**Imaging Strategy For Claudication**

*Duplex Ultrasound Alone is Adequate to Select Patients for Endovascular Intervention*  
-Pro: Dennis Bandyk MD

No Disclosures

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**Who are the Debators?**

**PRO**
- Vascular Surgeon
- Trained by Dr. Strandness (U of Wash)
- Authored articles on duplex surveillance after bypass & endovascular intervention to detect stenosis

**Con**
- Internationally renowned Interventional Cardiologist
- Investigator in multiple clinical trials on endovascular Rx in claudicants, e.g. Resilient Trial

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**Clinical Decisions in the Claudicant**

**Patient history** – functional level of disability

**Physical examination** – femoral pulses + or -

**Vascular Lab Testing**
- ABI, selective exercise (treadmill) testing
- Duplex ultrasound
  - Single or multilevel disease
  - Occlusion length
  - Artery caliber

**Imaging**
- MRA
- CTA
- Procedural angiogram

**Procedural:** Do I adhere to endovascular 1st or only policy?
Lower Limb Arterial Duplex Imaging

Aorta: aneurysm,
Iliac: stenosis vs occlusion
Femoral: severity of ASO, nl or abn waveform, status of deep femoral origin,
SFA: stenosis (multilevel, diffuse ASO) occlusion (site, length), artery caliber
Popliteal: velocity waveform, caliber, stenosis, aneurysm
Tibial: velocity waveform, caliber, calcification, stenosis, patency to pedal arch

Pressure-, Flow Reducing Arterial Stenosis

>75% DR Stenosis in proximal SFA
PSV = 551 cm/s
EDV = 180 cm/s

Severe damping of distal SFA spectral waveform
- Indicates poor collaterals e.g. deep femoral art.stenosis

Multilevel ASO – Velocity Spectra

American College of Radiology – ACR Appropriateness Criteria®

Major Recommendation
Clinical Condition: Claudication – suspected vascular etiology

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segmental Doppler pressures and pulse volume recordings</td>
<td>9</td>
<td>Appropriate for screening patients with symptoms and findings suggestive of peripheral vascular disease. Compressibility artifact limits interpretation of pressures, but pulse volume recordings remain interpretable in this setting.</td>
</tr>
<tr>
<td>MRA lower extremity without and with contrast</td>
<td>8</td>
<td>See statement regarding contrast in text under &quot;Anticipated Exceptions.&quot;</td>
</tr>
<tr>
<td>CTA lower extremity with contrast</td>
<td>8</td>
<td>Test of choice in patients that cannot have MRA.</td>
</tr>
<tr>
<td>Ultrasound lower extremity with Doppler</td>
<td>7</td>
<td>Useful in patients with contrast allergy or renal dysfunction.</td>
</tr>
<tr>
<td>Angiography lower extremity</td>
<td>7</td>
<td>Indicated only if intervention is planned.</td>
</tr>
<tr>
<td>MRA lower extremity without contrast</td>
<td>5</td>
<td>Appropriate in patients with contraindications to iodinated and gadolinium-based contrast agents.</td>
</tr>
<tr>
<td>Rating Scale</td>
<td>1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</td>
<td></td>
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*Relative Radiation Level
The role of duplex scanning in decision making for patients with claudication.

Ramaswami G1, Al-Kutoubi A, Nicolaides AN, Dhanjil S, Coen LD, Belcaro G.

Imperial College School of Medicine at St. Mary's Hospital, London, UK.

Objective. Compare the accuracy of clinical decisions made for patients presenting with claudication on the basis of the ankle/brachial index (ABI) (at rest & postexercise) and duplex scanning with that made on the basis of angiograms.

Results. 56 patients with claudication (ABI<0.8); exercise testing in 49 patients. Duplex scan compared with angiogram to decide on medical Rx, angioplasty or surgery. ABI+duplex can replace angiogram for clinical Rx in 80% of claudicants.

Lower extremity revascularization without preoperative contrast arteriography: experience with duplex ultrasound arterial mapping in 485 cases.

