Tips and Tricks in Vascular Imaging

LOWER EXTREMITY CTA

• Clinical context
• Scanning and Contrast Technique
• Postprocessing
• Interpretation & Reporting
Tip 1: Clinical Context
Role of Imaging in PAD*

*Peripheral Artery Disease
Peripheral Artery Disease (PAD)

• manifestation of atherosclerosis in arteries supplying blood to lower extremities

Clinical Symptoms:

• **at 'stress'**: intermittent claudication
  perfusion pressure (ABI<0.8) can’t keep up with increased demand when walking;
  ischemic tissue is muscle

• **at 'rest'**: critical limb ischemia
  perfusion pressure<baseline demand;
  ischemic tissue is skin, nerve- connective tissue
Diagnosis and Staging of PAD

- symptoms +
- ankle-brachial-index

- poor correlation of symptoms and ABI with number, location and severity of lesions → i.e. calf claudication can be caused by isolated vs a combination of iliac or femoropopliteal lesions

Role of Imaging NOT diagnosis / staging

- mapping of lesions to symptoms for treatment planning
Figure 7: Peripheral CTA (16x0.75mm, 2.0mm/1.0mm) of a 73 year old woman with intermittent claudication bilaterally. MIP (a) shows long right femoropopliteal occlusion, and diffuse disease of the left superficial femoral artery with a short distal occlusion. CPR through left ilio-femoral axis demonstrates multiple web-like stenosis of the external iliac artery, a diffusely diseased left superficial femoral artery, and short (<3cm) distal left SFA occlusion. Corresponding selective DSA images (c, d) obtained immediately before PTA/stenting of the left iliac.
**TASC II Criteria**

*Transatlantic Society Consensus (2007)*

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Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II)

J. Mogave, F.A. Bass, G.A. Freimark, K.J. Spittler, R.P. Bevan, and T.G. Hans by on behalf of the TASC II Working Group, "Inter-Society Consensus for the Management of Peripheral Arterial Disease" (TASC II)."
TASC II Criteria
Transatlantic Society Consensus (2007)

Type A
endovascular

Type B

Type C

Type D
surgical

aortoiliac
femoropopliteal
Tip 2: Technique

Scanning and CM Injection
Scanning and CM Injection

- no fancy scanner needed: any CT scanner with ~1mm thickness (≥16-slice MDCT);
- ideally isotropic resolution (sub-millimeter)

Account for slow bolus transit in diseased arteries:

- long injection (~35s)
- scan slow (40s)
- add delayed acquisition, if needed
Peripheral Arterial Enhancement
(20 patients with PAOD)

Aorto-popliteal transit

Transit time  Transit speed
mean: 10 s     65 mm/s
min:  4 s     177 mm/s
max: 24 s     30 mm/s

\[ t_{\text{APT}} = \text{aorto-popliteal transit time} \]

\[ t_{\text{CMT}} = \text{contrast medium transit time} \]
**Integrated Scanning-Injection Protocol**

**64 - channel Lower Extremities**

<table>
<thead>
<tr>
<th>Weight</th>
<th>Biphasic Injection</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;55kg</td>
<td>20 mL (4.0mL/s) + 96 mL (3.2mL/s)</td>
</tr>
<tr>
<td>&lt;65kg</td>
<td>23 mL (4.5mL/s) + 108 mL (3.6mL/s)</td>
</tr>
<tr>
<td>75kg</td>
<td>25 mL (5.0mL/s) + 120 mL (4.0mL/s)</td>
</tr>
<tr>
<td>&gt;85kg</td>
<td>28 mL (5.5mL/s) + 132 mL (4.4mL/s)</td>
</tr>
<tr>
<td>&gt;95kg</td>
<td>30 mL (6.0mL/s) + 144 mL (4.8mL/s)</td>
</tr>
</tbody>
</table>

