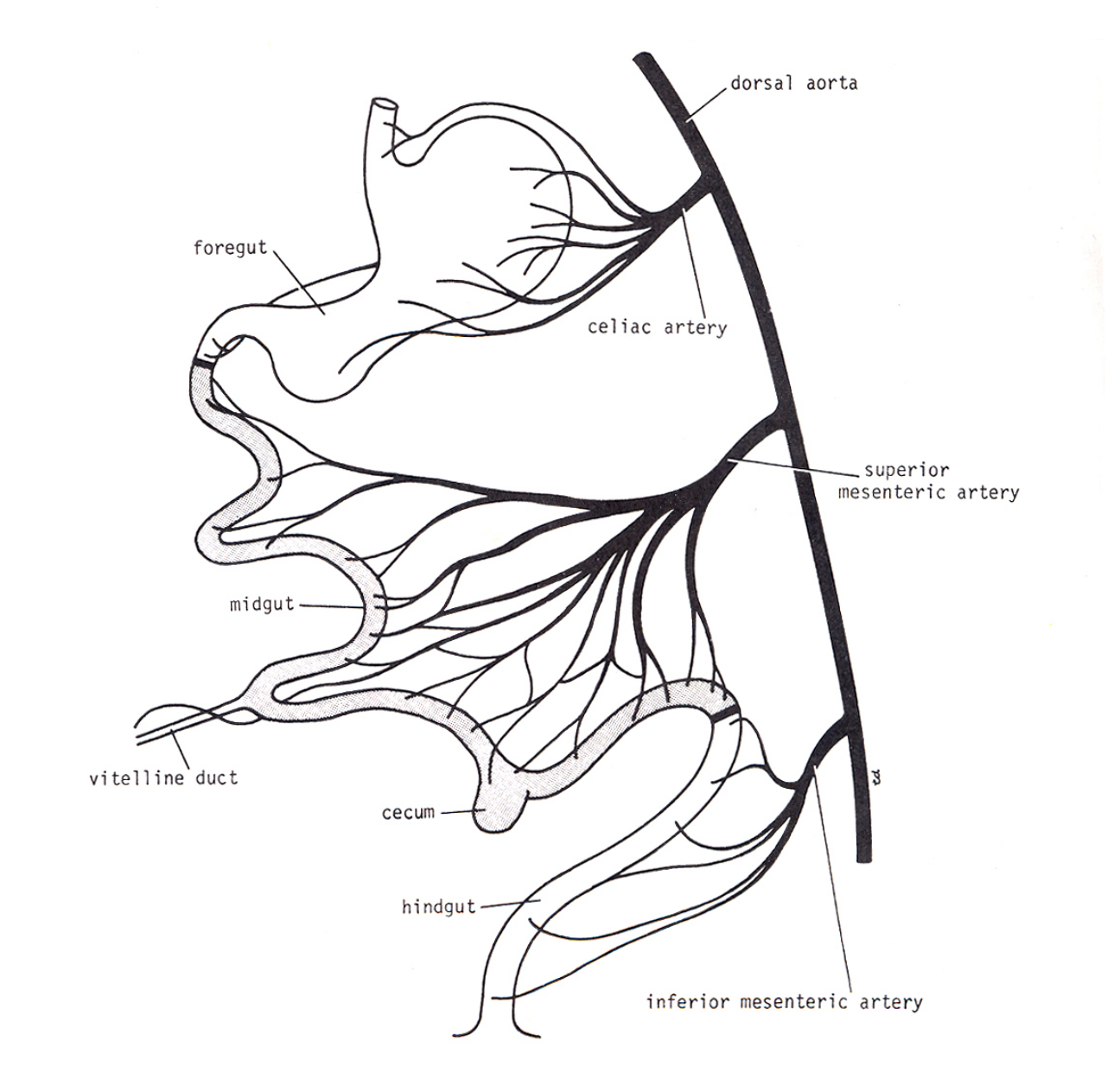
Lecture Objectives

- To grow in our understanding of the anatomy, pathophysiology, diagnosis, and treatment of mesenteric vascular emergencies.



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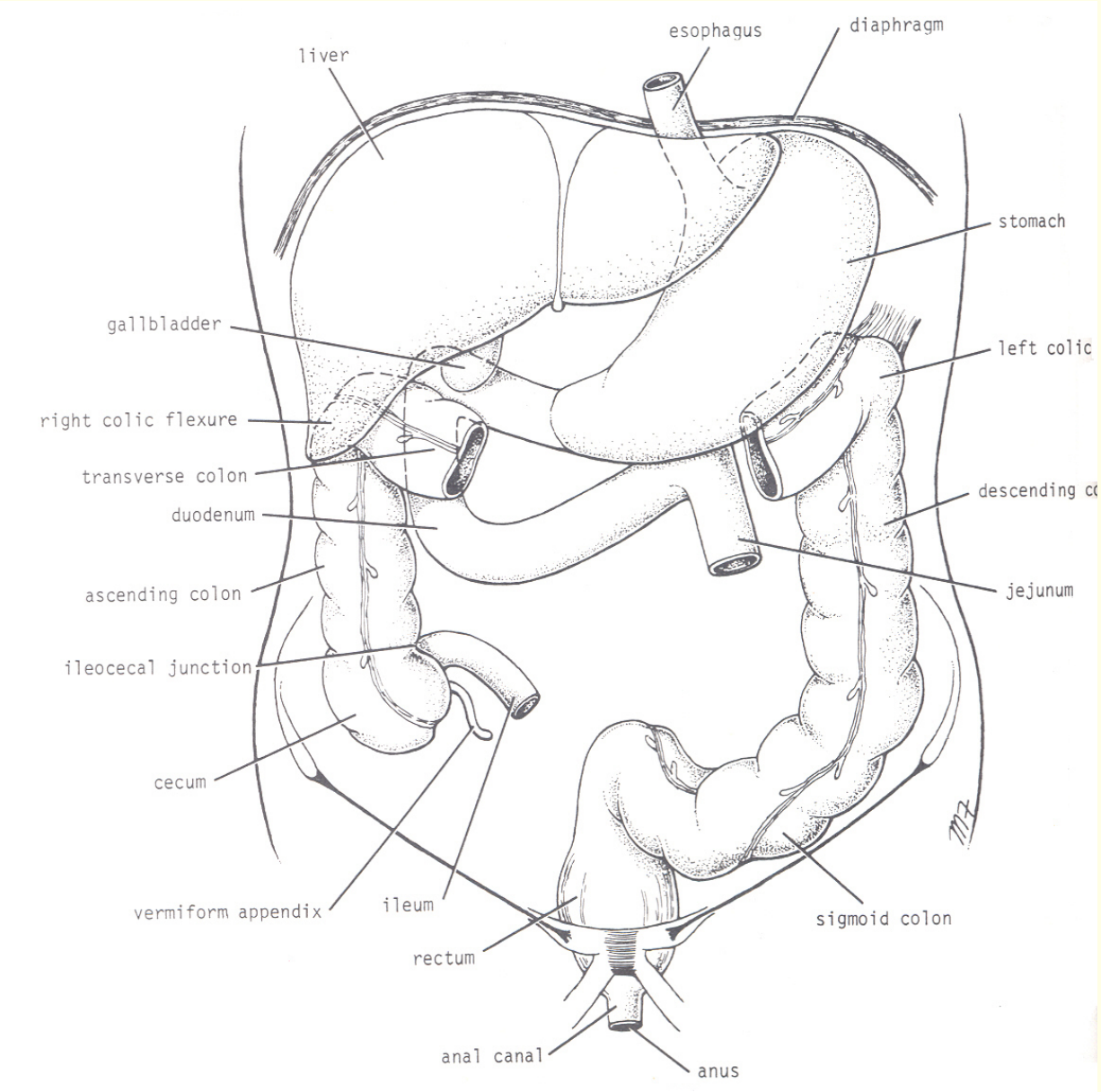

