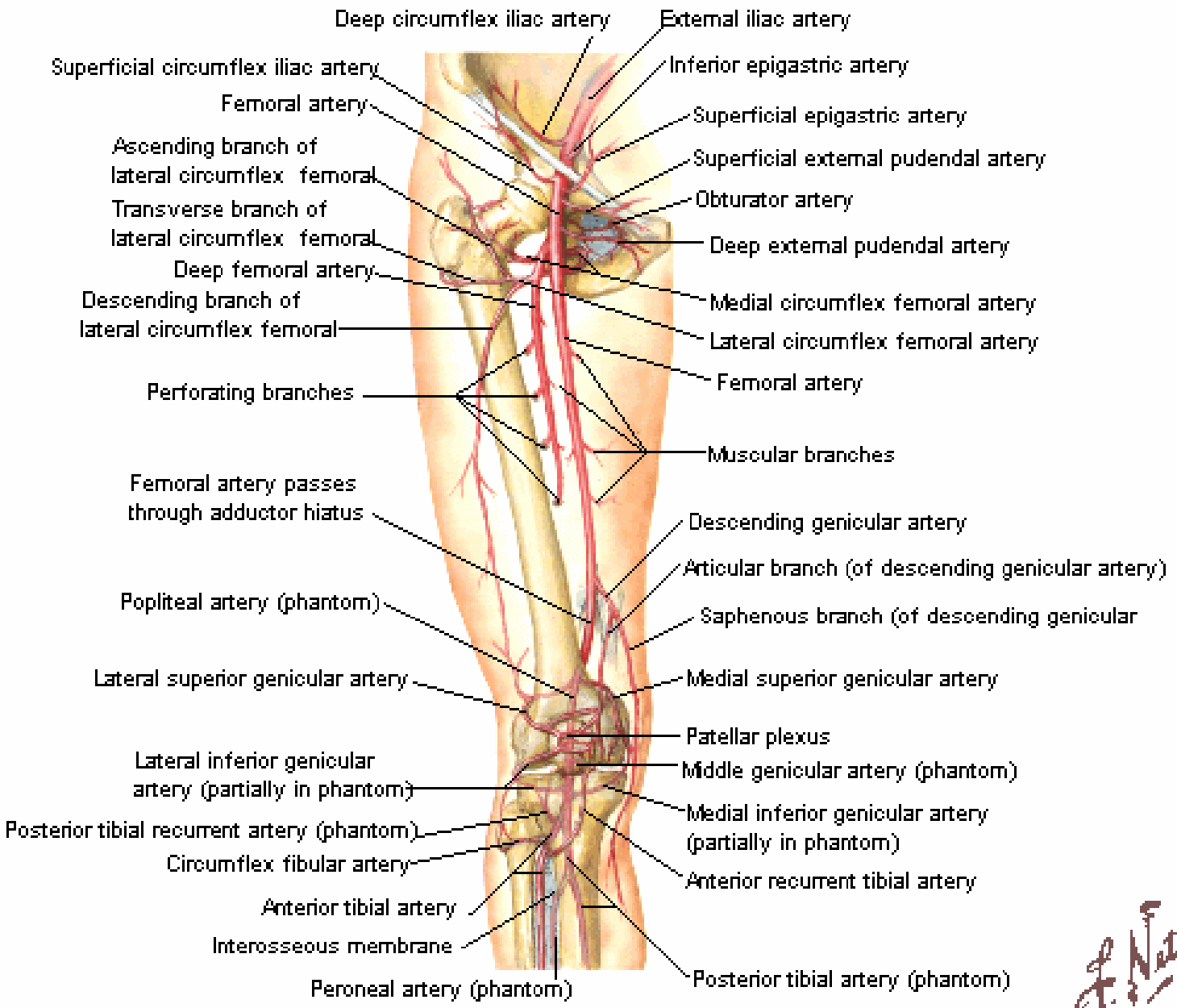
# Peripheral Arterial Occlusive Disease

# Arteries of Thigh and Knee

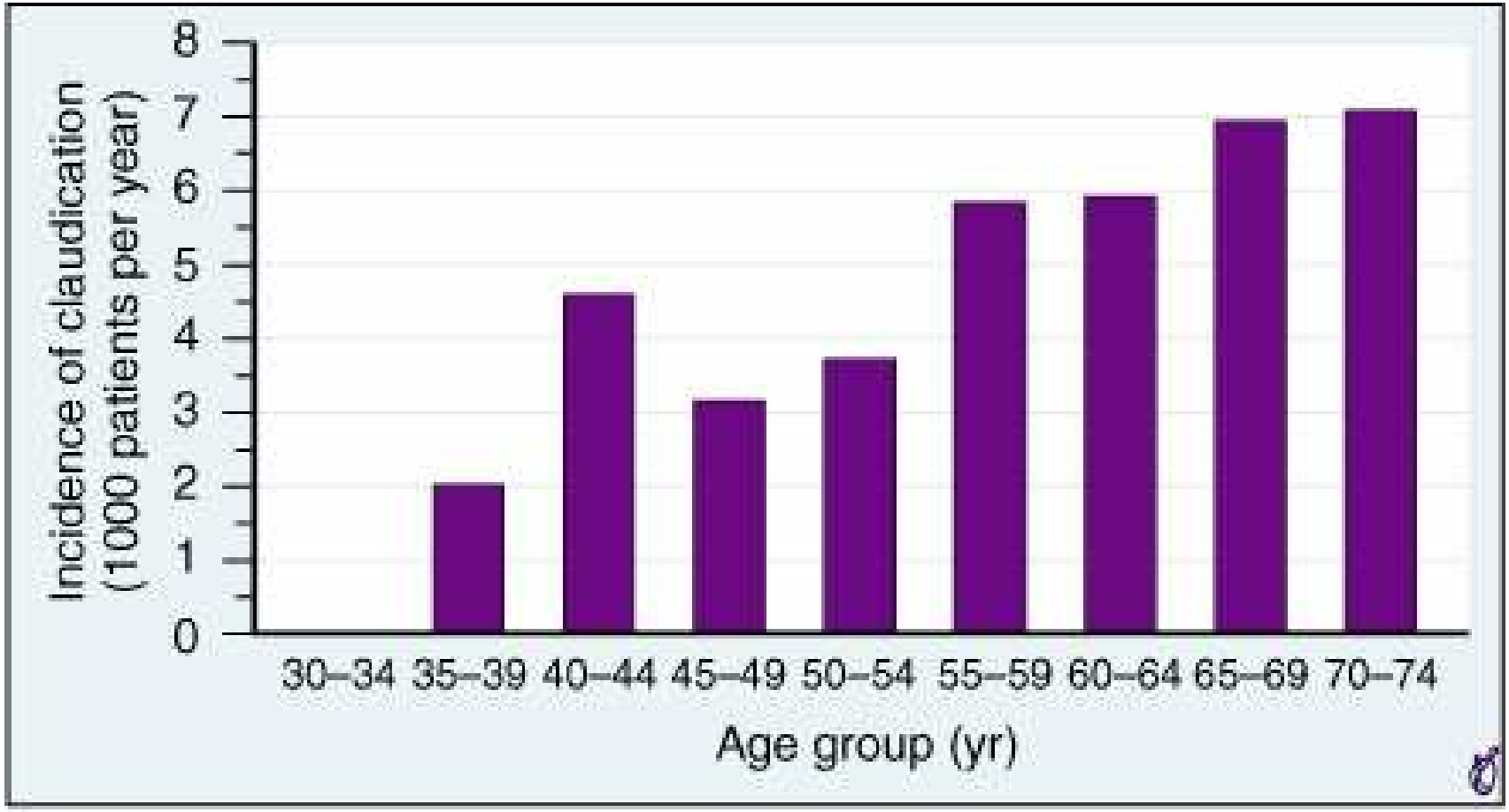
## Schema



# Epidemiology

- Intermittant claudication
  - 2-3% of men over age 60
  - 1-2% of women over age 60
- PAD (ABI <0.9) over age 55
  - 17% of Men
  - 21% of Women

