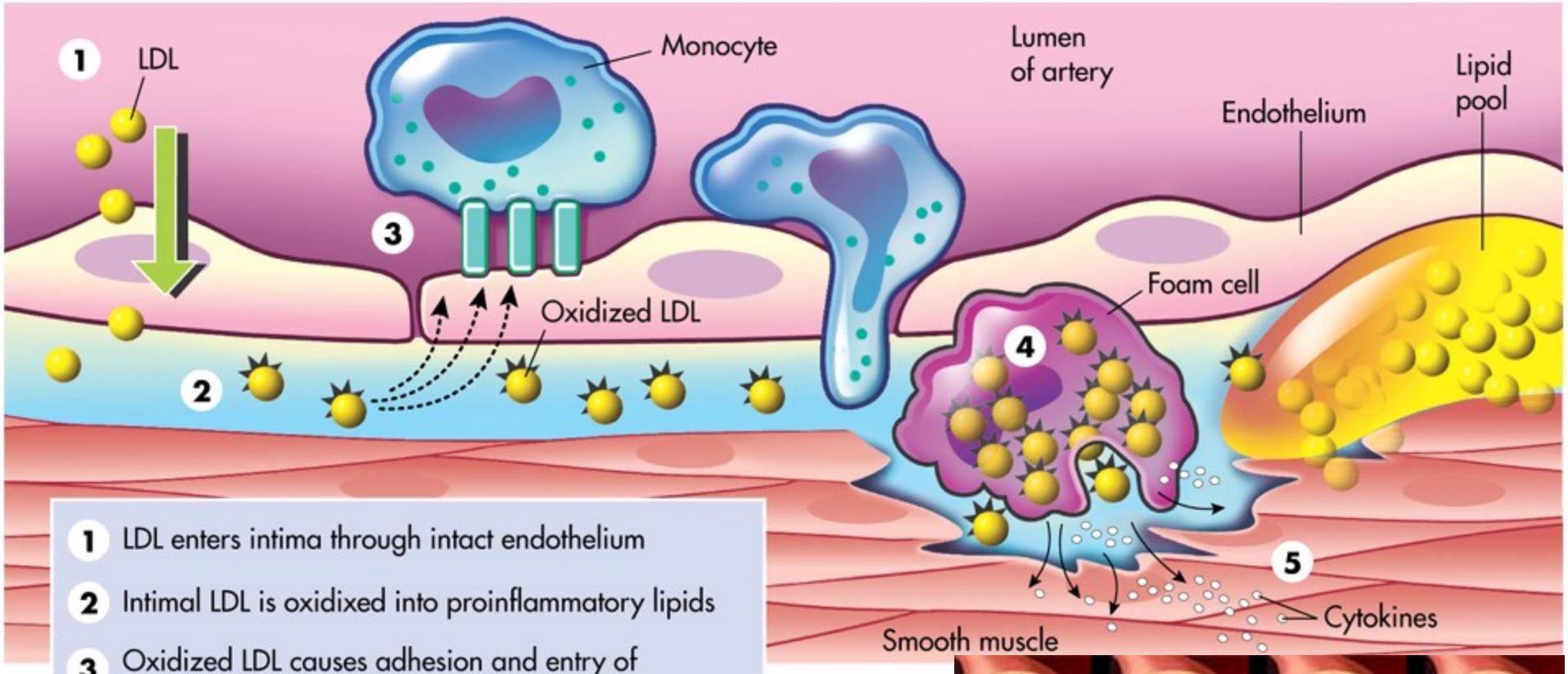
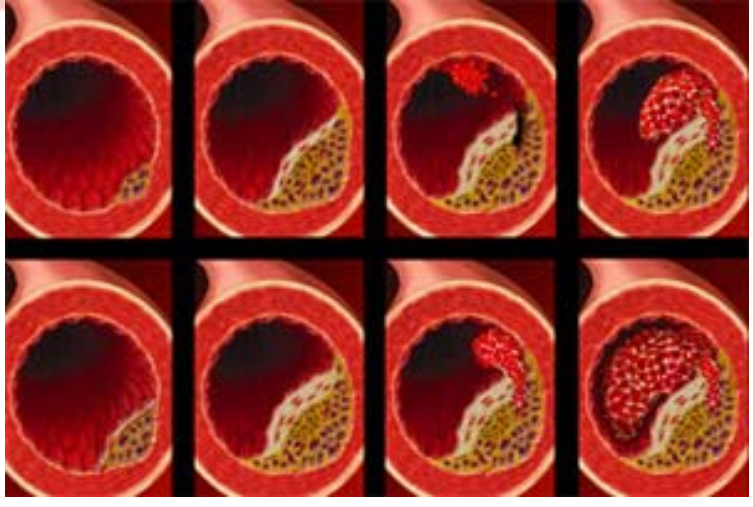
Special Lecture
Peripheral Arterial Disease
November 22, 2013

