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Diseases and Conditions

Pulmonary embolism

By Mayo Clinic Staff

Pulmonary embolism is a blockage in one of the pulmonary arteries in your lungs. In most cases, pulmonary embolism is caused by blood clots that travel to the lungs from the legs or, rarely, other parts of the body (deep vein thrombosis).

Because pulmonary embolism almost always occurs in conjunction with deep vein thrombosis, most doctors refer to the two conditions together as venous thromboembolism.

Although anyone can develop deep vein thrombosis (DVT) and pulmonary embolism, factors such as immobility, cancer and surgery increase your risk.

Pulmonary embolism can be life-threatening, but prompt treatment can greatly reduce the risk of death. Taking measures to prevent blood clots in your legs will help protect you against pulmonary embolism.

Pulmonary embolism symptoms can vary greatly, depending on how much of your lung is involved, the size of the clots and your overall health — especially the presence or absence of underlying lung disease or heart disease.

Common signs and symptoms include:

- **Shortness of breath.** This symptom typically appears suddenly and always gets worse with exertion.
- **Chest pain.** You may feel like you're having a heart attack. The pain may become worse when you breathe deeply (pleurisy), cough, eat, bend or stoop. The pain will get worse with exertion but won't go away when you rest.
- **Cough.** The cough may produce bloody or blood-streaked sputum.

Other signs and symptoms that can occur with pulmonary embolism include:

- Leg pain or swelling, or both, usually in the calf

- Clammy or discolored skin (cyanosis)
- Fever
- Excessive sweating
- Rapid or irregular heartbeat
- Lightheadedness or dizziness

When to see a doctor

Pulmonary embolism can be life-threatening. Seek immediate medical attention if you experience unexplained shortness of breath, chest pain or a cough that produces bloody sputum.

Pulmonary embolism occurs when a clump of material, most often a blood clot, gets wedged into an artery in your lungs. These blood clots most commonly originate in the deep veins of your legs, but they can also come from other parts of your body. This condition is known as deep vein thrombosis (DVT).

Occasionally, substances other than blood clots can form blockages within the blood vessels inside your lungs. Examples include:

- Fat from within the marrow of a broken long bone
- Part of a tumor
- Air bubbles

It's rare to have a single pulmonary embolism. In most cases, multiple clots are involved but not necessarily all at once. The portions of lung tissue served by each blocked artery are robbed of blood and may die. This is known as pulmonary infarction. This makes it more difficult for your lungs to provide oxygen to the rest of your body.

Although anyone can develop blood clots and subsequent pulmonary embolism, certain factors can increase your risk.

Medical history

You're at higher risk if you or any of your family members have had venous blood clots or pulmonary embolism in the past. This may be due to inherited disorders that affect blood, making it more prone to clot.

In addition, certain medical conditions put you at risk, such as:

- **Heart disease.** Cardiovascular disease, specifically heart failure, makes clot formation more likely.
- **Cancer.** Certain cancers — especially pancreatic, ovarian and lung cancers, and many cancers with metastasis — can increase levels of substances that help blood clot, and

chemotherapy further increases the risk. Women with a personal or family history of breast cancer who are taking tamoxifen or raloxifene also are at higher risk of blood clots.

Prolonged immobility

Blood clots are more likely to form in your legs during periods of inactivity, such as:

- **Bed rest.** Being confined to bed for an extended period after surgery, a heart attack, leg fracture, trauma or any serious illness makes you far more vulnerable to blood clots. When the lower extremities are horizontal for long periods of time, the flow of venous blood slows and blood pools in the legs.
- **Long journeys.** Sitting in a cramped position during lengthy plane or car trips slows blood flow, which contributes to the formation of clots in your legs.

Surgery

Surgery is one of the leading causes of problem blood clots, especially seen after joint replacements of the hip and knee. During the preparation of the bones for the artificial joints, tissue debris may enter the bloodstream and contribute to causing a clot. Simply being immobile during any type of surgery can lead to the formation of clots. The risk increases with the length of time you're under general anesthesia. For this reason, most people undergoing a type of surgery predisposing them to DVT will receive medication before and after surgery to prevent clot formation.