# IC increases with age



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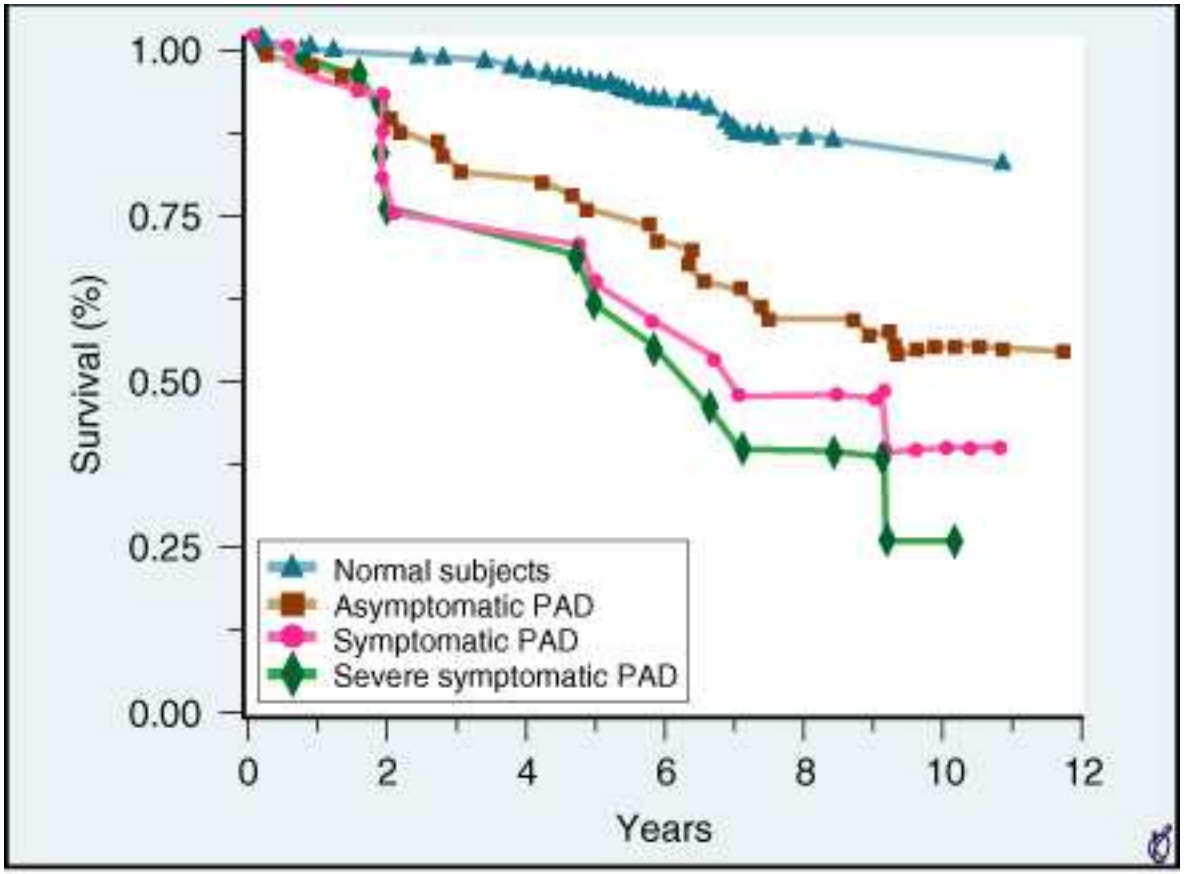
# Disease Progression in Claudicants

- 25% of Claudicants will ultimately require revascularization
  - Overall deterioration fastest in 1st year (6-9%) then 2-3% annually therafter
- 5% will develop critical limb ischemia
- Overall major amputation rate 1-3% at 5 years

# PAD is a marker of systemic atherosclerosis

- Cleveland Clinic study of routine heart catheterization prior to peripheral vascular surgery
  - 90% had CAD
  - 28% had severe, 3 vessel CAD
- Carotid ultrasound shows atherosclerosis in 25-50% of patients with PVD
- Over 10 years, overall 4.5x mortality risk for patients with PAD



# Risk factors for PAD

- More common in elderly, men
- Smoking is most important modifiable risk factor
  - Smokers have 1.7-5.6x risk of PAD than nonsmokers
  - Smokers have 3x risk of intermittent claudication
  - Amputation more common in smokers (up to 11%)
- Diabetes
  - DM have 1.5-6x prevalence of PAD
  - DM have 2-4x more intermittent claudication
  - DM have 10x risk of amputation
  - However – there is some uncertainty that DM is a causative agent in PAD

# Risk factors for PAD

- Hypertension
  - Men with HTN have 2.5x risk of PAD
  - Women with HTN have 4x risk of PAD
- Lipids
  - Total cholesterol/HDL ratio predictive
  - Hs-CRP predicitve

**TABLE 54–2 Risk of Peripheral Arterial Disease in Persons with Modifiable Risk Factors**

| Risk Factor | Estimated Relative Risk |
|---|---|
| Cigarette smoking | 2.0-5.0 |
| Diabetes mellitus | 3.0-4.0 |
| Hypertension | 1.1-2.2 |
| Hypercholesterolemia (per 40-50 mg/dl increase in total cholesterol) | 1.2-1.4 |
| Fibrinogen (per 0.7 g/liter increase in fibrinogen) | 1.35 |
| C-reactive protein | 2.1 |
| Hyperhomocysteinemia | 2.0-3.2 |



