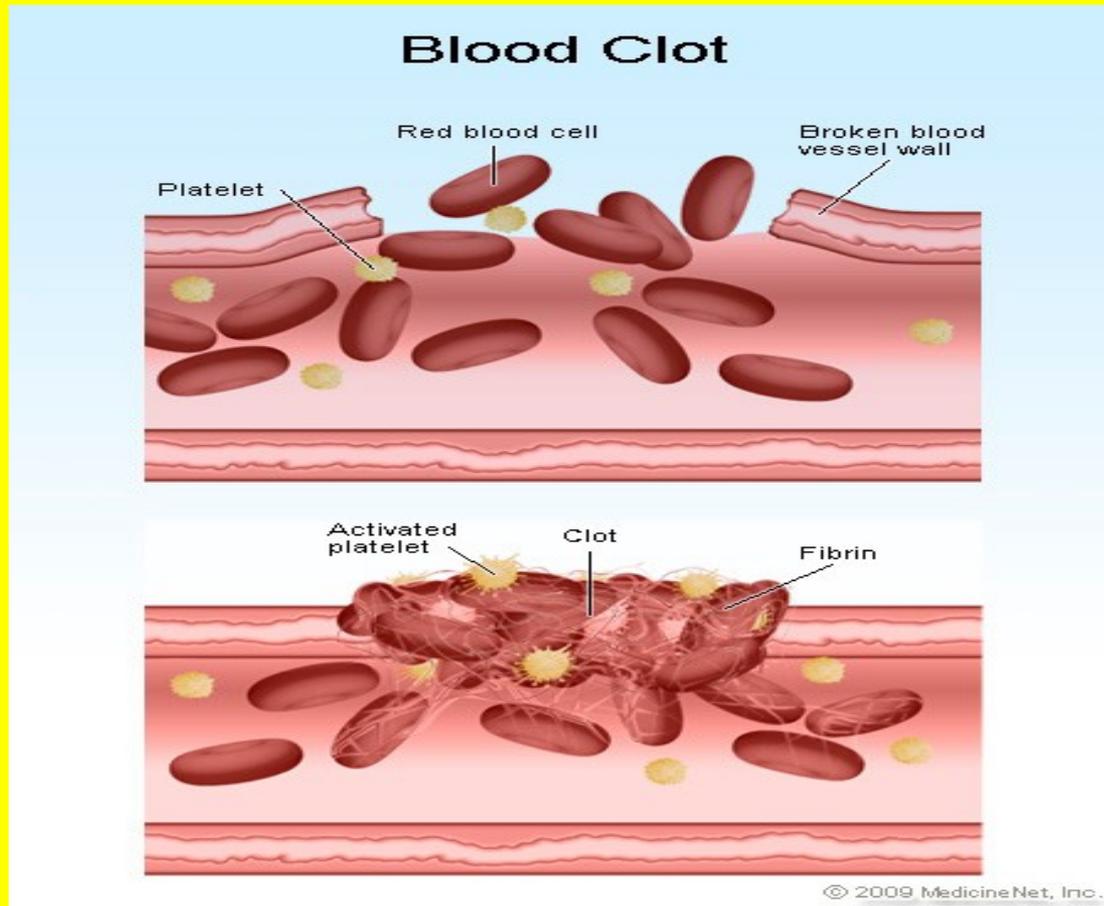


Deep vein Thrombosis and Pulmonary Embolism



- **Deep Vein Thrombosis (DVT)**

- **Definition**

Deep vein thrombosis (DVT) is a blood clot in a leg vein. The common cause is immobility. A complication occurs in some cases where part of the blood clot breaks off and travels to the lung (pulmonary embolus).

- **Pathology**

A deep vein thrombosis (DVT) is a blood clot that forms in a deep leg vein. These are blood vessels which go through the muscles (they are not the veins which you can see just below the skin). A calf vein is the common site for a DVT. A thigh vein is less commonly affected.

- **Why do blood clots form in leg veins?**

- Blood normally flows quickly through veins, and does not usually clot. Sometimes a DVT occurs for no apparent reason. However, the following increase the risk of having a DVT.

- **Immobility** which causes blood flow in the veins to be slow. Slow flowing blood is more likely to clot than normal flowing blood.
- **A surgical operation which lasts more than 30 minutes** is the most common cause of a DVT. The legs become still when you are under anaesthetic. Blood flow in the leg veins can become very slow.
- **Any illness or injury that causes immobility** increases the risk of a DVT.
- **Long journeys by plane, train, etc** are thought to cause a slightly increased risk of DVT. This is probably due to sitting cramped for long periods.
- **Faulty blood clotting** is an uncommon cause. One example is an inherited condition that causes the blood to clot more easily than normal (factor V leiden).
- **The contraceptive pill and hormone replacement therapy (HRT)** which contain oestrogen can cause the blood to clot slightly more easily. Women taking 'the pill' or 'HRT' have a small increased risk of DVT.
- **Damage to the inside lining of the vein** increases the risk of a blood clot forming. For example, a DVT may damage the lining of the vein. So, if you have already had a DVT, then you have a higher than average risk of having another one sometime in the future.
- **Older people** are more likely to have a DVT, particularly if you have poor mobility or have a serious illness such as cancer.
- **Pregnancy** increases the risk. About 1 in 1000 pregnant women have a DVT.
- **Obesity** also increases the risk of having a DVT.

- **What are the symptoms of a deep vein thrombosis?**
- The typical symptoms are pain, tenderness, and swelling of the calf. Blood that would normally go through the blocked vein is diverted to outer veins. The calf may then become warm and red. Sometimes there are no symptoms, and a DVT is only diagnosed if a complication occurs (see below).
- Sometimes it is difficult for a doctor to be sure of the diagnosis as there are other causes of a painful and swollen calf. For example, a muscle strain or infection. You will normally be seen urgently at hospital if you have a suspected DVT. Tests may be done to confirm the diagnosis.

- **Is a deep vein thrombosis serious?**
- When a blood clot forms in a leg vein it usually remains stuck to the vein wall. The symptoms tend to settle gradually. But, there are two main possible complications:
- Pulmonary embolus (a blood clot which travels to the lung).
- Post thrombotic syndrome (persistent calf symptoms).

- **Pulmonary embolus**

In a small number of people who have a DVT, a part of the blood clot 'breaks off'. This travels in the bloodstream and is called an embolus. An embolus will travel in the bloodstream until it becomes stuck. An embolus that comes from a clot in a leg vein will be carried up the larger leg veins to the heart, through the large heart chambers, but will get stuck in a blood vessel going to a lung. This is called a pulmonary embolus. A small pulmonary embolus may not cause any symptoms. A medium sized pulmonary embolus can cause breathing problems and chest pain. A large pulmonary embolus can cause collapse and sudden death.

- **Treatment:**
The aims of treatment are:
- To prevent the clot spreading up the vein and getting larger. This prevents the possibility of a large embolus breaking off and travelling to the lungs.
- To reduce the risk of post-thrombotic syndrome developing.
- To prevent a further DVT in the future.
- **Anticoagulation - preventing the clot from getting bigger**
Anticoagulation is often called 'thinning the blood'. However, it does not actually thin the blood. It alters certain chemicals in the blood to stop clots forming so easily. This prevents a DVT from getting bigger, and prevents any new clots from forming. Warfarin is the usual anticoagulant. However, it takes a few days for warfarin tablets to work fully. So, heparin injections are often used in the first few days for immediate effect. A serious embolus is rare if you start anticoagulation treatment early after a DVT.
- The aim is to get the dose of warfarin just right so the blood will not clot easily, but not too much which may cause bleeding problems. You will need regular blood tests whilst you take warfarin. You need them quite often at first, but then less frequently once the correct dose is found. (If you are pregnant, regular heparin injections rather than warfarin tablets may be used.)

- **Compression and raising the leg - to prevent post-thrombotic syndrome**
If the DVT was in a thigh vein, you may be advised to wear a compression stocking. With this treatment the risk of developing post-thrombotic syndrome is much reduced. You should wear the stocking each day, for at least 2 years. (Symptoms of post-thrombotic syndrome may develop even several months after a DVT, which is why you should wear the stocking long-term.)
- The slight pressure from the stocking helps to prevent fluid seeping into the calf tissues from the outer veins which carry the extra diverted blood following a DVT. The stocking also reduces, and may prevent, calf swelling. This in turn reduces discomfort and the risk of skin ulcers forming.
- If you are advised to wear a compression stocking, you should put it on each day whilst lying in bed before getting up. Wear it for the whole day until you go to bed, or until you rest in the evening with the leg raised. Take the stocking off before going to bed.
- In addition, the following are also commonly advised.
- Raise your leg when you are resting. This too reduces the pressure in the calf veins, and helps to prevent blood and fluid from 'pooling' in the calves. 'Raised' means that your foot is higher than your hip so gravity helps with blood flow returning from the calf. The easiest way to raise your leg is to recline on a sofa with your leg up on a cushion.
- Raise the foot of the bed a few inches if it is comfortable to sleep like this. This is so your foot and calf are slightly higher than your hip when you are asleep.