Ascher E1, Hingorani A, Markevich N, Costa T, Kallakuri S, Khanimoy Y.

• Duplex arterial mapping in 466 pts – Angiogram 36 pts (inadequate duplex scan)
• Imaging from aorta to pedal arteries
• Indication for surgery: claudication 19%
• Bypass grafts was the most common procedure.
• Secondary patency rates >85% at 1 year

Conclusion: Duplex ultrasound testing performed by a highly skilled vascular technologist may represent an alternative to conventional arteriography for patients in need of lower extremity revascularization.

Duplex Limitations: calcification, CLI with diseased tibial arteries, obesity

Limitations of and lessons learned from clinical experience of 1,020 duplex arteriography.

Hingorani AP1, Ascher E, Marks N, Puggioni A, Shlerson A, Tran V, Jacob T.

OBJECTIVE: Assess the clinical application of Duplex US prior to lower limb revascularization.

RESULTS:
- 30% of patients with claudication
- Endovascular procedures in 363 limbs – 1/3rd of limbs
- Additional imaging (angiogram) in 102 patients (10%)
  - diabetes p<0.001
  - infrapopliteal clacification p<0.001
  - limb threatening ischemia p<0.001
  - older age p<0.01

CONCLUSIONS:
In 90% of patients, duplex testing was able to obtain the needed information to plan lower extremity revascularization. Severe tibial vessel calcification was the most common reason for incomplete duplex exam.
Ascher et al – JVS 2006

Duplex-Guided
Infrainguinal PTA

Post-PTA
Duplex Testing
Intra-arterial Papaverine 30 mg

Re-intervention
- Stents: 55% of Cases
- Fluoroscopy needed: 8%

Normal PTA
- PSV < 180 cm/s
- Vr < 2

Residual Stenosis
- PSV 180-300 cm/s
- Vr > 2

Arterial imaging in patients with lower extremity ischemia and diabetes mellitus. Pomposelli F1.

- Precise, comprehensive arterial imaging is the cornerstone of successful limb revascularization
- Artery imaging in the diabetic is more challenging
  - Multisegmental lesion with predilection for distal tibial arteries.
  - Renal insufficiency (MRA not recommended)
  - Calcification
- Digital subtraction angiography provides best resolution and allows endovascular treatment

For patients in whom the planned intervention is a surgical bypass, DSA and MRA will provide high quality images of the lower extremity arterial anatomy.

For patients in whom a catheter-based intervention is the likely treatment, a duplex scan followed by a catheter-based treatment is the preferred approach.

UC San Diego
Sulpizio Cardiacvascular Center

Imaging Strategy For Severe Claudication

**Disclosure:** I get a duplex scan on everyone

**Physiologic Testing:** ABI & exercise (treadmill) testing;
No role for segmental testing

**Physical Exam:** Femoral pulses
- Absent: CT angiogram
- Present: duplex scan

**Patient Co-Morbidities:** Diabetes, Renal insufficiency
Recommend routine duplex arterial testing
- scan for AAA
- image common femoral artery for severe plaque (PTA access)
- is the proximal SFA patent?
- is the popliteal artery patent or diseased?
- obtain tibial artery waveforms at ankle

Why Duplex Ultrasound Alone is Adequate to Select Patients for Endovascular Intervention

- Duplex ultrasound accurate for mapping arterial disease – occlusive, aneurysm, or after intervention.

- Intervention planning based on duplex testing is possible in the majority of patients.
  - Endovascular intervention, >80%, re-intervention, >90%
  - Lower limb bypass grafting for PAD, >70%
  - Vein bypass stenosis repair, >80%
  - Popliteal aneurysm repair, >80%

- Use standardized testing technique & interpretation criteria – report findings with pressure measurements.

- Duplex arterial testing is complementary to CTA & MRA imaging by providing “physiologic” information on lesion severity or determining “hemodynamic significance.”
If Dr. Strandness was voting, he would say

Duplex alone is OK, & Don't vote for a cardiologist