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DIAGNOSIS AND MANAGEMENT OF PERIPHERAL OCCLUSIVE ARTERIAL DISEASE

Dr. ELRASHEED OSMAN

VASCULAR SURGEON

NOSM-TBRHSC

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Conflict of Interest Declaration: Nothing to Disclose

Presenter: Dr. ELRASHEED OSMAN

Title of Presentation:

DIAGNOSIS AND MANAGEMENT OF PERIPHERAL OCCLUSIVE ARTERIAL DISEASE

I have no financial or personal relationship related to this presentation to disclose.

CEPD continuing education and professional development

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LEARNING OBJECTIVES

- Three learning objectives:
  - a) Identify and assess risk factors
  - b) Appreciate the different categories of peripheral arterial occlusive disease (intermittent claudication versus critical limb ischemia)
  - c) Understand risk factor modification and pharmacological treatment

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PAD-TARGET AUDIENCE

- Primary care clinicians/Family practice
- Internal medicine
- PA, NP, nurse clinicians
- Cardiovascular/vascular medicine
- Vascular surgery
- Interventional radiology
- **Trainees and Specialists**

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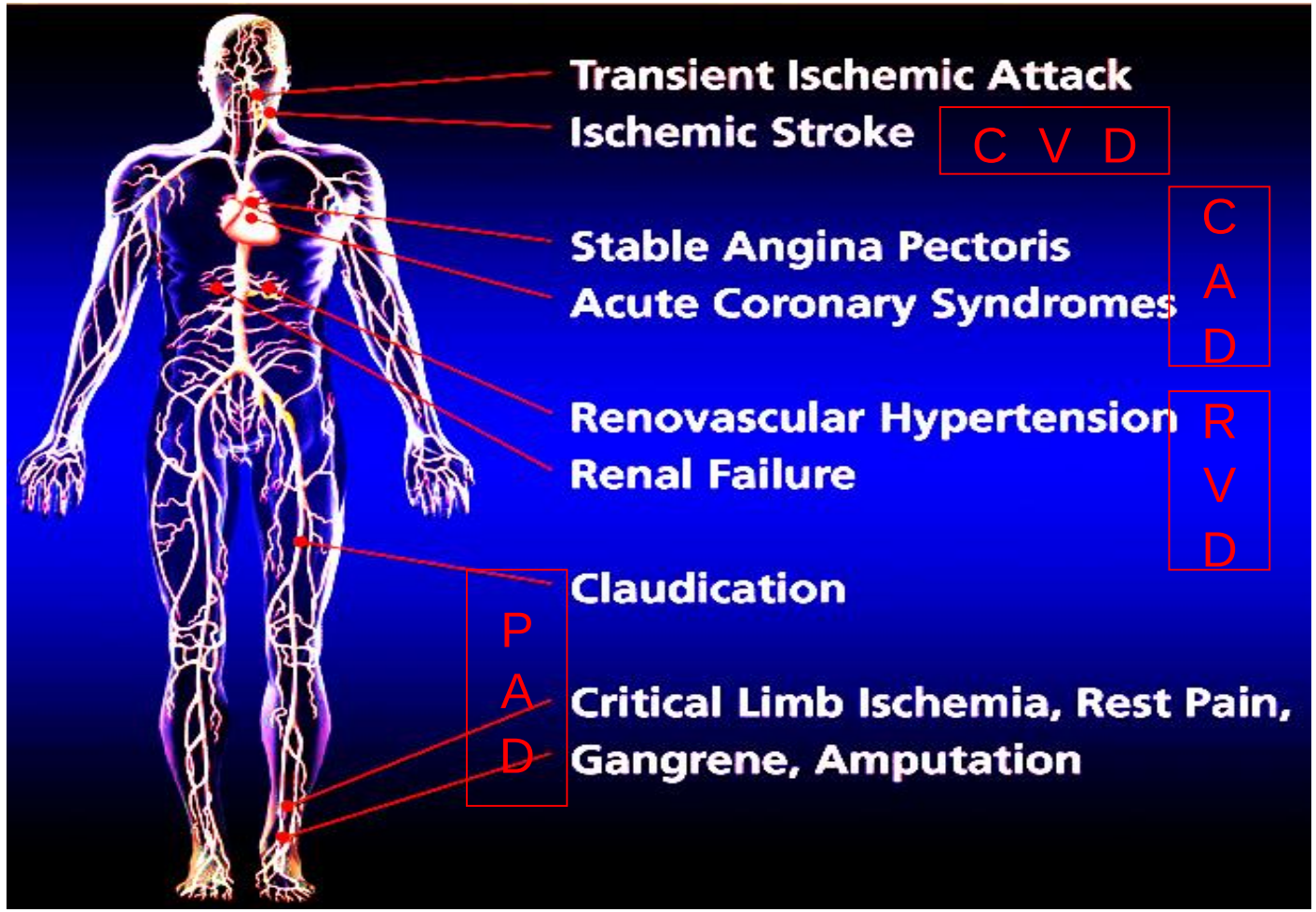
VASCULAR BEDS



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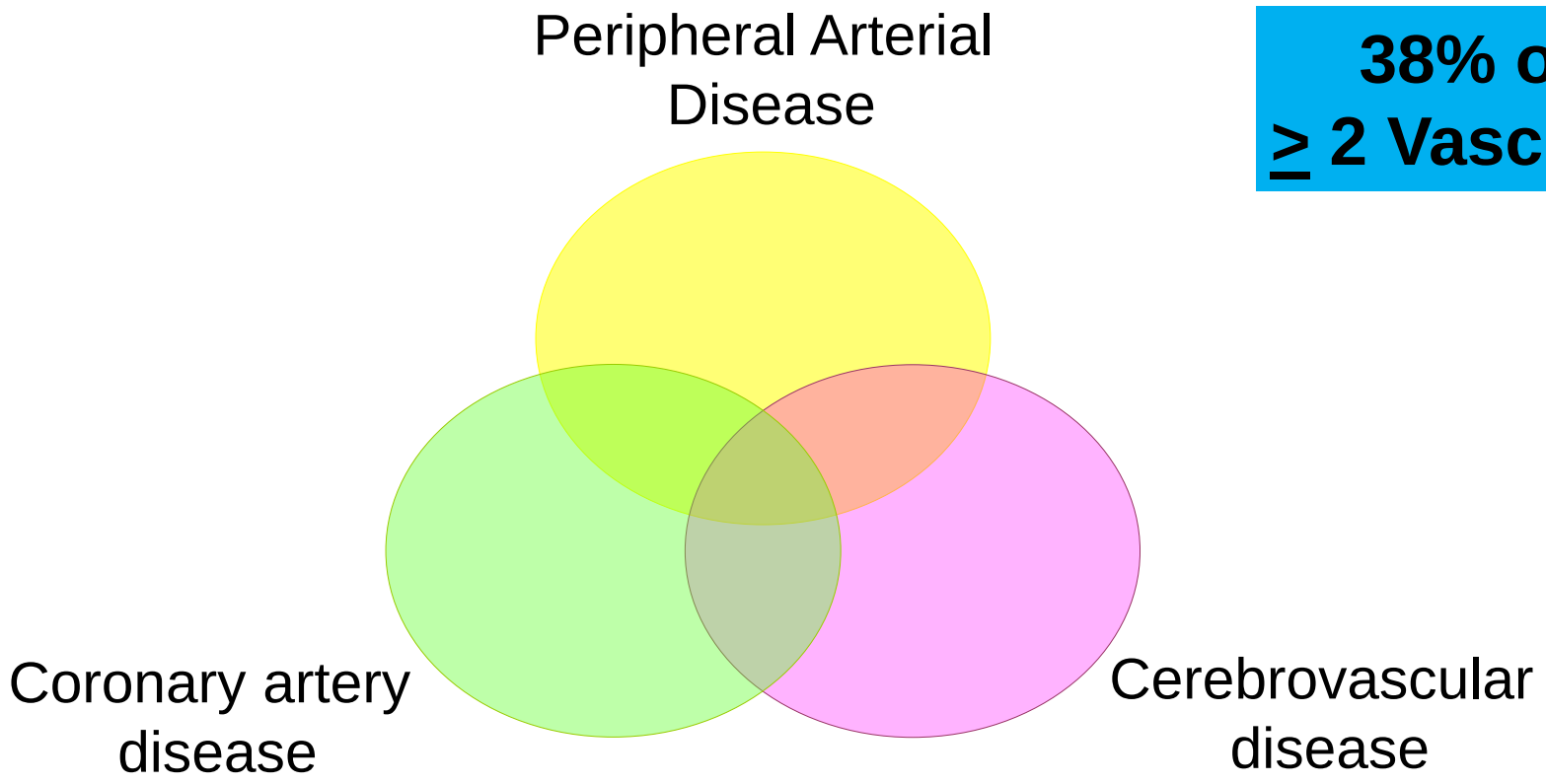
VASCULAR BEDS-OVERLAP



38% overlap
≥ 2 Vascular beds

Ness et al Am J Geriatr Soc 1999; 47:1255-6

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TIMING IS PERFECT

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DIFFERENT TERMS/NAMES?

- Peripheral arterial occlusive disease (PAOD)
- Peripheral arterial disease (PAD)
- Peripheral vascular disease (PVD)
- Lower extremity occlusive disease (LEOD)
- Critical limb ischemia (CLI)

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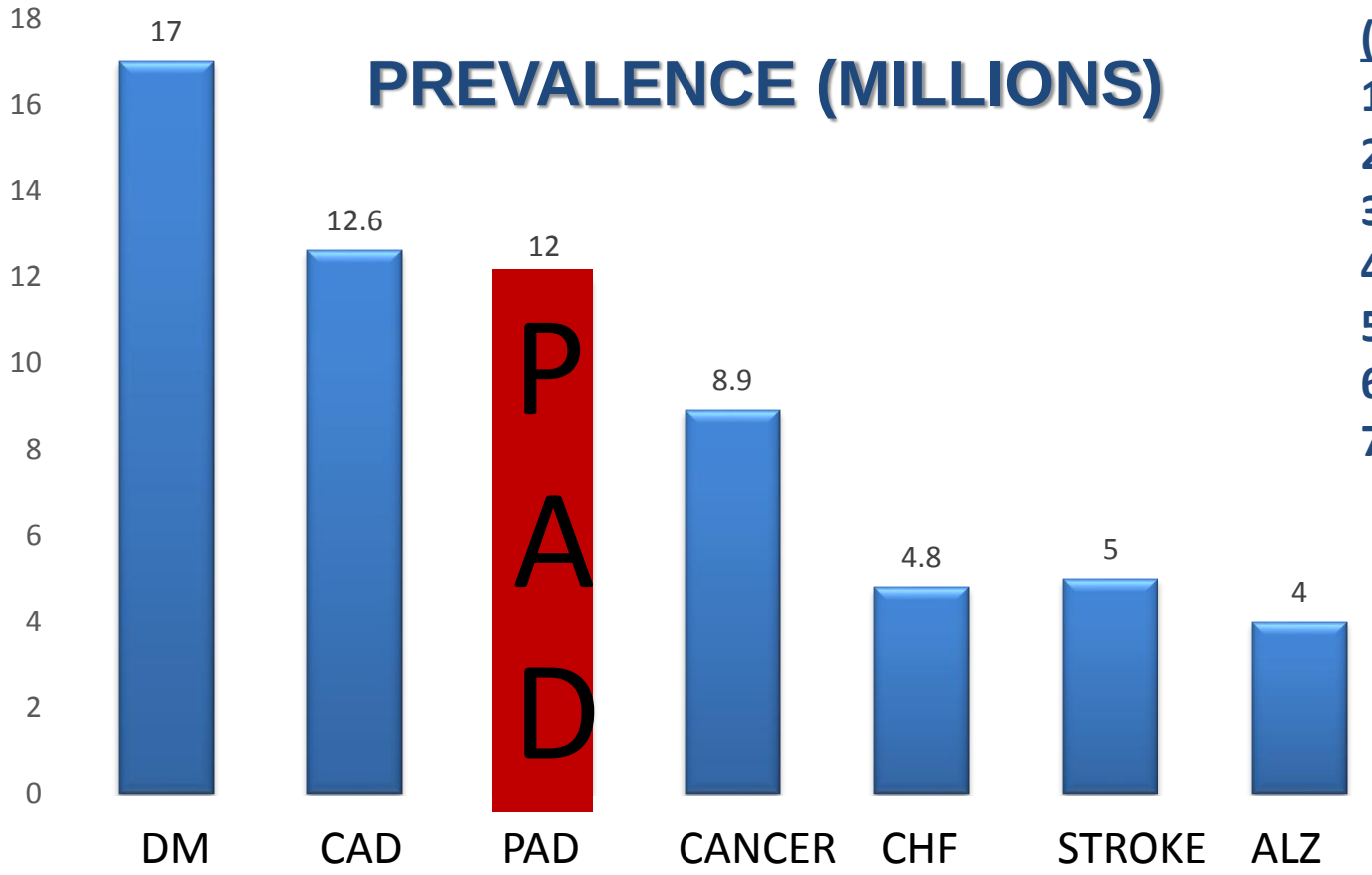
PAD-PREVALENCE



(ALPHABETICAL)

1. ALZHEIMERS
2. CAD
3. CHF
4. CANCER
5. DM
6. PAD
7. STROKE

Source: American Cancer Society, American Heart Association, Alzheimers Disease Education/Referral Center, American Diabetes Association, SAGE Group

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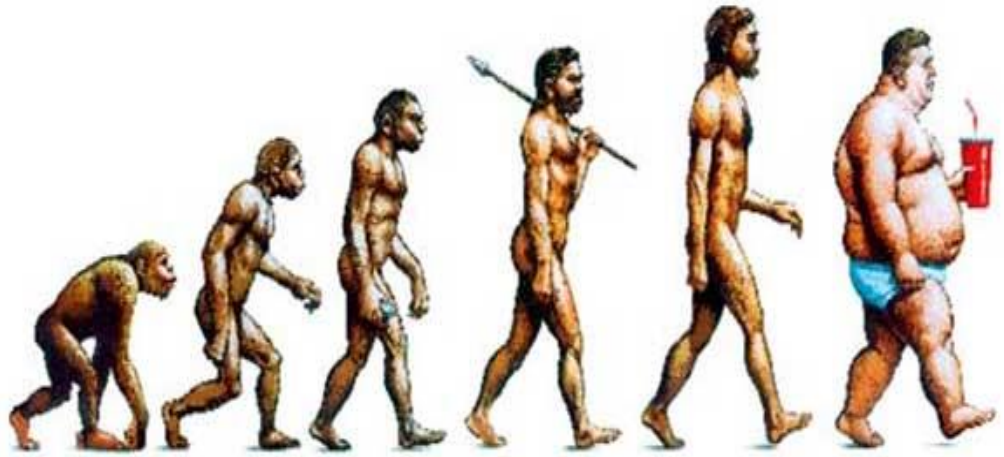
PAD-PREVALENCE