Dr. HN Mayrovitz

PAD – Largely atherosclerosis related

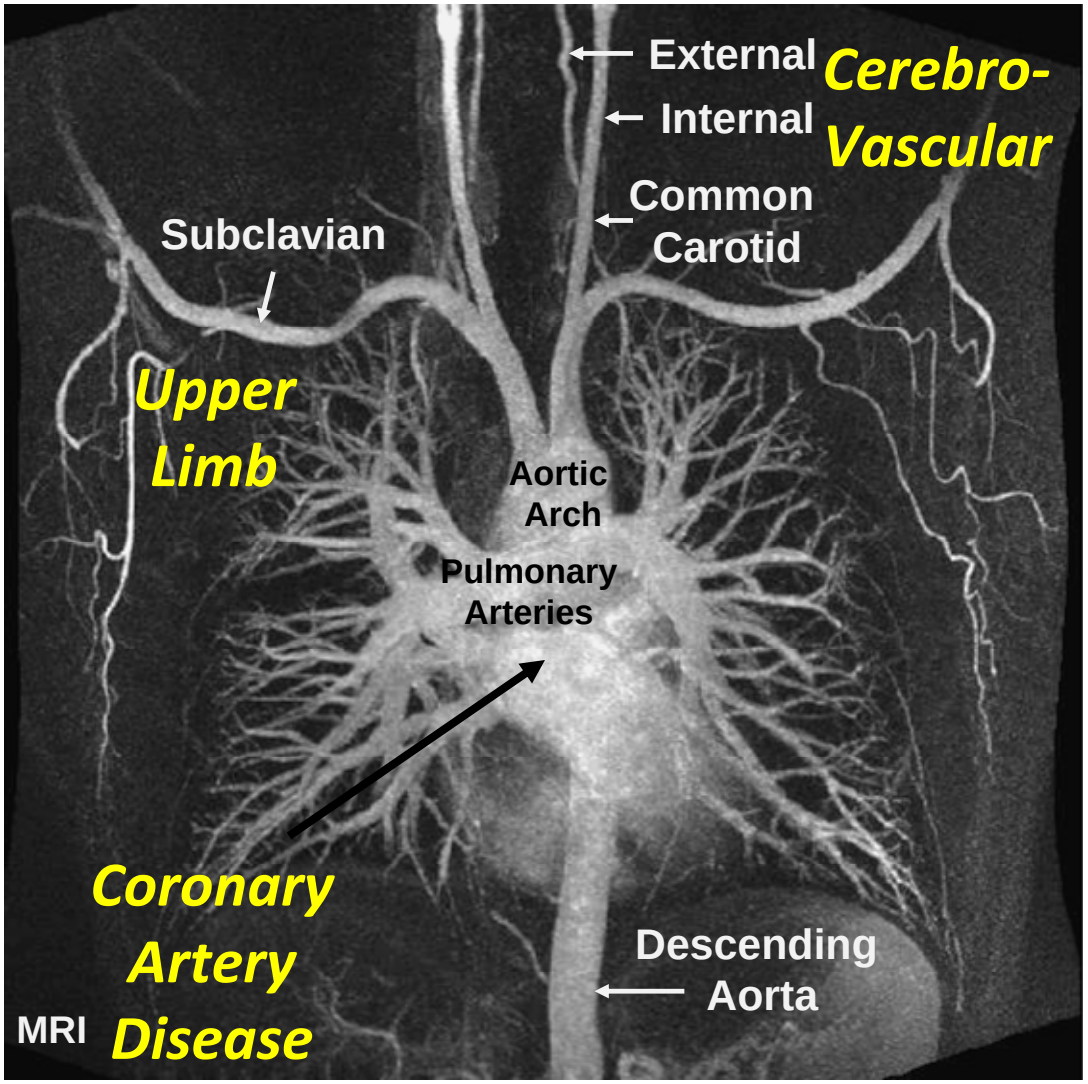


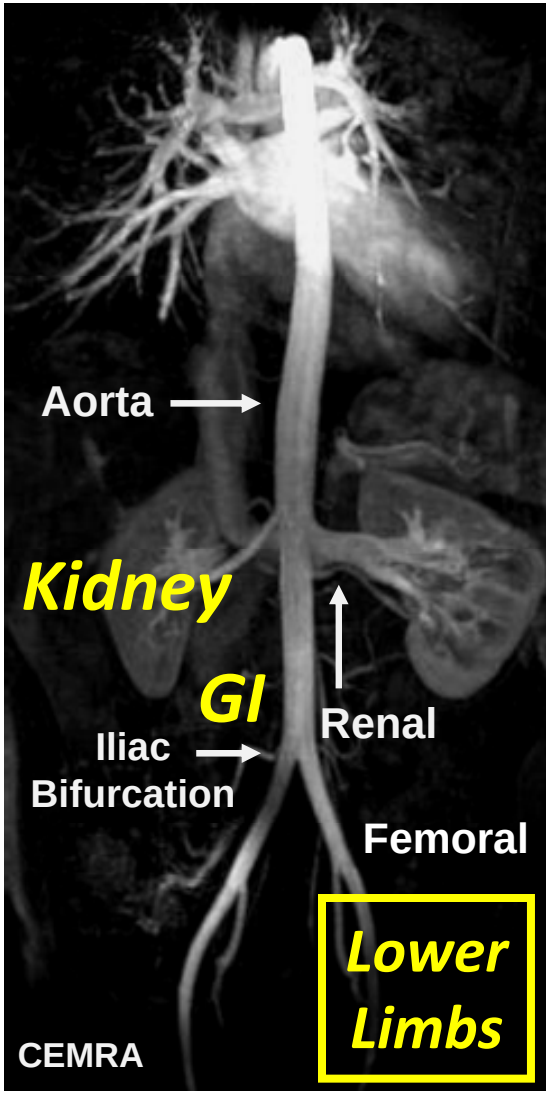
1. LDL enters intima through intact endothelium
2. Intimal LDL is oxidixed into proinflammatory lipids
3. Oxidized LDL causes adhesion and entry of monocytes and T lymphocytes across endothelium
4. Monocytes differentiate into macrophages and then consume large amounts of LDL, transforming into foam cells
5. Foam cells release growth factors (cytokines) that encourage atherosclerosis



Modified from Crawford MH, DiMarco JP, editors: *Cardiology*, London, 2001, Mosby.

