



Patient education: Pulmonary embolism (Beyond the Basics)

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PULMONARY EMBOLISM OVERVIEW

Pulmonary embolism (PE) occurs when a blood clot (thrombus) dislodges from a vein, travels through the bloodstream, and lodges in the lung (where it is called a "pulmonary embolus"). Most blood clots originally form in one of the deep veins of the legs, thighs, or pelvis; this condition is known as deep vein thrombosis (DVT). (See "[Patient education: Deep vein thrombosis \(DVT\) \(Beyond the Basics\)](#)".)

If a clot blocks the blood flow to parts of the lung, it prevents oxygen from reaching the brain and body. Pulmonary emboli are uncommon, but can be deadly if not identified and treated promptly. In the United States, it is estimated that over 50,000 people die every year as a result of a PE. Recognizing and treating a PE quickly can reduce the risk of serious complications and death.

PULMONARY EMBOLISM RISK FACTORS

There are a number of factors that increase a person's risk of developing PE.

Surgery and related conditions — Surgical procedures, especially those involving the hip, pelvis, knee, or brain and spine increase a person's risk of developing a blood clot. During the recovery period, prolonged inactivity can also increase the risk of developing a blood clot. Measures to help reduce the risk of blood clots are discussed below. (See '[Pulmonary embolism prevention](#)' below.)

Medical conditions or medications — Some medical conditions and medications increase a person's risk of developing a blood clot:

- Cancer.
- Immobilization (eg, due to hospitalization, recovery from injury, bedrest, or paralysis).
- Previous deep vein thrombosis (DVT) or PE.
- Increased age.
- Obesity.
- Pregnancy.
- Certain medications (eg, birth control pills, hormone replacement therapy, [tamoxifen](#), [thalidomide](#), erythropoietin, cancer chemotherapy medications). The risk of a blood clot is further increased in people who use one of these medications and also have other risk factors.
- Smoking.
- Heart failure.
- Kidney problems, such as nephrotic syndrome. (See "[Patient education: The nephrotic syndrome \(Beyond the Basics\)](#)".)
- Severe coronavirus disease 2019 (COVID-19). (See "[Patient education: COVID-19 overview \(The Basics\)](#)".)

Cancer — People with cancer, especially if they are receiving treatment (eg, with chemotherapy or radiation therapy), are at particularly increased risk for developing DVT or PE.

Inherited thrombophilia — Inherited thrombophilia refers to a genetic problem that causes the blood to clot more easily than normal. Various factors in the blood clotting process may be involved, depending on the type of genetic problem present.

An inherited thrombophilia, such as deficiencies of antithrombin, protein C, or protein S, is frequently present in people who develop a venous blood clot before the age of 50, and who do not have another clear cause (eg, surgery). Other factors, such as factor V Leiden or the prothrombin gene mutation, increase the risk of venous thrombosis in all age groups. However, venous blood clots are infrequent before adolescence.

If a person is found to have a PE and there is no known medical condition or recent surgery that caused the PE, it is possible that an inherited condition is the cause, although this is rare. This is especially true in people who have more than one PE or if a family member has also experienced a PE. In these cases, testing for an inherited thrombophilia may be recommended. (See '[Determining the cause](#)' below.)

Acquired thrombophilia — Some types of thrombophilia are not inherited, but can increase a person's risk of developing a blood clot:

- Certain disorders of the blood, such as polycythemia vera or essential thrombocythemia
- Antiphospholipid antibodies (antibodies in the blood that can affect the clotting process) (see "[Patient education: Antiphospholipid syndrome \(Beyond the Basics\)](#)")

Elevated clotting factors — Having an increased level of one or more factors involved in blood clotting increases the risk of a blood clot.

PULMONARY EMBOLISM SYMPTOMS

The signs and symptoms of PE can vary from one person to another. Common signs and symptoms of PE include the following:

- Shortness of breath or needing to breathe rapidly
- Chest pain, especially sharp, knife-like pain while taking a deep breath
- Coughing or coughing up blood
- A rapid heart rate
- Dizziness or fainting

Any of these symptoms along with leg pain or swelling increases the likelihood of PE. In rare cases, the person might pass out.

PULMONARY EMBOLISM DIAGNOSIS

If your history, symptoms, and physical exam suggest a PE, you will get tests to confirm the diagnosis. Tests to diagnose or rule out PE include D-dimer blood testing and imaging tests (most often a CT scan with pulmonary angiography). These tests are described in more detail below.

Some patients with a suspected PE will also undergo testing to determine if deep vein thrombosis (DVT) exists, which is described in detail separately (see "[Patient education: Deep vein thrombosis \(DVT\) \(Beyond the Basics\)](#)"). If a DVT is diagnosed, further testing to determine if a PE is present may not be necessary because, most of the time, both conditions are treated in the same way.

