PERIPHERAL VASCULAR DISEASE

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Normal cross-section of artery

Tear in artery wall

Fatty material is deposited in vessel wall

Narrowed artery becomes blocked by a blood clot
Cut-section of artery

- Tear in artery wall
- Macrophage cell
- Cholesterol deposits
- Red blood cell
- Macrophage foam cell
- Fat deposits
Chronic, peripheral manifestation of atherosclerosis, which may affect the lower limbs, cerebral vessels, or mesenteric/renal vasculature
Annual incidence of symptomatic disease 2.6/1000 (increased in individuals over 75 years old).

Increases with age; in those aged 55-74 years, 50/1000 have intermittent claudication and a further 100/1000 have asymptomatic peripheral vascular disease.
Risk increases with age: most often occurs in patients 60-80 years of age.

Males are generally affected twice as often as women.

Recent data suggests the overall prevalence in women is similar to men if asymptomatic disease is included (assessed by ABI).

Indo-Asians and African-Americans, however Indo-Asians have a higher prevalence of thromboangitis obliterans.
Contributory or predisposing factors

- **Diabetes mellitus or glucose intolerance**: 3-4 times
- **Smoking**: smokers are 2.5-3 times
- **Hyperhomocysteinemia**: 1.7-2.6
- **Hypertension**: 1.5-2.5
- **Hyperlipidemia**: for every 10mg/dL increase in total cholesterol there is a relative risk increase of 1.1
- **Age**: 1-2% of men under 50 years, but affects 5% of men over this age. A similar trend is seen in women
- **Male gender**: twice as great in men as in women
- **Obesity**:
- **Familial history**:
- **Sedentary lifestyle**: exercise is very effective in reducing symptoms of peripheral vascular disease
Associated disorders

- Mostly associated with general atherosclerosis
- **Myocardial infarction**
- **Coronary heart disease**
- **Stroke**
- **Renal artery stenosis**
- Sexual dysfunction in men (Leriche syndrome) in severe aorto-iliac occlusion
- Cardiac arrhythmias, including **atrial fibrillation**
- Hypercoagulable states
History

- Have you ever had discomfort, numbness, or weakness in the affected area that was regularly brought on by exercise and relieved by rest?
- *Intermittent claudication is the classic symptom of this disorder*
- Where is the pain felt?
  The location of the pain reflects the site of occlusion
- Is the affected limb numb? Can you move it?
  Numbness and paralysis indicate limb-threatening ischemia and constitute a surgical emergency
Have you ever had a heart attack or stroke? History of atherosclerosis helps to confirm the diagnosis.

Is the affected limb persistently cold, especially at night? Coldness reflects poor perfusion.

Does the affected limb hurt at night, particularly in the extremities? Night pain reflects poor perfusion.

Are you in constant pain? Constant pain reflects severe arterial occlusion.
Was the pain brought on suddenly
Peripheral vascular disease is a gradual, chronic disorder

Is any pain you feel aggravated by raising the affected limb and relieved by lowering it
*Poor perfusion is made worse by elevating the limb

Do you have painful ulcers or sores that do not seem to heal  This is indicative of ischemia

In a man) do you have difficulties getting sexually aroused

Sexual dysfunction in men may indicate severe aorto-iliac occlusion
Is there a family history of this disorder

diabetes mellitus, coronary heart disease, myocardial infarction, or stroke

Family history of atherosclerosis is associated with this disorder
Examining

- Changes in skin color
- Numbness and paralysis suggest severe arterial occlusion, which is a surgical emergency.
- Check pulses and look for bruits around the affected area.
- Use a Doppler to listen for pulses that are not palpable.
- Check the appearance of the limb for other signs of ischemia.
- Check whether the affected area feels cool. Coolness indicates poor perfusion.
- Test for poor perfusion in the affected region by raising the limb and flexing the muscles. In the ischemic patient, this produces pallor, which changes to rubor when the limb is lowered again.
- Measure brachial – ankle index.
**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

