MANIFESTATIONS OF VASCULAR DISEASE
CHRONIC ISCHEMIA

- CEREBROVASCULAR OCCLUSIVE ARTERIAL DISEASE

- Encompasses a variety of clinical disorders of the extra-cranial carotid arteries that result in transient cerebral ischemia or even stroke.

- Stroke is the third most common cause of death in the United States. The most common cause of stroke is extra-cranial carotid artery disease.

- The brain is supplied by a paired carotid arteries anteriorly (80% of cerebral circulation) and vertebral arteries posteriorly (20% of cerebral circulation).

- The Vertebral artery arises from the first part of the subclavian travel in the cervical vertebral foramina to join the artery of the other side forming the basilar artery which communicates with the carotid system through the circle of Willis.
Atherosclerosis remains the most common cause of stroke in adults.

The carotid bifurcation is the most common site for atherosclerosis is due to local turbulence of blood stream causing a plaque involving the intima and neighboring media causing progressive stenosis.

As plaques increase in size they can ulcerate and suffer intra-plaque hemorrhage, which in turn can result in emboli or total thrombosis of the artery.

Predisposing factors for plaque formation are Diabetes, Hyperlipidaemia, Hypertension, Cigarette smoking, Heredity, Hyper-coagulable states and Age.
CLINICAL PRESENTATION

- Most patients present either by transient ischemic attacks (TIA) or by hemispheric strokes
- TIA is the sudden onset of focal neurologic deficit that resolves completely within 24 hours of its onset
- They can occur as hemispheric attacks or as mono-ocular blindness (Amourosis fugax) due to obstruction of a branch of the central retinal artery
- Vertebro-basilar TIA’s present as transient loss of binocular vision, Vertigo (Drop attacks), dysarthria, dysphagia and incoordination attacks due to cerebellar insufficiency
- Stroke is an acute neurologic deficit that lasts more than 24 hours, most of which are due to embolic occlusion of a branch of the middle cerebral artery by platelet-fibrin aggregates or plaque debris resulting in contra lateral sensorimotor deficit and visual field defects according to the territory of the occluded artery
- Patients with vertebro-basilar strokes present with ipsilateral cranial nerve deficits, contra lateral sensorimotor deficits, signs of cerebellar insufficiency including ataxia, vertigo, nystagmus, diplopia and drop attacks.

DIAGNOSIS

- Careful neurologic examination of cerebrovascular occlusive disease remains the most important diagnostic modality. Complete physical examination to detect the presence of coronary or peripheral vascular disease should be done.
**Color flow duplex scanning;** determines the extent of carotid stenosis with reliable sensitivity and specificity, flow measurements can also be done. Scanning needs considerable skill and experience in interpretation. Recent refinements in duplex technology has put this investigative modality top priority in patients undergoing carotid endarterectomy.

- **Transcranial Doppler;** Uses the thin temporal bone to detect flow in the anterior, middle and posterior cerebral arteries, useful in detecting intracranial stenotic lesions.

- **Angiography;** Remains the gold standard for the diagnosis, permits visualization of extra cranial and intracranial arterial circulation, however, attended with the risk of allergy, renal toxicity and stroke.

- **CT scanning & MRI;** CT scanning can accurately distinguish between intra-cranial hemorrhage and infarction. MRI can immediately detect stroke, MR angiography is supposed to play an important role in the diagnosis of cerebrovascular disease in the future.
NATURAL HISTORY

Symptomatic disease: In patients experiencing TIA’s, the risk of stroke is 10-30% during the first year and increases by 6% every year for the subsequent five years to reach 30-50%. The initial stroke carries a mortality of 30%.

Asymptomatic disease: the risk of stroke is proportionate to the degree of stenosis, with stenotic lesions above 75-80% the risk of stroke ranges from 18-46%. The risk of stroke increases in patients with severe carotid stenosis who undergo major surgical procedures [coronary bypass], therefore, prophylactic carotid endarterectomy is preferred.

MANAGEMENT

Medical management: - Modification of risk factors [hypertension, DM, hyperlipidaemia, smoking, …etc.] to prevent progression of disease
   - Aspirin has been shown to reduce the risk of stroke in severe stenosis in some studies but anticoagulants had adverse effects and are not advised.

Surgical Treatment: - Major indications are * Symptomatic carotid artery stenosis
   * Stroke with minimal neurologic deficit
   * High grade asymptomatic stenosis >75%
   - Less common indication:* Global cerebral ischemia
CAROTID ENDARTERECTOMY

COMPICATIONS

Neurologic complications

- **Stroke**: due to* intraoperative embolization, ischemia due to inefficient collateral circulation or *intracranial hemorrhage [recent infarct.]

