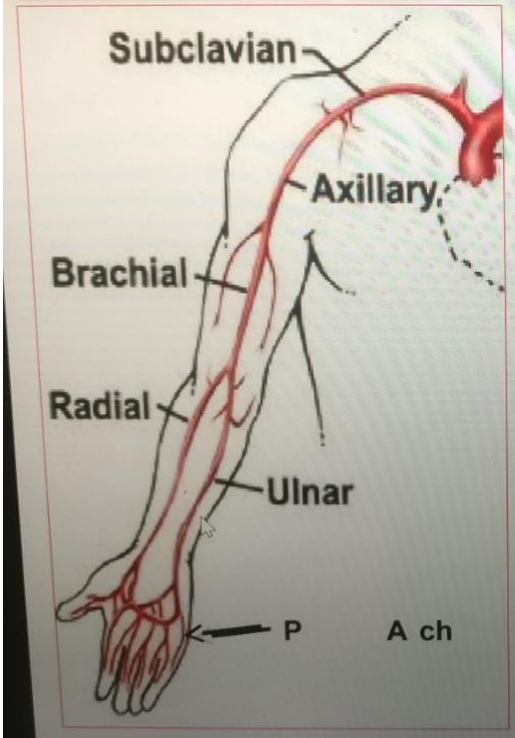
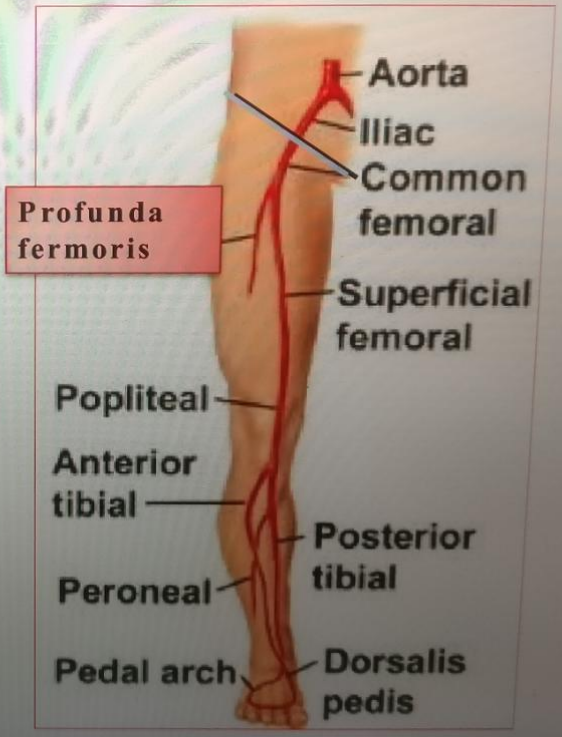
ARTERIES OF UPPER LIMB



ARTERIES OF LOWER LIMB



DEFINITION

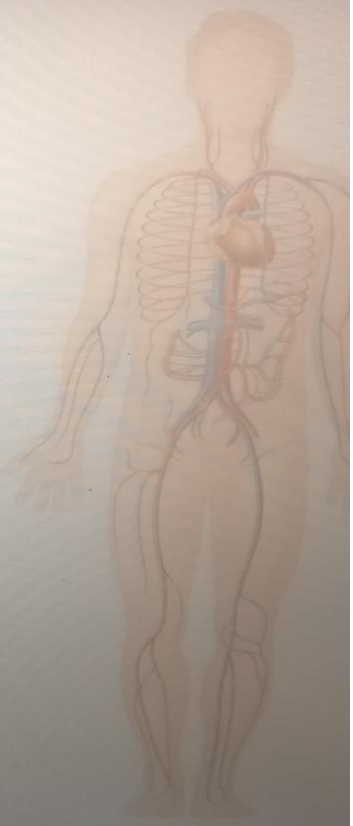
Acute Limb Ischemia (ALI)

- Acute (<2 wk), severe hypoperfusion of the limb characterized by these features

- Pain
- Pallor
- Pulselessness
- Poikilothermia(cold)
- Paraesthesias, and
- Paralysis

Critical limb ischemia

A condition characterized by chronic (>2 wk) ischemic rest pain, nonhealing wound/ulcers, or gangrene in 1 or both legs attributable to objectively proven arterial occlusive disease.



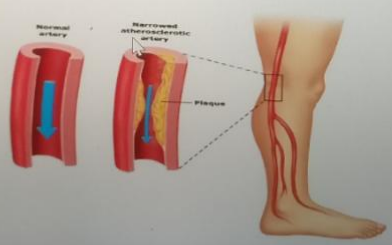
Chronic Limb ischemia

Decreased limb perfusion for > 2 weeks

2007 Trans-Atlantic Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II)

ETIOLOGY

LOWER LIMB ISCHEMIA
- Atherosclerosis
- thrombangiitis obliterans



UPPER LIMB ISCHEMIA
- Aorto-arteritis (Takayasu arteritis)
- Raynaud's disease
- Thoracic outlet obstruction
- Other rarer causes
  - mixed cryoglobulinemia,
  - nodular periarteritis,
  - dermatomyositis,
  - systemic scleroderma

SENILE ATHEROSCLEROSIS IS COMMON IN BOTH LOWER AND UPPER LIMB

RISK

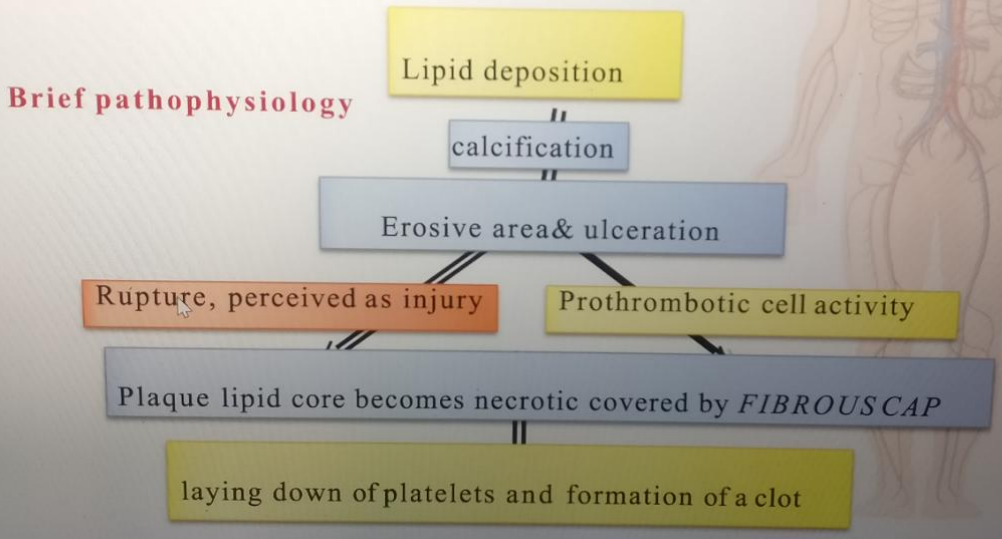
Old Age (>70 yrs)
Male gender
Diabetes
Smoking
Hypertension
Hypercholesterolemia
Hypertriglyceridemia
Hyperhomocysteinemia
Sedentary Lifestyle
Family History
Fatty diet
Drugs (beta blockers, OCP)

ATHEROSCLEROSIS

It is a **chronic complex inflammatory condition of elastic and muscular arteries**, involving as systemic and segmental.

Common arteries involved are— infrarenal part of abdominal aorta, coronary arteries, iliofemoral vessels, carotid bifurcation, popliteal arteries. It is less common in upper limb arteries, common carotid, renal and mesenteric arteries.

Brief pathophysiology



THROMBOANGIITIS OBLITERANS SYN. BUERGER'S DISEASE

exclusively seen in **males of young age** group with history of **smoking**.

Almost always starts in **lower limb**, may start on one side and later on the other side. Only upper limb involvement can occur (not uncommon) but it is *rare*.

segmental, progressive, nonatherosclerotic inflammatory occlusive, disease of small and medium sized vessels with **superficial thrombophlebitis** often may present with microabscesses, along with neutrophil and giant cell infiltration, with **skip lesions**.

Intermittent claudication in foot and calf progressing to **rest pain**, ulceration, gangrene.

Recurrent migratory superficial thrombophlebitis.

Absence/feeble pulses distal to proximal; dorsalis pedis, *posterior tibial, popliteal, femoral arteries.*

May present as **Raynaud's phenomenon**.

PATHOGENESIS

Smoking Causes vasospasm and hyperplasia of intima

↓

Thrombosis and obliteration of vessels occur, commonly medium sized vessels are involved

↓

Panarteritis is common .Usually involvement is *segmental*
Eventually artery, vein and nerve are together involved

↓

Nerve involvement causes rest pain
Patient presents with features of ischaemia in the limb

↓

If patient continues to smoke, disease progresses into the collaterals, blocking them eventually, leading to severe ischaemia and is called as ***decompensatory peripheral vascular disease.***

critical limb ischaemia.
It causes ***rest pain, ulceration, gangrene***

TAKAYASU'S PULSELESS

Progressive, initially symptomless panarteritis,
probably immunological.

common in young females (85%); common in Japan;

subclavian artery (85%); involves all layers of arteries; often bilateral.