**Right-arm systolic pressure**

**Left-arm systolic pressure**

**Right-ankle systolic pressure**  
- DP
- PT

**Left-ankle systolic pressure**  
- DP
- PT
Cardinal features

- elderly patients and smokers
- intermittent claudication
- Pain not relieved by sitting and leaning forward
- Pulses decreased or absent distal to the occlusion
- Bruits audible over the affected artery
- Ankle-brachial index of 0.95 or less (or toe systolic pressure index <0.60 in diabetics)
- In severe disease ischemic appearance of affected region (hair loss; thickened brittle nails; shiny and smooth skin; changed skin color, especially in the digits; muscular atrophy; presence of ulcers or gangrene)
Symptoms in mild disease

- Intermittent claudication
- Claudication reliably occurs in the same region (usually in the calf, but also in the thigh, hip, or buttock, or rarely in the arm) by a constant amount of exercise
- Occurs distal to the site of vascular stenosis or occlusion.
- May affect one or both limbs.
- Not relieved by sitting and leaning forward
- Persistently cold feet (or hands) at night
Limping gait

Pulses decreased or absent distal to the occlusion

Bruits audible over the affected artery (disappears with complete occlusion)

Ankle-brachial index of 0.95 or less, even in the absence of symptoms

Pallor in the extremities on raising the limb, and reactive hyperemia when lowered
Severe Disease

- Rest pain
- Ischemic appearance over affected region (hair loss; thickened, brittle nails; shiny and smooth skin; changed skin color, especially in the digits; muscular atrophy)
- Non-healing sores (resulting from even minor trauma) or gangrenous lesions
- Peripheral edema (due to keeping the limb lowered)
- Sexual dysfunction in men (Leriche syndrome) in severe aorto-iliac occlusion
- Numbness and/or paralysis, indicating limb-threatening ischemia
Critical limb ischemia, characterized by the 'five Ps' (pain, pallor, pulselessness, paresthesias, and paralysis), is a surgical emergency.

Patients should also be hospitalized if they present with gangrenous lesions or infected ischemic ulcers.
Symptoms & signs of lower limb ischemia

*Intermitent claudication:*  
Cramp-like pain felt in the muscle that brought on by walking relieved by standstill.  
The distance walked is **called (claudication distance)**  
Pain of claudication is felt in the calf but can affect thigh or buttock  
Associated with sexual impotence *(Leriche syndrome)*

*Rest pain:* severe pain felt in the foot at rest made worse by elevation of the foot  
The pain is worse at night, relieved by hanging the foot out of the bed or by sleeping in a chair

Coldness, numbness & parasthesia
color changes: temperature, sensation & movement

Ulceration & gangrene

Ulceration occurs with severe arterial insufficiency & often presents as a painful, superficial erosion between toes (over malleolus), heel. The blackened mummified skin.

O/E:

systolic bruit on huntarian canal over artery

Neck: carotid

Due to turbulence flow & stenos is of the artery
Management of PVD

1-Explanation & advice (worry of walking)
Spontaneous improvement occurs in some patients over the 1st 6 months after an occlusive episodes as collateral vessels are developed

2-Adjustment of lifestyle:
everyday habits of transport like bicycle or car

3-stop smoking
specially pt with burger’s disease

4-Perform regular excercise

5-Diet: reduce weight
Treat hyperlipidemia, D.M, HTN

6-Drugs (vasodilators drugs are ineffective)
General: If surgery is indicated, a full assessment is essential.

Investigations: for

DM
Hyperlipidemia
Dyslipidemia:
Anemia (CBC)
(High blood viscosity)
ESR
Plasma fibrinogen
Protein electrophoresis
Plain Abdomen x-ray
(blood & urine sugar)
Lipid profile
(polycythemia, thrombocythemia)
(arterial calcification & flecks of calcium may outline an aneurysm)
ECG—normal ECG doesn’t exclude severe coronary artery disease

Exercise ECG: more accurate cardiac assessment

Radioisotope ventriculography:
Measure Lt ventricular (EF) by using isotope technique

Echocardiography: to assess Lt ventricular function
Doppler U/S: blood flow detection

