

# PATHOPHYSIOLOGY AND CLINICAL FEATURES OF PERIPHERAL VASCULAR DISEASE

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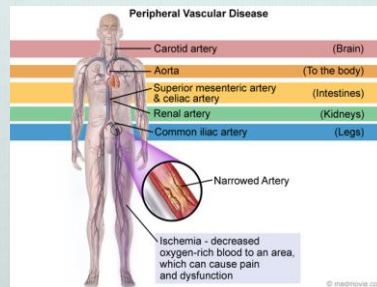
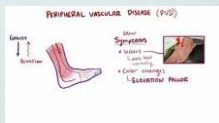
Radiation Protection Seminar 2017

## PERIPHERAL ARTERY DISEASE

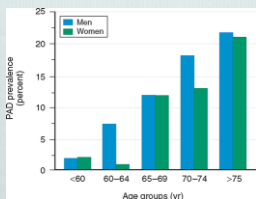


## Introduction

- ❖ Prevalent condition
- ❖ Blood circulation disorder
- ❖ Arterial insufficiency
- ❖ Build-up of fatty deposits – atherosclerosis
- ❖ Restricts blood supply
- ❖ Outside the heart and brain



- ❖ Affects 15 – 20% of people more than 70 years old.



## Risk factors of PVD

- ❖ A form of cardiovascular disease

## Factors contributing to PVD

- ❖ Smoking – tobacco use in any form is the single most important modifiable cause of PAD internationally. Smokers have up to a tenfold increase in relative risk for PAD in a dose-response relationship. Exposure to second-hand smoke from environmental exposure has also been shown to promote changes in blood vessel lining (endothelium) which is a precursor to atherosclerosis. Smokers are 2 to 3 times more likely to have lower extremity peripheral arterial disease than coronary artery disease. More than 80%-90% of patients with lower extremity peripheral arterial disease are current or former smokers. The risk of PAD increases with the number of cigarettes smoked per day and the number of years smoked.
- ❖ Diabetes mellitus – causes between two and four times increased risk of PAD by causing endothelial and smooth muscle cell dysfunction in peripheral arteries. The risk of developing lower extremity peripheral arterial disease is proportional to the severity and duration of diabetes.

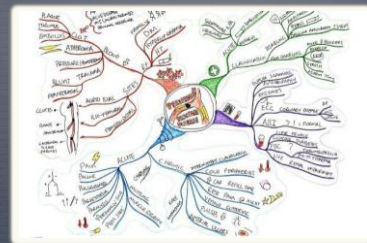
- ❖ Dyslipidemia – a high level of low-density lipoprotein (LDL cholesterol) and a low level of high-density lipoprotein (HDL cholesterol) in the blood - elevation of total cholesterol, LDL cholesterol, and triglyceride levels each have been correlated with accelerated PAD. Correction of dyslipidemia by diet and/or medication is associated with a major improvement in rates of heart attack and stroke.
- ❖ Hypertension – elevated blood pressure is correlated with an increase in the risk of developing PAD, as well as in associated coronary and cerebrovascular events (heart attack and stroke). Hypertension increased the risk of intermittent claudication 2.5- to 4-fold in men and women, respectively.

- ❖ Risk of PAD also increases in individuals who are over the age of 50, male, obese, heart attack, or stroke or with a family history of vascular disease.
- ❖ Other risk factors which are being studied include levels of various inflammatory mediators such as C-reactive protein, fibrinogen, hyperviscosity, hypercoagulable state.

## PVD commoner in...

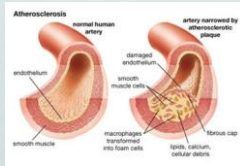
- ❖ All people who have leg symptoms with exertion (suggestive of claudication) or ischemic rest pain.
- ❖ All people aged 65 years and over regardless of risk factor status.
- ❖ All people between the age of 50 to 69 and who have a cardiovascular risk factor (particularly diabetes or smoking).

- ❖ Age less than 50 years, with diabetes and one other atherosclerosis risk factor (smoking, dyslipidemia, hypertension, or hyperhomocysteinemia).
- ❖ Individuals with an abnormal lower extremity pulse examination.
- ❖ Those with known atherosclerotic coronary, carotid, or renal artery disease.
- ❖ All people with a Framingham risk score 10%-20%.
- ❖ All people who have previously experienced chest pain.



