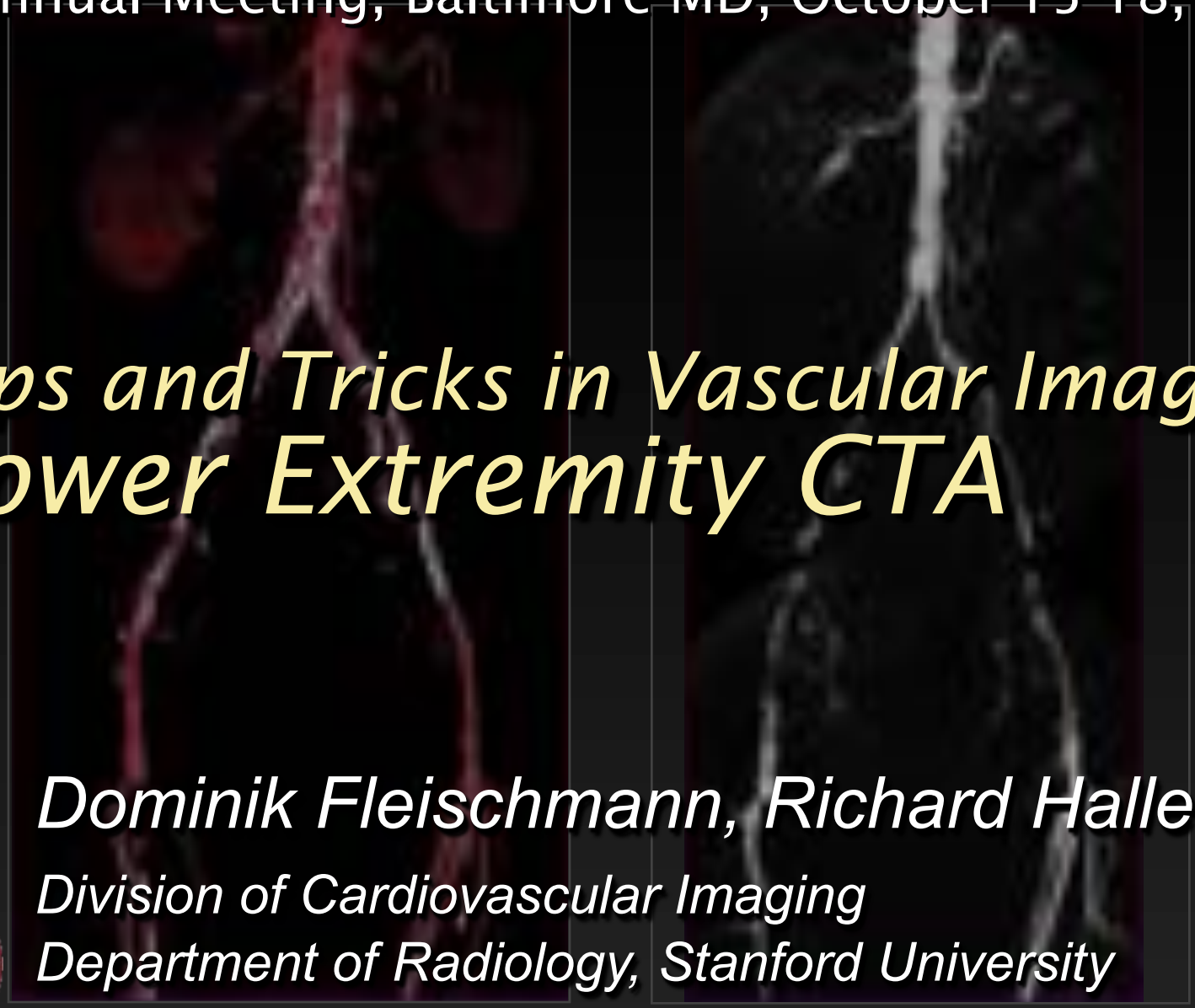
North American Society of Cardiovascular Imaging
Annual Meeting, Baltimore MD, October 15-18, 2016