**Scantime:** 40s for ALL patients (pitch variable) (automated tube current modulation)

**Inj.duration:** 35s for ALL patients

**Delay:** bolus triggering
82 y.o. woman
bilateral claudication re>lt

Scanner: 64 × 0.6mm
Scantime: 40 s

Injection (biphasic): 35 s
20mL (4 mL/s) + 95mL (3.2 mL/s)

Delay: 'CareBolus'
Peripheral CTA

Scanning Range

Scanning Range 1

celiac artery (Th12) → toes
(105 – 130 cm)

Optional Additional Scanning Range 2

above the knees → toes

Always pre-programmed, but only initiated by technologist if no contrast in crural vessels
Arteriomegaly

1st acquisition

preprogrammed, optional 2nd acquisition
Tip 3: Postprocessing
Tips and Tricks for Lower Extremity CTA

Postprocessing

• greatest challenge in lower extremity CTA: difference between quick read vs. painful (literally) scrolling through images

• axial (transverse) images inadequate, except in acute ischemia (i.e. thromboembolic)

• need longitudinal cross sections (MPR/CPR)

• ideally, mapping of lesions needs a ‘map’: ‘multipath curved planar reformations’

• try to delegate (3D-Lab, trained technologist) if routinely performing runoff CTAs
• 59 year old man with intermittent claudication bilaterally.

• Past medical history significant for prior Stent-PTA of right EIA MultiPath CPR; thin, stretched DSA. ThinCPR Right, stretched post kissing stent pre-PTA/re-stent of stent-stenosis.
Display on PACS

MIP  Multi-Path CPR  single CPR
Tip 4: Interpretation & Reporting
<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>aorto-iliac</td>
<td>= ‘suprainguinal’ = ‘inflow’</td>
</tr>
<tr>
<td>common fem. a.</td>
<td>important landmark; bypass target/source</td>
</tr>
<tr>
<td>[deep fem.a.]</td>
<td>[important collateral if SFA occluded; post amput.]</td>
</tr>
<tr>
<td>femoropoplital a.</td>
<td>‘infra-inguinal’ = ‘runoff’</td>
</tr>
<tr>
<td>(pop.: P1, P2, P3)</td>
<td>reconstitution of pop. a. above (P1) or below (P3) knee</td>
</tr>
<tr>
<td>below knee aa.</td>
<td>only relevant in CLI, can ignore in claudicants</td>
</tr>
<tr>
<td>pedal arteries</td>
<td>only CLI, bypass targets</td>
</tr>
</tbody>
</table>
answer clinical questions rather than listing lesions

• intermittent claudication? critical limb ischemia?
  -- determines how you read scan

• organize first by leg, and then by station

**Right/left lower extremity**
- aortoiliac (inflow disease [above inguinal lig.])
- (common fem a.); - (deep femoral artery)
- femoropopliteal artery; SFA, P1, P2, P3
- below knee (infra-pop.) runoff: 2 vessels cross ankle)
- (pedal)
Tips and Tricks in Vascular Imaging

LOWER EXTREMITY CTA: SUMMARY

• Clinical context
  ■ goal is to map lesions to clinical symptoms
  ■ ‘stress’ (claudication) vs. ‘resting’ (CLI) ischemia

• Scanning and Contrast Technique
  ■ inject long, and scan slow

• Postprocessing
  ■ curved planar reformats

• Interpretation & Reporting
  ■ don’t read study without knowing symptoms
  ■ answer clinical question rather listing lesions
SAM Question

Which of the following statements regarding lower extremity CTA is correct?

A. the diagnosis of peripheral artery disease is fundamentally based on imaging

B. symptoms and ankle-pressure-index (ABI) not only establish the diagnosis of peripheral artery disease, but also accurately localize the anatomic level of obstruction

C. the role of imaging in peripheral artery disease is not making the diagnosis, but to map (localize) obstructive lesions for treatment planning

D. in patients with calf claudication, evaluation of the distal below-knee arteries is important for treatment planning
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Reference: Fleischmann D, Hallett RL, Rubin GD. CT angiography of peripheral arterial disease. J Vasc Interv Radiol. 2006;17:3-26
Thank you...