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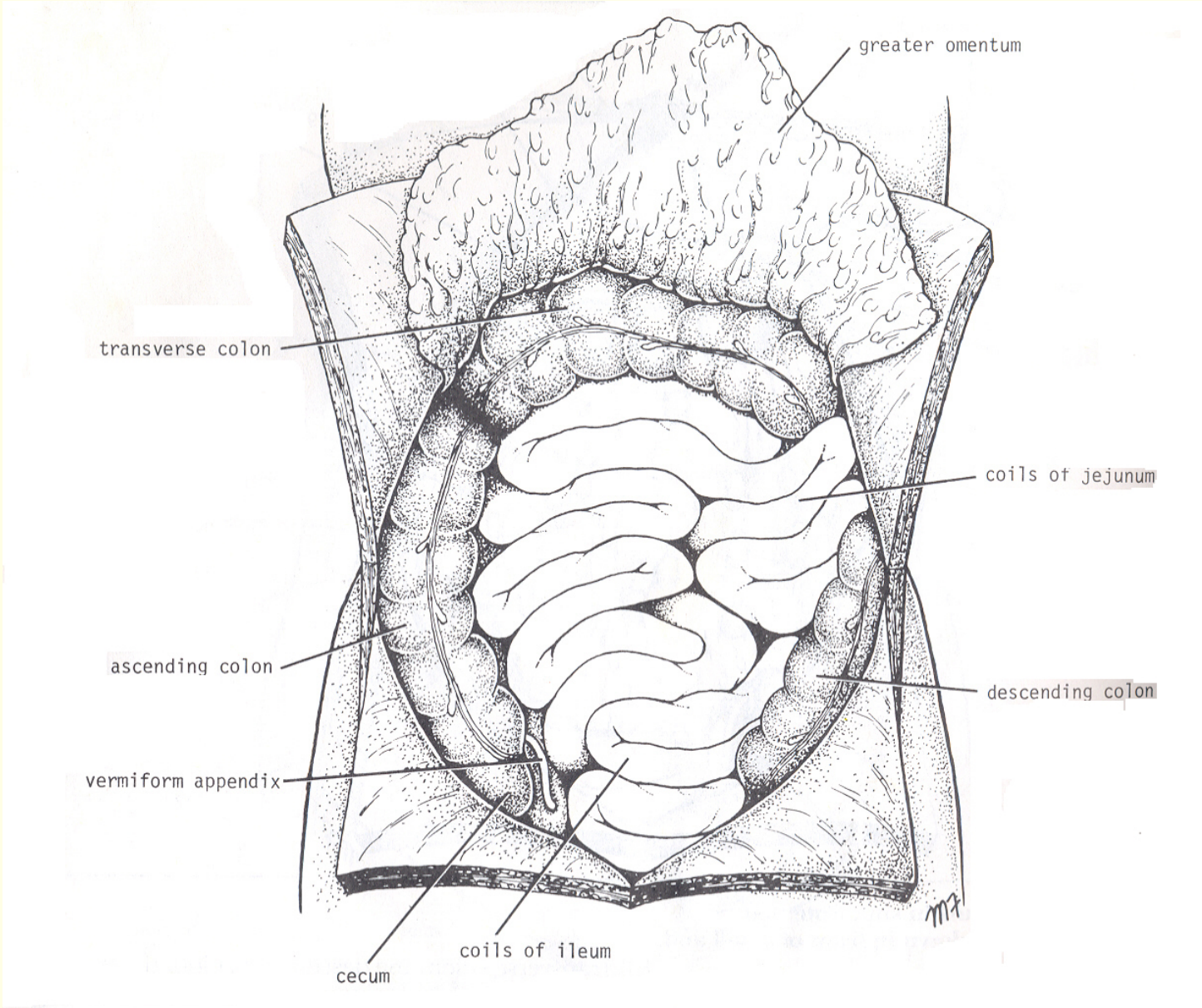

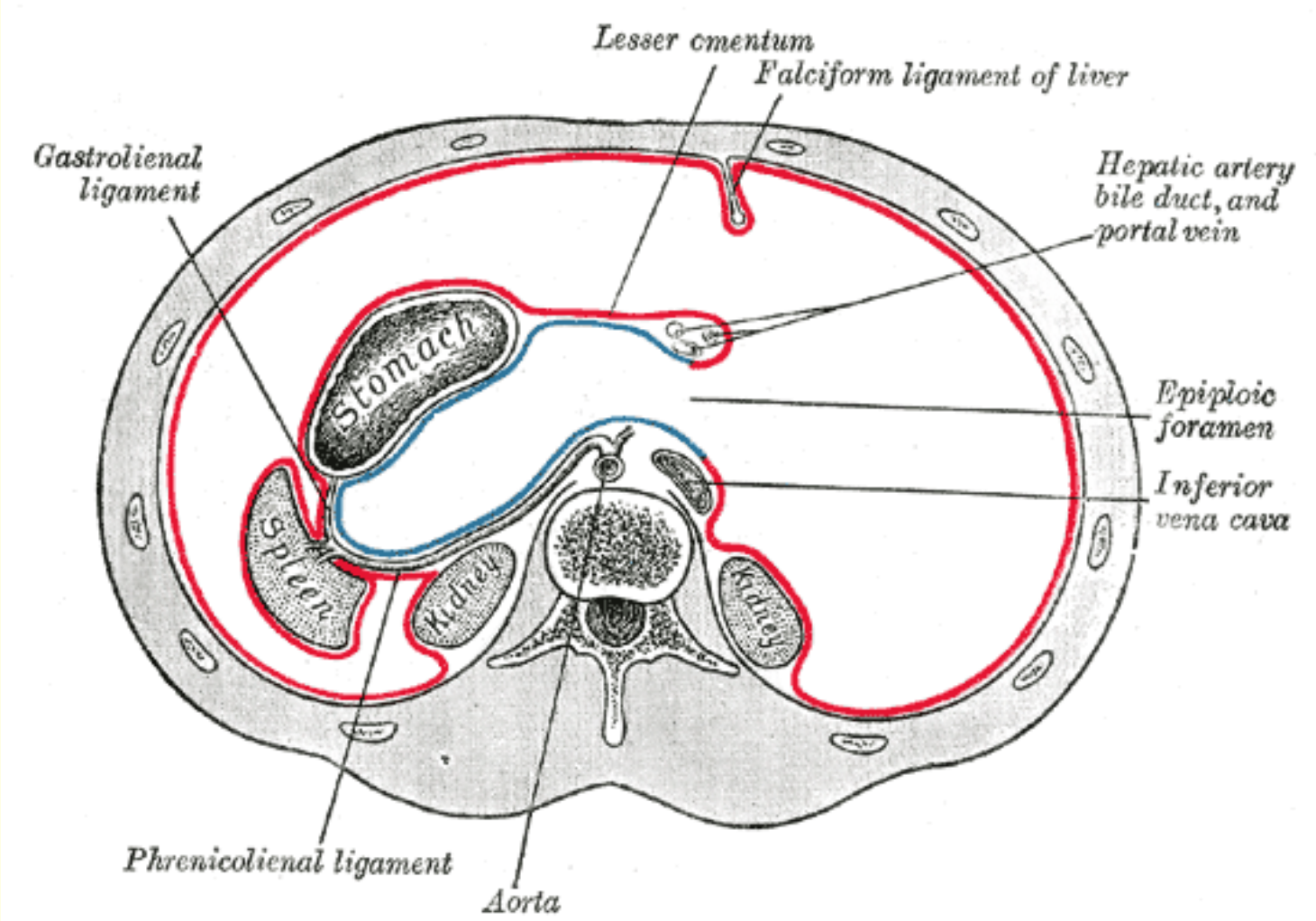

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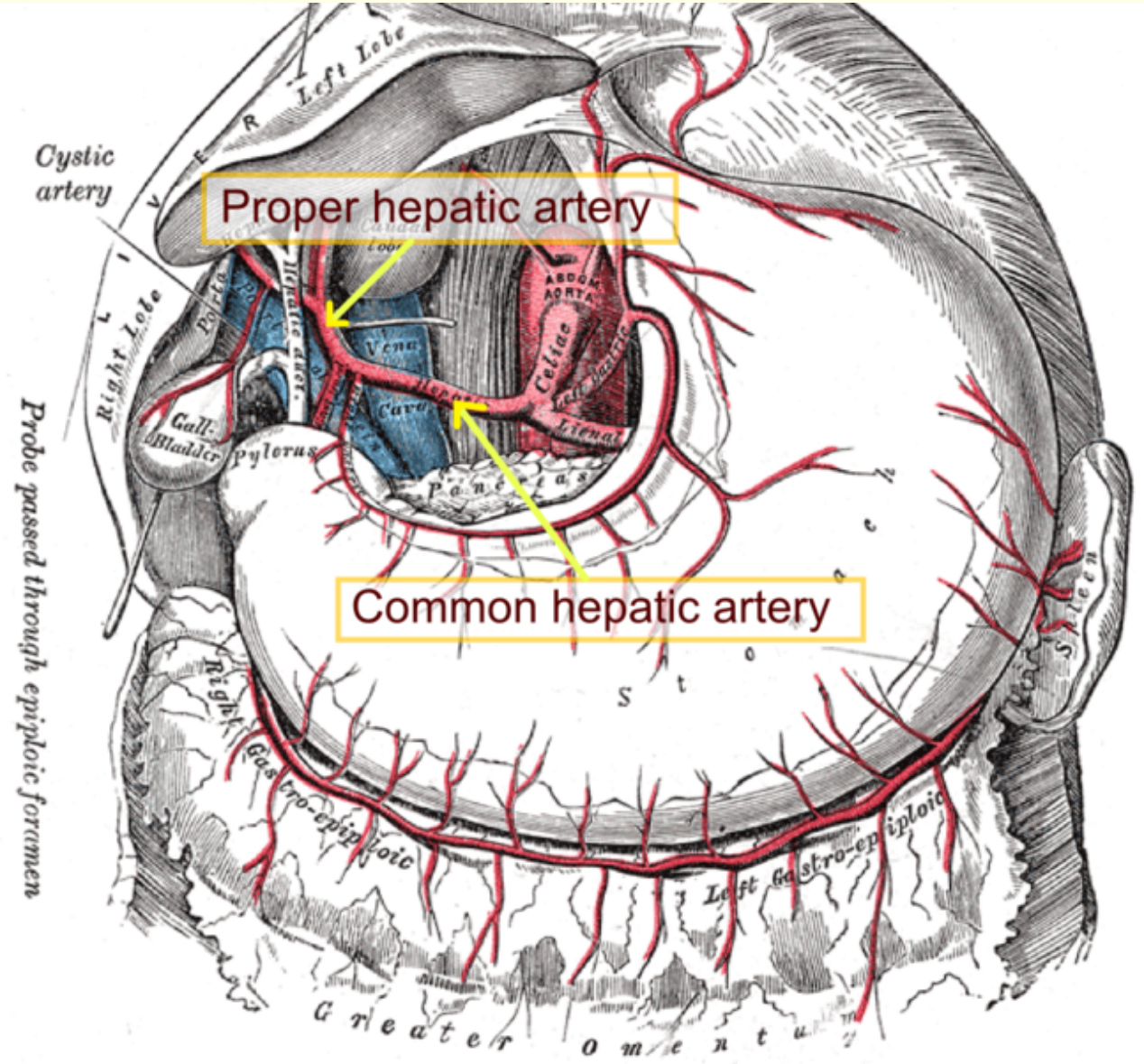

