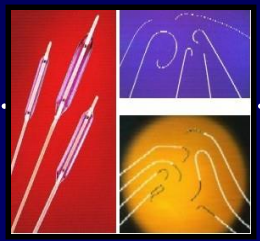
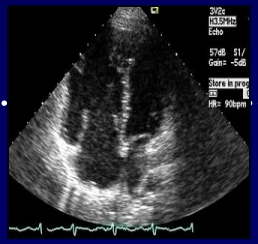
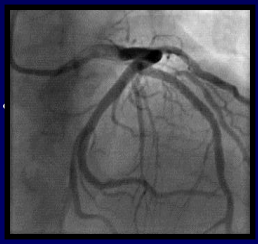
Peripheral Artery Disease: Diagnosis and Management

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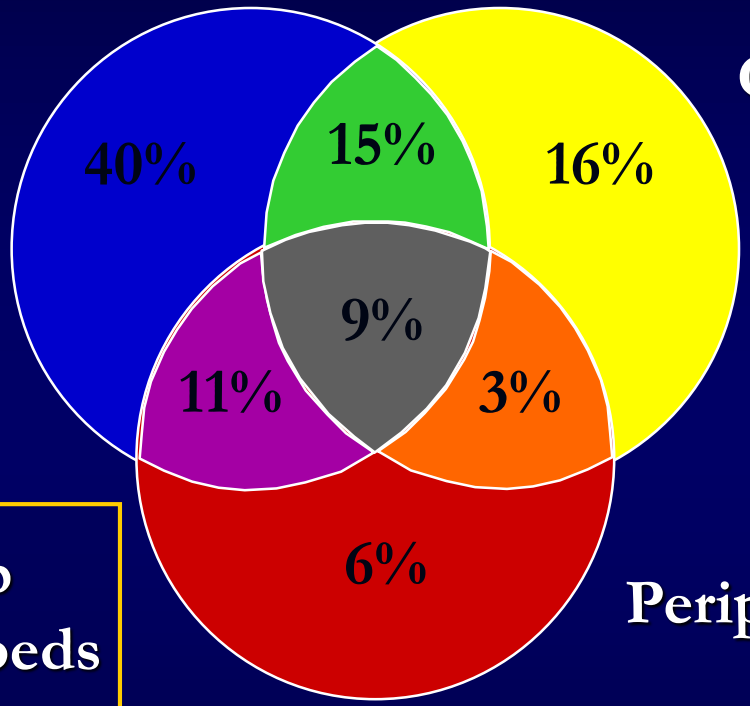
Introduction

- PVD/PAD effects 27 million people over 55 yrs in North America and Europe.
- PAD often occurs in concert with CAD
- CAD is leading cause of death in patients with PAD (75% of deaths)
- Patients with PAD are at increased risk of atheroembolic events and 6 times more likely to die than patients without PAD

Cardiologists and PAD
Rationale

- Coexistence of CAD & PAD
- Common risk factors & modification
- Expertise in clinical evaluation of the patient
- Expertise in risk factor adjustment
- Interest in longitudinal follow-up and global approach to patient's disease

Overlap of Atherosclerotic Disease



38% overlap of 2 vascular beds

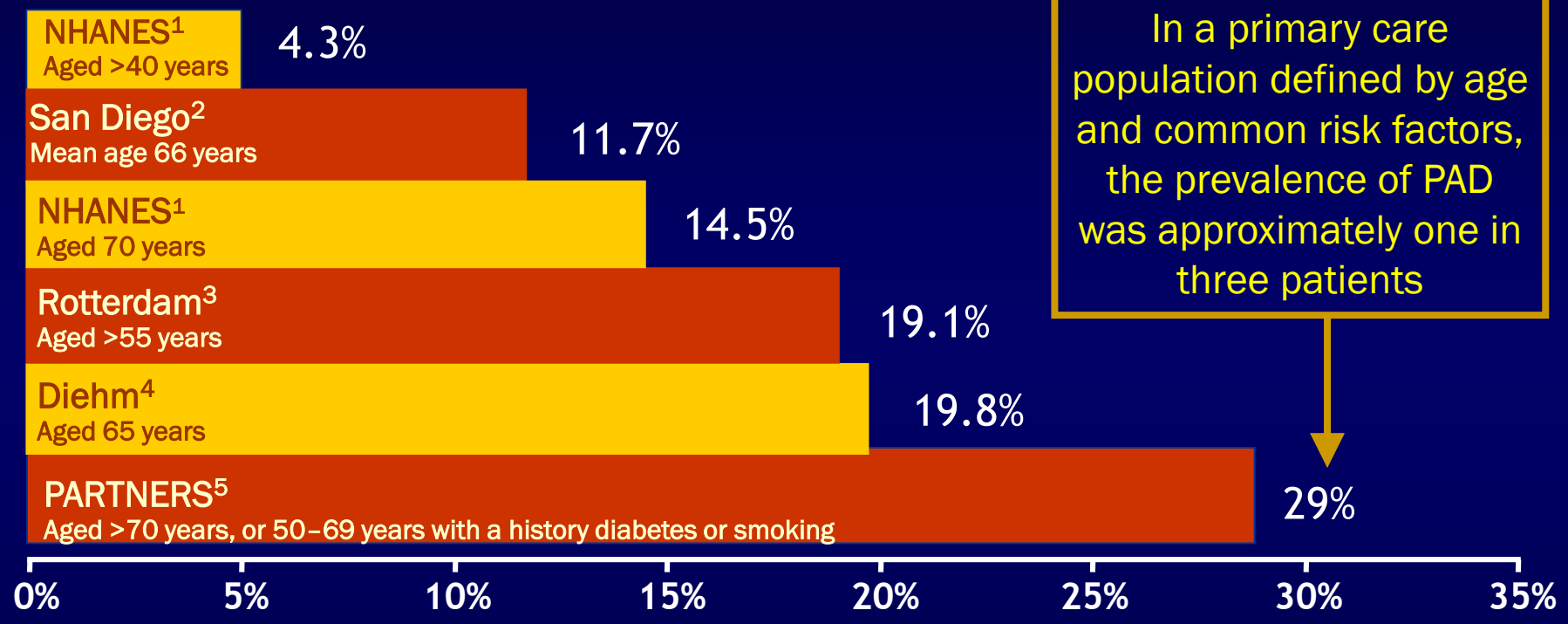
Patients with one manifestation often have coexistent disease in other vascular beds

N= 1802 patients

Mean age = 80 yrs (60-102)

Ness J, Aronow WS. *J Am Geriatric Soc.* 1999;47:1255-1256.

Prevalence of PAD



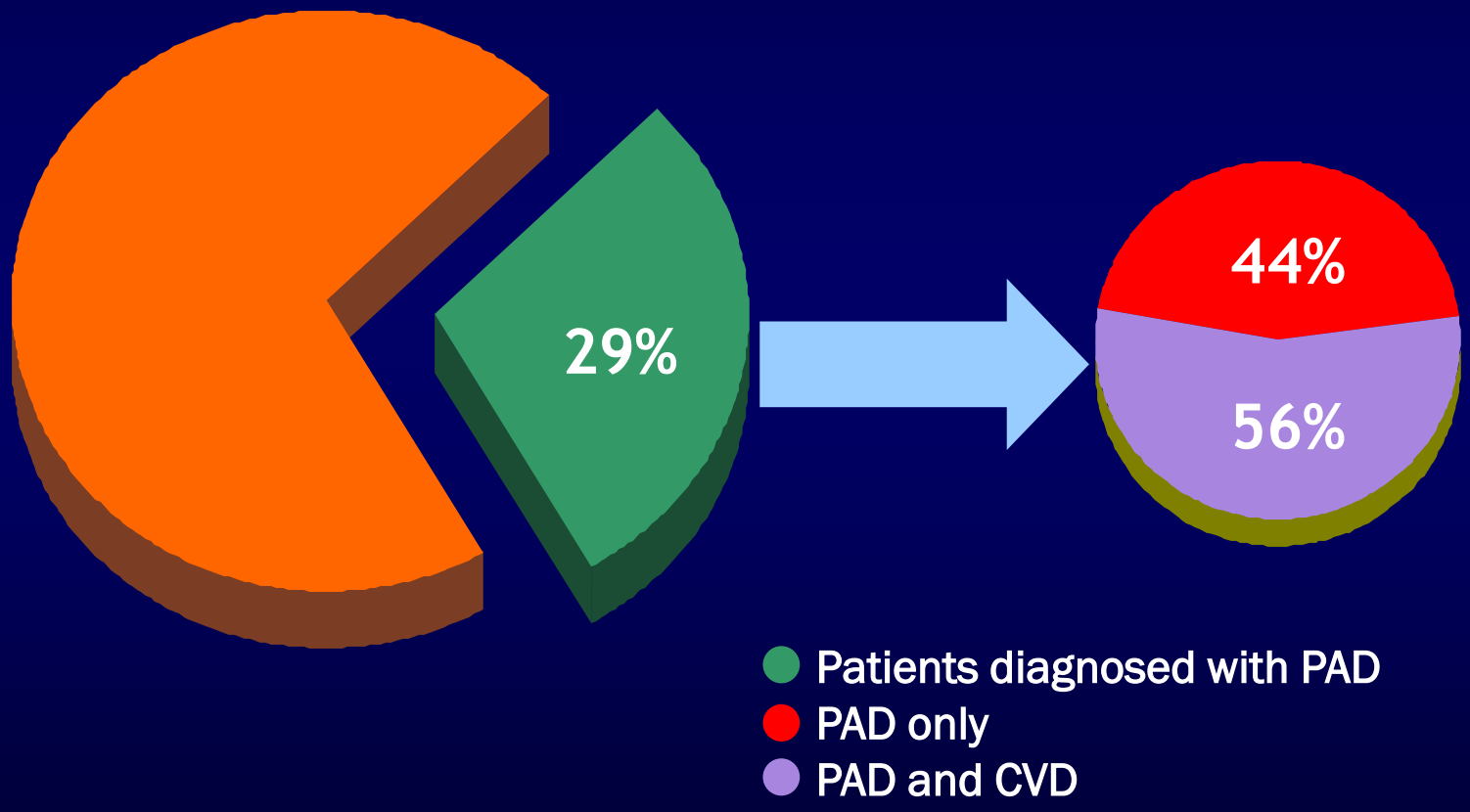
In a primary care population defined by age and common risk factors, the prevalence of PAD was approximately one in three patients

NHANES=National Health and Nutrition Examination Study;
PARTNERS=PAD Awareness, Risk, and Treatment: New Resources for Survival [program].

1. Selvin E, Erlinger TP. *Circulation*. 2004;110:738-743.
2. Criqui MH, et al. *Circulation*. 1985;71:510-515.
3. Diehm C, et al. *Atherosclerosis*. 2004;172:95-105.
4. Meijer WT, et al. *Arterioscler Thromb Vasc Biol*. 1998;18:185-192.
5. Hirsch AT, et al. *JAMA*. 2001;286:1317-1324.