Hand held: This often possible even at sites where the arterial pulse cannot be palpated

(ABPI) is the ratio of systolic pressure at the ankle to that in the arm (0.9-1.2)

<0.9 \longrightarrow \text{arterial obstruction}

<0.3 \longrightarrow \text{imminent necrosis}

Doppler U/S probe can be also used to assess differences in arterial blood pressure between segments of a limb, giving an indication of the site of stenosis is

(\textit{Segmental pressure})

High ABI (calcification & D.M)
Duplex imaging

A duplex scanner used B-mode U/S to provide an image of vessels, gives information about vessel blood flow, turbulence.

The various color indicate change in direction & velocity of flow.

[Points of high flow] indicate stenosis.
Assesses changes in volume of alimb or digit over the cardiac cycle (for research uses)

_Treadmill_: with slight incline useful diagnostic apparatus in the assessment of walking distance in claudication
A duplex scanner used B-mode U/S to provide an image of vessels, gives information about vessel blood flow, turbulence.

The various color indicate change in direction & velocity of flow.

[Points of high flow] indicate stenosis.
Angiography

Injection radio-opaque solutions into arterial tree, percutaneous injection (femoral, brachial, axillary...) Seldinger technique

Complications
Hematoma
Thrombosis
Arterial dissection
Neurological obstruction
Anaphylaxis

D.S.A

Employs a computer system to digitize the angiographic information before & after the contrast
It allows injection to be subtracted from the contrast image, yielding great clarity
This technique use fine catheter & less contrast agent
Avoid arterial puncture.
Antiplatelet:
- 
  aspirin is the best-documented and most cost-effective treatment
  Clopidogrel

Claudication can be effectively reduced by a prescribed walking program

- Cilostazol reduces intermittent claudication symptoms and can be prescribed with an antiplatelet agent

- Pentoxifylline is approved by the FDA for relief of intermittent claudication, but reviews of the clinical evidence have questioned its efficacy. May be effective in selected patients
A- Praxilene: alter tissue metabolism
  Increase O2 supply to the tissue.
B- Trental (pentoxifylline): affect whole blood viscosity
C- prostacyclin: in critical limb ischemia
D- lipid abnormalities
E- D.M&HTN (C/I B-blockers)
F- Care of the feet (avoid socks)
G- Heel raise: Analgesia& position
  Burger’s position (elevate head of the bed)
H- Aspirin: Anti-adhesive effect on platelet
Differential diagnosis

- Osteoarthritis
Venous insufficiency

- Ulcers associated with only mild pain that is relieved (not exacerbated) by elevation
- Does not affect ankle-brachial index or toe systolic pressure index
- Pulses normal peripherally
Spinal stenosis

- Narrowing of the spinal canal, which may lead to paralysis
- Pain relieved not just by rest, but by sitting or squatting, and leaning forward to straighten the lumbar spine
- Affect ankle-brachial index or toe systolic pressure index
Neuropathy
Subclavian steal syndrome

Syncopal attack & visual disturbances ----→ associated with arm exercise

If 1st part of subclavian A is obstructed, the vertebral A may provide collateral circulation in to the arm by reversing it’s direction of flow

Treatment:
1- PTA
2- Endartectomy
3- Bypass from ipsilateral common carotid A to 3rd part of subclavian A
Arteritis

(Major- medium- small),

Takayasu’s disease (pulseless disease)

Obliterative arteritis of female
Narrowing & obstruction of major arteries
Burger’s disease
(thromboangitis obliterans)

* Occlusive disease of the small & medium size

* This condition doesn’t occur in women or non-smoker

* Localized inflammatory changes occur in the walls of arteries & veins leading to thrombosis

* Gangrene of toes & fingers is common & progressive

**Treatment:** Total abstinences of smoking
It will not reverse established arterial occlusion

Sympathectomy useful adjunctive procedure & amputation
Localized infilltration with inflammatory & giant cells leads to arterial occlusion

Temporal arteries→ischemic headache& tender palpable pulse less thrombosed arteries in scalp