- **Cranial nerve injury**: Recurrent laryngeal nerve [hoarseness of voice], hypoglossal nerve, superior laryngeal nerve…etc.

Non neurologic complications

- Hemorrhage [aspirin administration]
- Hyper and hypotension [dissection around the carotid sinus and its nerves]
- Myocardial infarction and death [association of carotid & coronary disease]
- Recurrent carotid stenosis; occurs in 30% of cases, however less than 3% are symptomatic may be due to atherosclerosis [late], or intimal hyperplasia [early]
UPPER EXTREMITY ARTERIAL DISEASE

- **History taking:** Including occupational, athletic, pharmacological and medical history is important in the diagnosis of upper extremity ischemia.

- **Symptoms:** *symptoms of embolism*
  - Raynaud’s disease and phenomenon
  - Exercise related forearm fatigue and pain.

- **Clinical examination:** Examination of the thoracic outlet, the supraclavicular region for aneurysms, or cervical rib, infra-clavicular bruit on hyper abduction. Palpation of pulsations if weak, absent or exaggerated. Performance of Adson and Allen tests

- **Noninvasive Examination:** *Doppler examination and wave form analysis of superficial and digital arteries*
  *Segmental pressure measurements of both upper extremities & digital vessels*  *Duplex scanning is useful in diagnosing aneurysms*

- **Laboratory Examination:** In severe bilateral hand ischemia systemic causes should be sought, laboratory tests include serologic, immunologic and hematologic may establish the diagnosis

- **Radiologic Examination:** *Plain X-ray may show CREST syndrome or cervical rib*  *Angiography is important in defining the disease and visualizing anatomical variations*
Diagnosis:
Diagnosing proximal vessel occlusion is usually not difficult. Distal vessel occlusion is diagnosed by Doppler examination differentiating it from vasospastic disease

**Proximal arterial lesions:** *Atherosclerosis is the most common cause of proximal upper extremity lesions, the first part of the subclavian artery is the commonest site of disease lesions may be high grade stenosis or occlusion causing subclavian steal, or ulcerating plaques causing distal embolisation.*

*Arteritis includes diverse autoimmune disease states that can cause proximal upper limb disease*

*Thoracic outlet syndrome is the most common condition causing upper extremity complications in young adults. Possible compression sites include the first rib, cervical rib, scalenus anterior & pectoralis minor. Arterial symptoms are usually accompanied by neurologic and venous symptoms.*

**Distal arterial lesions:** *Collagen disease [Scleroderma, systemic lupus, rheumatoid arthritis…etc.] can cause digital vessel occlusion. Burger’s disease cryoglobulinemia, polycythemia can also cause distal ischemia*

*Vibrating tools, can cause raynauds syndrome*

* Hypothenar hammer syndrome, is another form of occupational trauma
AORTOILIAC DISEASE

- Because atherosclerosis is a generalized process aortoiliac disease frequently exists with infrainguinal disease, therefore, proper inflow evaluation is as important as outflow selection.

- Atherosclerosis can produce partial or complete obstruction in the aorta or the iliac arteries; the disease is commonly centered around the aortic bifurcation, producing claudication and impotence. More severe symptoms usually indicate the presence of additional distal disease. Aorta around the renal arteries is usually free of disease.

- More advanced ischemic symptoms include rest pain ischemic ulcer or gangrene.

- Degeneration or ulceration of plaques may lead to athero-embolism.
DISEASE PATTERNS AND CLINICAL PRESENTATIONS

- Type I disease: disease is confined to the distal aorta and proximal iliac vessels. It is infrequent (10%) and occurs in relatively young patients, with women equally affected as men. Patients present with proximal muscle claudication (thigh, hip, and buttocks), and impotence may also be present in 50% of patients.

- Type II disease: confined to the abdominal vessels, but external iliac and common femoral vessels are also involved. More common and composes 20-25% of cases.

- Type III disease: Diffuse disease (multi-segment disease), affects both inflow and outflow sites. Most common, composes about 66% of cases. Male to female ratio is 6:1. Patients are old and suffer from most of the predisposing factors. Symptoms are typically severe. Morbidity and mortality are high.
DIAGNOSIS

- Clinically, the triad of, proximal claudication, decreased sexual potency and absent femoral pulsations is referred to as **Leriche Syndrome**.

- In an appreciable number of patients calf claudication may also be present [multi-level disease].