Fever, myalgia, arthralgia, upper limb claudication & hypertension
Absence pulses in upper limb/limbs, neck

Fainting on turning the neck or change in position; atrophy of face.

Optic nerve atrophy without papilloedema.

Weakness and paraesthesia of upper limb.

DSA; MR angiography and Doppler are the *investigations*.

To suppress immunity prednisolone 50 mg/day and cyclophosphamide daily is given.

RAYNAUD'S DISEASE:

It is seen in females, usually bilateral.

It occurs in upper limb with normal peripheral pulses.

It is due to upper limb (hand) arteriolar spasm as a result of abnormal sensitivity to cold.

Patient develops blanching, cyanosis and later flushing as in Raynaud's syndrome.

Occasionally if spasm persists it results in gangrene.

Symptoms can be precipitated and observed by placing hands in cold water.

Types of Raynaud's phenomenon
Vasospastic
Obliterative

Raynaud's syndrome

Local syncope

Local asphyxia

Local recovery *Local gangrene*

CHRONIC LIMB ISCHEMIA IN DIABETES

High glucose level in tissues

A good culture media for bacteria

Diabetic neuropathy

Loss of sensation

ULCER

Diabetic microangiopathy

blockade of microcirculation

Glycosylated haemoglobin

Increased in blood causes defective oxygen dissociation

Hypoxia

Infection

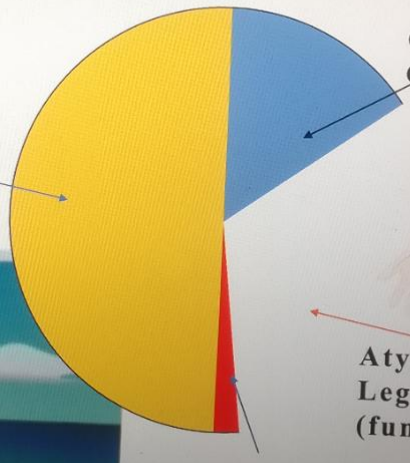
Thrombosis can be precipitated by infection causing infective gangrene.

Blockage occurs at plantar, tibial, and dorsalis pedis vessels

Diabetic Atherosclerosis

Limb Ischemia

DEMOGRAPHY OF CLINICAL SYMPTOMS



CLINICAL PRESENTATIONS

- Pain(most common symptom) – on walking (Intermittent claudication / Rest pain
- Paraesthesia
- Pallor
- Diminished or absent pulse
- Cold limb (Poikilothermia)
- Diminished hair , brittle nail , thinning & shining of skin
- Small Ulcer
- Gangrene

Level of Claudication according to the site of obstruction

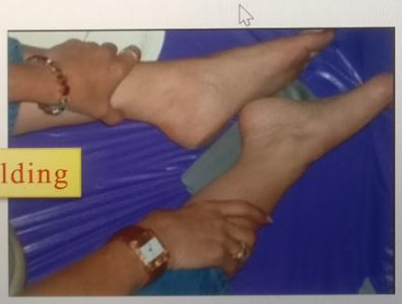
Obstruction level	Pain upto
Aorta or iliac artery(30%)	Buttock, hip
Femoral artery or branches(60%)	Thigh, upper2/3rd calf
Popliteal artery	lower 1/3rdCalf,
Tibial & dorsalis pedis artery	Ankel & foot

Rest Pain

Rest Pain is the pain felt even at rest. It is due to the Ischemia of the somatic nerves (*cry of the dying nerves*)

Rest pain

Felt in the foot (most distal parts)
Exacerbate on lying down or elevation of foot
Worse at night; patient sits in **"hen-holding"** position
Pressure of even bed clothes worsens the pain
Lessened by hanging the foot down or sleeping on a chair as the gravity aids in the blood flow to the nerves.
Patient may commit suicide



hen-holding

Examination:	What do to:
Inspection Expose the skin and look for:	• Colour Changes (pallor) • Thick Shiny Skin • Hair Loss • Brittle Nails • Muscle Wasting • Ulcers- number, site, shape, size ,margin ,edge,floor • Gangrene :type, colour, extent, line of demarcation
Palpation	• Temperature (cool, bilateral/unilateral) • Sensation/Movement • Pulses: ?Regular,?diminished or absent • Capillary Refilling time(normal: <2 sec) • Venous refilling time(Harvey sign)
Auscultation	•Systolic bruit may be heard over stenosed artery like subclavian artery, femoral artery, carotid artery, iliac, renal artery.
Buerger's postural Test	• Ask the Patient lying in supine position to raise his leg an d look for development of pallor • In normal individuals pallor do not develops even at 90° • *Buerger's angle of vascular insufficiency*: It is the angle in which pallor develops on raising legs. • *If this angle is* <30°, it indicates severe ischaemia.

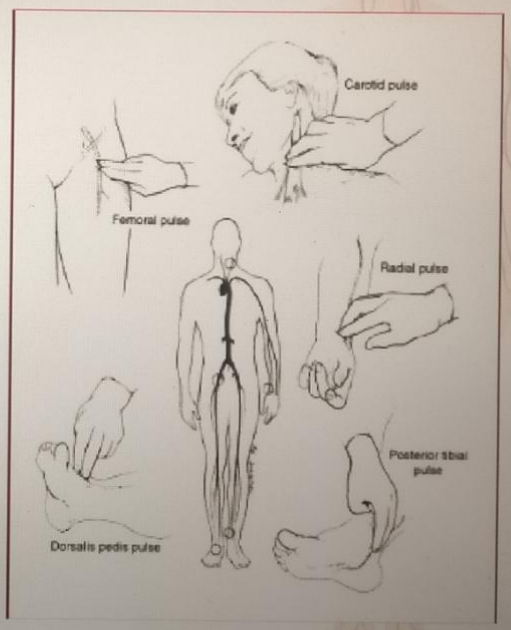
CLINICAL EXAMINATION

Pulse Examination

- Carotid
- Radial/ulnar
- Femoral
- Popliteal(cross leg test)
- Dorsalis pedis
- Posterior tibial

Scale:

- 0=Absent
- 1=Diminished
- 2=Normal
- 3=Bounding (aneurysm or AI)



Arterial Ulcer

- Ulcers are punched out with destruction of deep fascia.
- Tendon, bones & underlying joints exposed in the floor
- Covered with minimal granulation tissue.
- Presence of ischaemic changes : pallor, dry skin, loss of hair, fissuring of nails.

Gangrene

It is macroscopic death of tissue *in situ* *with or without putrefaction.*

Dry gangrene	Wet gangrene
Dry, shriveled, mummified	Odematous, putrified and discoloured
Occurs due to slow and gradual loss of blood supply	Occurs due to sudden loss ofblood supply
Infection not present	Infection present offensive odor)
Cold temp. ,dull aching pain skin changes colour to dark brown→ dark purplish→ completely dark	offensive odor Swollen, red and warm
Clear line of demarcation is present	Vague/ No line ofdemarcation
No proximal extention	Proximal extension
Limited amputation	High amputation

INVESTIGATION

Routine Blood investigation
sugar , urea ,creatinine

Serum cholesterol ,
Triglyceride

Urine sugar

X- ray of lower limb –
calcification of vessels,
condition of underlying bone

Ankle-Brachial Index

Usg Duplex

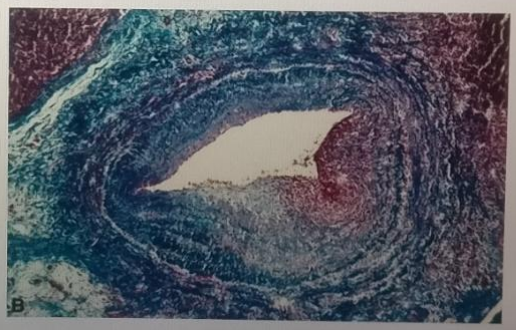
Arteriography

Biopsy of the vessels

Other investigation
- USG whole abdomen
- ECHO
- ECG

Recent Advances in investigations

Xenon 133 Isotopes scanning
Trans-cutaneous oximetry



HEMODYNAMIC NONINVASIVE TESTS

Resting Ankle-Brachial Index (ABI)

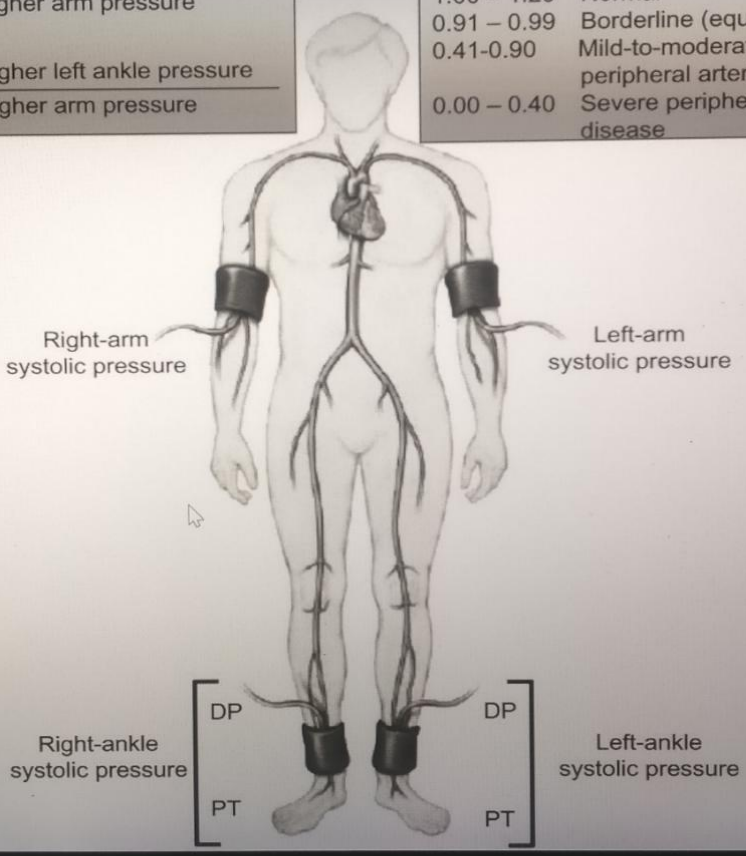
Exercise ABI

Segmental pressure measurement

These traditional tests continue to provide a simple, risk-free, and cost-effective approach to establishing the limb ischemia diagnosis as well as to follow up after the procedures.