- US, 8)00)
- Worl
- 20% D
- Prevalence is expected to increase worldwide:
  - Aging population
  - Pers igarette smoking
  - Grov ic of DM, HTN &



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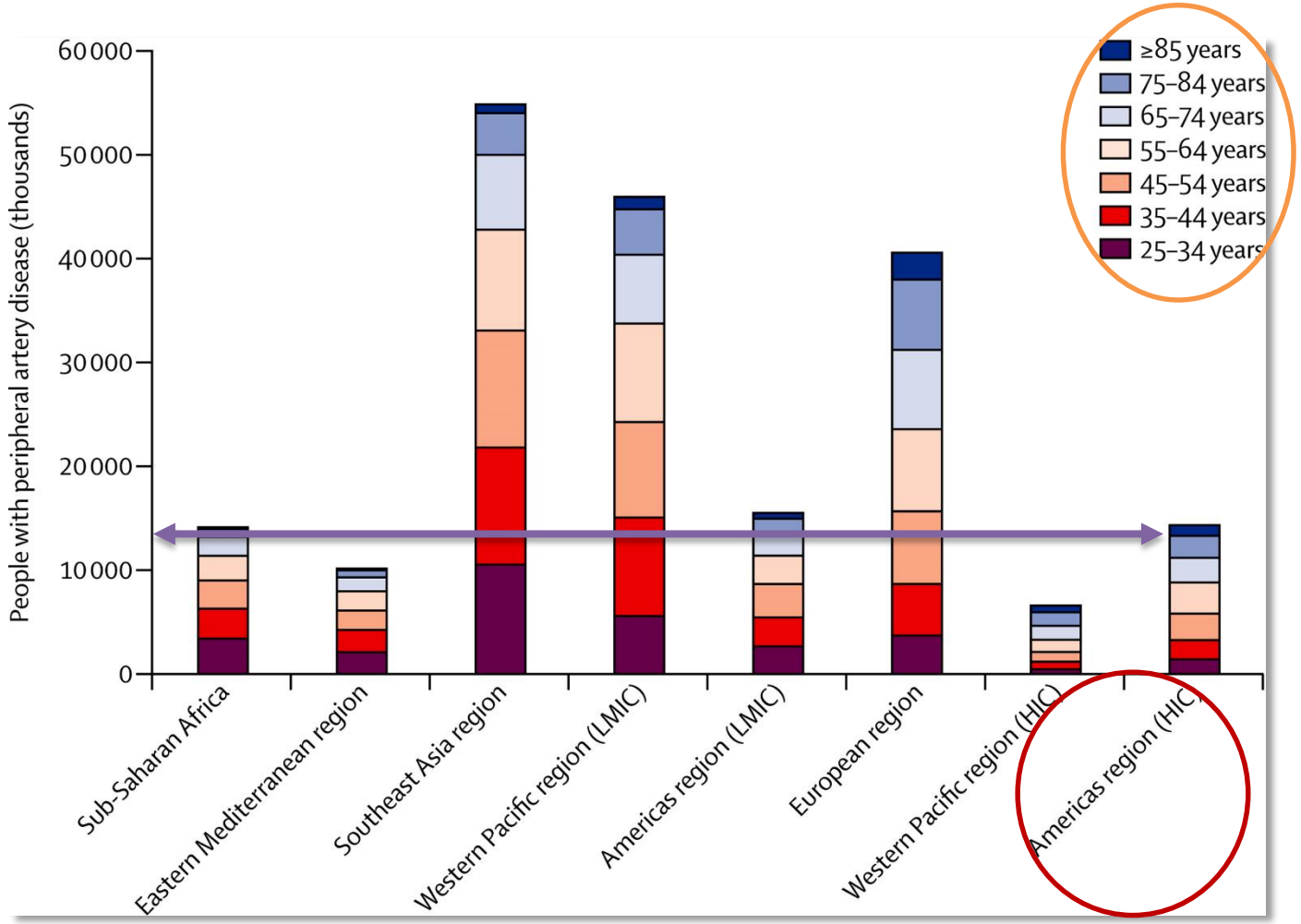
Worldwide PAD (2013)



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SIGNIFICANCE?

- Manifestation of systemic disease
- Powerful predictor of atherosclerotic disease in other vascular beds
  - Non-fatal heart attack X5
  - Total mortality X3

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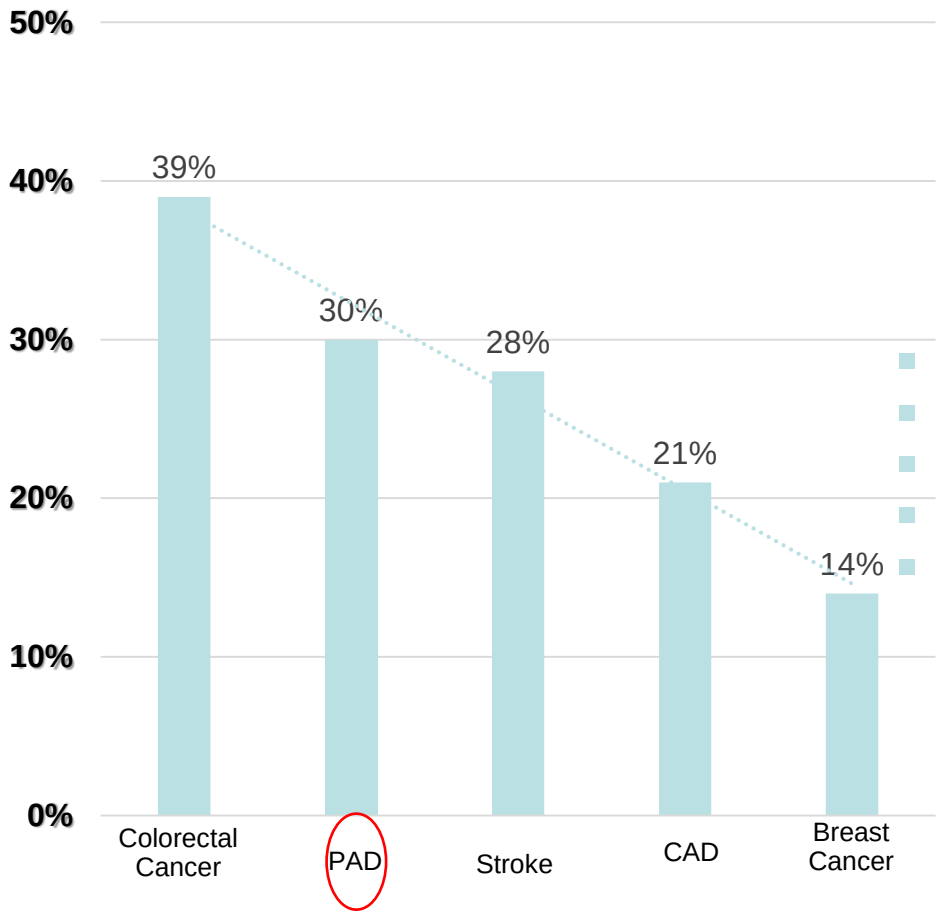
FIVE-YEAR MORTALITY



ALPHABETICAL
1. Breast Cancer
2. CAD
3. Colorectal Cancer
4. PAD
5. Stroke

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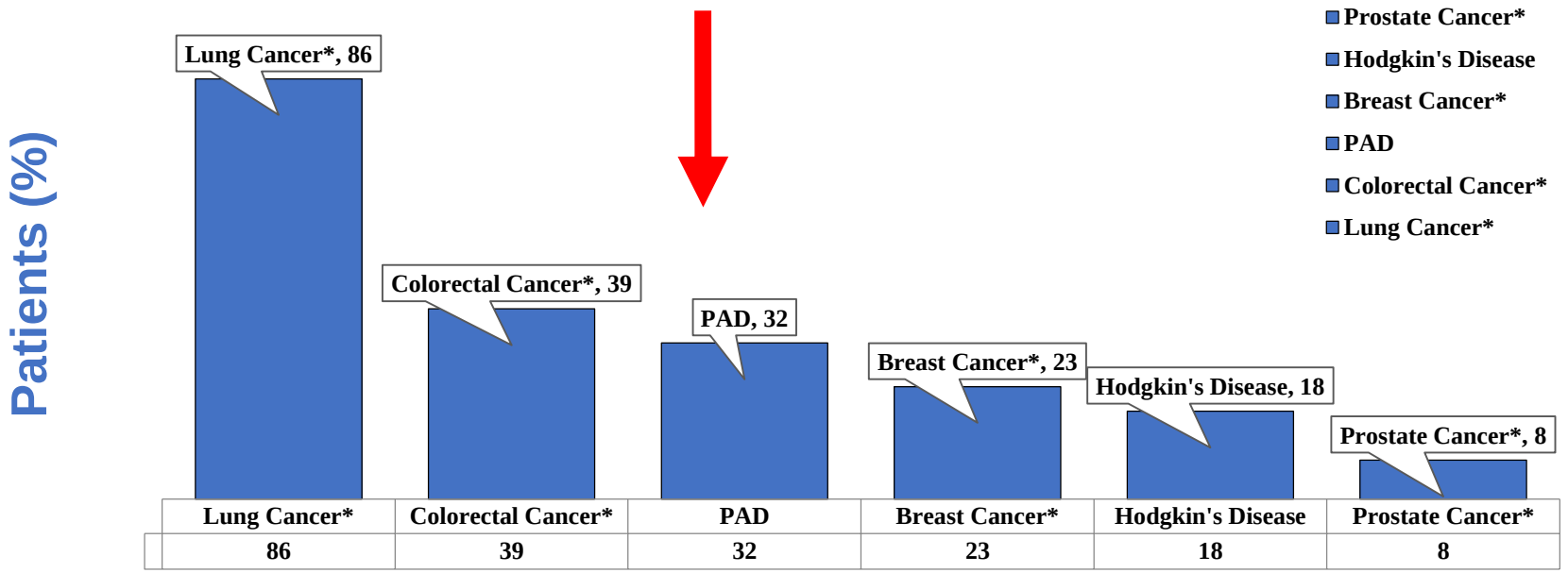
FIVE-YEAR MORTALITY



* American Cancer Society. Cancer Facts and Figures, 2000.
† Criqui MH, et al. N Engl J Med. 1992;326:381-386.

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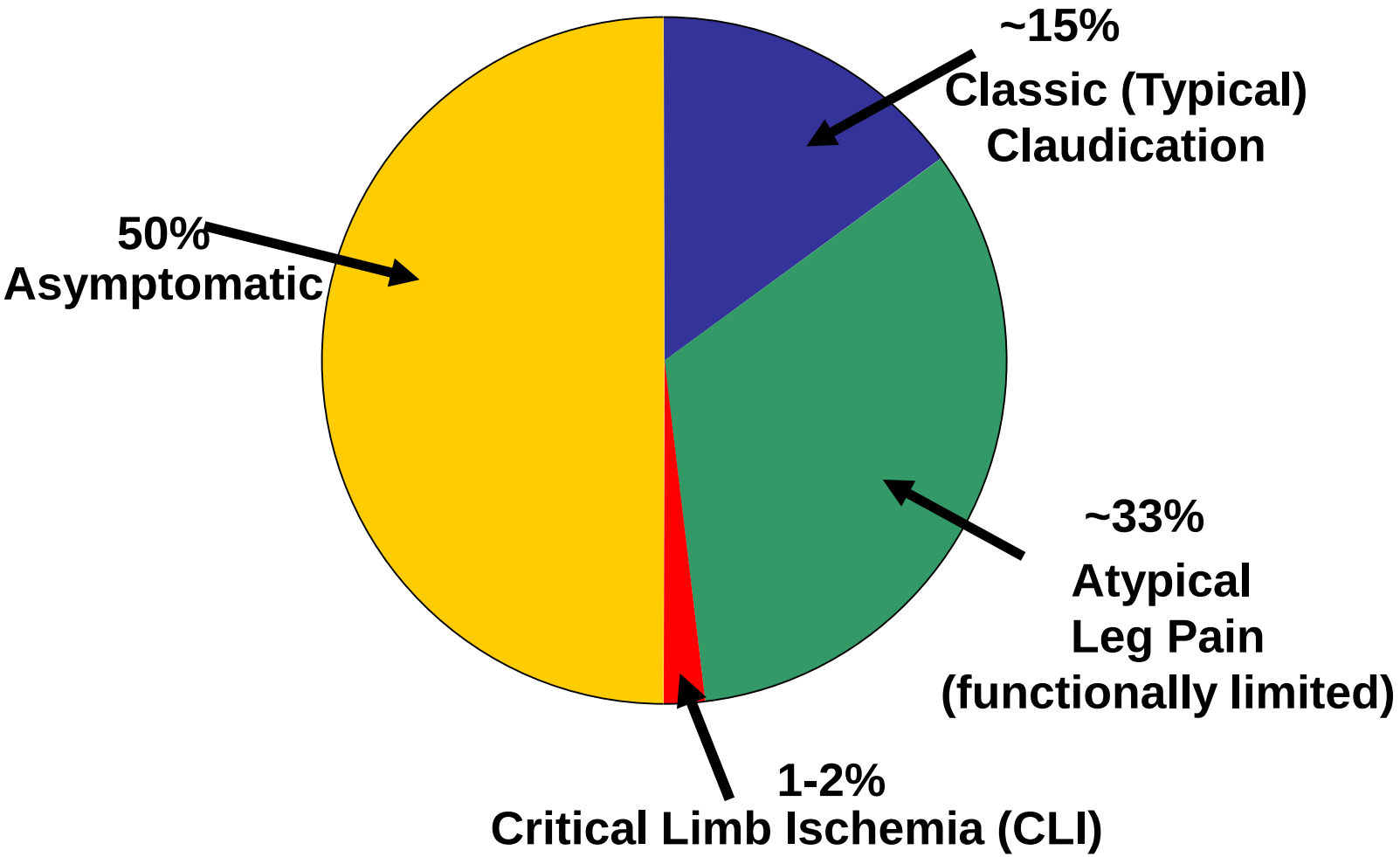
PAD-CLINICAL PRESENTATION



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PAD-CLASSIFICATION

FONTAINE		RUTHERFORD		
Stage	Clinical	Grade	Category	Clinical
I	Asymptomatic	0	0	Asymptomatic
IIa	Mild claudication	I	1	Mild claudication
IIb	Moderate–severe claudication	I	2	Moderate claudication
		I	3	Severe claudication
III	Ischemic rest pain	II	4	Ischemic rest pain
IV	Ulceration or gangrene	III	5	Minor tissue loss
		IV	6	Ulceration or gangrene