# *Tips and Tricks in Vascular Imaging*
# *Lower Extremity CTA*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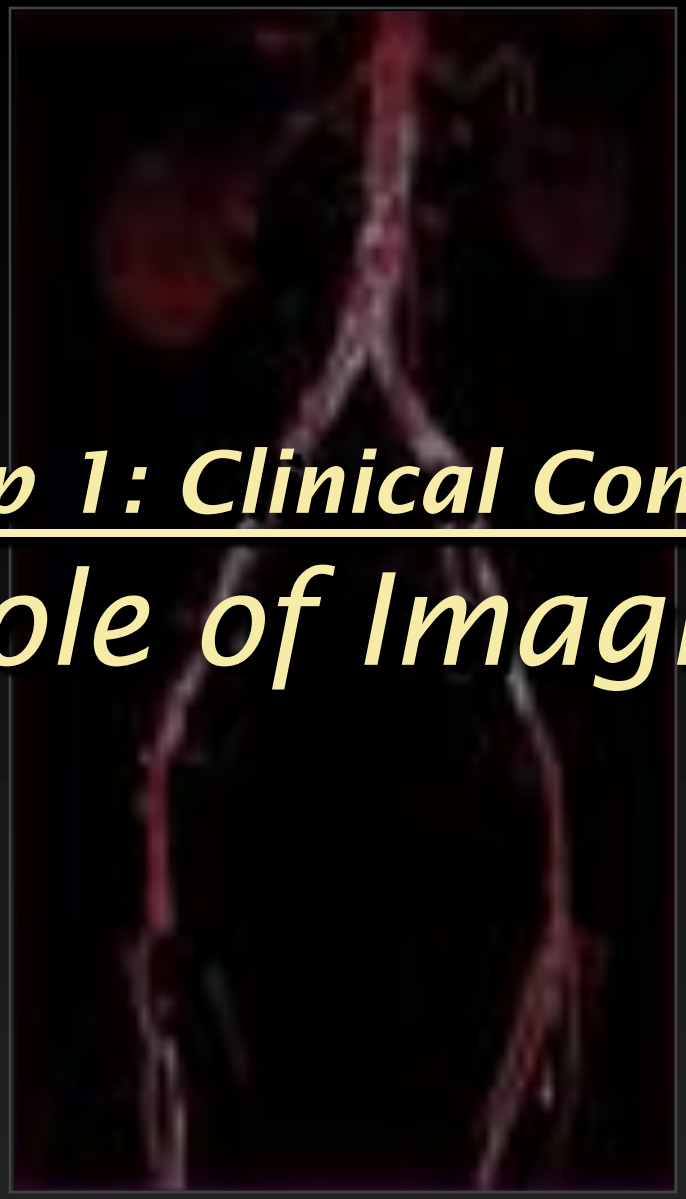
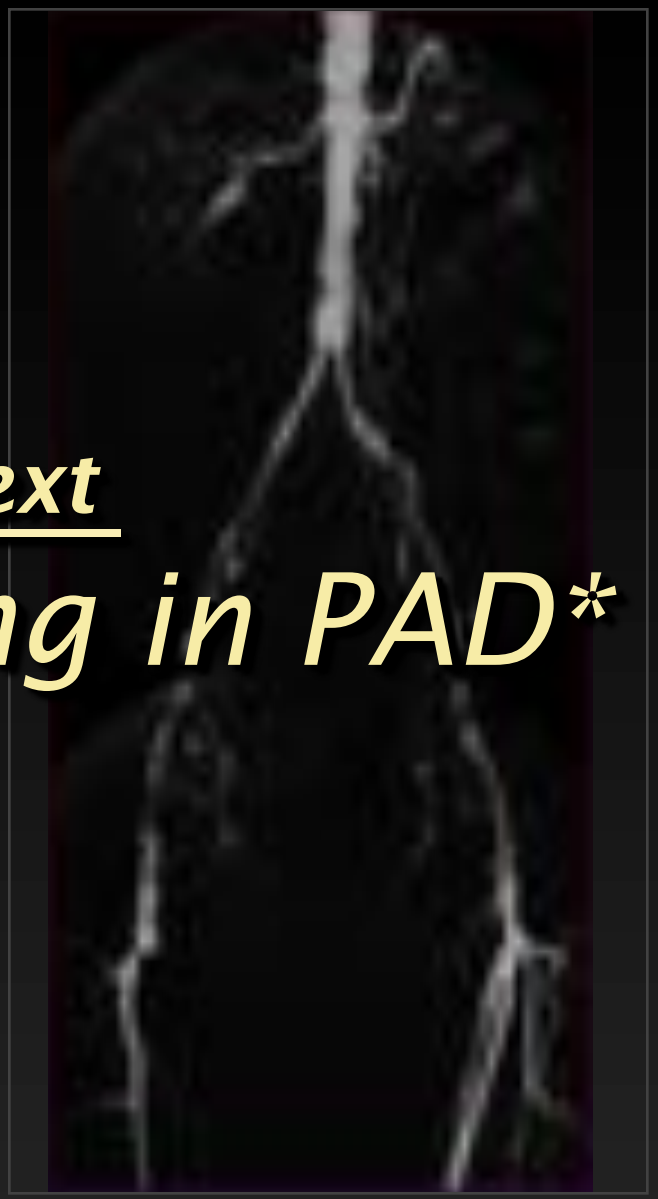
*Department of Radiology, Stanford University*

*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 claudiaction 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