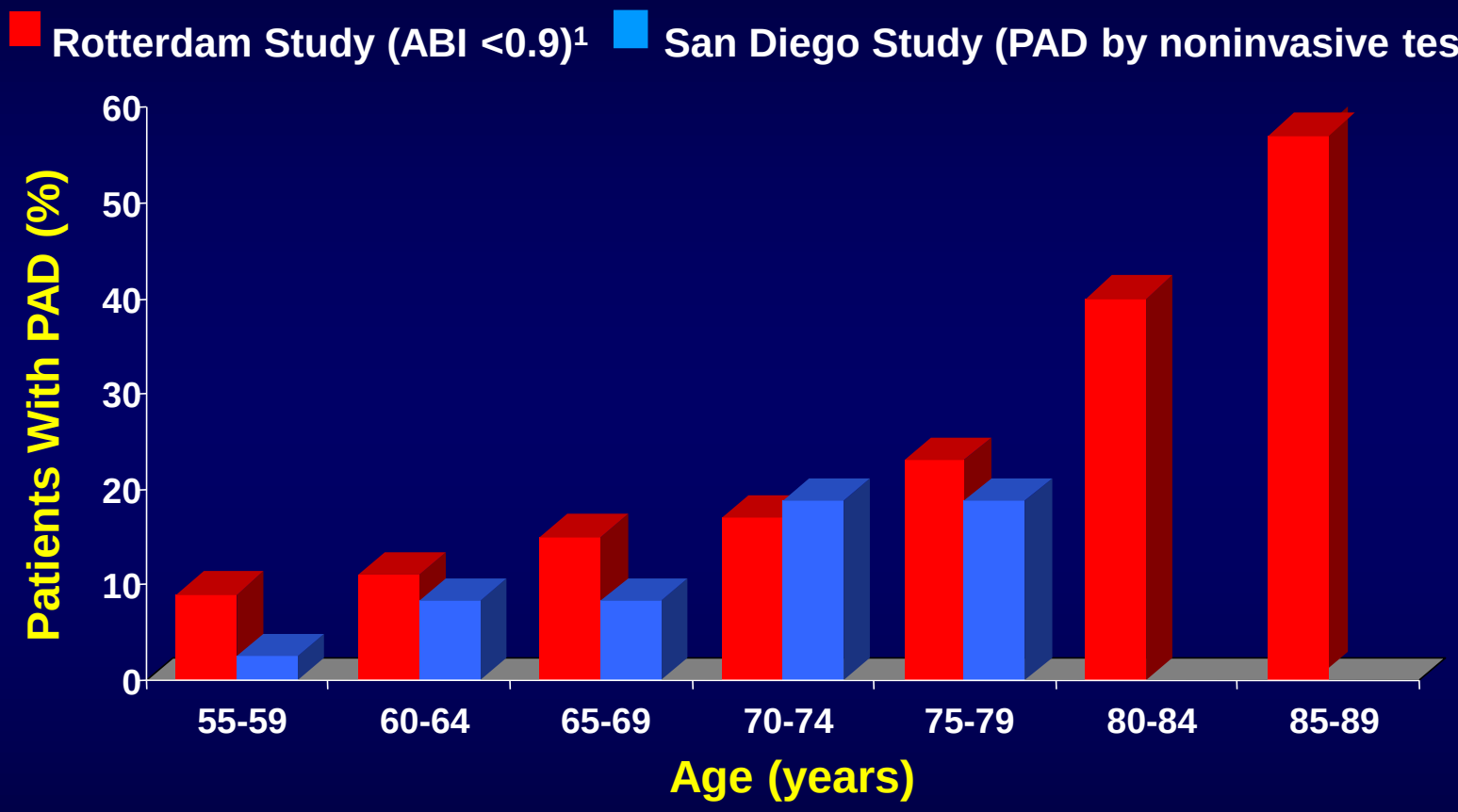
PARTNERS: Prevalence of PAD and Other CVD in Primary Care Practices

29% of Patients in a Target Population Were Diagnosed With PAD Using An Office-Based ABI



ABI=ankle-brachial index; CVD=cardiovascular disease.

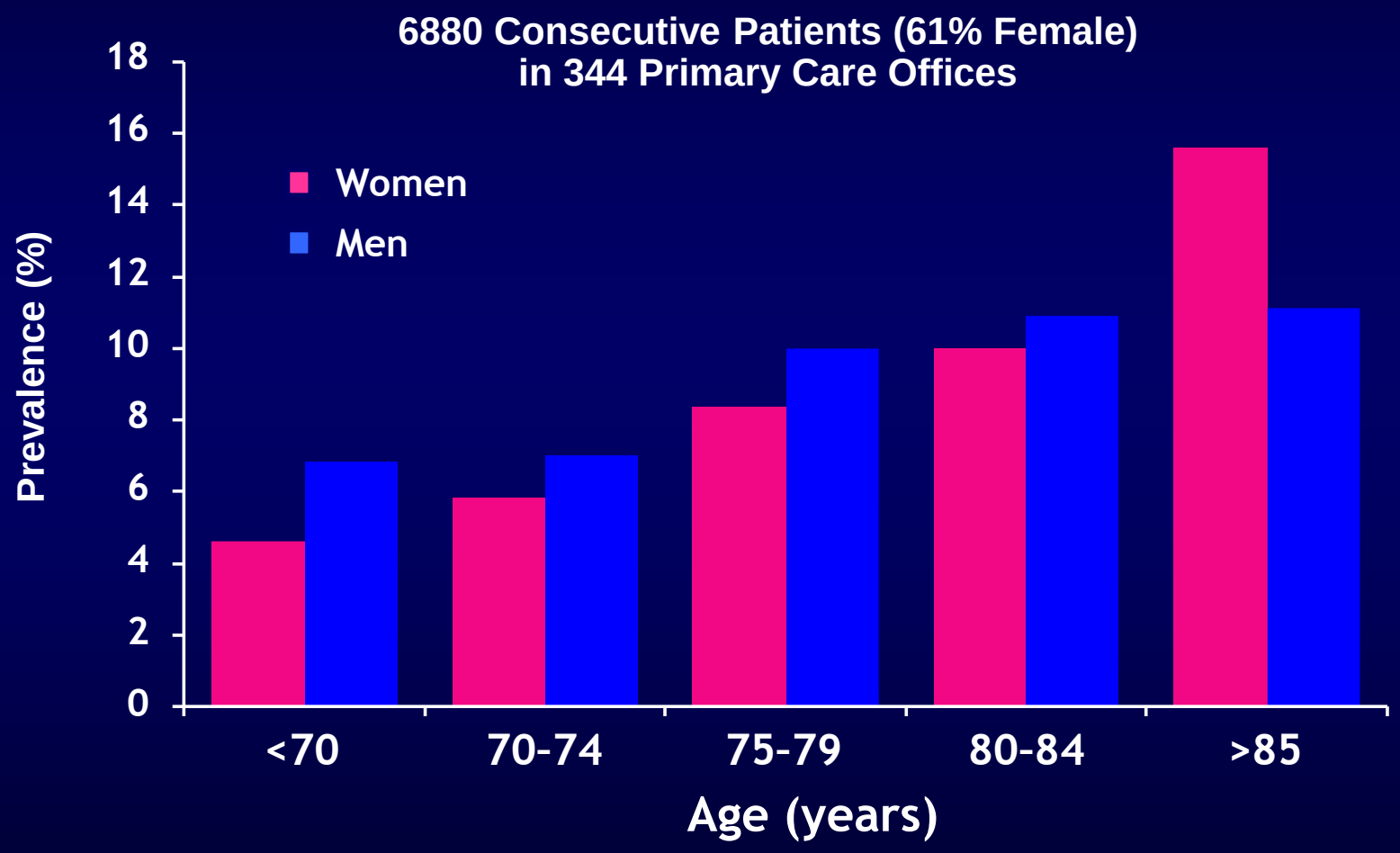
Prevalence of PAD Increases With Age



ABI=ankle-brachial index

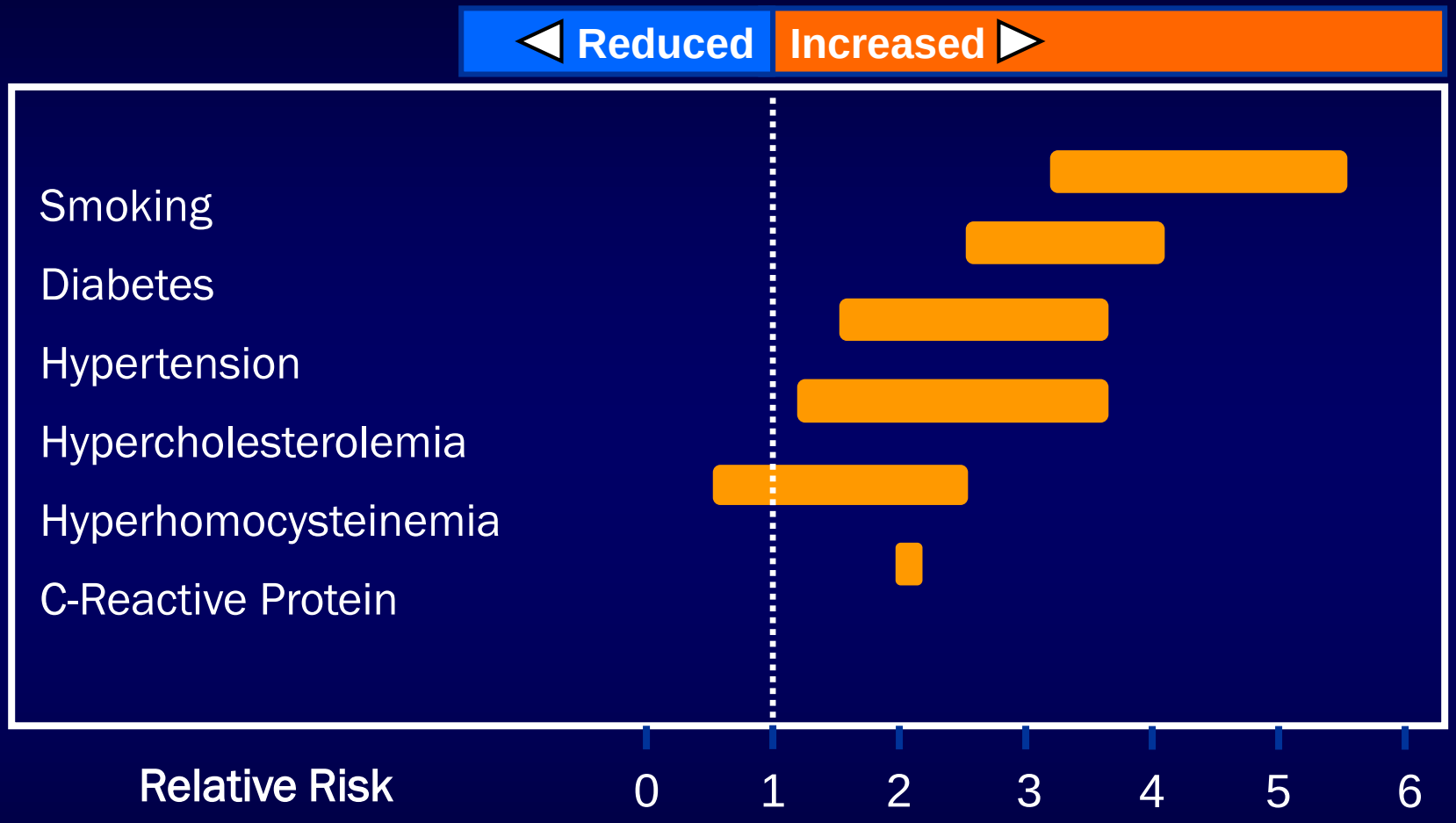
1. Meijer WT, et al. *Arterioscler Thromb Vasc Biol*. 1998;18:185-192.
2. Criqui MH, et al. *Circulation*. 1985;71:510-515.

Gender Differences in the Prevalence of PAD



Adapted from Diehm C. *Atherosclerosis*. 2004;172:95-105 with permission from Elsevier.