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PAD-CURRENT SITUATION

- Much commoner than we think
- Under-diagnosed
- Under-treated

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PAD-SYMPTOMS

- **Claudication** (Latin "claudicare"=to limp)
  - Fatigue
  - Heaviness
  - Tiredness
  - Cramps

  } in the leg muscles that occurs during activities

- Stop activity=Pain/discomfort disappears

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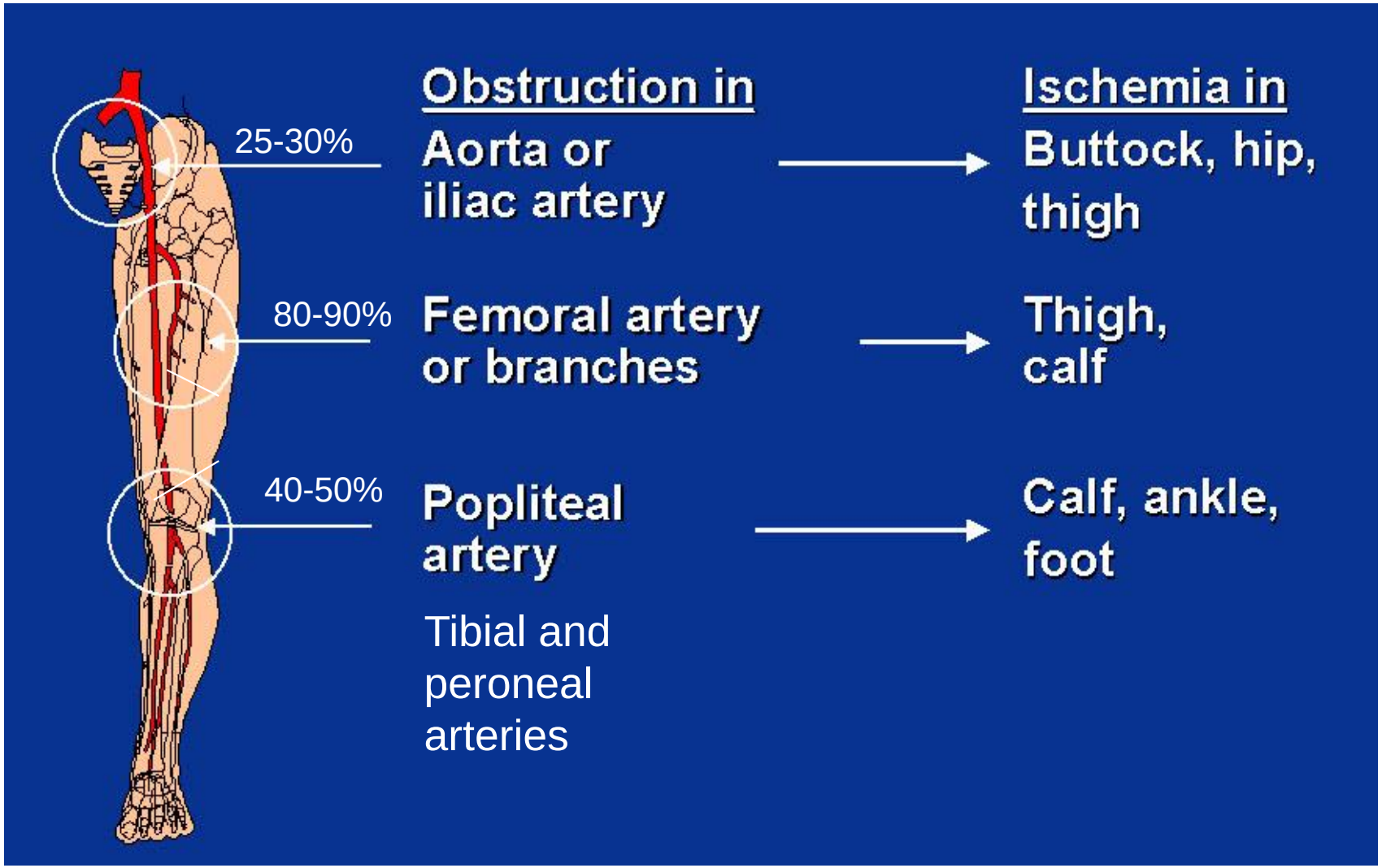
SYMPTOMS AND ARTERIAL SEGMENTS



Adapted from TCT 2005

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ATYPICAL/NO PRESENTATION

- Most people:
  - do not have the typical signs and symptoms
  - Fail to report symptoms (natural process of aging)

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PAD-ASYMPTOMATIC

- True asymptomatic=No PAD
- Asymptomatic PAD="not challenged"
  - Poor medical condition
  - Poor functional capacity
  - Active, but with reduction of walking speed

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Circulation. 2008 May 13; 117(19): 2484–2491. doi:10.1161/CIRCULATIONAHA.107.736108.

Asymptomatic Peripheral Arterial Disease Is Associated With More Adverse Lower Extremity Characteristics Than Intermittent Claudication

Mary M. McDermott, MD, Jack M. Guralnik, MD, PhD, Luigi Ferrucci, MD, PhD, Lu Tian, ScD, Kiang Liu, PhD, Yihua Liao, MS, David Green, MD, PhD, Robert Sufit, MD, Frederick Hoff, MD, Takashi Nishida, MD, Leena Sharma, MD, William H. Pearce, MD, Joseph R. Schneider, MD, PhD, and **Michael H. Criqui, MD, MPH**

Feinberg School of Medicine, Northwestern University, Chicago, Ill (M.M.M., L.T., K.L., Y.L., D.G., R.S., F.H., T.N., L.S., W.H.P.); National Institute on Aging, Bethesda, Md (J.M.G., L.F.); Central DuPage Hospital, Winfield, Ill (J.R.S.); and University of California at San Diego, San Diego (M.H.C.).

- 72 asymptomatic
- 215 claudicants
- 292 no PAD

- ***Slower usual-paced and fast-paced walking***
- ***Poorer physical functioning score (QoL)***

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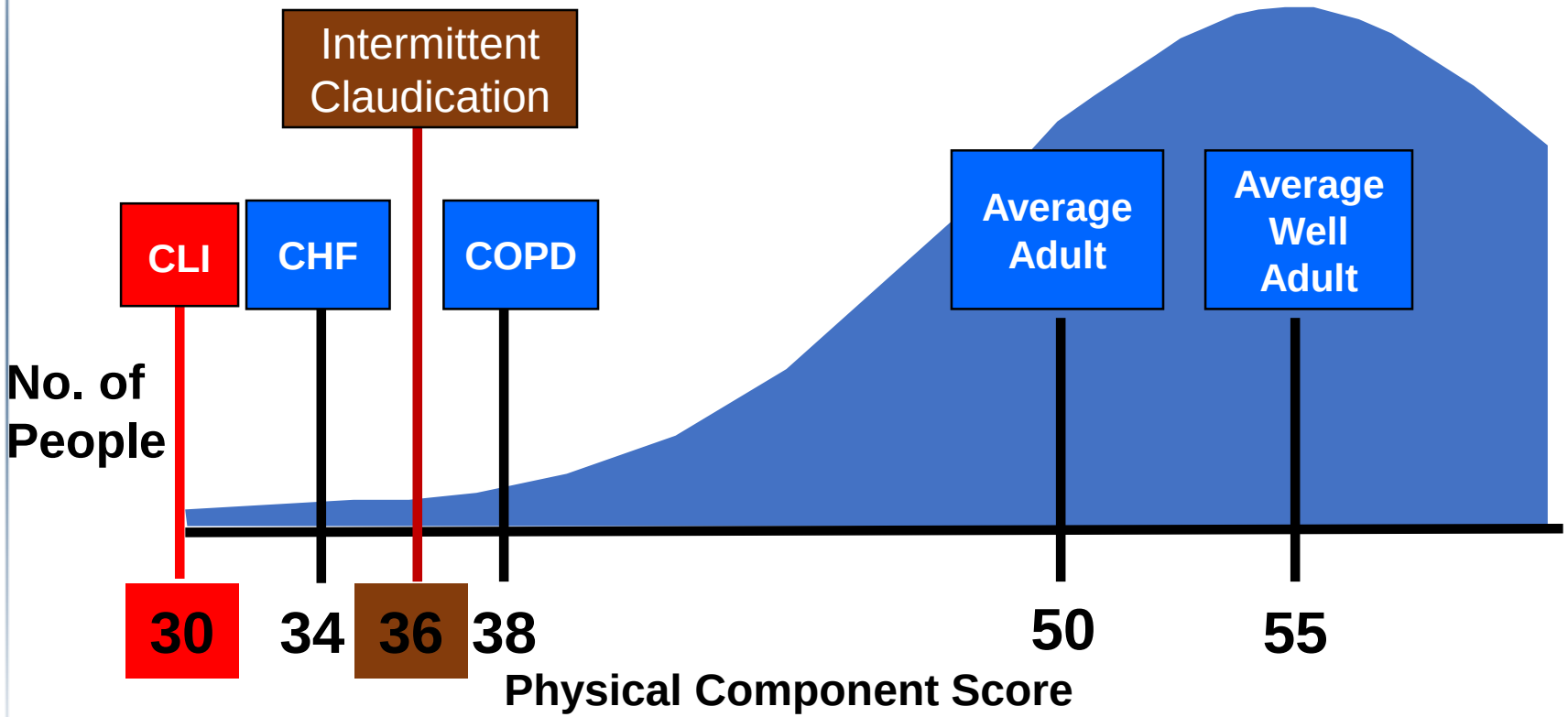
SF-36 PHYSICAL FUNCTION SCORES



Ware JE. Ann Rev Pub Health. 1995;16:327-354.

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PAD-CRITICAL LIMB ISCHEMIA (CLI)

- The most severe form of PAD
- 1% of total number of PAD patients
- Major manifestations
  - Rest pain
  - Ulceration
  - gangrene

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PAD-SIGNS

- Muscle atrophy
- Hair loss
- Thickened nails
- Shiny skin
- Pallor/Dependent rubor
- Coldness/coolness of feet
- Decreased/absent pulses

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EXAMINATION OF PULSES

Femoral Pulse

Popliteal Pulse

Posterior Tibial Pulse

Dorsalis Pedis Pulse

Beard JD. BMJ. 2000;320:854.

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PAD-ETIOLOGY

- Atherosclerosis
- Degenerative diseases
  - Marfan's syndrome
  - Ehlers-Danlos syndrome
  - Neurofibromatosis
- Dysplastic disorders
  - Fibromuscular dysplasia
- Vascular inflammation
  - Takayasu's disease
- Thromboembolism

Hirsh et al Circulation 2006; 113(11): e463-654. ACC/AHA Guidelines

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PAD-AT RISK GROUPS

- <50 years with diabetes, and one additional risk factor (e.g., smoking, dyslipidemia, hypertension, or hyperhomocysteinemia)
- 50 to 69 years and history of smoking or diabetes
- >70 years
- Leg symptoms with exertion (suggestive of claudication) or ischemic rest pain
- Abnormal lower extremity pulse examination
- Known atherosclerotic coronary, carotid, or renal artery disease

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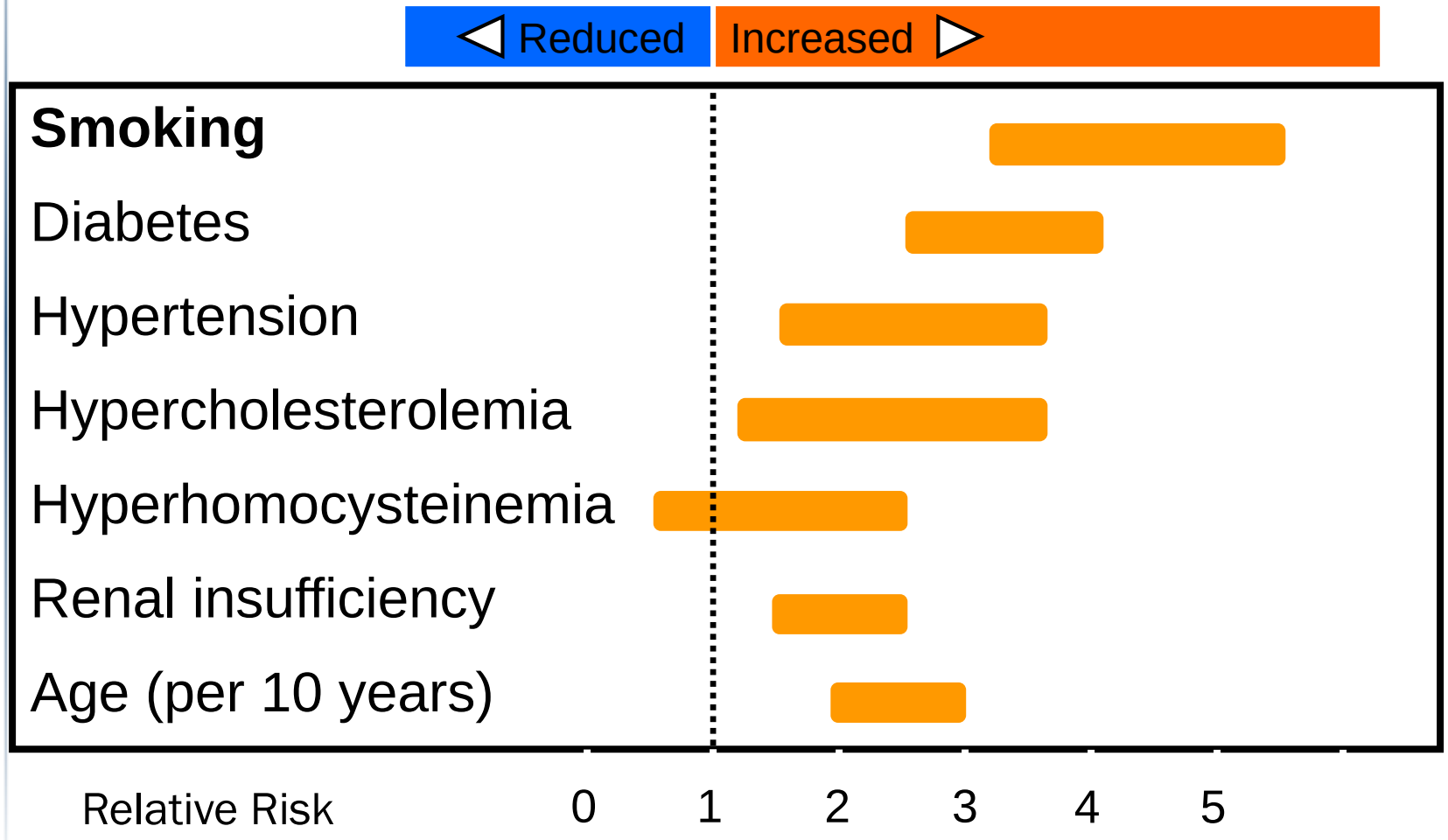
RISK FACTORS FOR PAD



Hirsch AT, et al. J Am Coll Cardiol. 2006;47:e1-e192.