- **Preventing a first DVT - or a recurrence of a DVT**
A DVT is often a 'one-off' event after a major operation. In this situation you will normally be advised to stop taking warfarin after a few months. Some people have an ongoing risk of a further DVT. For example, if you have a blood clotting problem, or continued immobility. You may then be advised to continue taking warfarin long-term.
- Other things that may help to prevent a first or recurrent DVT include the following.
- If possible, avoid long periods of immobility such as sitting in a chair for many hours. If you are able, get up and walk around now and then. A daily brisk walk for 30-60 minutes is even better if you can do this. The aim is to stop the blood 'pooling', and to get the circulation in the legs moving. Regular exercise of the calf muscles also helps. You can do some calf exercises even when you are sitting.
- Major surgical operations are known to be a risk for a DVT - particularly operations to the hip, lower abdomen, and leg. You may be given aspirin or heparin just before having an operation to help prevent a DVT. An inflatable sleeve connected to a pump to compress the legs during a long operation may also be used. It is also common practice to get you up and walking as soon as possible after an operation.
- When you travel on long plane journeys, train journeys, etc, you should have little walks up and down the aisle every now and then. Also, exercise your calf muscles every now and then whilst sitting in your seat. A separate leaflet called 'Preventing DVT When You Travel' gives more details.

- **In summary**
- The main cause of DVT is immobility - especially during surgery.
- The most serious complication of DVT is a pulmonary embolus where part of the blood clot breaks off and travels to the lung.
- Persistent calf symptoms may occur after a DVT.
- With treatment, the risk of the above two complications is much reduced.
- Treatment includes anticoagulation, compression stockings, leg elevation, and keeping active.
- Prevention is important if you have an increased risk of DVT. For example, during long operations or when you travel on long journeys.

- **Pulmonary Embolism**

Seen in the pulmonary artery to the left lung on cut section is a **large pulmonary thromboembolus.**

Such thromboemboli typically originate in the leg veins or pelvic veins of persons who are immobilized.

Other contributing factors include trauma to the extremities, hypercoagulable states patients with carcinomas; protein C or S deficiency; use of oral contraceptives), heart failure, pregnancy, and older age.



**pulmonary
thromboembolus.**

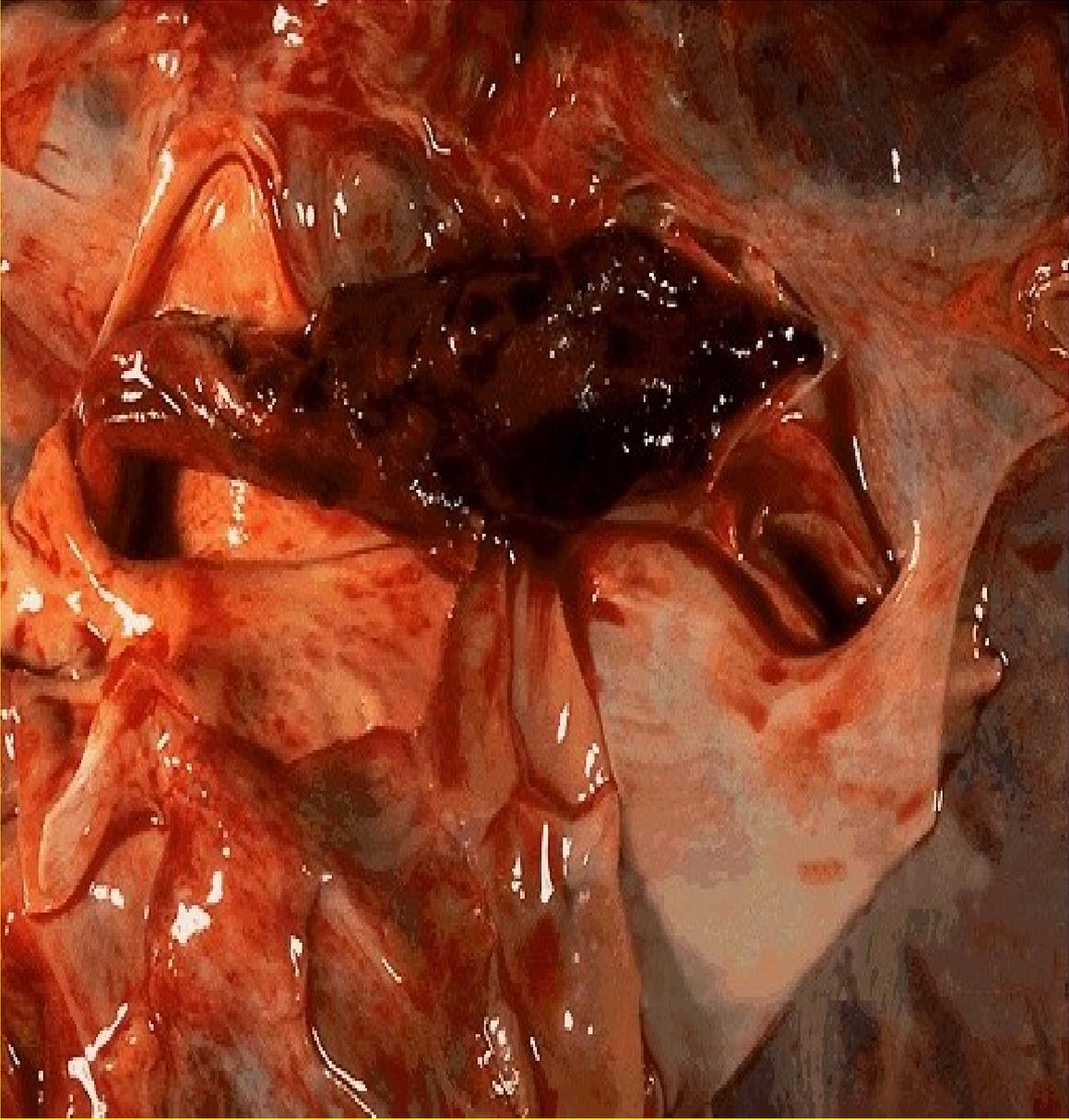
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HUPH Anatomic Path



Here is a "saddle embolus" that bridges across the pulmonary artery from the heart as it divides into right and left main pulmonary arteries. Such a saddle embolus is a cause for sudden death. This thromboembolus displays the typical gross appearance.

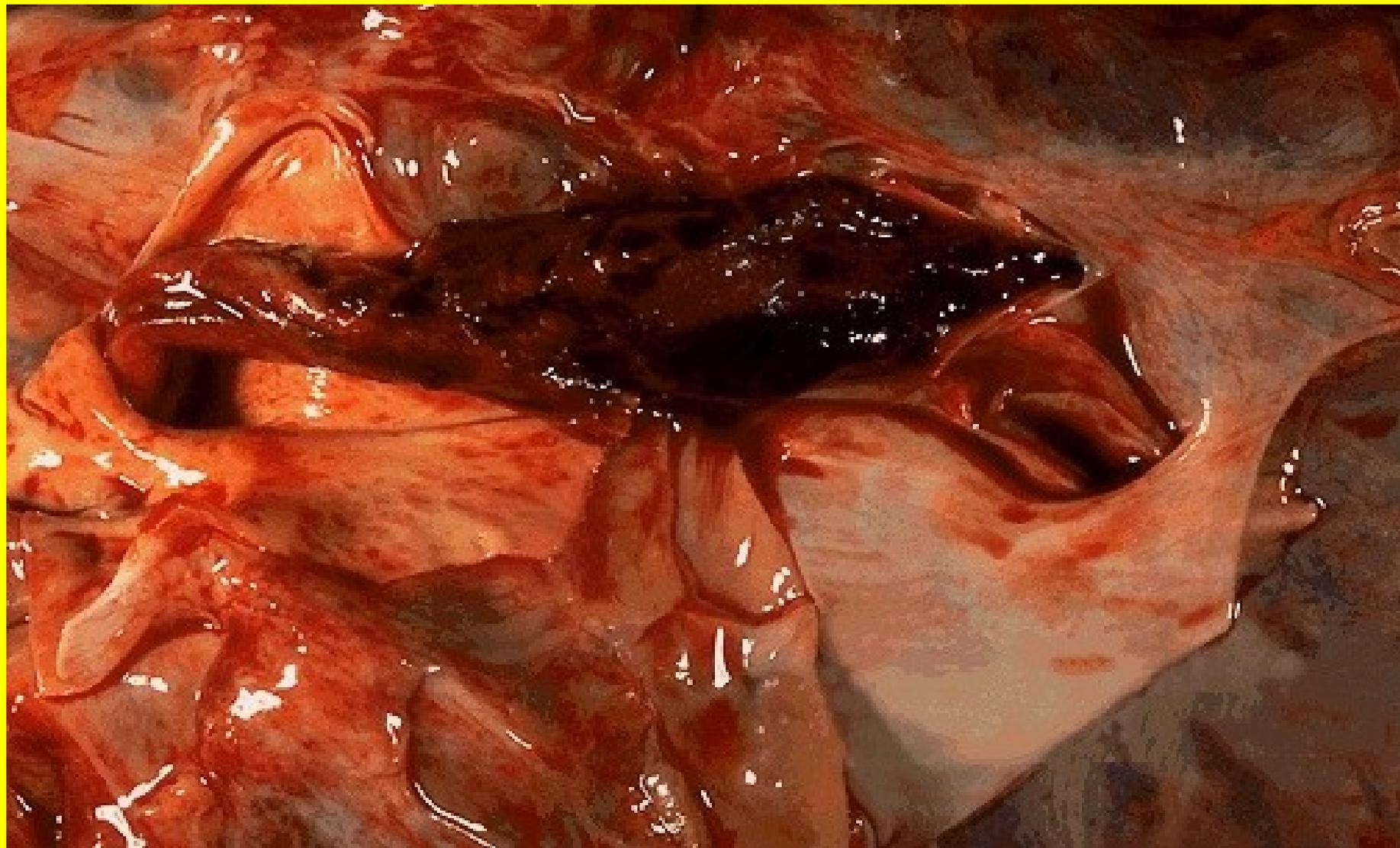
The surface is somewhat irregular, and there are areas of pale tan to white admixed with dark red areas. The thrombus often has the outlines of the vein in which it