Risk Factors for PAD



Physical Exam Findings of Lower Extremity PAD

The Physical Exam Should Be Performed With Patient's Pants/Shoes Off

Limb examination (and comparison with the opposite limb) includes:

- Absent or diminished femoral or pedal pulses (especially after exercising the limb)
- Arterial bruits
- Hair loss
- Poor nail growth (brittle nails)
- Dry, scaly, atrophic skin
- Dependent rubor
- Pallor with leg elevation after 1 minute at 60 degrees (normal color should return in 10 to 15 seconds; longer than 40 seconds indicates severe ischemia)
- Ischemic tissue ulceration (punched-out, painful, with little bleeding), gangrene

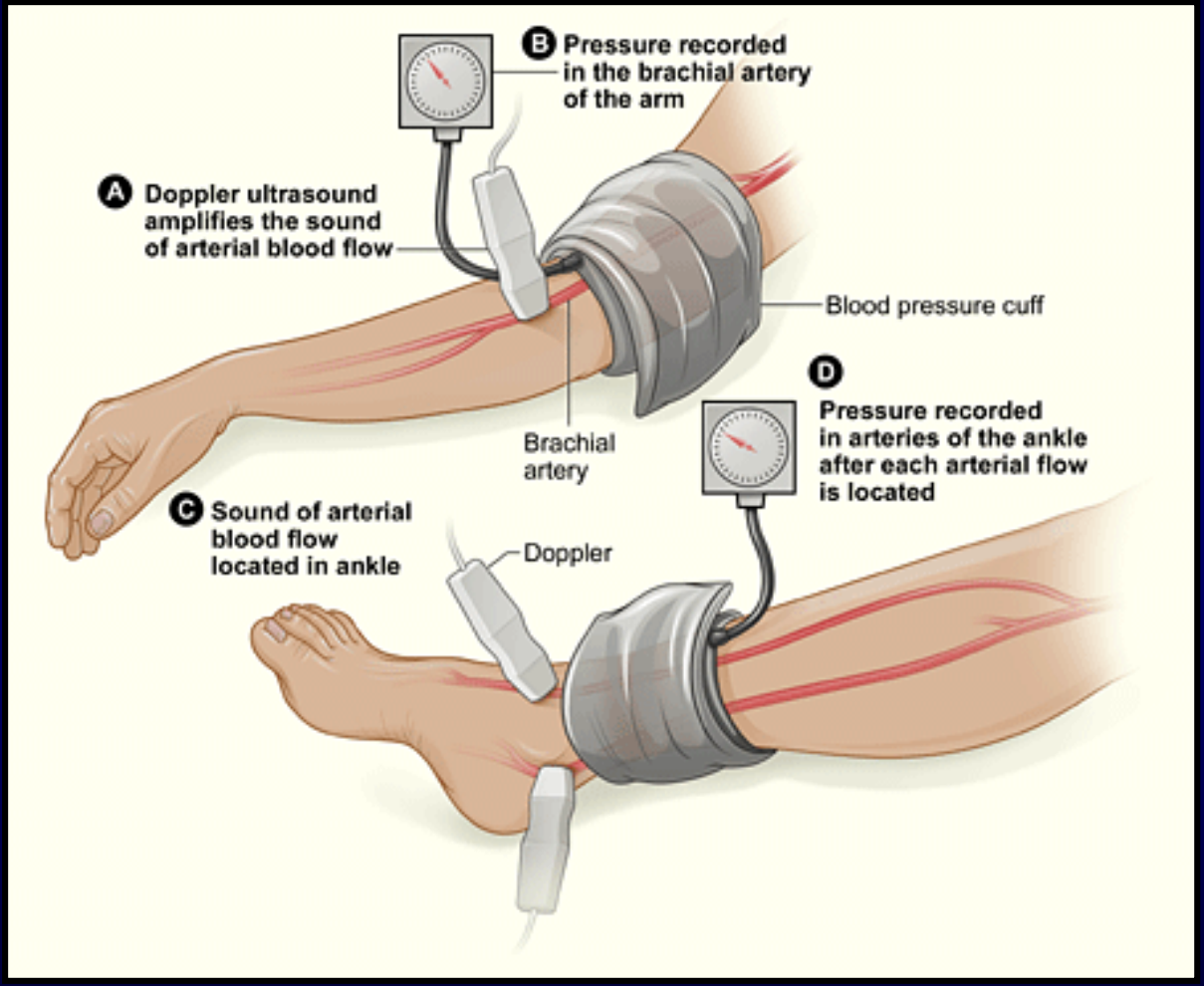
Lesho EP, et al. *Am Fam Physician*. 2004;69:525-533.

Elevation Pallor/Dependent Rubor

Elevation Pallor/Dependent Rubor

Gangrene

ABI Procedure



http://www.nhlbi.nih.gov/health/dci/Diseases/pad/pad_diagnosis.html

Using the ABI

Right ABI
80/160=0.50

Left ABI
120/160=0.75

ABI
(Normal >0.90)

Brachial SBP
150 mm Hg

Brachial SBP
160 mm Hg

Highest
brachial SBP

PT SBP 40 mm Hg

DP SBP 80 mm Hg

PT SBP 120 mm Hg

DP SBP 80 mm Hg

Highest of PT
or DP SBP

Interpreting the Ankle-Brachial Index

ABI	Interpretation
1.00–1.29	Normal
0.91–0.99	Borderline
0.41–0.90	Mild-to-moderate disease
≤0.40	Severe disease
≥1.30	Noncompressible

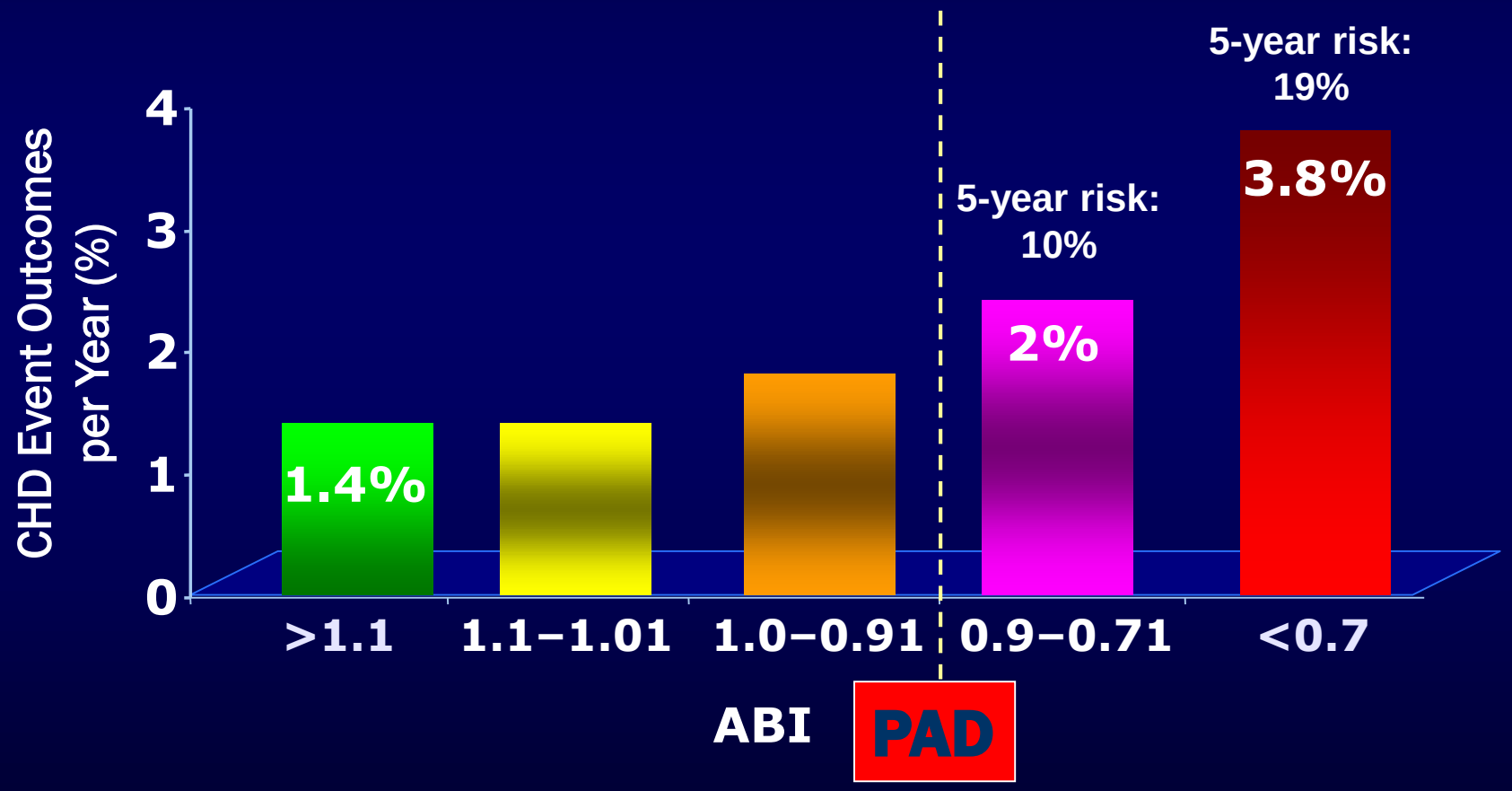
Adapted from Hirsch AT, et al. *J Am Coll Cardiol*. 2006;47:e1-e192. Figure 6.

Normal values: Ankle pressure > Brachial; ABI after Exercise: Fall < 20%; Proximal thigh pressure 30 mmHg higher than brachial; Segmental Pressure < 20mm Hg drop between levels

Cardiovascular Risk Increases With Decreases in Ankle-Brachial Index

Framingham "High Risk" = 20% at 10 years

Every patient with PAD is at "very high risk"



*Fatal or nonfatal MI. ABI=ankle-brachial index; CHD=chronic heart failure

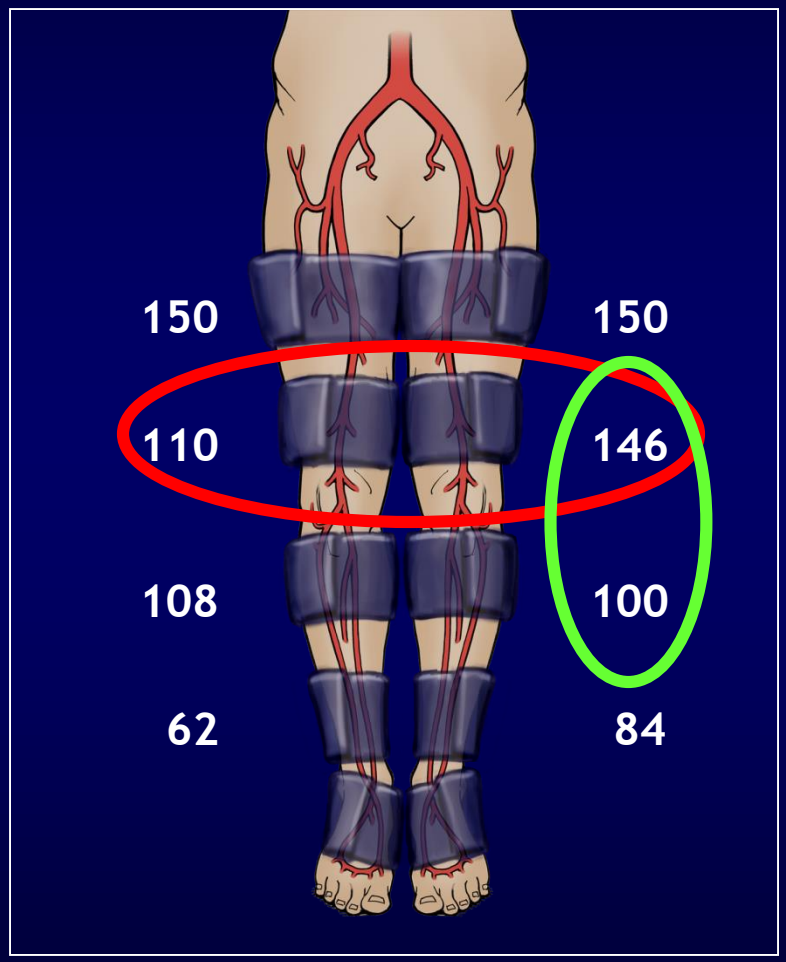
Leng GC, et al. *Brit Med J.* 1996;313:1440-44.

