Imaging for Chronic Mesenteric Ischemia

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No disclosures
Chronic Mesenteric Ischemia

Risk Factors

• HTN
• DM
• Hypercholesterolemia
• Smoking
Celiac & SMA Anatomy
Identification of the Celiac Axis

- Celiac artery/trunk is the first *abdominal* branch off the aorta
  - 2 to 3 cm in length
  - Gives rise to common hepatic, splenic, and left gastric branches
  - Common SMA trunk < 1%
  - Evaluated in longitudinal and transverse views
Celiac Artery Anatomy
Celiac Artery Anatomy

Important collateral: Gastroduodenal artery
SMA Anatomy

- Middle colic
- Inferior pancreaticoduodenal
- Right colic
- Ileocolic
- Jejunal and ileal branches
Identification of the Superior Mesenteric Artery (SMA)

- SMA originates 1-2 cm distal to the celiac artery
  - Often takes off at a sharp angle from the aorta
  - Parallels the aorta as it courses distally
  - Color Doppler helps to identify distal course and branches
SMA: Red $\rightarrow$ Blue

It turns, remember?
Identification of the Inferior Mesenteric Artery (IMA)

- Last major branch of the abdominal aorta
  - Originates from anterior aorta
  - Curves to the left and then inferiorly
  - May serve as a source of collateral flow (legs or gut)
  - Failure to identify does not imply occlusion
Inferior Mesenteric Artery Anatomy
Mesenteric Arterial Physiology

- Free communication between the celiac, SMA and IMA
- Celiac is a low-resistance system due to liver and splenic beds. No change in flow after eating
- SMA is a high-resistance system at fasting states, and low-resistance system after eating
- If celiac is occluded, low resistance & high flow in SMA
Normal Doppler Velocity Waveforms

Celiac:
- Forward flow throughout diastole
- Spectral broadening expected due to size of the sample volume relative to the artery
- Not turbulence.

➔ PSV normally <200 cm/sec; >200 cm/sec suggests a stenosis of >70% (EDV >55 cm/sec suggests a stenosis of >50%)

SMA:
- High resistance flow pattern when fasting
- Sharp systolic upstroke
- May find some turbulence proximally becoming laminar distally

➔ PSV normally <275 cm/sec; EDV normally <45 cm/sec

Retrograde common hepatic artery flow suggests a hemodynamically significant stenosis or occlusion of the celiac artery

PSV >275 cm/s in the SMA or IMA suggests a stenosis > 70%
Indications for duplex:

- Postprandial pain or cramping
- Chronic diarrhea
- Unexplained weight loss
- Abdominal bruit
- Postoperative evaluation of vascular reconstruction
Patterns of disease:
SMA chronic vs. acute occlusion

- Atheromas usually lie at or within 2.5 cm of ostium
- Emboli usually lodge at the division of middle colic and jejunal branches
- Right colic
- Ileo-colic
- Jejunal branches
- Collateral pancreatico-duodenal
Limited role for duplex imaging for an acute abdomen!
Limitations

- Excessive bowel gas
- Obesity or skinny – neither is easy!
- Recent abdominal surgery
- SOB and rapid breathing interferes with accurate Doppler recordings
- Experience helps
Diagnostic Criteria: Celiac Occlusive Disease

**Celiac: fasting**

- PSV >200 cm/sec indicates >70% stenosis (Moneta, 1991)
- EDV >55 cm/sec indicates >50% stenosis (Bowersox, 1991)
- Post-stenotic turbulence (PST) documented
- Hepatic/splenic
  - Delayed SRT
  - Monophasic waveforms
Celiac stenosis

- Spectral broadening
- Post-stenotic turbulence
- Color flow disturbance
Diagnostic Criteria:  
SMA Occlusive Disease

**SMA: fasting**
- PSV >275 cm/sec indicates >70% stenosis (Moneta)
- EDV >45 cm/sec indicates >70% stenosis
- Post-stenotic turbulence (PST) documented
- Monophasic waveforms in mid-SMA
Superior mesenteric stenosis

Hi-flow collateral
Disordered flow
Turbulent jet
Dampened distal flow
Mesenteric Ischemia

- Clinical picture (intestinal angina)
  - Thin patient
  - Food aversion
  - Postprandial abdominal pain

- **Duplex**
  - Good screening test
  - Can rule out the diagnosis
  - No clear role for post-prandial testing

- Angiography is the gold standard
Technical considerations

- Fasting patient
- Appropriate angle correction is crucial:
  - 60° or less, corrected to the line of the vessel walls
  - Smaller the angle, the lower the estimated velocity

60° → 160 cm/sec
22° → 90 cm/sec
Case

• 90 yF with post prandial pain
• Hx of extensive vascular procedures
HISTORY:

Diabetes: yes
Hypertension: yes
Smoking: yes
Hx of MI: yes
Hx of stroke: yes
Weight: 180 lbs
Height: 5'11"

INDICATION:
Post-Peptic Ulcer
Chronic Mesenteric ischemia

Comments:
Post Acute bowel obstruction, SMA stenosis noted.

Technologist: Michael R. Lane, RG EVT

Rev. 8/10
Stented, now what do I do?

Abstract

**Background:** This study sought to define duplex ultrasound (DUS) velocity criteria predicting ≥70% stenosis in superior mesenteric artery (SMA) stents by correlating in-stent peak systolic velocity (PSV) with computed tomographic angiography (CTA) measurements of percent stenosis.

**Methods:** A retrospective review of 109 patients undergoing SMA stenting between 2003 and 2018 was conducted at a single institution. Thirty-seven surveillance duplex ultrasound studies were found to have a CTA performed within 30 days of study completion. Bare metal (n = 20) and covered stents (n = 17) were included. Velocity was correlated to in-stent restenosis (ISR) measured by mean vessel diameter reduction on SMA centerline reconstructions from CTA. Receiver operating characteristic (ROC) curves were generated and logistic regression models for ≥70% ISR probability were used to define velocity criteria in the stented SMA.

**Results:** At a PSV of 300 cm/sec, the sensitivity is 100% and specificity 80% for a ≥70% in-stent SMA stenosis. At a PSV of 400 cm/sec, the sensitivity and positive predictive value (PPV) is 63% and the specificity and negative predictive value (NPV) is 90%. A PSV of 450 cm/sec was consistent with the highest specificity (100%) and PPV (100%) but lower sensitivity (50%) and NPV (87.9%). One patient with a PSV of 441 cm/sec on surveillance DUS died from complications of acute-on-chronic mesenteric ischemia.

**Conclusions:** A PSV of 400 cm/sec on mesenteric DUS can predict ≥70% ISR with high sensitivity and should be considered as a diagnostic threshold for SMA in-stent restenosis.

Obtaining a baseline DUS early after mesenteric stenting should be considered to compare future surveillance DUS. An increase above this baseline or an in-stent SMA PSV approaching 500 cm/s should be considered suspicious for ISR.


Conclusion

Keys to interpretation:

- **Celiac velocity**
  - Greater than or less than 200 cm/sec?
- **SMA velocity**
  - Greater than or less than 275 cm/sec?
- **IMA**
  - Visualized with normal flow patterns?
- **Distal waveforms**
  - PST or dampened waveforms?
  - Collateral vessels?

Other Causes:

- Celiac compression syndromes
- Non-occlusive mesenteric ischemia
- Embolic disease
- Acute on Chronic

**Different criteria for stenting!**
Thank You