Clinical characteristics & impact of Peripheral Vascular Disease in Diabetes

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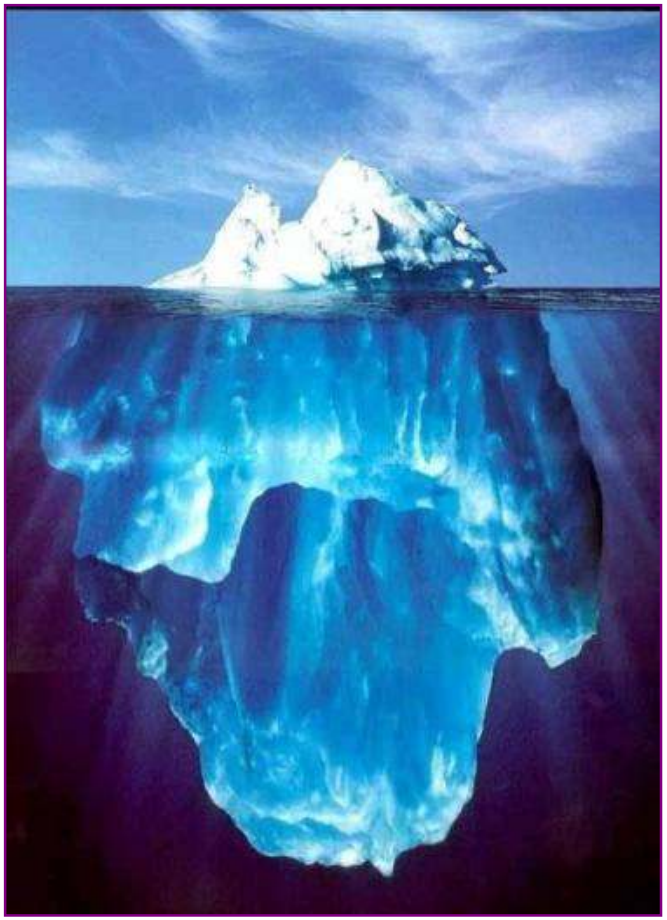
Peripheral Vascular Disease

- Diseases to arteries & veins outside thoracic region
- Main cause is **atherosclerosis**
  - **Peripheral arterial disease (PAD)**
  - Carotid artery disease
  - Aortic aneurysmatic disease
  - Renovascular hypertension
  - Abdomninal angina
  - Ischemia of upper extremity

Atherosclerotic Peripheral Arterial Disease (PAD)

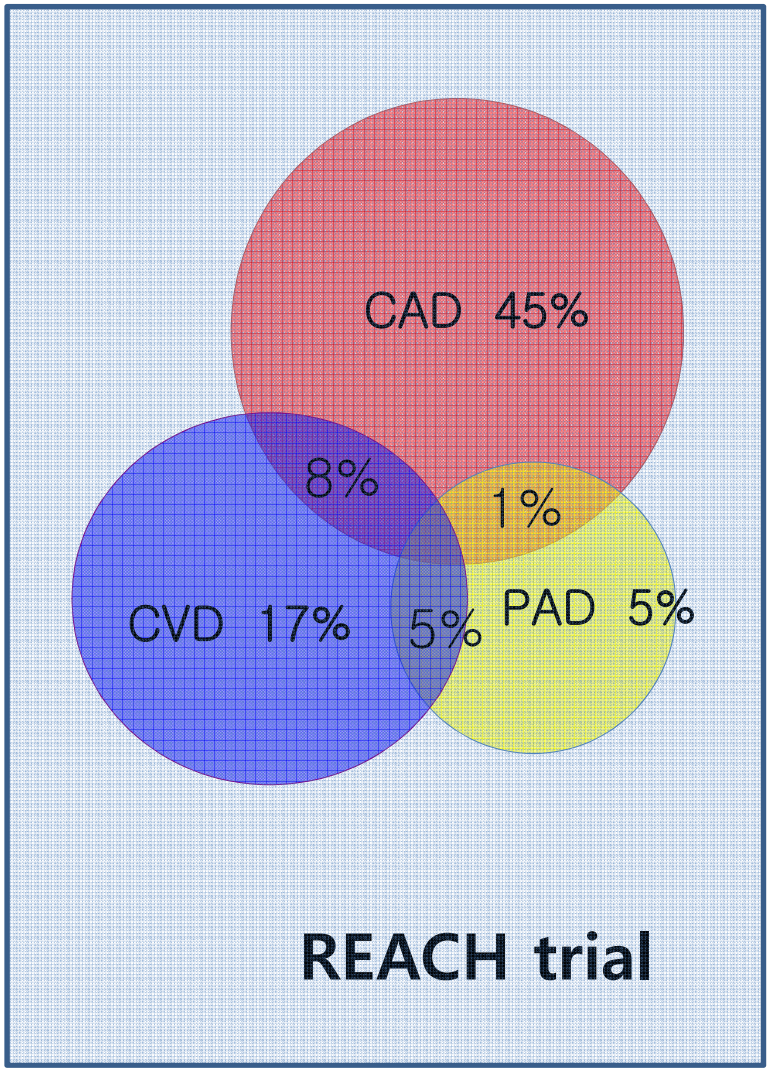
PAD is a manifestation of systemic atherosclerosis

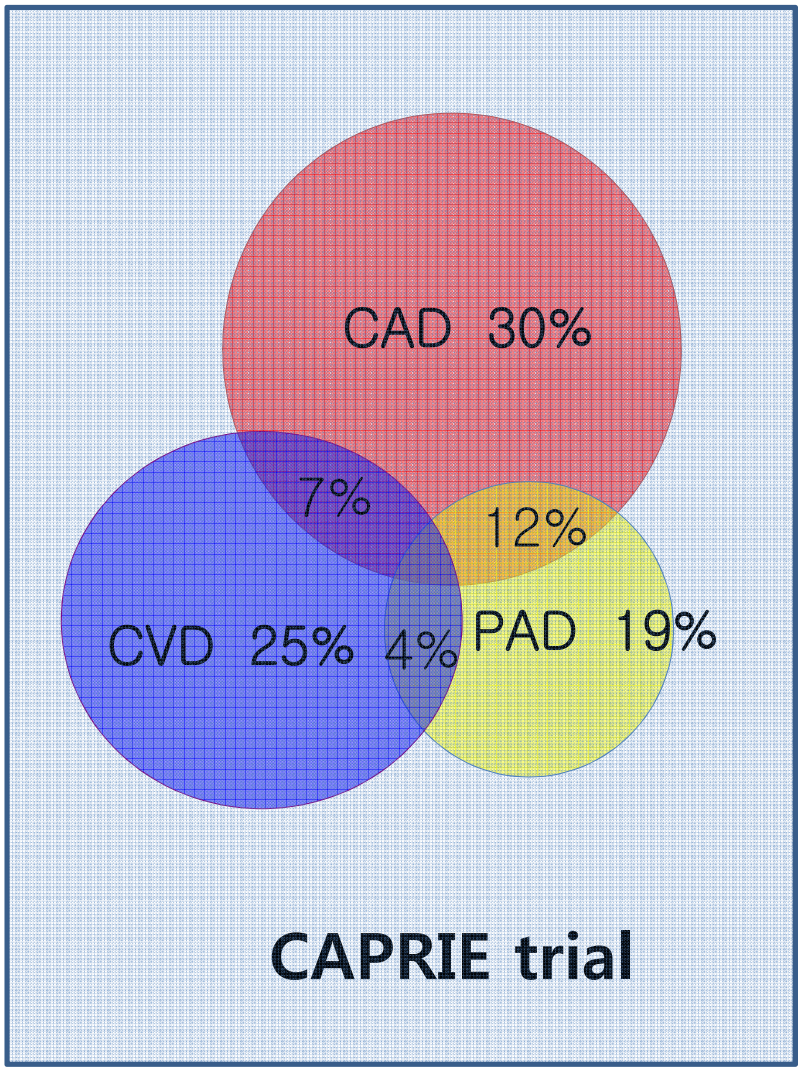


- Coronary artery
- Carotid artery
- Cerebrovascular
- Renal artery
- Visceral artery

Etc.

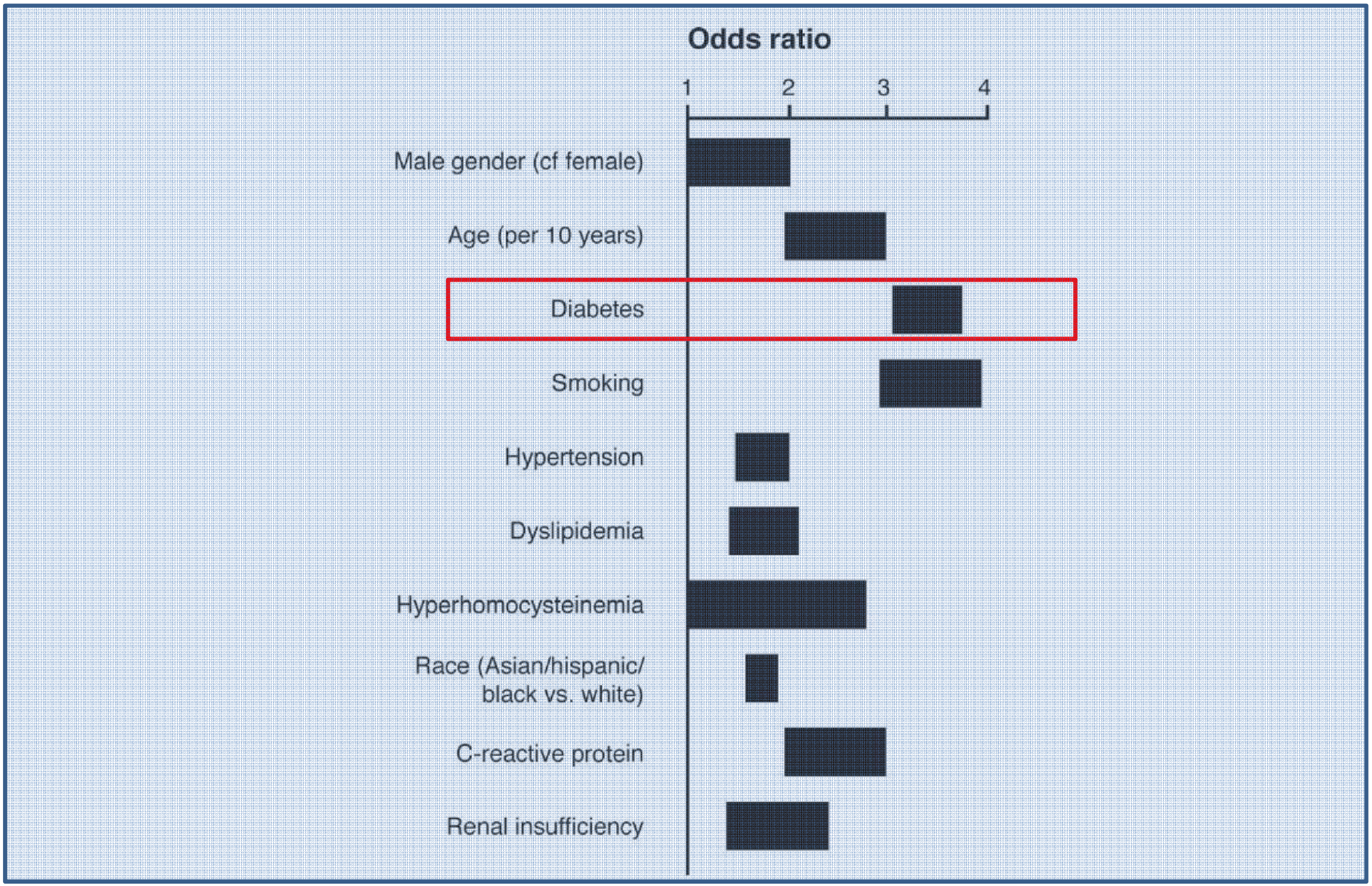
Overlap in Vascular Disease





CAD, coronary artery disease; CVT, cerebrovascualr disease; PAD, peripheral arterial disease