Other risk factors

- **Smoking.** For reasons that aren't well-understood, tobacco use predisposes some people to blood clot formation, especially when combined with other risk factors.
- **Being overweight.** Excess weight increases the risk of blood clots — particularly in women who smoke or have high blood pressure.
- **Supplemental estrogen.** The estrogen in birth control pills and in hormone replacement therapy can increase clotting factors in your blood, especially if you smoke or are overweight.
- **Pregnancy.** The weight of the baby pressing on veins in the pelvis can slow blood return from the legs. Clots are more likely to form when blood slows or pools.

Pulmonary embolism can be life-threatening. About one-third of people with undiagnosed and untreated pulmonary embolism don't survive. When the condition is diagnosed and treated promptly, however, that number drops dramatically.

Pulmonary embolism can also lead to pulmonary hypertension, a condition in which the blood pressure in your lungs and in the right side of the heart is too high. When you have obstructions in the arteries inside your lungs, your heart must work harder to push blood through those

vessels. This increases the blood pressure within these vessels and the right side of the heart, which can weaken your heart.

In rare cases, small emboli occur frequently and develop over time, resulting in chronic pulmonary hypertension, also known as chronic thromboembolic pulmonary hypertension.

Most cases of pulmonary embolism are initially evaluated in hospitals, emergency rooms or urgent care centers. If you think you might have a pulmonary embolism, seek immediate medical attention.

What you can do

You may want to write a list that includes:

- Detailed descriptions of your symptoms
- Information about your past medical problems, especially any recent surgeries or illnesses that kept you bedridden for several days
- Details on any recent journeys that involved long car or plane rides
- Information about the medical problems of parents or siblings
- Medications you're taking
- Questions you want to ask the doctor

What to expect from your doctor

During the physical exam, your doctor might inspect your legs for evidence of a deep vein clot — an area that's swollen, tender, red and warm. He or she will also listen to your heart and lungs and check your blood pressure.

Pulmonary embolism can be difficult to diagnose, especially in people who have underlying heart or lung disease. For that reason, your doctor may order a series of tests to help find the cause of your symptoms. Your doctor may order one or more of the following tests.

Blood tests

Your doctor may order a blood test for the clot-dissolving substance D dimer in your blood. High levels may suggest an increased likelihood of blood clots, although D dimer levels may be elevated by many other factors, including recent surgery. In addition, blood tests may be done to determine whether you have an inherited clotting disorder.

Chest X-ray

This noninvasive test shows images of your heart and lungs on film. Although X-rays can't diagnose pulmonary embolism and may even appear normal when pulmonary embolism exists, they can rule out conditions that mimic the disease.

Ultrasound

A noninvasive "sonar" test known as duplex ultrasonography (sometimes called duplex scan, or compression ultrasonography) uses high-frequency sound waves to check for blood clots in your thigh veins. In this test, your doctor uses a wand-shaped device called a transducer to direct the sound waves to the veins being tested. These waves are then reflected back to the transducer and translated into a moving image by a computer. The absence of the presence of clots reduces the likelihood of DVT. If the upper thigh vessels are clear, the ultrasonography will also scan the veins behind the knee looking for residual clots. If clots are present, treatment likely will be started immediately.

CT scan

Regular CT scans take X-rays from many different angles and then combine them to form images showing 2-D "slices" of your internal structures. In a spiral (helical) CT scan, the scanner rotates around your body in a spiral — like the stripe on a candy cane — to create 3-D images. This type of CT can detect abnormalities within the arteries in your lungs with much greater precision, and it's also much faster than are conventional CT scans. In some cases, contrast material is given intravenously during the CT scan to outline the pulmonary arteries.

Pulmonary angiogram

This test provides a clear picture of the blood flow in the arteries of your lungs. It's the most accurate way to diagnose pulmonary embolism, but because it requires a high degree of skill to administer and has potentially serious risks, it's usually performed when other tests fail to provide a definitive diagnosis.

In a pulmonary angiogram, a flexible tube (catheter) is inserted into a large vein — usually in your groin — and threaded through into your heart and on into the pulmonary arteries. A special dye is then injected into the catheter, and X-rays are taken as the dye travels along the arteries in your lungs.

One risk of this procedure is a temporary change in your heart rhythm. In addition, the dye may cause kidney damage in people with decreased kidney function.

