Management of Atherosclerotic Disease
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Atherosclerosis

- It is a degenerative disease that causes narrowing and hardening of large and medium sized arteries.
- It is a form of arteriosclerosis.
- It is a *systemic disease*, i.e. when it starts in one artery; by default it's affecting all arteries. ☝
- It appears clinically, depending on the site, as:
  - Cerebrovascular disease.
  - Coronary artery disease.
  - Peripheral artery disease.
  - Renal vascular disease.
  - Mesentery vascular disease.
- The symptoms depend on how much the atherosclerosis is accentuated and where it appears.

Risk factors:

A. Unmodifiable risk factors:
   - Male gender.
   - Advanced age.
   - Family history.
   - Genetic abnormalities, e.g. abnormalities in cholesterol metabolism (elevated levels of LDL and depressed level of HDL).

B. Modifiable risk factors:
   1. Major:
      - Hyperlipidemia.
      - Hypertension.
      - Smoking.
      - Diabetes.
   2. Minor:
      - Homocystinemia.
      - Life style, i.e. diet and physical activity.
      - Obesity.
      - Stress (type-A personality).

Pathogenesis:

- It is an *inflammatory process*. ☝
- First, there is injury to the endothelium under the influence of risk factors that lead to endothelial dysfunction yielding increased permeability, leukocyte adhesion and thrombotic potential.
- Phagocytes and WBC's will act on the wall.
- Deposition of lipid occurs (whether the person is hyperlipidemic or not), the leukocytes will engulf the deposited lipids and be transformed to *foam cells* leading to more inflammation and recruitment of inflammatory cells.
- Platelets will be activated leading to fibrin deposition forming a complicated plaque.
- Calcium will try to contain the inflammation thereby causing calcification and hardening of the artery.

Epidemiology:

- It is the most killer disease in the world, except in some areas, like Africa, with infections as the predominant problem.
- It's responsible for a *quarter* of the deaths in the world, either in the form of MI, stroke, renal vascular disease, mesenteric ischemia or any other complications.

Peripheral Arterial Disease (PAD)

- It's an occlusion or stenosis of the arteries of the lower extremities.
- It is a good *marker* to identify systemic atherosclerosis. ☝
- Usually affects lower limb arteries more than others.
- PAD could co-exist with other diseases, such as:
  - Coronary artery disease in 35-92% of patients.
  - Cerebral vascular disease in 50% of patients.
  - Death from other causes such as cancer or infection in 20% of patients.
- A patient with PAD has a *6 fold increased risk of death* compared to a patient without the disease. ☝

Epidemiology:

- The risk of dying is 7% per year.
- About 2% will have MI per year.
- About 1% needs intervention in their lower limbs to improve circulation.
- 0.4% will lose their limb per year.

Clinical features:

- All patients will present the same way.
- Symptoms are related to decrease in the blood supply:
  - Intermittent claudication: when the blood supply is not enough to meet the demands of the muscle *at exertion* (like stable angina in the heart).
  - Pain at rest: when the blood supply is not enough to meet the muscle demand *at rest* (like unstable angina in the heart).
  - Tissue loss (gangrene): when the blood supply is not enough to supply the muscle to the degree where it causes ischemia and tissue necrosis (like MI).

NOTE:

- *Critical limb ischemia is a term referring to pain at rest and tissue loss in a limb (just as ACS refers to unstable angina and MI in the heart).*
- *First sign: localized redness in the foot (not as inflammatory redness, because it's caused by cutaneous capillary vasodilatation which is a compensatory mechanism to the decreased blood supply to the limb).*

Diagnosis:

- History:
  - History of related symptoms.
  - History of risk factors symptoms.
- Physical examination.

Investigations:

- Non invasive:
  - Duplex.
  - MRI.
  - CT scan.
- Invasive:
  - Angiogram (gold standard).
- Ankle brachial index (ABI):
  - It's the ratio between the ankle pressure and the systolic pressure in the brachial artery.
  - We obtain the ankle pressure either from the posterior tibial artery or dorsalis pedis artery.
  - By this manner we can detect the disease in asymptomatic people.

NOTE

- *Only 10% of people are symptomatic.*
- *At calculation, which ever pressure is highest of the two (posterior tibial, dorsalis pedis) is considered to be the ankle pressure.*

- We can measure it by the formula:

$$\frac{\text{Ankle pressure (the highest of the two)}}{\text{Brachial pressure}}$$

- If the ratio is *less than 0.9*, it's PAD. ☝

Treatment:

- Goals:
  - Relieve the symptoms.
  - Improve quality of life.
  - Limb salvage.
  - Prolong survival.

- Strategies:
  A. Aggressive control of the risk factors by:
     - Diet and weight control.
     - Exercise.
     - Anti-platelets to prevent thrombosis.
     - Control blood pressure.
     - Control blood glucose.
     - Control lipid.
     - Smoking cessation.

  B. Improve the circulation by:
     1. Conservative management, i.e. exercise program, which works by two mechanisms:
        a. Natural bypass:
           - When the patient exercises, he/she increases the demand on the muscle, consequently leading to angiogenesis activation improving the circulation.
        b. Adaptation of the nerve:
           - If the patient adapts the muscle to the anaerobic environment by exercise; nerve endings will start adapting to lactate (which causes pain by irritating nerve endings) then consequently, perception to pain will be decreased, although lactate production may not have changed.
     2. Revascularization:
        - Inside the artery (intraluminal), e.g. angioplasty (stenting).
        - Bypass the lesion (bypass surgery).