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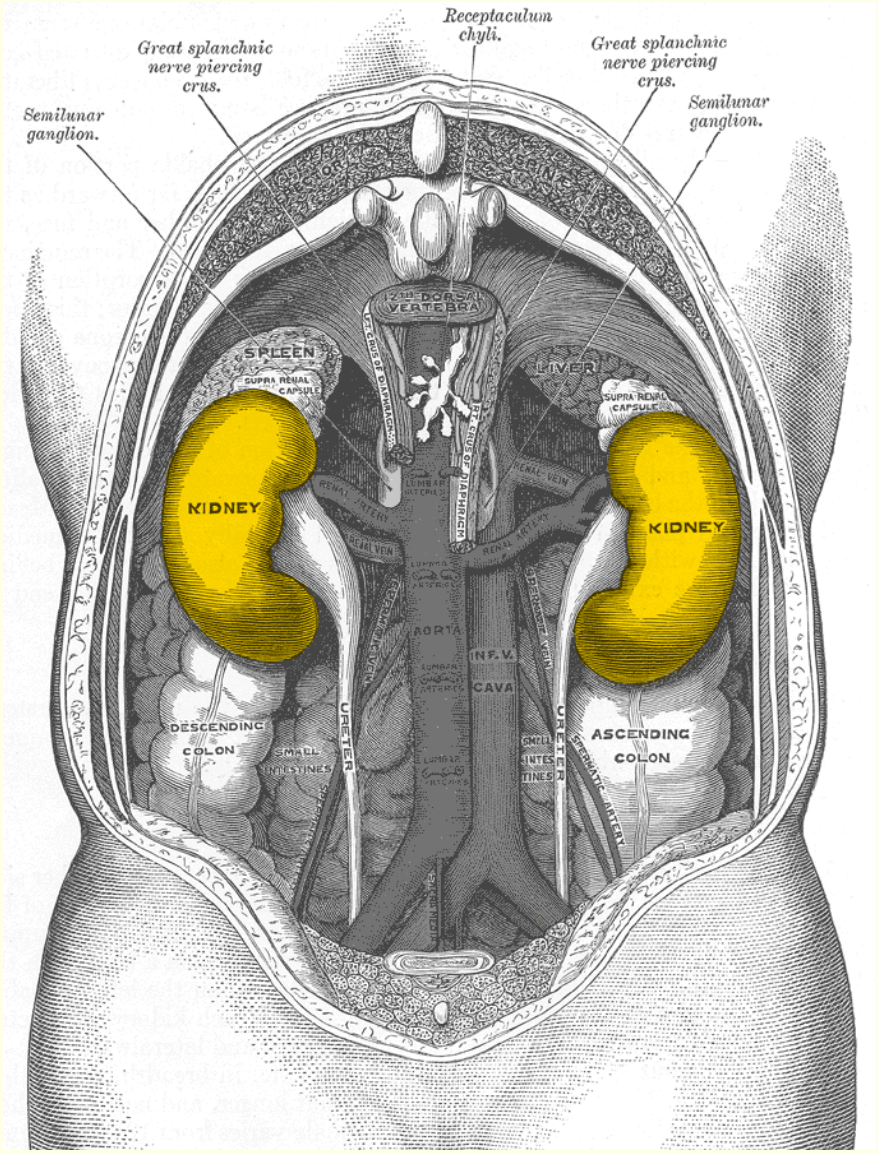

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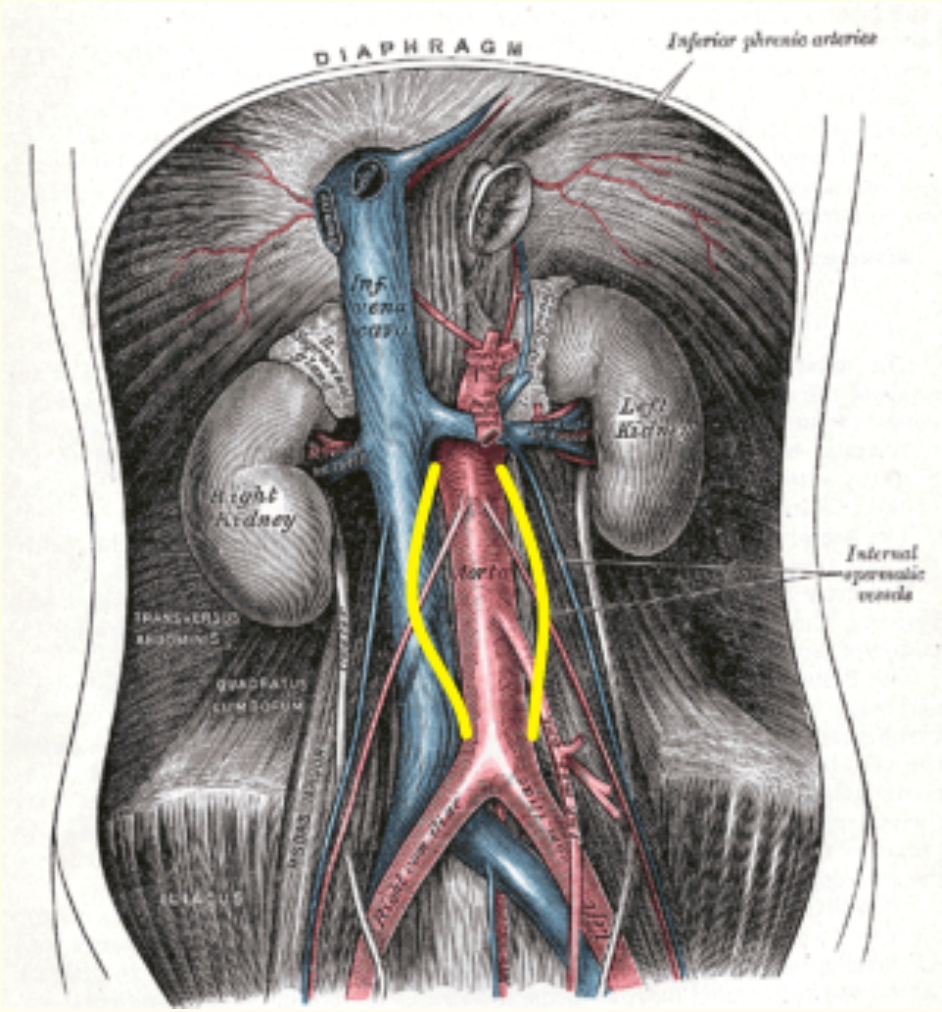

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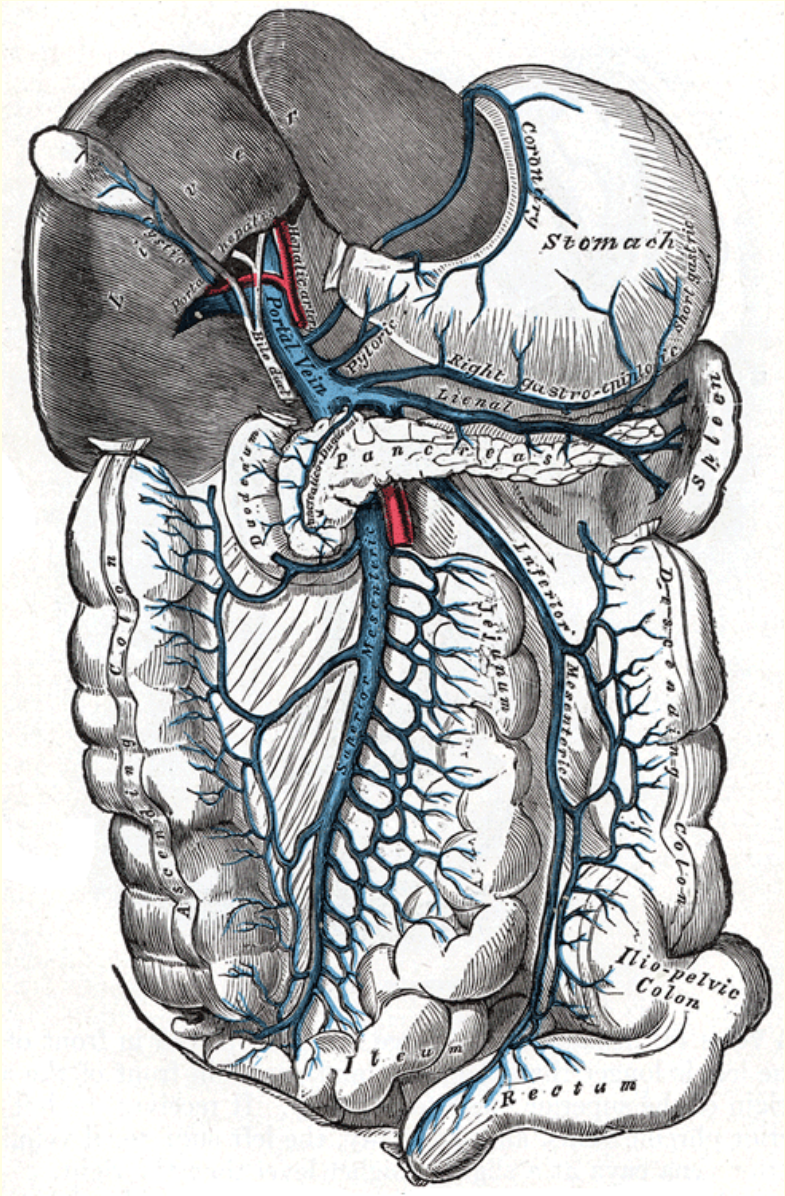