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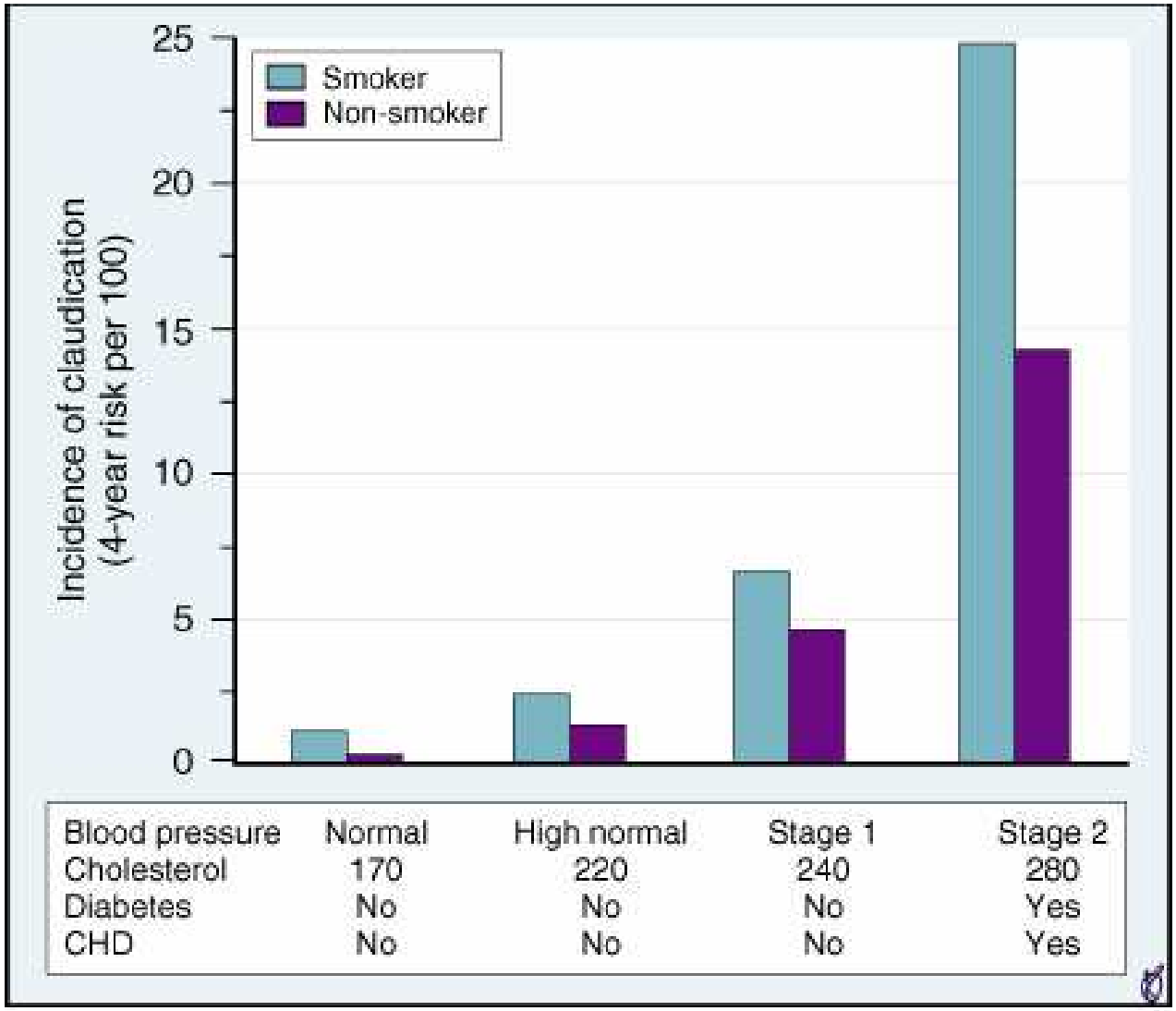
# Framingham data



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# Diagnosis – H+P

- History of claudication
  - Pain in muscle groups with exertion
  - Relieved with rest (usually 5-10 minutes) but not positional
  - Claudication variants
    - Pseudoclaudication – neurogenic or muscular, requires positional change for relief
    - *Vasospastic – normal pulses at rest, LE ischemia at exercise with absent pulses; usually there is proximal subcritical disease
    - Venous – congestion with standing or walking, relief with leg elevation
    - Muscular distress – common with myopathies, muscular dystrophy, amyotrophic lateral sclerosis; associated muscular deficits
- Physical exam for pulses and bruits

**TABLE 54–4 Differential Diagnosis of Exertional Leg Pain**

- Vascular causes
  - Atherosclerosis
  - Thrombosis
  - Embolism
  - Vasculitis
    - Thromboangiitis obliterans
    - Takayasu arteritis
    - Giant cell arteritis
  - Aortic coarctation
  - Fibromuscular dysplasia
  - Irradiation
  - Extravascular compression
    - Arterial entrapment (e.g., popliteal artery entrapment, thoracic outlet syndrome)
    - Adventitial cysts
- Nonvascular causes
  - Lumbosacral radiculopathy
    - Degenerative arthritis
    - Spinal stenosis
    - Herniated disc
  - Arthritis
    - Hips, knees
  - Venous insufficiency
  - Myositis
  - McArdle syndrome

# Diagnosis - ABI

- Ankle-Brachial index
  - Most effective non-invasive test for detection of PAD
  - Resting ABI <90%; 95% sensitive, 99% specificity for >=mild PAD
  - Exercise – may bring out >20mm Hg ankle pressure drop if PAD present
  - When ABI >130%, consider vessel incompressibility, toe pressures should be examined

# Interpretation of ABI

- In peripheral arteries, significant symptoms arise from 70-90% decrease in cross sectional area
- >20 mm Hg drop between segments is considered significant for lower extremity
  - (>10 mm Hg drop for upper extremity)
- Toe pressures should be >60% of brachial pressure
- Normal ABI – 0.9-1.0
- Claudication – 0.5-0.8
- Critical limb ischemia - <0.5
  - With ABI <0.4, <40% of patients can walk 6 minutes
- Ankle pressure <55 mm Hg predicts poor wound healing

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**Right ABI** = Higher right-ankle pressure / Higher arm pressure

**Left ABI** = Higher left-ankle pressure / Higher arm pressure

**Interpretation of ABI**

| | |
|---|---|
| > 1.30 | Noncompressible |
| 0.91–1.30 | Normal |
| 0.41–0.90 | Mild-to-moderate peripheral arterial disease |
| 0.00–0.40 | Severe peripheral arterial disease |

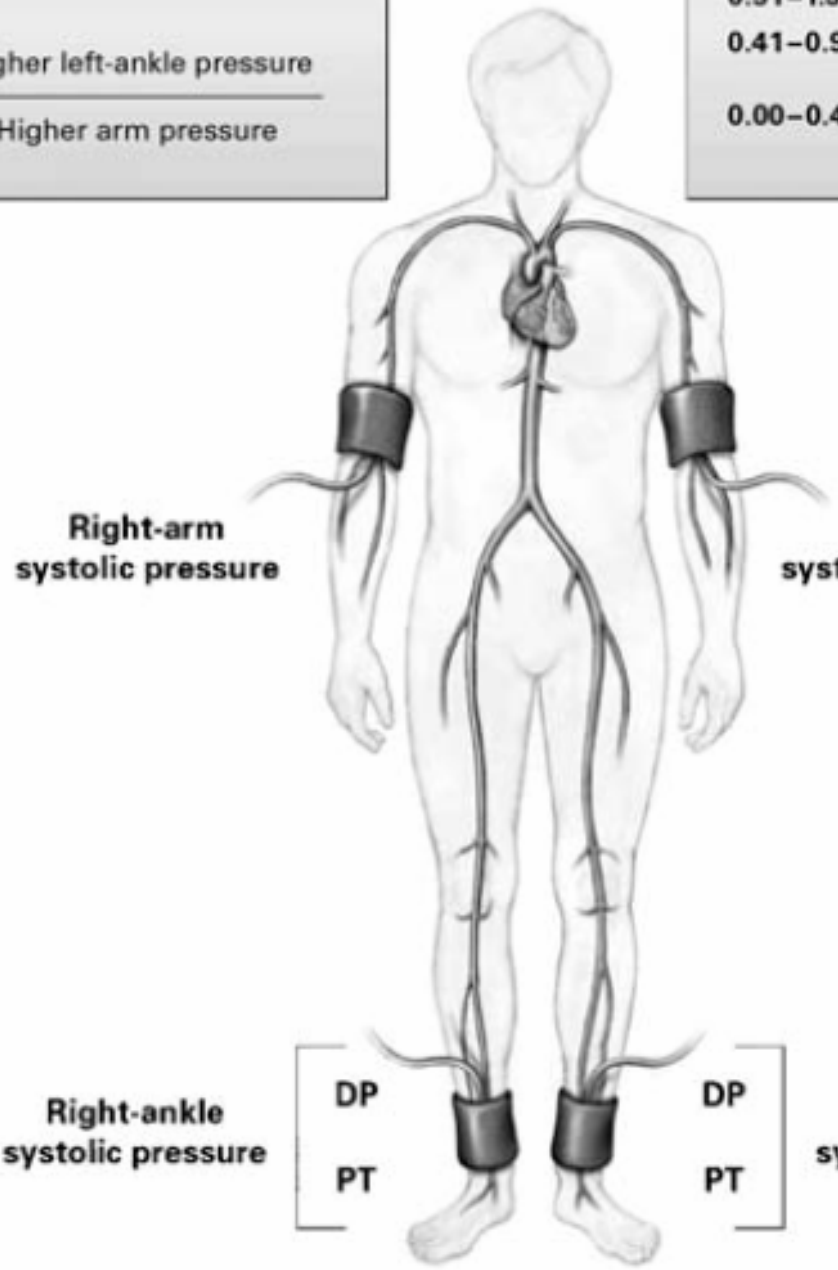

**TABLE 54–7 Leg Segmental Pressure Measurements in a Patient with Bilateral Calf Claudication**

| | 152/84 | |
|---|---|---|
| **Brachial Artery** | ***Right leg*** | ***Left leg*** |
| Upper thigh | 160 | 162 |
| Lower thigh | 110 | 140 |
| Calf | 108 | 100 |
| Ankle | 64 | 78 |
| Ankle/brachial index | 0.42 | 0.51 |



