Pulmonary Embolism

- Pulmonary embolism (PE) is the third most common cause of cardiovascular death after acute myocardial infarction and stroke.

- As well as leading to PE, deep vein thrombosis (DVT) frequently results in the post-thrombotic syndrome, which is a major cause of long-term disability.

Pathophysiology of thrombosis

- Thrombosis is the pathological process by which a localized solid mass of blood constituents (a blood clot or ***thrombus***) forms within a blood vessel, mostly as a result of fibrin formation with a variable contribution from platelets and other cells.

- This differentiates it from physiological haemostasis, the process in which a fibrin-rich blood clot occurs outside the vessel-wall lining (or endothelium) as a result of injury. Thrombi form on, and are attached to, the vessel wall but fragments (***emboli***) may break off and occlude vessels downstream.

- Thrombosis is considered to arise from the interplay between the three factors that make up Virchow's triad:
    1. changes in blood flow (stasis or turbulence)
    2. vessel wall dysfunction
    3. changes in blood components, leading to hypercoagulability.

- Most often, venous thrombosis originates in the deep veins of the leg: hence the term ***deep vein thrombosis***.

- The thrombus may remain localized to the leg veins or may embolize through the circulation to result in a **pulmonary embolus**

Risk factors

- ***Transient risk factors***

Surgery, especially major, lower limb/pelvis or cancer-related

Trauma, especially lower limb/pelvis

Active cancer

Acute medical admission

Immobilization (bed rest >3 days) ,Plaster cast

Pregnancy/puerperium

Oestrogen administration (combined hormonal contraception, oral hormone therapy)

Recent long-haul travel (>4 h)

Central venous catheter

Superficial vein thrombosis

Risk factors

- ***Persistent risk factors***

Increasing age

Body mass index >30 kg/m2

Ethnicity

Previous episode of venous thromboembolism

Inflammatory conditions, e.g. inflammatory bowel disease, systemic lupus erythematosus, Behçet's syndrome

Nephrotic syndrome

Lower limb paresis, e.g. after stroke

Heritable thrombophilia (factor V Leiden, prothrombin gene mutation, deficiencies of antithrombin, protein C or protein S)

Antiphospholipid syndrome

Myeloproliferative neoplasms

Risk factors

- ***Strong risk factors*** increase the risk 10–50-fold and include major surgery, trauma and absolute bed rest.

- ***Moderate risk factors*** increase the risk 3–10-fold and include pregnancy, oestrogen therapy, and minor surgery under general anaesthesia.

- ***Weak risk factors*** increase the risk up to 3-fold and include obesity and long-haul travel. For reasons that are not yet evident, the incidence of VTE is highest in people of African descent, intermediate in white people and lowest in Asians.

Clinical features

- Small emboli may be asymptomatic, whereas large emboli are often fatal.

- *Symptoms:* Acute breathlessness, pleuritic chest pain, haemoptysis; dizziness; syncope. Ask about risk factors, past history or family history of thromboembolism.

Clinical features

- *Signs:* Pyrexia; cyanosis; tachypnoea; tachycardia; hypotension; raised JVP; pleural rub; pleural effusion. Look for signs of a cause, eg deep vein thrombosis.

Investigations

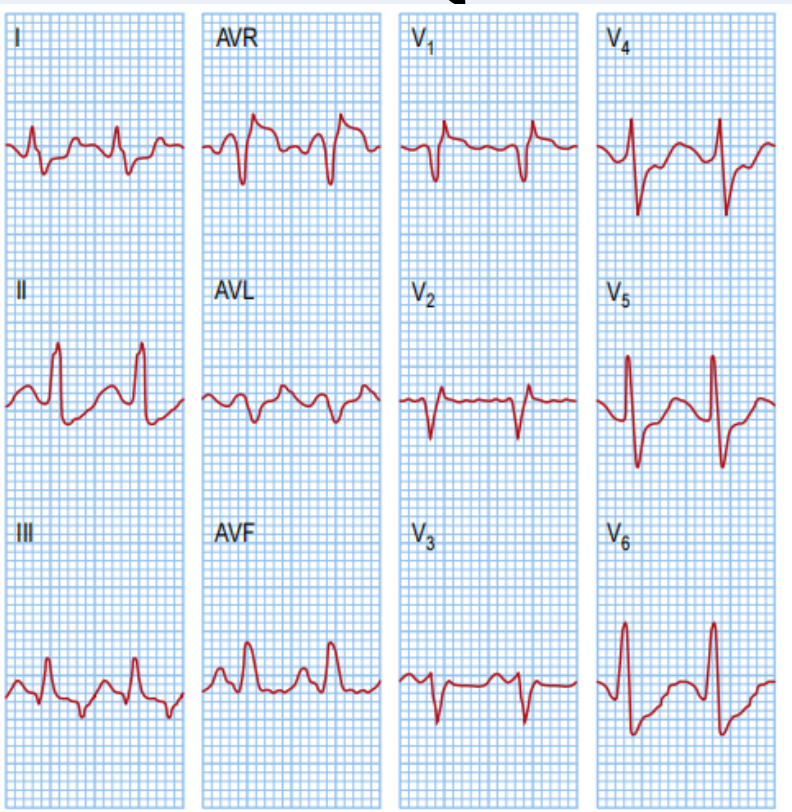
- FBC, U&E, baseline clotting, D-dimers .

- ABG may show low *P*aO2 and low *P*aCO2.

- Imaging: CXR may be normal, or show oligaemia of affected segment, dilated pulmonary artery, linear atelectasis, small pleural effusion, wedge-shaped opacities or cavitation (rare).

Investigations

- ECG may be normal, or show tachycardia, right bundle branch block, right ventricular strain (inverted T in V1 to V4). The classical **S**I **Q**III **T**III pattern is rare.



Treatment

- If haemodynamically unstable, thrombolyse for massive PE (alteplase 10mg IV over 1min, then 90mg IVI over 2h; max 1 . 5mg/kg if <65kg).

- Haemodynamically stable: start LMWH or unfractionated heparin if underlying renal impairment and treat for 5 days. Then, start DOAC (direct oral anticoagulant) or warfarin .

Treatment

- For warfarin, stop heparin when INR is 2–3, due to intial prothrombotic effect of warfarin (target INR of 2–3).

- Consider placement of a *vena caval filter* if contra-indication to anticoagulation.

Treatment

- **Unprovoked PE** In patients with no known provoking risk factors, consider investigation for possible underlying malignancy.

- Undertake full history, examination (including breast), CXR, FBC, calcium, Liver function tests, urinalysis.

Treatment

- Patients >40yrs consider abdo-pelvic CT and mammography in women.

- Consider antiphospholipid and thrombophilia testing if family history positive

Prevention

- Give heparin to all immobile patients.
- Stop HRT and the combined contraceptive pill pre-op (if reliable with another form of contraception).
- early mobilization

Prevention

- elevation of the legs

- use of anti-embolic stockings of knee or thigh length; these should not be used in peripheral arterial disease, stroke or situations where they could result in skin damage.

Prevention

- intermittent compression devices that can be applied to patients

- during surgery or on bed rest and aim to improve blood flow.