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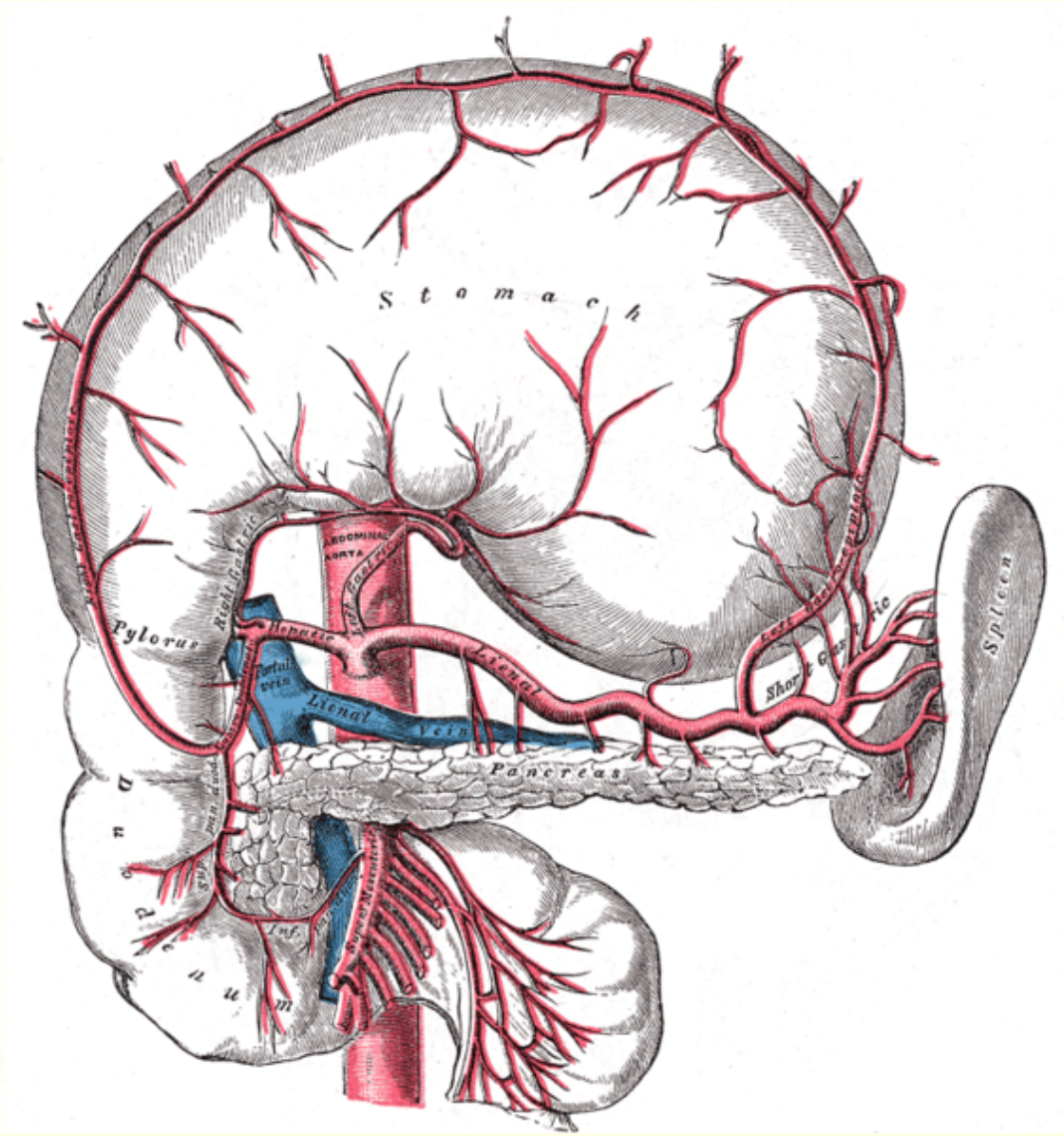

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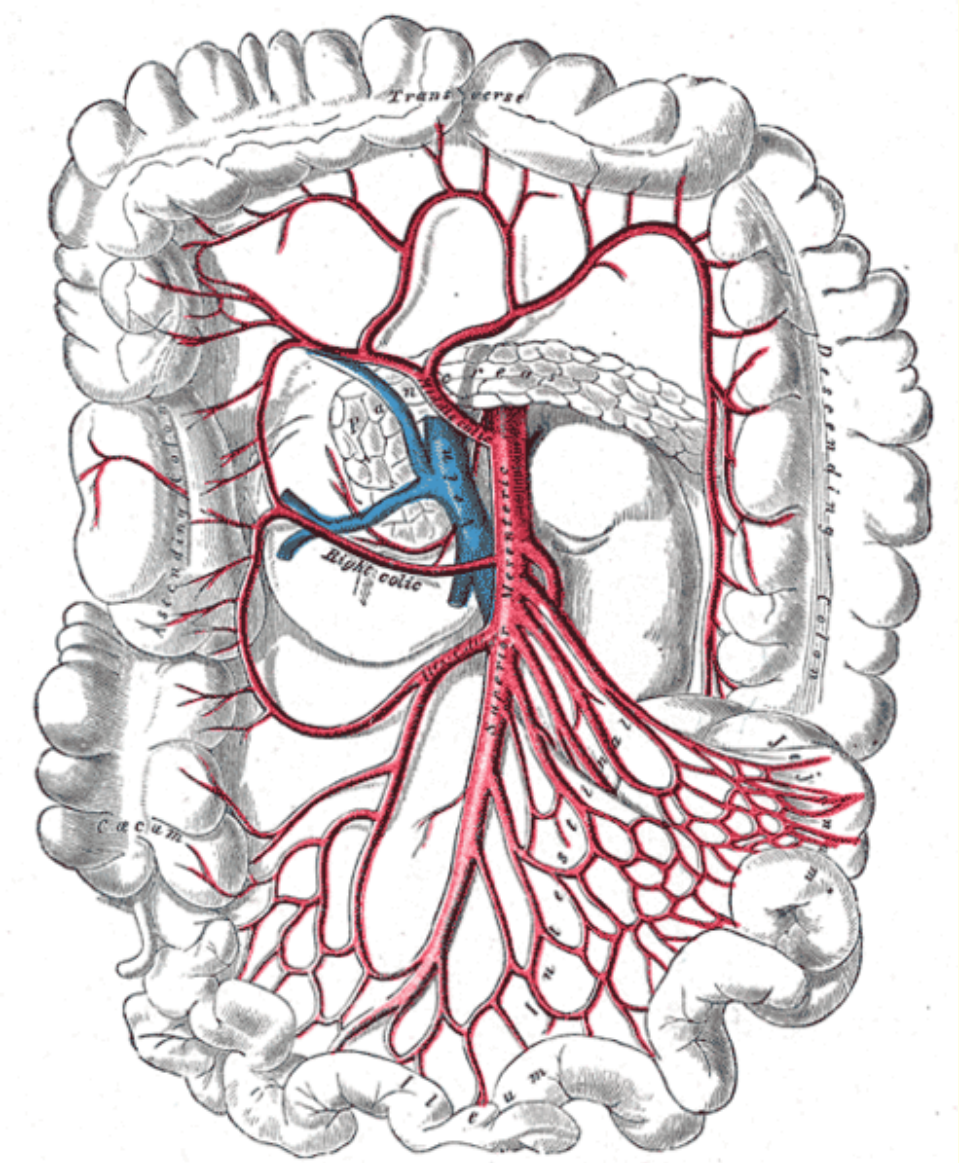

