National MALS Foundation

Protocol for Mesenteric Ultrasound to Evaluate Artery Compression and to Diagnose Possible Median Arcuate Ligament Syndrome

PURPOSE:
A mesenteric ultrasound is the most straightforward way to determine if there is compression to the arteries in the abdomen. Capturing images of the arteries to look for compression is important. Measuring the specific velocity of blood flow in each artery is the clearest means of understanding the severity of possible compression. The higher the velocities, the more significant the compression or stenosis. In many cases, velocities will be higher on deep expiration (breathing out) than on inspiration (breathing in) because the median arcuate ligament shifts and compresses the artery more deeply as the diaphragm moves when lungs deflate. So, it is important to ensure that measurements and images are taken when the patient breathes in and breathes fully out.

MALS SYMPTOMS THAT MIGHT LEAD DOCTOR OR PATIENT TO REQUEST MESENTERIC ULTRASOUND:

- Abdominal pain associated with eating
- Significant weight loss
- Bruit
- Nausea
- Chest pain or pressure
- Exercise induced pain or exercise intolerance
- Suspected celiac artery compression; median arcuate ligament syndrome (MALS)

INSTRUCTIONS USUALLY GIVEN TO PATIENT IN ADVANCE OF PROCEDURE:

- No food or drink 8 hours prior to ultrasound
- Wear comfortable clothing
- Come prepared to have ultrasound in supine and standing position, and to breathe in and out deeply while images are taken.
- Many doctors recommend taking oral Simethicone the night before and the morning of the test to reduce the impact of gas on imaging

PREFERRED EQUIPMENT:

- Color Doppler ultrasound to capture optimal blood flow

GENERAL EXAMINATION GUIDELINES FOR CLINICIAN:
A complete examination includes evaluation of the entire course of the accessible portions of abdominal aorta and major visceral arteries including the celiac artery, superior mesenteric artery (SMA), and inferior mesenteric artery (IMA).

If exploring possible compression syndrome, obtain velocities on inspiration and expiration in both a supine (horizontal) and erect (upright) position. For MALS (Median Arcuate Ligament

Syndrome) in particular, it is essential to capture Spectral Doppler with PSV at both deep inspiration and complete expiration and to document celiac artery excursion between deep inspiration and complete expiration. It is also important to calculate the deflection angle (DA), which is the angle between the celiac and aorta at inspiration.

As asserted in the MALS Foundation video made in partnership with Osmosis and NORD, a mesenteric duplex ultrasound of the abdomen that is indicative of MALS will show increased peak-systolic velocity of blood flow in the celiac artery typically more than 200 cm/sec, and end-diastolic velocity of more than 55 cm/sec. An increase in velocity on deep expiration indicates celiac artery compression. A deflection angle >50 degrees between inspiration and expiration is also indicative of MALS.

TECHNICAL GUIDELINES FOR OPTIMAL USE OF EQUIPMENT:
[credit to UT Southwestern Department of Radiology: Ultrasound - Mesenteric Artery Protocol]

- Optimize gain and display setting with respect to depth, dynamic range, and focal zones on grayscale imaging first
- Optimize color Doppler setting to show optimal flow
- Adjust scale and gain to maximally fill the vessel of interest without artifact
- Light color in the middle of the vessel lumen
- Areas of aliasing due to turbulent flow should be documented
- Use Power Doppler if suspect absent flow with color Doppler
- Optimize spectral Doppler
- Place time-gate centrally within the vessel of interest
- Adjust scale to extend spectral waveform (amplitude adequate for interpretation)
- Reduce aliasing for high flow evaluation
- As much as possible, utilize angle correction of ≤ 60 degrees to measure velocities
    - Angle correction should always be parallel to the vessel wall
    - For certain anatomy, may need to try from different approaches to optimize angle
- Areas of suspected stenosis or obstruction will include spectral Doppler waveforms and velocity measurements recorded at and distal to the stenosis or obstruction
- If a stent has been placed, these sites will include spectral Doppler waveforms and velocity measurements within the proximal, mid, and distal stent as well as interrogation of the native vessel proximal and distal to the stent.
- The gastroduodenal vessel should be evaluated if it is suspected the celiac is occluded.
- If MALS is suspected, calculate the deflection angle (DA)

REPORTING AFTER ULTRASOUND CONDUCTED:
- This report should include the velocities for the celiac artery documented both on inspiration and expiration, as well as the velocities of the common hepatic, left gastric and splenic artery, and the superior and inferior mesenteric arteries.
- Patients should request a copy of the written report.