DIABETES is a major contributor to PAD



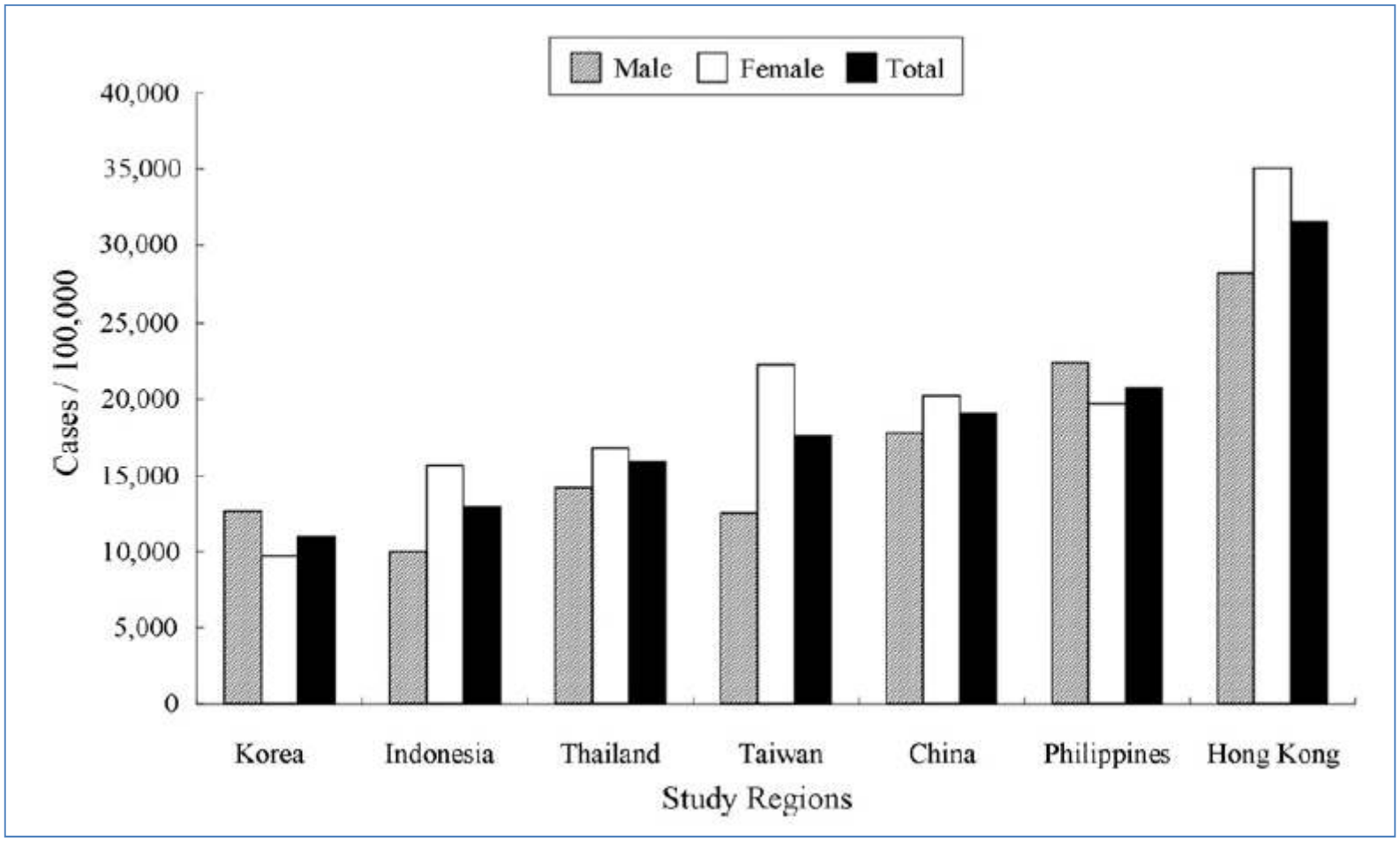
Prevalence of PAD

- **NHANES** [Circulation 2004]
  - **Age>40yrs; 4.3%**
  - **Age>70yrs; 14.5%**
- **San Diego** [Circulation 1985]
  - **Mean age 66; 11.7%**
- **Rotterdam** [Atheroscoerosis 2004]
  - **Age>55yrs; 19.1%**
- **Diehm** [Arteriolscler Thromb Vasc Biol 1998]
  - **Age>65yrs; 19.8%**
- **PARTNERS** [JAMA 2001]
  - **Age>70yrs or 50~69yrs with a history diabetes or smoking; 29%**

NHANES; National Health and Nutrition Examination survay
PARTNER; PAD Aqarness, Risk and Treatment

PAD in Asian type 2 diabetes

at high risk of atherosclerosis

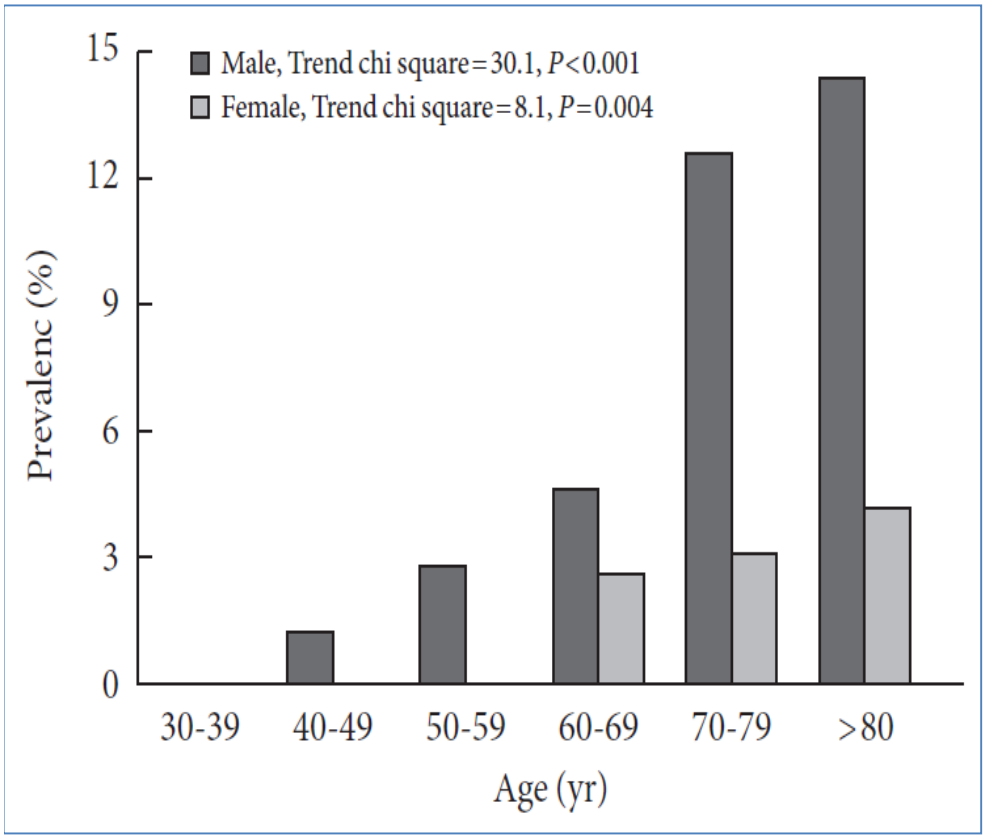


17.7 % (1,172/6,625) by ABI <0.9

Diabetes Research and Clinical Practice 76 (2007) 82–92

PAD in Korean T2DM

- **아산병원**

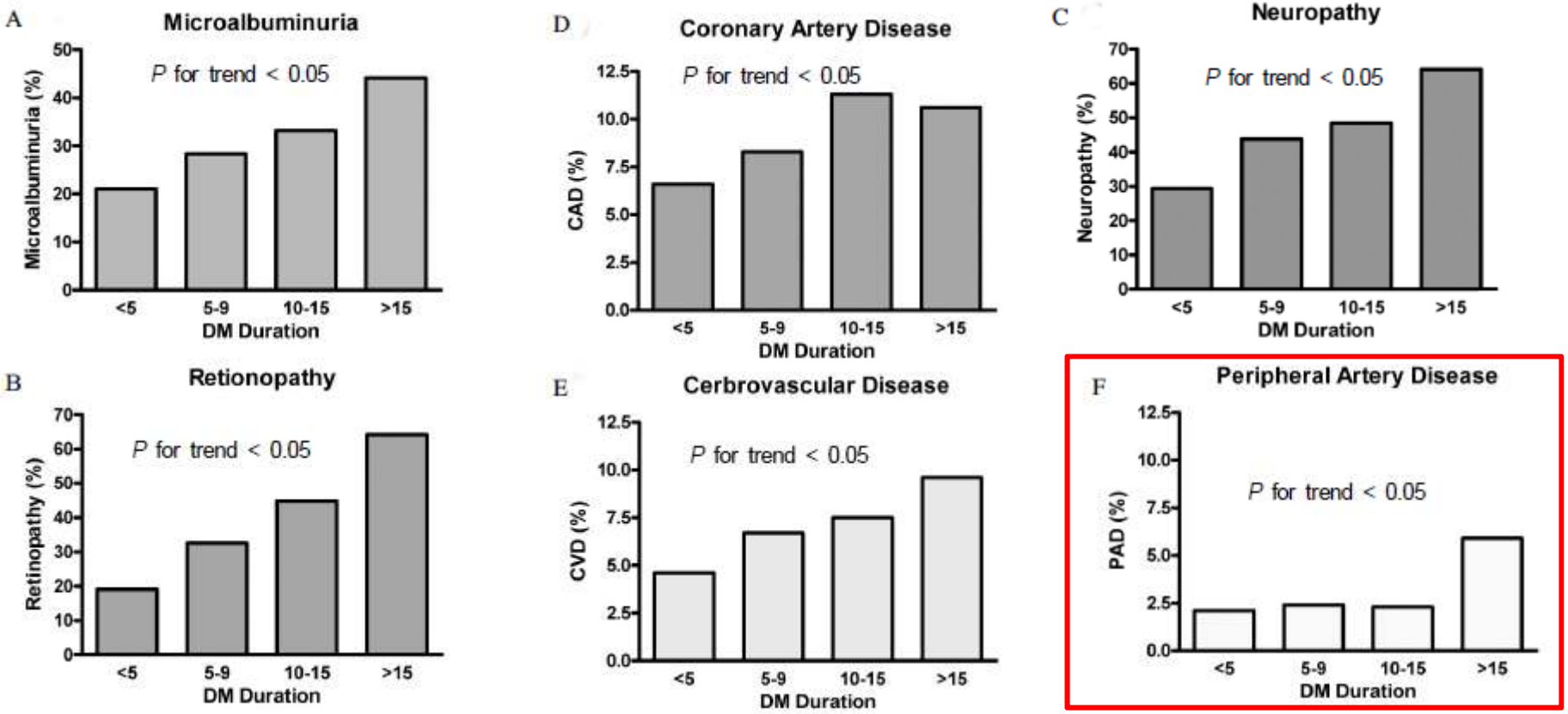


- PAD in diabetes
  - 3.2% (64/2,002)
- Severe PAD (ABI<0.4)
  - 1.8% (3/64)
- Mean age
  - 59.5세
- Mean diabetes duration
  - ; 14.7 vs 12.3년