## Pathophysiology

- ❖ Results from atherosclerosis
- ❖ Atherosclerosis cause blood vessel narrowing



- ❖ Disease manifest as acute disease when thrombus, embolus or acute trauma compromise perfusion
- ❖ Thrombosis occur more frequently in lower limbs
- ❖ Factors affecting or causing thrombosis
  - ❖ Sepsis
  - ❖ Low cardiac output
  - ❖ Aneurysms
  - ❖ Aortic dissection

- ❖ Embolus commonly causes sudden ischemia
- ❖ Commonly lodge at artery bifurcations
  - ❖ Femoral artery bifurcation (40%)
  - ❖ Iliac arteries (20%)
  - ❖ Aorta (15%)
  - ❖ Popliteal arteries (15%)
- ❖ Usually originate from
  - ❖ Heart
  - ❖ Atheroma
  - ❖ Tumor
  - ❖ Foreign objects

- ❖ Emboli causes higher morbidity
- ❖ Severity of acute manifestation (pain) determined by
  - ❖ Nature of occlusion (thrombus or embolus)
  - ❖ Site of occlusion
  - ❖ Presence of collateral circulation



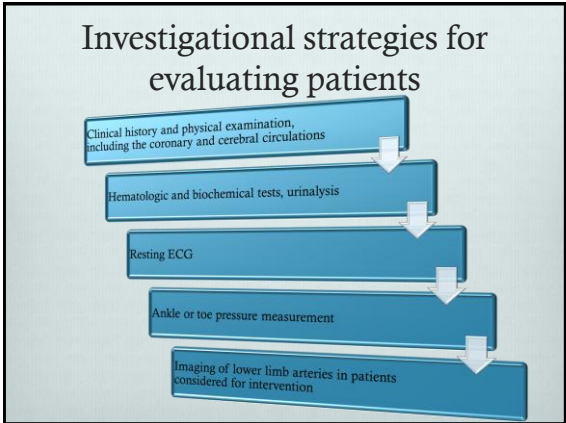
## Signs & Symptoms

- ❖ Half of PVD may be asymptomatic
- ❖ Symptoms mainly in lower limbs
  - ❖ Critical limb ischemia
    - ❖ Rest pain – pain in soles of the feet, especially when elevated
    - ❖ Tissue loss – arterial insufficiency ulcers – sores or wounds that heal slowly/not at all and gangrene
  - ❖ Intermittent claudication
    - ❖ Pain in muscles when walking
    - ❖ Unmet oxygen demand in muscles in use – inadequate blood flow



- ❖ Signs in the legs due to inadequate perfusion
  - ❖ Noticeable change in color – blue and cold
  - ❖ Diminished hair and nail growth
- ❖ Signs in other organs depend on the affected organ
  - ❖ Renal artery disease cause renovascular hypertension
  - ❖ Carotid artery disease cause strokes and TIA

Signs and Symptoms of Acute Limb Ischemia
Pain
Pallor
Pulselessness
Poikilothermia
Paralysis
Paresthesia



## Ankle-brachial index (ABI)

- ❖ Easy and accurate diagnosis for PVD
- ❖ Ratio of systolic blood pressure measured at the ankle to the systolic blood pressure at the brachial arteries – Doppler ultrasound
- ❖ Helpful
  - ❖ Most PAD patients are asymptomatic or have atypical leg symptoms.
  - ❖ Among symptomatic patients, 11% to 33% report classic intermittent claudication, and up to one third fail to communicate their symptoms to their health care provider.
  - ❖ Those with asymptomatic PAD have a risk of cardiovascular events (e.g., myocardial infarction, stroke, cardiovascular mortality) comparable with that of patients with symptomatic coronary artery disease.
  - ❖ The severity of PAD (as determined by a lower ABI value or presentation with symptomatic disease) predicts limb outcome and patient survival.
  - ❖ The ABI is an accurate measure (ABI less than 0.9 has a sensitivity of 95% and specificity of 100% in detecting PAD) that is noninvasive, inexpensive, office-based, and can be reliably performed by primary care providers and other health care personnel.