Exercise ABI Testing

- Confirms the PAD diagnosis
- Assesses the functional severity of claudication
- May "unmask" PAD when resting the ABI is normal
- Aids differentiation of intermittent claudication vs. pseudoclaudication diagnoses

Normal values: Ankle pressure > Brachial; ABI after Exercise: Fall < 20%; Proximal thigh pressure 30 mmHg higher than brachial; Segmental Pressure < 20mm Hg drop between levels

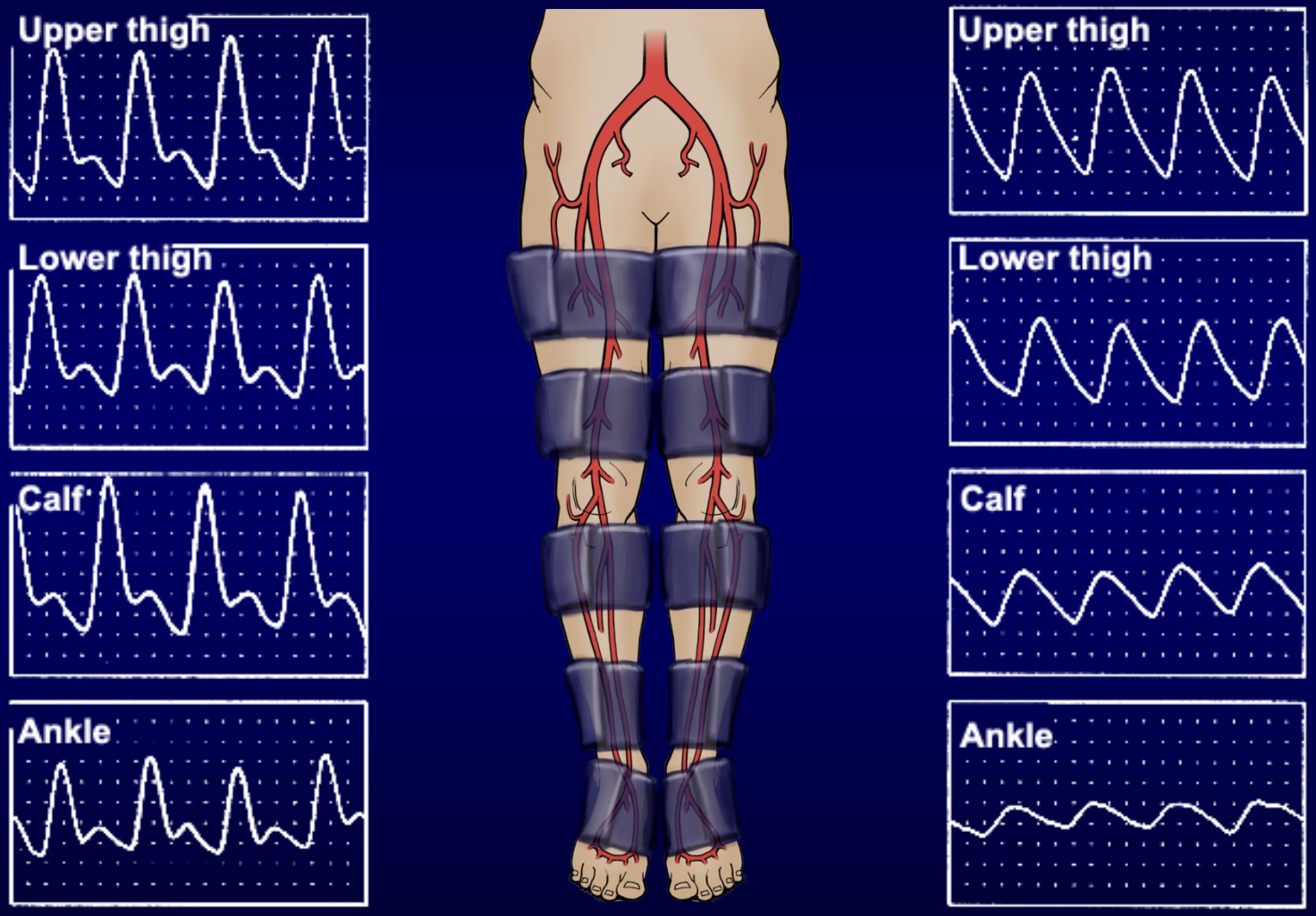
Segmental Pressures (mm Hg)



Greater than 20-30mm Hg = significant disease

Decrease in pressure between 2 levels > 30mm Hg = stenosis proximal to cuff

Pulse Volume Recordings

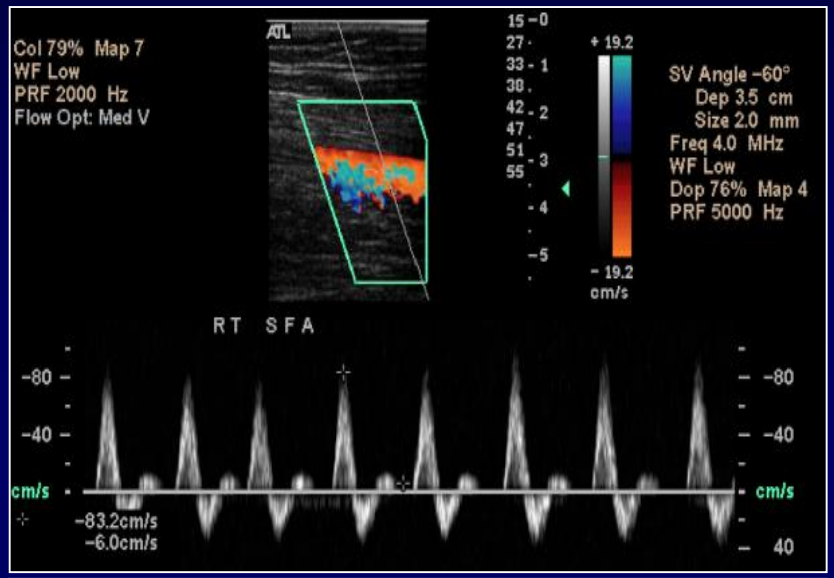


Normal waveform is rapid systolic upstroke and rapid downstroke with prominent dicrotic notch. With increasing PAD severity the waveform is attenuate and widened with ultimate flat or non-pulsatile waveform

Arterial Duplex Ultrasound Testing

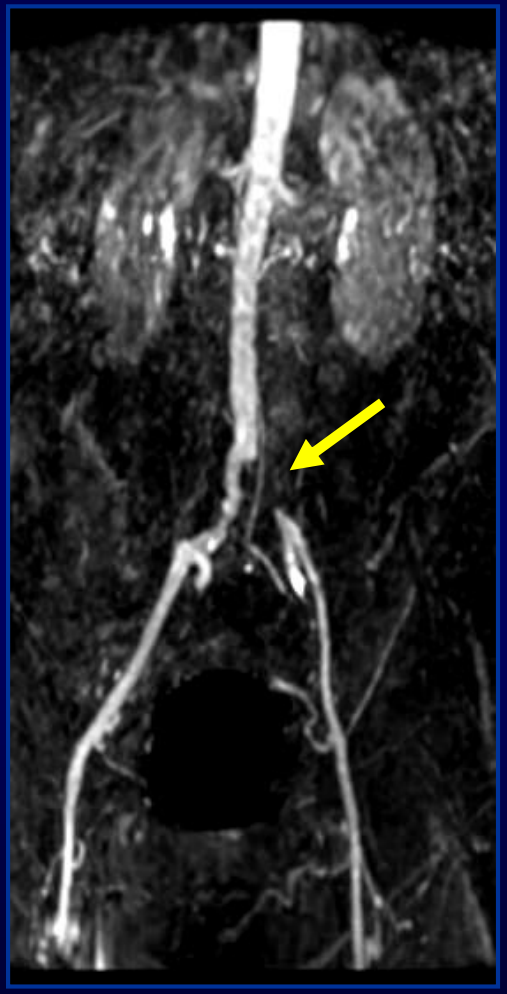
- Diagnose anatomic location and degree of stenosis of peripheral arterial disease.

- Duplex ultrasound of the extremities can be used to select candidates for:
  (a) endovascular intervention
  (b) surgical bypass, and
  (c) to select the sites of surgical anastomosis.

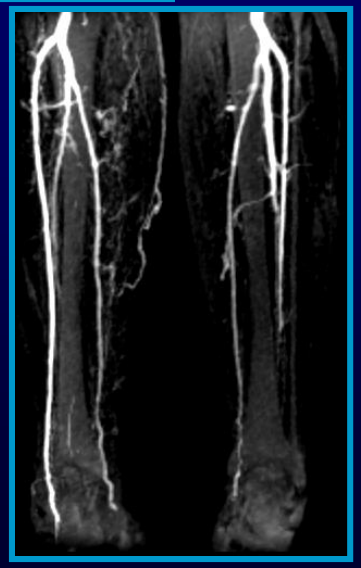


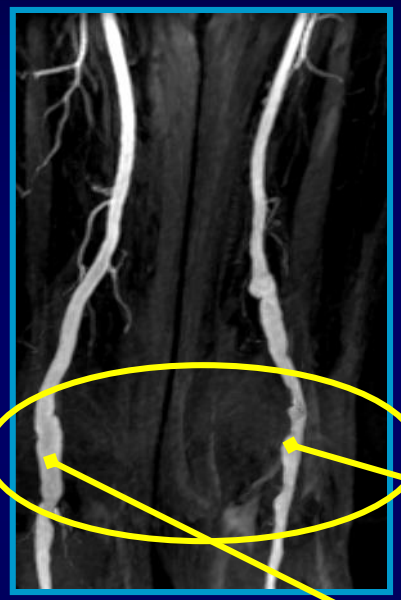
Magnetic Resonance Angiography (MRA)

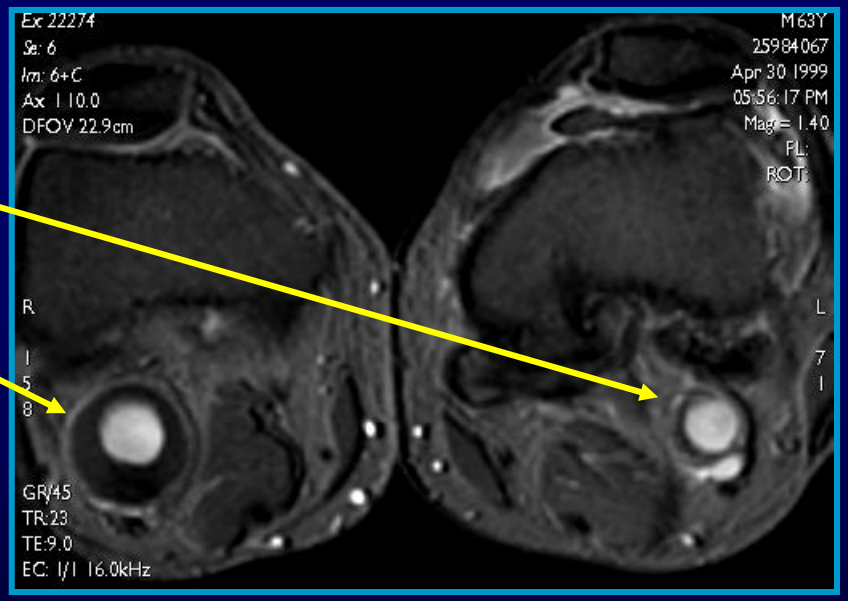
- MRA has virtually replaced contrast arteriography for PAD diagnosis
- No ionizing radiation
- Non-iodine–based intravenous contrast medium
- ~10% of patients cannot utilize MRA because of:
  - Claustrophobia
  - Pacemaker/implantable cardioverter-defibrillator
  - Obesity
- Gadolinium use in individuals with an eGFR <60 mL/min has been associated with nephrogenic systemic fibrosis (NSF)/nephrogenic fibrosing dermopathy