Diabetes Metab J 2011;35:543-550

Prevalence of vascular complication

duration of diabetes

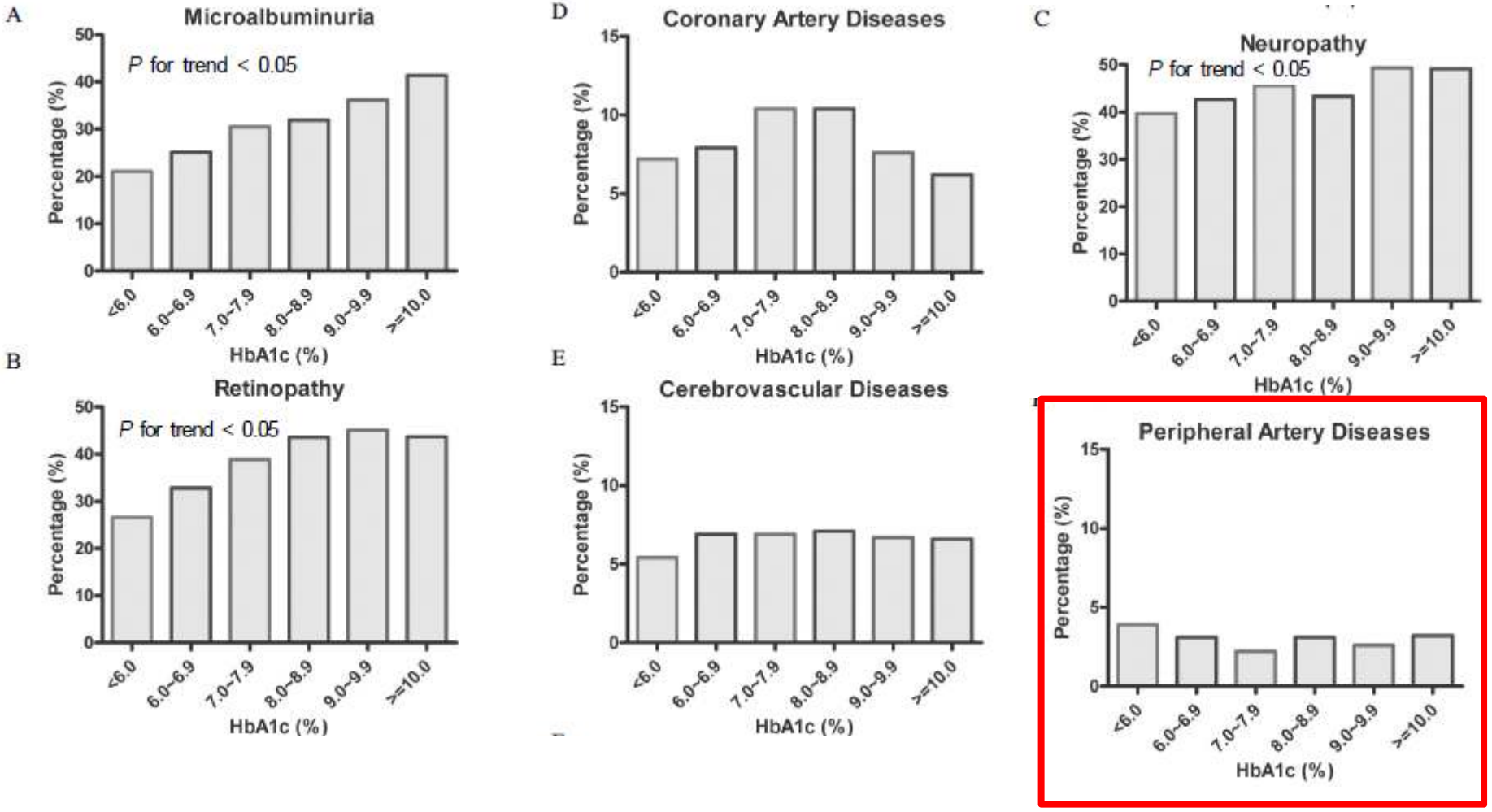


13병원, 5,652명
말초혈관질환 3.0 %

Korean Diabetes J 33:48~57, 2009

Prevalence of vascular complication

duration of diabetes



Korean Diabetes J 33:48~57, 2009

Risk factor	PAD (n=64)	No PAD (n=192)	P value[a]
Sex, M/F	50/14	150/42	1.000
Age, yr	66.9±9.1	66.5±8.8	0.749
Duration of DM, yr	14.7±10.8	12.3±8.7	0.113
BMI, kg/m^2	24.8±3.1	24.8±2.9	0.989
Smoking status, % current or ex	65.6	54.2	0.109
Smoking amount, median pack-yr	25	10	0.017
SBP, mm Hg	134.9±17.7	127.8±15.0	0.002
DBP, mm Hg	71.2±9.9	70.2±8.7	0.456
FBS, mg/dL	138.1±42.2	134.2±36.8	0.478
2hPG, mg/dL	218.9±60.8 (n=64)	216.8±71.1 (n=190)	0.828
HgA1c, %	7.4±1.2	7.4±1.2	0.847
C-peptide, ng/mL	2.6±1.4 (n=63)	2.4±1.5 (n=189)	0.254
Total cholesterol, mg/dL	166.8±40.1	161.7±32.7	0.308
Triglyceride, mg/dL	163.4±99.5	138.6±71.8	0.032
HDL-C, mg/dL	43.4±12.1	46.1±11.3	0.105
LDL-C, mg/dL	99.7±31.6	97.1±28.9	0.541
DM management			
Diet & exercise	1 (1.6)	5 (2.6)	0.383
OHA	47 (73.4)	156 (81.3)	0.383
Insulin+OHA	10 (15.6)	22 (11.4)	0.383
Insulin	6 (9.4)	9 (4.7)	0.383
Microvascular complication			
Retinopathy	38 (59.4)	66 (34.3)	<0.001
Nephropathy	38 (59.4)	46 (24.0)	<0.001
Neuropathy	40 (63.0)	84 (44.0)	0.009
Macrovascular complication			
CVA	20 (31.0)	17 (9.0)	<0.001
CAD	30 (47.0)	35 (18.0)	<0.001
Medication			
Cholesterol-lowering drugs	49 (77)	107 (56)	0.003
Antihypertensive drugs	56 (88)	126 (66)	0.001
ABI			
Right ABI	0.84±0.20	1.16±0.08	<0.001
Right baPWV, m/sec	17.18±4.99	17.27±3.55	0.887
Left ABI	0.82±0.21	1.15±0.08	<0.001
Left baPWV, m/sec	16.08±6.25	17.36±3.62	0.131

Table 4. Adjusted odds ratios of PAD for various independent indicators: results from multivariate conditional logistic regression analysis

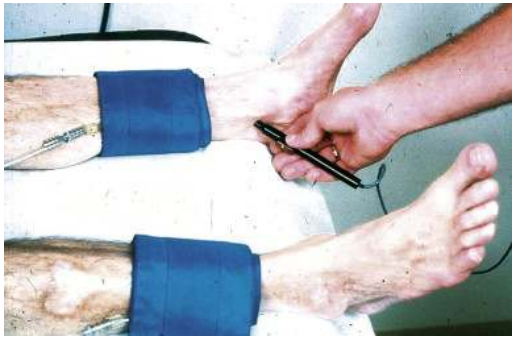
Risk factor	OR	95% CI	*P* value[a]
SBP ≥140 mm Hg	2.492	1.249-4.970	0.010
Microvascular complication	6.156	2.270-16.695	<0.001
Macrovascular complication	5.319	2.689-10.523	<0.001

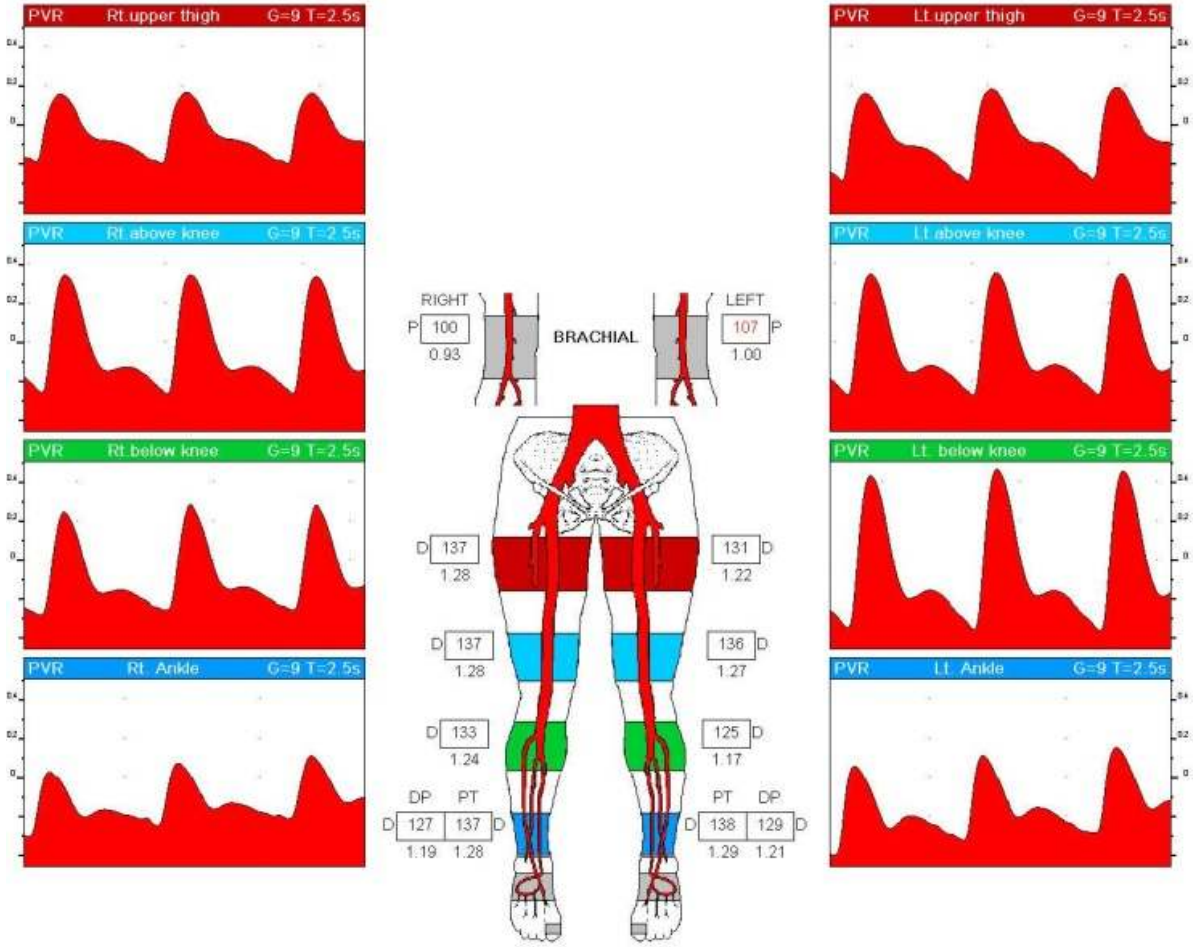
Diabetes & PAD

- **Very common, affecting up to 30% of people with diabetes**
- **ABI can easily identify PAD at an early asymptomatic stage**

Ankle-brachial index (ABI)

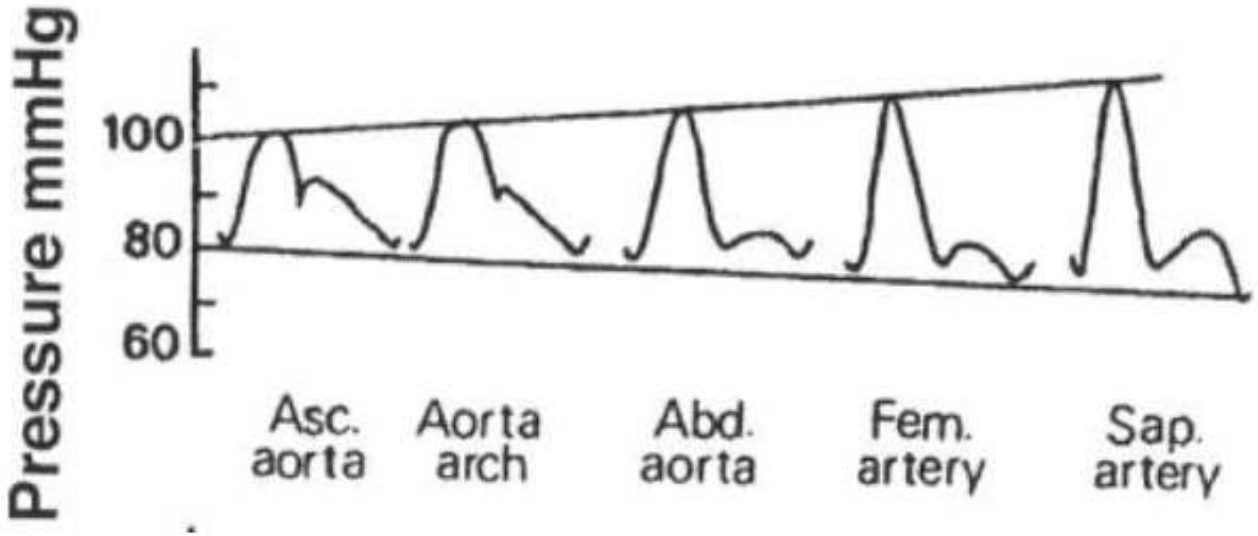
- $\frac{\text{Ankle SBP}}{\text{Brachial SBP}}$
- ABI ≤ 0.9
- Sensitivity ~90%
- Specificity >95%





Basic Concept of ***Central Blood Pressure***

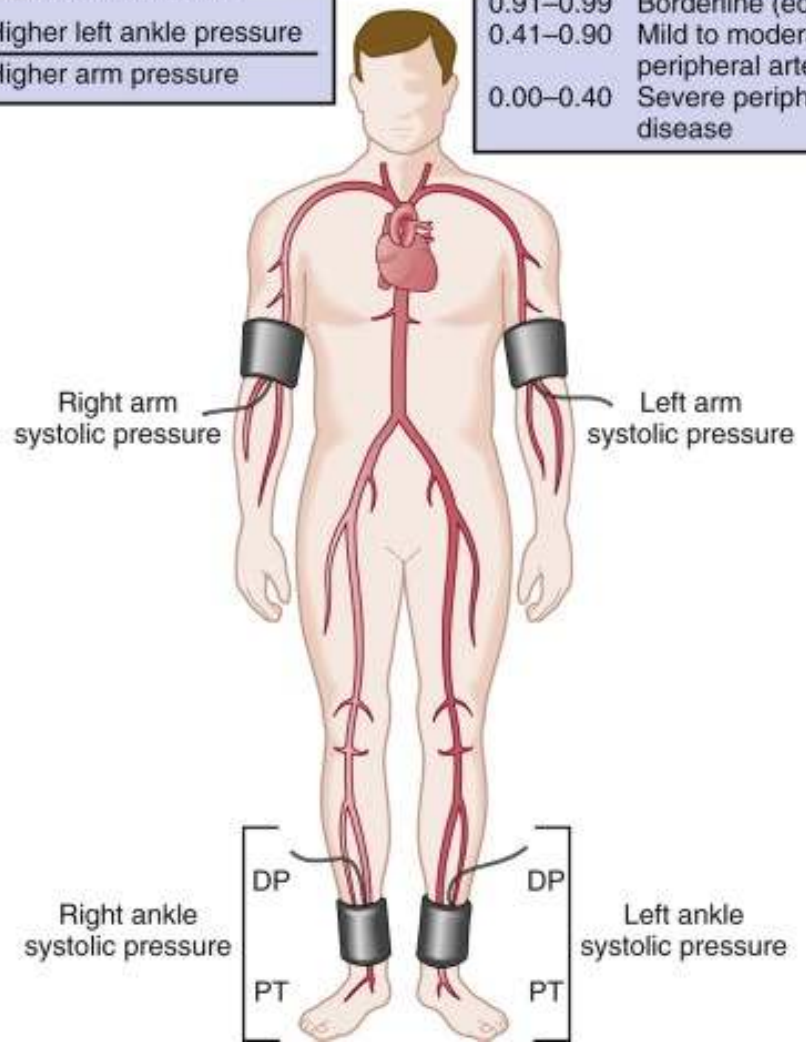
- Pressure Exerted by the blood within the Aorta
- Peripheral BP ≠ Central BP



Method for measurement of the ABI

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



Supine position
Resting at least 5minutes
DP: Dosalis pedis
PT: posterior tibial.