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

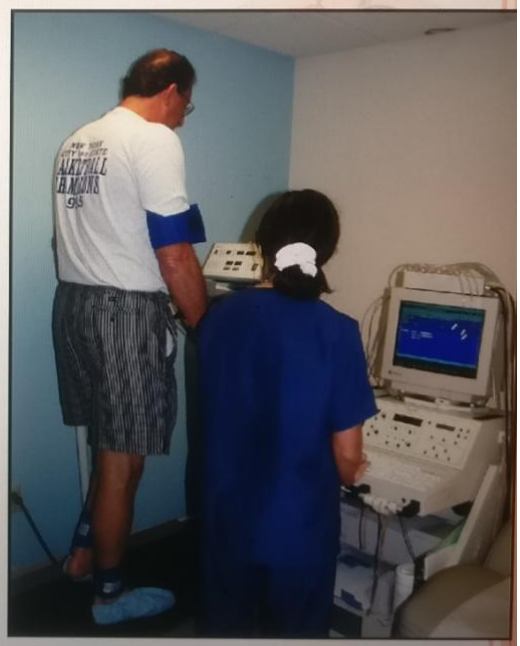


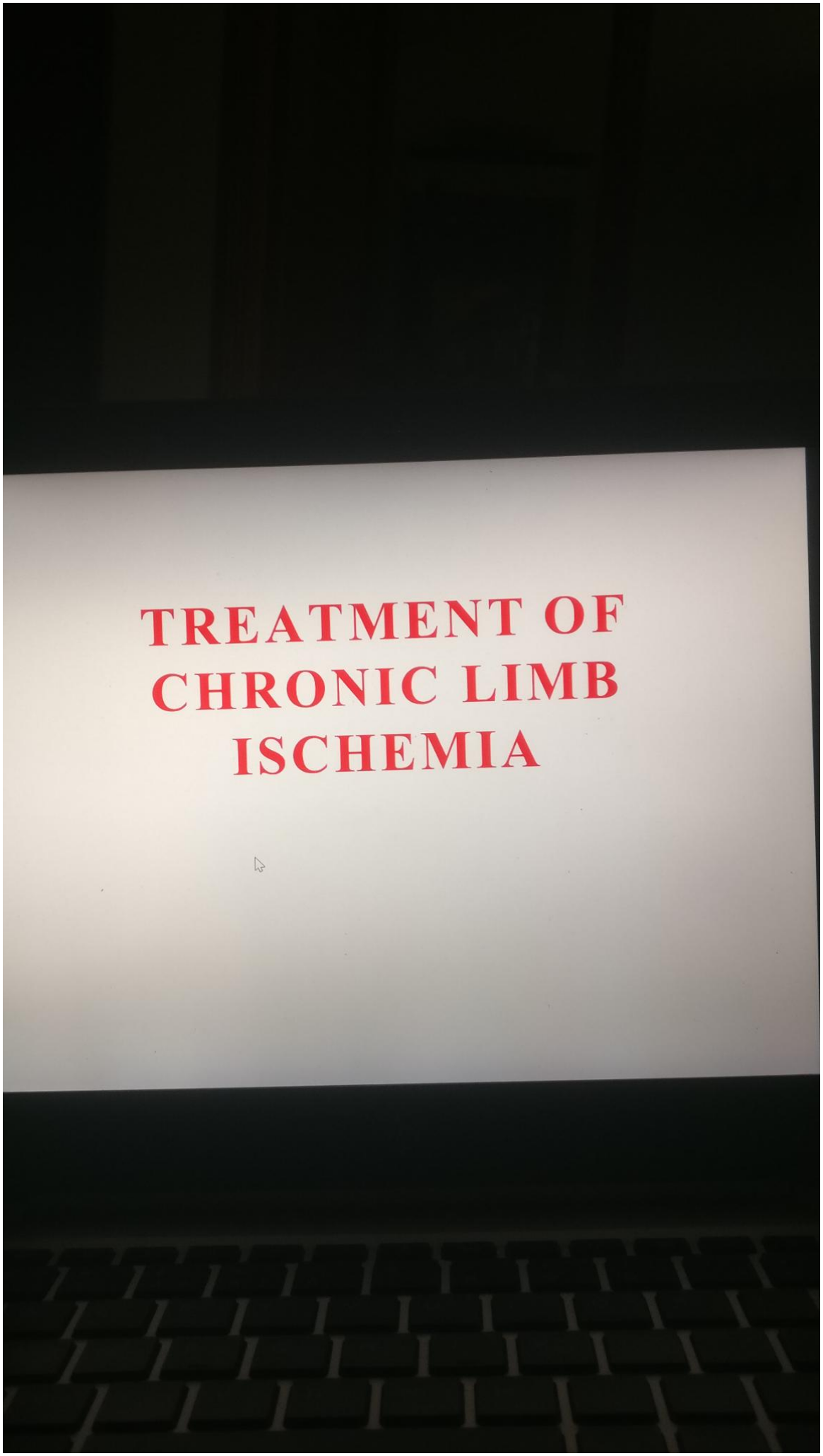
EXERCISE ABI

Confirms the limb ischemia diagnosis

Assesses the functional severity of claudication

May "unmask" limb ischemia when resting the ABI is normal




TREATMENT OF
CHRONIC LIMB
ISCHEMIA

TREATMENT

Life style modification

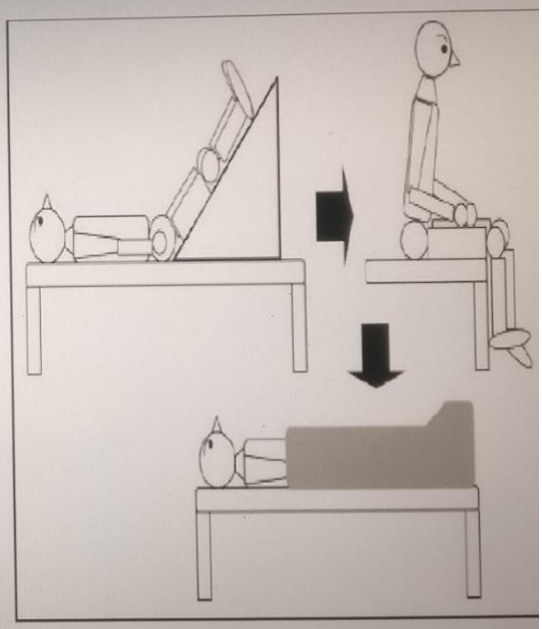
- **Stop smoking**
- Supervised exercise
- Regular walk
- Fat free diet
- Weight reduction
- limb care
  - buerger's excercise
  - foot cleaning
  - Application of mousteriser

Strict control of
- Blood pressure
- Blood sugar
- Cholesterol

Avoid precipitating factors— Cold/Drugs

BUERGER'S EXERCISES

- Pt. in supine position ,legs elevated to 45 degree.
- Observe time taken for blanching +2 min.
- Made to sit in high sitting position + 3 min. [hyperemia]
- Pt. is made to lying supine for 3 – 5 min.
- This sequence is repeated 4 – 5 times / session , for 3 sessions a day.