MRA in PAD



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Se: 6
Im: 6+C
Ax 1 10.0
DFOV 22.9cm
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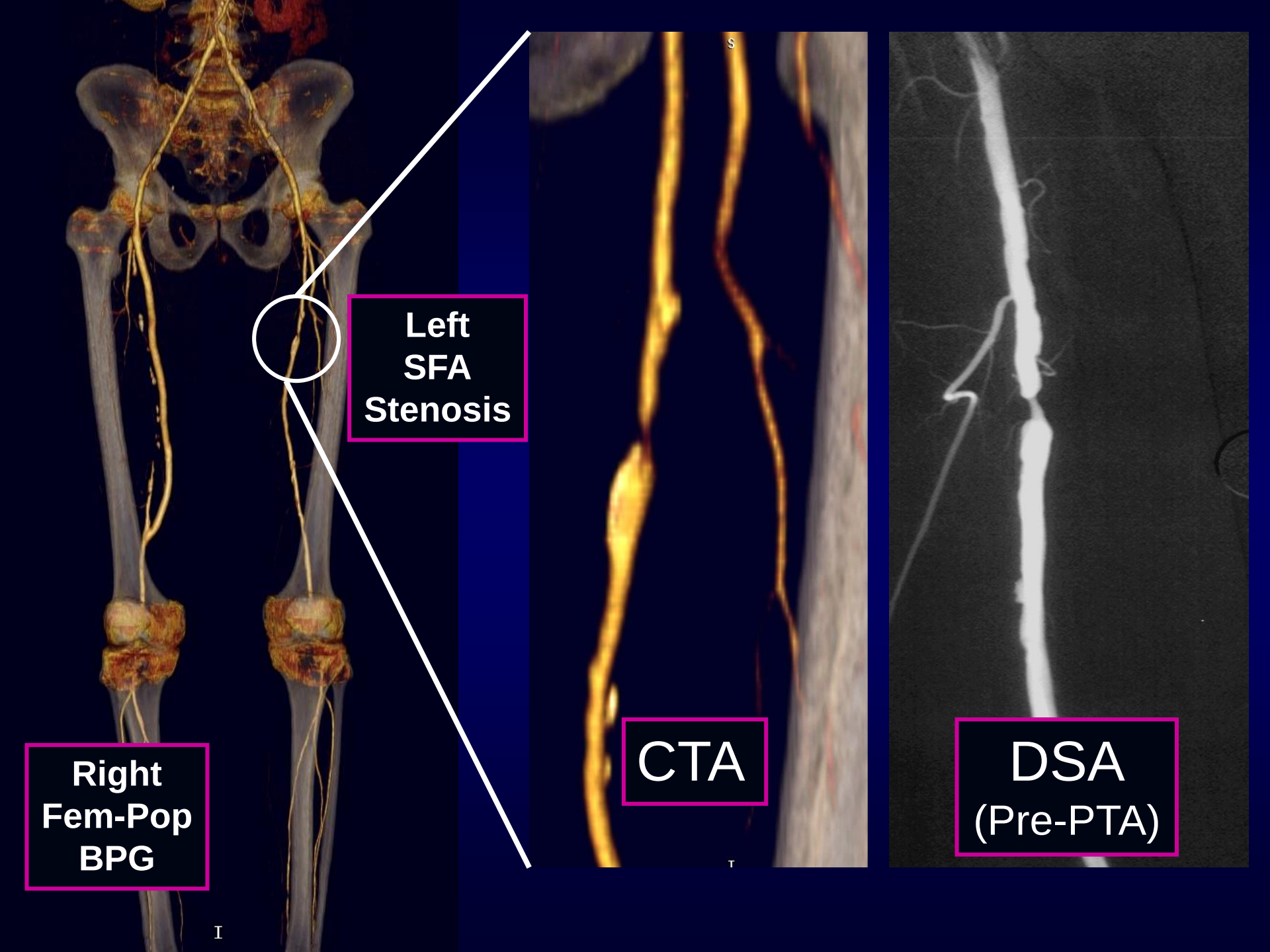
05:56:17 PM
Mag= 1.40
FL:
ROT:
R
L
GR/45
TR:23
TE:9.0
EC: 1/1 16.0kHz

Computed Tomographic Angiography (CTA)

- Requires iodinated contrast
- Requires ionizing radiation
- Produces an excellent arterial picture


Left
SFA
Stenosis
Right
Fem-Pop
BPG
CTA
DSA
(Pre-PTA)

Two Major Goals in Treating Patients With PAD

Limb outcomes	Cardiovascular morbidity and mortality outcomes

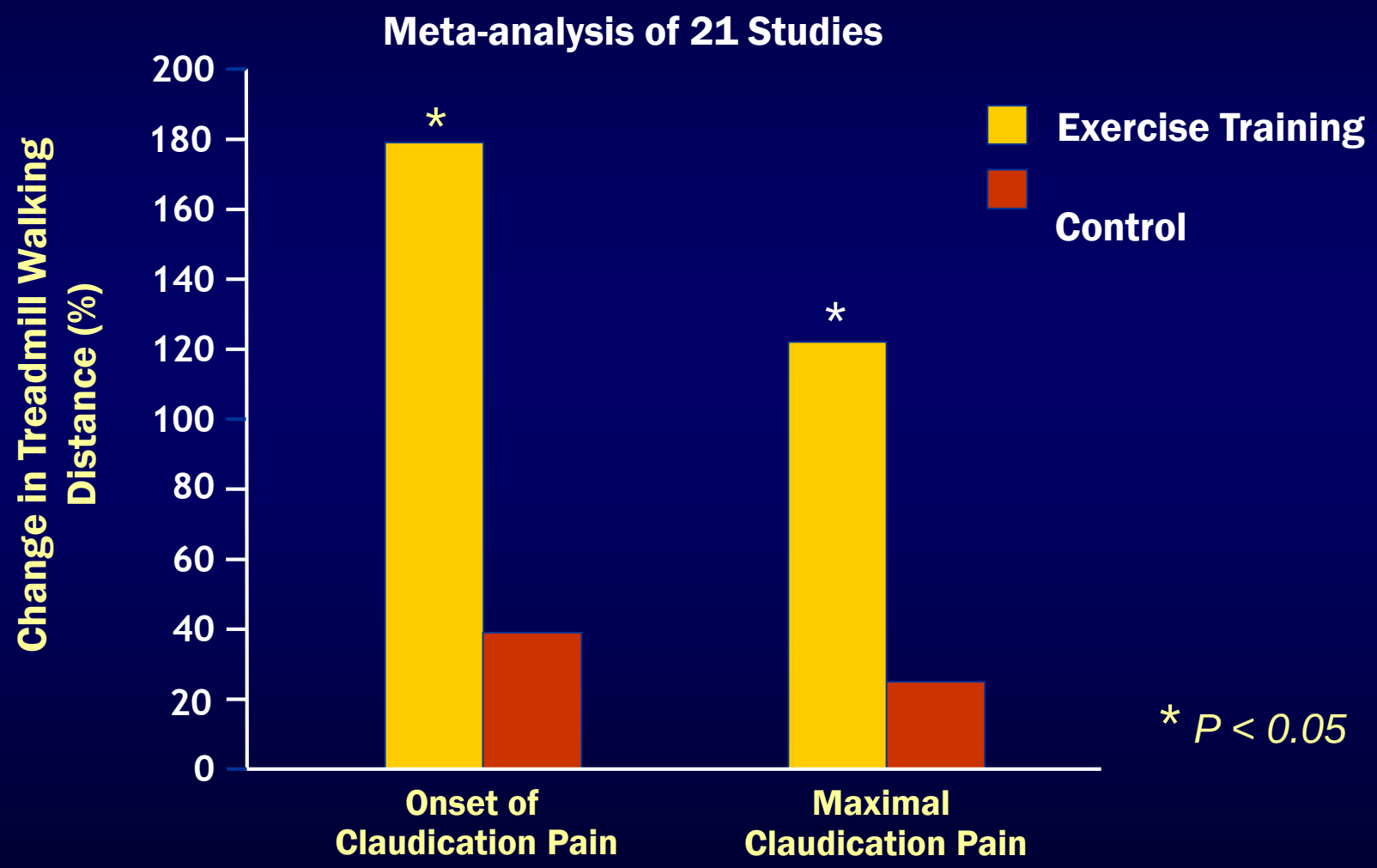
■ Improved ability to walk
  ■ Increase in peak walking distance
  ■ Improvement in quality-of-life
■ Prevention of progression to CLI and amputation
	• Decrease in morbidity from non-fatal MI and stroke
	• Decrease in cardiovascular mortality from fatal MI and stroke

Treatment of Claudication:

Therapeutic Choice & Evidence

Intervention	Benefit on Treadmill/QoL	Limitations	PAD Cohort Indicated
Exercise	100% / Improved	Availability Motivation	50%-85%
Cilostazol	50% / Improved	CHF Medication	50%-85%
Angioplasty	Improvement	Proximal arteries best	10%-15%
Surgery	150% / Improved	Graft failure Morbidity, mortality	< 5%

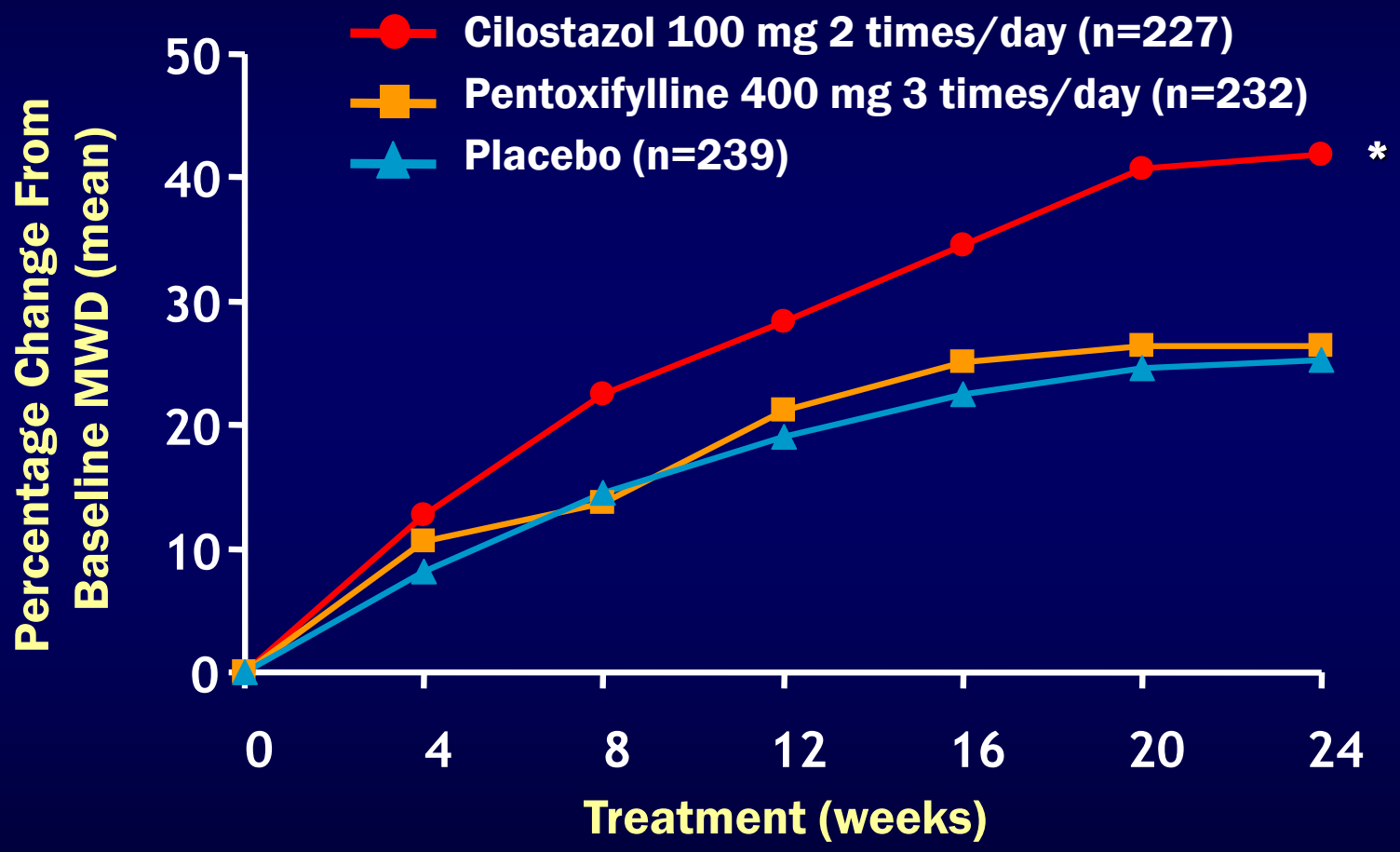
Effects of Exercise Training on Claudication



Gardner AW, Poehlman ET. *JAMA*. 1995;274:975-980.