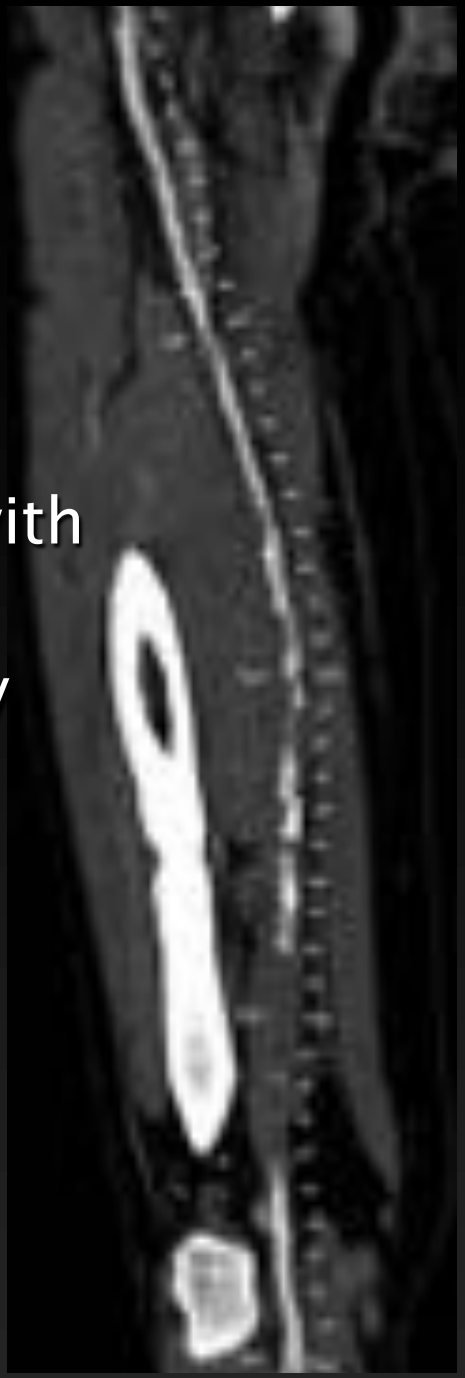
## Diagnosis and Staging of PAD

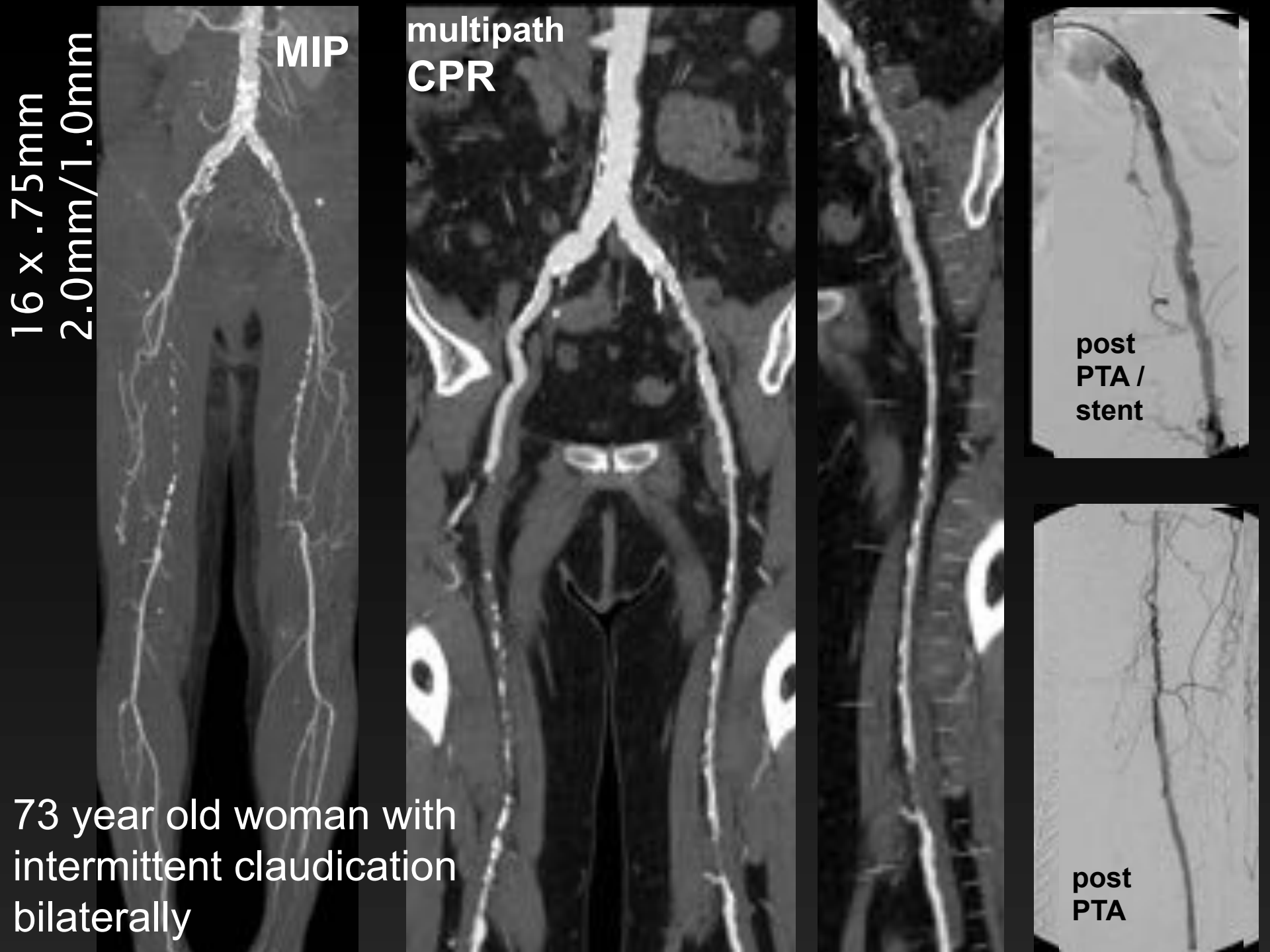
- symptoms +
- ankle-brachial-index

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

## Role of Imaging NOT diagnosis / staging

- mapping of lesions to symptoms for treatment planning




16 x .75mm
2.0mm/1.0mm
MIP
multipath
CPR
post
PTA /
stent
post
PTA
73 year old woman with
intermittent claudication
bilaterally

# *TASC II Criteria*

## *Transatlantic Society Consensus (2007)*

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

# *TASC II Criteria*

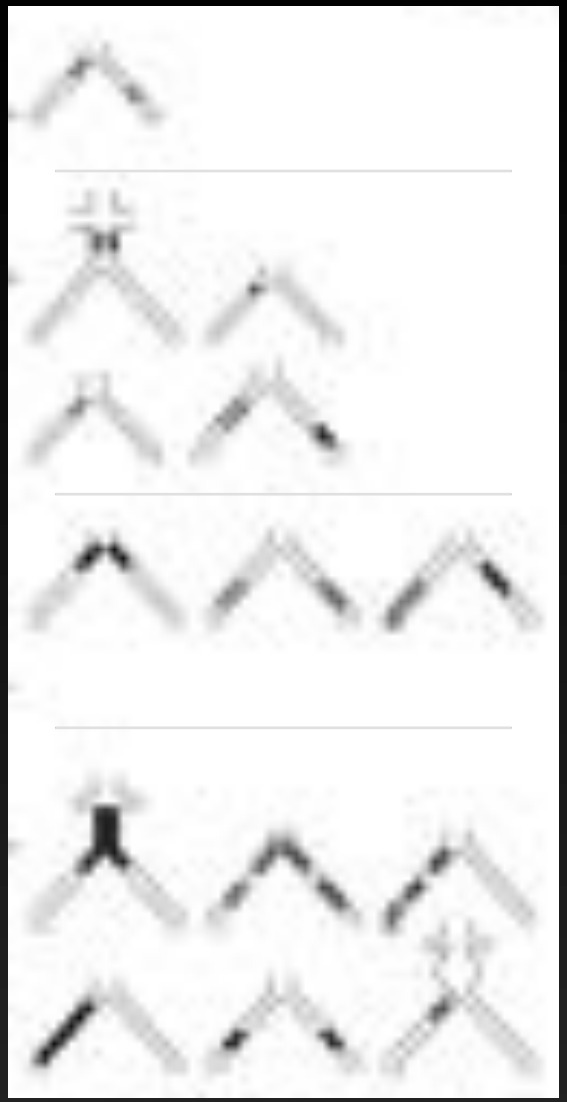
## *Transatlantic Society Consensus (2007)*