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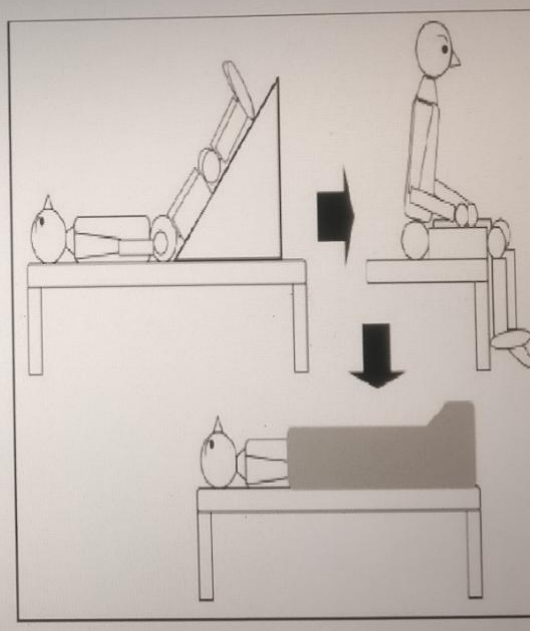


MEDICAL TREATMENT

Vasodialators – Nifedipine

Xanthinol nicotinate

Pentoxifylin 400 mg TDS PO

Decreases blood viscocity

Increases flexibity of RBC

Anti-Plateletes Drugs

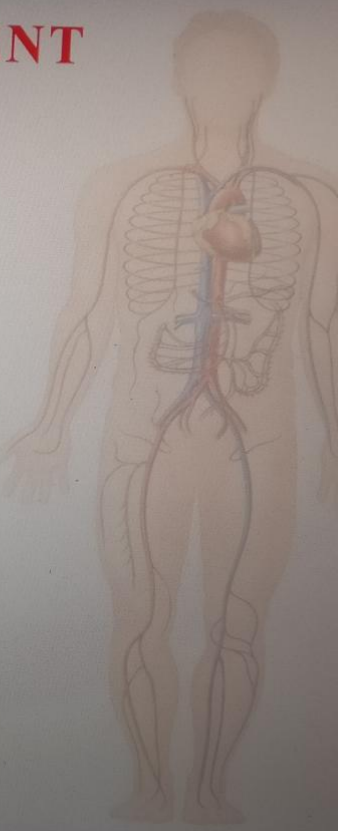
Low dose Asprin 75 mg OD PO

Clopidogrel 75 mg OD PO

Cilastazole - 100 mg BD PO

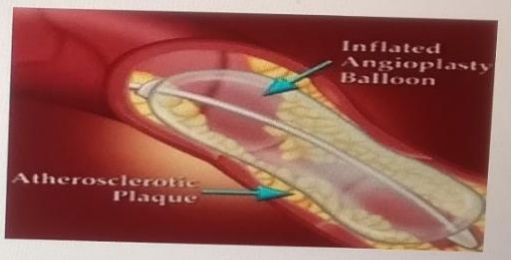
Hypolipidimics - Atrovastatin 10- 40 mg OD PO

ANALGESICS



SURGICAL MANAGEMENT

Indications:
claudication interfering with lifestyle
critical limb ischemia



Angioplasty : Conventional
Sub- intimal

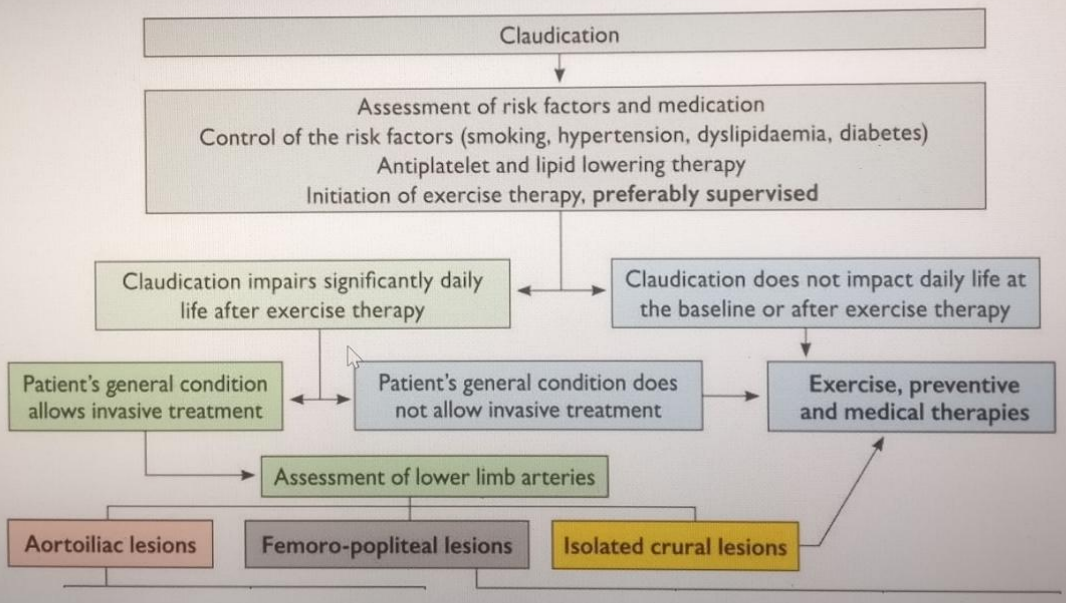
End artrectomy : Open
Semiclosed
Weily eversion technique

Stenting

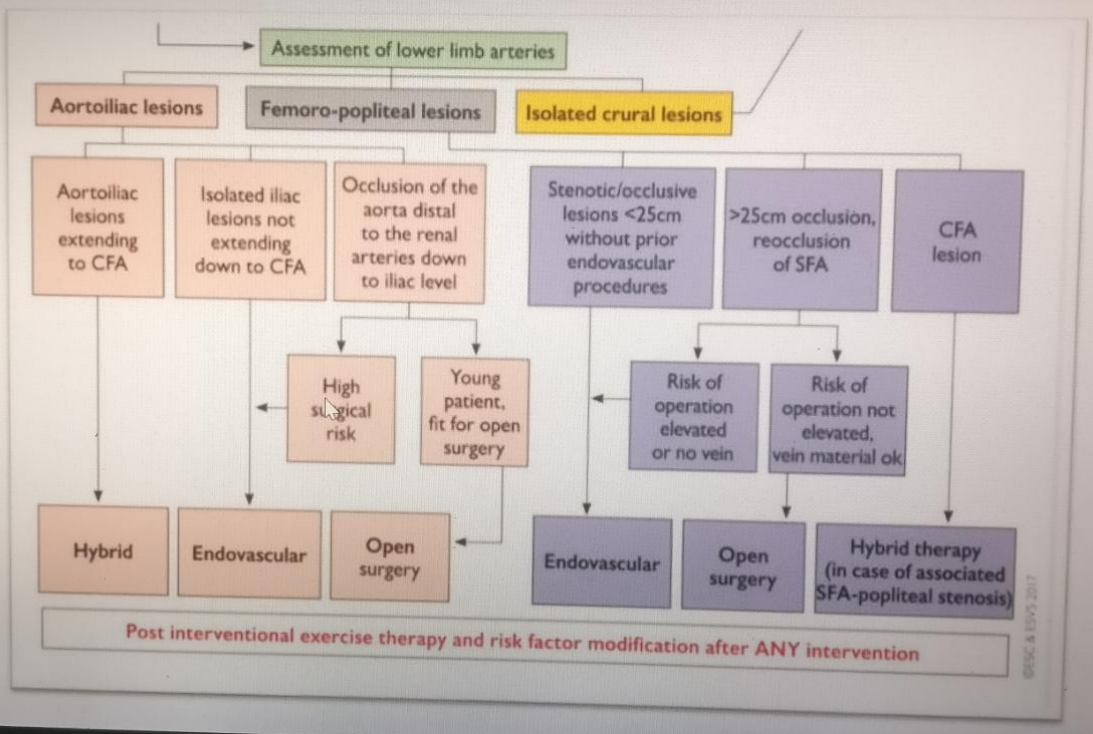
Arterial bypass
Graft : Natural : Insitu sephanous
Reverse sephanous
Artificial : Anatomical
Extra Anatomical

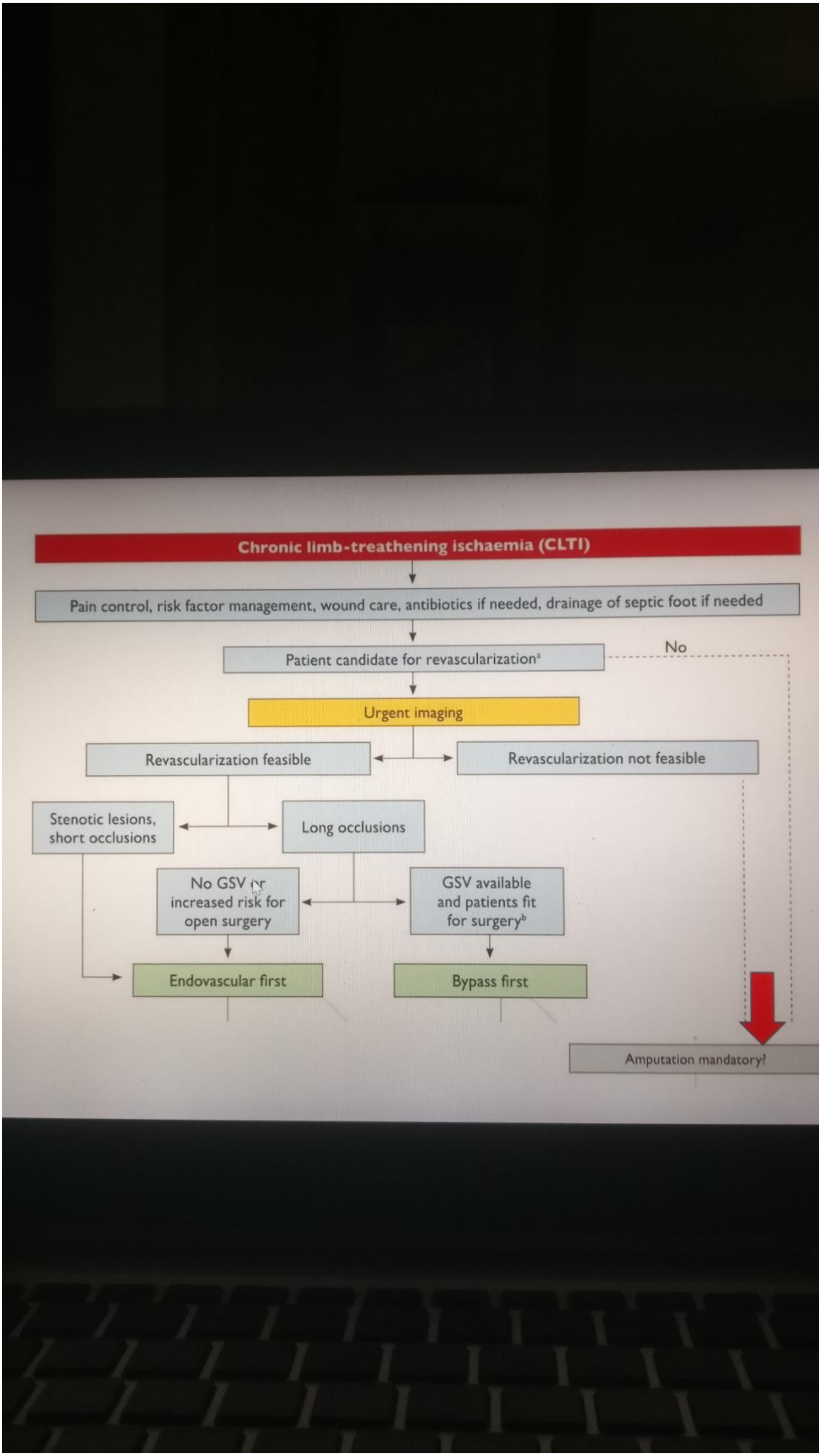
Amputation :