## Ankle-brachial index (ABI)

ABI	Severity
>1.30	Non-compressible
0.91 – 1.30	Normal
0.71 – 0.90	Mild
0.41 – 0.70	Moderate
0 – 0.40	Severe

- ❖ Who should undergo ABI?
  - ❖ Individuals with overt clinical lower extremity peripheral arterial disease who present with claudication or more severe limb ischemic symptom
  - ❖ Age  $\geq$  70 years or older
  - ❖ Age = 50-69 years with history of diabetes or smoking
  - ❖ Age < 49 years with diabetes and one additional risk factor (smoking, diabetes, hypertension, or elevated cholesterol levels)
  - ❖ Abnormal lower extremity pulse examination
  - ❖ Known atherosclerotic disease elsewhere (coronary, carotid, or renal arteries)



## Treatment

- ❖ Treatment goals are
  - ❖ Limb salvage
  - ❖ Symptom relief
  - ❖ Improving functional status
  - ❖ Preventing cardiovascular events

Therapy	Intervention
Lifestyle changes	<ul style="list-style-type: none"> <li>• Complete smoking cessation</li> <li>• Supervised walking exercise program</li> <li>• Weight loss (target BMI, 18.5-24.9 kg/m<sup>2</sup>)</li> <li>• Healthy diet</li> <li>• Foot and skin care, other protective measures</li> </ul>
Pharmacotherapy	<ul style="list-style-type: none"> <li>• Treat hyperlipidemia</li> <li>• Control HTN</li> <li>• Antiplatelet therapy</li> <li>• Optimize diabetes management</li> <li>• Treat claudication</li> </ul>
Limb revascularization	Indicated for acute limb ischemia, critical limb ischemia, or lifestyle-limiting claudication; percutaneous or surgical

## Treatment of Underlying Conditions and Risk Factors

- ❖ Smoking Cessation
  - ❖ Preventable risk factor
  - ❖ Improvement in leg symptoms, lowers the amputation risk, improves long-term patency after revascularization, and reduces the cardiovascular event rate
- ❖ Managing Diabetes Mellitus
  - ❖ Reduced the rate of cardiovascular events and microvascular complications (e.g., retinopathy, neuropathy)

- ❖ Dyslipidemia Treatment
  - ❖ Reduces the risk of new or worsening symptoms of intermittent claudication
- ❖ Significantly reduced the cardiovascular ischemic event rate by 23%
- ❖ Improve pain-free walking distance and ambulatory activity

#### ❖ Hypertension Treatment

- ❖ The target blood pressure in hypertensive PAD patients is similar to that for patients who have CAD
- ❖ In addition to reducing the risk of fatal and nonfatal ischemic events, an ACEI may also increase peripheral perfusion and lead to improvement in walking distance
- ❖ Risk of renal artery stenosis in this population, renal function should be monitored closely when starting a PAD patient on an ACEI or ARB

## Antiplatelet treatment

- ❖ Use of antiplatelet therapy (aspirin [ASA], 75 to 325 mg daily, or clopidogrel, 75 mg daily) in those with atherosclerotic lower extremity PAD – proven benefit in reducing the risk of myocardial infarction, stroke, and vascular death

#### ❖ Treatment of Leg Symptoms and Improving Walking Distance

- ❖ Exercise, pharmacotherapy, and invasive (surgical or percutaneous) procedures are strategies that relieve exertional leg symptoms, increase ambulatory distance, and improve quality of life
- ❖ Revascularization procedures may also be required to prevent tissue loss, facilitate wound healing, and preserve the limb

#### ❖ Supervised Exercise Rehabilitation Program

- ❖ Structured exercise rehabilitation program is one of the most effective strategies to improve claudication symptoms
- ❖ Rehabilitation programs increase pain-free walking time by 179% and maximal walking time by 122%
- ❖ Greatest benefit is obtained when the patient participates in three to five sessions/week, each lasting 30 to 45 minutes, for a minimum of 12 weeks

## Revascularization

- ❖ Absolute indications for lower extremity revascularization
  - ❖ Acute limb ischemia
  - ❖ Critical limb ischemia (usually manifested as rest pain, nonhealing lower extremity ulcers)
  - ❖ Lifestyle, vocational, or economically limiting claudication