Cilostazol vs. Pentoxifylline:

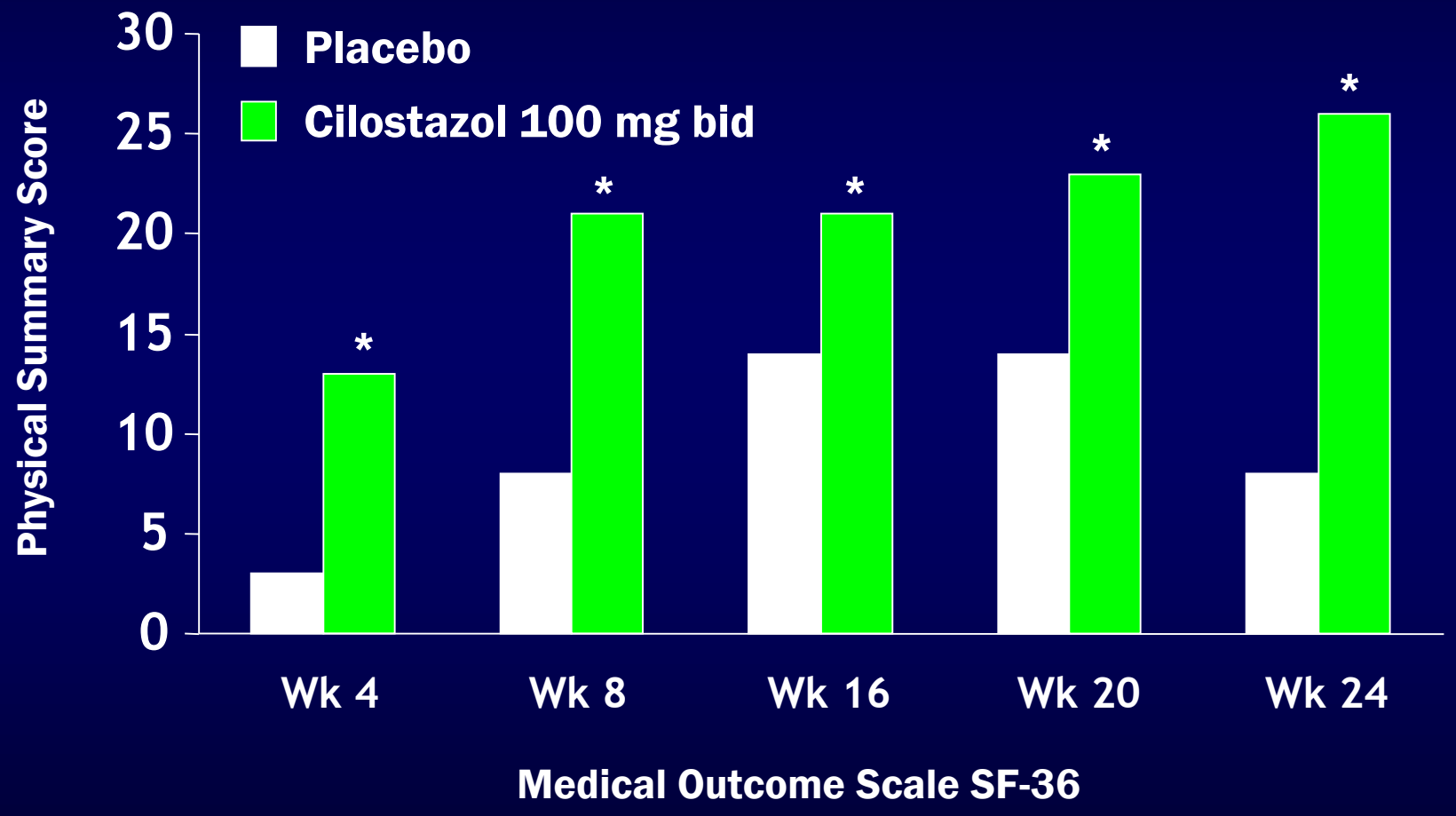
Relative Efficacy to Improve Walking Distance in Claudication



MWD=maximal walking distance.
*P<0.001 vs pentoxifylline.

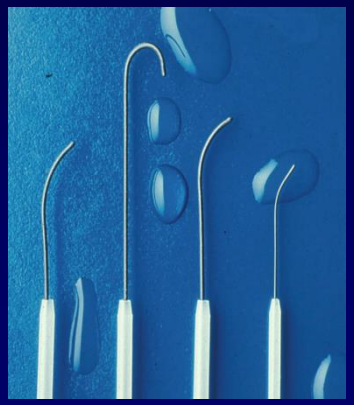
Reprinted from Dawson DL, et al. *Am J Med*. 2000;109:523-530 with permission from Elsevier.

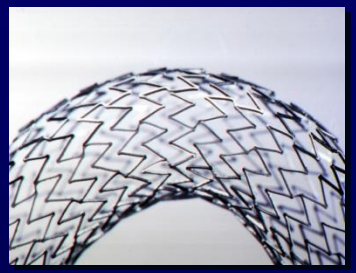
Effect of Cilostazol on Quality of Life

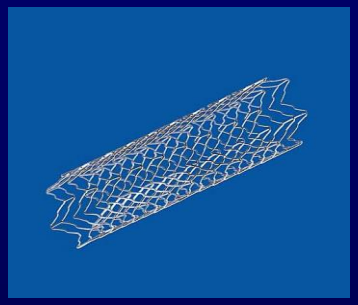


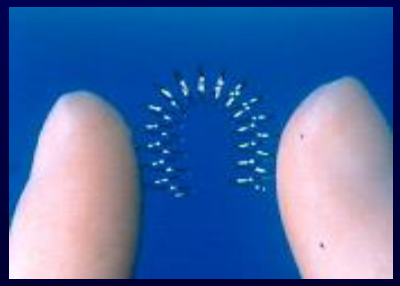
Tools of the trade for Infrainguinal Endovascular Intervention

- Hydrophilic & "coronary" guidewires
- Nitinol S-E Stents (flexible, strong)
- Atherectomy (remove plaque)
- Thrombolytic Therapy
- Laser
- Cryoplasty



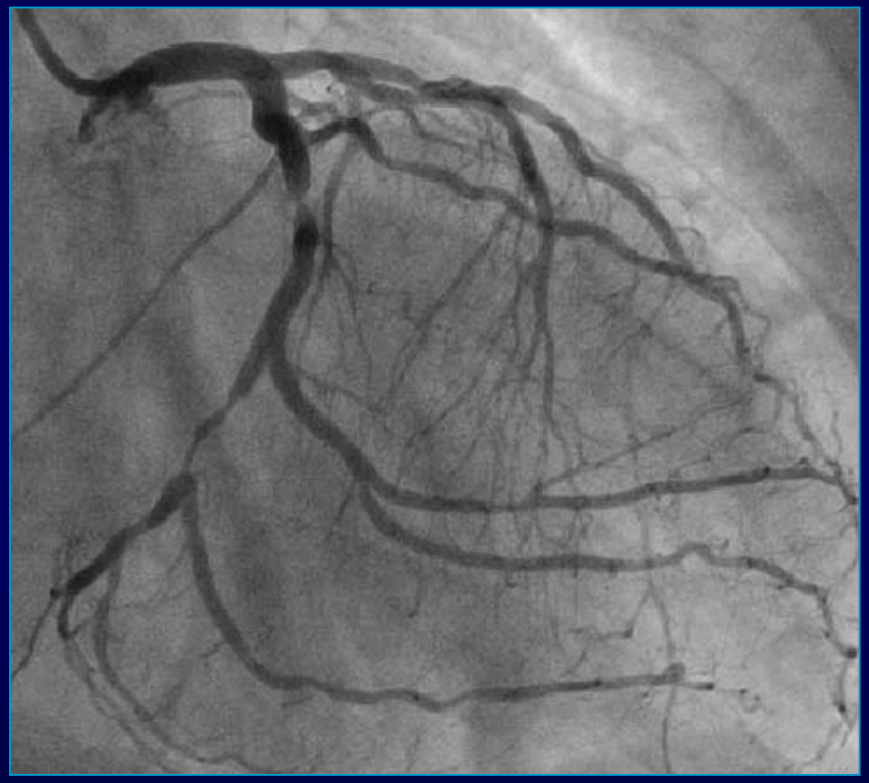




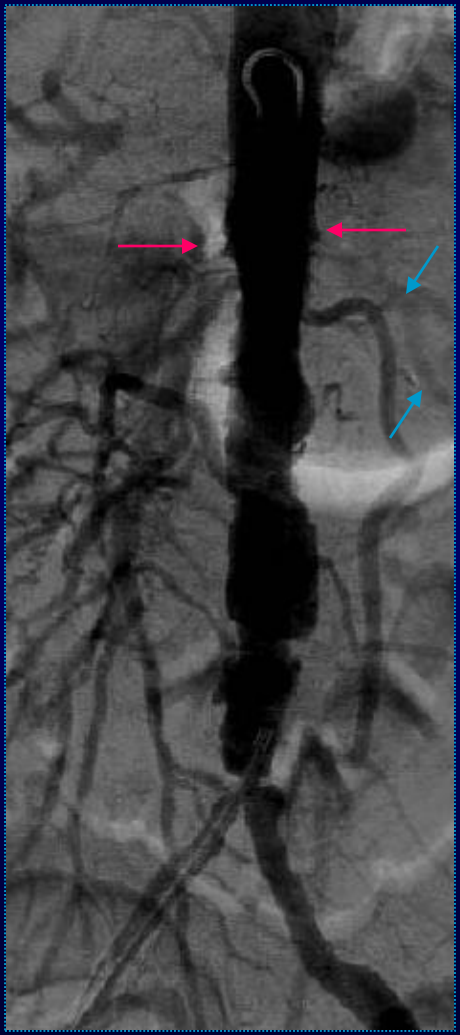


60 y.o woman has chest pain, HTNsive crisis. Also complains of LE claudication

- **Abnormal adenosine myocardial perfusion scan**
- **Coronary Angiogram: sequential LCX stenosis and occluded mid LAD that fills via collateral vessels**
- **Patient refusing CABG**



60 y.o woman with CAD, HTN and dyslipidemia presents with HTNsive crisis, ACS, claudication (LE) and renal insufficiency. Cr ~ 1.5 → 2.5 → 7.6.