Medical treatment of peripheral arterial disease and claudication. NEJM 2001;344:1608

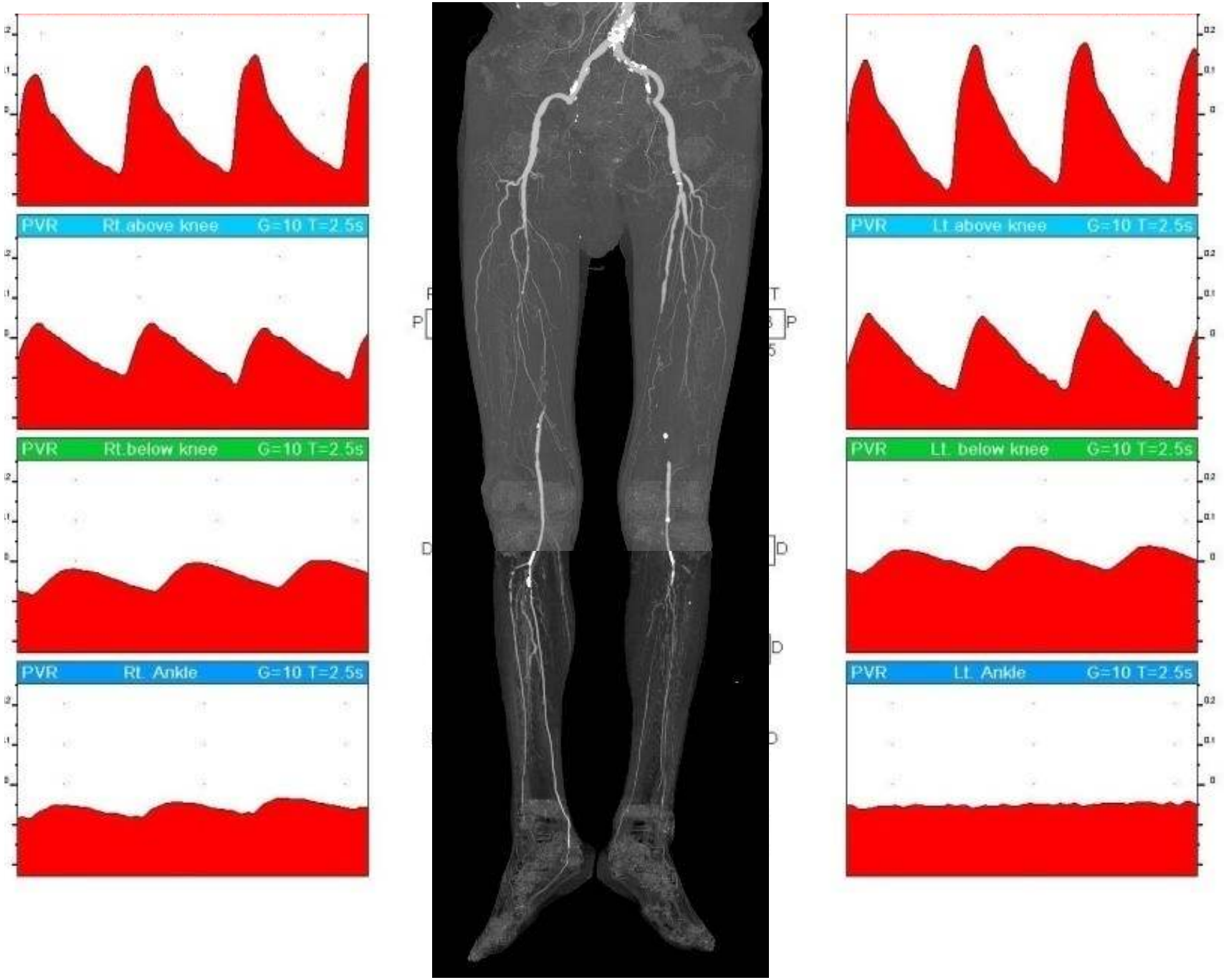
ABI: Technical Errors

Medial calcinosis: diabetes, renal failure

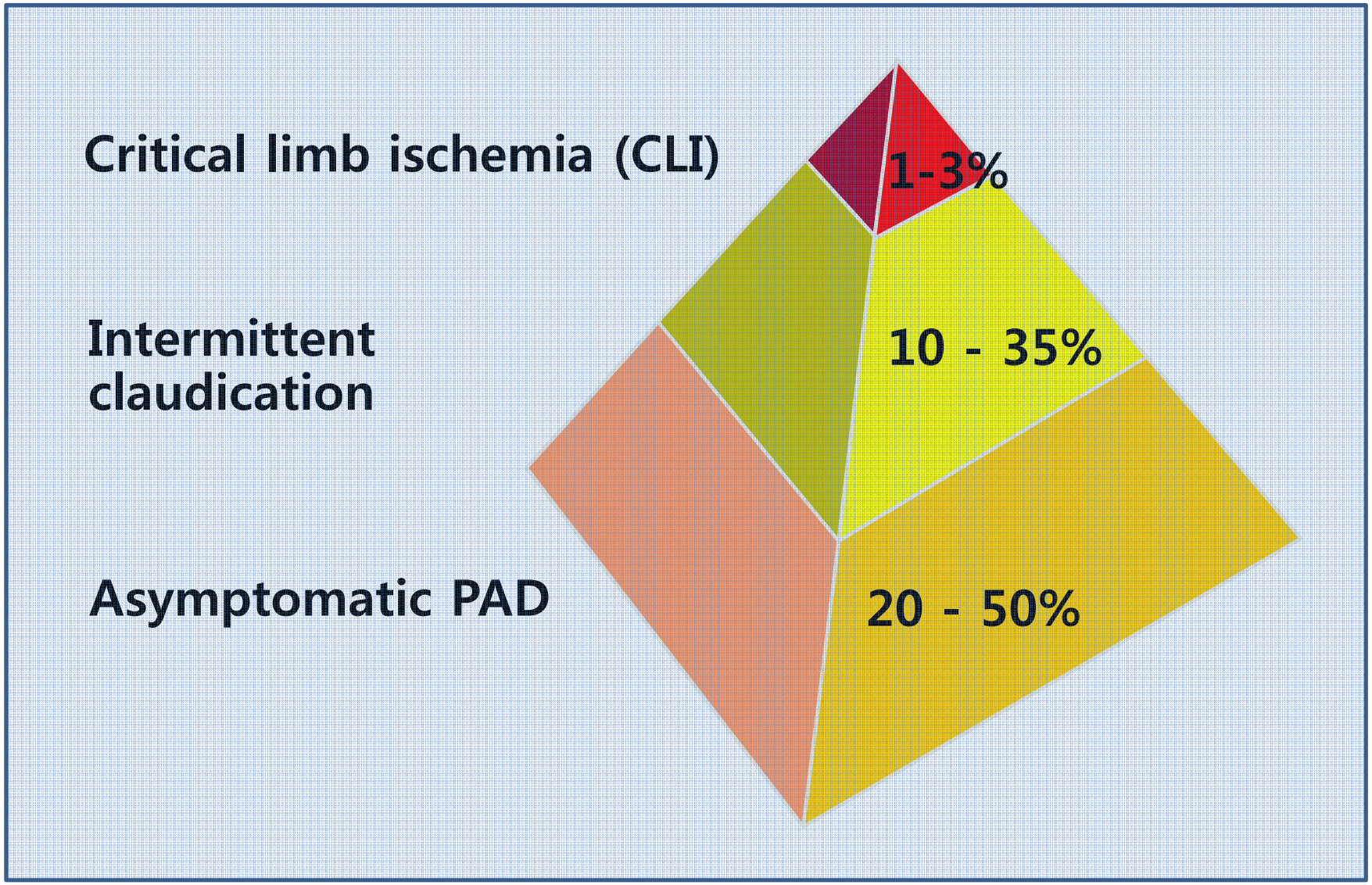
ABI > 1.3 or never occluded even at the highest cuff pr.

1. Check Doppler waveform: blunted wave
2. Not palpable pulse even though ABI >1.0
3. Clinically, ischemic ulceration/claudication/rest pain..
4. Doppler signal may diminish if the ankle is elevated
5. Check toe pressure

   [distal arteries are less involved with calcification]

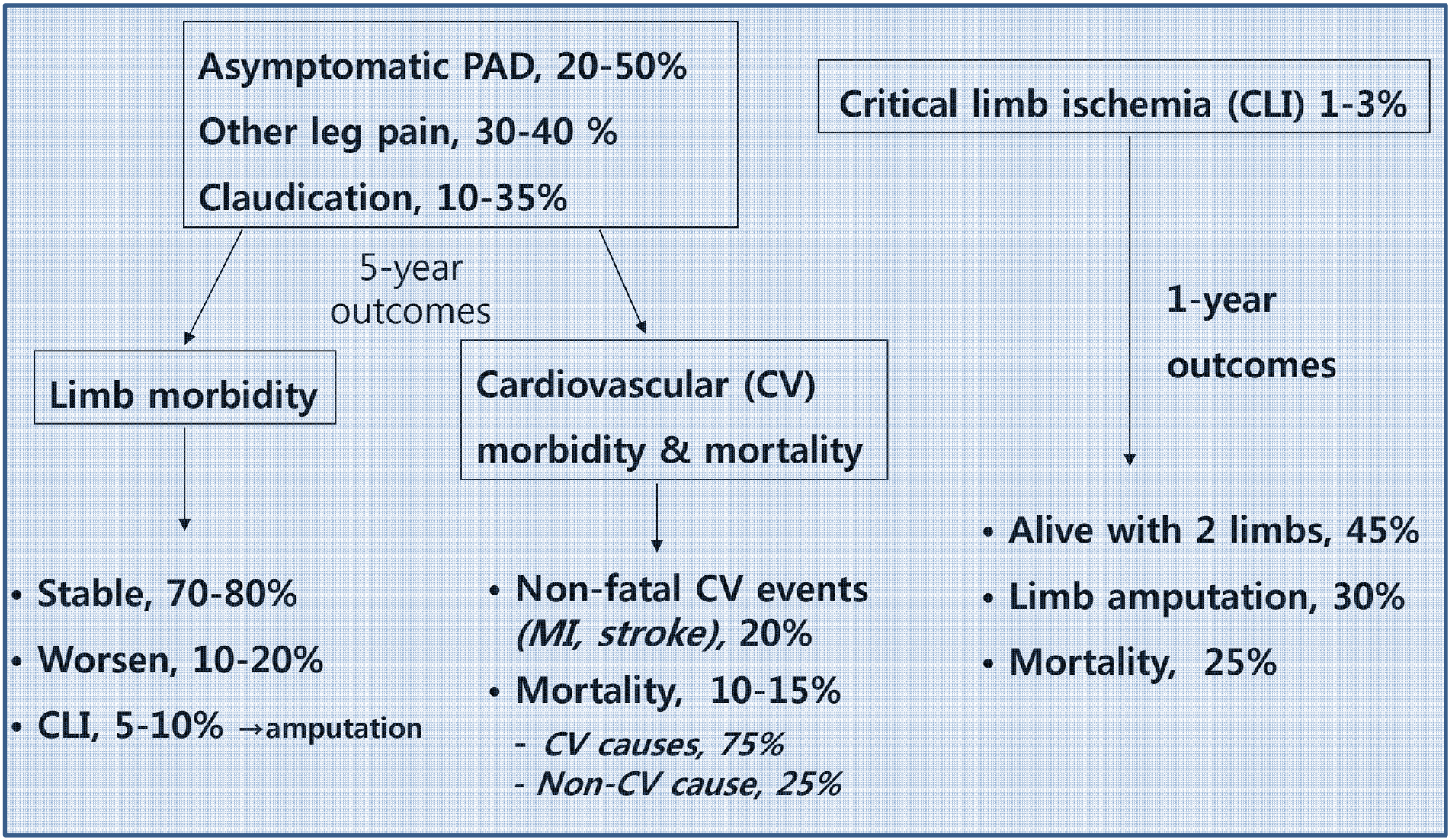

PVR Rt.above knee G=10 T=2.5s
PVR Rt.below knee G=10 T=2.5s
PVR Rt. Ankle G=10 T=2.5s
PVR Lt.above knee G=10 T=2.5s
PVR Lt. below knee G=10 T=2.5s
PVR Lt. Ankle G=10 T=2.5s