MRI

MRI scans use radio waves and a powerful magnetic field to produce detailed images of internal structures. Because MRI is expensive, it's usually reserved for pregnant women (to avoid radiation to the fetus) and people whose kidneys may be harmed by dyes used in other tests.

Treatment is aimed at keeping the blood clot from getting bigger and preventing new clots from forming. Prompt treatment is essential to prevent serious complications or death.

Medications

- **Blood thinners (anticoagulants).** These drugs prevent new clots from forming while your body works to break up the clots. Heparin is a frequently used anticoagulant that can be given through the vein or injected under the skin. It acts quickly and is often overlapped for several days with an oral anticoagulant, such as warfarin, until it becomes effective, which can take days. A newer class of anticoagulants has been tested and approved for treatment of venous thromboembolism, including pulmonary embolism. These medications have the advantage of being given by mouth, without the need for overlap with heparin. Also, they work quickly and have fewer interactions with other medications. All blood thinners have side effects, with bleeding being the most common.
- **Clot dissolvers (thrombolytics).** While clots usually dissolve on their own, there are medications given through the vein that can dissolve clots quickly. Because these clot-busting drugs can cause sudden and severe bleeding, they usually are reserved for life-threatening situations.

Surgical and other procedures

- **Clot removal.** If you have a very large, life-threatening clot in your lung, your doctor may suggest removing it via a thin, flexible tube (catheter) threaded through your blood vessels.
- **Vein filter.** A catheter can also be used to position a filter into the body's main vein — called the inferior vena cava — that leads from your legs to the right side of your heart. This filter can help keep clots from being carried into your lungs. This procedure is typically reserved for people who can't take anticoagulant drugs or when anticoagulant drugs don't work well enough or fast enough. The catheter with the filter in the tip is usually inserted in a vein in your neck, and then into the vena cava. Some filters can be removed when they are no longer needed.

Preventing clots in the deep veins in your legs (deep vein thrombosis) will help prevent pulmonary embolism. For this reason, most hospitals are aggressive about taking measures to prevent blood clots, including:

- **Anticoagulants.** Anticoagulants are often given to people at risk of clots before and after an operation — as well as to people admitted to the hospital with a heart attack, stroke or complications of cancer.
- **Compression stockings.** Compression stockings steadily squeeze your legs, helping your veins and leg muscles move blood more efficiently. They offer a safe, simple and inexpensive way to keep blood from stagnating during and after general surgery.
- **Pneumatic compression.** This treatment uses thigh-high or calf-high cuffs that automatically inflate with air and deflate every few minutes to massage and squeeze the veins in your legs and improve blood flow.
- **Physical activity.** Moving as soon as possible after surgery can help prevent pulmonary embolism and hasten recovery overall. This is one of the main reasons your nurse may push

you to get up, even on your day of surgery, and walk despite pain at the site of your surgical incision.

- **Leg elevation.** Elevating your legs when possible and during the night also can be very effective**.** Raise the bottom of your bed 4 to 6 inches with blocks or books.

Prevention while traveling

The risk of blood clots developing while traveling is low, but increases as travel increases. If you have risk factors for blood clots and you're concerned about traveling, talk with your doctor. He or she might suggest the following steps to help prevent blood clots from forming:

- **Take a break from sitting.** Move around the airplane cabin once an hour or so. If you're driving, stop every hour and walk around the car a couple of times. Do a few deep knee bends.
- **Fidget in your seat.** Flex your ankles every 15 to 30 minutes, or try rising up and down on your toes while standing. Don't sit with your legs crossed at the knees for long periods of time.
- **Drink plenty of fluids.** Water is the best liquid for preventing dehydration, which can contribute to the development of blood clots. Avoid alcohol, which contributes to fluid loss.
- **Wear support stockings.** Your doctor may recommend these to help promote circulation and fluid movement in your legs. Compression stockings no longer look like something only a grandmother would wear — they're available in a range of stylish colors and textures. There are even devices, called stocking butlers, to help you put on the stockings.

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March 18, 2015

Original article: http://www.mayoclinic.org/diseases-conditions/pulmonary-embolism/basics/symptoms/con-20022849