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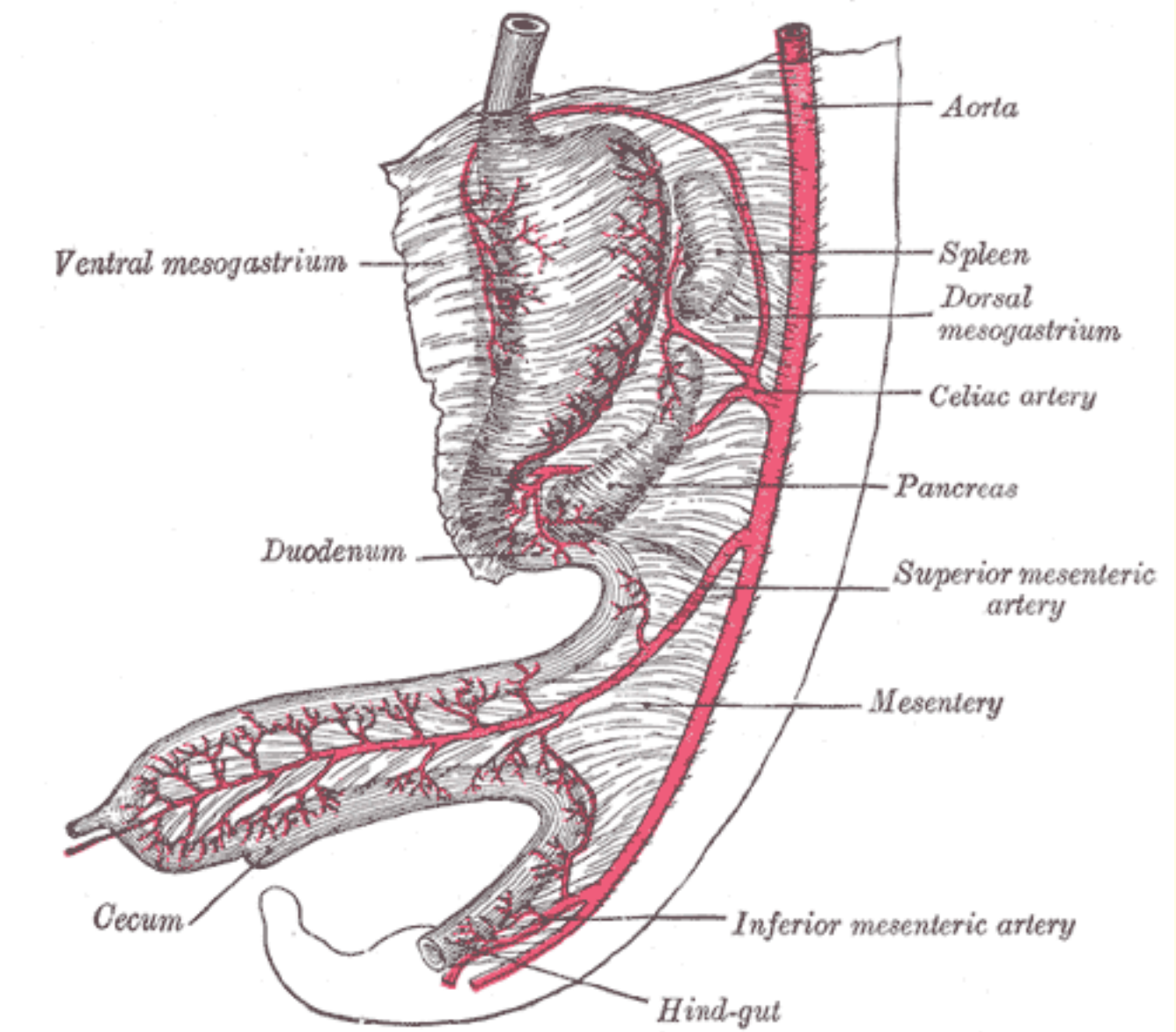

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Introduction
Mesenteric Ischemia

- A devastating disease increasing in incidence
- 1/1000 hospital admissions
- 2/100 hospital admissions for abdominal pain
- Despite diagnostic advances, mortality remains approximately 70%
- Delays in diagnosis continue to decrease chance of survival
- Presentation is nonspecific and initial abdominal exam may be unimpressive

History

- 1500 - First described in Florence
- 1815 - Guy's Hospital, London
- 1875 - Litten ligates the SMA of an animal and records events
- 1894 - Councilman describes chronic MI
- 1895 - Venous thrombosis (MVT) described by Elliott
- 1959 - Non-occlusive mesenteric ischemia (NOMI) first described in NEJM

History

- 1940 - Heparin first used
- 1950 - First SMA embolectomy without bowel resection
- 1958 - First successful revascularization after SMA thrombosis
- 1960 - Arteriography used successful and became standard of diagnosis

Anatomy

- Celiac artery - distal esophagus to second portion of duodenum
- Superior Mesenteric Artery (SMA) - duodenum to distal transverse colon
- Inferior Mesenteric Artery (IMA) - transverse colon to rectum
- Marginal Artery of Drummond - Anastomotic collateral between SMA and IMA

Etiology

- Acute versus Chronic
- Occlusive versus Nonocclusive

Etiology (Continued)

- 50% - AMI due to an embolus to the SMA
- 15% - AMI due to thrombosis of the SMA
- 15% - AMI due to mesenteric venous thrombosis
- 20% - NOMI

Superior Mesenteric Artery Embolism

- Catastrophic event typically in patients with heart disease
  - - Atrial Fibrillation
  - - Arrhythmias
  - - Valvular disease
  - - Myocardial infarction with ventricular thrombus
- Embolus lodges 3-10 cm distal to origin of SMA at point of taper
  - - Blood flow preserved to proximal SMA branches (duodenal and middle colic distributions)
  - - Proximal small bowel and large bowel generally spared
  - One-third of patients have a history of prior embolic event

Superior Mesenteric Artery Thrombosis

- Occurs in setting of long standing atherosclerotic disease
- Cause is usually rupture of a plaque at origin of SMA
- Well developed collateral may be present due to chronicity of disease

Mesenteric Venous Thrombosis

- Found mostly in patients with hypercoagulable states
- Half of patients have history of DVT/PE
- Other predisposing factors are malignancy, pregnancy, sepsis, portal hypertension
- Presentation less acute than SMA occlusion (i.e., harder to diagnose)

Nonocclusive Mesenteric Ischemia (NOMI)

- Occurs in low flow states (e.g., CHF, sepsis, volume depletion)
- Noted increasingly after cardiac surgery and after dialysis
- Multiple medications predispose patients
- Often presents without pain, but with distention and GI bleed
- Mortality is extremely high, reflecting poor health of population

Chronic Mesenteric Ischemia

- Presents as "intestinal angina“
- Abdominal pain soon after eating, lasting 1-2 hours
- Patients develop "food fear" and "small meal syndrome“
- Associated weight loss
- Often concomitant atherosclerotic disease elsewhere
- Diabetes and hypertension often coexist and predispose

Clinical Findings
History

- History is exceedingly important
- Evaluation of risk factors exceedingly important
- Classic triad -- severe abdominal pain, gut emptying, underlying heart disease
- SMA embolus – patients may pinpoint exact moment of pain
- SMA thrombosis – long history of intestinal angina with escalation
- NOMI – history of low flow states

Clinical Findings
Physical Examination

"*In contrast to the catastrophic nature of the pain, there is usually a paucity of physical findings. The clinician must be careful not to minimize the patient's complaints because of lack of specific signs.*"

Clinical Findings
Physical Examination

- Vital signs often normal
- Tachycardia is first finding
- Fever – elderly often do not mount this response
- Tachypnea – pain or early acidosis
- Hypothermia – may see with impending sepsis
- Hypotension – late and ominous finding
- Cold sweats – often seen as a result of overwhelming sympathetic discharge
- Much confusion separating acute myocardial infarction

Clinical Findings
Physical Exam - Abdomen

- Often unimpressive and nonspecific
- Hallmark is “pain out of proportion”
- Bowel sounds are active in 3/4ths of patients early in process (absent after complete infarction)
- Localized tenderness rare
- Peritoneal signs – late
- Blood in stool - late

Clinical Findings
Physical Exam – General

- Utility of the full physical exam is in the search for other causes of symptoms
- Cardiac – murmurs or arrhythmias as source of emboli
- Neuro – look for prior stroke
- CHF – at risk for NOMI
- Underlying malignancy – consider MVT
- “Perhaps the best overall finding was an uneasy feeling on the part of the examining physician that his patient looks sick, but that he could not say why or from what.”