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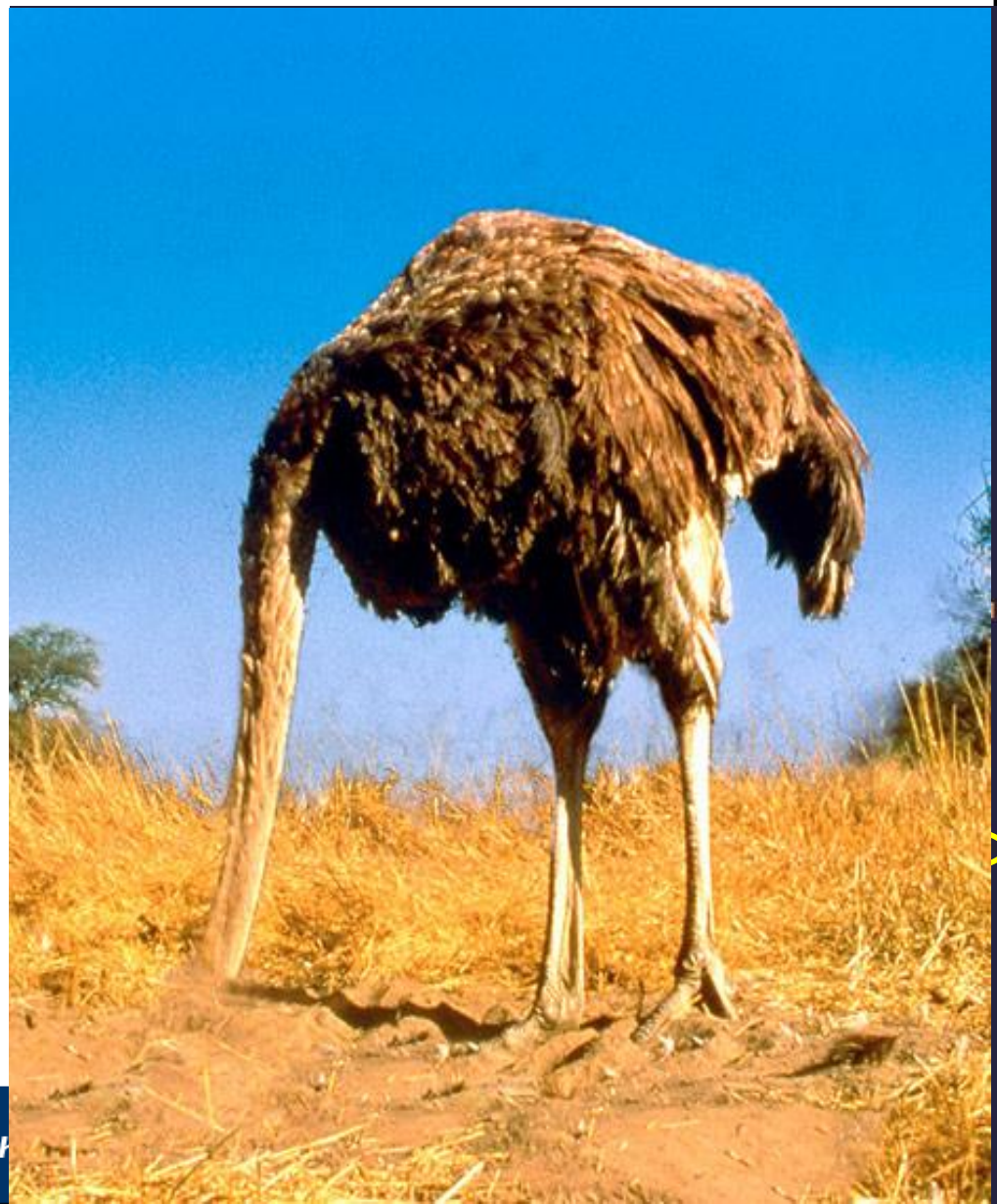
RAISE TOBACCO TAX=LOWER DEATH AND DISEASE

- One billion smokers

FIRST NATIONS CIGARETTE ALLOCATION SYSTEM



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INITIAL ASSESSMENT

- Comprehensive medical history
  - Exercise-related leg symptoms (claudication)
  - Ischemic rest pain
  - Non-healing wounds
- Vascular examination
  - Palpation of lower extremity pulses (i.e., femoral, popliteal, dorsalis pedis, and posterior tibial)
  - Inspection of legs and feet
- **Noninvasive testing**

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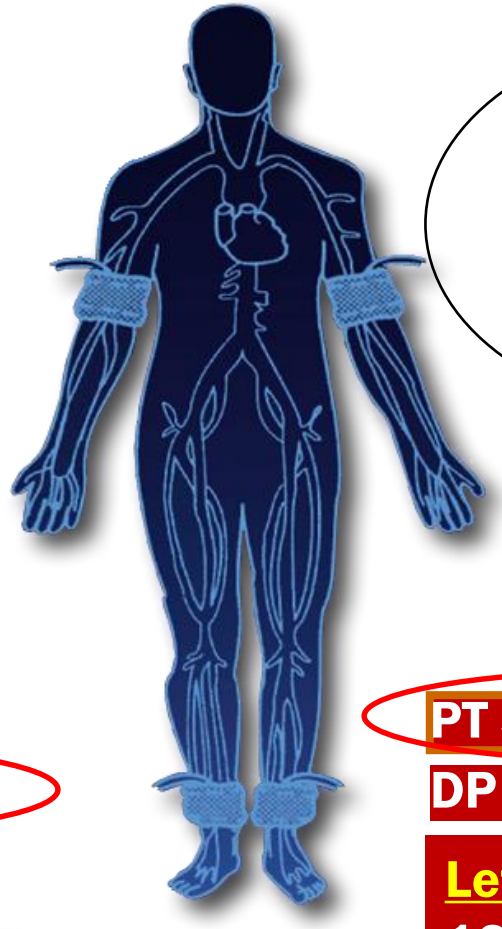
ANKLE-BRACHIAL INDEX (ABI)

Brachial SBP
150 mm Hg



Brachial SBP
160 mm Hg

Highest brachial SBP

PT SBP 40 mm Hg
DP SBP 80 mm Hg

Right ABI
80/160=0.50

PT SBP 120 mm Hg
DP SBP 80 mm Hg

Left ABI
120/160=0.75

Highest of PT or DP SBP

ABI=ankle-brachial index; DP=dorsalis pedis; PT=posterior tibial; SBP=systolic blood pressure.

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ANKLE-BRACHIAL INDEX

ABI	Interpretation
1.00–1.39	Normal
0.91–0.99	Borderline
0.41–0.90	Mild-to-moderate disease
≤0.40	Severe disease
≥1.40	Non-compressible (DM & CKD)

ACC/AHA PAD Guidelines 2011

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ABI Vs OTHER COMMON SCREENING TESTS

Diagnostic Test	Sensitivity, %	Specificity, %
Pap smear [1]	30 - 87	86 – 100
Fecal occult blood test [2]	37 - 78	87 – 98
Mammography [3]	75 - 90	90 – 95
ABI [4,5,6]	95	100

Belch JJ et al, Arch Intern Med, 2003;163:884

1. Nanda et al Ann Intern Med 2000;132:810-9
2. Allison et al New Eng J Med 1996;334:155-9
3. Ferrini et al Ame J Prev Med 1996;12:340-1
4. Dormandy et al Semin Vasc Surg 1999;12:96 -108
5. Fowkes et al Inter J Epid 1991; 20:384-392
6. Newman et al Arterioscler Thromb Vasc Biol. 1999;19:538–545

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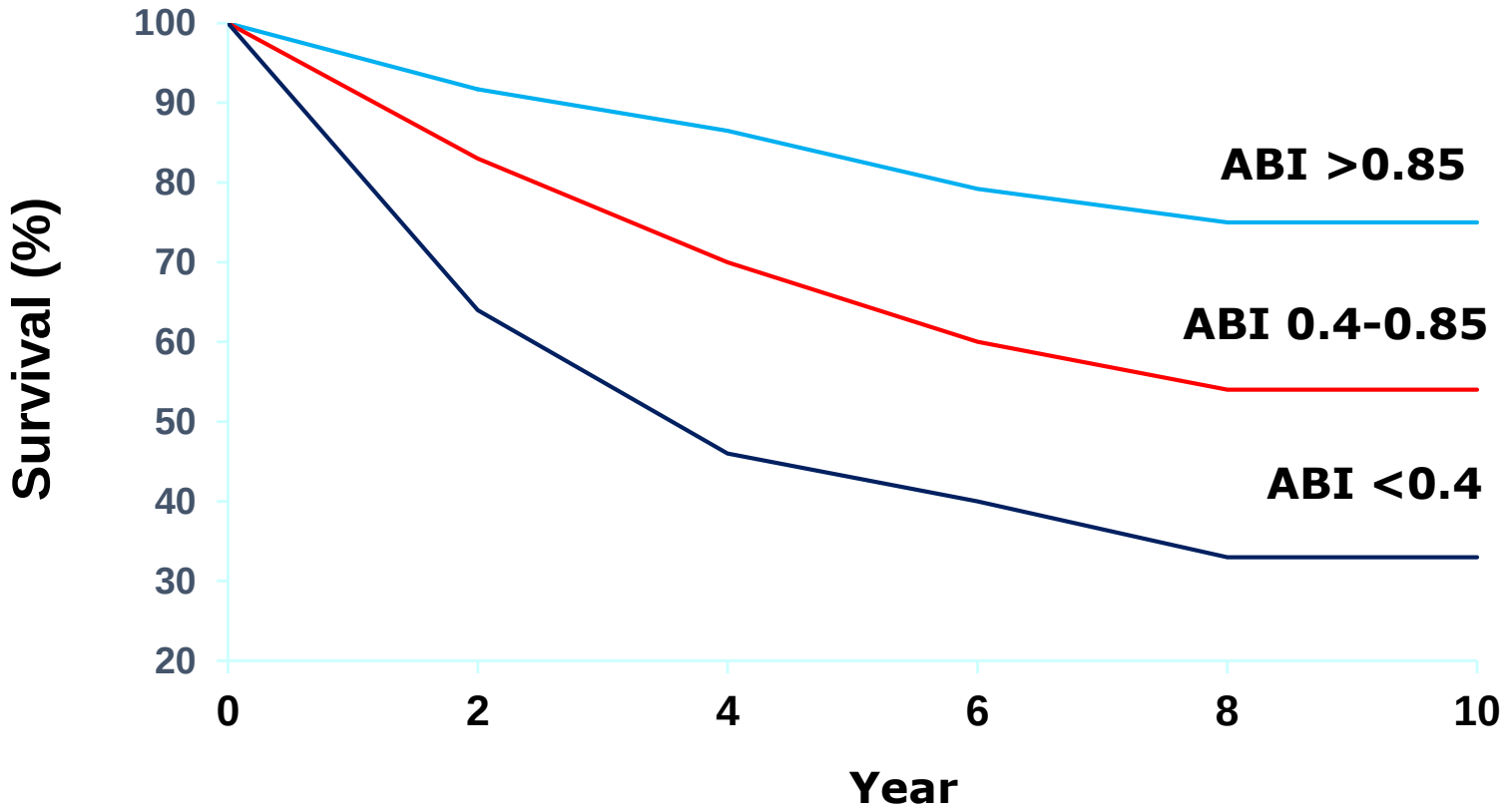
PREDICTOR OF SURVIVAL



McKenna et al *Atherosclerosis* 1991;87:119-128.

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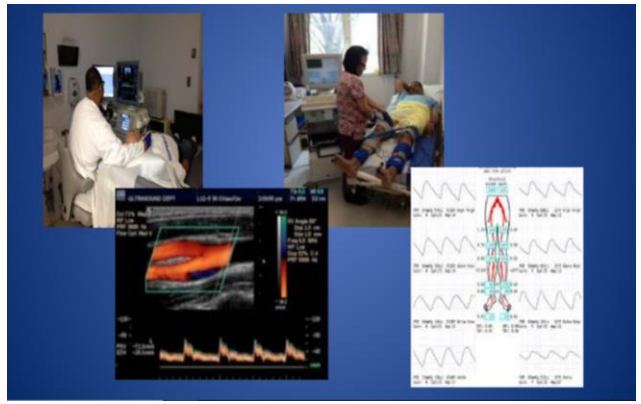
OTHER INVESTIGATIONS



- Treadmill (exercise) test +/- ABI and 6 minute walk test
- Arterial doppler ultrasound
- Computed tomographic angiography
- Magnetic resonance angiography
- **Conventional angiography**

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CONVENTIONAL ANGIOGRAPHY

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Typical Noninvasive Tests for PAD Patients (Based on Clinical Presentation)

Clinical presentation	Noninvasive vascular test
Asymptomatic lower extremity PAD	ABI
Claudication	ABI Duplex ultrasound Exercise test with ABI Assess functional status
Candidate for revascularization	Duplex ultrasound, MRA, or CTA
Postoperative graft follow-up	Duplex ultrasound

ACC/AHA Guidelines
Primary cardiology, 2nd ed., Braunwald E, Goldman L, eds.
"Recognition and management of peripheral arterial disease"