  NOTE
        - *Angioplasty (stent) vs. bypass; indication depends on several factors, including:*
          a. *Disease factors; whether the disease will respond better to one over the other, or the risk of disease worsening is higher with one over the other…etc.*
          b. *Patient factors, e.g. age.*
          c. *Resources; depending on whether the right equipment or resources are present or not.*

  C. Amputation:
     - Last resort treatment in these cases.
     - Classification:
       - Primary; when amputation is done *without* an attempt to treat the problem with surgery (bypass, angioplasty).
       - Secondary; when amputation is done *after* an attempt to treat the problem with surgery.
     - There are two kinds of amputation; major and minor:
       - Major: when amputation affects the quality of life, e.g. above knee amputation (AKA) and below knee amputation (BKA).
       - Minor: when amputation has no affect on the quality of life, e.g. toe amputation.

Carotid Artery Disease

- It may lead to stroke, which is the *3rd cause of death*.

Present symptoms:

- Transient ischemic attack (TIA):
  - It's a brief episode of hemiparesis (weakness), paraesthesia (loss of sensation; numbness) or hemiplegia *in one half of the body* (in the contralateral side of the affected carotid) which lasts less than 24 hours (usually 5-15 minutes) and then recovers completely.
  - If lasts more than 24 hours we call it stroke.
  - It's caused by emboli (which come from the carotid arteries, heart valves and the great vessels) or hypoperfusion.
- Amaurosis fugax (transient loss of vision or fleeting blindness):
  - Caused by retinal emboli.
  - O*ccurs in one eye*, *ipsilateral* to the affected carotid.
  - To the patient, it seems like a curtain coming across the visual field or grey veil blocking out all or part of the vision in one eye.

Diagnosis:

- By usual investigations:
  - Duplex.
  - CT scan.
  - MRI.
  - Angiogram: rarely used, because it carries a 1% risk of stroke.
- Hearing carotid bruit:
  - It's the most important clinical diagnosis.
  - 50% of carotid stenoses can be picked-up by auscultation (bruit).

NOTE:

- *Severe internal carotid artery stenosis can be present without any bruit, and a loud bruit can be caused by a stenosis of the external carotid artery.*
- *Almost always, the blood demand of the brain is the same, even during sleep.*

Treatment:

- Goals:
  - Relieve the symptoms.
  - Improve quality of life.
  - Prolong survival.
- Strategies:
  A. Control the risk factors (same as in PAD treatment).
  B. Improve the circulation by revascularization, achieved by:
    - Surgery (endarterectomy):
      - *Gold standard.* ☝
      - Done y exposing the artery and removing the plaque then patching the area occupied by it.
      - Also done in asymptomatic individuals with more than 60% occlusion of the carotid by atheroma.
    - Transluminal angioplasty:
      - *Rarely* done.
      - It carries a risk of stroke.

NOTE:

- *There is no conservative treatment for stroke.*

Acute Limb Ischemia

- It is sudden decrease or interruption of the blood supply of a limb that leads to a *sudden onset of ischemic symptoms* (no time for collaterals to form)

Causes:

- Embolus, the most common.
  - 80% of the emboli are cardiac in origin, or it may come from an aneurysm or atherosclerotic plaque. ☝
  - Usually lodges at sites of bifurcation (most commonly the femoral artery). ☝
- Thrombus.
- Trauma.
- Iatrogenic.

Clinical presentation:

- 6 P's: ☝
  - Pain (mainly unilateral).
  - Paresthesia (the first to appear).
  - Pallor.
  - Poikilothermia (coldness).
  - Pulselessness.
  - Paralysis.
- Pulselessness and paralysis are late signs, and if they appear, it's unlikely to save the limb.
- The commonest presentation of acute limb ischemia is MI.

Investigations:

- *No investigations are done* in a case of acute limb ischemia, because *it is an emergency case*.☝
- It's a clinical diagnosis.

Treatment:

- Goals:
  - Rapid restoration of blood in order to save the limb, but not on the expense of life.
- Strategies:
  - ABC's.
  - Heparin; to prevent further propagation of the thrombus.
  - We don't do thrombolysis. ☝
  - Rapid surgical restoration (revascularization); thrombectomy.

- Complication of revascularization:
  - It may cause reperfusion injury, that has two effects:
    a. Local effect: it causes compartment syndrome (that's why we always do fasciotomy with thrombectomy as prophylactic).
    b. Systemic effect: when the muscle cells are under ischemia, a lot of cells will die, and when they are reperfused after thrombectomy they will release their material into the circulation, e.g. K^+ and myoglobulin, that will cause cardiac arrest (K^+ effect) and plugging of renal tubules leading to acute renal failure (myoglobulin effect).

NOTE:

- *The golden time of ischemic limb is 6 hours from onset of the symptoms.*
- *The golden time of the brain is 3 minutes, for kidney 30 minutes, for mesentery 1 hour and for heart is 5 minutes.*

For extra reading
Lawrence's Essential of general surgery
Chapter 23 442 – 460

Browse's Introduction to the Symptoms and Signs of Surgical Disease
Chapter 7
175-196

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