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# Exercise ABI

- Used to enhance detection of PAD
  - When rest ABI is normal with claudication symptoms
- Treadmill – 12% grade, 1.5-2.0 mph
- Dorsiflexion

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# Pulse Volume Recording

- Records blood volume changes in each segment of limb
  - Resembles arterial pulse
- Typically sharp systolic upstroke, shart peak, dicrotic notch, concave down to baseline
- Distal to stenosis – blunted rise, rounded peak, loss of dicrotic notch, slow descent
- Compare segments upstream and contralateral

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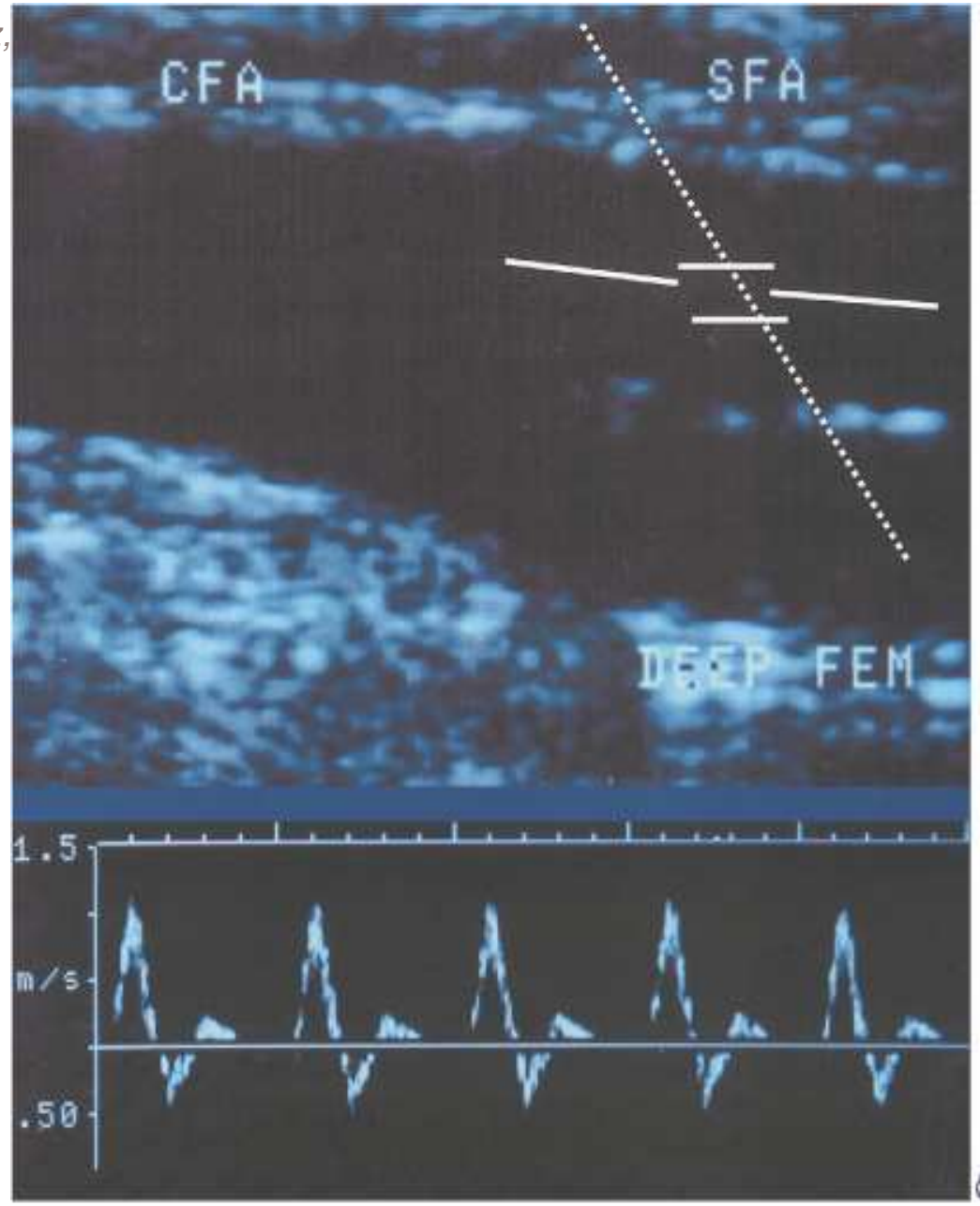
# Diagnosis – Ultrasound and MRA

- US
  - May be useful to screen patients for PAD, or assess vasculature for revascularization
  - B-mode ultrasound + doppler
    - Look for rise in velocities to find stenosis
      - 2x increase in velocitiy = 50% stenosis
      - 3x rise in velocity = 75% stenosis
      - 4x rise in velocity = 90% stenosis
- MRA
  - 97% sensitive and 99% specific compared to angiography for detection of PAD



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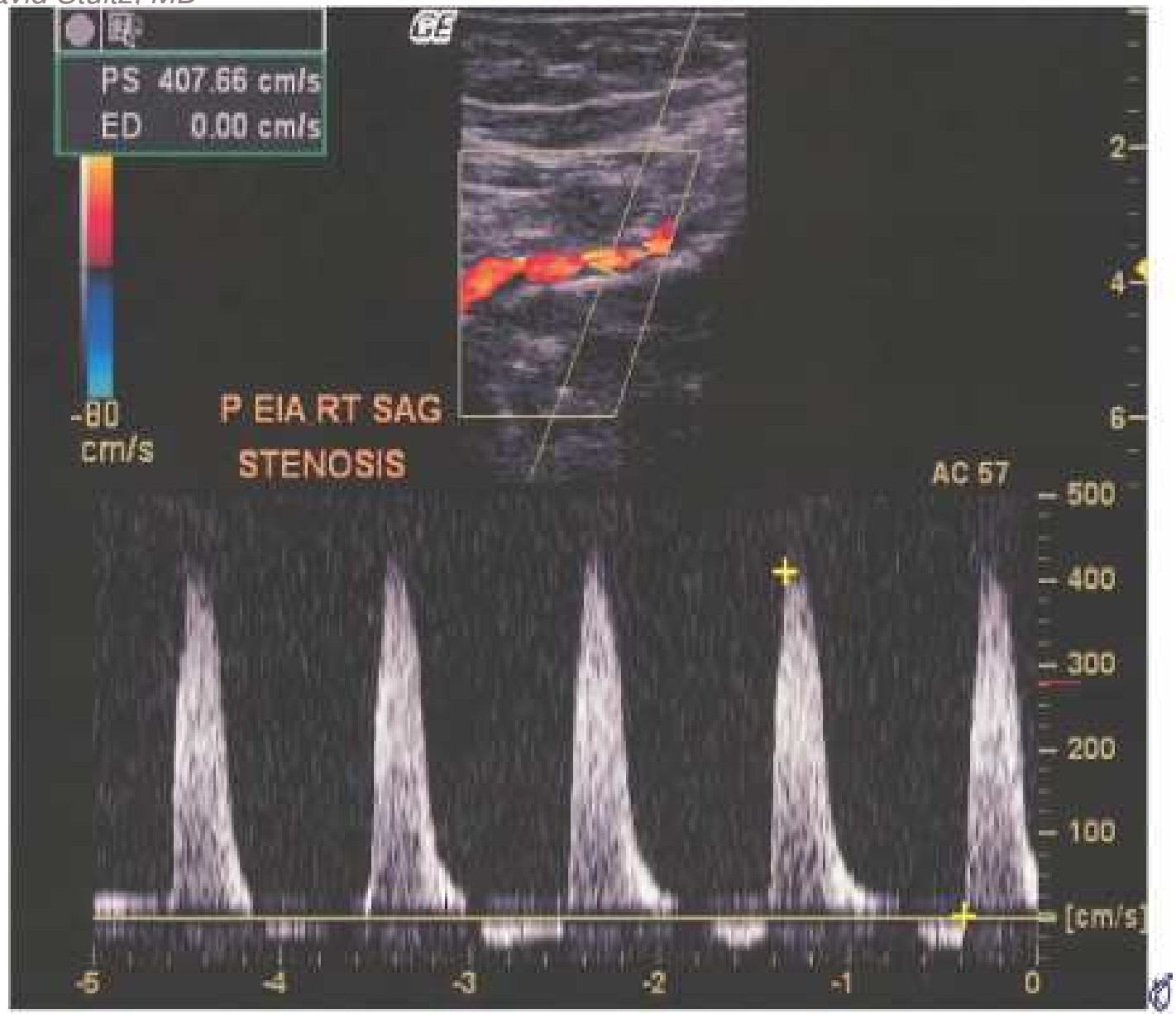