*Type A*
*endovascular*

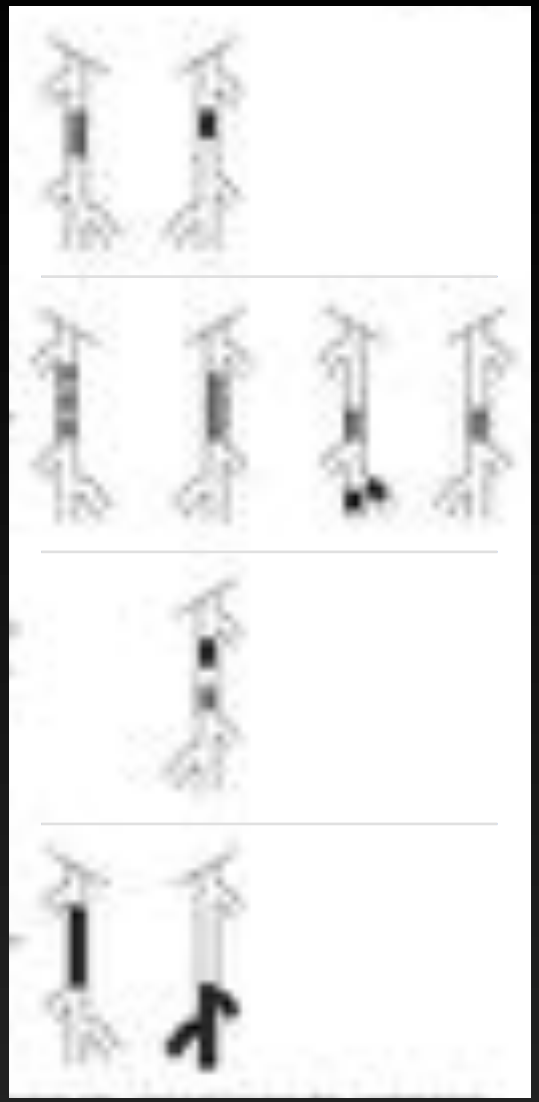
*Type B*

*Type C*

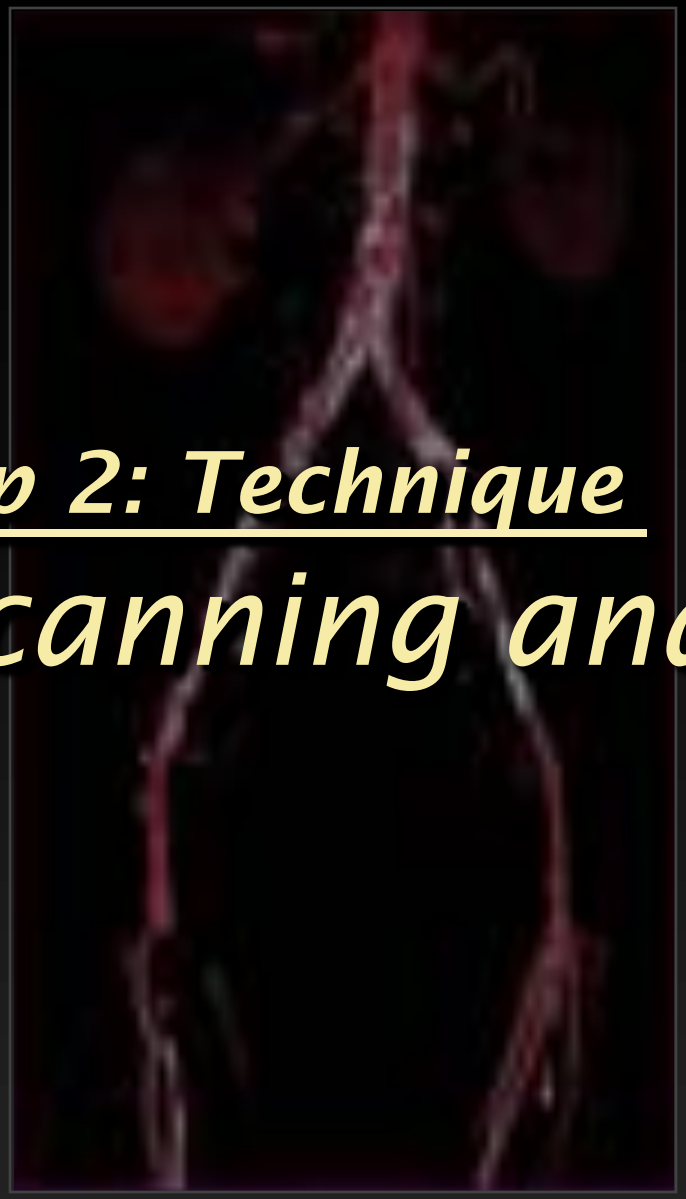
*Type D*
*surgical*



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:*

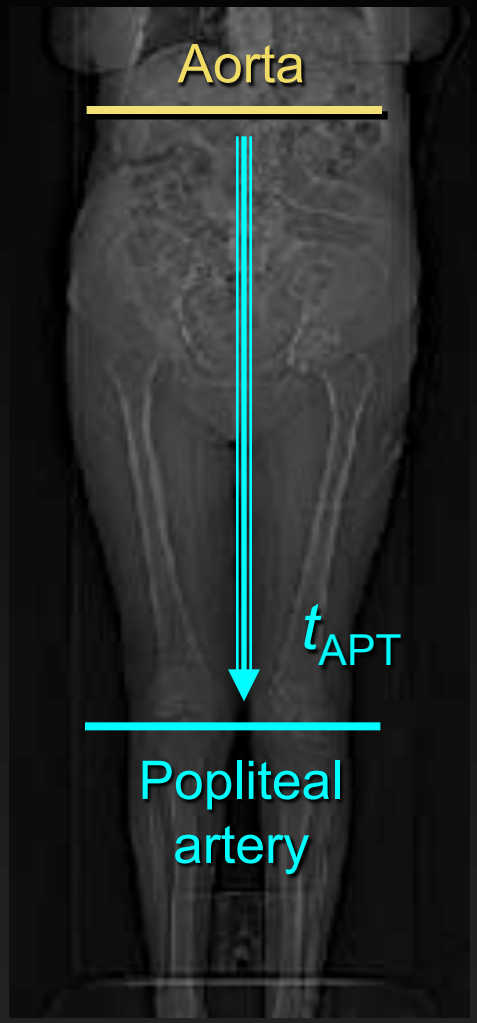
- long injection (~35s)
- scan slow (40s)
- add delayed acquisition, if needed

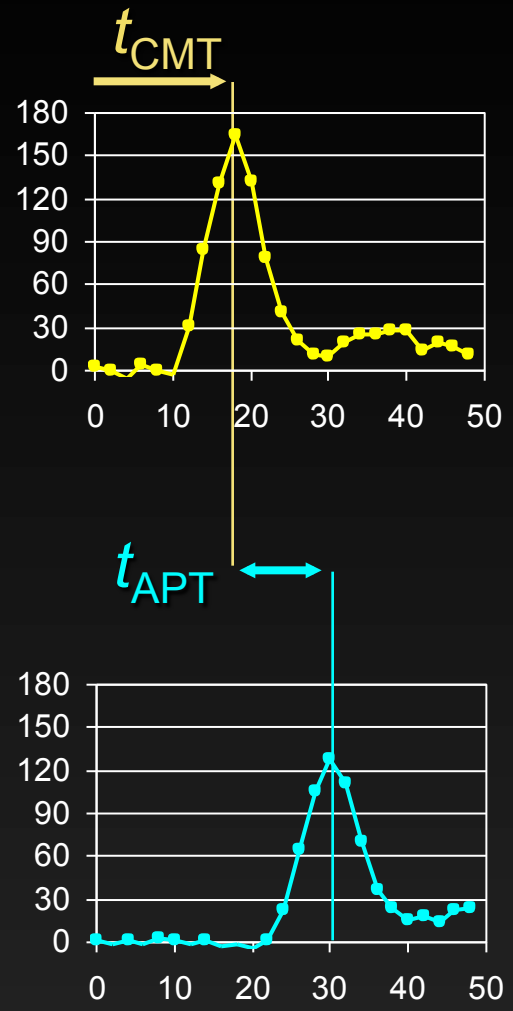
# Peripheral Arterial Enhancement

(20 patients with PAOD)

Aorto-popliteal ..

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




$t_{APT}$= aorto-popliteal transit time
$t_{CMT}$= contrast medium transit time

*Radiology 236 (Sept.) 2005*

# 64 - channel Lower Extremities

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

Inj.duration: 35s for ALL patients

Delay: bolus triggering

| weight | Biphasic Injection |
|---|---|
| <55kg | 20 mL (4.0mL/s) + 96 mL (3.2mL/s) |
| <65kg | 23 mL (4.5mL/s) + 108 mL (3.6mL/s) |
| 75kg | 25 mL (5.0mL/s) + 120 mL (4.0mL/s) |
| >85kg | 28 mL (5.5mL/s) + 132 mL (4.4mL/s) |
| >95kg | 30 mL (6.0mL/s) + 144 mL (4.8mL/s) |

