OCCLUSIVE ARTERIAL DISEASE

ACUTE LIMB ISCHAEMIA IS A TRUE MEDICAL EMERGENCY REQUIRING IMMEDIATE THERAPY FOR LIMB SALVAGE

CRITICAL LIMB ISCHAEMIA REFERS TO WHEN CHRONIC PROGRESSIVE PERIPHERAL ARTERIAL DISEASE RESULTS IN ISCHAEMIC PAIN AT REST, ULCERATION OR GANGRENE

ONE YEAR MORTALITY AFTER ONSET OF CRITICAL LIMB ISCHAEMIA IS >25% AND 25% SURVIVORS REQUIRE LIMB AMPUTATION

PATHOPHYSIOLOGY:

- Acute limb ischaemia results from a lack of blood supply to meet tissue oxygen and nutrient requirements
- Peripheral nerves and skeletal muscle are most sensitive to ischaemia and irreversible changes occur within 6 hours of anoxia at room temperature
- REPERFUSION INJURY can occur:
    - Characterised by myoglobinaemia, renal failure and peripheral muscle infarction → ↑K, metabolic acidosis and ↑CK
- Extent of injury depends on duration and location of arterial blockage as well as extent of collateral flow and previous health of the involved limb
- NON-EMBOLIC ISCHAEMIA:
    - Due to atherosclerosis, complete obstruction from plaque rupture and occlusion by clot
        - Uncommonly related to hypercoagulable state → consider if youn
    - Progression of ischaemic injury occurs through:
        - Propagation of clot to occlude collateral vessels
        - Ischaemia-related distal oedema leading to compartment syndrome
        - Fragmentation of clot into microcirculation
        - Oedema of microvasculature cells

AETIOLOGY:

- Thrombotic occlusion is the most common cause of acute limb ischaemia and both native vessels and grafts are affected → accounts for 80% cases in lower limbs, in upper limbs 1/2 due to thrombosis, 1/3 due to embolism, ¼ due to arteritis
- Occlusion from embolism less common. Emboli originate from the heart in 80-90% cases
    - AF accounts for 2/3 of peripheral emboli followed by mural thrombus after MI → local poor wall motion predispose
    - Non cardiac sources of emboli include aneurysms and atherosclerotic plaques
    - Paradoxical emboli can occur from venous site when intracardiac shunt is present (most often PFO)

- Most common site of embolism in lower limb is femoral bifurcation, in upper limb it is brachial artery
- Natural history of embolism is to fragment and propagate or to locally extend into larger clot

- Rarer causes → local trauma at injection site, hypercoagulability, intra-arterial injection, thoracic dissection occluding iliofemoral or subclavian vessels