#### Accepted indications for revascularization in patients presenting with intermittent claudication

**Before a patient with intermittent claudication is offered the option of any invasive revascularization therapy, endovascular or surgical, the following considerations must be taken into account:**

- ✓ Predicted or observed lack of adequate response to exercise therapy and claudication pharmacotherapies
- ✓ Presence of a severe disability, with the patient being unable to perform normal work or having very serious impairments of other activities important to the patient
- ✓ Absence of other disease that would limit exercise even if the claudication was improved (e.g., angina or chronic respiratory disease)
- ✓ Anticipated natural history and prognosis of the patient
- ✓ Morphology of the lesion, which must be such that the appropriate intervention would have low risk and a high probability of initial and long-term success

#### Factors that Increase Risk of Limb Loss in Patients with Critical Limb Ischemia

##### Factors that reduce blood flow to the microvascular bed:

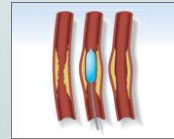
- ✓ Diabetes
- ✓ Severe renal failure
- ✓ Severely decreased cardiac output (severe heart failure or shock)
- ✓ Vasospastic diseases or concomitant conditions (e.g., Raynaud's phenomenon, prolonged cold exposure)
- ✓ Smoking and tobacco use

##### Factors that increase demand for blood flow to the microvascular bed:

- ✓ Infection (e.g., cellulitis, osteomyelitis)
- ✓ Skin breakdown or traumatic injury

## Endovascular intervention

- ❖ Short stenotic or occlusive lesions can generally be successfully treated percutaneously
- ❖ Percutaneous angioplasty carries a lower risk
- ❖ Can be performed on an outpatient basis



## Endovascular intervention

- ❖ Predictors of favourable long-term outcomes include
  - ❖ Locations of treated lesions (better results with iliac artery angioplasty compared with femoropopliteal or infrapopliteal arteries)
  - ❖ Quality of the underlying vessels (better with preserved inflow and distal runoff arteries)
  - ❖ Patient's comorbid conditions (worse in those who fail to abstain from tobacco, diabetics, or when the risk factors are poorly controlled)
  - ❖ Indication for the procedure (claudication better than acute or critical limb ischemia)
  - ❖ Immediate postprocedure outcome (return of ABI to normal postintervention value)

## Catheter-Directed Thrombolysis

- ❖ initial treatment strategy for acute limb ischemia
- ❖ reduces the number of immediate surgical interventions required – markedly reduces perioperative risk
- ❖ Thrombus resolution allows for better visualization of underlying atherosclerotic lesions

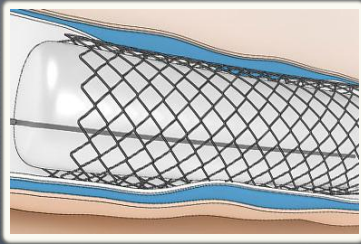
## Surgical Procedures

- ❖ advocated for many patients presenting with acute or critical limb ischemia
- ❖ Endarterectomy and bypass grafting are the two most commonly used surgical techniques
- ❖ endarterectomy is feasible and offers an excellent success rate when used for proximal arterial segments (aorta, iliac, common femoral or profunda arteries)
- ❖ bypass grafting is preferable for distal, long, or diffuse disease

## Surgical Procedures

- ❖ Operative complications include
  - ❖ Myocardial infarction and stroke
  - ❖ Wound or graft infection
  - ❖ Peripheral embolization
  - ❖ Sexual dysfunction secondary to autonomic nervous system injury
- ❖ Operative mortality rate ranges from 1% to 3% and success rates depend on the lesion site and severity, anastomotic site, and status of the outflow system





## Conclusion

- ❖ Prevalent systemic atherosclerotic disease with associated high cardiovascular morbidity and mortality
- ❖ Symptomatic PAD often impairs a patient's quality of life and untreated disease can lead to limb loss
- ❖ Often remains underdiagnosed and undertreated
- ❖ Detect the disease at an early stage, assess associated risk factors, and provide proper long-term care
- ❖ Aggressive management of atherosclerotic risk factors, a structured exercise program, use of antiplatelet agents and, when indicated, percutaneous or surgical revascularization are the keys for successful management



Thank you