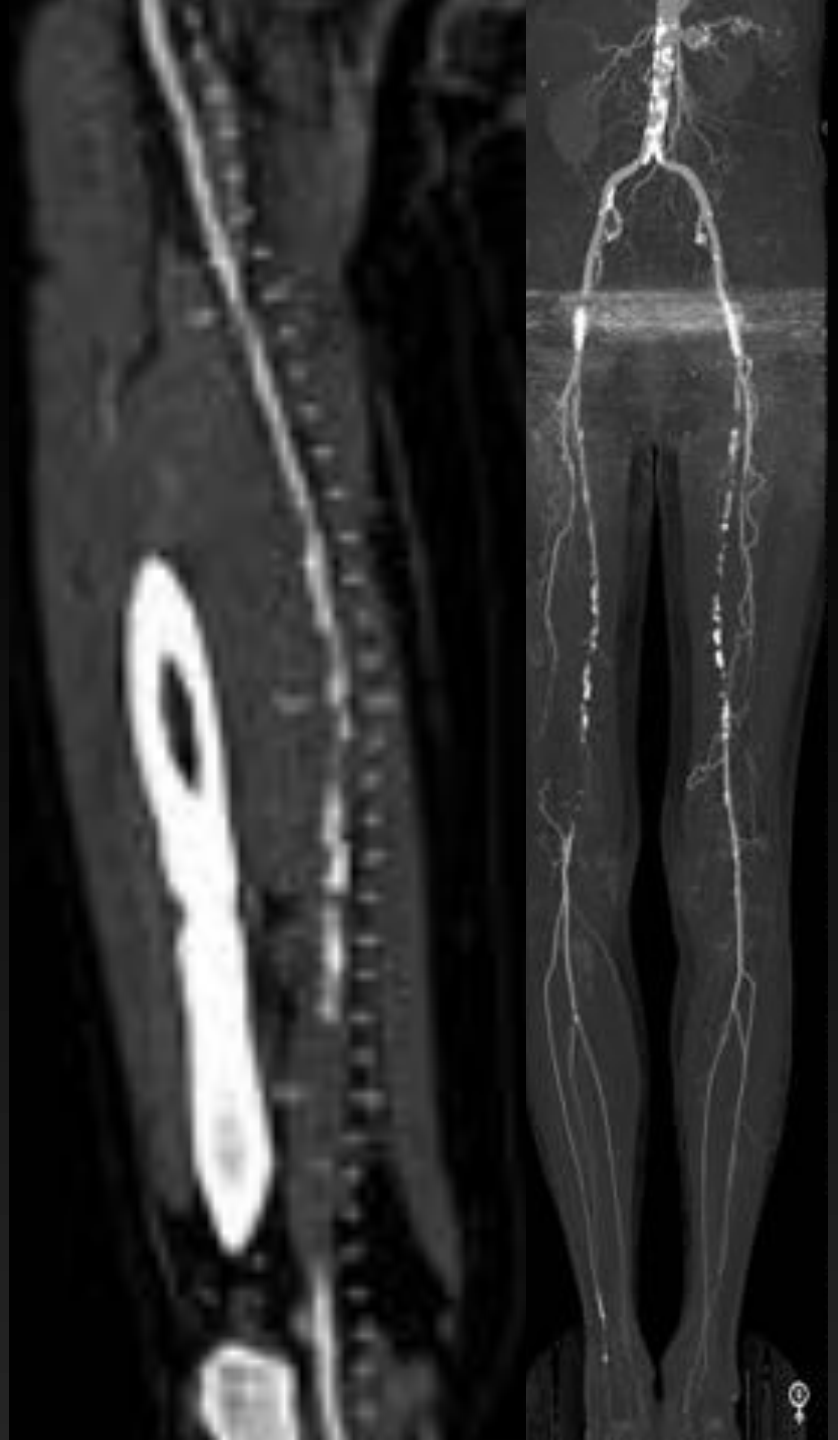
**82 y.o. woman**
bilateral claudication re>lt