MANAGEMENT OF CRITICAL LIMB ISCHEMIA: REVASCULARIZATION OPTIONS: GENERAL ASPECTS



MANAGEMENT OF CRITICAL LIMB ISCHEMIA: REVASCULARIZATION OPTIONS: GENERAL ASPECTS

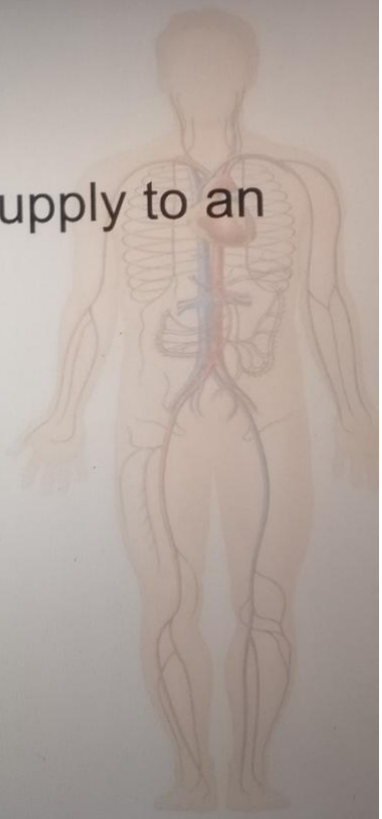



Chronic limb-treathening ischaemia (CLTI)
Pain control, risk factor management, wound care, antibiotics if needed, drainage of septic foot if needed
Patient candidate for revascularization[a]
No
Urgent imaging
Revascularization feasible
Revascularization not feasible
Stenotic lesions, short occlusions
Long occlusions
No GSV or increased risk for open surgery
GSV available and patients fit for surgery[b]
Endovascular first
Bypass first
Amputation mandatory?

Acute Limb Ischemia

Definition

- Acute interruption of blood supply to an organ or extremity.



Aetiology

1) Arterial embolism

2) Thrombosis: native arteries, baypass grafts

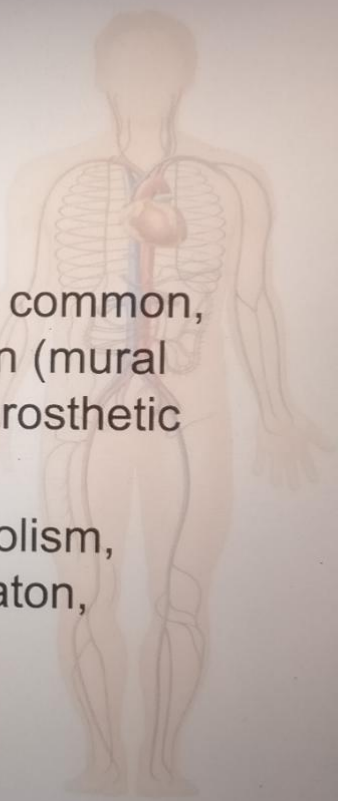
3) Traumatic

4) Acute aortic dissection.

5)Rare causes: low flow states: e.g. cardiogenic shock / sepsis, drugs (cocaine, vasopressors), vasculitis.

Embolism

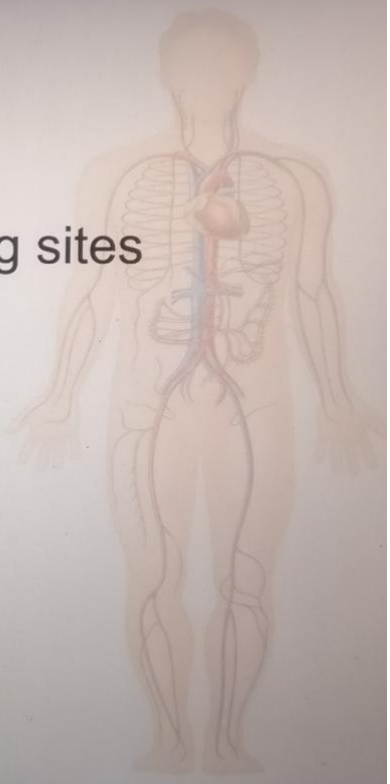
- The most common.
- Secondary to:
  - ***Cardiac causes*** (80-90%): most common, arrhythmias, myocardial infarction (mural thromus), vegetations (SABE) , prosthetic valves, cardiac tumors, etc..
  - ***Noncardiac causes***: atheroembolism, aneurysms, paradoxical emoblizaton, iatrogenic.
  - ***Cryptogenic*** emboli: 5-10%.



Embolism (cont.)

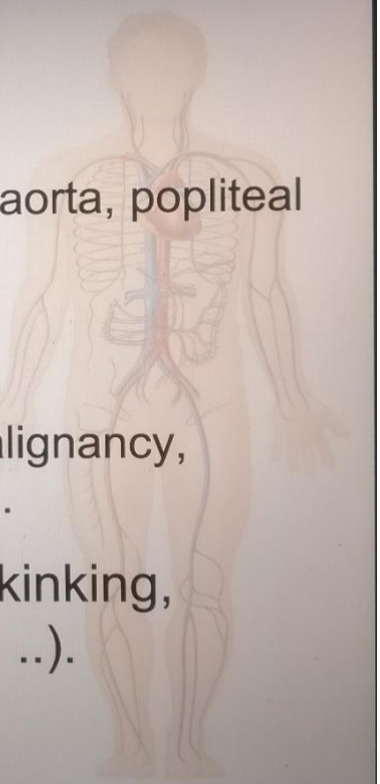
Site of impaction:
bifurcations, major branching sites

- Lower limb
  - Femoral bifurcation
  - Popliteal
  - Distal aorta
- Cerebrovascular
- Visceral
- Upper limb



Thrombosis

- Secondary to ASO: distal SFA, aorta, popliteal
- In absence of stenotic lesion:
  - Intra-arterial injections
  - hypercoagulable states: e.g. malignancy, antiphospholipid syndrome, etc..
- Thrombosis of bypass grafts (kinking, stenosis, anastomotic lesions, ..).

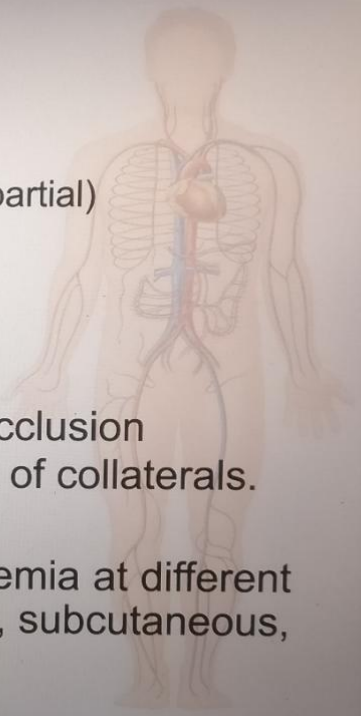


Embolism versus Thrombosis

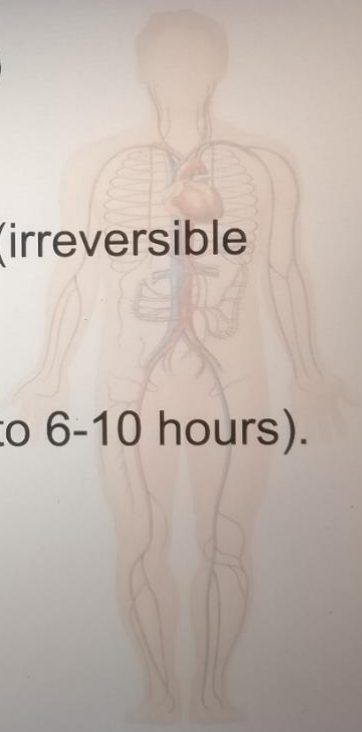
	Embolism	Thrombosis
Sources	Frequently detected	Not specified
Onset	Normal vessels, soft	On top of a stenosis, calcified
Site		
Previous complaint	Rare	Symptoms of chronic ischemia
Findings	Normal pulses	Evidence of peripheral arterial disease
Multiplicity	Multiple sites	Single site
Angiography	No or minimal ASO, sharp cut off (Fontaine sign), multiple cclusions, no collaterals	Diffuse atherosclerosis, tapered and irregular cut off, developed collaterals

Pathophysiology

- Depends on:
  - Degree of obstruction (complete or partial)
  - Site of occlusion
  - Presence of collaterals
  - Affected tissues.
- Sluggish circulation distal to the occlusion secondary thrombosis occlusion of collaterals.
- Different tissues can tolerate ischemia at different rates (brain and heart versus skin, subcutaneous, and muscles).