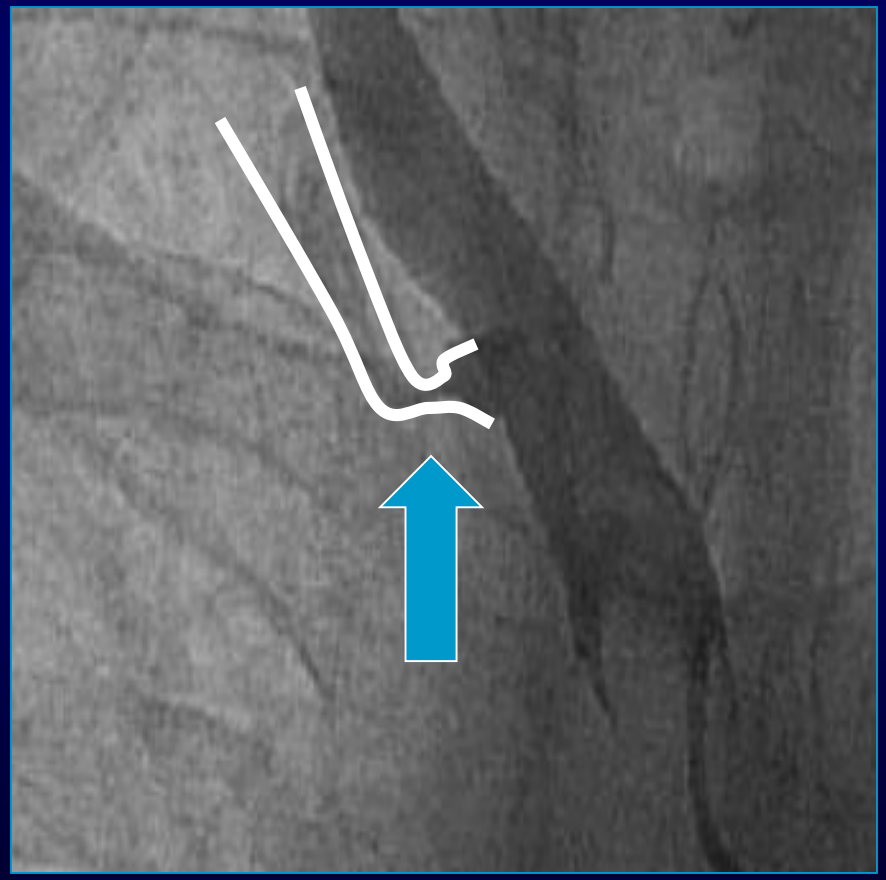


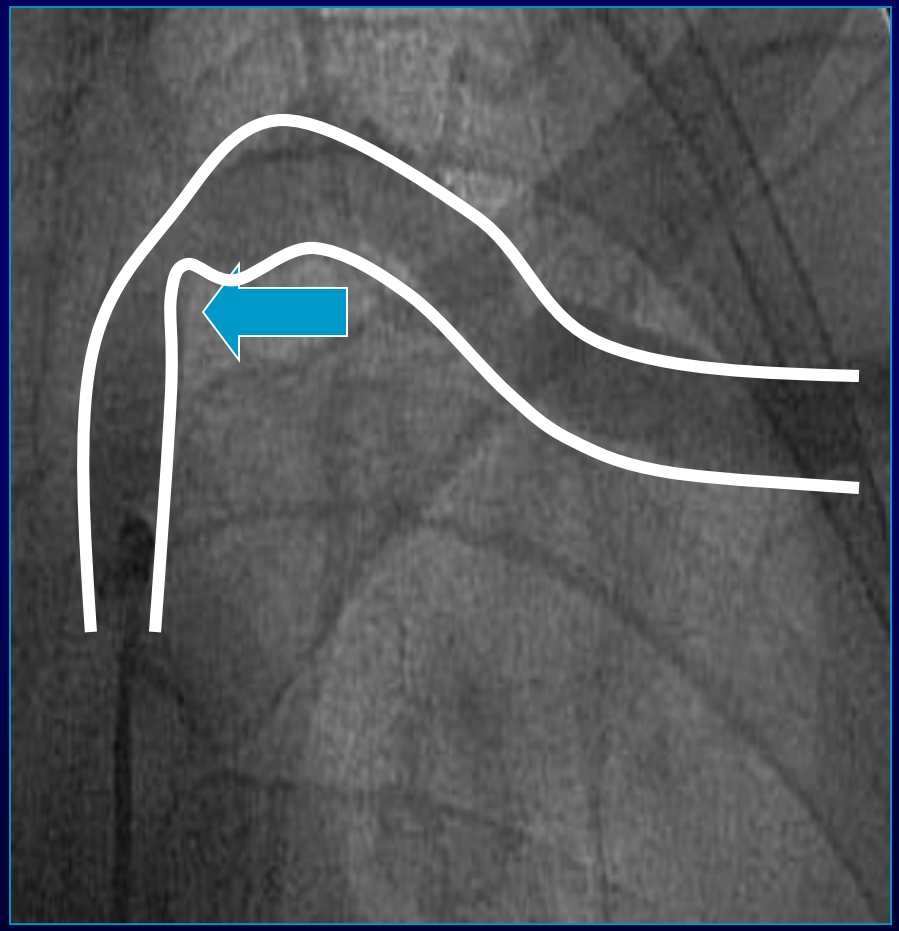
Angiogram of innominate and left subclavian artery

Pressure difference of 60mmHg between aorta & right brachial artery
Pressure difference of 40 mmHg between aorta and left brachial artery

Angiogram of innominate and left subclavian artery

Pressure difference of 60mmHg between aorta & right brachial artery
Pressure difference of 40 mmHg between aorta and left brachial artery





Final angiogram of left renal artery

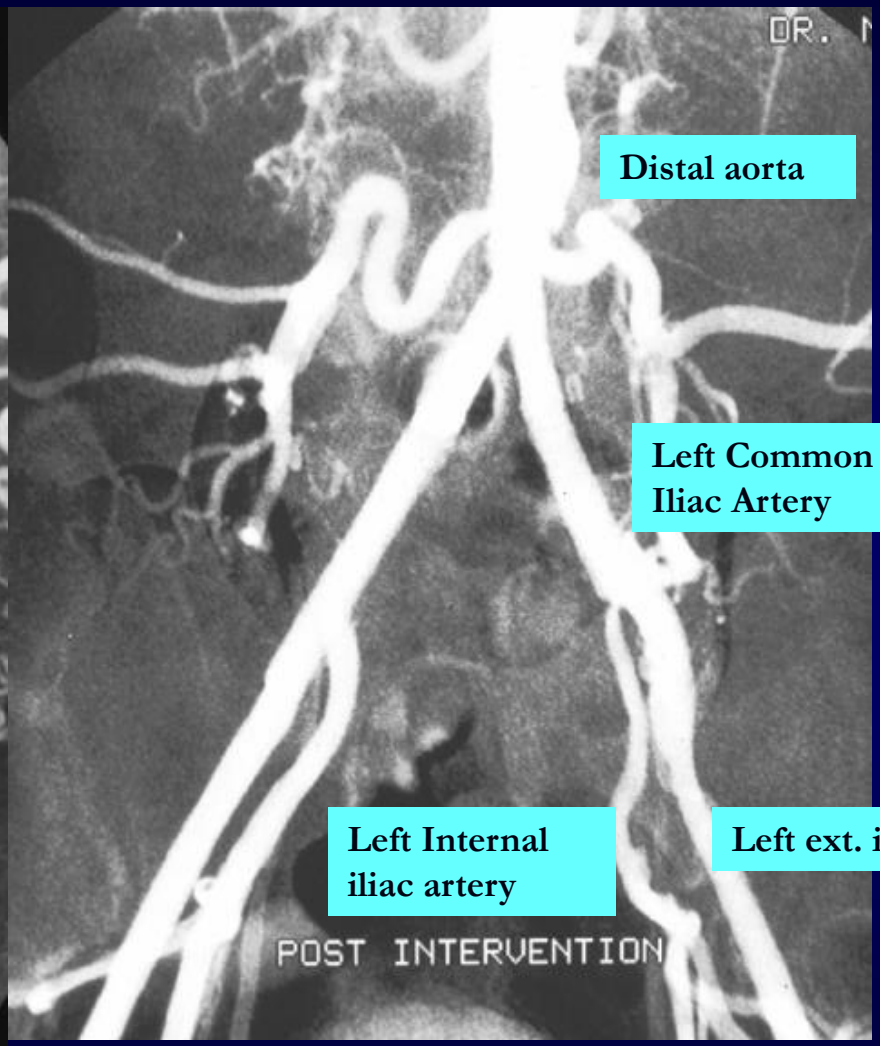
Final angiogram of right renal artery

Creatinine back to baseline at 6 month follow up

SFA Intervention

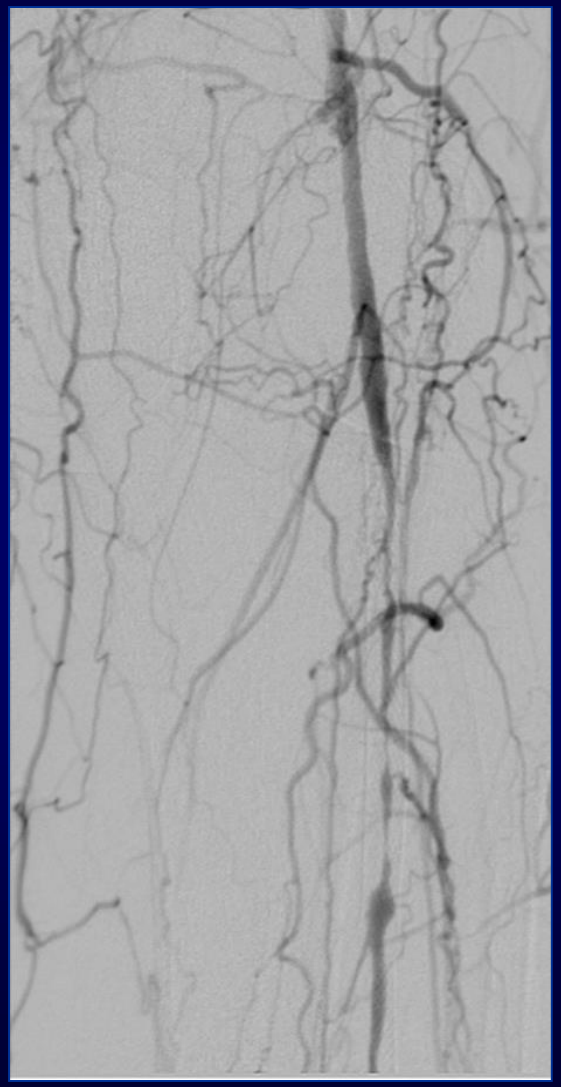
Pre

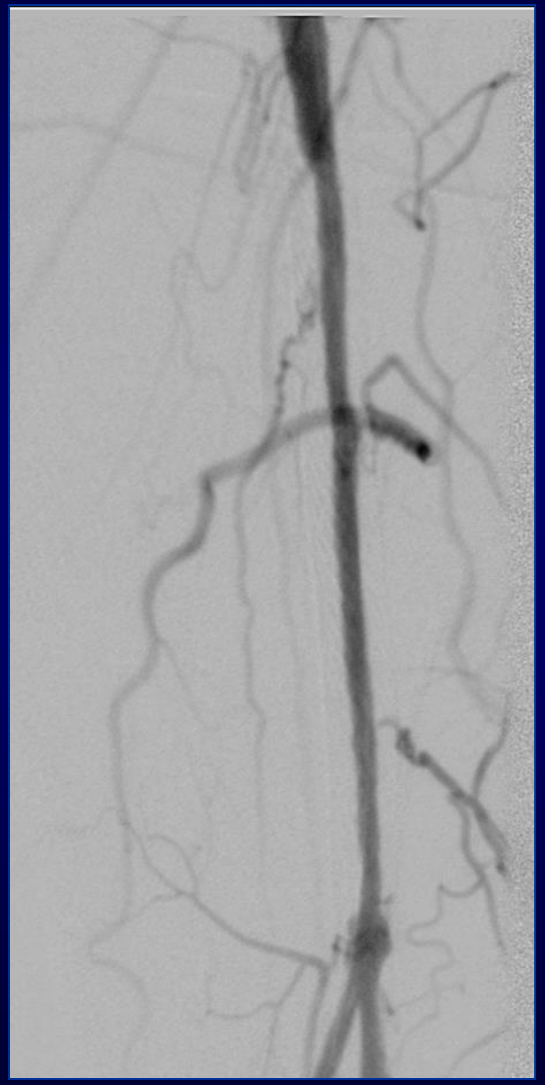
Post



66 y.o man with CAD, DM, PAD and severe claudication. Three years after intervention-no further claudication