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

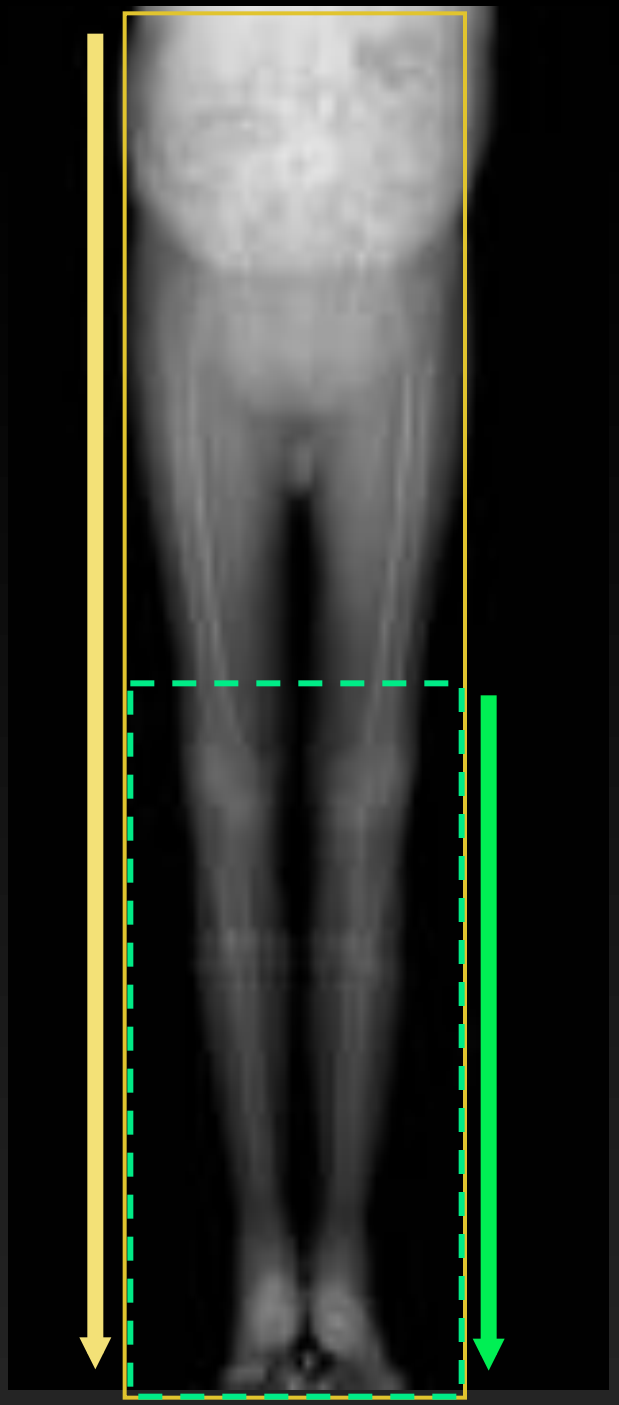
celiac artery (Th12) → toes

(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



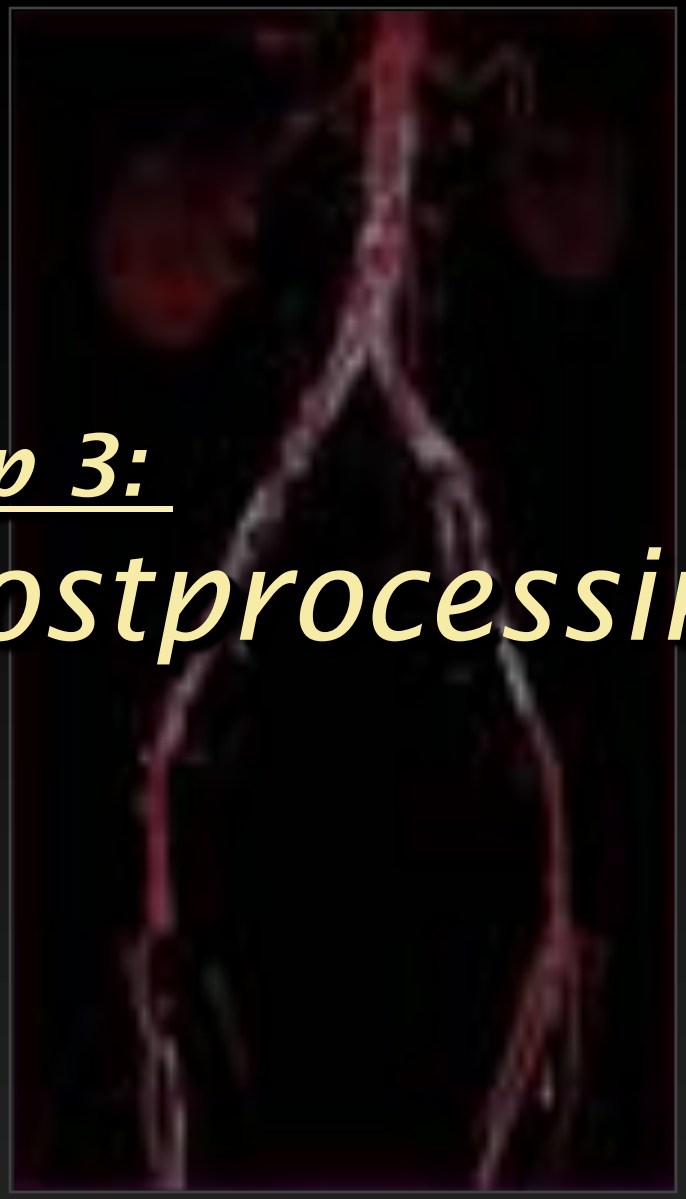
## *Arteriomegaly*

1st acquisition

preprogrammed,
optional 2nd acquisition

## *Tip 3:*

# *Postprocessing*

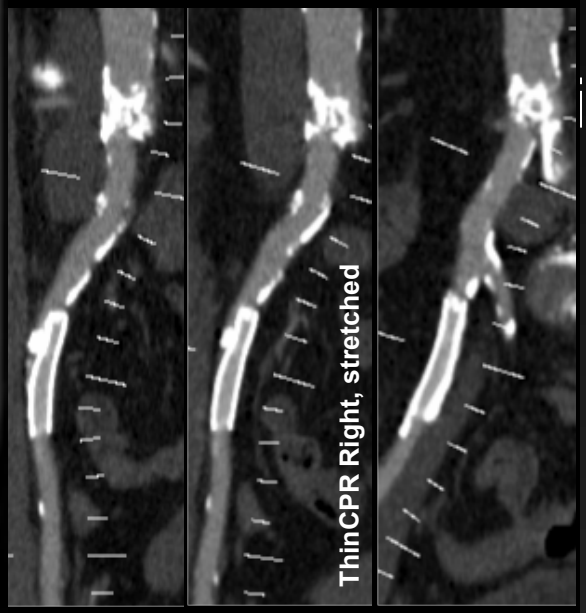


# *Tips and Tricks for Lower Extremity CTA*
# *Postprocessing*

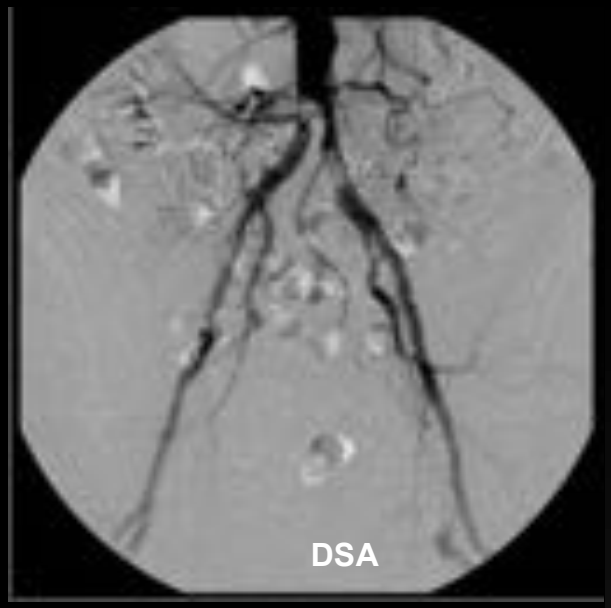
- greatest challenge in lower extremity CTA: difference between quick read vs. painful (literally) scrolling through images
- axial (transverse) images inadequate, except in acute ischemia (i.e. thromboembolic)
- need longitudinal cross sections (MPR/CPR)
- ideally, mapping of lesions needs a 'map': 'multipath curved planar reformations'
- try to delegate (3D-Lab, trained technologist) if routinely performing runoff CTAs