Arterial System 'Common' Sites



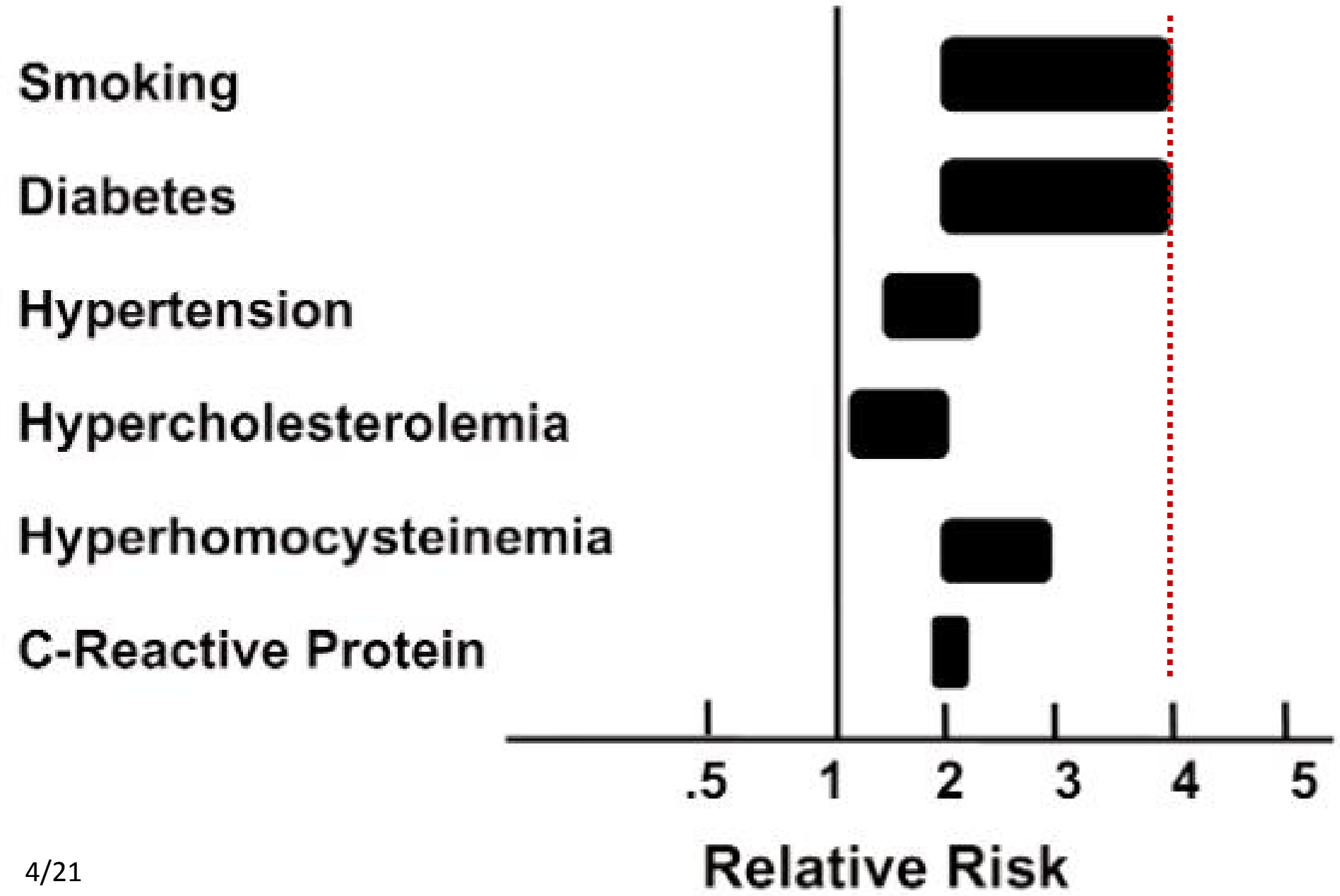


Organ Impacts Depend on Location

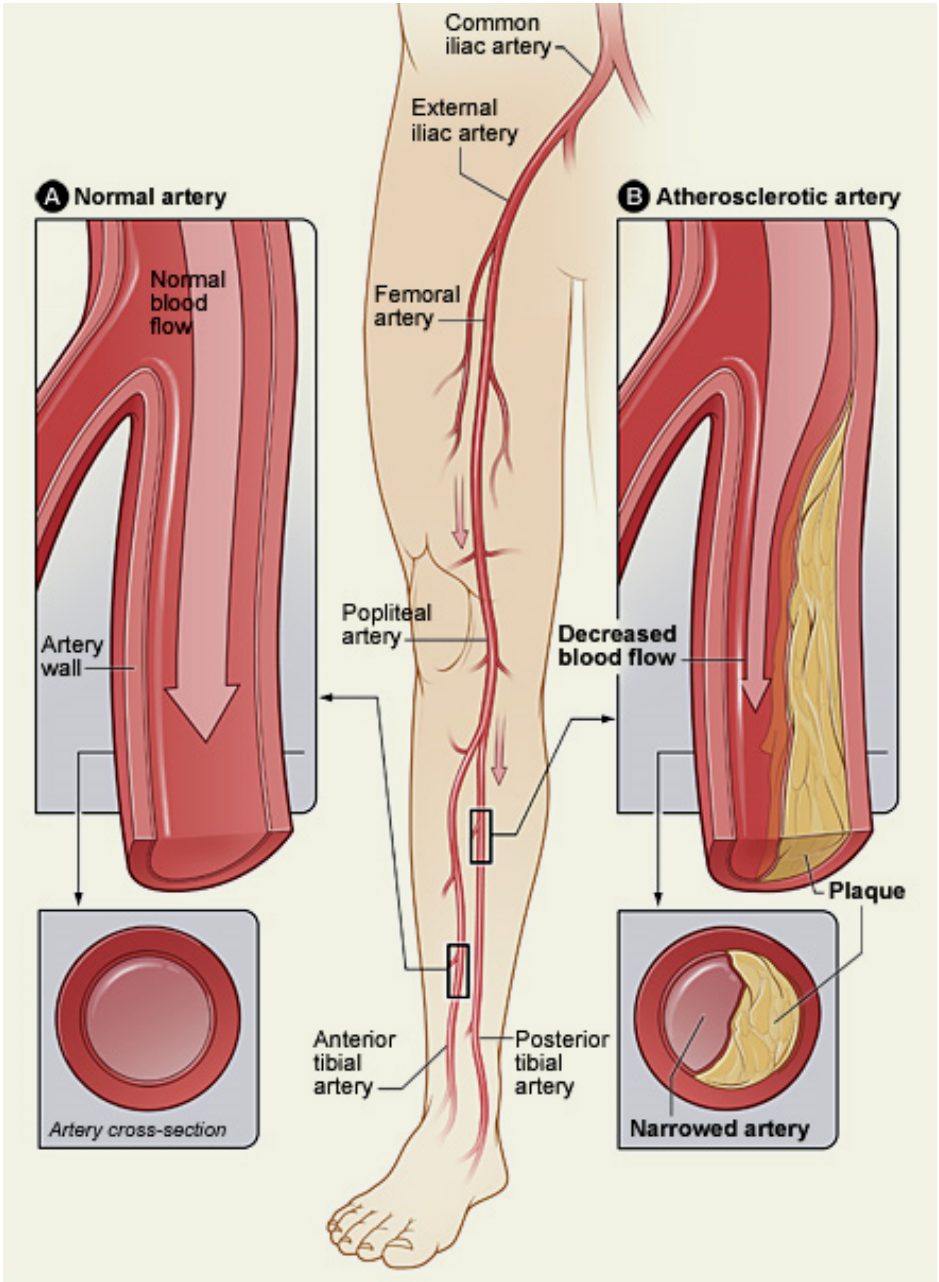
PAD Risk Factors

- Diabetes
- Dyslipedemia
- Cigarette smoking
- High blood pressure (or family history)
- Coronary heart disease (or family history)
- Stroke (or family history)
- High cholesterol (or family history)
- Age over 50
- High homocysteine level in blood
- Gender: Male
- Family history of PAD

Relative Risks



PAD – Lower Extremities



Major Issues

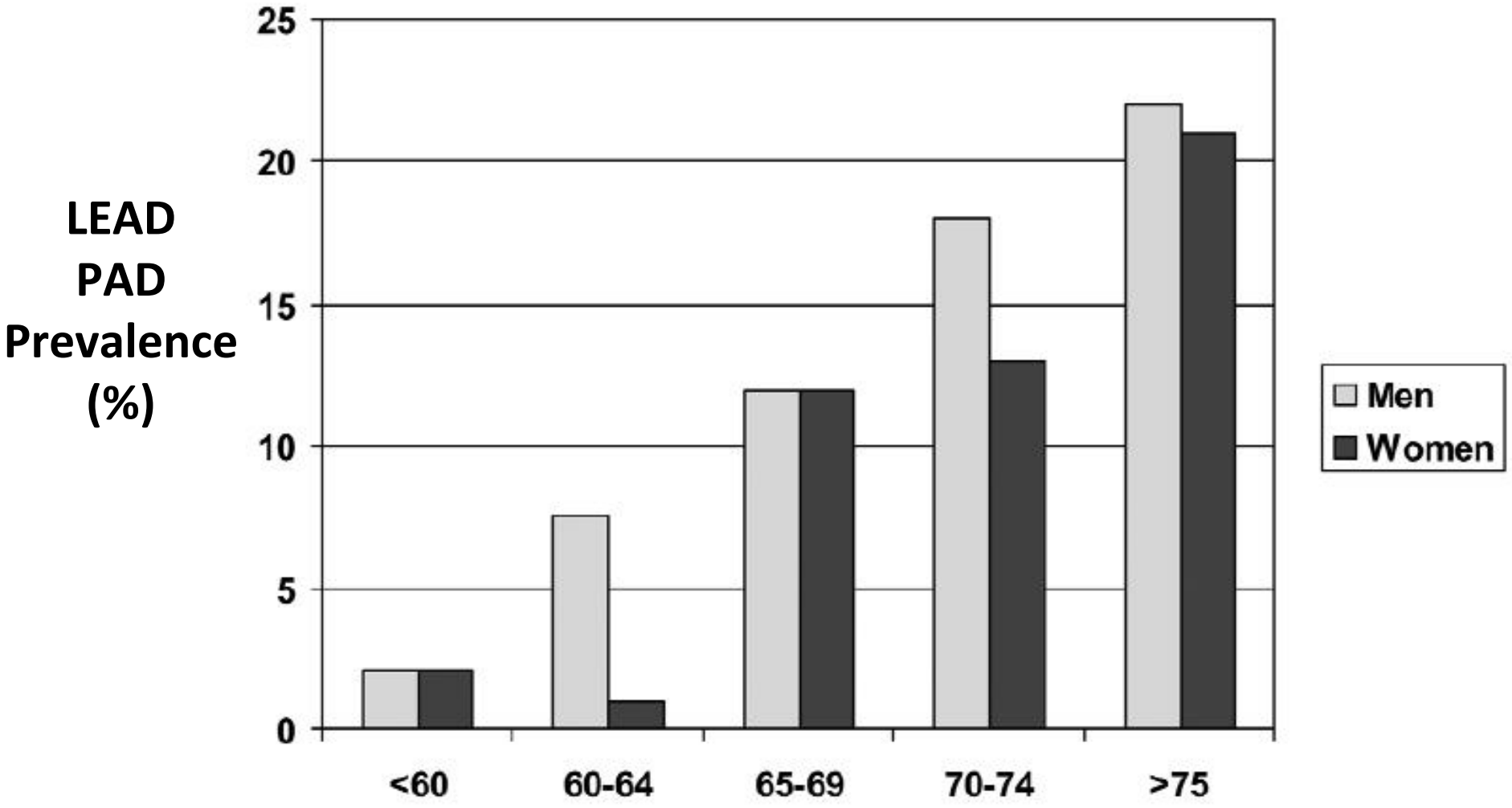
1. Ischemia
   - Walking
   - Resting
2. Correlates with Coronary and Cerebrovascular Diseases
3. Early Warning

Lower Extremity Arterial Disease (LEAD)