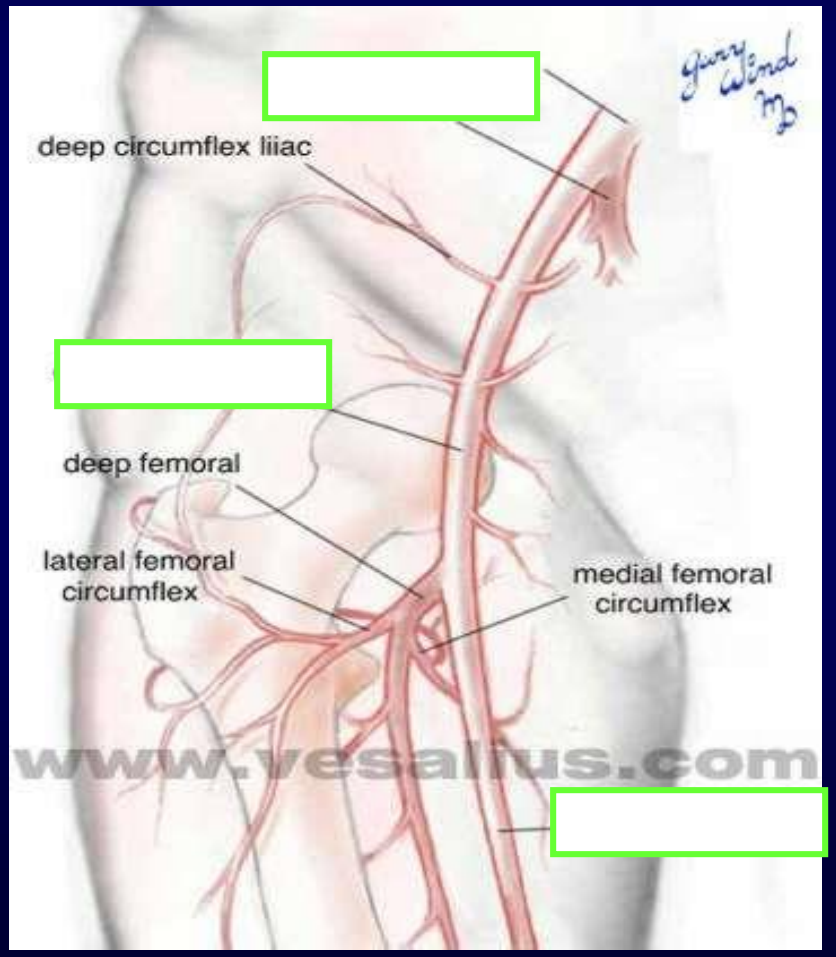
Tibio-Peroneal Trunk Atherectomy

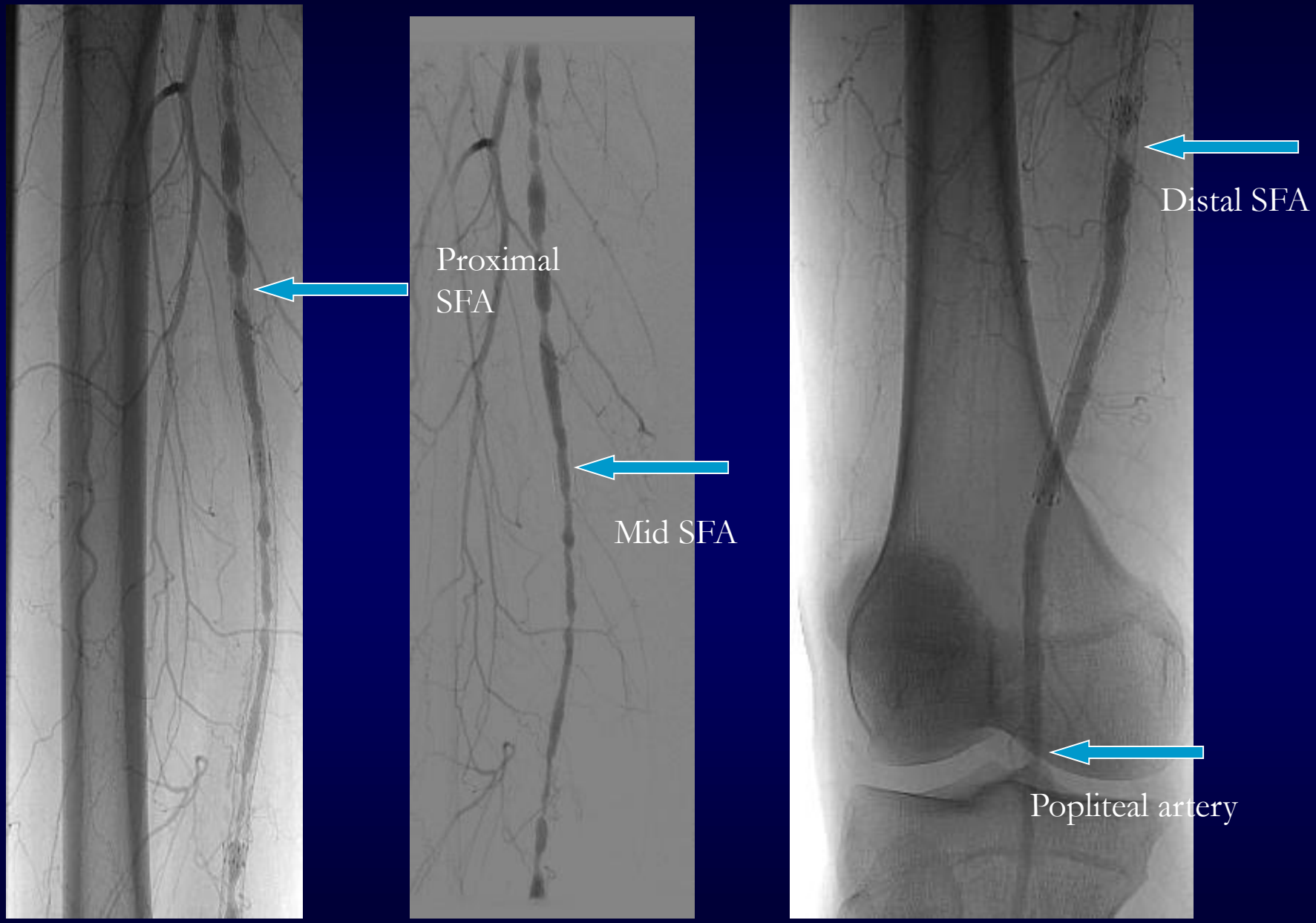


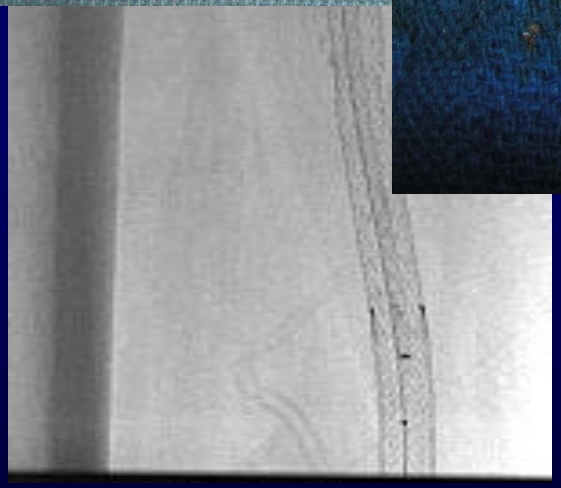


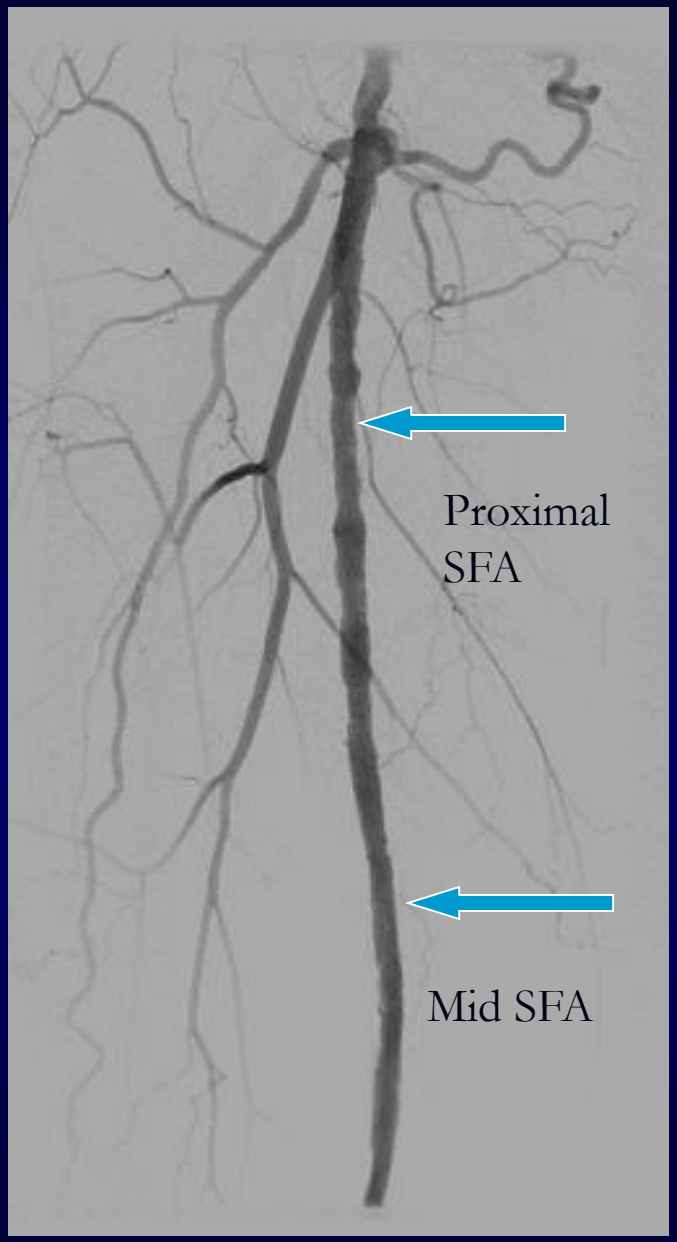
56 y.o male patient with PAD, CAD and tobacco use. Presents with recurrent disabling RLE claudication.

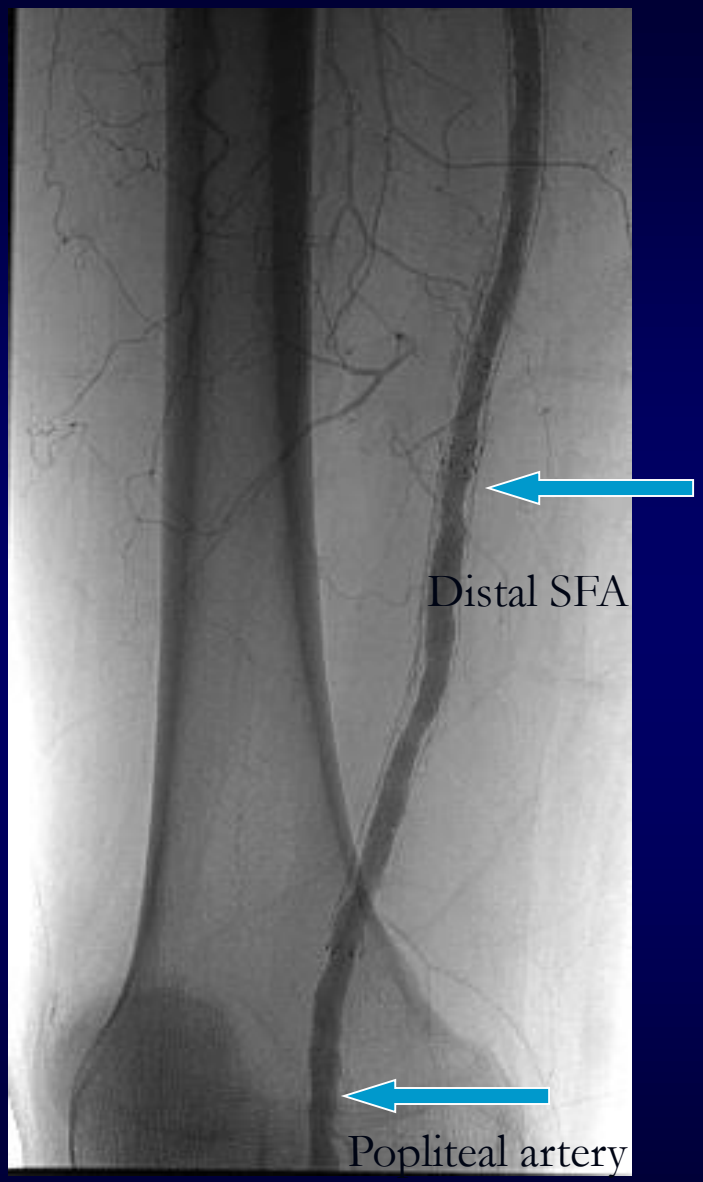
Noted to have hemodynamically significant in-stent restenoses within the previously-stented Right SFA




Proximal
SFA
Mid SFA
Distal SFA
Popliteal artery




Proximal
SFA
Mid SFA


Distal SFA
Popliteal artery