*Irreversible blindness
Raynaud's phenomenon

- Abrupt onset of digital pallor and/or cyanosis in response to cold exposure or stress
- Symptoms not related to exercise and rest
- Induced by cold, emotional stress, working with vibrating machinery, or smoking
- Intermittent, short-term attacks of triphasic color changes: pallor to cyanosis to rubor
- Only the digits are normally affected
- Gangrene is absent or is minimal and limited to the skin
- More prevalent in women than in men
Vasospastic conditions
Raynaud’s syndrome (primary/secondary)

Primary:
Idiopathic
Young women
Affect upper limb > lower limb
Peripheral pulse (normal)
Abnormal sensitivity in the direct response of the arterioles to cold
Fingers becomes painful, blanched, capillaries then dilates & become swollen & dusky

Treatment:
Protective from cold
& avoidance of pulp and nail-bed infections
-Calculator antagonist (nifidipine)
*electrical heated gloves
* sympatheticectomy
Secondary Raynauds disease

Peripheral vasospasm in-atherosclerosis
Thoracic outlet syndrome
Carpal tunnel syndrome
Collagen vascular disease(scleroderma)
Ergot poising
SLE
Vibrating tools

Treatment: treat the cause
Frost bites
Death with putrefaction of macroscopic portion of tissue like distal part of limbs, appendix, loop of small intestine

Slough (piece of dead soft tissue)

Causes:

1 - Secondary:
   - arterial obstruction
   - Thrombosis of atherosclerotic artery
   - Embolus from heart due to atrial fibrillation
   - Arteritis
   - Burgers' disease
2- Infective: boils, carbuncles, gas gangrene, Fournier’s gangrene
3- Traumatic: crushes, pressure sores, strangulated bowel
4- Physical: frostbite, chemical, irradiation

Clinical types

1- Dry: The tissue are desiccated by gradual slowing of the blood stream like atherosclerosis.
Affected part ----> dry, wrinkled, discolored from disintegration of haemoglobin & greasy to touch
[Fine line of demarcation appears in a matter of days]

2- Moist: venous as well as arterial.
Obstruction is present when artery suddenly occluded by ligature, embolus & in D.M
Infection & putrefaction are always present. Crepitus may be palpated, acute appendicitis & strangulated hernia due to infection & suppuration. [Fine line of demarcation to be more proximal than in dry gangrene]

Vague demarcation (combine pathology)

Treatment:
General principles
Our goal (limb saving)
General treatment of cardiac failure
AF, anemia, improve tissue oxygenation (hyperbaric O2 therapy)
Control D.M, HTN, Lipid
Local treatment:
MOIST----------->DRY
Exposure & using fan
Padded rings over prominence bone
Acute arterial occlusion

Sudden occlusion of artery is commonly due to either emboli, or trauma

**A- Embolic occlusion:** is a body which is foreign to the bloodstream & which may become lodged in vessel & cause obstruction

**Simple Emboli:** due to mural thrombosis following M.I, M.S, cardiac arrhythmia, AF & aneurysm

Emboli may lodge in any organ

**Brain:** Middle cerebral A → hemiplegia or T.I.A

**Retina:** Maurois fugax → total & permanent blindness

**Mesenteric vessels** (Occlusive / Non-occlusive)

**Gangrene of bowel**
Kidneys: loin pain & haematuria.
Spleen: painful spleenomegaly
Lungs: P.E (dyspnea, chest pain, haemoptysis)
L.L: (5ps) pain, pulseless, parasthesia, pallor, paralysis

Treatment:
1- Analgesia (opoids)
2- I.V heparin (80 I.U/kg) 5000I.U--------18 I.U/KG
3- Embolectomy or thrombolytic
   Fogarty balloon catheterization & post-op anticoagulant
Prevention further emboli
You must treat the cause whenever possible & using long term warfarin anticoagulation
Fig. 4. The technique of Fogarty catheter embolectomy with catheter insertion in the distal vessel.
If ischemia is not so severe that immediate operation is mandatory, it may be possible to treat either embolus or thrombosis.