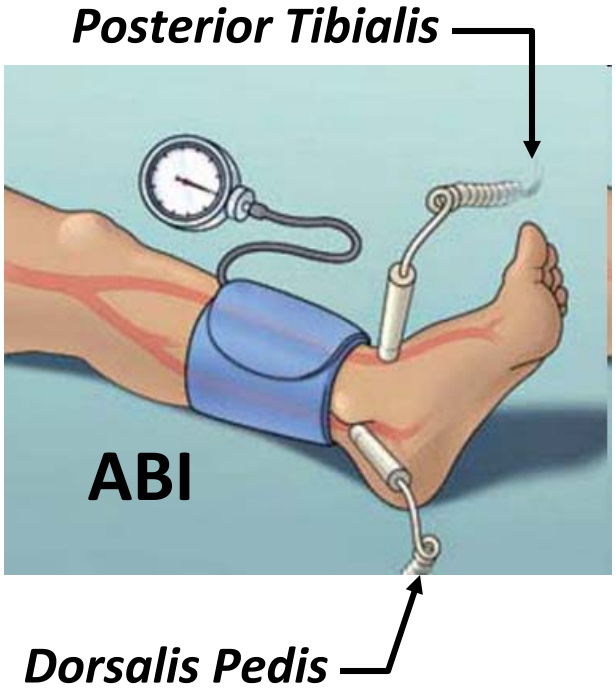
Classification Systems

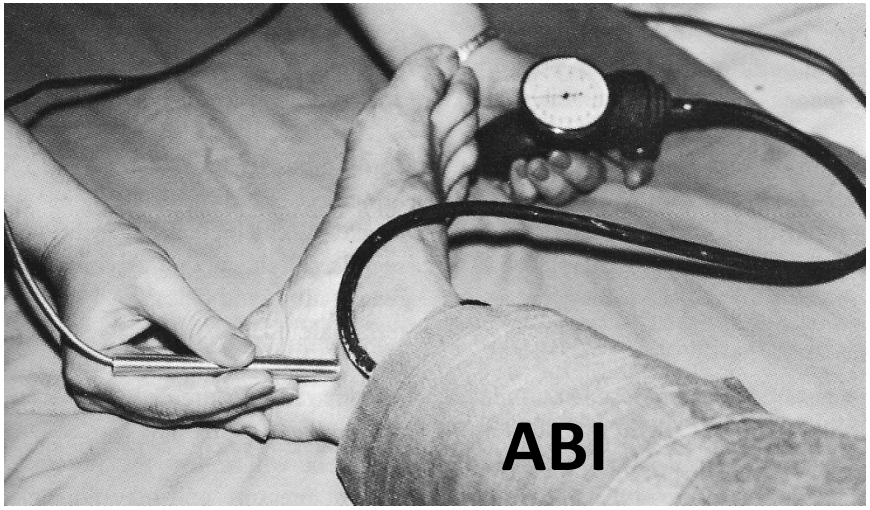
Fontaine		Rutherford		
Stage	Clinical	Grade	Category	Clinical
I	Asymptomatic	0	0	Asymptomatic
IIa	Mild claudication	I	1	Mild claudication
IIb	Moderate-severe claudication	I	2	Moderate claudication
		I	3	Severe claudication
III	Ischemic rest pain	II	4	Ischemic rest pain
IV	Ulceration or gangrene	III	5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

Prevalence increases with age (sharply above age 60)



Non-Invasive Assessments - ABI





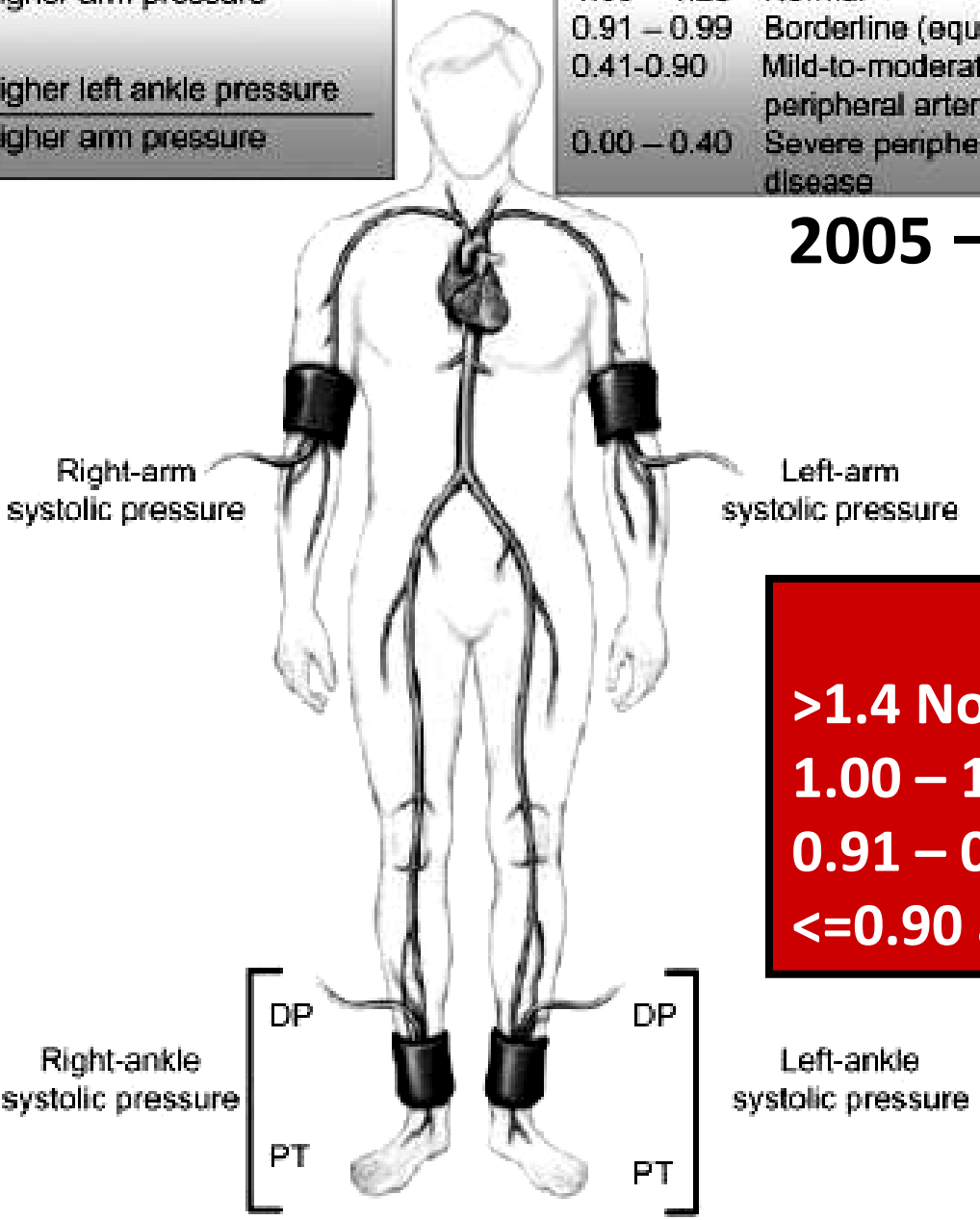
Is Atherosclerotic Disease Likely Present (Stenosis)

Right ABI = Higher right ankle pressure / Higher arm pressure

Left ABI = Higher left ankle pressure / Higher arm pressure

Interpretation of ABI	
>1.30	Noncompressible
1.00 – 1.29	Normal
0.91 – 0.99	Borderline (equivocal)
0.41-0.90	Mild-to-moderate peripheral arterial disease
0.00 – 0.40	Severe peripheral arterial disease

