MESENTERIC DOPPLER: PROTOCOLS AND PITFALLS

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OBJECTIVES

Define and describe the clinical presentations of mesenteric ischemia
Discuss sonographic technique and protocol information
Discuss interpretation criteria
Discuss common pitfalls
Describe new technology
Review good practice tips

MESENTERIC ARTERIES

- Celiac Artery
- Superior Mesenteric Artery (SMA)
- Arc of Riolan
- Artery of Drummond
- Pancreaticoduodenal arcade
- Inferior Mesenteric Artery (IMA)

Causes:
- Arterial stenosis or occlusion
- Venous thrombosis
- Nonocclusive disease (low flow states, hypotension, shock)

MESENTERIC ARTERIES

Acute Mesenteric Ischemia (AMI)
- Severe abdominal pain
- N/V
- Diarrhea
- Surgical emergency

Chronic Mesenteric Ischemia (CMI)
- Postprandial pain
- Nonspecific abdominal pain
- Weight loss
- Bloating

MESENTERIC ARTERIES

Clinical Presentations:

Acute Mesenteric Ischemia (AMI)
- Severe abdominal pain
- N/V
- Diarrhea
- Surgical emergency

Chronic Mesenteric Ischemia (CMI)
- Postprandial pain
- Nonspecific abdominal pain
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PROTOCOL

Intersocietal Accreditation Commission (IAC)
- Aorta adjacent to visceral vessel origins
- Celiac artery origin
- Common hepatic artery
- SMA origin and proximal segment
- IMA

The Society for Vascular Ultrasound (SVU)
- Splenic artery
- Mesentery
-Descending SMA
- Documentation of SMV and IMV patency
TECHNIQUE
- Patient preparation fasting at least 6-8 hrs.
- Low-frequency transducers (2-5 MHz) optimized for body habitus

Grayscale
- Vessel tortuosity
- Aneurysm/dissection
- Bowel wall thickening/distension
- Ascites

Color Doppler
- Optimized gain, PRF, wall filter
- Homogeneous flow pattern
- No aliasing/color bruit

Spectral Doppler
- Longest axis of vessel
- Angle correction
- "Step" through vessel from aorta to origin

TECHNIQUE
- Patient preparation fasting at least 6-8 hrs.
- Low-frequency transducers (2-5 MHz) optimized for body habitus

PROTOCOL AORTA
- Sagittal longitudinal axis of aorta at celiac artery origin
- Obtain angle corrected waveform
- Measure PSV

PROTOCOL CELIAC ARTERY
- Transverse "seagull sign"
- Turn sagittal to obtain the longest axis
- Obtain angle corrected waveform
- Measure PSV during inspiration
- Measure PSV during deep inspiration (R/O MALS)
- Measure PSV 1–2 cm from origin during quiet breathing

PROTOCOL SMA
- Obtain sagittal SMA
- Obtain angle corrected waveform
- Measure PSV/EDV at SMA origin
- Measure PSV/EDV 1 cm from origin
- Measure PSV/EDV 2 cm from origin

PROTOCOL IMA
- Identify aortic bifurcation and ascend proximally up the efferent aorta for 1–3 cm
- Obtain angle corrected spectral waveform
- Measure PSV/EDV
**INTERPRETATION CRITERIA**

<table>
<thead>
<tr>
<th>Vessel</th>
<th>Post Prandial NORMAL Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA</td>
<td>More diastolic flow</td>
</tr>
<tr>
<td></td>
<td>Increased PSV</td>
</tr>
<tr>
<td></td>
<td>Less pulsatility</td>
</tr>
<tr>
<td>Celiac</td>
<td>No change</td>
</tr>
<tr>
<td>Hepatic artery</td>
<td>Increased pulsatility</td>
</tr>
<tr>
<td>Portal vein</td>
<td>Increased flow</td>
</tr>
</tbody>
</table>

**INTERPRETATION CRITERIA DIRECT SIGNS**

<table>
<thead>
<tr>
<th>Celiac (fasting)</th>
<th>SMA (fasting)</th>
<th>SMA</th>
<th>Aorta Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>No good criteria</td>
<td></td>
<td>SMA: Aorta 3.5</td>
<td></td>
</tr>
<tr>
<td>&gt;275 cm/s indicates &gt;70% diameter stenosis</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Increased EDV (&gt; 45 cm/s) also a criteria</td>
<td></td>
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</tbody>
</table>

**INTERPRETATION CRITERIA INDIRECT SIGNS**

- Parvus tardus
- Turbulence → Bruit
- Flow reversal (RAIR)
- SMA
- GDA
- Hepatic artery indication of celiac occlusion

**INTERPRETATION CRITERIA**

- Elevated PSV
- Post stenotic turbulence
- Distal parvus tardus

**INTERPRETATION CRITERIA**

<table>
<thead>
<tr>
<th>SMA</th>
<th>Celiac</th>
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</thead>
<tbody>
<tr>
<td>Sensitivity: 89-100%</td>
<td></td>
</tr>
<tr>
<td>Specificity: 91-96%</td>
<td></td>
</tr>
<tr>
<td>Sensitivity: 87-93%</td>
<td></td>
</tr>
<tr>
<td>Specificity: 80-100%</td>
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</tbody>
</table>
PITFALLS

- Patient limitations/Post-procedural states
- Anatomical variants
- Stented vessel higher velocities in stented vessels compared to native
- Aortic and mesenteric arteries should have similar velocities
- Aortic stenosis may result in increased velocities and parasternal window
- Angiography may cause dynamic velocities
- Dissection. Most often involve the SMA and are commonly extensions of aortic dissections
- Median Arcuate Ligament Compression Syndrome (MALS)

Common Variants:
1. Replaced right hepatic artery originates from SMA
2. Replaced common hepatic artery originated from SMA
3. Common hepatic artery originating from aorta
4. Common origin of the celiac and SMA

APPLICATION: Vascular Perfusion Status

Diagnosis: Complex Distal Endoleak

NEW HORIZONS

Application: Vascular Perfusion Status
Diagnosis: Complex Distal Endoleak

TRANSIENT COMPRESSION OF THE CELIAC ARTERY BY THE MEDIAN ARCULATE LIGAMENT OF THE DIAPHRAGM

EXPIRATION

INSPIRATION

MALS

Expiation

Inspiration

Expiation

Inspiration

NEW HORIZONS
NEW HORIZONS

GOOD PRACTICE TIPS

- Fasting state
- Scan all air views (AP axial, RLQ, LLQ, MUM, and supine (LPO, LMA)
- “Test in through” (AMP, LEM) omental branch
- Acquire PSV with angle correction on the longest arm of vessel.

<table>
<thead>
<tr>
<th>Pathology</th>
<th>Color</th>
<th>Doppler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stenosis &gt; 50%</td>
<td>High velocity</td>
<td>High velocity poststenotic turbulence</td>
</tr>
<tr>
<td>Occlusion</td>
<td>No color flow at origin</td>
<td>Absent flow signals</td>
</tr>
<tr>
<td>MALS</td>
<td>Increased color velocity during exhalation</td>
<td>Increased velocities on HS inhalation and decreased with inspiration</td>
</tr>
</tbody>
</table>

REFERENCES