formed.



The main pulmonary trunk and pulmonary arteries to the right and to the left lung are seen here opened to reveal a large "saddle" pulmonary thromboembolus.

Patients with such an embolus will have a high mortality rate.



- Large thromboemboli can cause death. Medium sized thromboemboli (blocking a pulmonary artery to a lobule or set of lobules) can produce the lesion seen here--a hemorrhagic pulmonary infarction, because the patient survives. The infarct is wedge-shaped and based on the pleura. These infarcts are hemorrhagic because, though the pulmonary artery carrying most of the blood and oxygen is cut off, the bronchial arteries from the systemic circulation (supplying about 1% of the blood to the lungs) is not cut off



- Occlusion of main pulmonary arteries can kill the patient suddenly.
- Occlusion of small pulmonary arteries has no major immediate effect.
- Occlusion of a medium-sized branch of pulmonary artery can lead to a pulmonary infarction in a person with compromised cardiac or respiratory status.
- A pulmonary infarct is hemorrhagic because of the dual blood supply: some blood still flows from the non-occluded bronchial arteries which mainly supply blood to interstitium, but do not prevent the infarction.

- Here is a larger area of infarction produced by a medium-sized thromboembolus to the lung. This infarction has begun to organize at the margins. It is also possible to have multiple small pulmonary thromboemboli that do not cause sudden death and do not occlude a large enough branch of pulmonary artery to cause infarction. However, if there are lots of small emboli, particularly if they are showered to the lungs over a period of time, then they collectively may block enough small arteries to produce pulmonary hypertension