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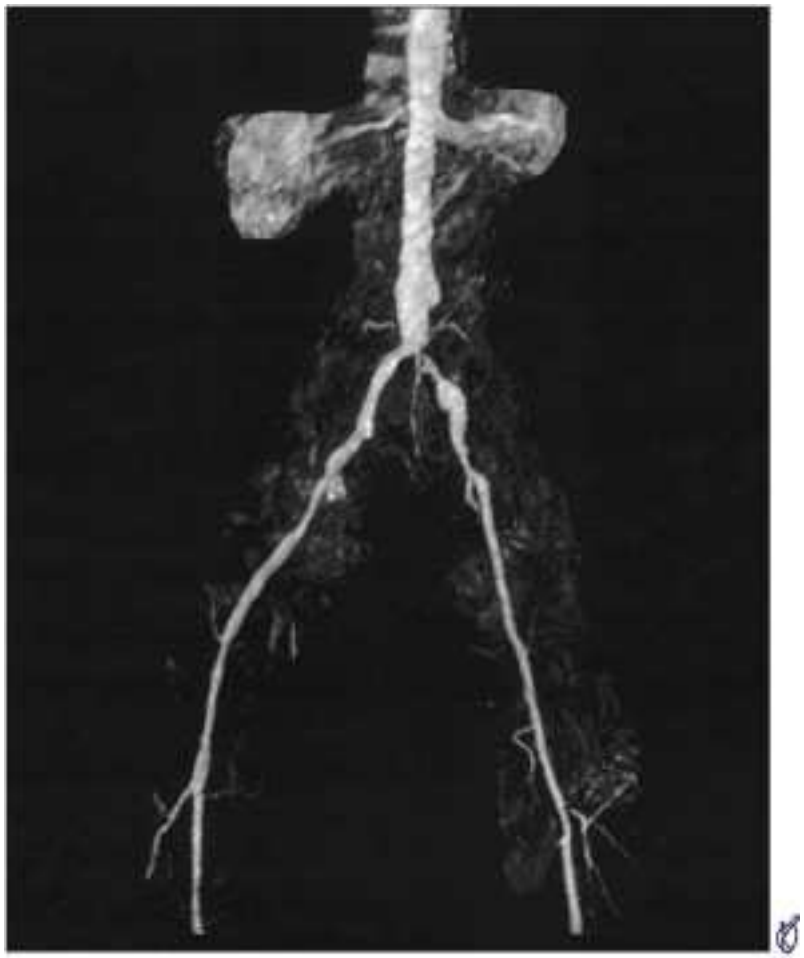


A

B

C

# Diagnosis - Screening

- Broad based screening not cost effective
- Target screening to patients
  - With exertional leg pain
  - >50 years old with risk factors (smoking, DM)
  - With DM >20 years
  - >70 years old

# Noninvasive testing - followup

- For patients with stable intermittant claudication who have a deterioration in status, consider angiography
- Noninvasive studies can be used for periodic followup of grafts or previously intervened segments