Diagnostic tests

D-dimer — D-dimer is a substance in the blood that is often increased in people with PE. D-dimer levels are abnormal in >95 percent of patients with PE; a person with a normal D-dimer level is unlikely to have a PE. If the D-dimer test is negative and the patient is thought

to have a low risk of PE based upon their signs and symptoms, further testing is not typically needed.

Computed tomography pulmonary angiography — This is a type of computed tomography (CT) scan that involves getting a special dye injected into your pulmonary arteries before the scan is taken. The dye shows up on the images and allows your doctor to identify any blood clots or blockages in your lungs.

CT pulmonary angiography (also called CTPA) may not be suitable for people with poor kidney function or who are allergic to contrast dye. Occasionally, medications for a contrast allergy may be needed to complete the test.

Other imaging tests — In some cases (for example, if it is not possible to perform CTPA for some reason), another imaging test may be done. Options include a ventilation/perfusion lung scan (in which you inhale and have an intravenous injection of a small amount of a radioactive dye, then get tested to see how it is distributed in your lungs), ultrasonography of your legs to look for DVT (which uses sound waves to generate pictures of the blood vessels), and catheter-based or magnetic resonance pulmonary angiography.

Determining the cause — After determining that a PE is present, your healthcare provider will want to know what caused it. In many cases, there are obvious risk factors such as recent surgery or immobility (see '[Pulmonary embolism risk factors](#)' above). In other cases, the person may be tested for inherited or acquired thrombophilia. (See '[Inherited thrombophilia](#)' above and '[Acquired thrombophilia](#)' above.)

People with an ongoing acquired or inherited risk factor for PE may require additional treatment or preventive measures (eg, long-term treatment with an anticoagulant medication) to reduce the risk of future blood clots. Some experts recommend that the family members of a person with an inherited thrombophilia be screened for the inherited condition if this information would impact their care, although this issue is controversial. If you have a genetic condition or are concerned that you might have one, your doctor or a genetic counselor can talk to you about what it means as well as the pros and cons of screening other family members.

PULMONARY EMBOLISM TREATMENT

Treatments for PE aim to prevent the clot from becoming larger, prevent new blood clots from forming, and prevent long-term complications.

The primary treatment for venous thrombosis is anticoagulation. Other treatments include thrombolytic therapy, embolectomy (removal of the clot), and placing a filter in one of the major blood vessels (the inferior vena cava).

Anticoagulation — Anticoagulants are medications that are commonly called "blood thinners." They do not actually dissolve the clot but rather prevent new blood clots from forming and help your body remove clots that are already formed. There are several different medications that might be given after a deep vein thrombosis (DVT) diagnosis (referred to as "initial anticoagulation"), including:

- Direct oral anticoagulants (DOACs) – These are available in pill form; those available, depending on the country, for initial anticoagulation are [rivaroxaban](#) (brand name: Xarelto), [apixaban](#) (brand name: Eliquis), [dabigatran](#) (brand name: Pradaxa), or [edoxaban](#) (brand name: Savaysa).
- Low molecular weight (LMW) heparin, which is given as an injection under the skin – Options include [enoxaparin](#) (brand name: Lovenox), [dalteparin](#) (brand name: Fragmin), and [tinzaparin](#) (brand name: Innohep).
- [Fondaparinux](#) (brand name: Arixtra), also given by injection.
- Heparin, which is given into a vein (intravenously) or as an injection under the skin – This may be the preferred choice in certain circumstances, such as if a person has severe kidney failure.

For most patients, a DOAC is the best choice for initial anticoagulation. For patients treated with LMW heparin, [unfractionated heparin](#), or [fondaparinux](#), initial anticoagulation usually consists of 5 to 10 days of treatment. After that, long-term anticoagulation is continued for at least three months (see "[Patient education: Deep vein thrombosis \(DVT\) \(Beyond the Basics\)](#)", [section on 'Duration of treatment'](#)). DOACs are also an option for long-term anticoagulation; these pills include [rivaroxaban](#) (brand name: Xarelto), [apixaban](#) (brand name: Eliquis), [dabigatran](#) (brand name: Pradaxa), and [edoxaban](#) (brand name: Savaysa). An advantage of initiating treatment with a DOAC is that some DOACs (rivaroxaban, apixaban) can be started right after a clot is diagnosed without the need for an initial 5 to 10 days of an injectable blood thinner (eg, LMW heparin). In some situations, another oral medication called [warfarin](#) (sample brand name: Jantoven, also known as Coumadin in some places) can be used for long-term anticoagulation. Warfarin is typically started during the initial 5 to 10 days of treatment with an injectable anticoagulant. If you take warfarin, you need to get regular blood tests to monitor how well your blood is clotting; this is not needed for patients on DOACs (see "[Patient education: Warfarin \(Beyond the Basics\)](#)"). Less commonly, a person does not take warfarin or any of the DOACs but takes a daily injection of heparin or fondaparinux for the entire treatment period. In rare circumstances, unfractionated heparin as an injection can also be given.