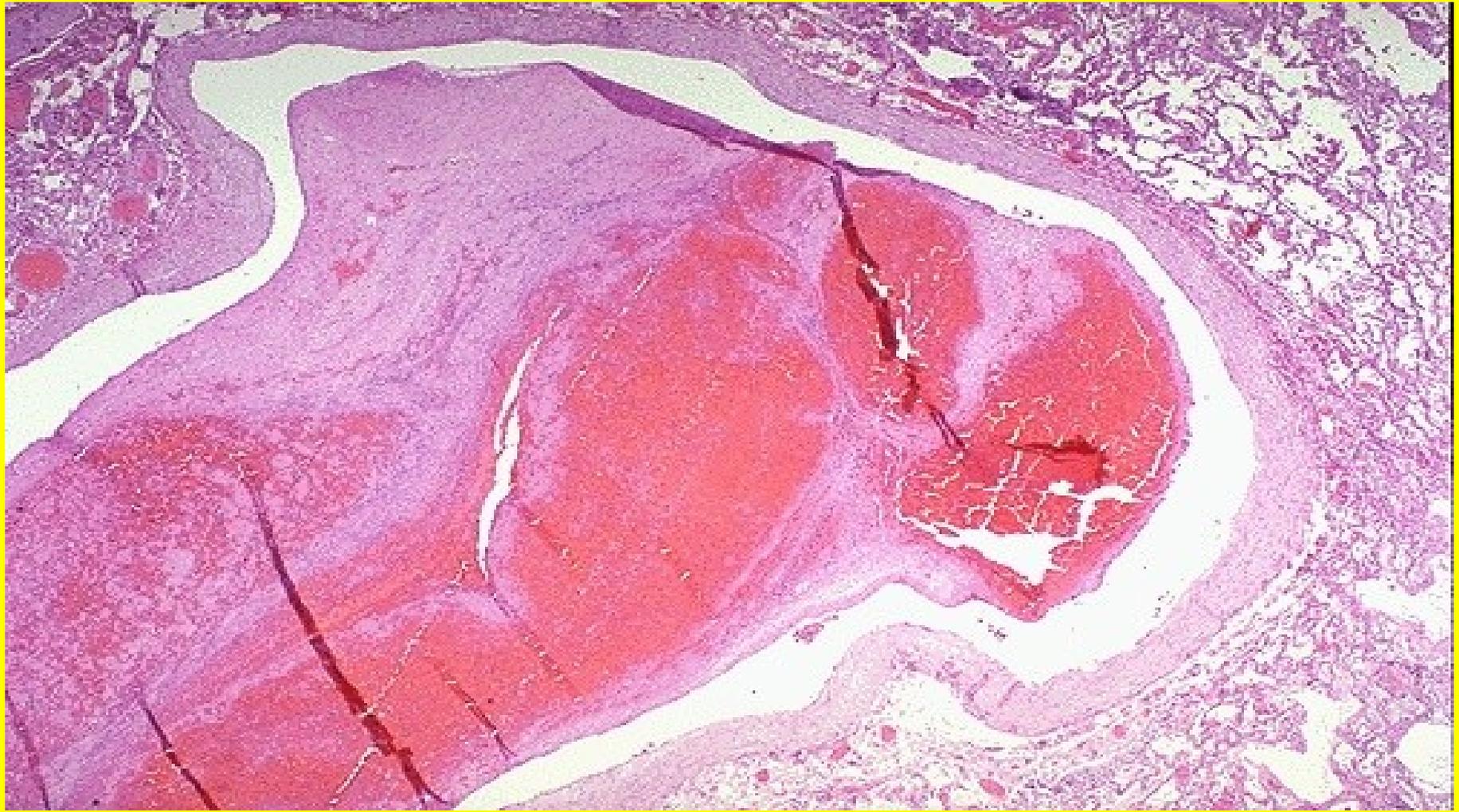




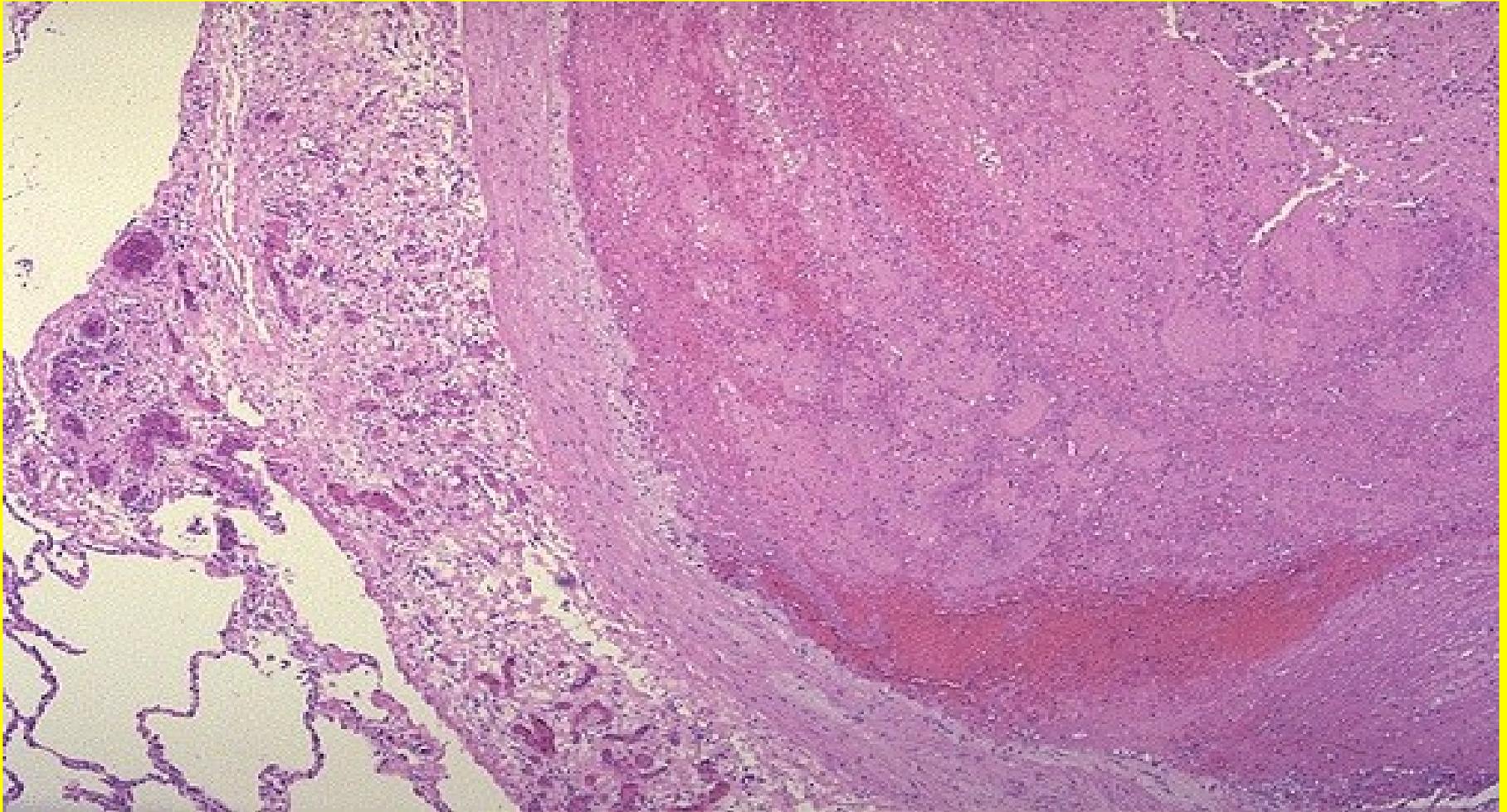
- A closer view of a thromboembolus filling a main pulmonary artery reveals a layered appearance, typical of a thrombus that formed in a large vein of the pelvis or lower extremity.



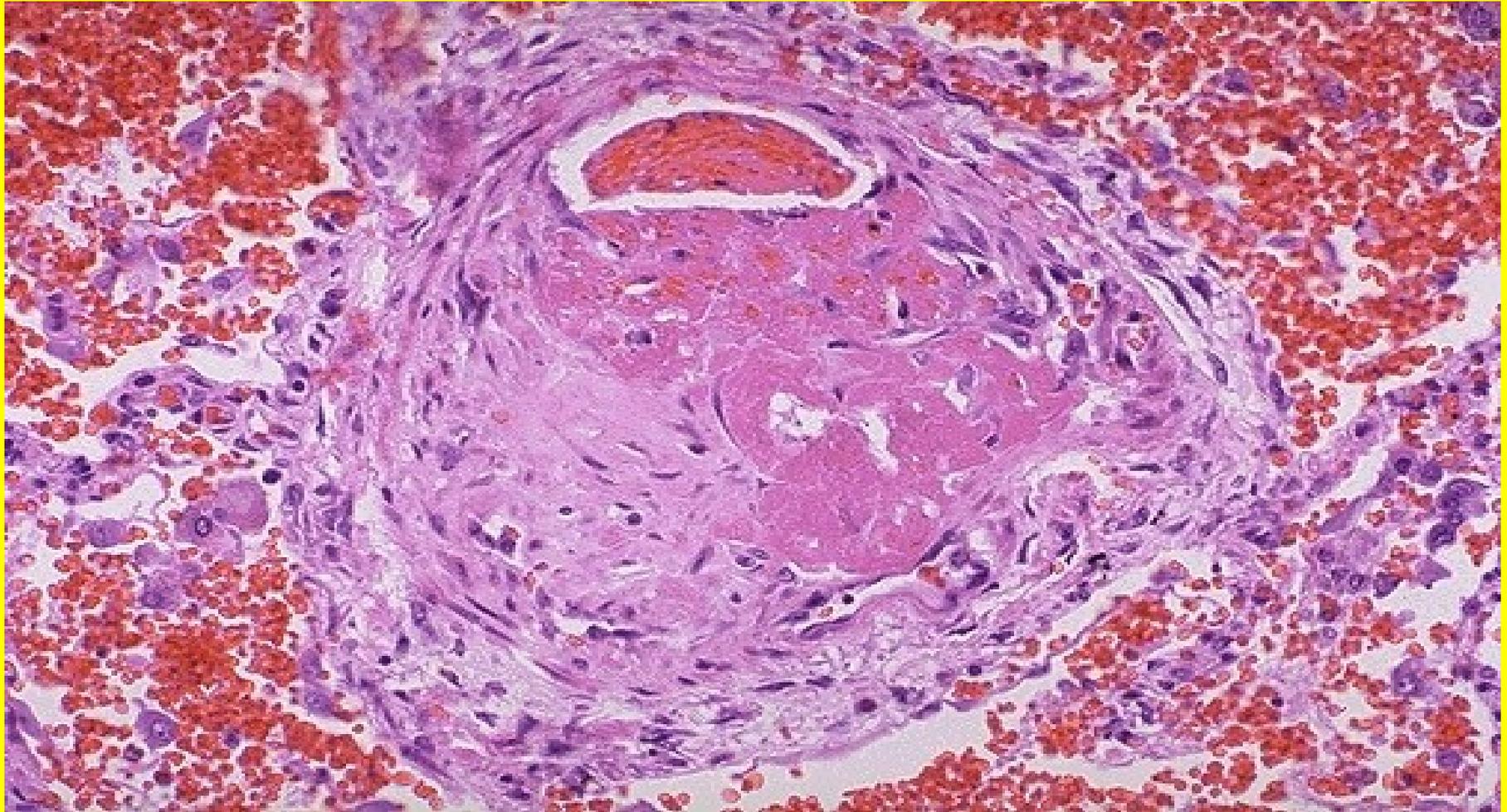
- This pulmonary thromboembolus is occluding the main pulmonary artery. Persons who are immobilized for weeks are at greatest risk. The patient can experience sudden onset of shortness of breath. Death may occur within minutes.