2005



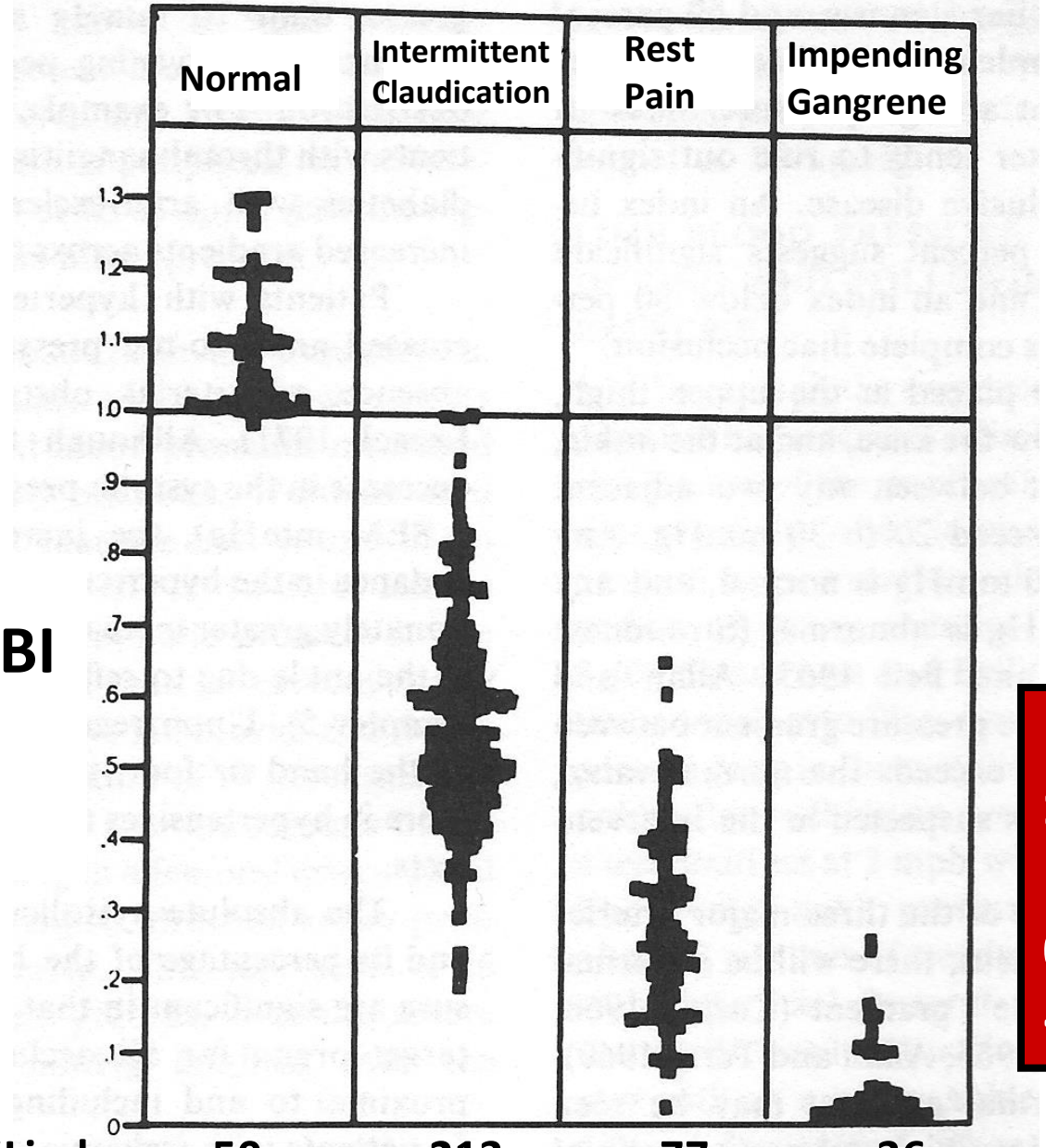
2011

>1.4 Noncompressible

1.00 – 1.40 normal

0.91 – 0.99 borderline

<=0.90 abnormal



	Normal	Intermittent Claudication	Rest Pain	Impending Gangrene
#Limbs	50	213	77	36
ABI	1.11	0.59	0.26	0.05
SD	0.10	0.15	0.26	0.08