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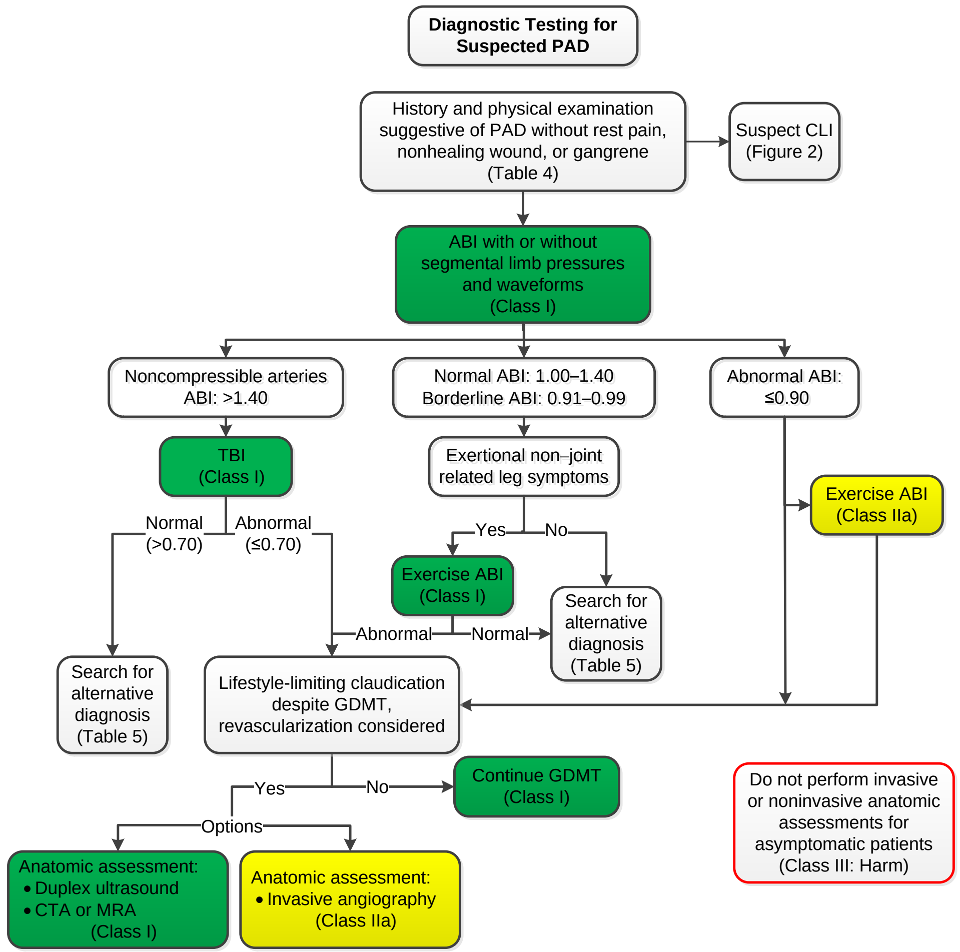
PAD Diagnostic Testing Algorithm



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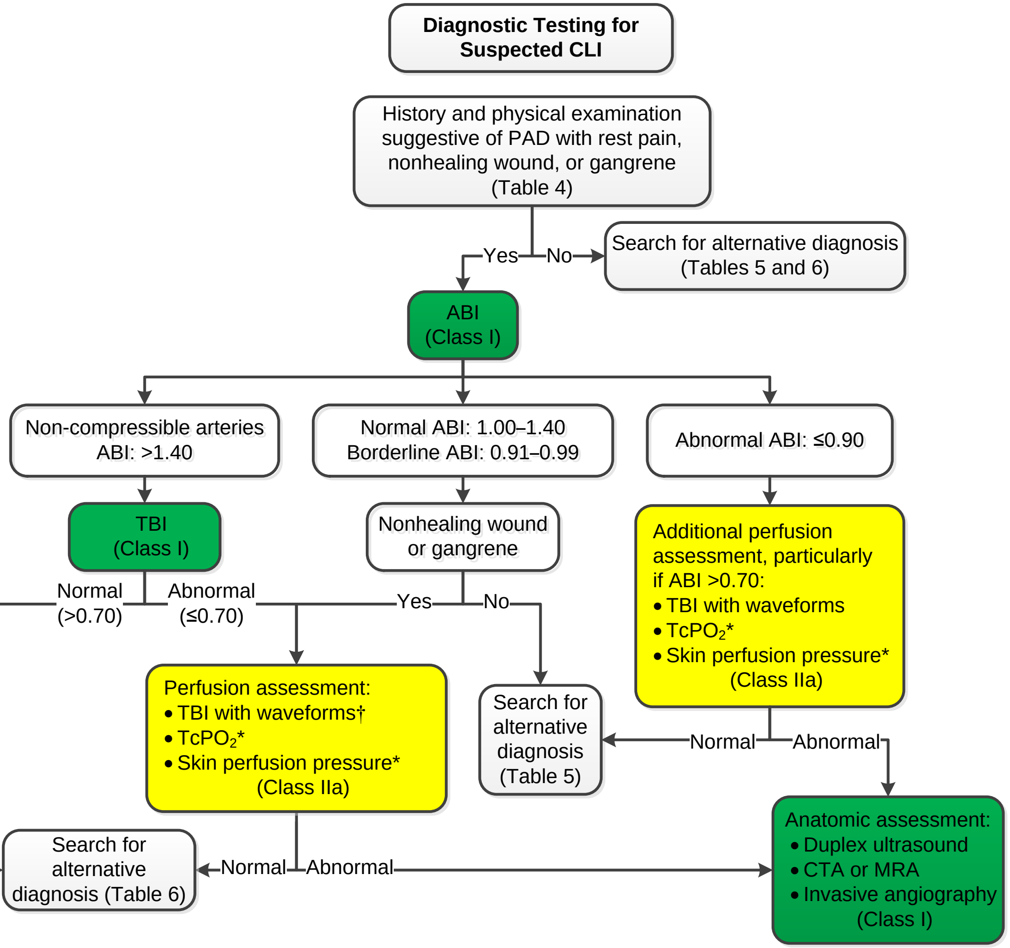
CLI Diagnostic Testing Algorithm



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APPROACHES OF MANAGEMENT

- Lifestyle changes
- Medical therapy
- Operative intervention

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NATURAL HISTORY OF CLAUDICATION

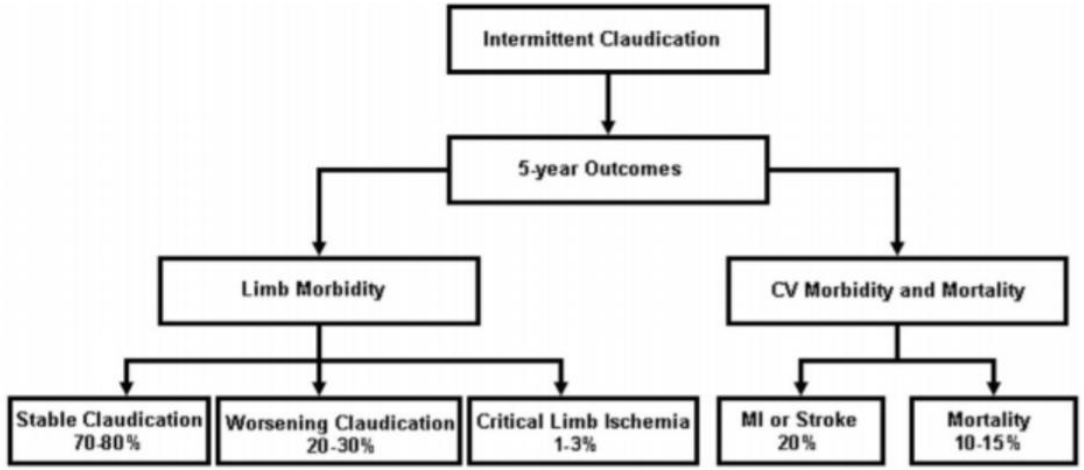

Fig 2. The natural history of patients with intermittent claudication (IC) treated with non-invasive management. *CV,* Cardiovascular; *MI,* myocardial infarction. Adapted from American College of Cardiology/Americal Heart Association guidelines.[43]

Society for Vascular Surgery practice guidelines for atherosclerotic occlusive disease of the lower extremities: Management of asymptomatic disease and claudication
Conte, Michael S. et al.
Journal of Vascular Surgery , Volume 61 , Issue 3 , 2S - 41S.e1

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OVERALL GOAL OF TREATMENT

- Reduce symptoms
- Improve mobility
- Improve quality of life
- Prevent systemic (heart attack, stroke) complications
- Prevent extremity (amputation) complications

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GENERAL APPROACH TO TREATMENT

Confirmation of **PAD** diagnosis

Risk factor normalization:
- Immediate smoking cessation
- Treat hypertension
- Treat lipids
- Treat Diabetes mellitus: hbA_{1c} less than 0.7%

Pharmacological Risk Reduction:
Antiplatelet therapy
(ACE inhibition)

ACC/AHA Guidelines

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CLASS OF RECOMMENDATION

CLASS (STRENGTH) OF RECOMMENDATION

CLASS I (STRONG) — **Benefit >>> Risk**

Suggested phrases for writing recommendations:
- Is recommended
- Is indicated/useful/effective/beneficial
- Should be performed/administered/other
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is recommended/indicated in preference to treatment B
  - Treatment A should be chosen over treatment B

CLASS IIa (MODERATE) — **Benefit >> Risk**

Suggested phrases for writing recommendations:
- Is reasonable
- Can be useful/effective/beneficial
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is probably recommended/indicated in preference to treatment B
  - It is reasonable to choose treatment A over treatment B

CLASS IIb (WEAK) — **Benefit ≥ Risk**

Suggested phrases for writing recommendations:
- May/might be reasonable
- May/might be considered
- Usefulness/effectiveness is unknown/unclear/uncertain or not well established

CLASS III: No Benefit (MODERATE) — **Benefit = Risk**
(Generally, LOE A or B use only)

Suggested phrases for writing recommendations:
- Is not recommended
- Is not indicated/useful/effective/beneficial
- Should not be performed/administered/other

CLASS III: Harm (STRONG) — **Risk > Benefit**

Suggested phrases for writing recommendations:
- Potentially harmful
- Causes harm
- Associated with excess morbidity/mortality
- Should not be performed/administered/other

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LEVEL OF EVIDENCE

LEVEL (QUALITY) OF EVIDENCE‡	
LEVEL A	
▪ High-quality evidence‡ from more than 1 RCT ▪ Meta-analyses of high-quality RCTs ▪ One or more RCTs corroborated by high-quality registry studies	
LEVEL B-R	**(Randomized)**
▪ Moderate-quality evidence‡ from 1 or more RCTs ▪ Meta-analyses of moderate-quality RCTs	
LEVEL B-NR	**(Nonrandomized)**
▪ Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies ▪ Meta-analyses of such studies	
LEVEL C-LD	**(Limited Data)**
▪ Randomized or nonrandomized observational or registry studies with limitations of design or execution ▪ Meta-analyses of such studies ▪ Physiological or mechanistic studies in human subjects	
LEVEL C-EO	**(Expert Opinion)**
Consensus of expert opinion based on clinical experience	

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CLASS OF RECOMMENDATION/LEVEL OF EVIDENCE

Diagnosis of Peripheral Arterial Disease (PAD)

Recommendation	Grade	LOE
2.1. We recommend using the ABI as the first-line noninvasive test to establish a diagnosis of PAD in individuals with symptoms or signs suggestive of disease. When the ABI is borderline or normal (>0.9) and symptoms of claudication are suggestive, we recommend an exercise ABI.	1	A
2.5. In symptomatic patients in whom revascularization treatment is being considered, we recommend anatomic imaging studies, such as arterial duplex ultrasound, CTA, MRA, and contrast arteriography.	1	B

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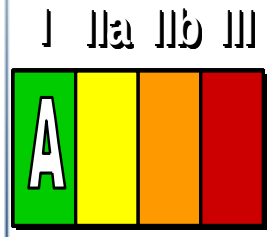
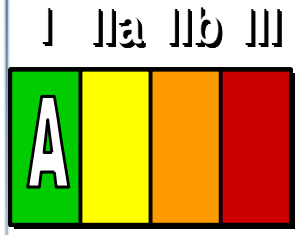
Supervised Exercise Rehabilitation



A program of supervised exercise training is recommended as an initial treatment modality for patients with intermittent claudication.



Supervised exercise training should be performed for a minimum of 30 to 45 minutes, in sessions performed at least three times per week for a minimum of 12 weeks.

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EXERCISE PROGRAM

Improves walking ability
Improves physical function
Safe
cheap
Supervised 3 times/wk (30 min session) unsupervised twice/wk
Duration 3-6 months
Requires discipline
Requires motivation
Requires maintenance
Limited availability of supervised programs

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Antiplatelet Therapy

I IIa IIb III — A

Antiplatelet therapy is indicated to reduce the risk of myocardial infarction, stroke, or vascular death in individuals with atherosclerotic lower extremity PAD.

I IIa IIb III — A

Aspirin, in daily doses of 75 to 325 mg, is recommended as safe and effective antiplatelet therapy to reduce the risk of myocardial infarction, stroke, or vascular death in individuals with atherosclerotic lower extremity PAD.

I IIa IIb III — B

Clopidogrel (75 mg per day) is recommended as an effective alternative antiplatelet therapy to aspirin to reduce the risk of myocardial infarction, stroke, or vascular death in individuals with atherosclerotic lower extremity PAD.

Lipid Lowering and Antihypertensive Therapy

I IIa IIb III

B

Treatment with an HMG coenzyme-A reductase inhibitor (statin) medication is indicated for all patients with peripheral arterial disease to achieve a target LDL cholesterol of less than 100 mg/dl.

I IIa IIb III

A

Antihypertensive therapy should be administered to hypertensive patients with lower extremity PAD to a goal of less than 140/90 mmHg (non-diabetics) or less than 130/80 mm/Hg (diabetics and individuals with chronic renal disease) to reduce the risk of myocardial infarction, stroke, congestive heart failure, and cardiovascular death.

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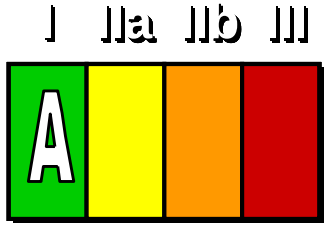
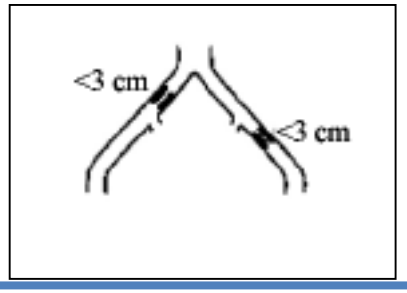
Endovascular Treatment for Claudication



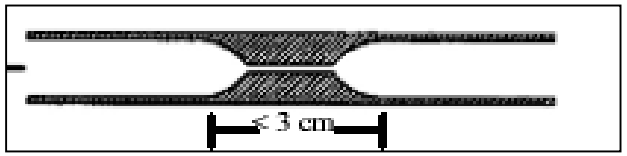
Endovascular intervention is recommended as the preferred revascularization technique for TASC type A iliac and femoropopliteal lesions.