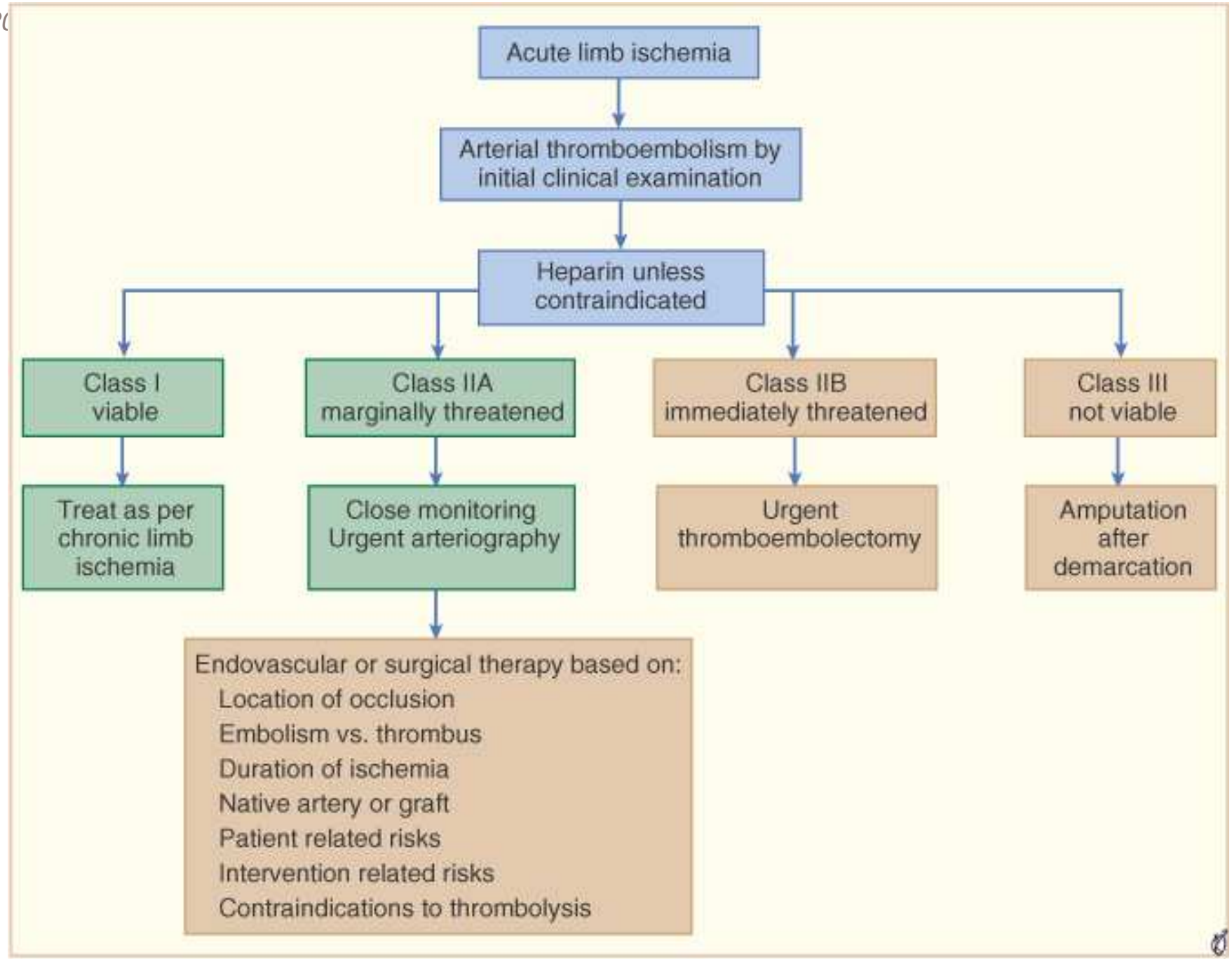
# Acute Limb Ischemia

- Worsening limb perfusion, causing a threat to limb viability
- Due to embolization or thrombosis
- Pain, Pulselessness, Pallor, Parasthesia, Paralysis
- 15% 30-day mortality rate
- 10-30% 30-day amputation rate

**TABLE 54–8 Clinical Categories of Acute Limb Ischemia (Modified from the SVS/ISCVS Classification)**

| Category | Description/Prognosis | Findings | | Doppler Signals | |
|---|---|---|---|---|---|
| | | *Sensory loss* | *Muscle weakness* | *Arterial* | *Venous* |
| I. Viable | Not immediately threatened | None | None | audible | Audible |
| II. Threatened | | | | | |
| a. Marginally | Salvageable if promptly treated | Minimal (toes) or none | None | (Often) inaudible | Audible |
| b. Immediately | Salvageable with immediate revascularization | More than toes, rest pain | Mild, moderate | (Usually) inaudible | Audible |
| III. Irreversible | Major tissue loss or permanent nerve damage inevitable | Profound, anesthetic | Profound, paralysis (rigor) | Inaudible | Inaudible |

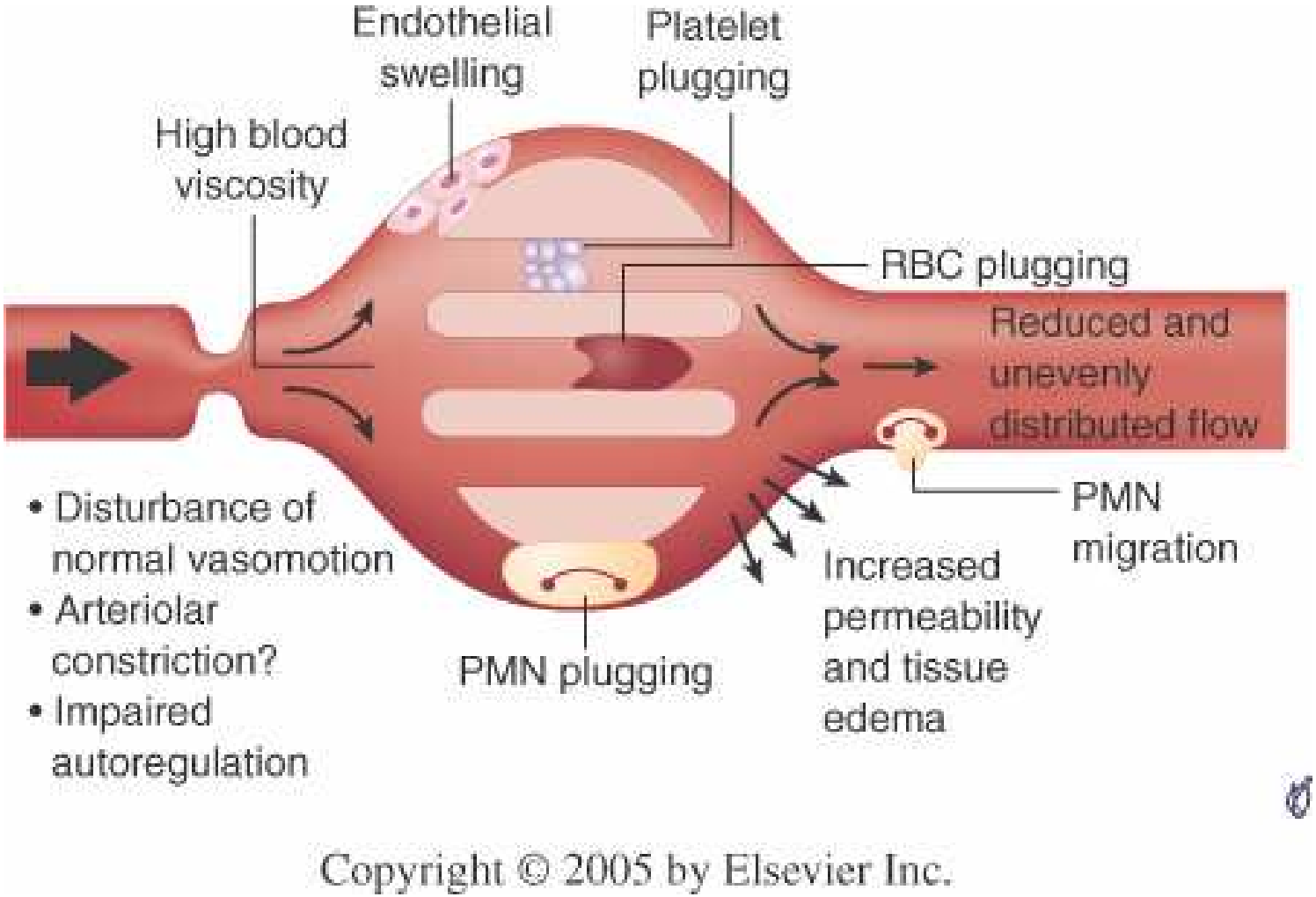
Adapted from Rutherford RB, Baker JD, Ernst C, et al. Recommended standards for reports dealing with lower extremity ischemia: revised version. J Vasc Surg 26:517, 1997.



# Chronic Critical Limb Ischemia

- Includes ischemic rest pain, ulcers, gangrene, or at risk for major amputation
- Absolute ankle pressure <=50 mm Hg
- Toe pressure <=30 mm Hg

# Pathophysiology of Microvascular circulation in Critical Ischemia

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| | Fontaine | | | Rutherford | |
|---|---|---|---|---|---|
| Stage | Clinical description | Grade | Category | Clinical description | Objective description |
| I | Asymptomatic | | 0 | Asymptomatic | Normal treadmill test |
| IIa | IC,* painfree walking distance >200 m | I | 1 | Mild IC | Treadmill exercise limited to 5 min; ankle pressure after exercise >50 mm Hg, but at least 20 mm Hg lower than at rest |
| | | | 2 | Moderate IC | Between Rutherford 2 and 3 disease |
| IIb | IC, painfree walking distance <200 m | | 3 | Severe IC | Treadmill exercise limited to <5 min; ankle pressure after exercise <50 mm Hg |
| II (compli-cated) | Lesions without CLI* (ankle pressure >50 mm Hg and/or great toe pressure >30 mm Hg) | | | | |
| III | Rest pain | II | 4 | Rest pain | Ankle pressure <40 mm Hg and/or great toe pressure <30 mm Hg; pulse volume recording barely pulsatile or flat |
| IV | Ischemic lesion (ulcer, gangrene, necrosis) | III | 5 | Limited ischemic lesion | Ankle pressure <60 mm Hg and/or great toe pressure <30 mm Hg; pulse volume recording barely pulsatile or flat |
| | | | 6 | Extended ischemic lesion (above metatarsal level) | |

*IC, intermittent claudication; CLI, critical leg ischemia.