2011

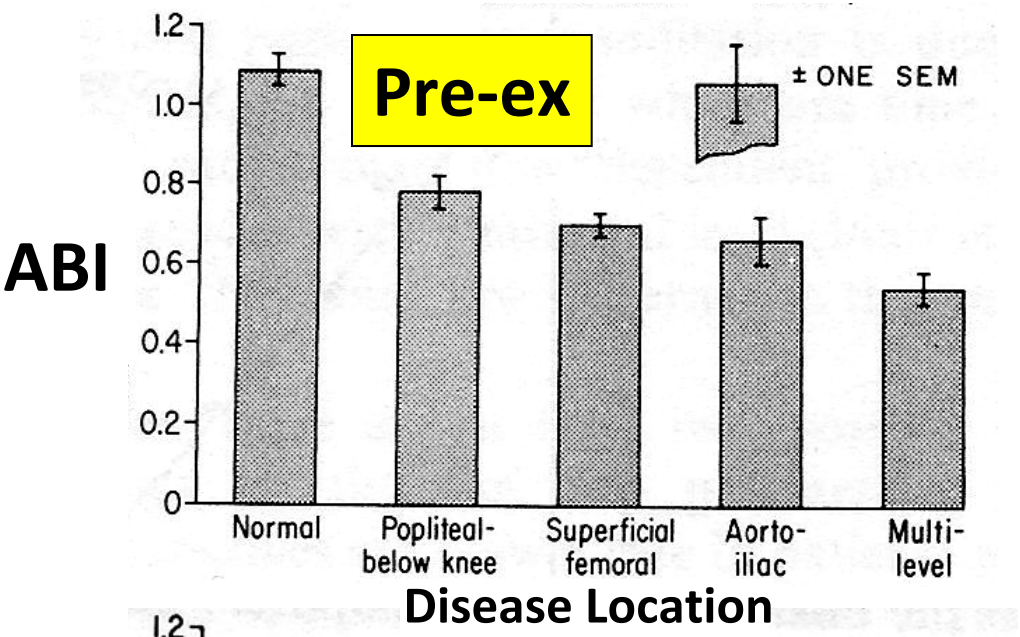
>1.4 Noncompressible

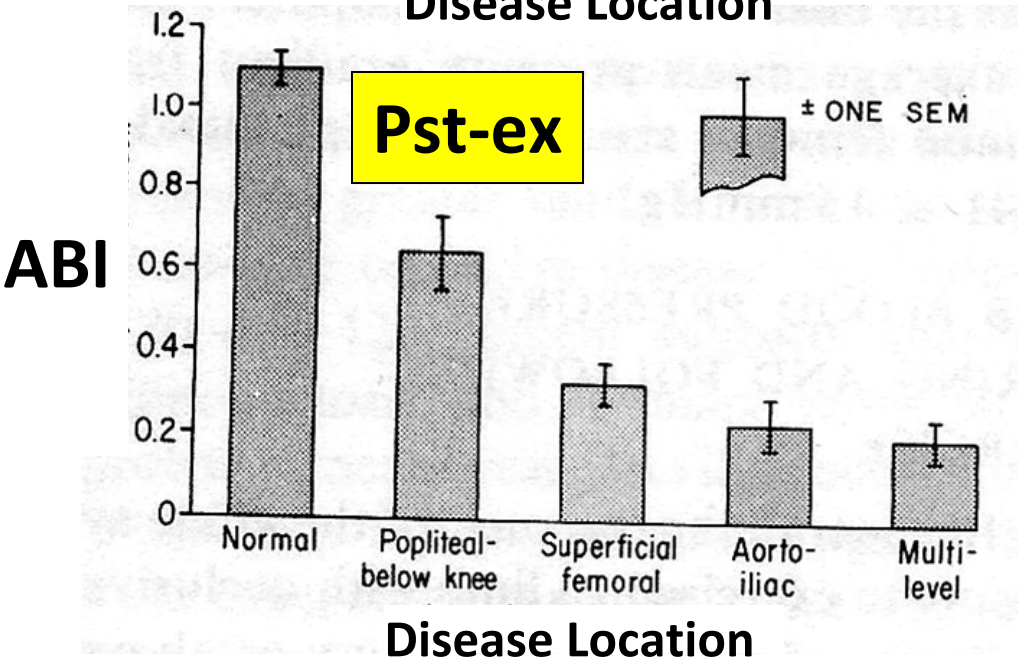
1.00 – 1.40 normal

0.91 – 0.99 borderline

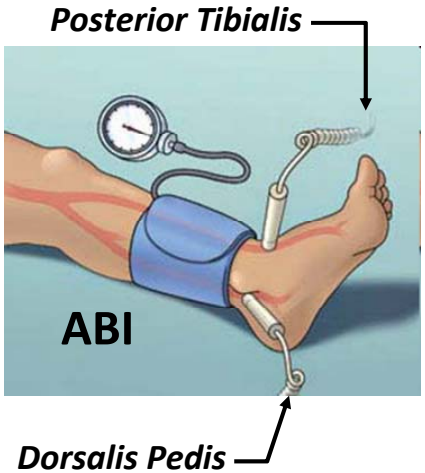
<=0.90 abnormal

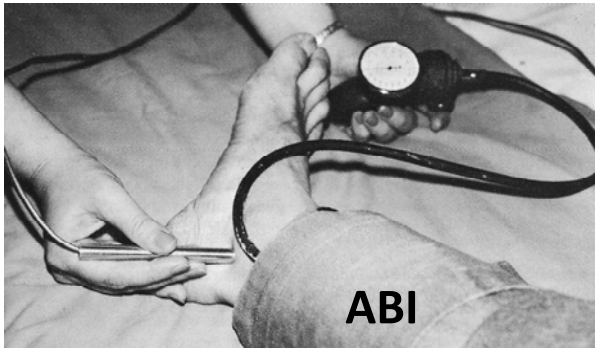
ABI- Resting vs. Post Walking





Non-Invasive Assessments - ABI





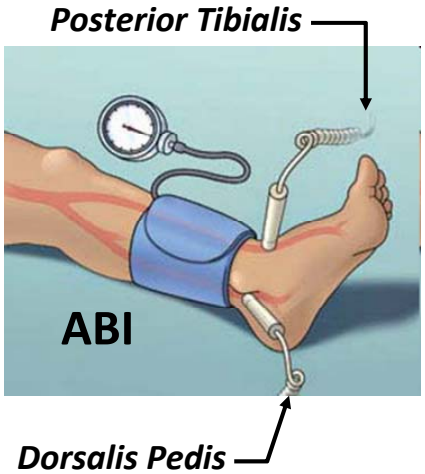
Is Atherosclerotic Disease Likely Present (Stenosis)

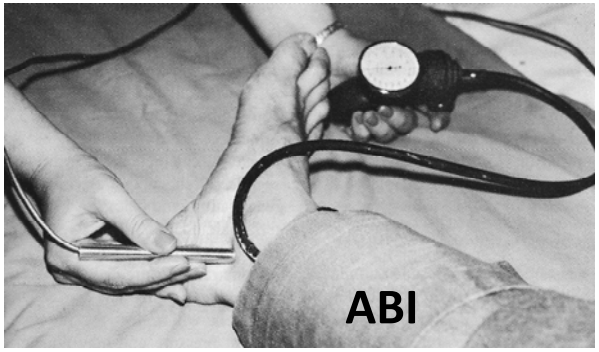
Possible Results of a 'Diagnostic' Test

FP → Detects something that does NOT exist
FN → Does NOT detect something that DOES exist
TP → Detects something that DOES exist
TN → Does NOT detect something that does NOT exist

FP → False Positive FN → False Negative
TP → True Positive TN → True Negative

Non-Invasive Assessments - ABI





Is Atherosclerotic Disease Likely Present (Stenosis)

Possible Results of a 'Diagnostic' Test

Sensitivity = *Detecting disease if disease is present*

$$\text{Sensitivity} = \frac{TP}{TP + FN} \sim 0.75$$

Specificity = *Not detecting disease if disease not present*

$$\text{Specificity} = \frac{TN}{TN + FP} \sim 0.90$$

Predictive Values of a 'Diagnostic' Test

What is the probability that a person with a *positive* test actually has the condition?

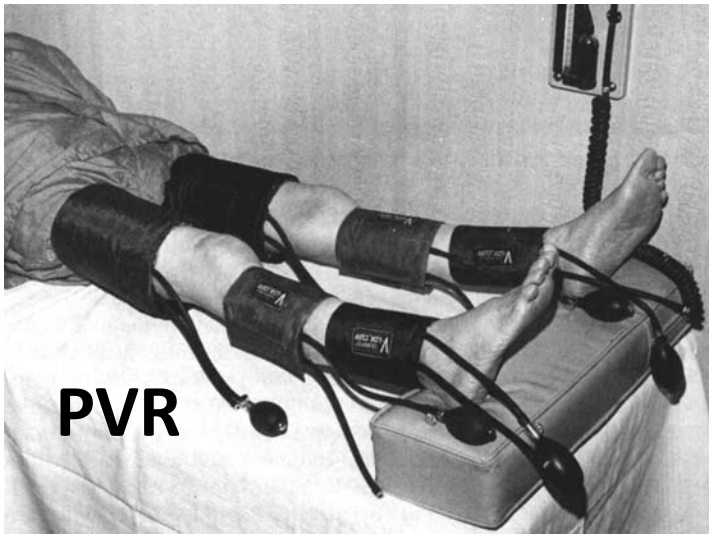
<u>Positive Predictive Value</u> (PPV) of the diagnostic test as applied to the person

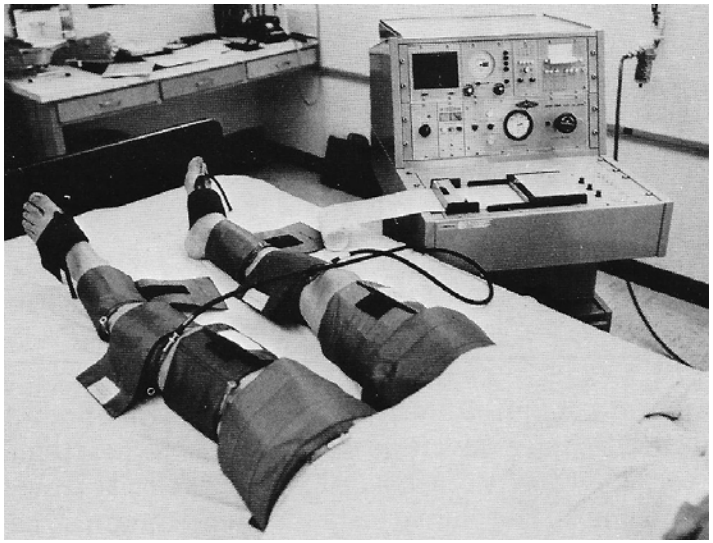
$$PPV = \frac{\text{Sensitivity} \times \text{Prevalence}}{\text{Sensitivity} \times \text{Prevalence} + (1-\text{Specificity})(1-\text{Prevalence})}$$