The choice of anticoagulant depends upon multiple factors, including your preference, your doctor's recommendation based on your situation and medical history, and cost

considerations.

Duration of treatment — Anticoagulation is recommended for a **minimum** of three months in a patient with DVT.

- If you had a reversible risk factor contributing to your DVT, such as trauma, surgery, or being confined to bed for a prolonged period, you will likely be treated with anticoagulation for only three months or until the risk factor is resolved.
- Expert groups suggest that people who develop a DVT but do not have a known risk factor may need treatment with an anticoagulant for an indefinite period of time. However, if this is your situation, you should discuss the pros and cons with your doctor after three to six months of treatment. If the decision is made to continue anticoagulation, your doctor will continue to reassess on a regular basis. Some people prefer to continue the anticoagulant, which may carry an increased risk of bleeding while others prefer to stop the anticoagulant at some point, which may carry an increased risk for repeat thrombosis.
- Most experts recommend continuing anticoagulation indefinitely for people with two or more episodes of venous thrombosis or if a risk factor for clotting persists (eg, antiphospholipid syndrome, cancer).

Thrombolytic therapy — In some severe life-threatening cases, a clinician will recommend a medicine to dissolve blood clots (ie, a "clot-busting" medication). This is called thrombolytic therapy. Thrombolytic therapy can be given through a vein in your arm (by "IV"; also called systemic thrombolysis) or through a catheter in the pulmonary artery where the clot is. Thrombolytic therapy is associated with an increased risk of serious bleeding. This is especially true for systemic thrombolysis. Therefore, thrombolytic therapy is reserved for people who have serious complications related to PE or DVT and who have a low risk of serious bleeding as a side effect of the therapy. The response to thrombolytic therapy is best when there is a short time between the diagnosis of DVT/PE and the start of thrombolytic therapy.

Embolectomy — Embolectomy is the medical term for removal of PE from the lung. It may be performed using catheters that are placed into the blood vessel that contains the clot or with a surgical procedure that is similar to open heart surgery. This procedure may be considered if a person is in serious condition as a result of the PE (eg, persistent low blood pressure due to PE). In this situation, thrombolytic therapy may be attempted first, but if thrombolysis fails or is not an option, embolectomy may be attempted.

Inferior vena cava filter — An inferior vena cava (IVC) filter is a device that blocks the circulation of clots in the bloodstream, especially the movement of clot from the legs to the lungs. It is placed in the inferior vena cava (the large vein leading from the lower body to the

heart) with a catheter that is inserted into a vein in the groin and threaded through the blood vessels. An IVC filter is often recommended in patients with PE who cannot use anticoagulants because of recent surgery, a stroke caused by bleeding, or significant bleeding in another area of the body. However, IVC filters can be used along with other therapies such as anticoagulation, thrombolysis, or embolectomy when these are appropriate.

An IVC filter is also recommended in some patients who develop recurrent PE despite anticoagulation. It may also be recommended for patients whose condition makes them susceptible to life-threatening complications if another PE were to occur. IVC filters are generally removed at a later point in time.

PULMONARY EMBOLISM PREVENTION

During hospitalization — Some people who are in the hospital, either for surgery (especially bone or joint surgery and cancer surgery) or because of a serious medical illness, may be given anticoagulants to decrease the risk of blood clots. Anticoagulants may also be given to females at high risk for venous thrombosis during and after pregnancy.

In people who are hospitalized and have a moderate to low risk of blood clots, other preventive measures may be used. For example, some people are fitted with inflatable compression devices after surgery. These devices are worn around the legs during and immediately after surgery and periodically fill with air. These devices apply gentle pressure to improve circulation and help prevent clots. Compression stockings may also be recommended.

In all cases, walking as soon as possible after surgery can decrease the risk of a blood clot.

Extended travel — Prolonged travel (for example, taking a long airplane flight or car ride) appears to increase the risk of developing blood clots, although the risk is very small. There are a few tips that may be of benefit during extended travel ([table 1](#)).

SPECIAL PRECAUTIONS FOR PEOPLE WITH PULMONARY EMBOLISM

Risk of developing another clot — People who have had a PE are at an increased risk for developing another blood clot, although this risk is significantly smaller when an anticoagulant is actively being used. Watch for signs of a new PE, including new chest pain with difficulty breathing, a rapid heart rate, or lightheadedness. Recurrent PE can be life-threatening and requires **immediate attention**. If you have any of these symptoms, call for help right away (In the United States and Canada, call 9-1-1 for an ambulance.)