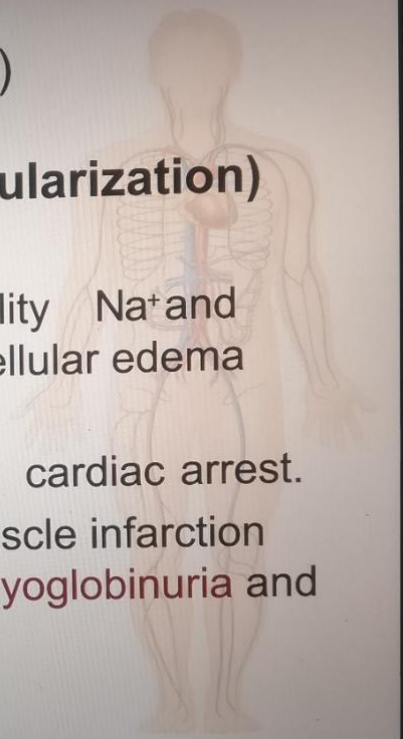
Pathophysiology (Cont.)



- ***Nerves***: First to be affected (irreversible damage after 6 hours)
- ***Muscles***: more tolerant (up to 6-10 hours).
- ***Skin***: last to show necrosis.

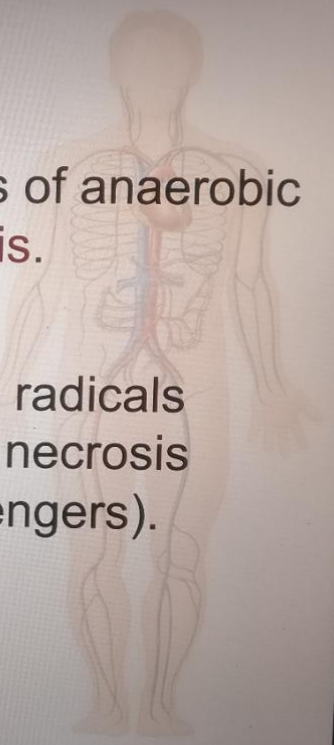
Pathophysiology (Cont.)

- **Cellular ischaemia (Revascularization)**
  - Alteration of cell wall permeability Na^+ and water influx intra and extra cellular edema compartment syndrome
  - Release of K^+ hyperkalaemia cardiac arrest.
  - Release of myoglobin after muscle infarction precipitate in renal tubules myoglobinuria and acute renal failure.



Pathophysiology (Cont.)

- Accumulation of acidic products of anaerobic metablolism metabolic acidosis.
- During reperfusion, oxygen free radicals accumulate cellular insult and necrosis (Mannitol and free radical scavengers).



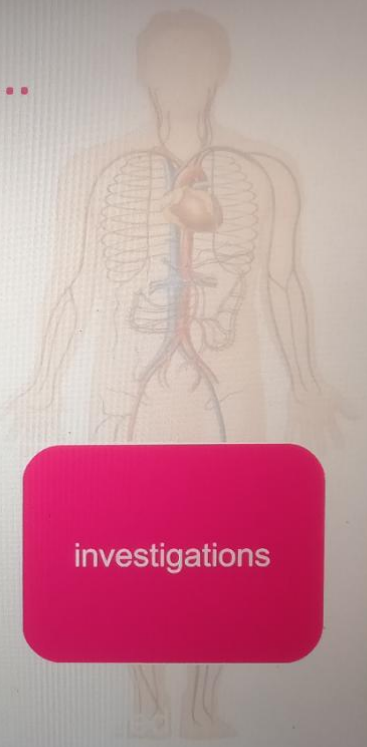
Algorithm to be followed...

Patient with suspected ischemia

History

Examination

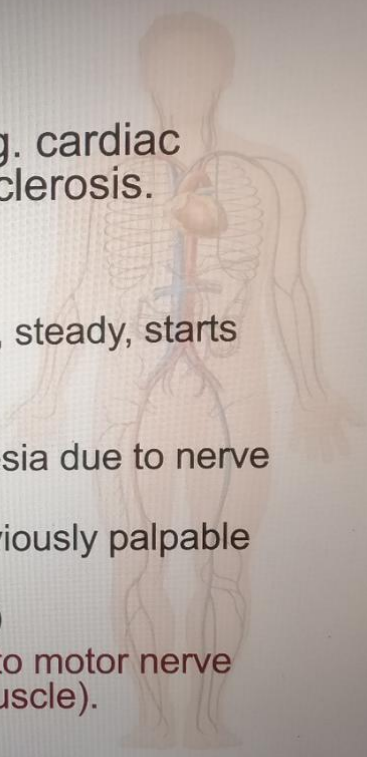
investigations



Diagnosis

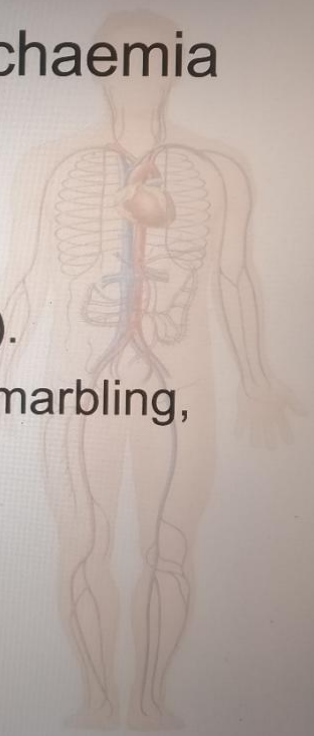
- **History:** source of embolism (e.g. cardiac patients), risk factors for atherosclerosis.

- **Clinical picture: 6 Ps**
  - Pain (sudden / acute onset, severe, steady, starts most distal).
  - Pallor or cyanosis
  - Parasthesia (numbness anaesthesia due to nerve isch.)
  - Pulselessness (sudden loss of previously palpable pulse = embolic).
  - Poikelothermia (cooling of the limb)
  - Paralysis (fine movement first due to motor nerve isch. then because of nerve and muscle).