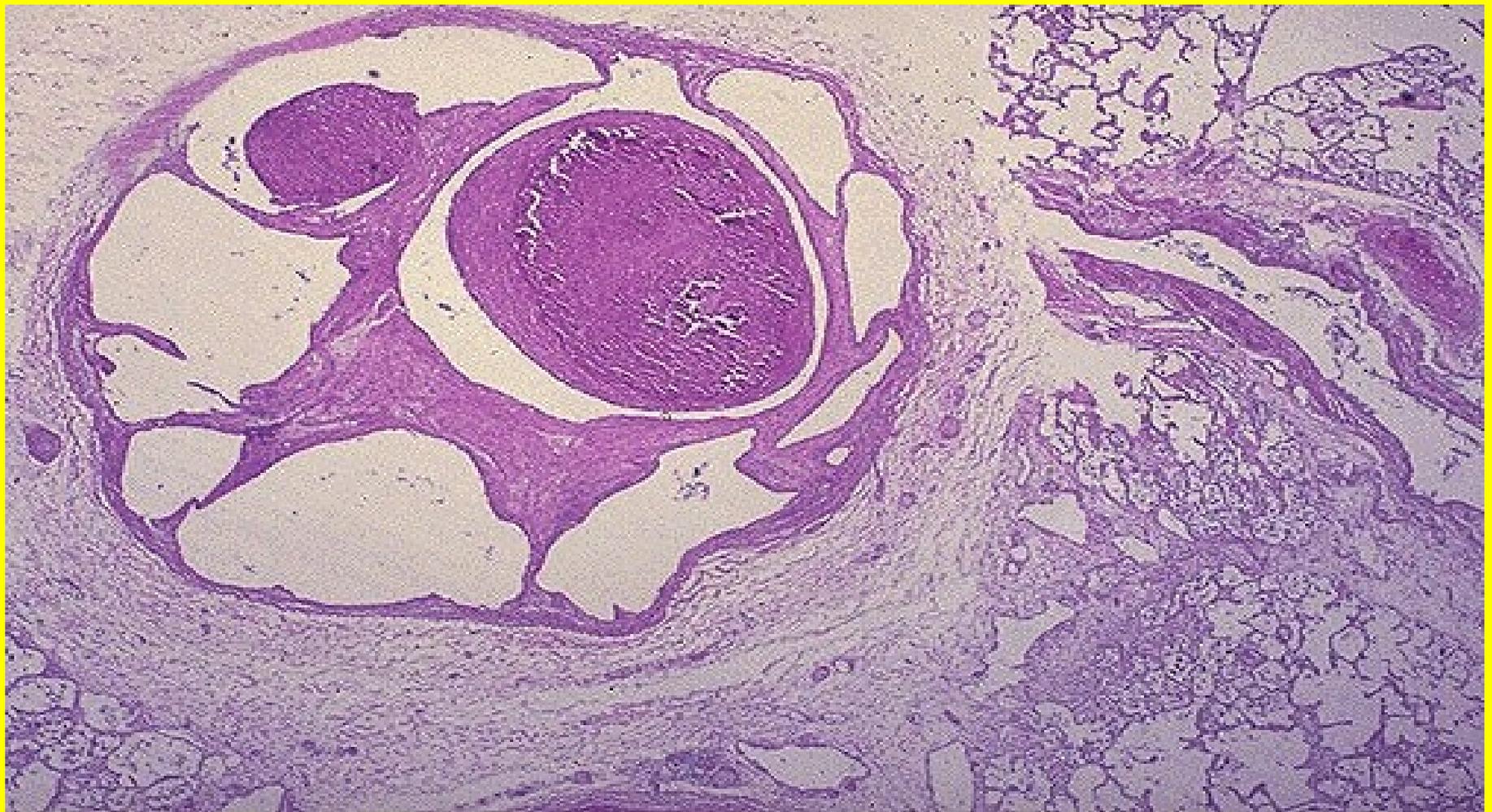
- This is the microscopic appearance of a pulmonary thromboembolus in a large pulmonary artery. There are interdigitating areas of pale pink and red that form the "lines of Zahn" characteristic for a thrombus. These lines represent layers of red cells, platelets, and fibrin which are laid down in the vessel as the thrombus forms.



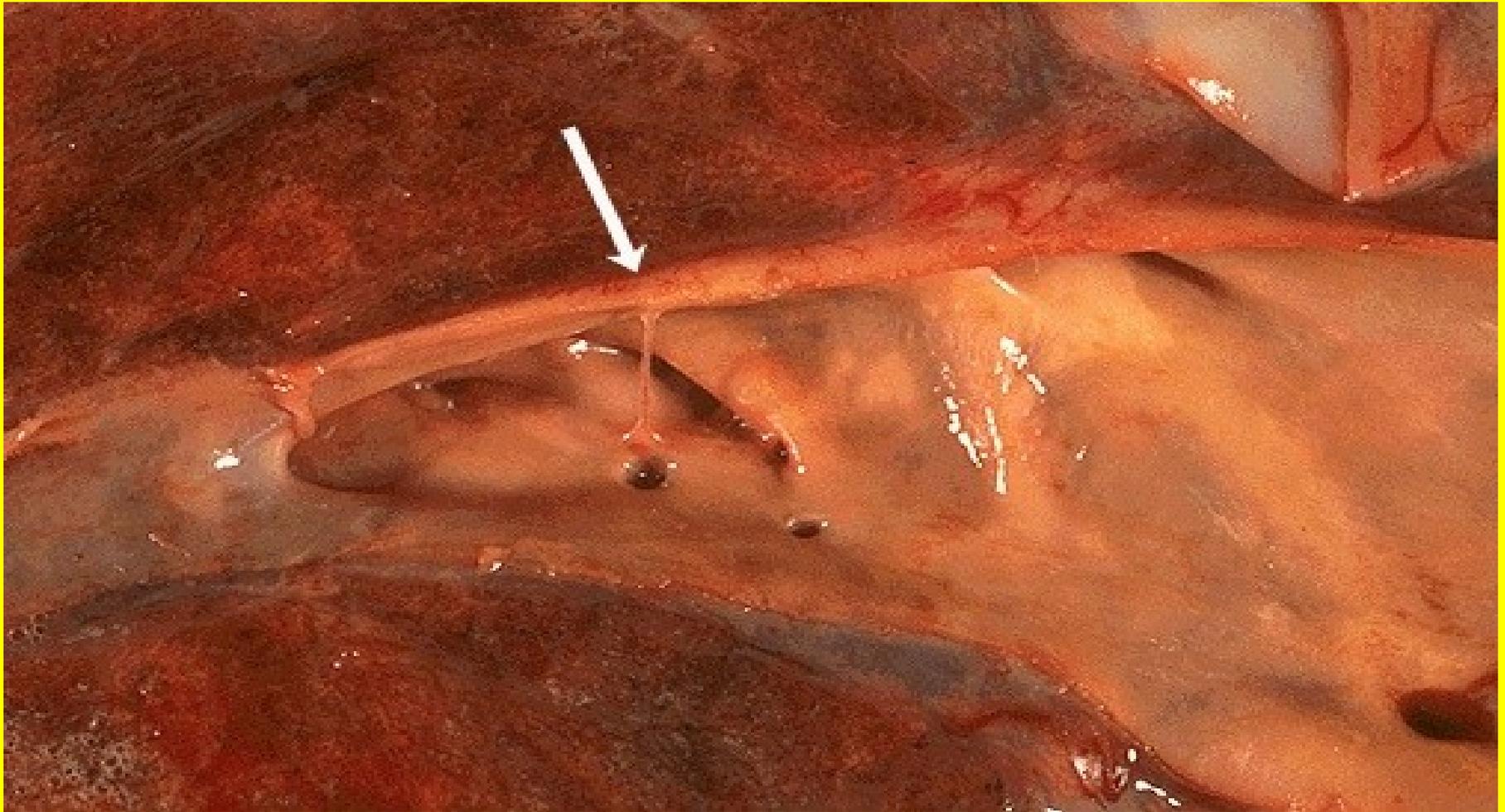
- Here a thromboembolus is packed into a pulmonary artery. Over time, if the patient survives, the thromboembolus will undergo organization and dissolution.



- Here is a small peripheral pulmonary artery thromboembolus. Such a small PE such as this one would probably not be noticed or cause problems unless there were many of them showered into the pulmonary circulation at once or over a period of time. This could lead to pulmonary hypertension.