Clinical Presentation of PAD



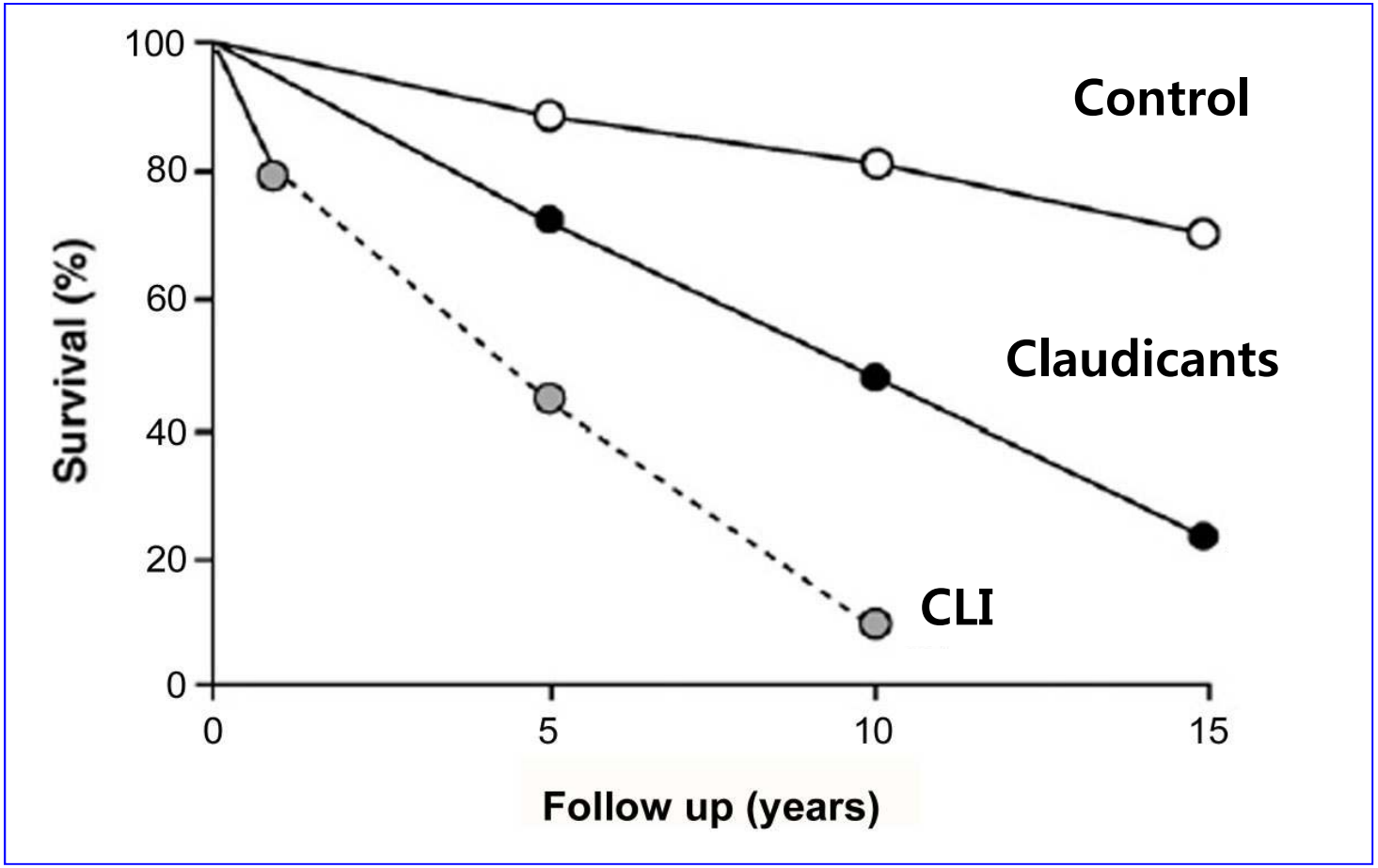
Natural History of Atherosclerotic PAD

Patients with PAD, Age > 50 years

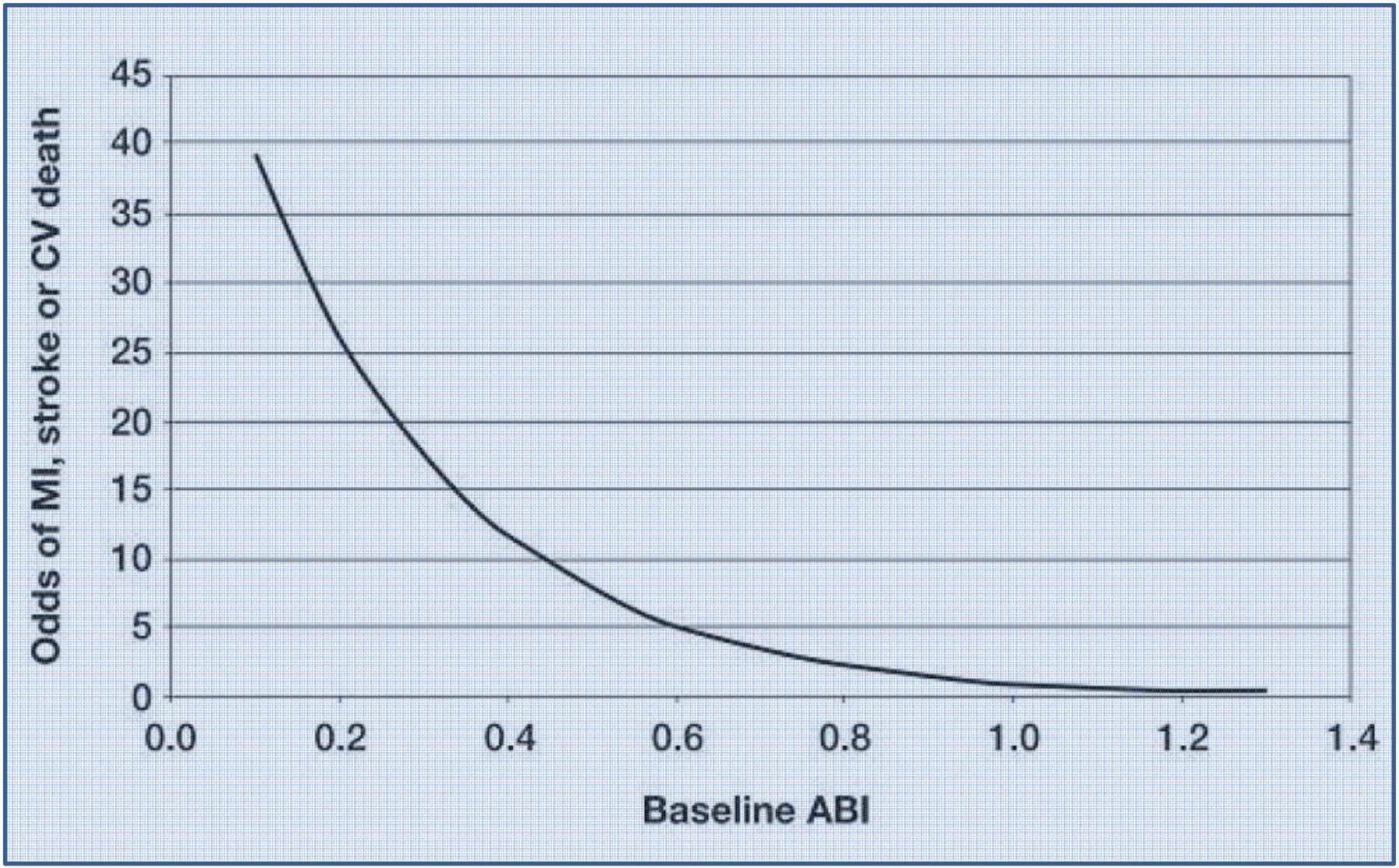


Adapted from ACC/AHA guidelines

Survival of Patients with PAD

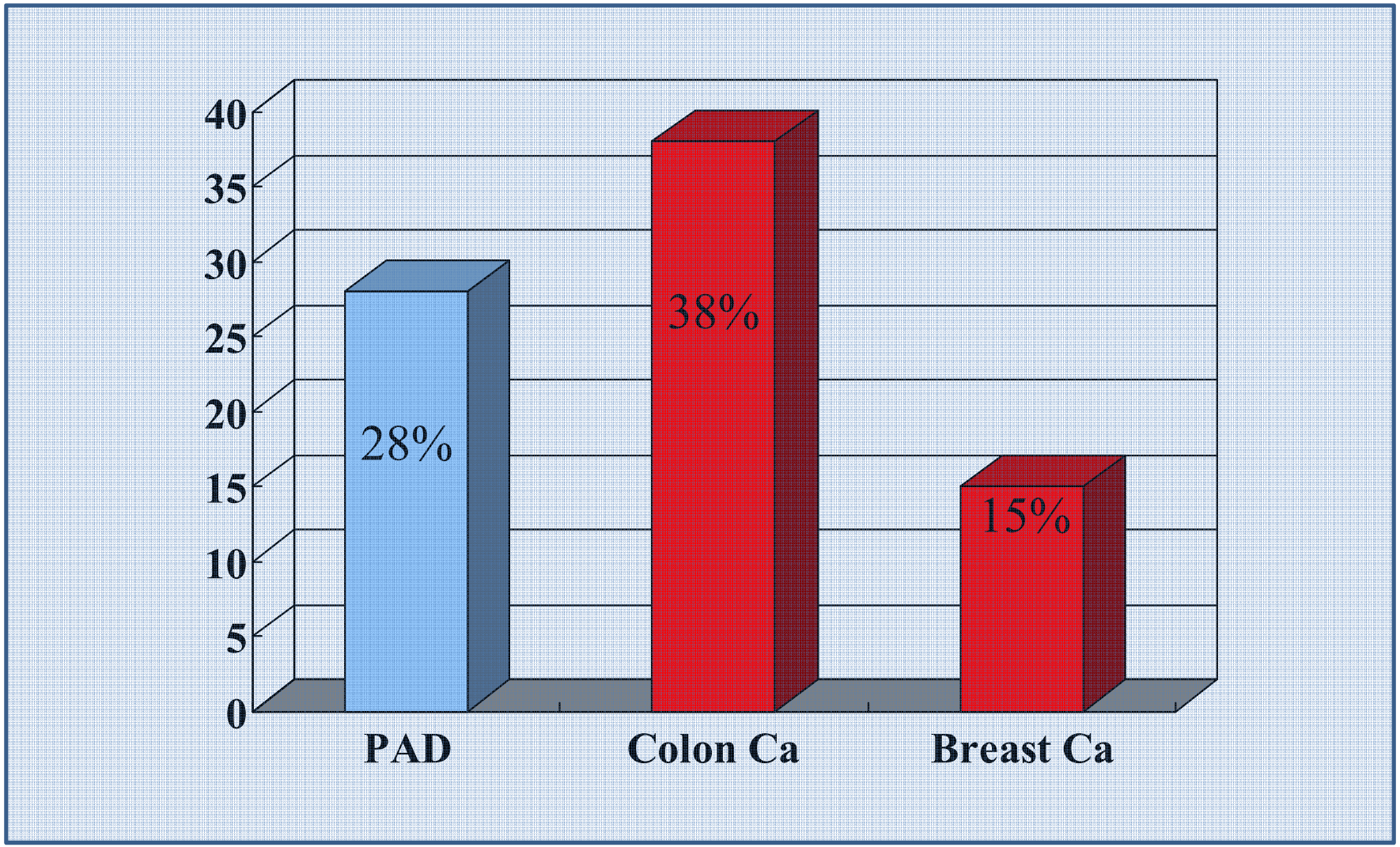


Cardiovascular event by ankle-brachial index



Mehler PS, et al. Circulation 2003;107:753-756.