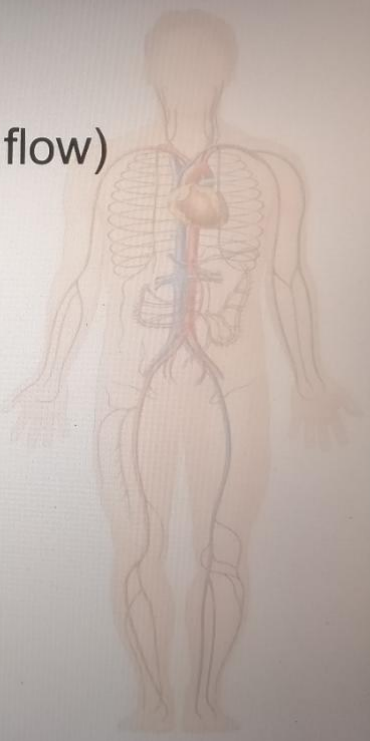
Acute late (irreversible) ischaemia

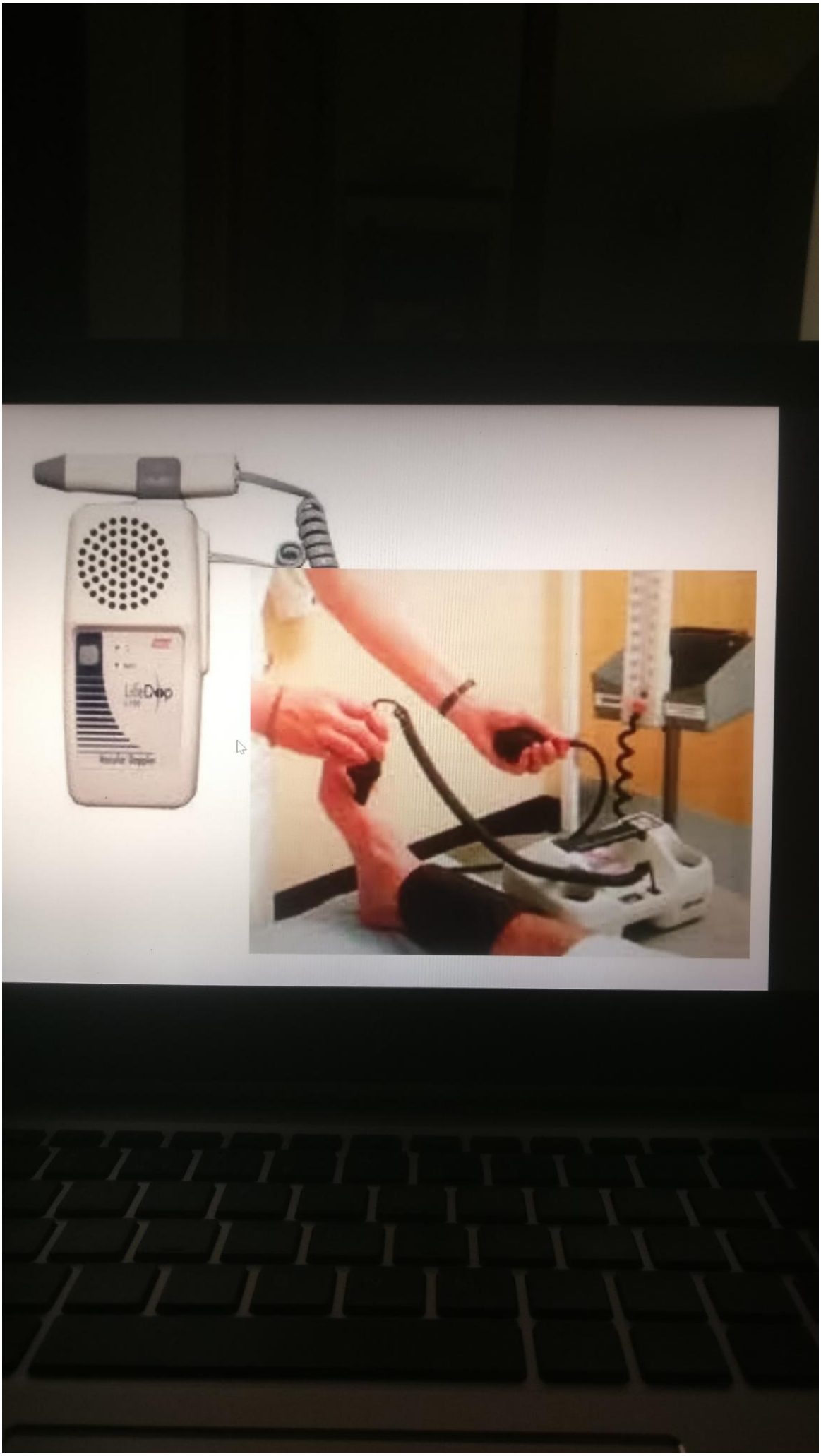
- Swollen limb
- Tender muscles
- Loss of muscle turgor (doughy).
- Fixed cyanotic color changes, marbling, necrosis, desquamation.
- Rigor mortis.



Investigations

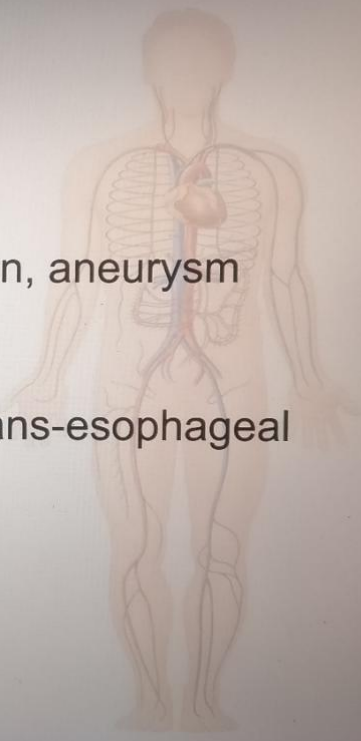
- Doppler US (to detect blood flow)
  - ABI.
  - Segmental pressure.
- Imaging:
  - Duplex US
  - Contrast angiography



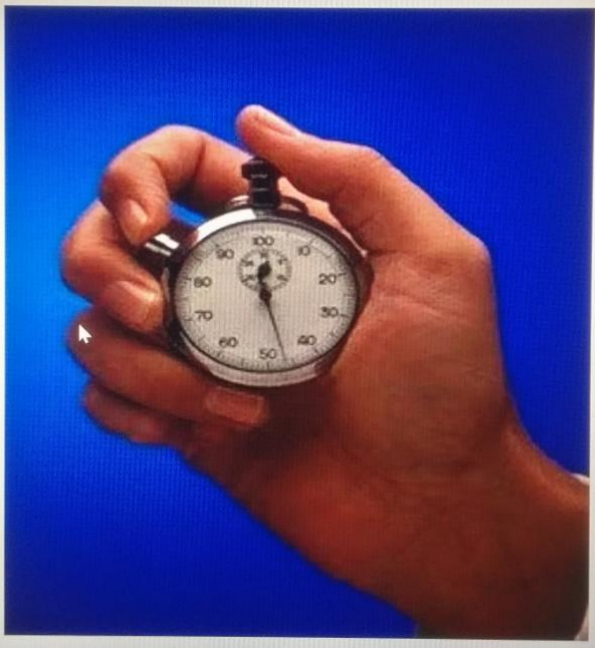

LifeDop
Vascular Doppler

Investigations (Cont.)

- To detect the cause:
  - Chest X-ray: heart, calcification, aneurysm
  - ECG: CAD, arrhythmias
  - Echo: trans-thoracic (TTE), trans-esophageal (TEE), intra-cardiac masses.
  - CTA, MRA.



Treatment of reversible ischaemia



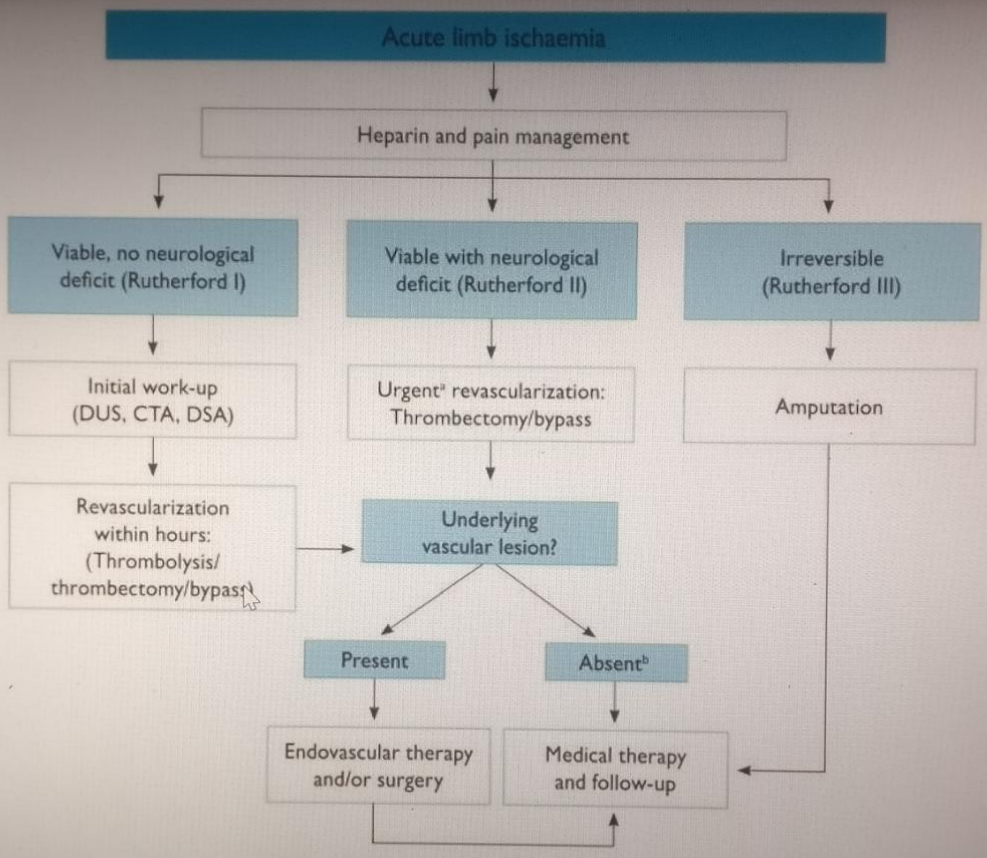
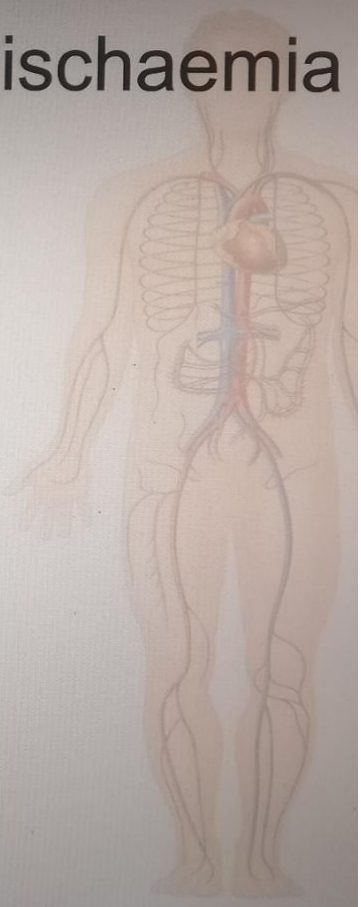