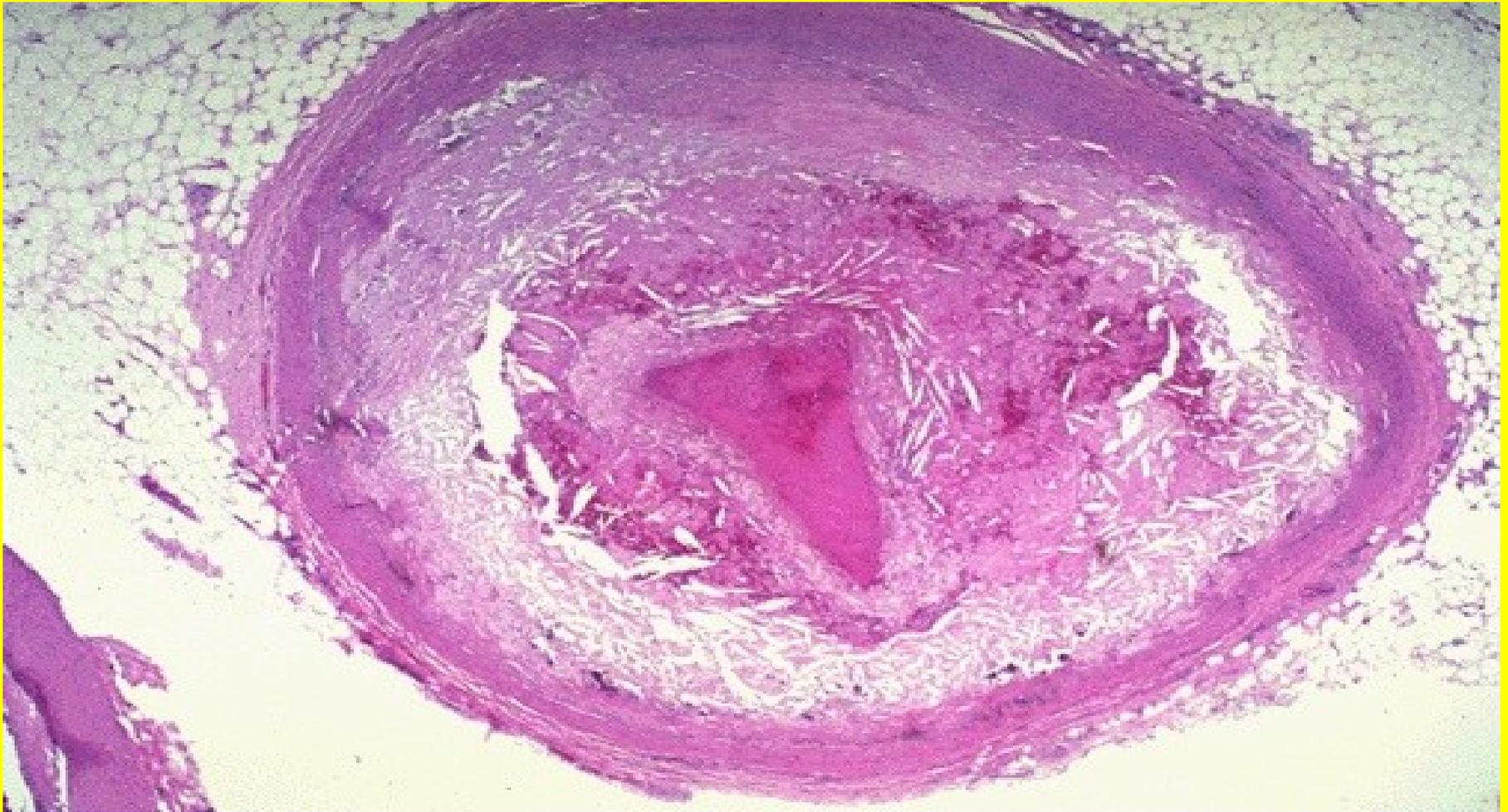


- The fibrous bands of connective tissue across this branch of pulmonary artery indicate organization of a remote pulmonary thromboembolus. If many pulmonary arteries are involved by this process, pulmonary hypertension could result.

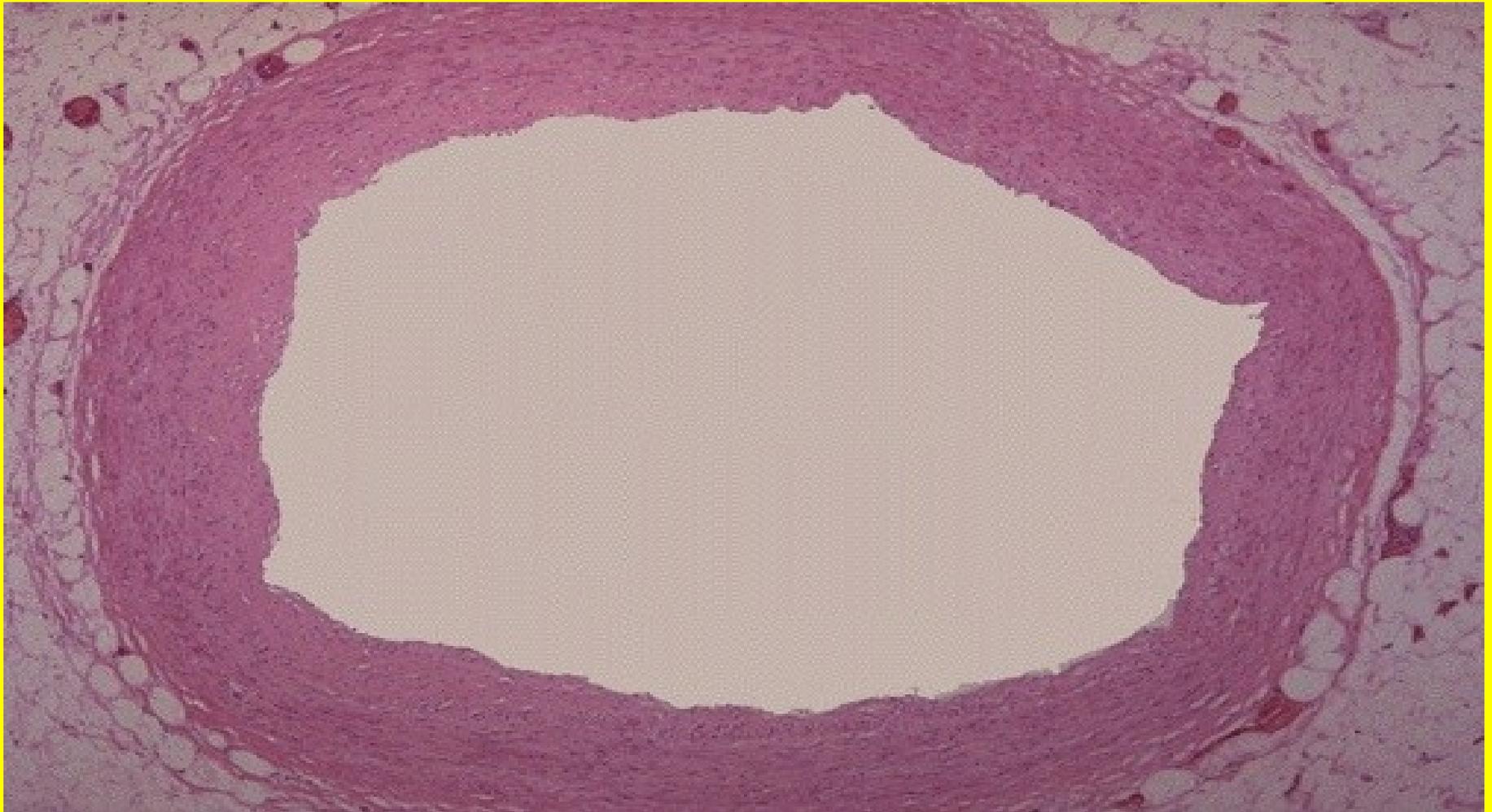


- Below the white arrow can be seen a fibrous band in a peripheral pulmonary artery from a remote organized pulmonary thromboembolus. Note that the atheromatous plaques of the pulmonar artery intima at the right are indicative of the effect of such embolization--pulmonary hypertension.