- In many instances pain could be mistaken with that of degenerative hip or spine disease, lumbar disc prolapse, spinal canal stenosis, in such instances non-invasive vascular laboratory testing may be helpful

- Duplex scanning could be used in the preoperative evaluation and post operative follow-up, but arteriography should be done if surgery is to be attempted.

- **ARTERIOGRAPHY;** Should be done if surgery is to be undertaken, for surgical planning it is valuable in selecting adequate inflow and outflow sites, and visualizing any arterial abnormalities

- Segmental pressure measurements are important in choosing the site of graft outflow

TREATMENT

**Indications for surgery:** * Gangrene Ulceration or rest pain are absolute indications

- Incapacitating claudication, provided the patient is fit for surgery is an indication as well

- Athero-embolization may be an indication in surgically fit patients.
CHOICE OF SURGICAL PROCEDURE

- Prosthetic bilateral aortoiliac reconstruction offers the most successful and durable results
- Remote procedures [extra-anatomic] are done in case of poor surgical risk or in the presence of a hostile abdomen
- Limited procedures may be employed in truly unilateral disease
FEMOROPOPLITEAL AND INFRAPOLITEAL OCCLUSIVE DISEASE

- Tolerance of ischemia is due to the redundant collateral arterial circulation.
- Moderate arterial obstruction produces no change in resting blood flow but restricts its ability to increase in response to exercise resulting in intermittent claudication.
- With progression of atherosclerotic disease perfusion decreases below the minimal metabolic requirements, at this stage ischemia produces pain in the foot and toes. [rest pain]
- Any minor traumatic lesion will not heal owing to the severe decrease in blood supply causing an ulcer.
- Further decrease in the blood supply results in spontaneous necrosis [gangrene].
PATIENT EVALUATION

- Non-invasive vascular testing should be regarded as an extension to clinical examination. Examination consists of, segmental pressure measurements, doppler arterial waveform tracings and plethysmography.
- Preoperative vascular laboratory testing is useful in evaluating the results of surgery and for the follow-up of patients thereafter.

NONOPERATIVE TREATMENT

- Consists of * Exercise, *risk factor modification and pharmacologic therapy
- **Exercise**: Walking distance improvement occurs in about 75% of patients who undergo regular exercise, not only due to opening of collateral circulation but due to better oxygen extraction by the muscle
- **Cessation of smoking**: Smokers who stop smoking have improved walking distance by at least 100-150%, the risk of amputation is eight fold decreased as well.
**PHARMACOLOGIC TREATMENT OF INFRAINGUINAL ISCHEMIA**

- **Hemorrhagic drugs:** * Reducing blood viscosity results in improvement of claudication * Increasing deformability of RBCs [6-8 micrometer] to pass through capillaries [4-5 micrometer]. Pentoxiphyllin decreases viscosity and increases deformability. [vasodilators, has no effect on atherosclerotic infrainguinal disease].

- **Metabolism-Enhancing drugs:** * Creatinine facilitates aerobic metabolism, thus, betters oxygen utilization, clinically lengthening of claudication distance is observed with creatinine administration.

- **Antiplatelet agents:** * Aspirin blocks the formation of thromboxane A2 decreasing platelet aggregation, thus decreasing graft occlusion rate and mortality rate from myocardial infarction or stroke. If there is a contraindication to aspirin administration a new antiplatelet drug [ticoplanin or ticlopidine] can be given.

**OPERATIVE TREATMENT OF INFRAINGUINAL OCCLUSIVE DISEASE**

**Indication for surgery:** * Severe symptoms including Rest pain, ischemic ulcer or gangrene [limb salvage] + ABI<0.4
  
  * Severe claudication <50 meters, interfering with the patient life style [incapacitating] + ABI<0.55

**Arteriography:** * Must be done for every patient undergoing surgical intervention high quality films showing proximal inflow and distal outflow sites & the use of reactive hyperemia techniques when necessary.

  * in the future duplex scanning and MR-angiography may replace the conventional techniques.
PRIMARY AMPUTATION

- Occasionally, patients have severe ischemia with no distal runoff on their angiograms in spite of angiographic techniques, those patients comprise only 2% of patients undergoing surgery.

VEIN BYPASS GRAFTING

- Saphenous vein bypass is the prime choice of infrainguinal grafts, bypass to foot arteries is feasible with proper surgical training.
- Both the reversed and the in-situ techniques could be used.
- For patients who have deficient saphenous vein utilization of the vein of the other side, the lesser saphenous vein or even arm veins could be used.
Complications of vein bypass grafting

- Mortality rate is 1-2% mainly from myocardial infarction and less often from stroke.
- Wound complications are common 20-30% but are usually not serious, but graft infection, 2ry hemorrhage or graft occlusion can occur.
- Long-term graft patency, 5 year patency in patients undergoing fem.-pop. Bypass is 80% while Infrapopliteal bypass have approximately 60% long term patency.