**TABLE 54–5 Fontaine Classification of Peripheral Arterial Disease**

| Stage | Symptoms |
|---|---|
| I | Asymptomatic |
| II | Intermittent claudication |
| IIa | Pain-free, claudication walking >200 m |
| IIb | Pain-free, claudication walking <200 m |
| III | Rest and nocturnal pain |
| IV | Necrosis, gangrene |



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**TABLE 54–6 Clinical Categories of Chronic Limb Ischemia**

| Grade | Category | Clinical Description |
|---|---|---|
| | 0 | Asymptomatic, not hemodynamically correct |
| I | 1 | Mild claudication |
| | 2 | Moderate claudication |
| | 3 | Severe claudication |
| II | 4 | Ischemic rest pain |
| | 5 | Minor tissue loss: nonhealing ulcer, focal gangrene with diffuse pedal ulcer |
| III | 6 | Major tissue loss extending above transmetatarsal level, functional foot no longer salvageable |

Adapted from Rutherford RB, Baker JD, Ernst C, et al. Recommended standards for reports dealing with lower extremity ischemia: Revised version. J Vasc Surg 26:517, 1997.



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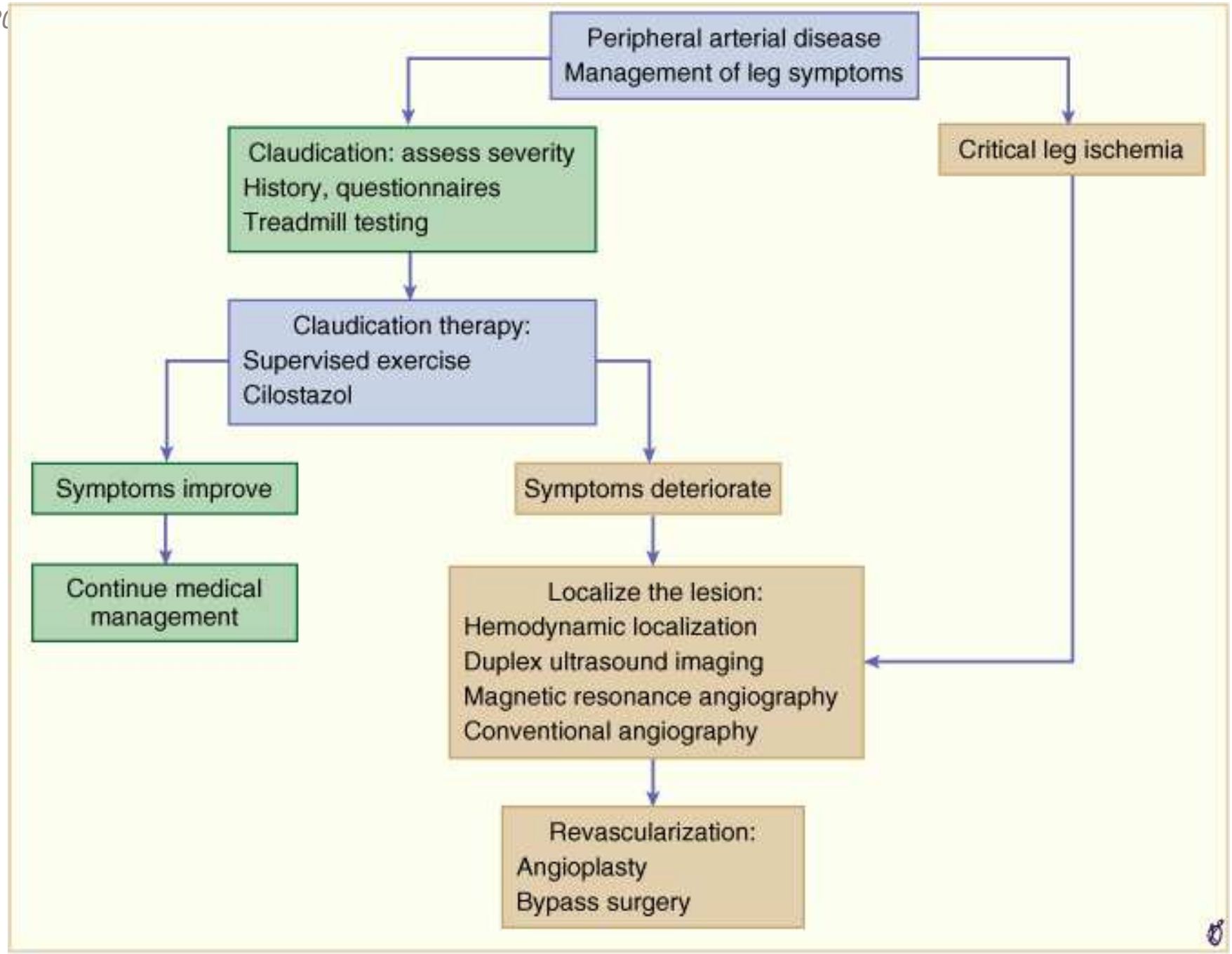
# Treatment

- Address and treat risk factors
- PAD is a CAD equivalent
- Medical management prior to revascularization for claudication
- Revascularization for chronic limb ischemia
- Limb salvage preferable to amputation



# Lifestyle Modification

- Low fat diet
- DM, HTN, HLP control
- Regular exercise (30-40 min/day, 4-5 times/week)
- Smoking cessation

# Antiplatelet Therapy

- ASA 75-150mg/d results in 23% relative risk reduction in MI, stroke, CV death
- CAPRIE trial supports use of Plavix over Aspirin for PAD (3.7% vs 4.9% annual risk of major vascular event)
- No data yet to support combination of ASA + Plavix

