

Medicine for Managers

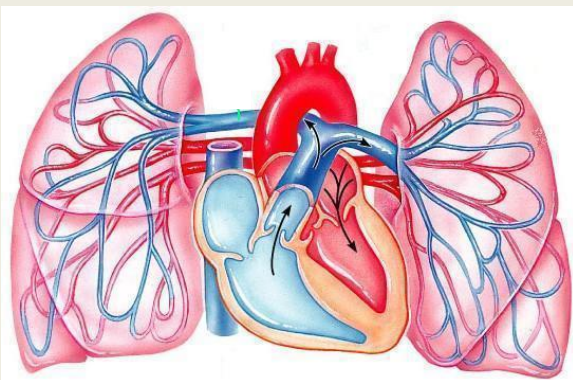
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Pulmonary Embolism

Pulmonary embolism is a potentially life-threatening disorder which occurs when an obstruction, usually a blood clot, becomes lodged in the pulmonary arterial system, reducing or obstructing the flow of blood to the lungs. Even the term sounds sinister. It may be precipitated by particular events or interventions or may occur without any obvious risk factor.

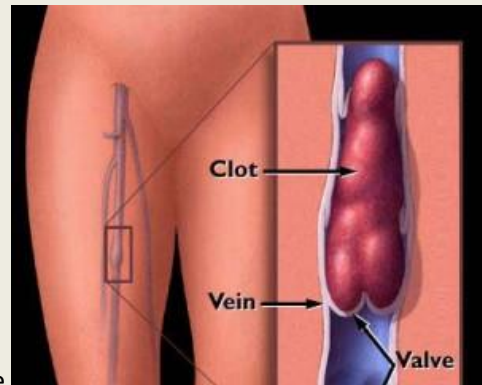
Blood passes from the **right ventricle**, through the **pulmonary artery** and the vessel divides into **right** and **left pulmonary arteries** where under normal circumstances they carry deoxygenated blood to the lungs to become oxygenated before the blood returns to the left side of the heart for pumping into the general circulation.



[Many of you will remember that arteries carry oxygenated blood and veins carry deoxygenated blood. The pulmonary system is different. The pulmonary arteries carry deoxygenated blood. It is easier to remember that arteries carry blood away from the heart, veins carry blood towards the heart]

So, why does a blood clot form in the blood stream and end up in the lungs. It often starts in the deep veins of the legs.

A clot forms and, as it gets larger, a piece may break off.



The unattached clot passes through the veins towards the heart. It does not get stuck because the veins are getting larger as they collect more blood and get closer to the heart.

The clot passes from the great vein into the heart through which it travels unimpeded. It then enters the trunk of the pulmonary artery .

A large clot may obstruct at the point where the pulmonary artery divides into right and left (a

so-called saddle embolus) or it may pass into one artery, either the right or the left, and obstruct at some point as the artery splits into its constituent branches.

Under normal circumstances, the circulation is moving through the vessels, which are smooth and undamaged. There is therefore no reason why the blood should start to clot within the vessels (so called *intra-vascular clotting*).

However if a patient, often elderly, is immobilised for a prolonged period through illness or infirmity, the blood slows and may stop in the veins of the calf, allowing clotting to start.

If the individual has surgery, experiences a traumatic injury or is pregnant, the risk, again the blood may thicken because of blood loss and the associated immobility of recovery may lead to clotting.

Other factors leading to clotting may include:

- Age above sixty
- A past history of blood clot
- Overweight or obesity
- Smoking
- The combined oral contraceptive pill
- Hormone replacement therapy

The hormonal effect on clotting may be significant although, with no other risk factors, the risk is small

- Active cancer, most commonly from breast or prostate.
- An excess of some types of blood cells such as *thrombocytes* (which promote clotting) – condition is called *thrombophilia*.
- Heart failure
- Sepsis

The consequence of a pulmonary embolism is that the heart is ventilated (that is oxygen enters the lungs) but is not perfused effectively (that is blood flow is reduced to one or both lungs and the degree to which the flow is reduced depends on the degree of obstruction which in turn depends on the calibre of the vessel(s) that are blocked.

If the clot blocks the main pulmonary arterial trunk or at its bifurcation, death is pretty-much instantaneous and the patient effectively dies of oxygen deprivation and complete failure of the right side of the heart.

If the obstruction is only partial, the patient will develop symptoms which will include:

- Chest pain, which may be worse on breathing in (inspiration)
- Cough, usually dry but there may be coughing of dark blood
- Breathlessness (tachypnoea)
- Faintness, dizziness or loss of consciousness.

Breathlessness, rapid breathing, pleuritic chest pain and signs of a deep vein thrombosis are present in 97% of patients with a pulmonary embolus.