Laboratory Studies

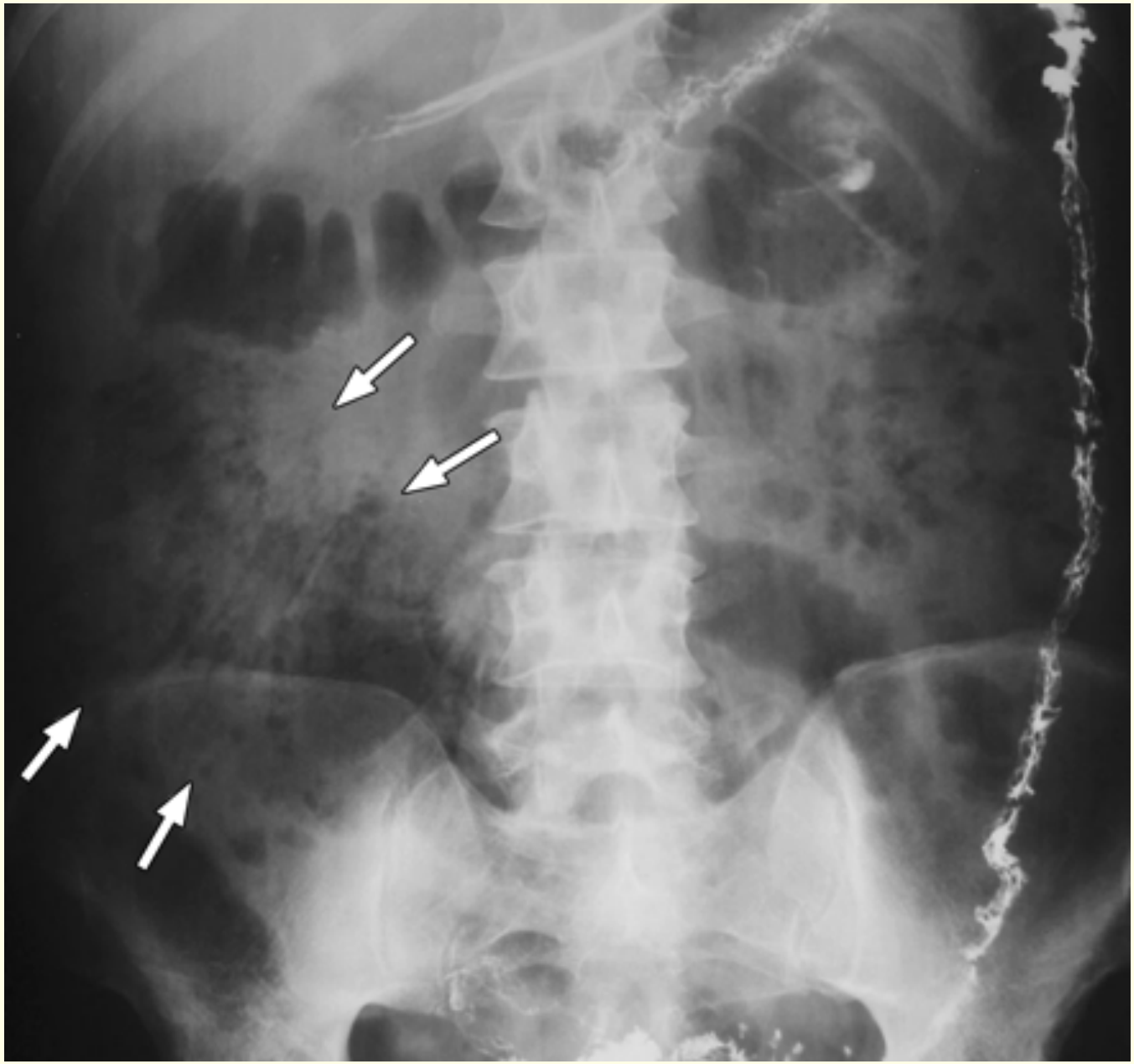
- There is no one test which can rule out acute MI
- Most studies lack sensitivity and specificity
- Some findings may support diagnosis - but normal values never exclude this diagnosis
- Normal values (amylase) should not sway you from pursuing the diagnosis

Laboratory Studies

- WBC - Greater than 15,000 in 90% of patients
- Electrolytes - 50% have anion-gap metabolic acidosis with large base deficit
- Lactate - increase in first hour and correlates with extent of damage
- Intestinal Fatty Acid Binding Protein (IFABP)
  - Produced by enterocytes and release intestinal injury
  - Half-life exceedingly short in serum
  - Excreted by kidneys
  - Urinary levels may prove to be valuable, but still quasi-experimental
- EKG - Atrial fibrillation common

Imaging Studies
Plain Radiographs

- Rarely diagnostic and completely normal 25% of the time
- Early findings nonspecific
  - Small bowel distention, air/fluid levels, ileus, etc.
  - With progression of disease, ischemia leads to bowel wall edema with "thumbprinting“
  - With necrosis, pneumatosis intestinalis, occasionally progressing to air in the portal venous system
- Mortality is 80% if positive radiographic findings at time of diagnosis, 30% if no abnormalities



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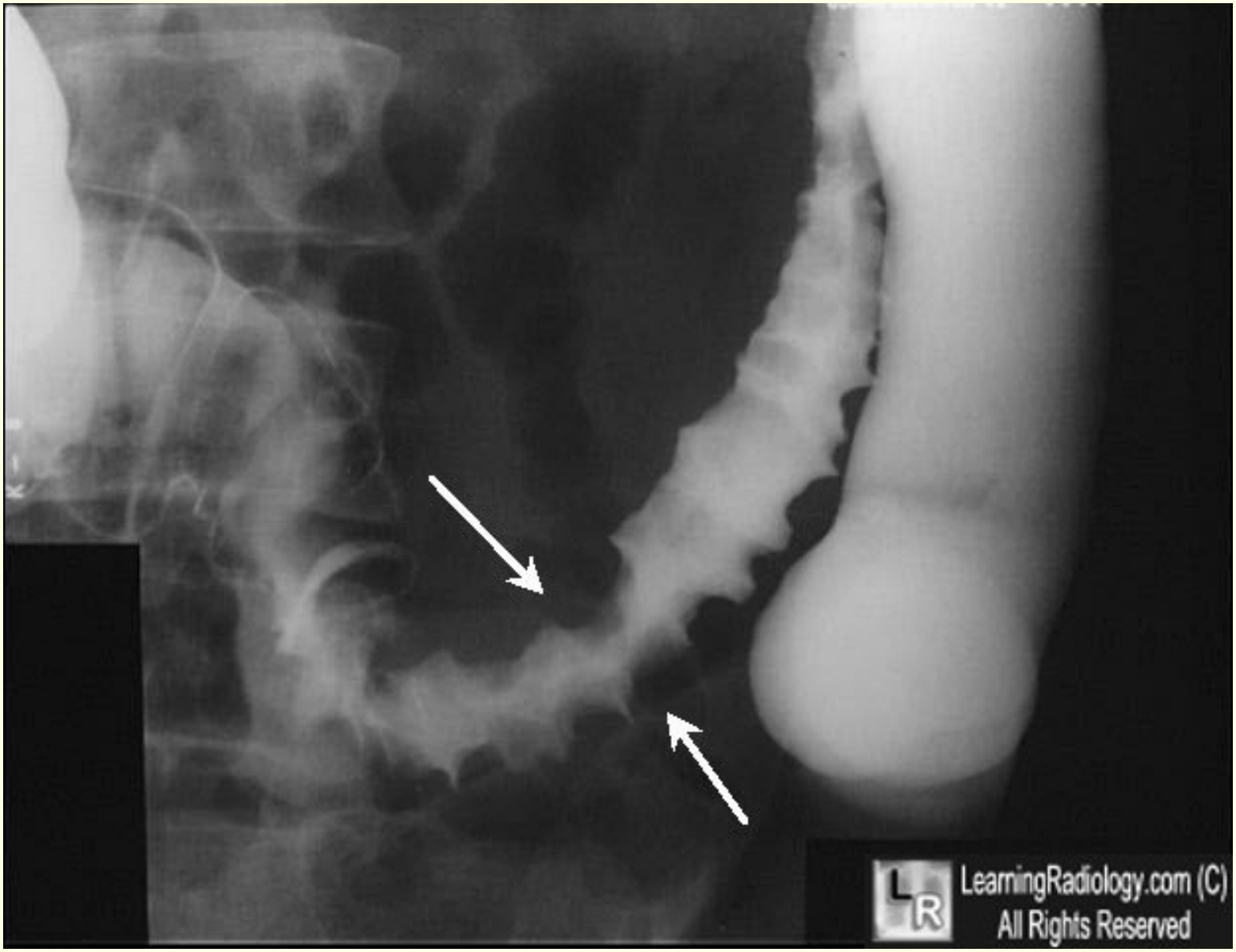

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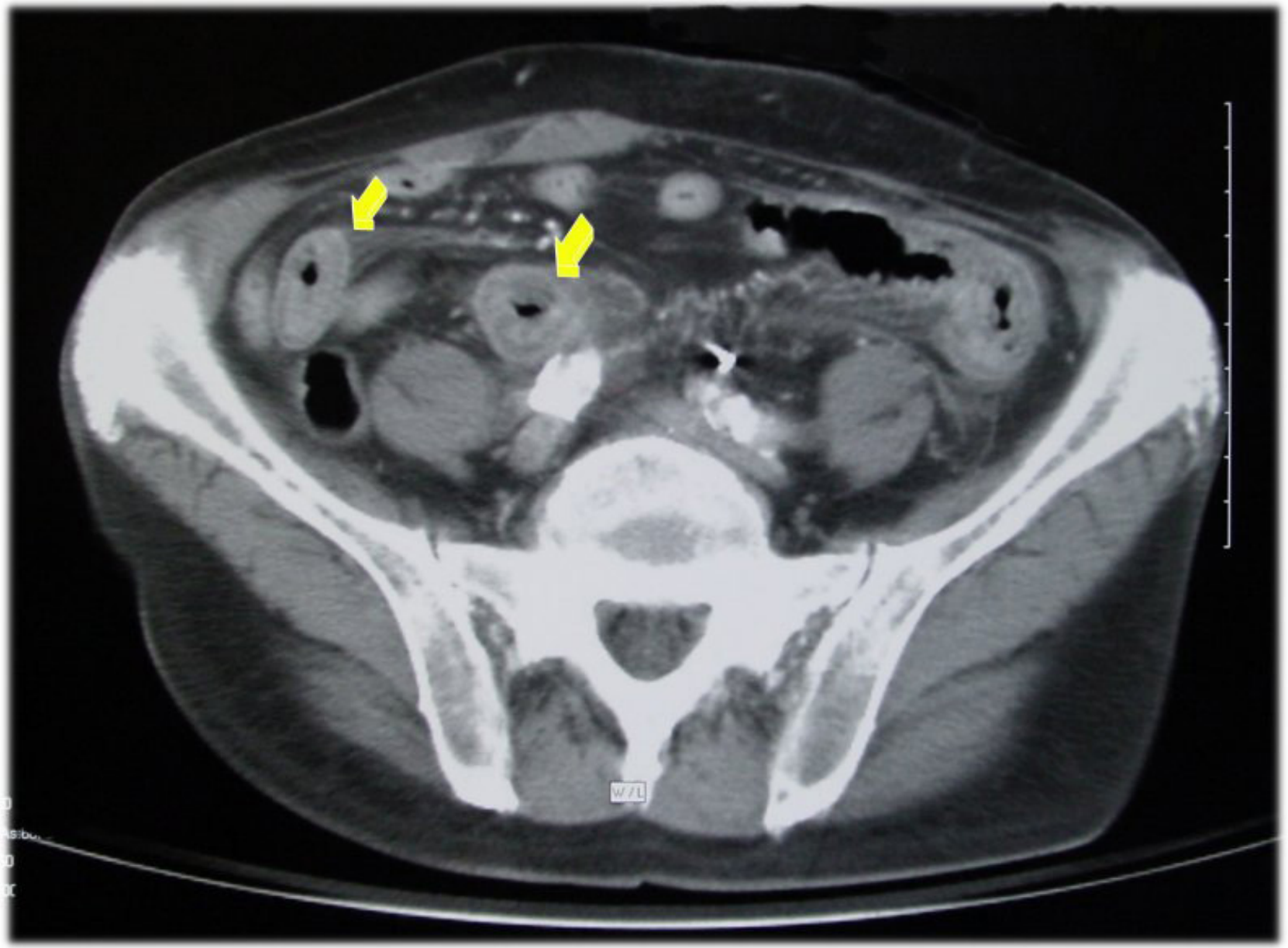
Imaging Studies
Ultrasound