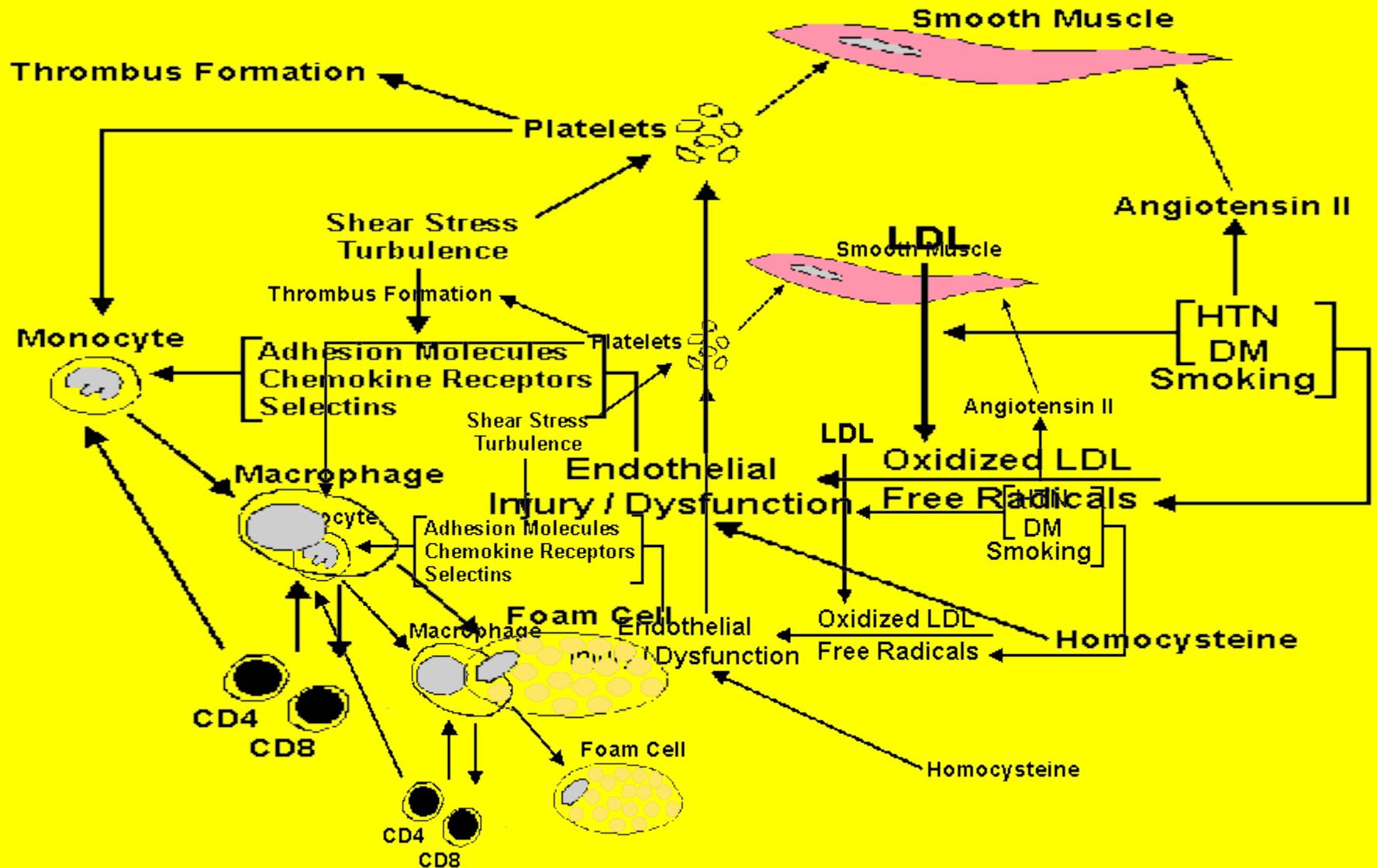
Coronary thrombosis



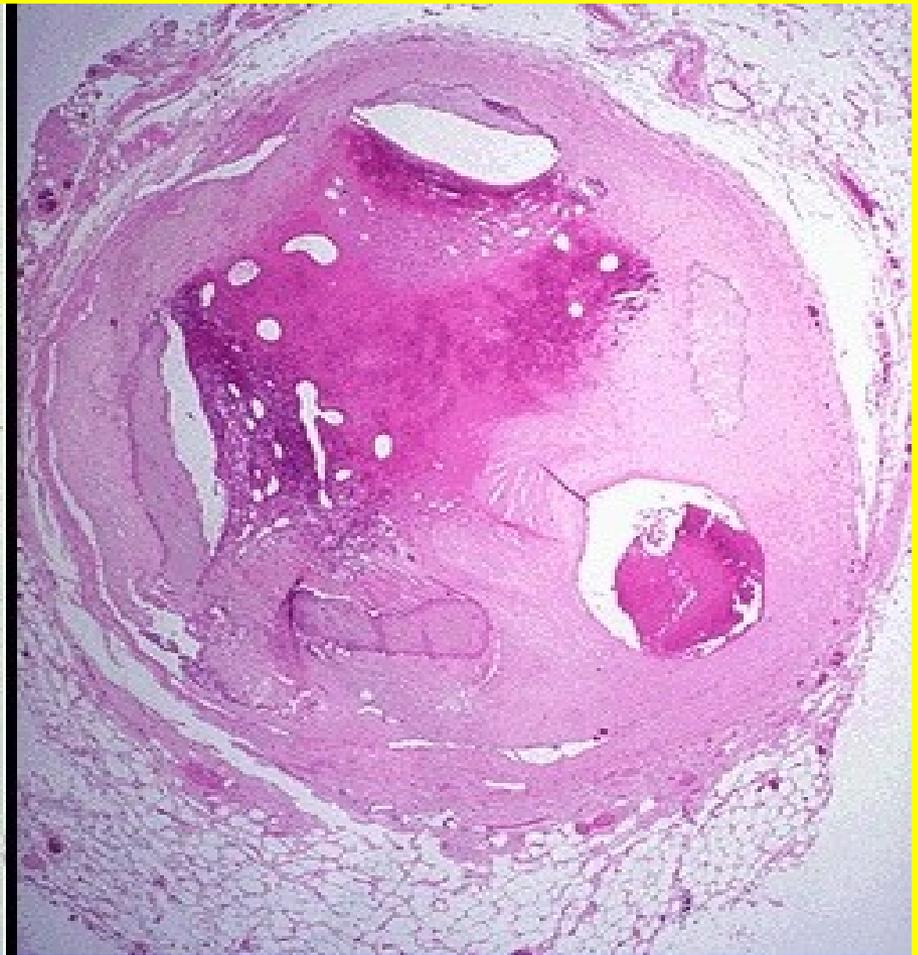
- A coronary thrombosis is seen microscopically occluding the remaining small lumen of this coronary artery. Such an acute coronary thrombosis is often the antecedent to acute myocardial infarction.



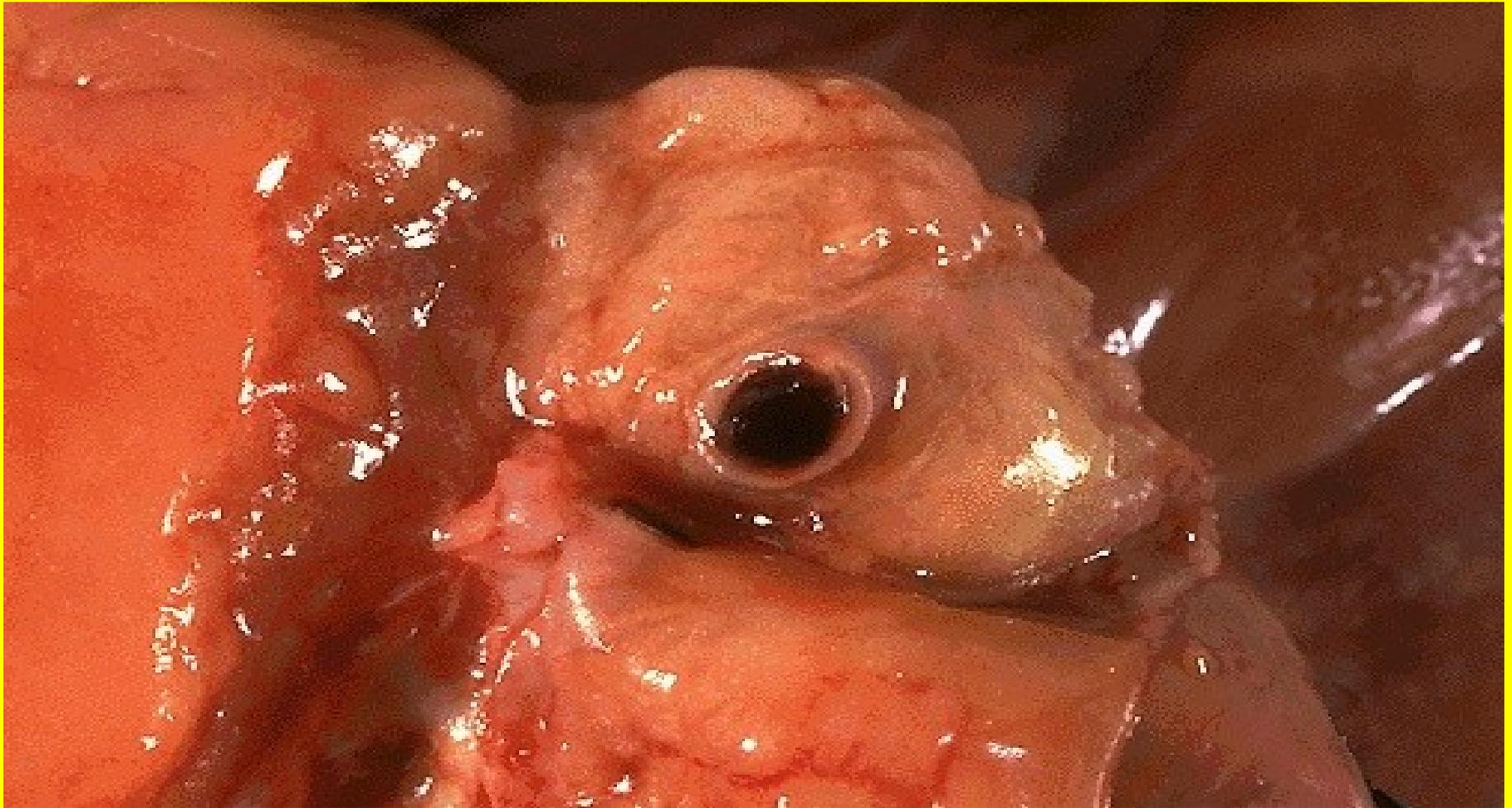
- This is a normal coronary artery with no atherosclerosis and a widely patent lumen that can carry as much blood as the myocardium requires. There is no impediment to blood flow.