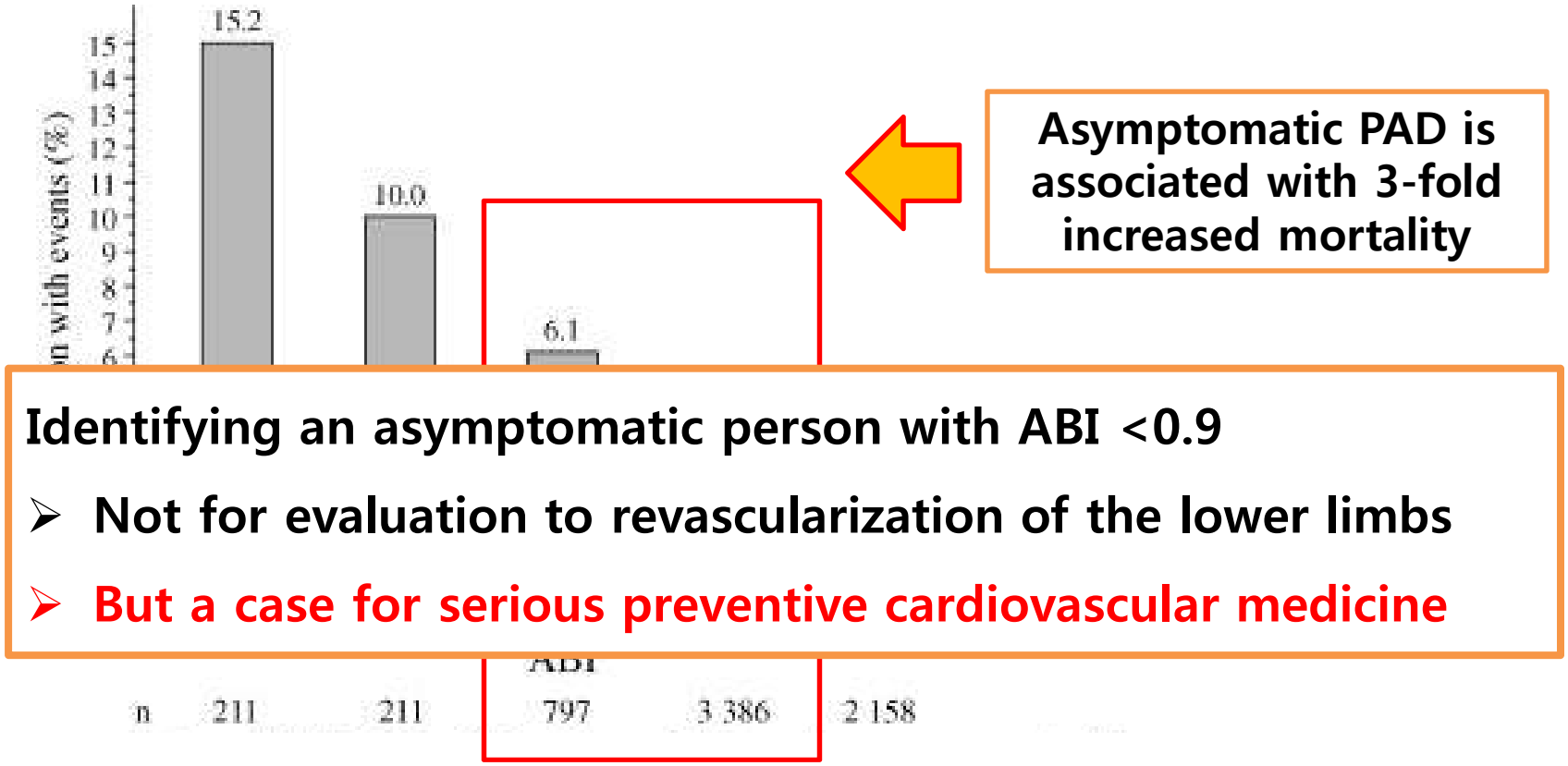
Overall 5-year Mortality Rate



PAD in 4 stages (Fontaine)

1. Asymptomatic (ABI <0.9)
2. Functional pain (claudication)
3. Rest pain
4. Non-healing ulcers or gangrene

The lower the ABI, the worse the prognosis



Asymptomatic PAD is associated with 3-fold increased mortality

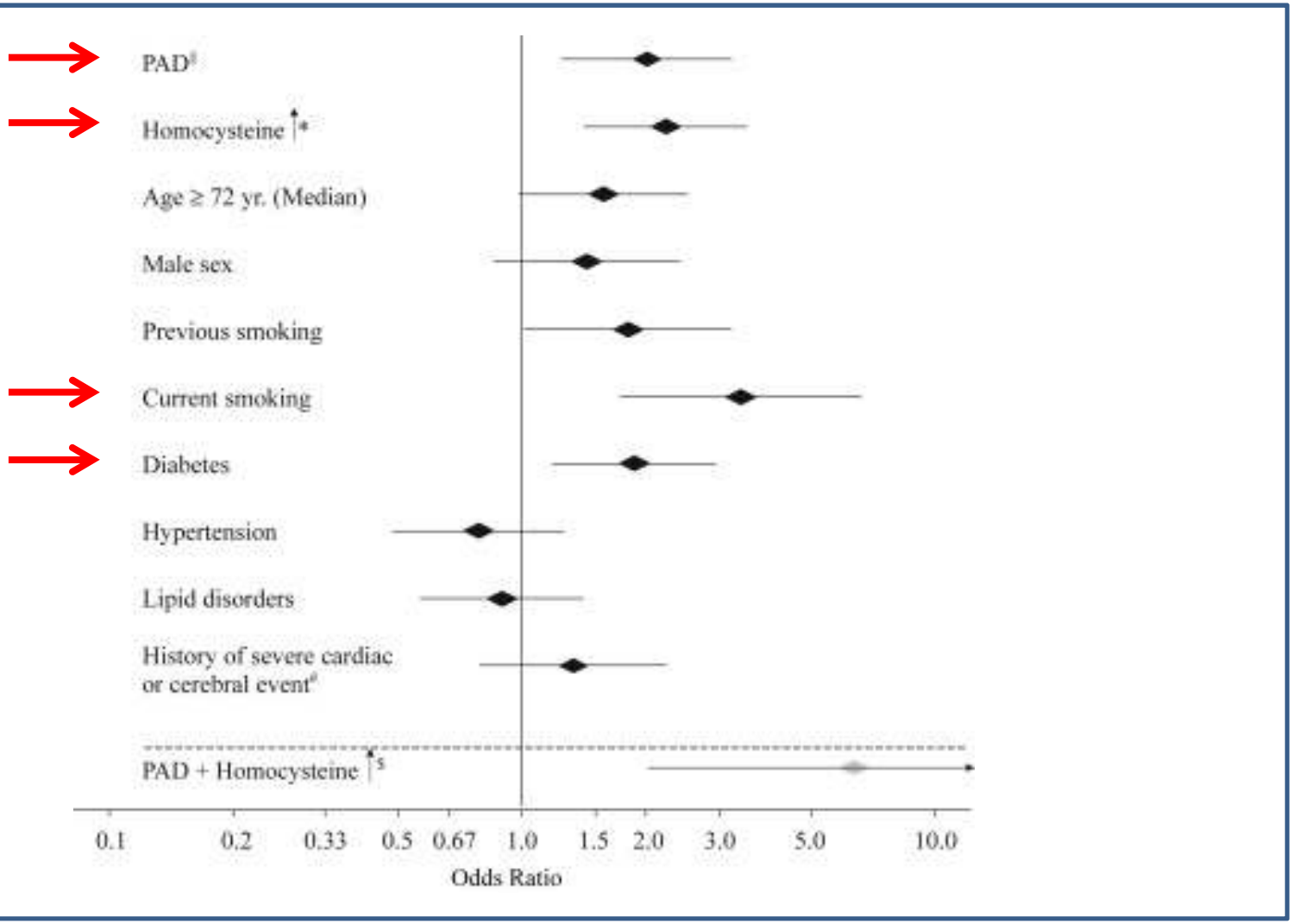
Identifying an asymptomatic person with ABI <0.9

- **Not for evaluation to revascularization of the lower limbs**
- **But a case for serious preventive cardiovascular medicine**

Atherosclerosis. 2005 Feb;178(2):351-7

Odds ratios for 1-year-mortality

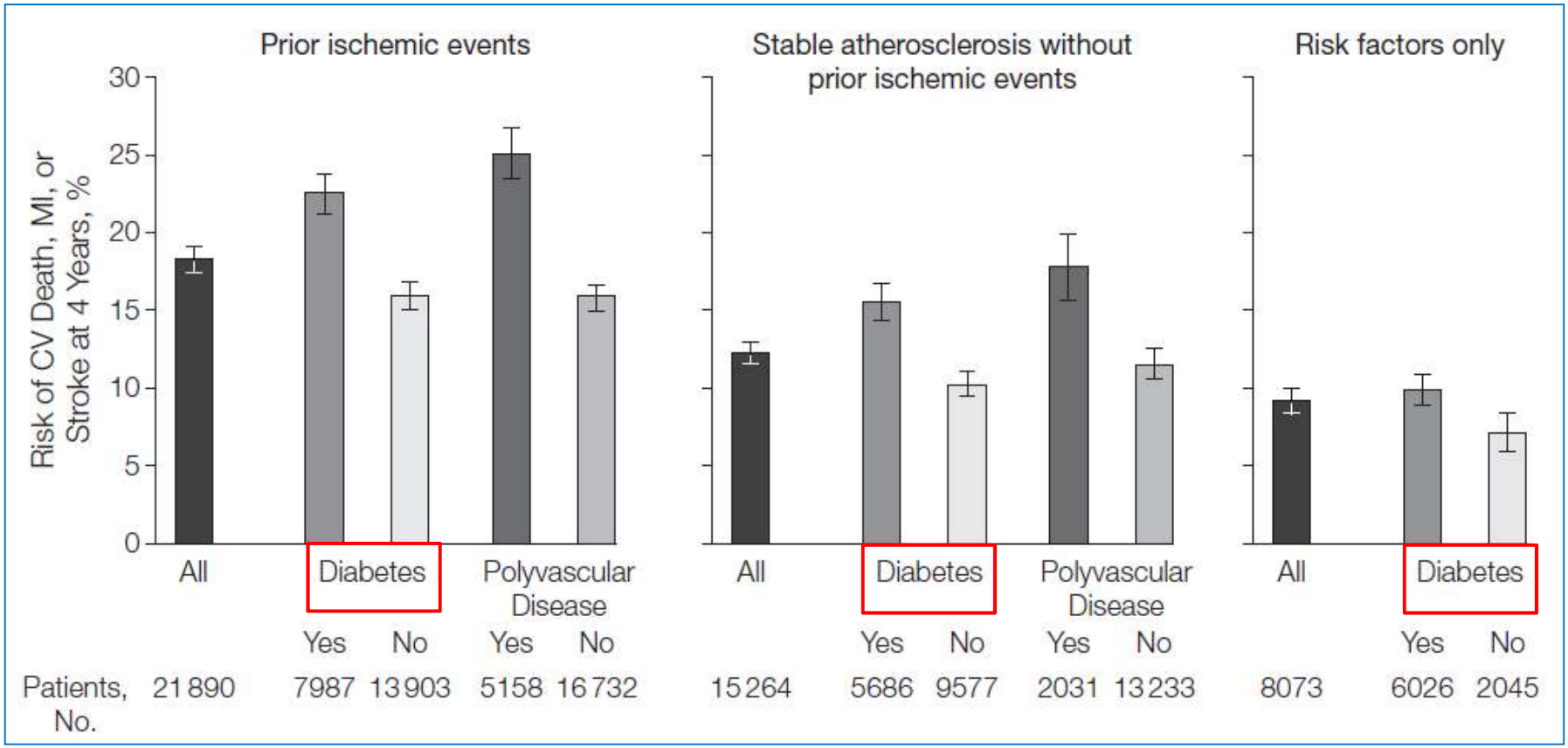
multivariate adjusted



Atherosclerosis. 2005 Feb;178(2):351-7

4-year CV event rate in stable oupatients

at risk of or with atherothrombosis [REACH registry]