$$PPV = \frac{0.75 \times 0.1}{0.75 \times 0.1 + (1-0.9)\,(1-0.1)} = 45.5\%$$

A positive test would mean there is less than a 50% chance she has the condition

Non-Invasive Assessments - PVR

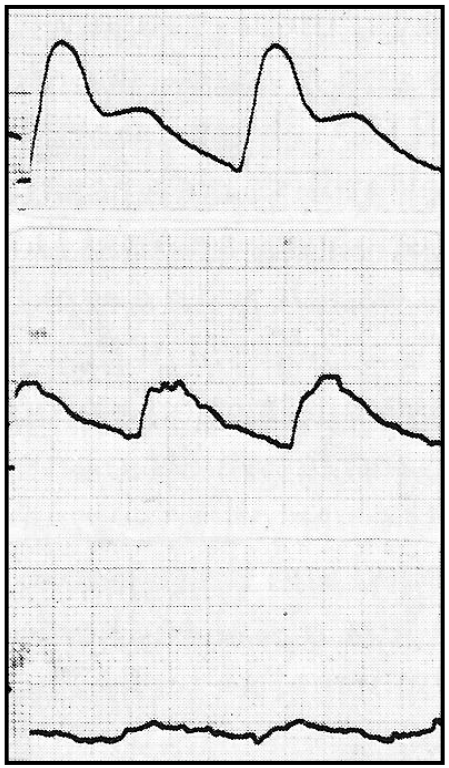




Normal

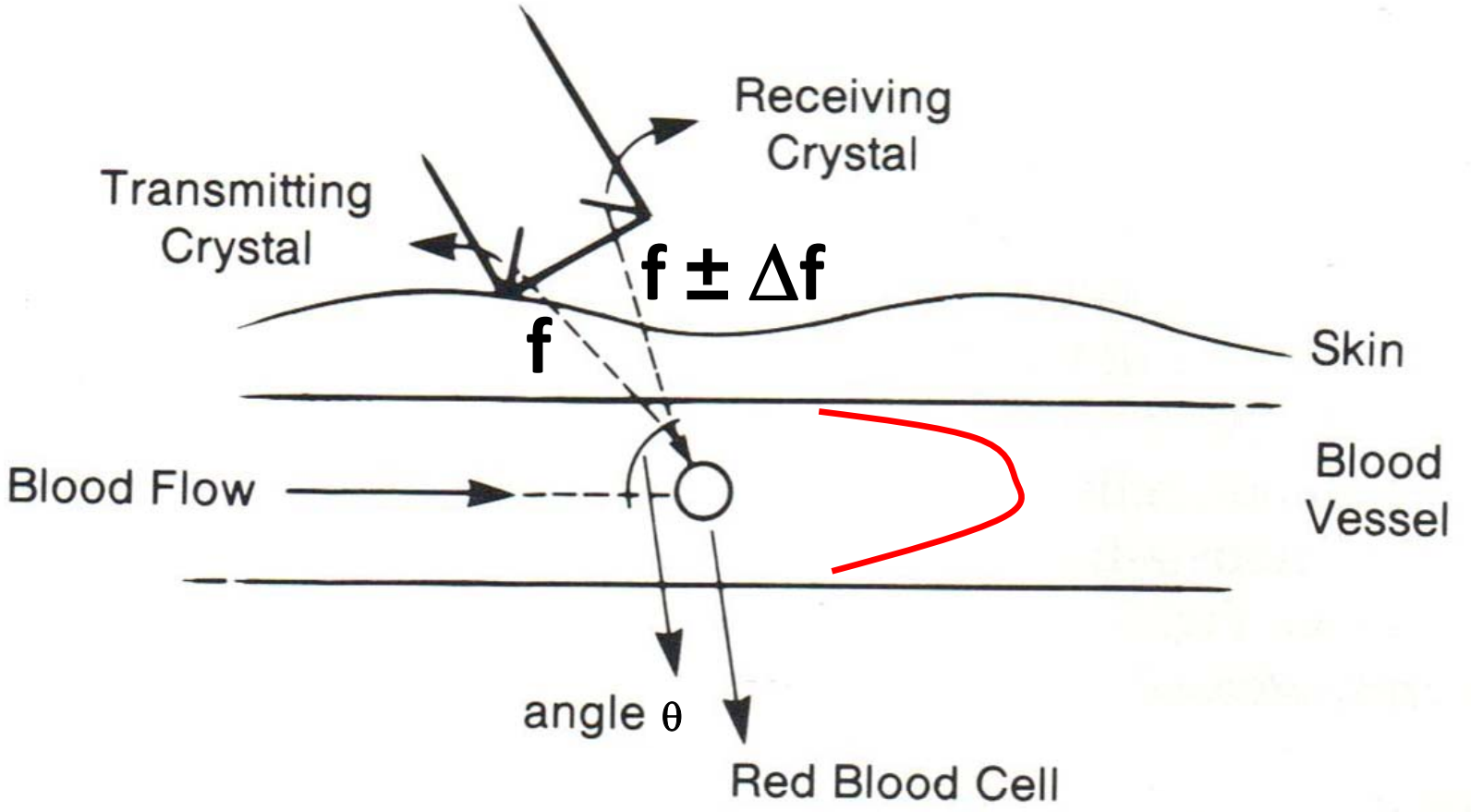
Aortoiliac Stenosis

Iliac artery Occlusion



Proximal thigh PVR recording

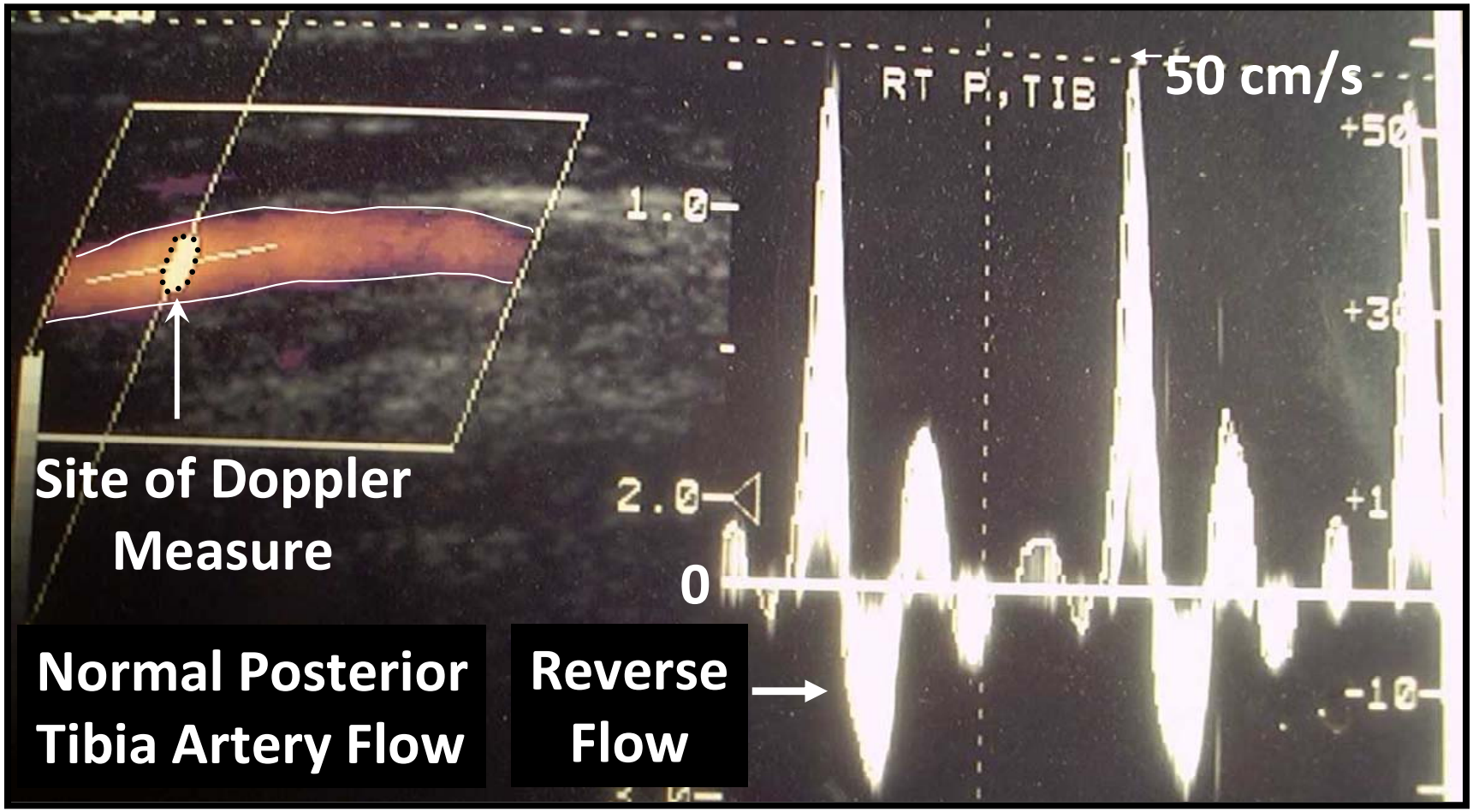
Non-Invasive Assessments – Doppler US



$$\Delta f = \frac{2fv\cos\theta}{C}$$