# Adjunctive Agents

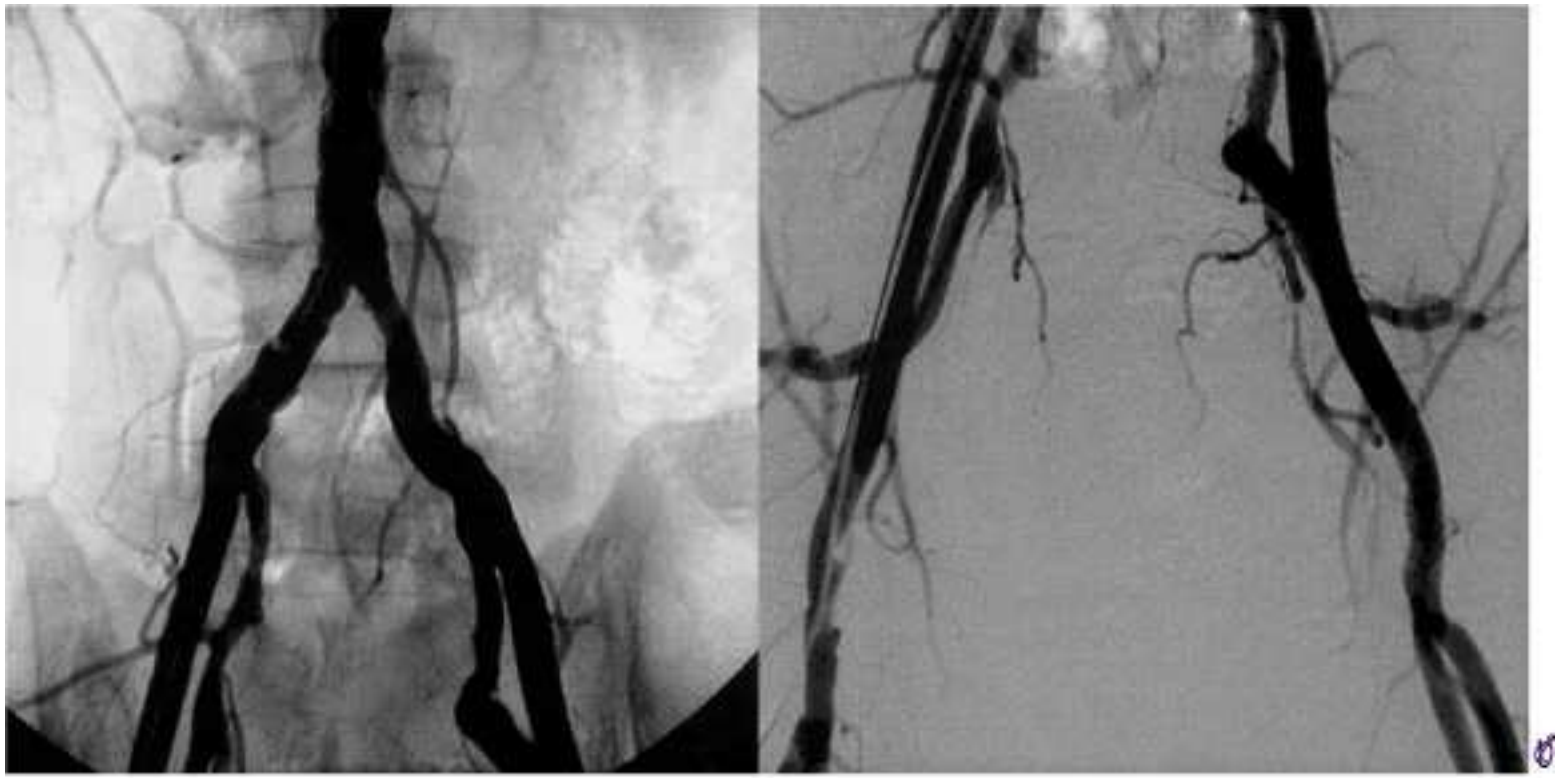
- Pentoxifylline not useful, average benefit of 44m of maximal walk distance
- Cilostazol (Pletal) approved for symptom relief, improves walk distance more than ASA or Pentoxifylline
- Prostaglandin $I_2$, $E_1$, and iloprost have shown improvement for severe PAD
  - Not commonly used as no oral form available

# Catheter-based revascularization

- Reserved for lifestyle disabling claudication, wounds without adequate arterial supply, or chronic limb ischemia
- Contraindications include abnormal hemostasis, CHF class 4, occlusion of abdominal aorta or calcified occlusions of iliac or femoral arteries (occlusions >10 cm have less favorable outcomes)

# Percutaneous treatment

- Acute or Subacute occlusion below inguinal ligament
  - Thrombus aspiration, thrombolytic infusion
  - Angioplasty
- Small trials support use of 2b-3a



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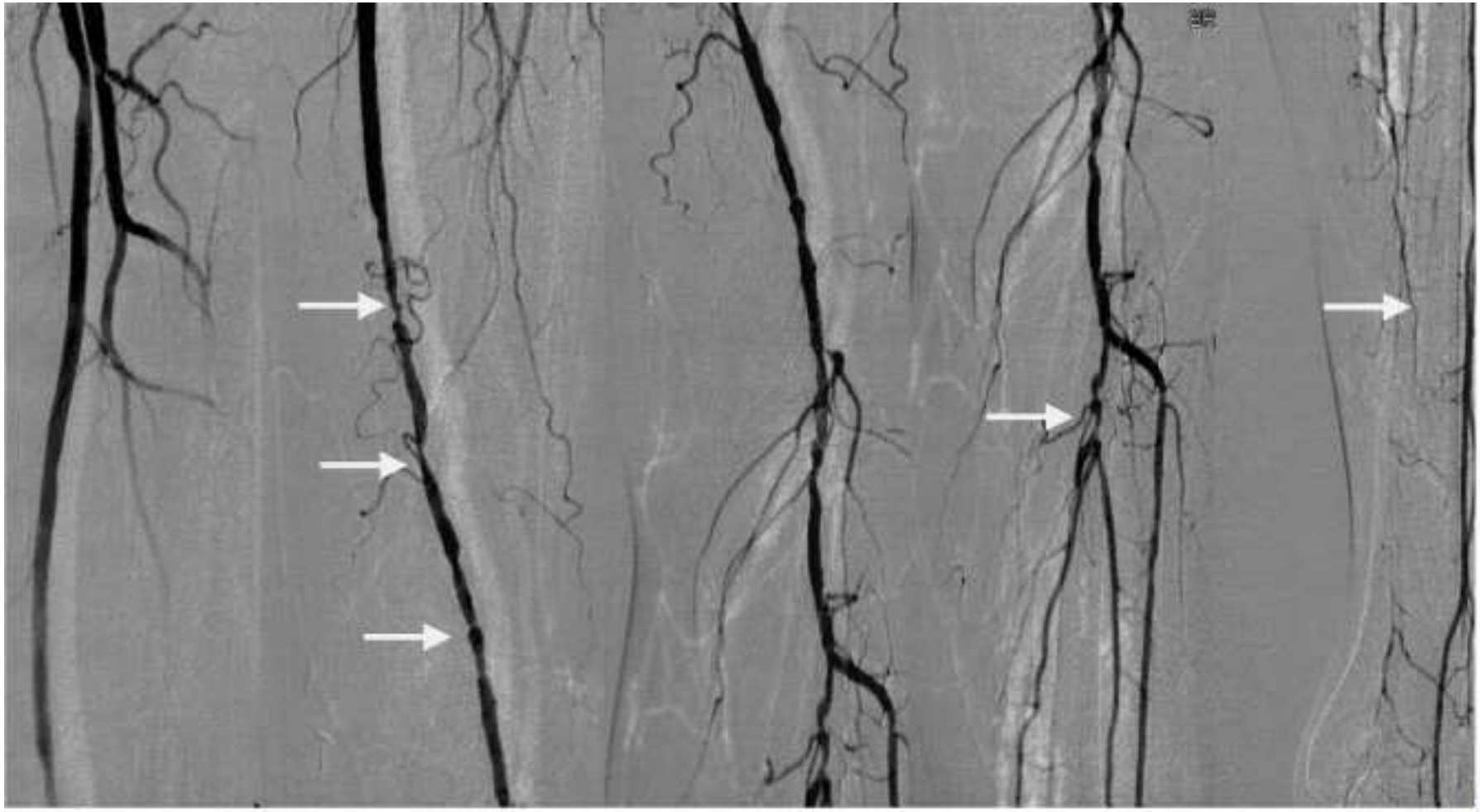

B

# Restenosis following catheter intervention

- Iliac arteries – 10-20% over 5 years
- Tibial vessels – 50% over 5 years

- Depends on length of interevened segment
- Most restenosis can be re-interevened

- Radiation therapy delays intimal hyperplasia
- Drug eluting stents being evaluated

# Surgical Revascularization

- Rarely indicated for intermittant claudication
- Aortobifemoral bypass uses prosthetic graft
- Venous graft preferred for infrainguinal bypass
- Higher success with more proximal disease
- 25-75% failure rate of femoral-distal grafts

# Antithrombotic Therapy

- Data supports use of antiplatelet therapy (ASA) following vein or prosthetic graft
- ASA should be started preoperatively
- Coumadin better at preserving patency of vein grafts; ASA better for prosthetic grafts
- However, coumadin reserved for patients at risk for graft failure
  - Femoral-distal bypass graft
  - Marginal quality vein
  - Poor arterial runoff
  - Previously failed bypass graft