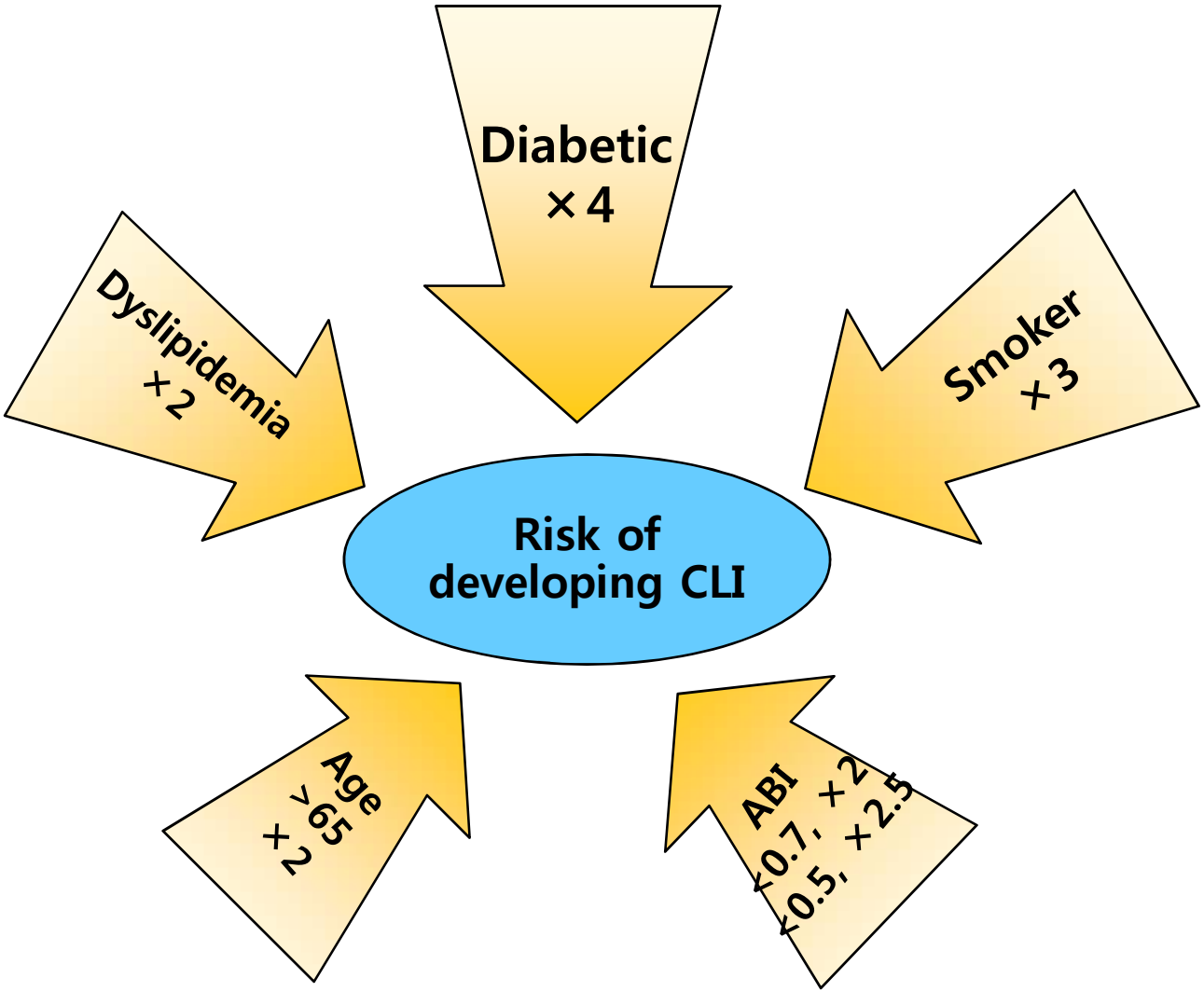


JAMA. 2010;304(12):1350-1357

PAD in 4 stages (Fontaine)

1. Asymptomatic (ABI <0.9)
2. Functional pain (claudication)
3. **Rest pain**
4. **Non-healing ulcers or gangrene**

Risk Factors for Critical Limb Ischemia (CLI)



Eur J Vasc Endovasc Surg Vol 33, Supplement 1, 2007(TASCⅡ)

Acute lower limb ischemia

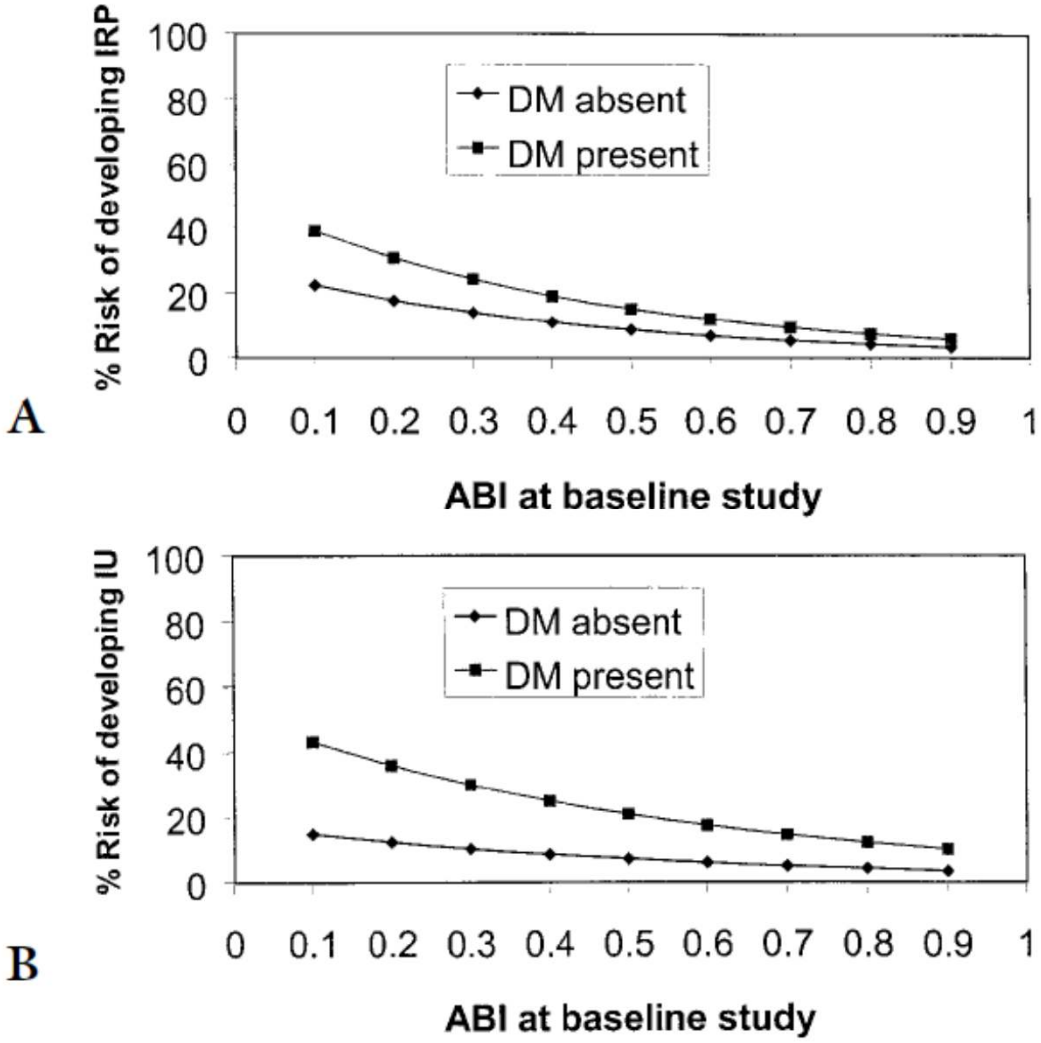
- **Thrombosis in existing atherosclerosis**
- Popliteal aneurysm
- Emboli from heart, aorta, peripheral aneurysm

- 5P’
  - Pallor, pain, pulselessness, paresthesia, paresis

Diabetes & PAD

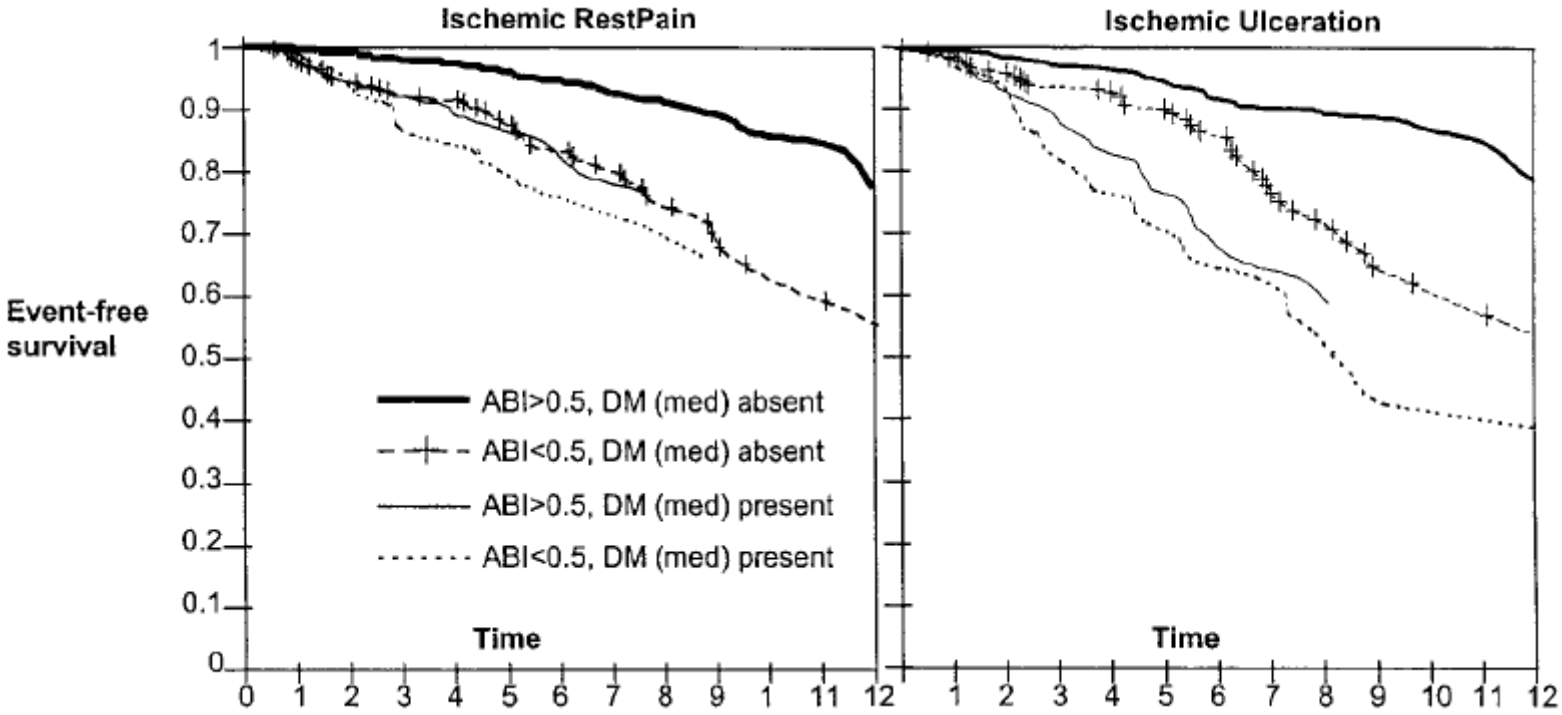
- Very common, affecting up to 30% of people with diabetes
- ABI can easily identify PAD at an early asymptomatic stage
- **Treatment is basically the same**
- Diabetes have more peripheral lesions & less operable
- Diabetes have more complications to surgery; locally(infection) & systemically(cardiac, pulmonary)
- Amputations are more common with diabetes

Predicted risk for Ischemic Rest Pain and Ischemic Ulceration



JOURNAL OF VASCULAR SURGERY Volume 34, Number 6

Outcomes stratified by the presence of diabetes and ABI



JOURNAL OF VASCULAR SURGERY
Volume 34, Number 6

Treatment of PAD

- **Main focus should be on preventive measures in order to halt atherosclerotic process**
  - Risk of cardiovascular complications is higher than amputation
  - Increased risk of surgical complications
  - Poorer results of revascularization
- **Exception; Critical Limb Ischemia!!**

Comparison of Leg Bypass Results

Diabetic vs. Non-diabetic

	Diabetic vs Non-diabetic patients			P
	1 yr	3 yr	5 yr	
1° graft patency	70% vs 56%	60% vs 54%	59% vs 54%	.024
2° graft patency	82% vs 63%	77% vs 55%	75% vs 55%	.001
Limb salvage	86% vs 82%	80% vs 77%	78% vs 77%	NS
Patient survival	91% vs 75%	78% vs 68%	64% vs 50%	.057

J Vasc Surg. 2001;33

Diabetes & PAD

- Very common, affecting up to 30% of people with diabetes
- ABI can easily identify PAD at an early asymptomatic stage
- Treatment is basically the same
- Diabetes have more peripheral lesions & less operable
- Diabetes have more complications to surgery; locally(infection) & systemically(cardiac, pulmonary)
- **Amputations are more common with diabetes**

Lower-Limb amputaion in diabetic & nondiabetic (100,000 person-years)