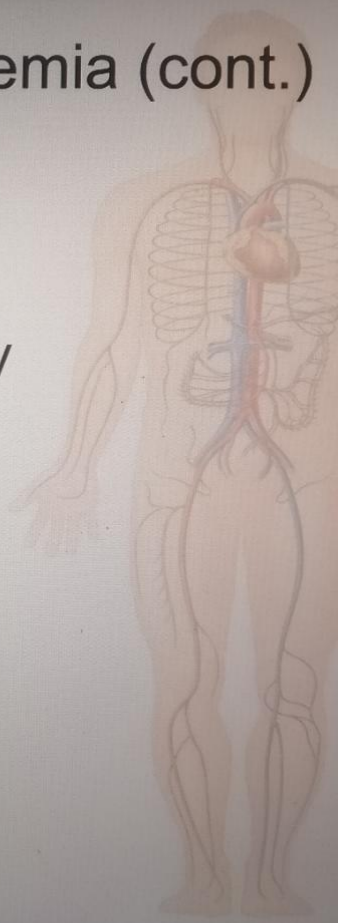
Figure 7 Management of acute limb ischaemia. CTA = computed tomography angiography; DSA = digital subtraction ultrasound; DUS = duplex ultrasound.
[a]Imaging should not delay revascularization.
[b]Specific etiological work-up is necessary (cardiac, aorta).

Treatment of reversible ischaemia

- **Immediate anticoagulation:**
- Unfractionated heparin or LMWH
  - Dose (bolus / maintenance)
  - Route
  - Methods
  - Complications
  - Monitoring
  - Antidote
- Oral anticoagulation
  - Contraindications
  - Monitoring
  - Complications
  - Antidote



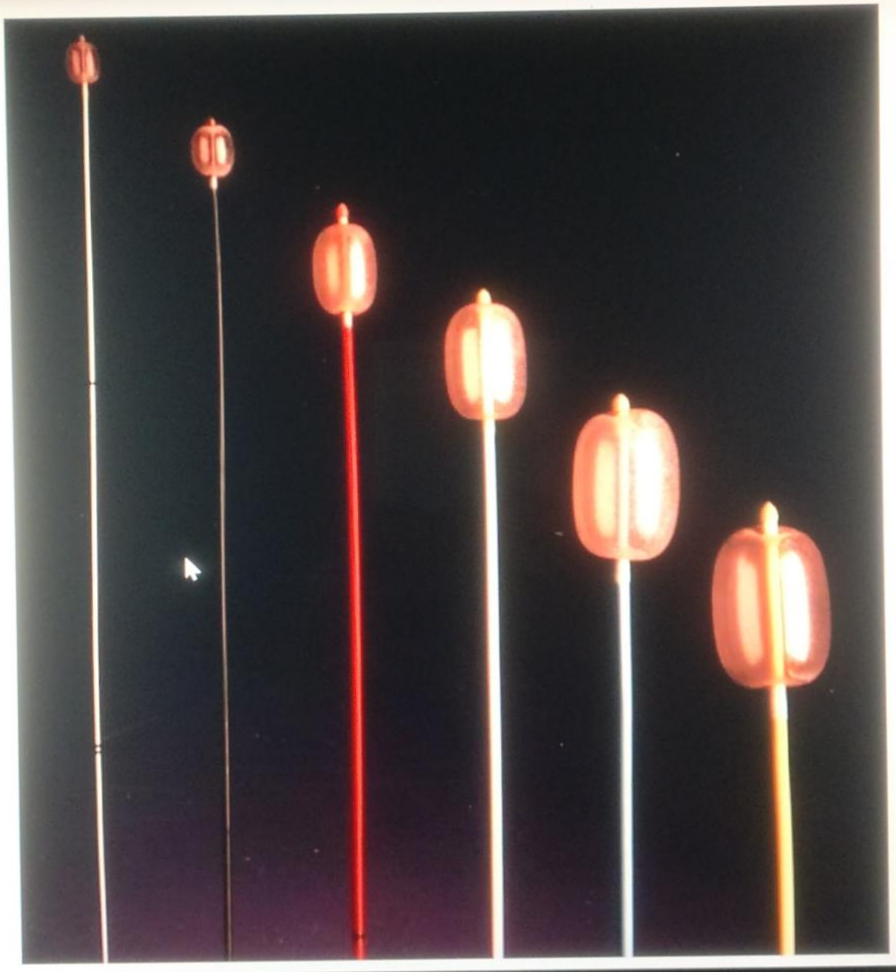
Treatment of reversible ischaemia (cont.)



- **Open surgical treatment:**
  - Embolectomy / thrombectomy
  - Bypass

Indications?

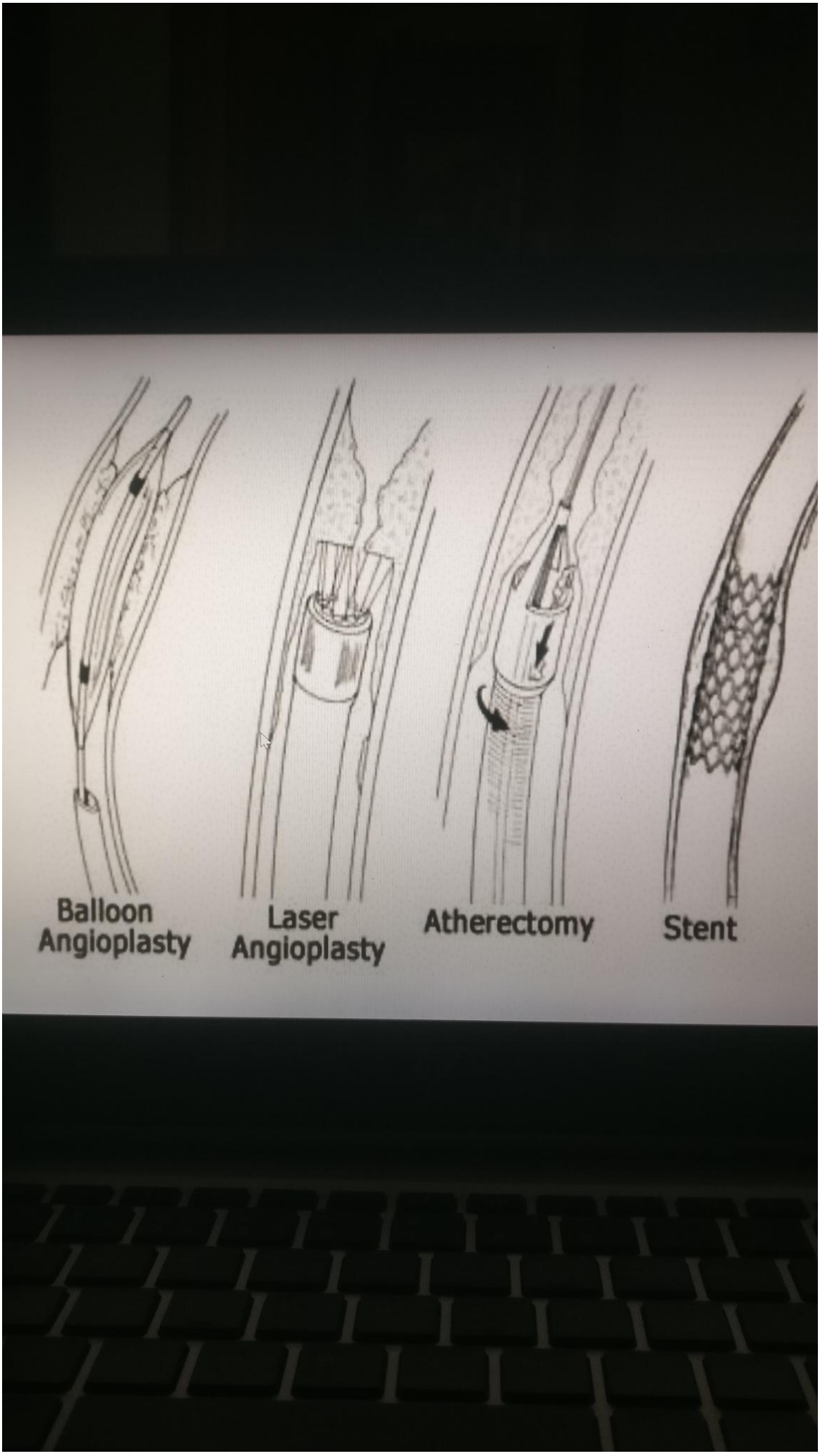
Contraindications?



Treatment of reversible ischaemia (cont.)

Thrombolysis

- Indications:
  1. Viable or marginally threatened limb
  2. Recent acute thrombosis *(not suitable for embolism or old thrombi)*
- Types: systemic / catheter-directed.
- Agents: streptokinase, urokinase, tissue plasminogen activator (TPA).
- Contraindications (absolute / relative).
- What is next local / systemic?


Balloon Angioplasty
Laser Angioplasty
Atherectomy
Stent

Treatment of irreversible ischaemia

- **Anticoagulation**
- **Amputation**