Iliac

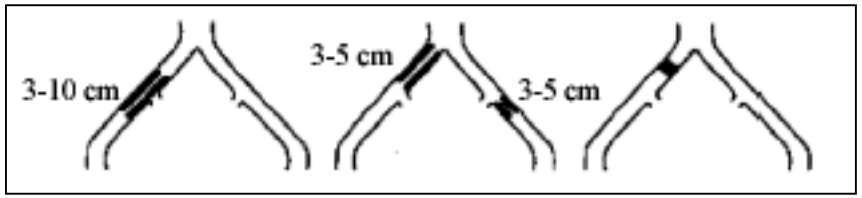
TASC A:
(PTA recommended)

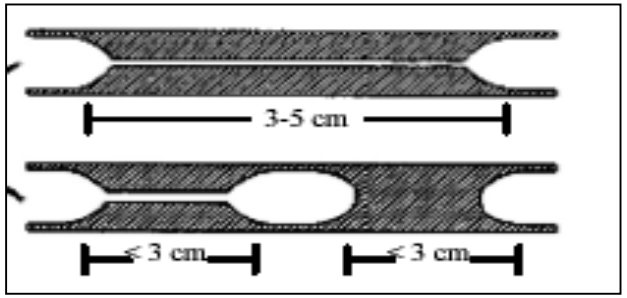


Femoropopliteal



TASC B: (insufficient data to recommend)





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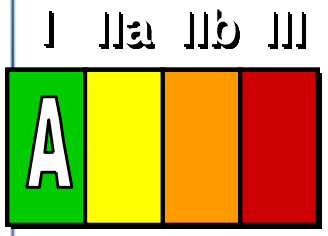
Endovascular Treatment for Claudication



Endovascular procedures are indicated for individuals with a vocational or lifestyle-limiting disability due to intermittent claudication when clinical features suggest a reasonable likelihood of symptomatic improvement with endovascular intervention *and*…

a. Response to exercise or pharmacologic therapy is inadequate, *and/or*

b. there is a very favorable risk-benefit ratio (e.g. focal aortoiliac occlusive disease)

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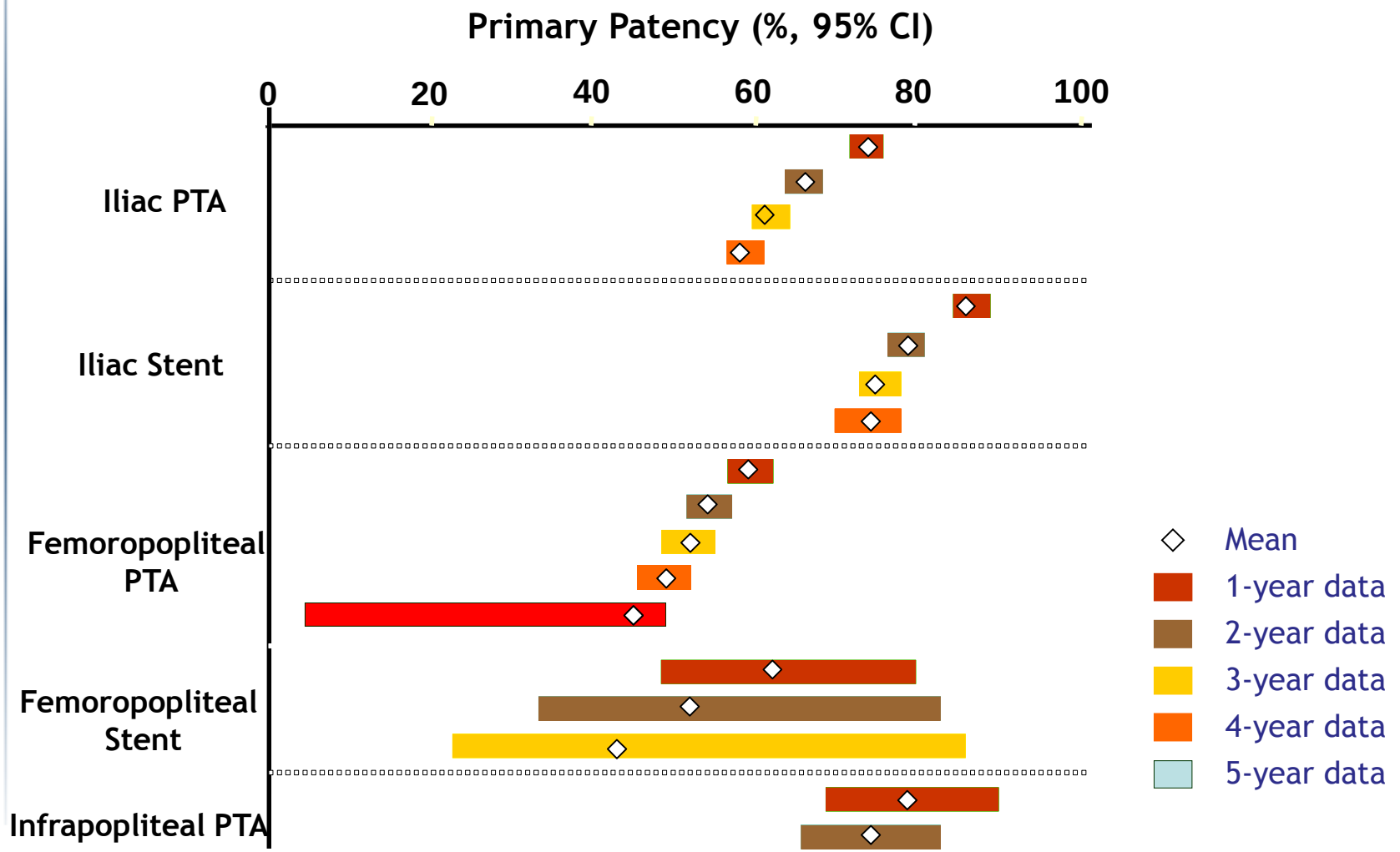
DURABILITY OF ENDOVASCULAR PROCEDURES

CI=confidence interval; PTA=percutaneous transluminal angiography

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



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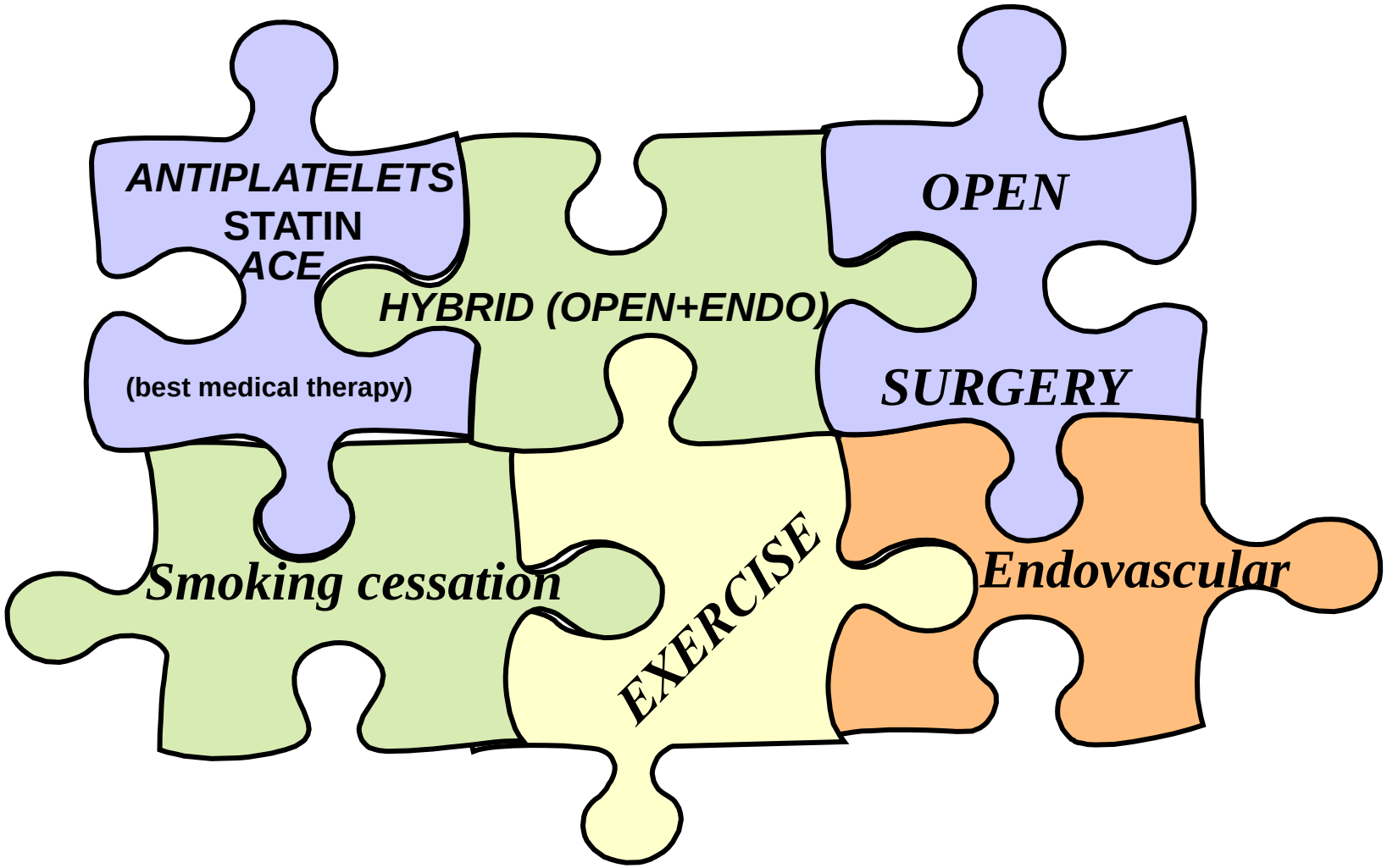
MANAGEMENT OF PAD



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MANAGEMENT OF SYMPTOMATIC PAD

Nonoperative	Endovascular	Surgery

• Risk factor modification
• Exercise
• Medication
	• Balloon angioplasty
	• Endovascular stenting
	• Intra-arterial thrombolytic therapy
		• Endarterectomy
		• Bypass
		  • Autogenous
		  • Prosthetic
		• Amputation

HYBRID PROCEDURE

Weitz et al Circulation 1996; 94; 3026-49

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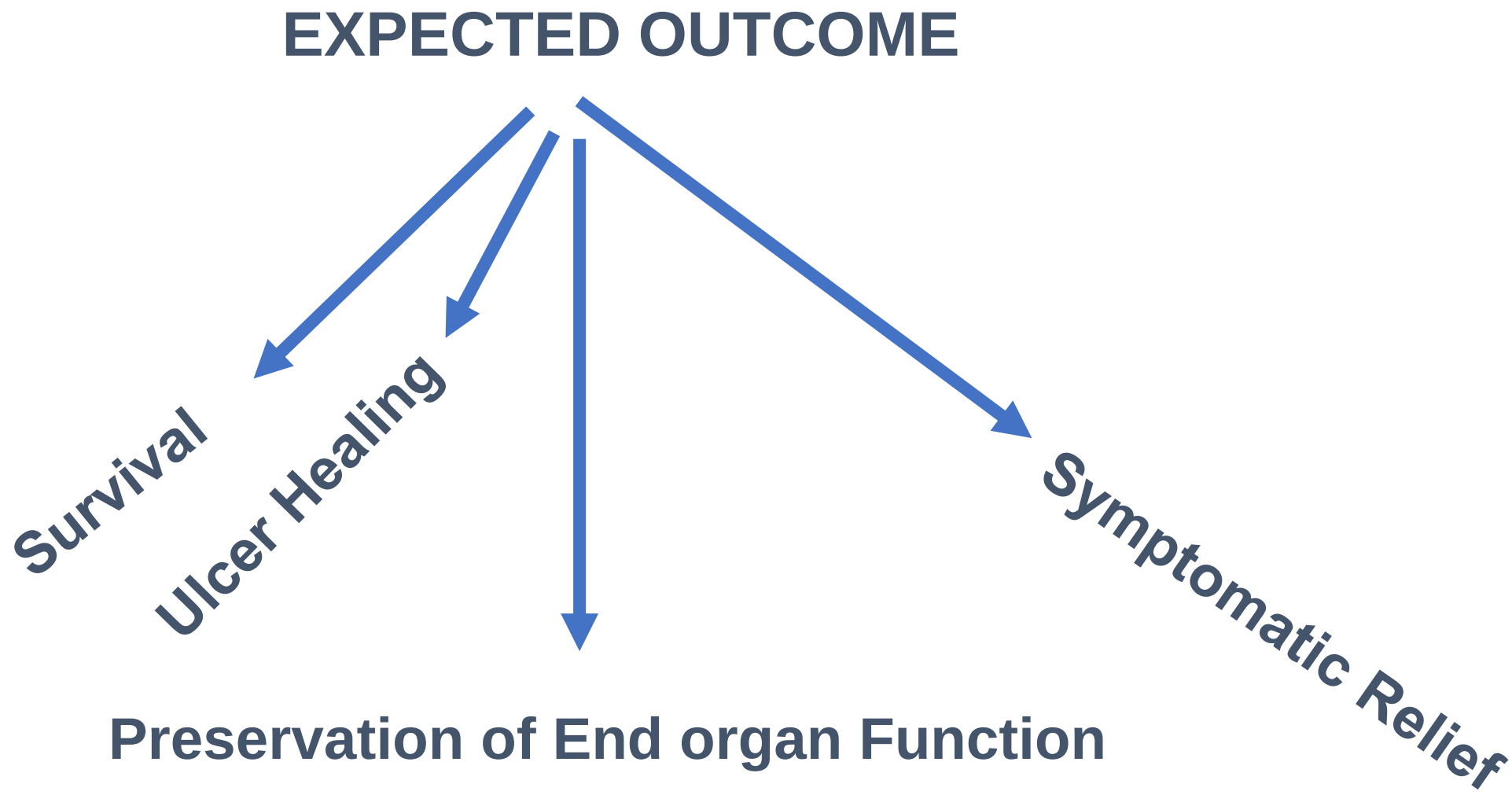