Table 64-1 Comparison of Disorders Associated with Acute Arterial Occlusion

Disorder	Cause	Symptoms/Signs	Management
Thrombus	Atherosclerosis or thrombosis of bypass grafts	Intermittent claudication	Medical vs. surgical
Embolism	Cardiac source: atrial fibrillation, rheumatic heart disease, mechanical valves, post–myocardial infarction thrombus, atrial myxomas and leaflet vegetations	Sudden onset of territorial arterial symptoms	Preventative anticoagulation, embolectomy
Catheterization complication (brachial or femoral)	Can occur during standard angioplasty, angiography, or arterial blood gas	Expanding hematoma, pain, temperature and pulse changes	Conservative vs. operative repair
Trash foot or blue toe syndrome	Cholesterol/platelet aggregate emboli	Painful cyanotic discoloration of isolated portion of foot, remainder of foot warm, dorsalis pedis pulse intact	Conservative therapy
Vasculitis: rheumatoid arthritis, lupus, polyarteritis nodosa	Autoimmune inflammation of small arteries	Systemic symptoms and multiorgan ischemia	Steroids, immunosuppressive agents
Raynaud disease	Vasospasm in small arteries or arterioles provoked by cold or stressors	Local pain, pallor, cyanosis, numbness, paresthesia in hands usually resolving in 30–60 min	Rewarming, medications: calcium channel blockers, α-blockers, vasodilators
Takayasu arteritis	Autoimmune vasculitis of aortic arch and branches	Young Asian women: peripheral ischemia and necrosis leading to pulseless phase; may have fever, rash, muscle aches, arthritis	Steroids, immunosuppressive agents
Thromboangiitis obliterans (Buerger disease)	Nonatherosclerotic segmental inflammation of small/medium vessels	Painful nodules, ulceration and gangrenous digits in young adults (aged 20–40 y)	Smoking cessation
HIV arteritis[24]	Chronic inflammation of arteries associated with low CD4 counts	Intermittent claudication	Optimization of HIV management, angioplasty or vein graft
Hypothenar hammer syndrome	Repeated trauma to the hypothenar area with hammering in laborers, causing narrowing of ulnar artery	Painful discoloration of one or more ulnar fingers with sparing of thumb	Aspirin, nifedipine, intra-arterial fibrinolysis, interposition vein graft
Popliteal artery entrapment[25]	Anatomic crowding of popliteal fossa with overdeveloped plantaris or gastrocnemius	Pain in anterior aspect of lower one third of leg reproduced with active ankle plantar flexion or passive dorsiflexion	Surgical repair of popliteal fossa
External iliac artery endofibrosis[26]	External iliac artery fibrosis secondary to prolonged hip flexion	Thigh pain and numbness in cyclists and triathletes: measure pre- and post-cycling ankle-brachial indexes	Surgical management or catheter dilatation
Local arterial trauma[27,28]	Penetrating or blunt damage to vessel	Suspect in patients with knee dislocation or penetrating extremity trauma	Surgical repair
Shock-related arterial ischemia	Low cardiac output states: congestive heart failure, sepsis, cardiogenic or hypovolemic shock	Generalized hypoperfusion	Resuscitation with fluids, blood products, vasopressors, inotropes; treat infection

CLINICAL FEATURES:

- See table above
- Patients with acute limb ischaemia exhibit one or more of SIX ‘P’s:
  - PAIN
  - PALLOR
  - PARALYSIS
  - PULSELESSNESS
  - PARAESTHESIAE
  - POLAR (OR PERISHINGLY COLD)
- However, lack of one or more does not exclude ischaemia and in those with severe peripheral vascular disease with well established collaterals → occlusion may not be dramatic and is typically silent

- PAIN ALONE MAY BE THE EARLIEST SYMPTOM
- Skin changes → pallor followed by blotchy and mottled areas of cyanosis
- With vessel occlusion, severe/steady pain in the involved extremity associated with decreased skin temperature
    - Hypo or hyperesthesia due to ischaemic neuropathy is an early finding, as is weakness
    - Loss of two-point discrimination, vibratory sensation and proprioception occur before loss of painful sensation
- As ischaemic injury progresses, anaesthesia and paralysis become evident and foreshadow impending gangrene and loss of limb viability
- Preservation of light touch is a good guide to tissue viability
- Tissue loss can occur much earlier than the standard wisdom of 4-6 hours → time limit is dependent on effectiveness of collaterals hence there is not arbitrary time limit

ACUTE VERSUS CHRONIC ARTERIAL DISEASE:

- CLAUDICATION → refers to cramplike pain or ache that is brought on by exercise and relieved by rest and reoccurs at consistent distances
    - Pain of acute limb ischaemia is not well localised and is not relieved by rest or gravity and can just be worsening of chronic pain

Table 64-2 Artery-Specific Claudication Sites

Artery Involved	Claudication Site
Iliac artery	Buttocks, thigh, and sometimes calf (if bilateral, may cause impotence in men)
Common femoral artery	Thigh
Superficial femoral artery	Upper two thirds of calf
Popliteal artery	Lower one third of calf
Infrapopliteal (tibial and peroneal) artery	Foot