At the tip of the catheter thrombolytic agent is infused ((Angiojet))

Streptokinase, urokinase & tPA

C/I:
1. Recent stroke
2. Bleeding diathesis
3. Pregnancy
**Air Embolism:**

If air accidently injected into venous circulation, air passes through circulation lodging in pulmonary trunk $\rightarrow$ Rt side Heart failure

**Treatment**

**Fat Embolism:**

Causes: Multiple or major #
- Long bone#
- Bone Marrow or adipose tissue
- Aggregation of chylomicrons
- Cerebral & pulmonary Emboli

**RX:** hydration-LMWH-heparin, O2, I.V hydrocortisone

**Infective Emboli:**
Arterial embolism
Fig. 1. Anomalous origin of the left vertebral artery (third branch of the aortic arch) identified on standard contrast angiogram (A) and computed tomography angiogram (B) in a patient with an aneurysm of the proximal descending thoracic aorta.
PTA: inserting balloon catheter in to artery & inflating it within narrowed area (short occlusion)

Intraluminal stents: keep the lumen patent expanded stent

Operations: it depends on site of occlusion
Patient with one or more of these characteristics:
Age 50–69 years and smoking or diabetes
Age ≥ 70 years
Leg symptoms with exertion
Abnormal leg vascular exam, or ischemia
Coronary/carotid/renal arterial disease

Measure ABI

>1.30
Vascular Laboratory:
PVR
Toe pressure
Duplex imaging
Normal results
Abnormal results
No PAD

0.91–1.30
Claudication Symptoms:
ABI treadmill test
Normal post-exercise ABI: No PAD
Decreased post-exercise ABI
Evaluate other causes of leg symptoms
PAD
Fig. 4. Angioplasty of the innominate artery via femoral approach.
A- Aorto-iliac occlusion:

- Aorto-femoral bypass.
- Femoro-femoral
- Ilio-femoral bypass
- Axillo-bifemoral bypass

B- SFA & profunda femoris artery occlusion:

- Femoro-popliteal bypass (saphenous-graft)

C- Occlusive disease below the popliteal artery.

- In situ saphenous vein after valvulotomies
- PTFE-Dacron
MANAGEMENT OF PAOD OF THE LEGS

Asymptomatic atherosclerosis (stage 1)

- Elderly patients
  - Not socially handicapped

- Clinical investigation
  - Ankle pressure
  - Ankle–brachial index
  - Segmental blood pressure recording, Duplex ultrasonography

- Walking training
  - Cessation of smoking
  - Drug treatment (?)

- Deterioration

- Amputation

Intermittent claudication (stages 2a and 2b)

- Younger patient
  - Elderly patient with social handicap

- Clinical investigation
  - Ankle pressure
  - Ankle–brachial index
  - Duplex ultrasonography
  - Angiography

- Percutaneous transluminal angioplasty
  - Vascular reconstructive surgery
  - General medical treatment
  - Special medical treatment for tissue survival

- Deterioration

- Amputation

Rest pain (stage 3) or skin ulcers (stage 4)

- All patients
Acute limb ischemia

Arterial thromboembolism by initial clinical examination

Heparin unless contraindicated

Class I viable
- Treat as per chronic limb ischemia

Class IIA marginally threatened
- Close monitoring
  - Urgent arteriography

Class IIB immediately threatened
- Urgent thromboembolectomy

Class III not viable
- Amputation after demarcation

Endovascular or surgical therapy based on:
- Location of occlusion
- Embolism vs. thrombus
- Duration of ischemia
- Native artery or graft
- Patient-related risks
- Intervention-related risks
- Contraindications to thrombolysis
Evidence

**Antiplatelet therapies** (e.g. aspirin, clopidogrel) have been shown to be effective at reducing the risk of arterial occlusion, disease progression, and other cardiovascular events in patients with peripheral vascular disease.

A systematic review and meta-analysis of 42 RCTs found that antiplatelet treatment (principally aspirin) significantly reduced the risk of arterial occlusion over 19 months compared with no additional treatment.
Thank you