- Doppler sonography may be helpful if complete obstruction of proximal SMA
- Limited ability to detect peripherally located emboli
- Color flow duplex sonography may be good in diagnosing chronic MI as peak systolic and diastolic velocity can be measure (not good for acute MI)

Imaging Studies
CT

- All findings evident on plain x-rays can be seen on CT as well, yet remain just as nonspecific in early disease
- CT w/IV contrast excellent in diagnosis of MVT
- CT angiography excellent in diagnosing AMI



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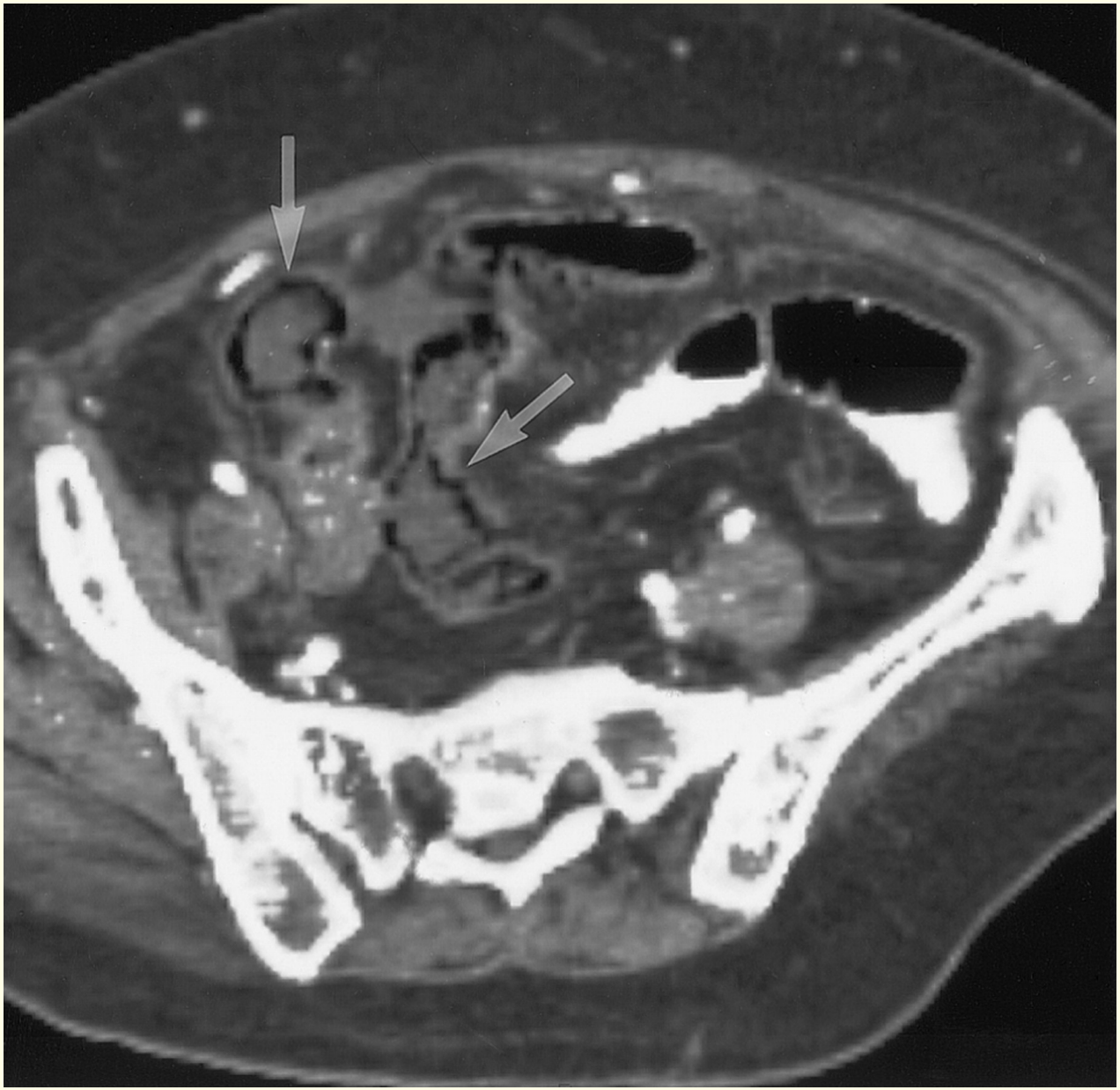

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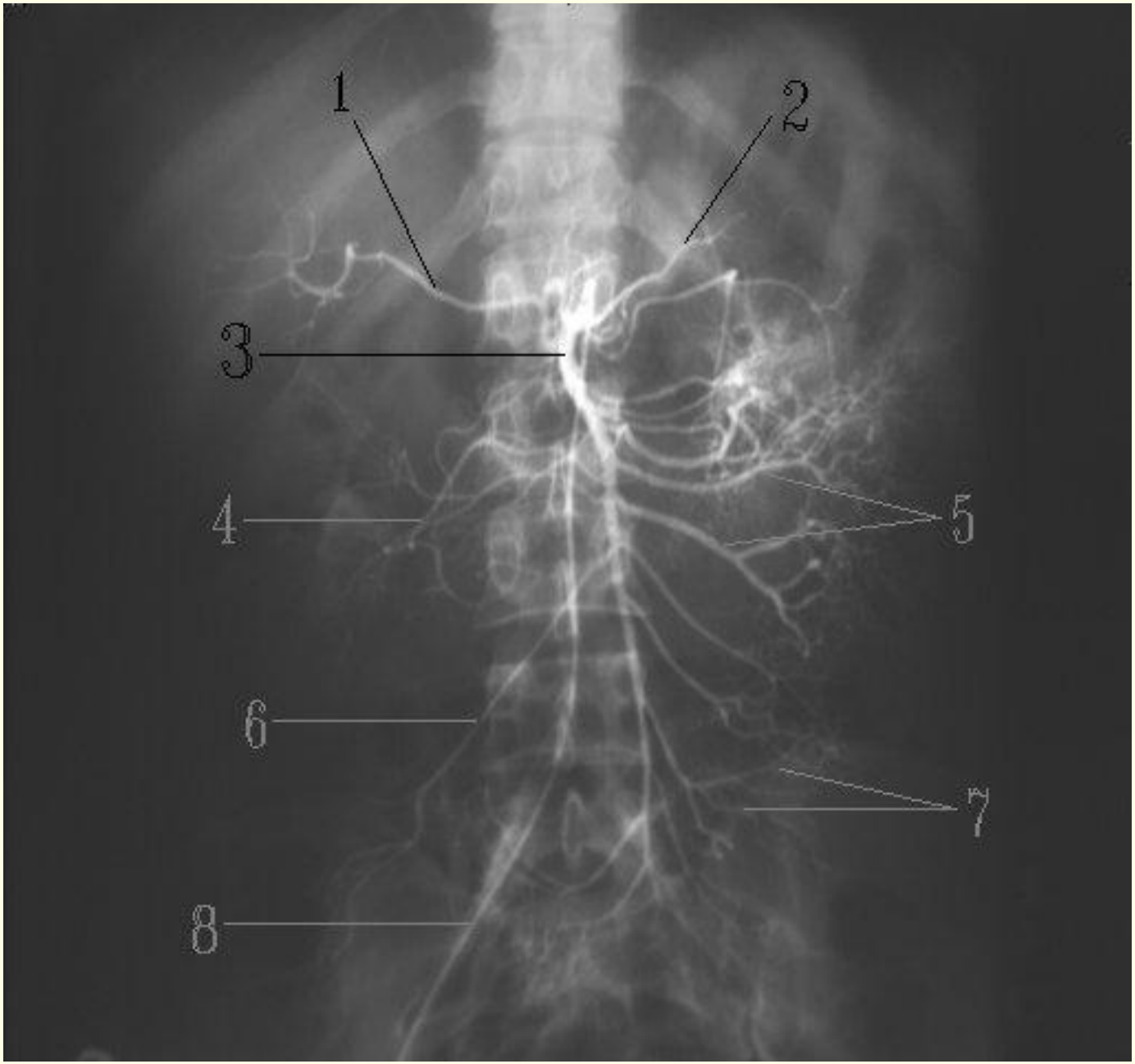
Imaging Studies
MRI