Prosthetic lower extremity bypass

- Dacron and PTFE grafts has been used for a long time for patients with infrainguinal arterial disease but with results inferior to those of vein grafts.
- Most surgeons reserve those grafts for patients in which no saphenous vein is available.
- Improvement of long term results can be achieved with administration of oral anticoagulants.
ABDOMINAL AORTIC ANEURYSMS

- Aneurysms of the abdominal aorta are common with an incidence of 30-60/1000 in the United States and is increasing due to the increasing age of the population.
- AAAs have a tendency to rupture, leading to 15,000 deaths per year in the United States.

**CLASSIFICATION:**

- An aneurysm is a localized dilatation of an artery more than double its original size.
- 95% of aneurysms are infra-renal, Thoracoabdominal aneurysms account for 2-2.5% of cases.
- Male:female ratio is 4:1.
- Associated aneurysms occur, 41% in the internal iliac & 15% in the popliteal.

**PATHOGENESIS:**

- Traditionally aneurysms are believed to be due to atherosclerosis, but cystic medial necrosis, Ehlers-Danlos syndrome, and Syphilis can be the cause.
- Alterations of elastin metabolism in the aortic wall is believed to be the underlying cause.
- Congenital deficiency of enzymes responsible for collagen cross-linking is also observed.
CLINICAL MANIFESTATIONS

- 75% OF AAAs are asymptomatic and are discovered during physical examination or during radiological imaging for other reason, the patient may complain of exaggerated abdominal pulsations.
- Symptoms of complications include pressure symptoms, distal embolization or thrombosis, rupture or leakage.
- Abrupt onset of back pain and shock is characteristic of aneurysmal leakage, aneurysmal rupture occurs in 20-25% of cases.

DIAGNOSTIC MODALITIES

- Accuracy of clinical examination ranges from 30-90% according to the built of the patient and the size of the aneurysm

**Imaging modalities:** Several modalities are available ultrasound, CT scanning and MRI.

**Ultrasound:** is cheap and available, but only useful in abdominal aneurysm diagnosis so only used in the initial evaluation

**CT Scanning:** very accurate in the diagnosis of all aneurysms, spiral CT scans allow the identification of aortic branches, contrast CT can show leakage
**MR imaging:**
- The newest imaging modality, the presence of metal objects makes imaging impossible
- More accurate in visualizing aortic branches, and does not need toxic contrast for enhancement, MR angiography is done with paramagnetic contrast agents

**Aortography:**
- Not accurate in determining the aneurysmal size, cannot diagnose aneurysms, but is useful to identify patency of aortic branches. It is indicated in:
  - Suspicion of visceral ischemia
  - Occlusion of the ilio-femoral segment.
  - Suspicion of renal artery affection [hypertension]
  - Horse shoe kidney
  - Suspicion of suprarenal extension
  - Presence of other aneurysms [fem., Pop.]
- Arteriography carries the risk of toxicity due to the injection of large amounts of contrast. Also catheters used can cause injury or thrombosis.

**ABDOMINAL AORTIC ANEURYSM REPAIR**

**Indications:**
- Suspected rupture of AAA regardless of the age or risk factors
- Elective aneurysm repair if the aneurysm is >5cm. In diameter
- Elective repair in smaller aneurysms in good risk patients
- In high operative risk patients with large aneurysms, thrombosis + extra-anatomic bypass could be done.
COMPLICATIONS OF AORTIC ANEURYSM REPAIR

- Mortality ranges from 3% in uncomplicated elective cases to 80% in shocked ruptured aneurysms, non fatal MI is also common [7%].
- Hemorrhage from iliac or renal vein injury during the operation
- Declamping hypotension especially in ruptured aneurysms
- Renal failure, may be due to suprarenal clamping, renal vasoconstriction, toxic dye administration & profound shock from ruptured aneurysm, mortality is 50-70%
- Bowel injury, or other structures adherent to the aneurysm
- Ischemic colitis 2% incidence, due to ligation of the inferior mesenteric artery in the presence of internal iliac occlusion. Manifests as bloody diarrhea after 48 hours of surgery, reoperation and resection of gangrenous bowl is mandatory. Mortality rate ranges from 50-90% according to the severity of ischemia
- Lower limb ischemia due to embolism by mural thrombus residues or thrombosis due to improper anticoagulation.
- Vascular graft sepsis, occurs in <6% of cases.
THANK YOU