The incidence of pulmonary embolism is reported as about 3-4/10,000 people per year. Some studies in other parts of the world suggest that the true figure may be severalfold higher.

The reason for the discrepancy is the way in which the diagnosis is made. When diagnosis is based on clinical findings, the diagnosis is made too infrequently because pulmonary embolism is thought not to be considered in as many as

half of deaths. If based on post-mortem findings, it may be over-estimated because some pulmonary emboli are clinically insignificant and do not contribute to death. The diagnosis of pulmonary embolism appears on about 13,000 death certificates a year.

Making the diagnosis may sometimes be difficult. It is estimated that about half of all people who develop a pulmonary embolism do so whilst they are an in-patient. This is because there is usually an accumulation of risk factors, such as age, immobility and illness.

Most of the emboli start with the blood clot in the leg and it is not diagnosed as frequently as it should be. Although it may not cause any symptoms, more commonly the leg (usually the calf) is swollen



and tender. The affected area aches and may feel warm and the skin overlying the clot may appear reddened. The problem usually affects only one leg. The pain is exacerbated if the foot is flexed (i.e. drawn up towards the knee).

Diagnosis may be suspected following a detailed examination but may be confirmed using tests:

- Chest X-ray
- Blood test. Some years ago, the diagnosis of deep vein thrombosis was made by injecting dye into a vein in the foot. If a thrombosis was present in the leg the dye would outline the clot. It was not always reliable and required organisation with radiology facilities and a radiologist to carry out and review the procedure. Nowadays, it has been replaced with a **D-dimer** blood test. D-dimer is a protein found in blood when a blood clot breaks down. If the result is high it suggests the presence of blood clot within the circulation.
- CT scanning. Used to view the chest in association with the injection of a radio-opaque dye to outline the blood vessels in the lungs, it may be used to identify any obstruction to blood flow caused by clot.
- Ventilation-Perfusion scan. To recap, a pulmonary embolism reduces perfusion (blood flow for gas exchange) but does not impair ventilation (oxygen entry into the lungs) to the same degree. Patients inhale radioactive gas and are injected with radio-opaque dye. A scan of the lungs then shows the relationship between air entry and blood exchange.

The mainstay of treatment of a PE is with anti-coagulant drugs, which prevent the clot from continuing to enlarge and which gradually absorb it. Occasionally the clot must be removed with surgery.

If a pulmonary embolism is suspected initial treatment is with **heparin** which is given by

injection and which is immediately effective in producing an anti-coagulant effect. The injections are given regularly for a few days whilst the longer-acting oral anticoagulants are prescribed or adjusted.

Warfarin has been a treatment of choice for many years. It takes 2-3 days to become fully active and the dose is adjusted according to the degree by which the clotting time has been prolonged.

For those patients taking warfarin a regular blood test is required to monitor the drug. If the clotting time is prolonged too much, the risk of unwanted bleeding in locations such as the bowel or bladder is increased.

Warfarin is usually prescribed as a three month course following diagnosis of a DVT or six months for a PE but may be required for life-long therapy in patients with a recurrence risk.

More recently, other oral agents such as **rivaroxaban**, **dabigatran** and **apixaban** have been introduced. The drugs have fewer side-effects and require less monitoring than warfarin.

Sometimes it is necessary to remove the blockage more definitively than using an anti-coagulant drug. It may be done in one of three ways:

- The use of a drug called a **thrombolytic** to break up the clot. Such drugs have been graphically described in popular media as 'clot busters'.
- The introduction of a catheter which is passed through the blood vessel tree to the site of the clot where high-frequency ultrasound waves combined

with some thrombolytic medication are used to break down the obstruction.

- Rarely, a surgical procedure called an **embolectomy** is undertaken where the pulmonary artery is opened and the clot is removed. This is a major surgical procedure with a high mortality and is usually a last resort approach.

If a patient is successfully treated for a pulmonary embolism, the risk of a recurrence is increased and the patient must take steps to reduce the risk wherever possible:

- Stop smoking
- Exercise for several hours a week
- Reduce weight if overweight or obese
- Have a healthy diet.

It may be necessary to continue with anticoagulant drugs if the risk is deemed sufficiently high.

- Prolonged immobility should be avoided, with particular attention to long flights or drives. In such circumstances it is important to stop regularly and to move about, exercising the legs to stimulate blood flow. Compression stockings may also be an important aid. They are used when a patient is in hospital and after returning home. The stockings fit tightly around the leg and, by compression of the lower leg muscles, encourage the blood to return to the heart.

The **British Thoracic Society** publishes information and guidance and can be contacted as follows:

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