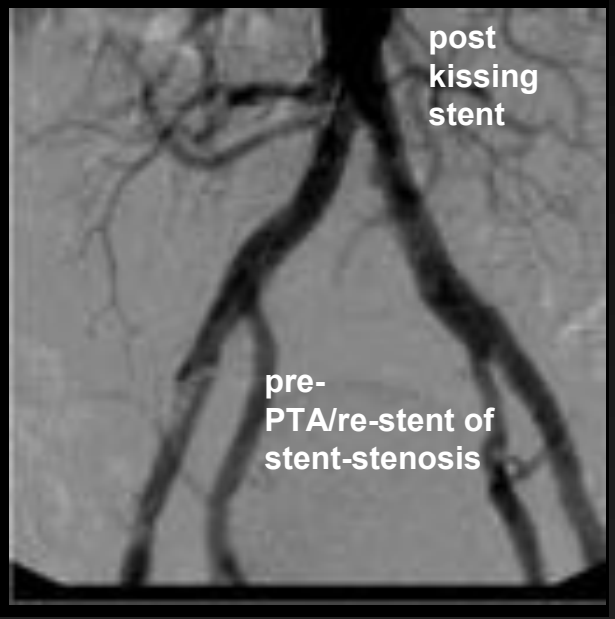
MIP


MultiPath-CPR; thin, stretched, close-up


ThinCPR Right, stretched

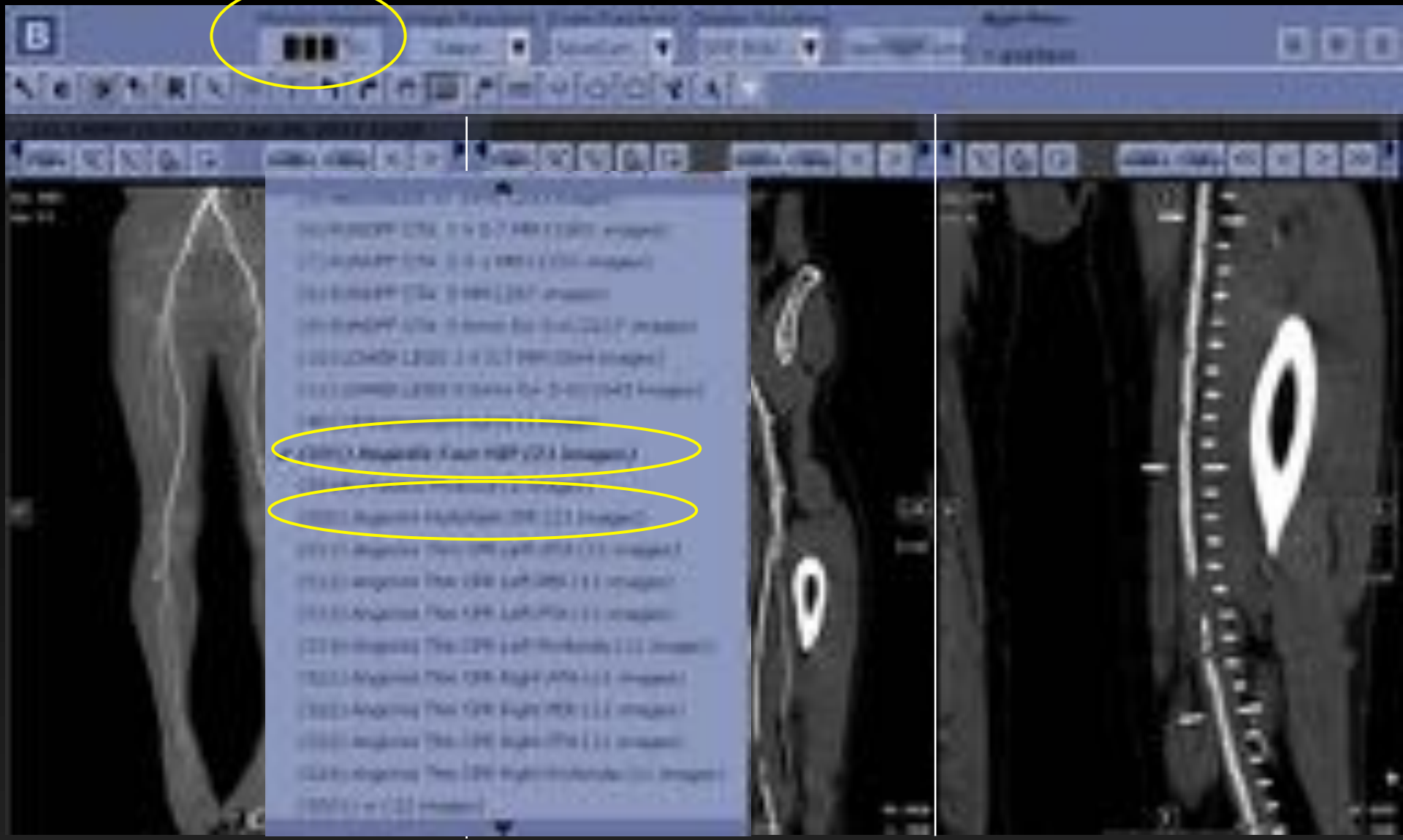
CPRs


DSA


post
kissing
stent
pre-
PTA/re-stent of
stent-stenosis

DSA

# *Display on PACS*



MIP Multi-Path CPR single CPR

## *Tip 4:*

# *Interpretation & Reporting*

# *'Surgical (endovascular) Segments'*

| | |
|---|---|
| • aorto-iliac | ='suprainguinal' ='inflow' |
| • common fem. a. | important landmark; bypass target/source |
| [deep fem.a.] | [important collateral if SFA occluded; post amput.] |
| • femoropoplital a. | 'infra-inguinal' = 'runoff' reconstitution of pop. a. |
| (pop.: P1, P2, P3) | above (P1) or below (P3) knee |
| • below knee aa. | only relevant in CLI, can ignore in claudicants |
| • pedal arteries | only CLI, bypass targets |

# *Systematic Approach to Reading Lower Extremity CTA*

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 (infrapop.) 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

# *SAM Question* ***ANSWER***

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D. in patients with calf claudication, evaluation of the distal below-knee arteries is important for treatment planning

Reference: Fleischmann D, Hallett RL, Rubin GD. CT angiography of peripheral arterial disease. J Vasc Interv Radiol. 2006;17:3-26

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*Thank you…*

*Dept. of Radiology, Stanford University, CA*