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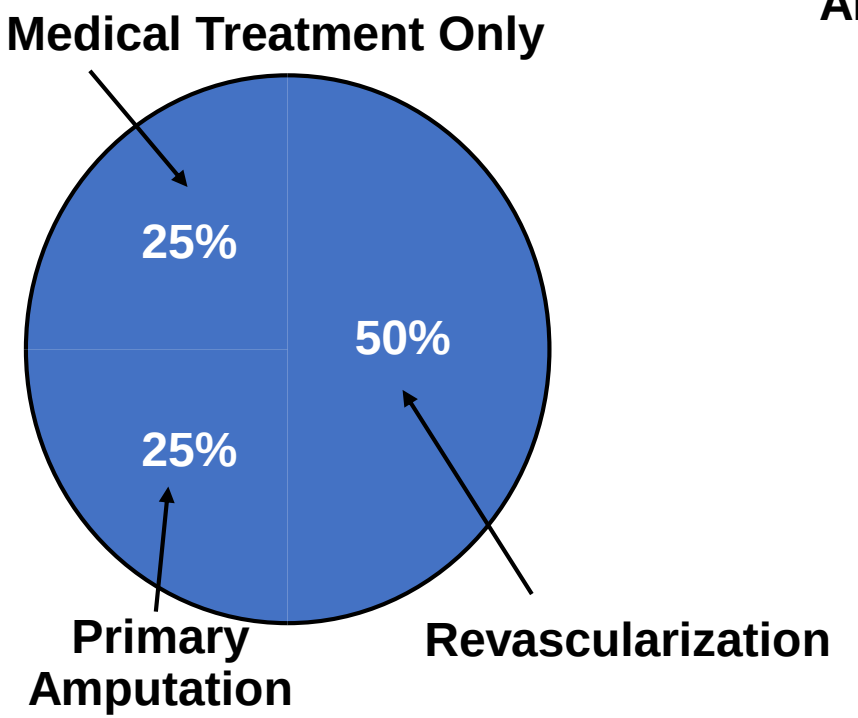
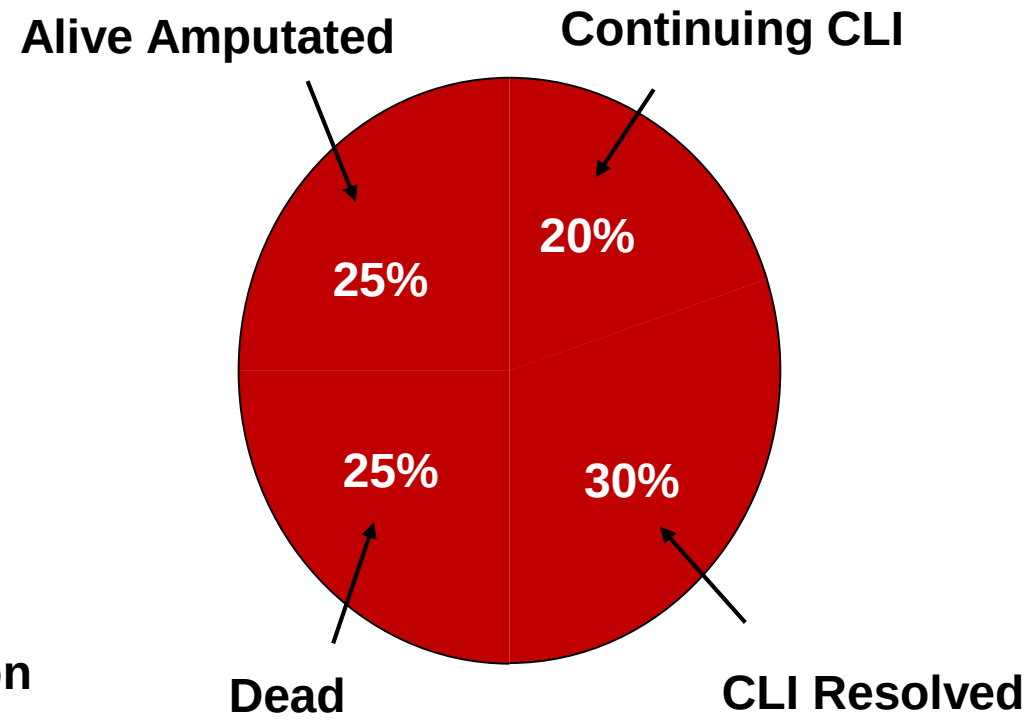
PROGNOSIS OF CRITICAL LIMB ISCHEMIA

PRIMARY TREATMENT



ONE YEAR LATER



Dormandy J. and Thomas PRS. in Greenhalgh RM ed. Limb Salvage and Amputation for Vascular Disease. Saunders, 1988

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CASE OF PATIENT CLI

- 65-year-old from Thunder Bay
- Married
- Retired
- Current smoker
- Intermittent claudication 20 metres
- Both lower limbs (left > right)
- Significantly disabling
- Poor quality of life

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RISK FACTORS

- Hypertension
- Dyslipidemia
- Type 2 Diabetes
- Smoking 50-pk-yr

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MEDICATION

- Perindopril 4 mg once daily
- Metformin 500 mg twice daily
- Aspirin 81 mg once daily
- Rosuvastatin 10 mg once daily

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PHYSICAL EXAMINATION

- Healthy-looking, in no distress
- Body mass index is normal at 22 (157 cm, 55 Kg)
- O2 saturation is 99 percent on room air
- Heart sounds S1 and S2 are normal, no murmurs
- Auscultation of lungs reveals good air entry bilaterally
- No peripheral edema

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EXAMINATION OF PULSES

- Absent femoral, popliteal and pedal pulses bilaterally

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ABI AND ARTERIAL DOPPLER

- Performed in June 2017 (arranged by Family Physician)
- Ankle brachial index (ABI)
  - Right 0.6
  - Left 0.5
- Right common iliac artery severely stenosed
- Left common iliac artery poorly visualized
- Vascular referral suggested

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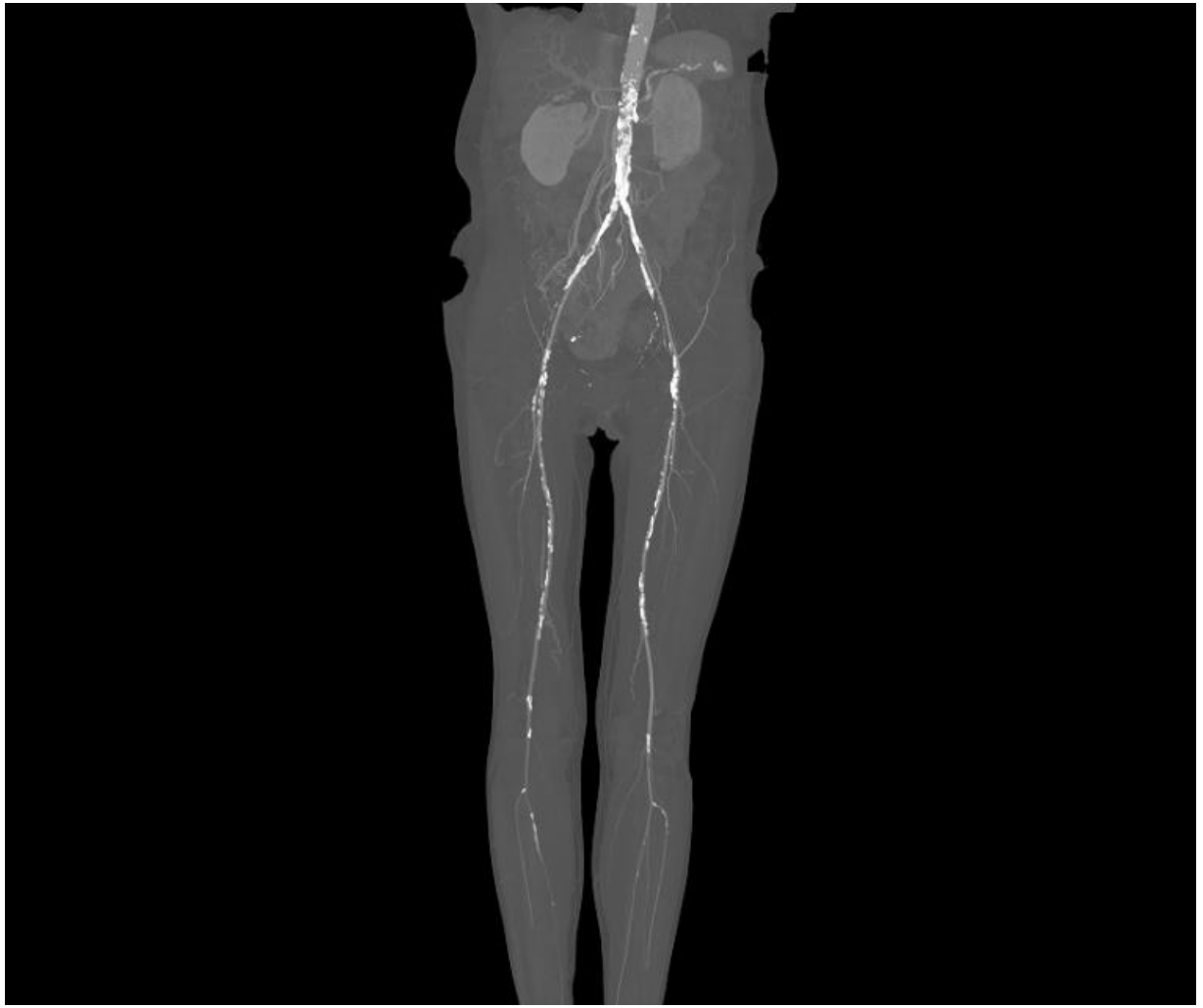
CT ANGIOGRAM

- Occluded left common iliac artery at it its origin
- Severe stenosis involving right common and external iliac arteries
- Severely stenosed bilateral common femoral arteries



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DIAGNOSIS

- Critical ischemia involving both lower limbs

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MULTIDISCIPLINARY MEETING

- Discussed at EVAR rounds with Toronto
- An open aorto-bi-femoral bypass technically not possible
- Hybrid procedure more suitable
  - Bilateral common femoral endarterectomy would be performed first, followed by right common and external iliac angioplasty plus right to left femoro-femoral bypass, all as one procedure

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PREOPERATIVE WORK UP

- ECG, sinus rhythm at 67 without acute or chronic ischemic changes
- Normal Spirometry
- Preoperative echocardiogram demonstrated moderate to severe MR and severe tricuspid regurgitation
- Preserved LV function
- The risk of perioperative MI and stroke have been discussed
- Based on history and physical exam, the patient is at low cardiovascular risk for the proposed procedure

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HYBRID PROCEDURE

- April 2018
- Bilateral common femoral endarterectomy
- Right common iliac stenting and balloon angioplasty
- Right to left femoral bypass graft

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INITIAL ON-TABLE ANGIOGRAM

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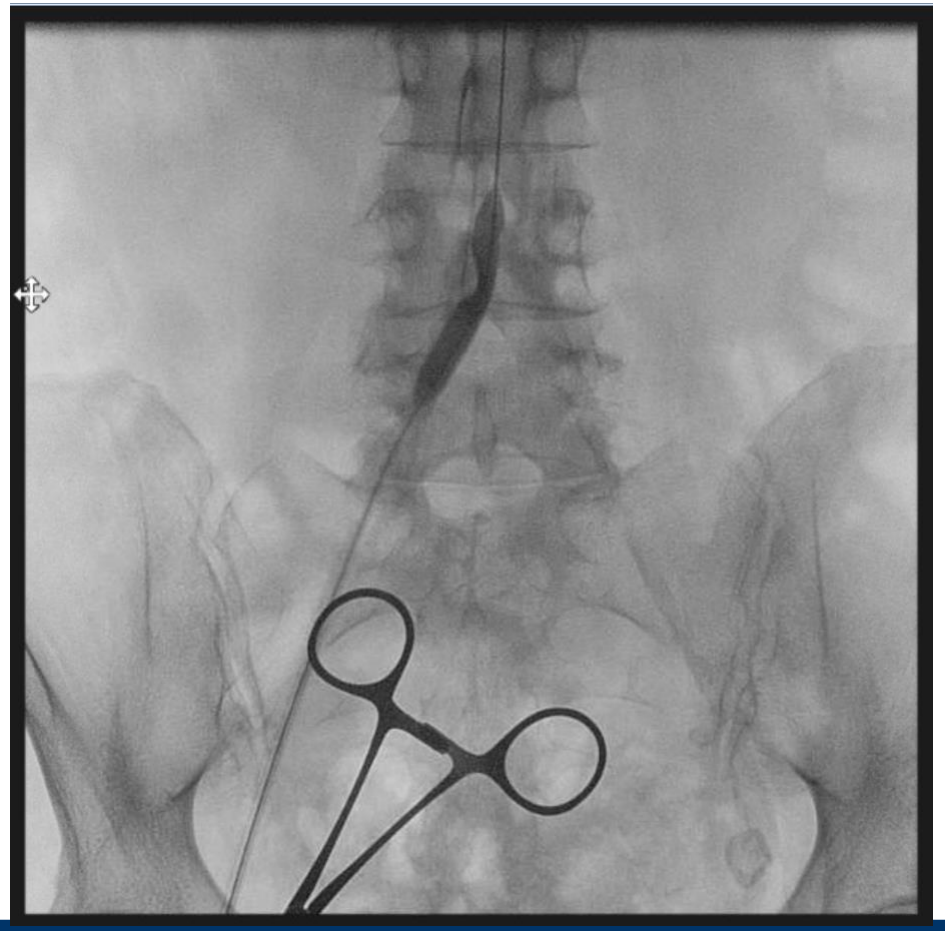
INITIAL BALLOON ANGIOPLASTY



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RECOIL WITH SHELF

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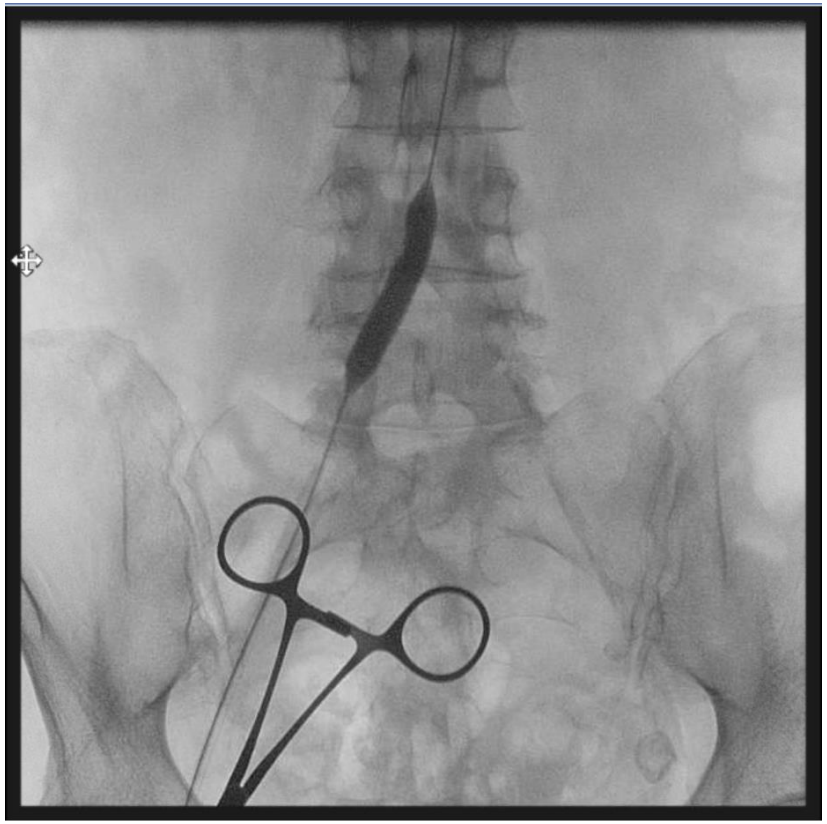
BALLOON MOUNTED STENT



