Radiologic Evaluation of Peripheral Arterial Disease

Grace Tye, Harvard Medical School Year III
Gillian Lieberman, MD
Patient D.M.

- **CC**: 44 y/o male with pain in his buttocks
  - Occurs after walking 2 blocks.
  - Pain is relieved by rest.
- **PE**: absent femoral pulses

**DDx for exertional pain in buttocks**
- Intermittent claudication
- Hip arthritis
- Spinal cord compression

**Clinical Dx** → Intermittent claudication
Claudication

**Definition**
- Pain secondary to exercise-induced muscle ischemia
- Relieved by rest within minutes
- Consistently reproduced by same degree of exercise

**DDx – Causes of claudication**
- Peripheral arterial disease/atherosclerosis
- Inflammatory conditions (e.g. Buerger’s, Takayasu’s)
- Atheroembolism
- Irradiation injury
- Remote trauma
Diagnosing Peripheral Arterial Disease (PAD)

Non-invasive, non-imaging tests

- Ankle-brachial index
- Segmental limb pressures
- Segmental pulse volume recordings
Diagnosing PAD: Non-Invasive non-imaging tests

Ankle-Brachial Index (ABI)

Segmental Pulse Volume Recordings

Segmental Limb Pressures

Diagnosing PAD: 
Non-Invasive non-imaging tests

Example: Patient S.P.

Patient D.M.: Findings

- ABI <<0.90
- Limb pressures: thigh << brachial
- Pulse volume recordings: abnormal waveforms starting at thigh level

Dx → PAD causing symptoms of intermittent claudication

Limitations

- Cannot localize disease
- # stenoses unknown
- Stenoses vs. occlusions?
Radiologic Evaluation of PAD

Noninvasive nonimaging tests → Established Dx of PAD

→ Doppler Ultrasound
  → Location, #, severity of lesions

→ Revascularization desired?
  No → Medical management
  Yes → Conventional/MR angiography

→ Lesion appropriate for bypass graft → refer to vascular surgery

→ Lesion appropriate for PTA, stent → interventional radiology
Non-Invasive Imaging: Doppler Ultrasound

Goal

• Non-invasive evaluation of location, number, and severity of arterial lesions

Technique

• Color Doppler localizes regions of abnormal flow
• Pulsed Doppler evaluates 1) peak systolic velocity and 2) waveform

Non-Invasive Imaging: Doppler Ultrasound

Normal waveform is triphasic

1) Forward systolic flow
2) Reverse diastolic flow
3) Forward diastolic flow

Findings in severe stenosis

- Increased peak systolic velocity
- Marked spectral broadening
- Monophasic waveform

Non-Invasive Imaging: Doppler Ultrasound

Example: Patient S.P.

Patient D.M.: Findings
• Abnormal monophasic waveforms at femoral levels bilaterally

Conclusion
• Bilateral aortoiliac occlusion
Patient D.M.

Additional information

- HPI: has had symptoms for several years.

Example: Patient S.P.

Diagnosis

- Bilateral aortoiliac occlusive disease secondary to peripheral arterial disease caused by atherosclerosis
Management and Treatment of Claudication/PAD

Medical Management
• Risk factor modification
• Platelet inhibition
• Exercise therapy
• Pharmacotherapy

Revascularization Interventions
• Percutaneous transluminal angioplasty
• Stenting
• Surgery: bypass graft
Invasive Imaging: Conventional Angiography

• The gold standard for localization and characterization of arterial occlusive disease

• Indication: intent to revascularize

• Contraindications: contrast allergy, renal insufficiency, abnormal hemostasis, CHF, etc.

• Alternative: MR Angiography
Angiography: Percutaneous Transluminal Angioplasty and Stenting in Patient J.C.

Before

Focal stenoses

External iliac a.

After


Branches of Abdominal Aorta

Patient D.M.: Angiography I
Vascular Calcification & Abnormal Aorta

Calcified iliac artery

Courtesy of Michael Mastromatteo, M.D., BIDMC/PACS
Patient D.M.: Angiography II - Digital Subtraction Image
Occlusion of Infrarenal Aorta

- Left hepatic artery
- Right hepatic artery
- Hepatic artery
- Renal arteries
- Splenic artery
- Celiac trunk
- SMA
- IMA

Occlusion of infrarenal aorta

Courtesy of Michael Mastromatteo, M.D., BIDMC/PACS
Patient D.M.: Angiography III - Digital Subtraction Image
Extensive collateral circulation

Courtesy of Michael Mastromatteo, M.D., BIDMC/PACS

Grace Tye, HMS III
Gillian Lieberman, MD
Collateral Circulation to Pelvis

IMA
Internal iliac a.
Superior rectal a.
Middle rectal a.
External iliac a.
Common iliac a.

Collateral Circulation to Lower Extremity

Patient D.M.: Angiography IV
Collateral circulation to LLE

Left superficial femoral a.
Left deep femoral a.

Digital Subtraction Image

Courtesy of Michael Mastromatteo, M.D., BIDMC/PACS
Patient D.M.: Angiography V
Collateral circulation to LLE

Digital Subtraction Image

Popliteal a.
Anterior tibial a.
Peroneal a.
Posterior tibial a.

Courtesy of Michael Mastromatteo, M.D., BIDMC/PACS
Patient D.M.: Angiography Findings

- Complete occlusion of infrarenal aorta
- Extensive collateral circulation
  - Pelvis: Superior rectal a. → internal iliac a.
  - LLE: Lumbar a. → deep iliac circumflex a.
- No evidence of collateral circulation to RLE
  - Collateral circulation likely filled from above level of injection of contrast

Conclusion:
- No appropriate target for PTA or stenting
- Refer to vascular surgery

Image courtesy of Michael Mastromatteo, M.D., BIDMC/PACS
Surgery: Bypass Graft in Patient J.C.

Vascular hood

Femoral-popliteal graft

Native vessel

Valve

Digital Subtraction Image

Courtesy of Michael Mastromatteo, M.D., BIDMC/PACS

Grace Tye, HMS III
Gillian Lieberman, MD
Radiologic Evaluation of PAD: Summary

Noninvasive nonimaging tests → Established Dx of PAD

Doppler Ultrasound
- Location, #, severity of lesions

Revascularization desired?
- No → Medical management
- Yes → Conventional/MR angiography

Lesion appropriate for bypass graft → refer to vascular surgery

Lesion appropriate for PTA, stent → interventional radiology
References

7. Schmieder FA, Comerota AJ. Intermittent claudication: magnitude of the problem, patient evaluation, and therapeutic strategies. Am J Cardiol 2001;87:3D-13D.
Acknowledgments

- Michael Mastromatteo, M.D.
- Daniel Saurborn, M.D.
- Larry Barbaras and Cara Lyn D’amour
- Gillian Lieberman, MD
- Pamela Lepkowski