- MRI-MRA provides excellent images of arterial and venous systems
- Time required limits utility for AMI (good for CMI)
- Ability to delineate small distal emboli is limited
- Newer techniques include MRO (magnetic resonance oximetery)
  - Measures selective O2 saturation in specific vessels

Imaging Studies
Angiography

- Remains the gold standard for diagnosing AMI
- Greater than 90% sensitivity
- Abrupt cut-off is diagnostic
  - 3-10 cm distal to SMA = embolus
  - Non-visualization of SMA = thrombus
- Aggressive angiography one of few methods to decrease mortality of AMI
- Downside:
  - Invasive
  - Time-consuming
  - Potentially nephrotoxic



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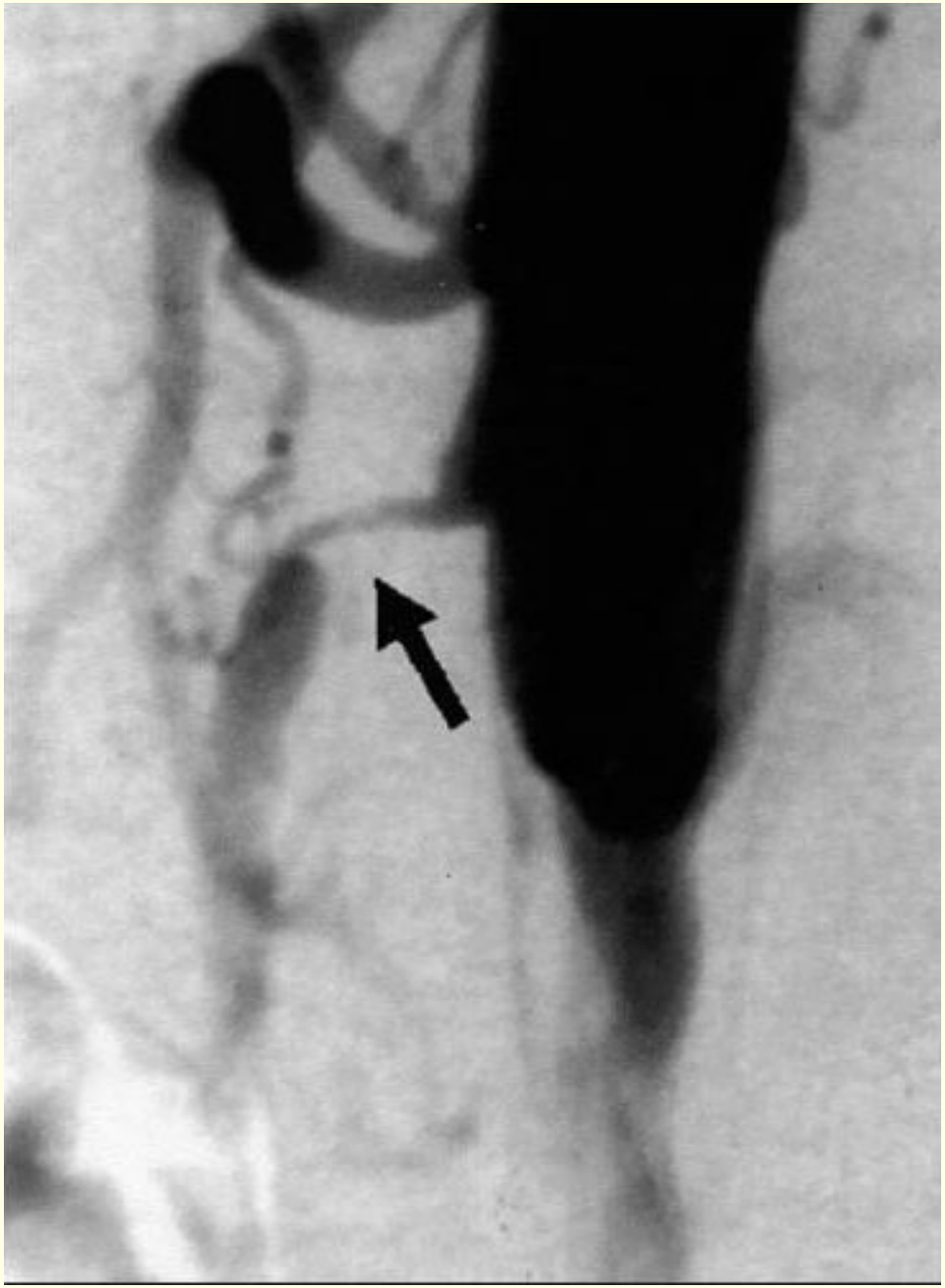

Treatment – Overall Goals

- Reestablish blood flow as soon as possible, before irreversible bowel ischemia has occurred
- The only way to achieve this is through early diagnosis

Treatment
General Measures

- **Broad spectrum antibiotics**
  - Theoretical protection against bacterial translocation
- **Anticoagulation with heparin**
  - When to begins is controversial – discuss w/ admitting surgeon
- **General**
  - NG, NPO, Foley, I&O, Surgery consult
- **Avoid**
  - Vasoconstricting medications

Treatment - Superior Mesenteric Artery Embolus

- **Strive for immediate attempts at revascularization**
  - Operative embolectomy most common with resection of areas of frank necrosis
- **If no peritoneal signs, thrombolytics may be considered**
  - Most often successful if embolism is only partially occluding
  - If no lysis at 4 hours or peritoneal signs develop – laparotomy indicated
- **Small emboli in patients with thrombolytic hemorrhage risk and/or poor surgical risk**
  - Short acting arterial vasodilator such as tolazoline

Treatment - Superior Mesenteric Artery Thrombosis

- Thrombolytics generally not successful in long term management
- Definitive revascularization recommended
- Bypass grafting types:
  - Antegrade from supraceliac aorta
  - Retrograde from infrarenal aorta

Treatment - Mesenteric Venous Thrombosis

- Immediate heparin anticoagulation recommended
- Anticoagulation with coumadin for 3-6 months
- Thrombectomy if thrombus less than 3 days old
- Resection of diseased bowel as indicated
- Thrombolytics - still under study without firm recommendation
- Thrombolytic approaches
  - Antegrade via superior mesenteric artery
  - Retrograde via internal jugular vein
  - Transhepatically via the portal vein

Treatment - Nonocclusive Mesenteric Ischemia

- Surgery reserved for patients with bowel obstruction
- Discontinue alpha-agonists, digitalis, and vasopressors
- Peripheral administration of heparin - precipitates if given with papaverine
- Papaverine via arterial catheter during arteriography
- Consideration of revascularization
- Iloprost still under study
  - Prostacycline analog
  - Fibrinolytic activity and platelet inhibitor

Treatment - Chronic Mesenteric Ischemia

- Open surgical revascularization most common
- Angioplasty with stenting for localized focal stenotic disease

Future Directions: Ischemia-Reperfusion Injury

- Intestinal ischemia results in formation of free radicals
- Free radicals promote systemic release of bacterial toxins
- Systemic release of toxins leads to pulmonary complications and distant organ disease
- Various medications and hyperbaric oxygen continue being studied to limit this form of injury

Summary

- **Acute insufficiency** of mesenteric arterial blood flow accounts for 60 to 70 percent of cases of mesenteric ischemia and results in **mortality rates exceeding 60 percent**. Specific risk factors include advanced age, atherosclerosis, low cardiac output states, cardiac arrhythmias, severe cardiac valvular disease, recent myocardial infarction, and intra-abdominal malignancy.

Summary

- The diagnosis of AMI depends upon a **high clinical suspicion**, especially in patients with known risk factors (such as atrial fibrillation, congestive heart failure, peripheral vascular disease, or a history of hypercoagulability). **Rapid diagnosis is essential** to prevent the catastrophic events associated with intestinal infarction. However, **early signs and symptoms of mesenteric ischemia are nonspecific**, and definitive diagnosis often requires invasive testing, exposing the patients who typically have several comorbidities to risk. As a result, the diagnosis is often delayed.

Summary

- **Mesenteric angiography remains the gold standard** diagnostic study for acute arterial ischemia. Early and liberal implementation of angiography has been the major factor for the decline in the mortality of patients with acute mesenteric ischemia over the past 30 years. Thus, in patients for whom a high clinical suspicion of mesenteric ischemia is present, **we suggest immediate angiography rather than other imaging modalities** . Such patients should also receive surgical consultation.

Summary

- **Multidetector-row CT angiography** appears to be an **acceptable alternative** in settings where obtaining early angiography is impractical, or there is **only a moderate suspicion** for acute intestinal ischemia, based upon the patient's clinical presentation. Accumulating evidence suggests that this imaging technique has a high degree of accuracy in diagnosing acute mesenteric ischemia, and it has the additional advantage of diagnosing alternative conditions.

Summary

- The **goal of treatment** of patients with acute mesenteric ischemia is to **restore intestinal blood flow** as rapidly as possible after initial management that includes aggressive hemodynamic monitoring and support, correction of metabolic acidosis, initiation of broad spectrum antibiotics, and placement of a nasogastric tube for gastric decompression.

"The philosophies of one age have become the absurdities of the next, and the foolishness of yesterday has become the wisdom of tomorrow."

William Osler

1848-1919