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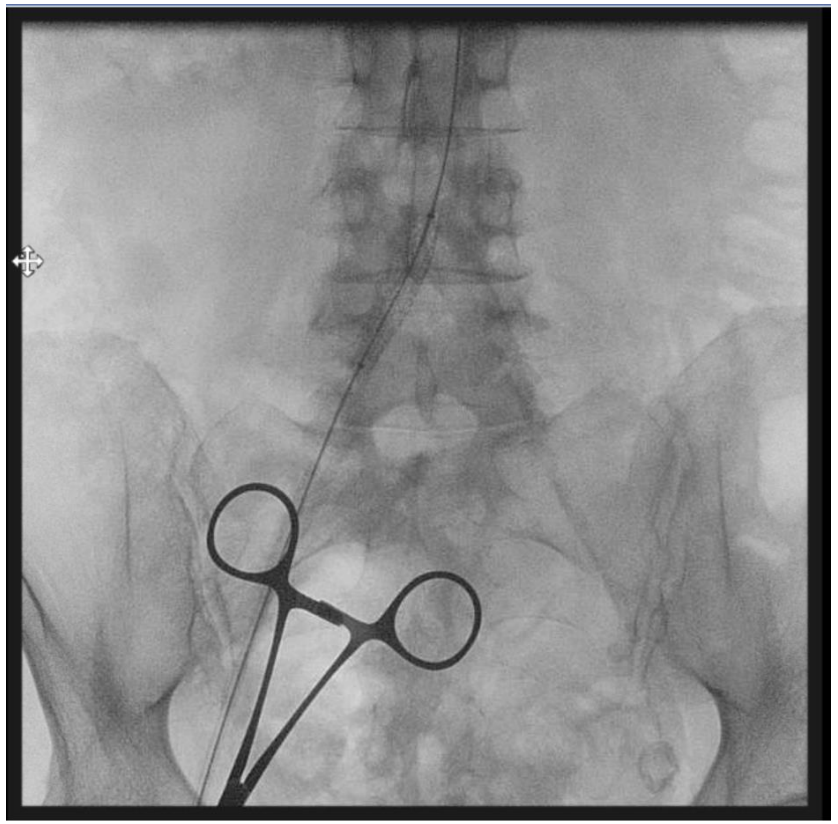
STENT IN PLACE



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PRESERVED COLLATERALS

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STENT BEFORE COMPLETION ANGIOGRAM

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COMPLETION ANGIOGRAM

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POSTOPERATIVE COURSE

- Postoperatively, developed a non-ST elevation myocardial infarction with flash pulmonary edema
- Once stabilized, was taken to the Cath Lab and underwent diagnostic coronary angiogram, which demonstrated severe multivessel coronary artery disease
- Urgent coronary bypass surgery was recommended

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CARDIAC SURGERY

- May 2018
- Underwent successful quadruple-vessel bypass graft surgery
- No valvular intervention was done
- Both Mitral and Tricuspid regurgitation improved (to mild MR and mild TR) on postoperative echocardiogram

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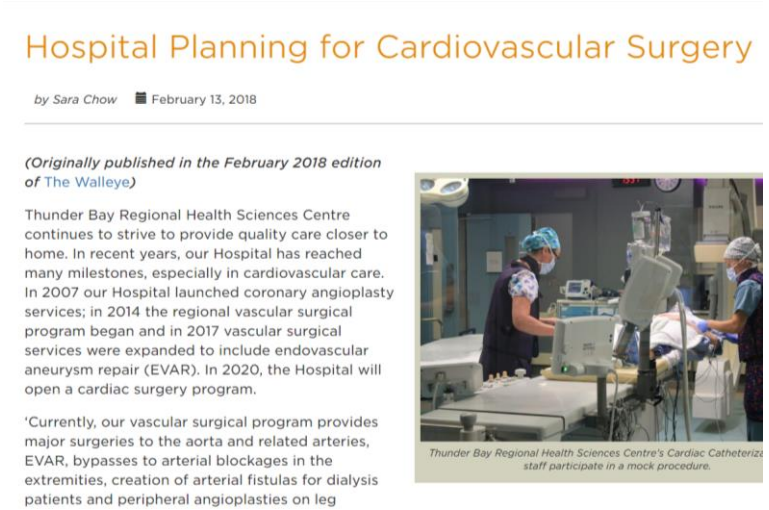
CARDIAC REHABILITATION



Hospital Planning for Cardiovascular Surgery

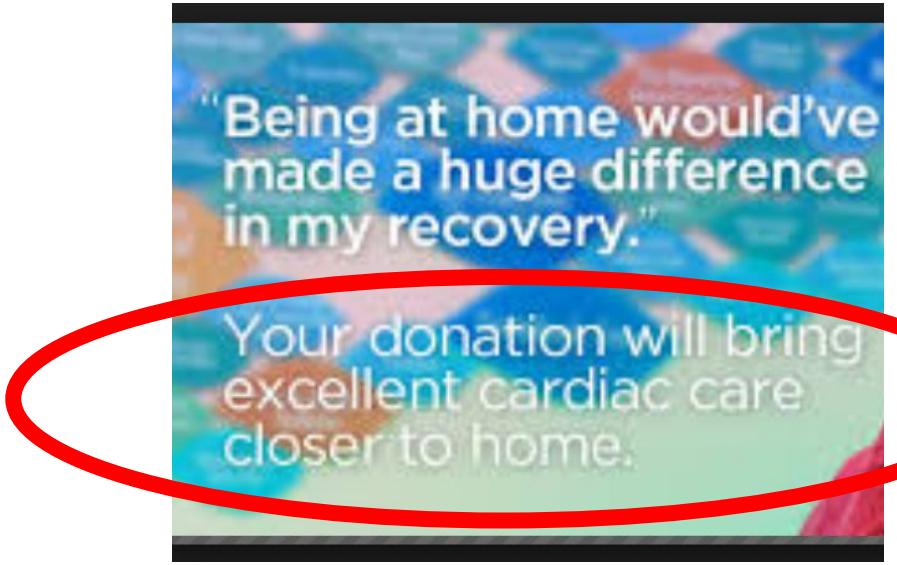
by Sara Chow February 13, 2018

(Originally published in the February 2018 edition of The Walleye)

Thunder Bay Regional Health Sciences Centre continues to strive to provide quality care closer to home. In recent years, our Hospital has reached many milestones, especially in cardiovascular care. In 2007 our Hospital launched coronary angioplasty services; in 2014 the regional vascular surgical program began and in 2017 vascular surgical services were expanded to include endovascular aneurysm repair (EVAR). In 2020, the Hospital will open a cardiac surgery program.

'Currently, our vascular surgical program provides major surgeries to the aorta and related arteries, EVAR, bypasses to arterial blockages in the extremities, creation of arterial fistulas for dialysis patients and peripheral angioplasties on leg

Thunder Bay Regional Health Sciences Centre's Cardiac Catheteriz staff participate in a mock procedure.



- June to August 2018
- Demonstrated a fairly stable and an amazing recovery after two major surgeries
- Reported no chest pain and no exertional dyspnea
- Reported no intermittent claudication

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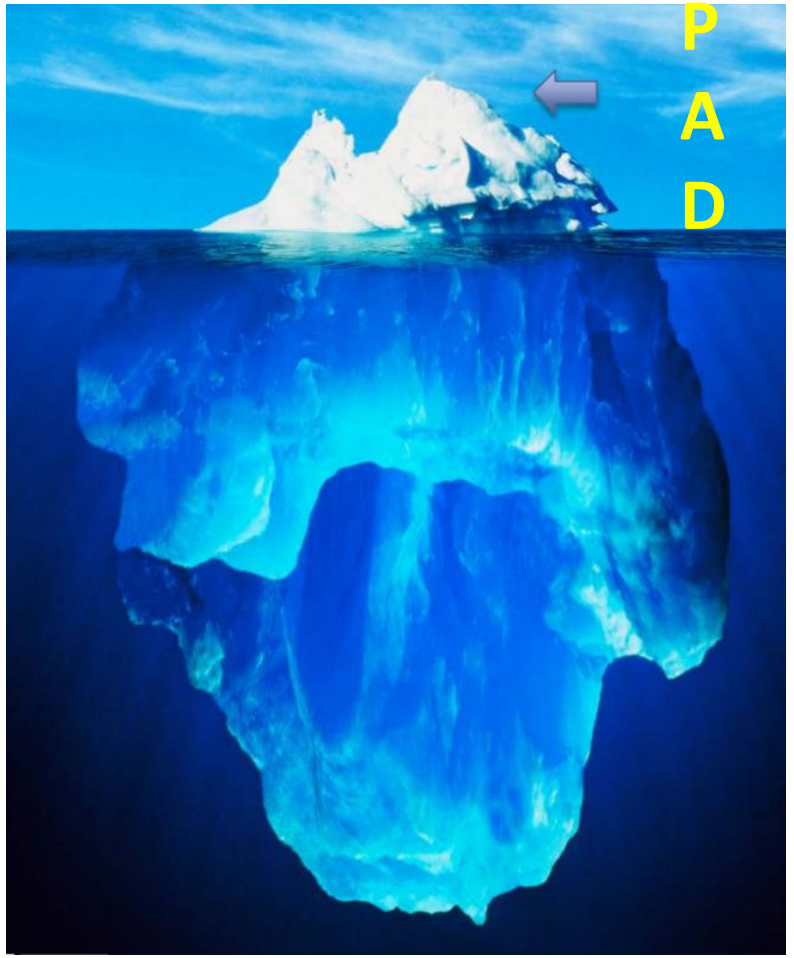
NOT JUST A "PAD" CASE

- Recognize the presence of PAD
- **Quantify the extent of local/systemic disease**
- Determine degree of functional impairment
- Identify/control modifiable risk factors
- Establish a comprehensive treatment plan



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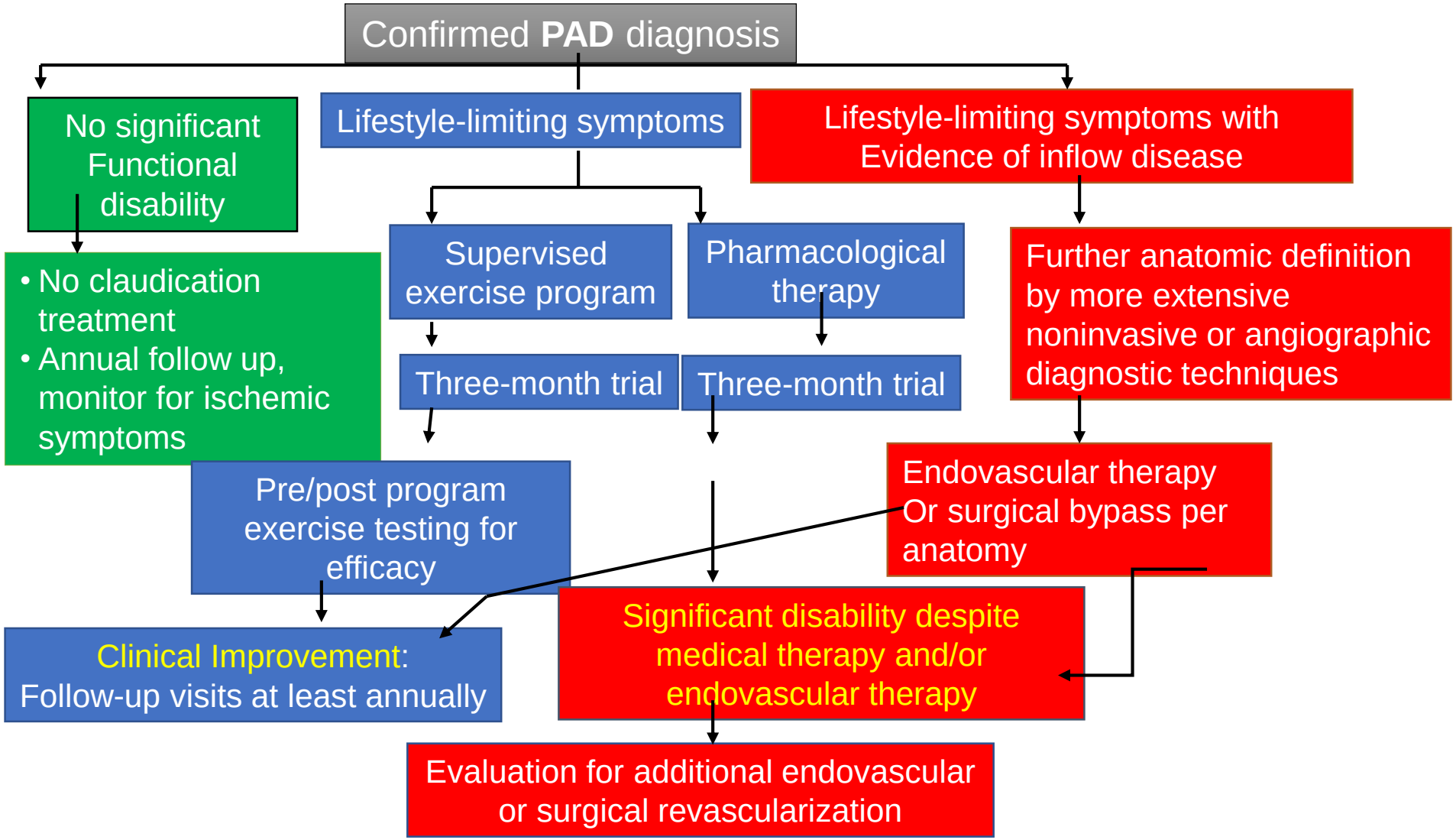
DETAILED APPROACH TO TREATMENT



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SUMMARY

- Clinical assessment for PAD
- Diagnostic testing (appropriate patients)
- Medical therapy
- Structured exercise therapy
- Selected revascularization (claudication)
- Management of CLI
- Follow-up
- SCREENING FOR ATHEROSCLEROTIC DISEASE IN OTHER VASCULAR BEDS

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CONCLUSION

- ✓PAD is commonly asymptomatic
- ✓Evaluation of PAD should be performed during any routine physical examination
- ✓PAD is associated with significantly high risk of heart attack and stroke
- ✓Appropriate and timely interventions (medical, open surgical, endovascular or hybrid) can significantly improve outcomes