		Diabetic			Nondiabetic		
Age-group	Prevalence of diabetes	No. of persons	Population	Incidence (95% CI)	No. of persons	Population	Incidence (95% CI)
Women							
45–64 years	4.3	7	9,277	75 (22–138)	0	—	—
65–74 (55–74) years	11.3 (8.0†)	11	9,179	120 (55–197)	11†	172,465	7† (3–10†)
75–84 years	14.7	30	10,100	297 (194–408)	34	58,769	58 (39–78)
≥85 years	13.4	14	4,256	329 (167–518)	34	27,548	123 (83–167)
Population ≥45 years‡	8.1	62	32,307‡	192 (145–241)	79	367,337‡	22 (17–26)
Total population	4.1	62	35,260	176 (134–221)	79	822,365	10 (8–12)
Men							
45–64 years	6.8	11	15,133	73 (33–117)	0	—	—
65–74 (55–74) years	14.6 (11.4†)	21	10,813	194 (118–282)	19†	161,088†	12† (7–17)†
75–84 years	16.7	19	8,551	222 (129–328)	39	42,767	91 (63–121)
≥85 years	14.3	20	2,153	929 (545–1,369)	20	12,945	154 (92–225)
Population ≥45 years‡	9.9	71	36,105‡	197 (152–244	78	327,467‡	24 (19–29)
Total population	4.6	71	38,860	183 (142–226	78	800,303	10 (8–12)

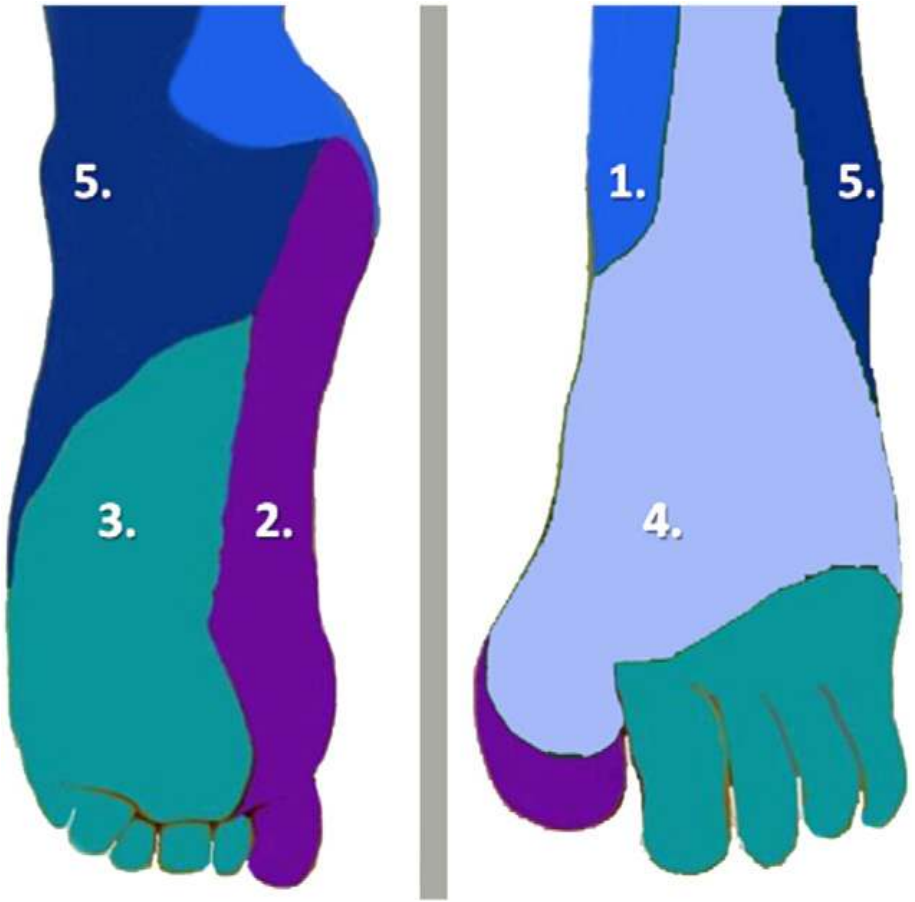
Diabetes Care 32:275–280, 2009

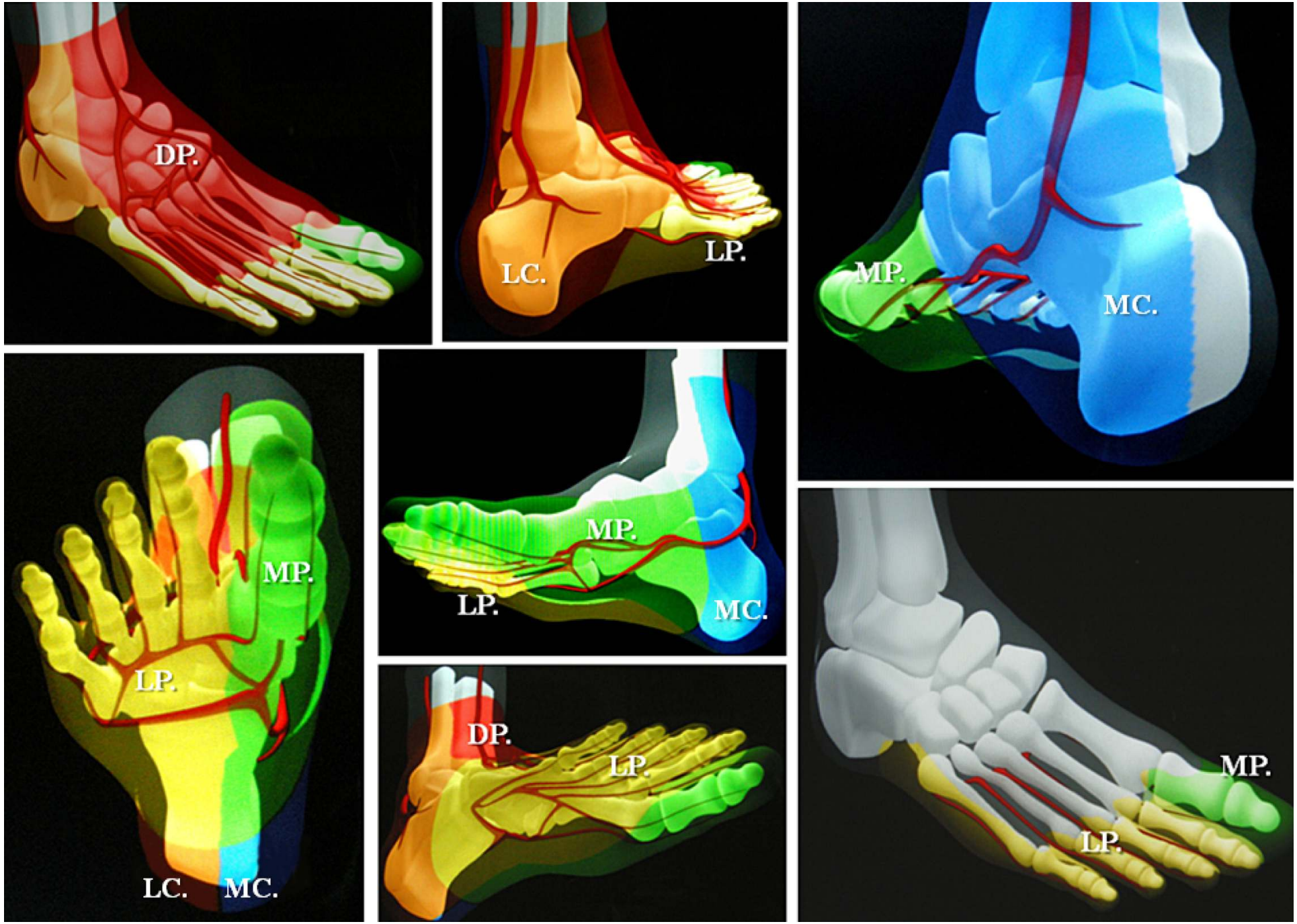
Angiosome

15% of bypasses to the foot fail to heal wounds on the foot, in spite of remaining patent, simply because these bypasses failed to revascularise the affected angiosome

Leg Arteries: 3 main arteries

1. **medial calcaneal ← PTA**
2. **medial plantar ← PTA**
3. **lateral plantar ← PTA**
4. **dorsalis pedis ← ATA**
5. **lateral calcaneal ← Peroneal**




DP.
LC.
LP.
MP.
MC.
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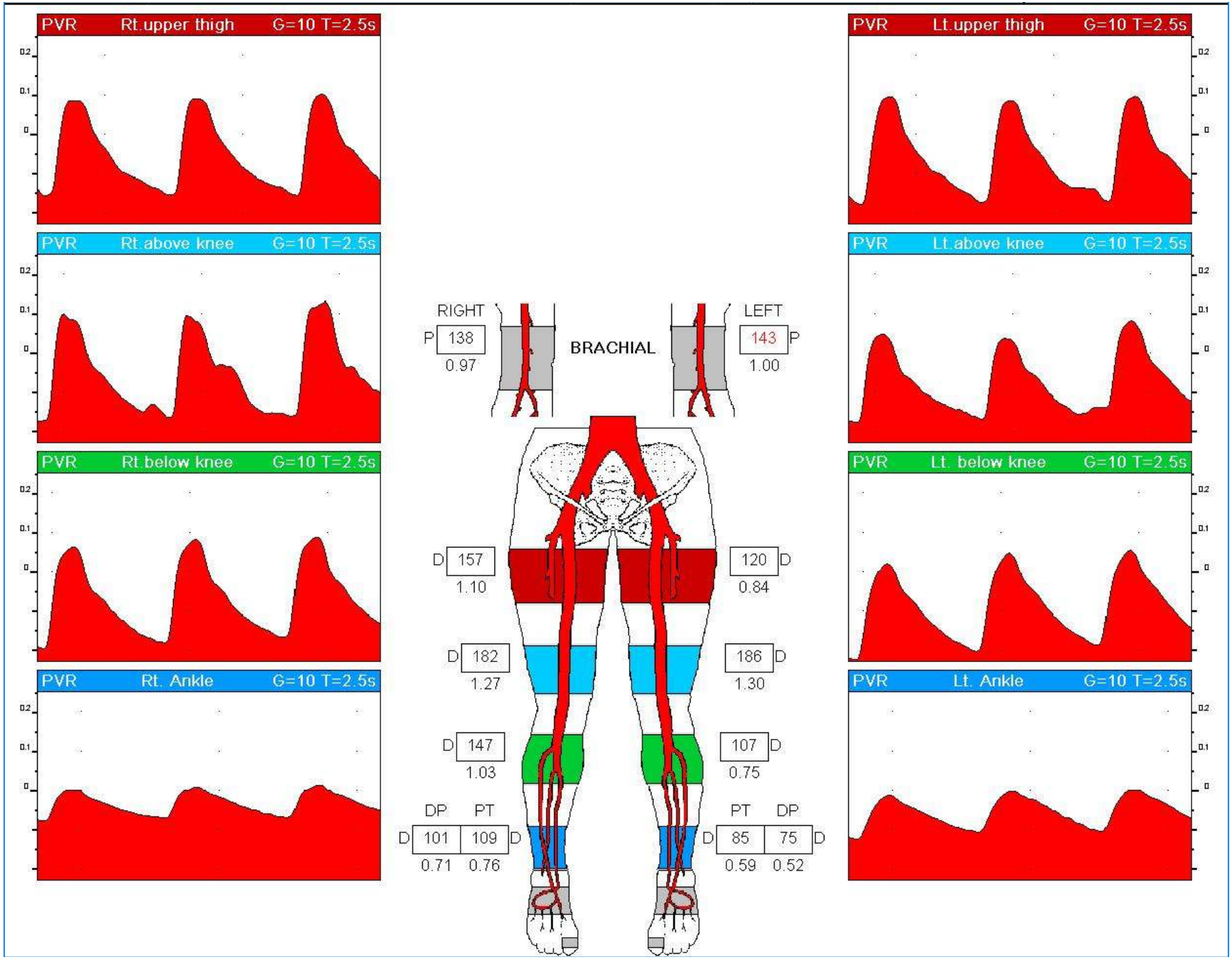
Left toe, non-healing ulcer


PVR Rt.upper thigh G=10 T=2.5s
PVR Lt.upper thigh G=10 T=2.5s
PVR Rt.above knee G=10 T=2.5s
PVR Lt.above knee G=10 T=2.5s
PVR Rt.below knee G=10 T=2.5s
PVR Lt. below knee G=10 T=2.5s
PVR Rt. Ankle G=10 T=2.5s
PVR Lt. Ankle G=10 T=2.5s
RIGHT
LEFT
P 138
0.97
BRACHIAL
143 P
1.00
D 157
1.10
120 D
0.84
D 182
1.27
186 D
1.30
D 147
1.03
107 D
0.75
DP PT
D 101 109 D
0.71 0.76
PT DP
D 85 75 D
0.59 0.52

감사합니다