- The pain of VENOUS CLAUDICATION is uncommon, but is associated with DVT:
    - PHLEGMASIA CERULEA DOLENS → painful BLUE inflammation. Extremely swollen and cyanotic leg from venous engorgement due to massive iliofemoral thrombosis. Can compromise perfusion from high compartment pressures leading to venous gangrene
    - PHLEGMASIA ALBA DOLENS → usually associated with pregnancy, also due to massive iliofemoral thrombosis, but the leg is pale or white secondary to associated arterial spasm

DIFFERENTIAL DIAGNOSIS OF CLAUDICATION-TYPE PAIN:

Table 64-3 Differential Diagnoses of Intermittent Claudication

Condition	Location	Prevalence	Characteristic	Effect of Exercise	Effect of Rest	Effect of Position	Other Characteristics
Calf IC	Calf muscles	3%–5% of adult population	Cramping, aching discomfort	Reproducible onset	Quickly relieved	None	May have atypical limb symptoms on exercise
Thigh and buttock IC	Buttocks, hip, thigh	Rare	Cramping, aching discomfort	Reproducible onset	Quickly relieved	None	Impotence
							May have normal pedal pulses with isolated iliac artery disease
Foot IC	Foot arch	Rare	Severe pain on exercise	Reproducible onset	Quickly relieved	None	Also may present as numbness
Chronic compartment syndrome	Calf muscles	Rare	Tight, bursting pain	After much exercise (jogging)	Subsides very slowly	Relief with elevation	Typically heavily muscled athletes
Venous claudication	Entire leg, worse in calf	Rare	Tight, bursting pain	After walking	Subsides slowly	Relief speeded by elevation	History of iliofemoral deep venous thrombosis, signs of venous congestion, edema
Nerve root compression	Radiates down leg	Common	Sharp lancinating pain	Induced by sitting, standing, or walking	Often present at rest	Improved by change in position	History of back problems
							Worse with sitting
							Relief when supine
Symptomatic Baker cyst	Behind knee, down calf	Rare	Swelling, tenderness	With exercise	Present at rest	None	Not intermittent
Hip arthritis	Lateral hip, thigh	Common	Aching discomfort	After variable degree of exercise	Not quickly relieved	Improved when not weightbearing	Symptoms variable
							History of degenerative arthritis
Spinal stenosis	Often bilateral buttocks, posterior leg	Common	Pain and weakness	May mimic IC	Variable relief but can take a long time to recover	Relief by lumbar spine flexion	Worse with standing and extending spine
Foot/ankle arthritis	Ankle, foot, arch	Common	Aching pain	After variable degree of exercise	Not quickly relieved	May be relieved by not bearing weight	Variable, may relate to activity level and be present at rest

DIAGNOSIS:

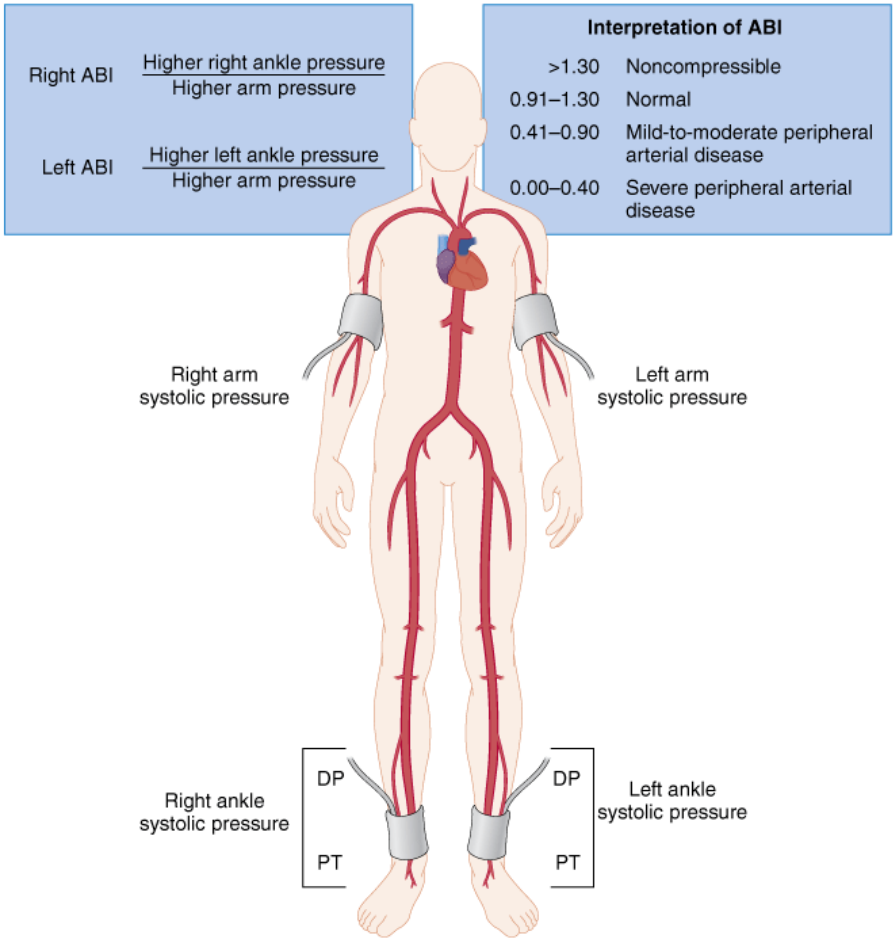
- If acute limb-threatening ischaemia is suspected, a vascular surgeon should be consulted prior to performing confirmatory imaging
- When considering thrombotic vs embolic cause of occlusion, think of below:

Table 64-4 Factors Favoring the Diagnosis of Embolic versus Thrombotic Occlusion

Factor	Embolism	Thrombosis
History of claudication	No	Yes
Physical examination	Normal contralateral limb	Marked signs of occlusive arterial disease bilaterally
Source identified	Often	None
Timing	Sudden, exact time known	More gradual
Radiologic features	Sudden abrupt cutoff in blood flow with no collateral circulation and minimal diseased vessel	Widespread disease with collaterals present and gradual narrowing of blood flow seen

- At the bedside → delayed capillary return is suggestive

- If Doppler flow is detected in the affected limb → the ankle-brachial reflex can be checked



- ABI >1.3 seen in severe disease with NON-COMPRESSIBLE VESSELS

LABORATORY EVALUATION:

- Basic laboratory studies plus CREATINE KINASE

IMAGING:

- Duplex ultrasound is very accurate for detecting complete or incomplete obstruction in the CFA, SFA and popliteal vessels
- CTA typically required before surgical intervention to plan surgery → FORMAL ANGIOGRAPHY IS ANOTHER OPTION → diagnostic and therapeutic

TREATMENT:

- **NO STUDY TO SUPPORT ANTICOAGULATION, BUT CURRENT BEST PRACTICE DICTATES ADMINISTRATION OF SYSTEMIC ANTICOAGULATION**
    - Prevents clot extension, recurrent embolisation, venous thrombosis and appearance of microthrombosis as well as preventing reocclusion after reperfusion

- Supportive treatment → analgesia, dependent positioning to increase perfusion pressure
- DEFINITIVE TREATMENT → URGENT VASCULAR SURGERY INVOLVEMENT → catheter directed lysis, percutaneous thrombectomy and angioplasty, open surgery
    - Prompt embolectomy is the optimal therapy for an acute arterial embolism
- Use of thrombolytics is controversial as no study has shown superiority over surgery → catheter directed lysis replacing systemic lysis for peripheral arterial disease
    - Downside of thrombolytics is delay of reperfusion, but rates of successful reperfusion up to 85%
    - It was thought that there is less likelihood of reperfusion syndrome with more gradual re-perfusion of lytics, but no study has shown a decrease in mortality, better limb salvage, improved safey or lowered costs
    - Consider in poor surgical candidates or in distal thromboembolic occlusion in small, inaccessible vessels
- Vascular mortality is decreased by 25% with use of aspirin
- Advise smoking cessation, exercise