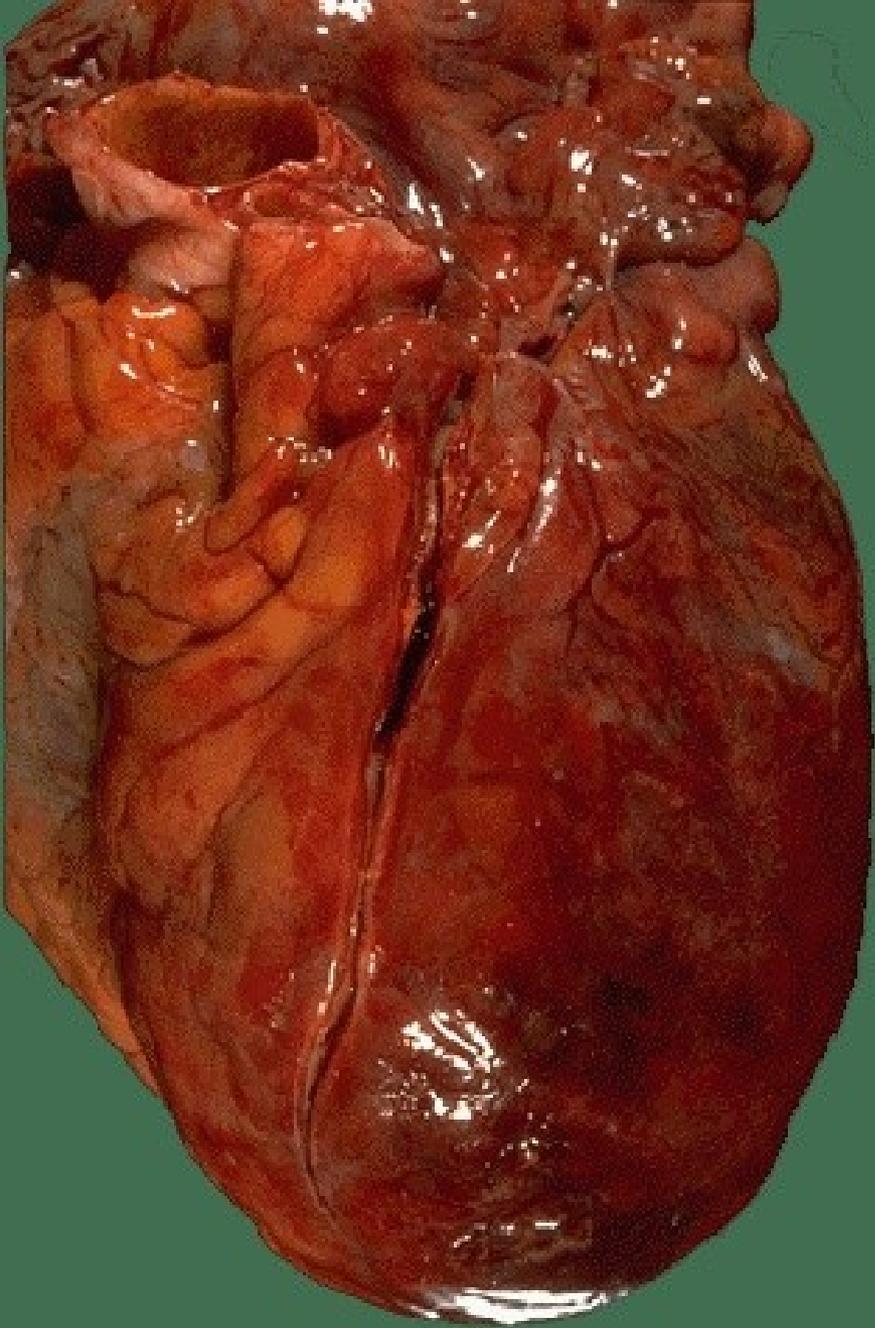
- The risk factors for atherosclerosis are diagrammed here in relation to the mechanisms that favor development of arterial atheroma formation. Atherosclerosis is a potentially reversible process. The process of reversal can be summarized as follows: eat fewer total calories and exercise more.



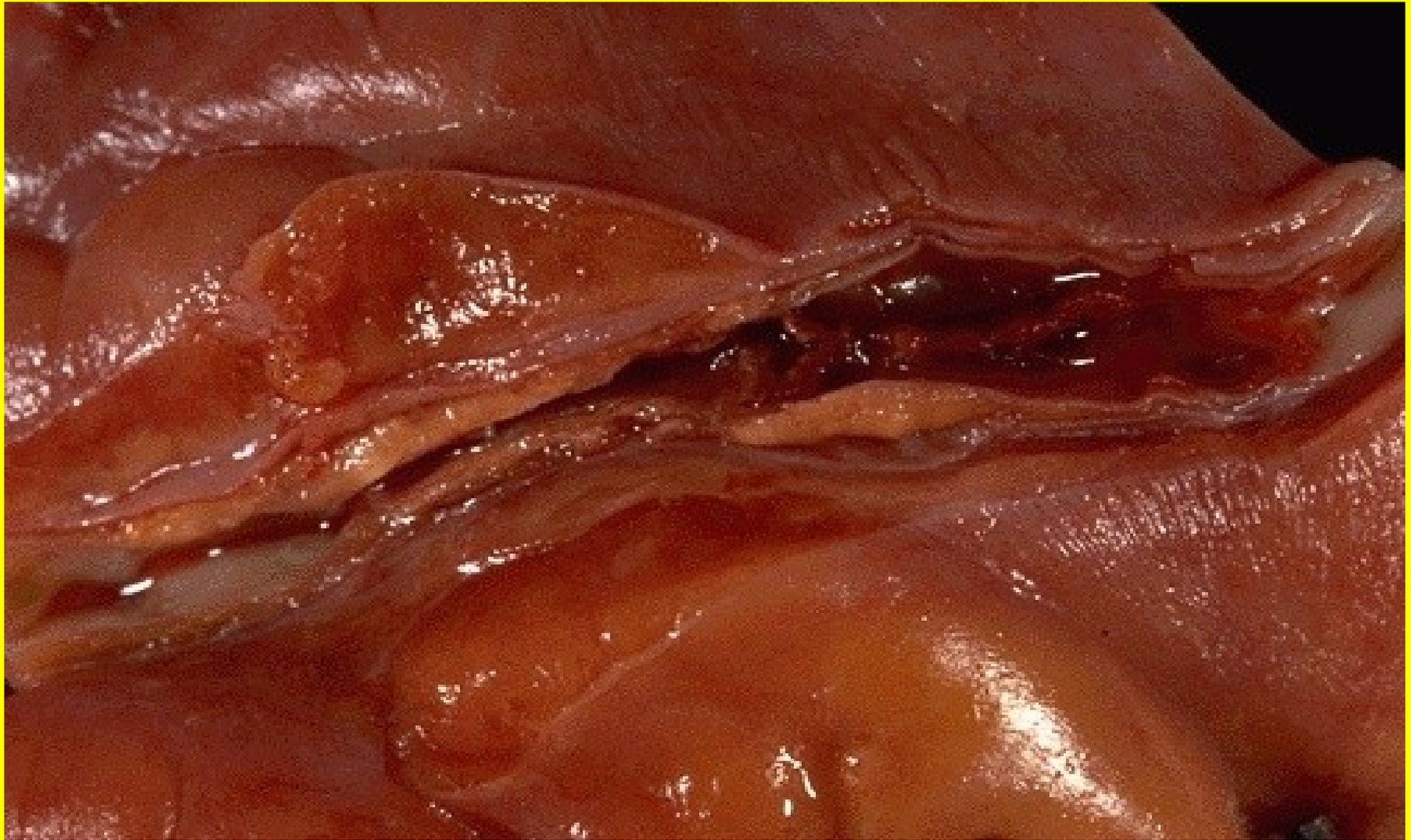
- Here is occlusive coronary atherosclerosis. The coronary at the left is narrowed by 60 to 70%. The coronary at the right is even worse with evidence for previous thrombosis with organization of the thrombus and recanalization such that there are three small lumens remaining, one of which contains additional recent thrombus.



- A thrombosis of a coronary artery is shown here in cross section. This acute thrombosis diminishes blood flow and leads to ischemia and/or infarction, marked clinically by the sudden onset of chest pain.



- Here is the anterior surface of the heart with the left anterior descending coronary artery opened longitudinally. This is coronary thrombosis, one of the complications of atherosclerosis. The occlusive dark red thrombus is seen within the lumen of the coronary artery. This produces an acute coronary syndrome.



- Here is a closer view of the gross appearance of a coronary thrombosis. The thrombus occludes the lumen and produces ischemia and/or infarction of the myocardium. The dark red thrombus is apparent in the lumen of the coronary. The yellow tan plaques of atherosclerosis narrow this coronary significantly and



- Infarction of the brain can result from thrombosis, though most cases occur following embolization, involving cerebral arteries, often the circle of Willis. Cerebral infarction typically results in liquefactive necrosis, as shown here with beginning cystic resolution of the infarct.