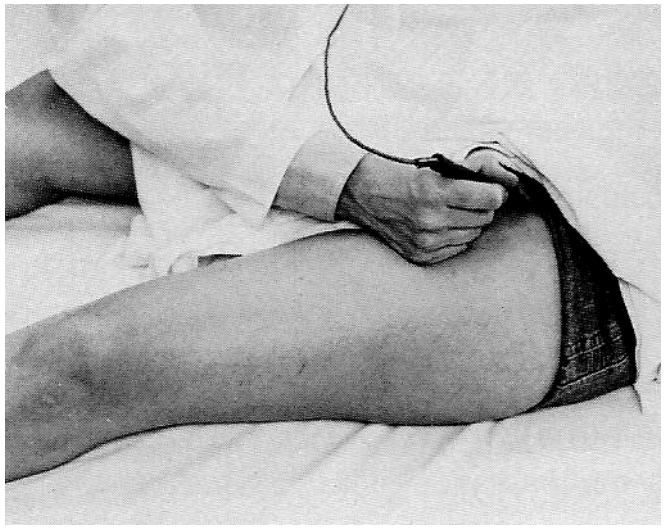
Non-Invasive Assessments – Doppler US

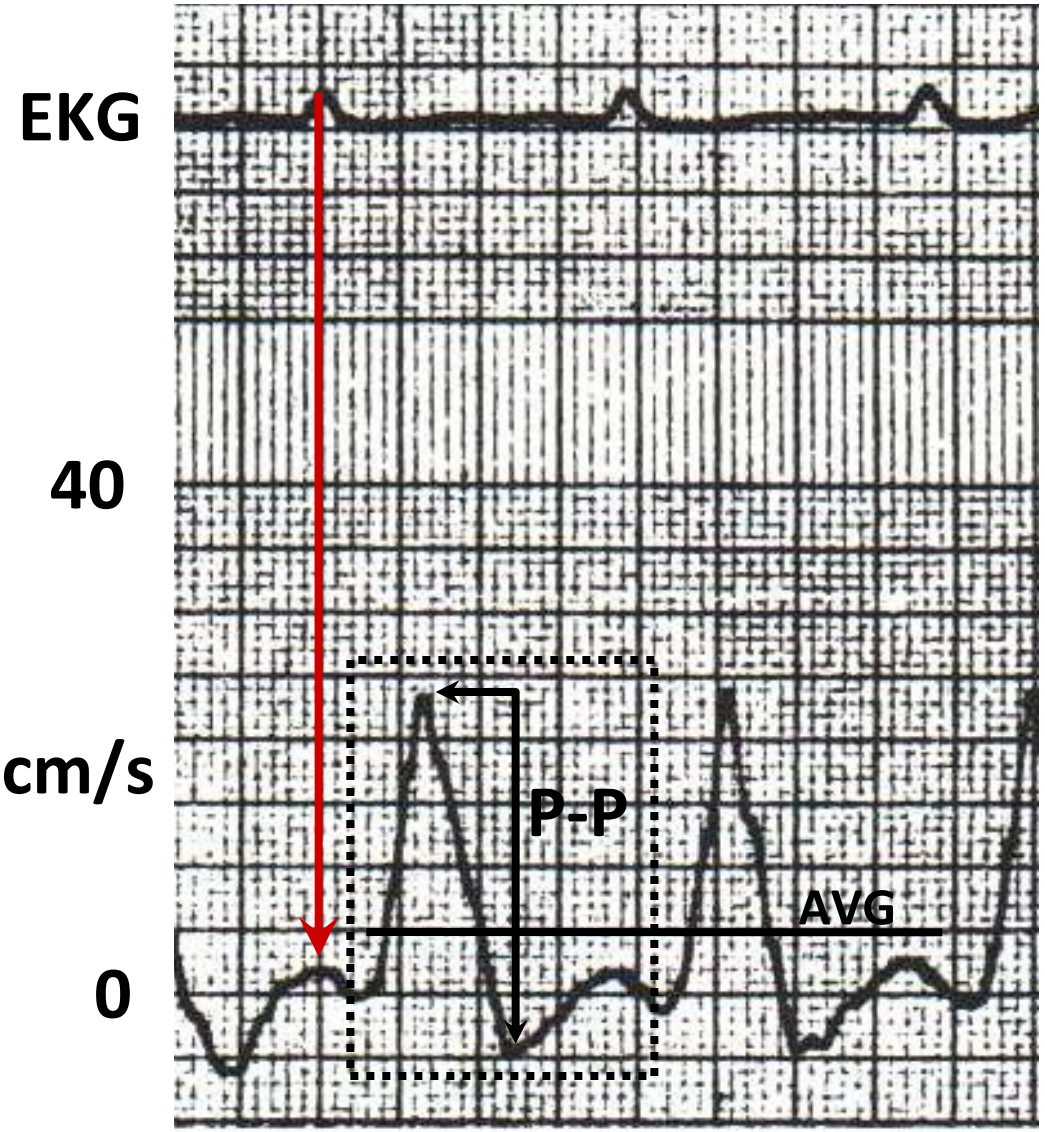
- Localization
- Better quantification



Normal Velocity Pattern

$$\text{Pulsatility Index} = \frac{P - P}{AVG}$$



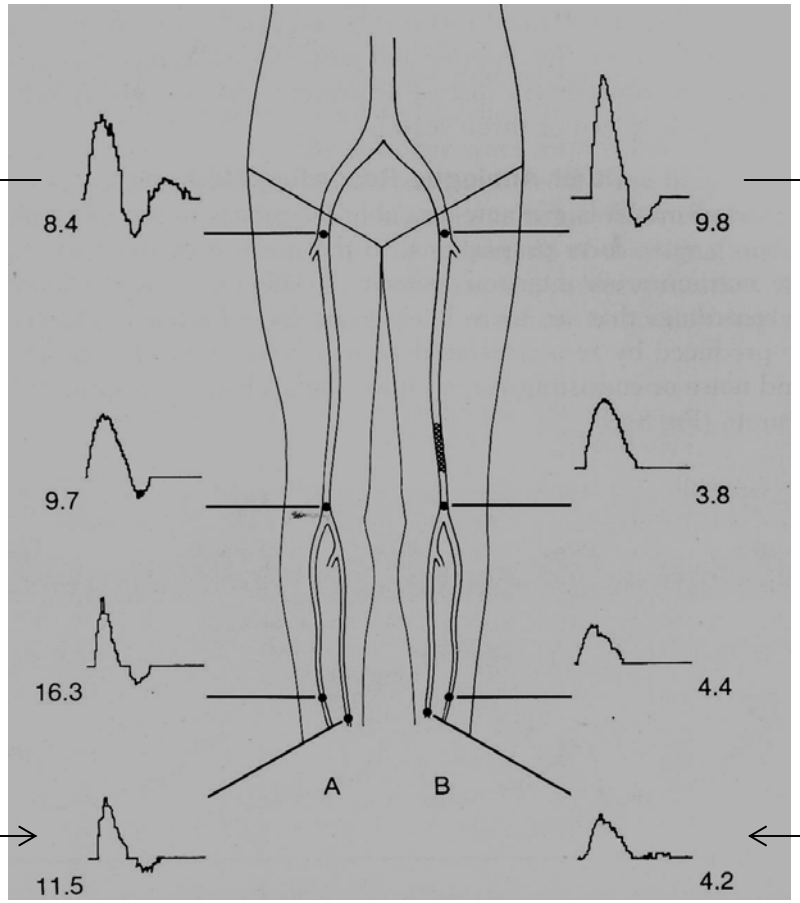


Femoral Artery Velocity

Approach to Quantification: Pulsatility Index

Normal Triphasic

Increased Pulsatility Index (PI)



Femoral

Popliteal

Dorsalis Pedis

Posterior Tibia


"That's
all
folks!"