Bleeding risk — Anticoagulants such as heparin and [warfarin](#) can have serious side effects and should be taken **exactly** as directed. If you forget or miss a dose, call your healthcare provider or clinic for advice. Do not try to take an extra dose or change the dose yourself unless your doctor specifically tells you to. If you get a refill of your medication and the pills or tablets look different from the last bottle, let your doctor or pharmacist know right away. If you take warfarin, there are other things you need to be aware of as well; these are discussed in detail in a separate topic review. (See "[Patient education: Warfarin \(Beyond the Basics\)](#)".)

You are more likely to bleed easily while taking anticoagulants. Bleeding may develop in many areas, such as bleeding from the nose or gums, excessive menstrual bleeding, bleeding in the urine or feces, bleeding or excessive bruising of the skin, or vomiting material that is bright red or looks like coffee grounds. In some cases, if there is internal bleeding, you may not notice right away. Bleeding inside the body can cause you to feel faint, or have pain in the head, back, or abdomen. Call your healthcare provider right away if you have these symptoms. It's also important to call immediately if you have an injury that could cause internal bleeding, such as a fall or a car accident. Even minor head injuries can be dangerous for people on anticoagulants and should be evaluated by a doctor.

Wear an alert tag — While you are taking anticoagulants, wear a medical bracelet, necklace, or similar alert tag that includes the name of your anticoagulant at all times. If you end up needing treatment and are unable to explain your condition, the tag will alert responders that you are on an anticoagulant and at risk of excessive bleeding. Many anticoagulants have good antidotes or reversal agents available, so it is important for responders to know the name of the anticoagulant you are taking.

The alert tag should list your medical conditions as well as the name and phone number of an emergency contact. One device, Medic Alert, provides a toll-free number that emergency medical workers can call to find out your medical history, list of medications, family emergency contact numbers, and healthcare provider names and numbers. You can also store this information in your smartphone, if you have one.

Reduce the risk of bleeding — Some simple modifications can limit the risk of bleeding at home:

- Use a soft bristle toothbrush.
- Use a humidifier to help reduce nosebleeds (if you live in a cold or dry climate).
- Take care when using scissors or knives.
- Avoid potentially harmful activities (eg, contact sports, skiing).
- Do not take [aspirin](#) or other NSAIDs (eg, [ibuprofen](#), Advil, Aleve, Motrin) while taking [warfarin](#) (unless specified by your clinician). Other nonprescription pain medications, such as [acetaminophen](#) (sample brand name: Tylenol), may be a safe alternative.

WHERE TO GET MORE INFORMATION

Your healthcare provider is the best source of information for questions and concerns related to your medical problem.

This article will be updated as needed on our web site (www.uptodate.com/patients). Related topics for patients, as well as selected articles written for healthcare professionals, are also available. Some of the most relevant are listed below.

Patient level information — UpToDate offers two types of patient education materials.

The Basics — The Basics patient education pieces answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials.

[Patient education: Deep vein thrombosis \(blood clot in the leg\) \(The Basics\)](#)

[Patient education: Pulmonary embolism \(blood clot in the lung\) \(The Basics\)](#)

[Patient education: Pleuritic chest pain \(The Basics\)](#)

[Patient education: Anticoagulant medicines – Uses and kinds \(The Basics\)](#)

[Patient education: How to take anticoagulants safely \(The Basics\)](#)

[Patient education: IVC filter placement \(The Basics\)](#)

[Patient education: How to give an anticoagulant shot \(The Basics\)](#)

[Patient education: Warfarin and your diet \(The Basics\)](#)

[Patient education: D-dimer test \(The Basics\)](#)

[Patient education: Lowering the risk of a blood clot \(The Basics\)](#)

[Patient education: Clot-dissolving medicines for heart attack or stroke \(The Basics\)](#)

Beyond the Basics — Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are best for patients who want in-depth information and are comfortable with some medical jargon.

[Patient education: Deep vein thrombosis \(DVT\) \(Beyond the Basics\)](#)

[Patient education: The nephrotic syndrome \(Beyond the Basics\)](#)

[Patient education: Antiphospholipid syndrome \(Beyond the Basics\)](#)

[Patient education: Warfarin \(Beyond the Basics\)](#)

Professional level information — Professional level articles are designed to keep doctors and other health professionals up-to-date on the latest medical findings. These articles are thorough, long, and complex, and they contain multiple references to the research on which they are based. Professional level articles are best for people who are comfortable with a lot of medical terminology and who want to read the same materials their doctors are reading.

Factor V Leiden and activated protein C resistance

Anticoagulation during pregnancy and postpartum: Agent selection and dosing

Deep vein thrombosis in pregnancy: Clinical presentation and diagnosis

Venous thromboembolism in pregnancy: Prevention

Venous thromboembolism in pregnancy and postpartum: Treatment

Clinical presentation, evaluation, and diagnosis of the nonpregnant adult with suspected acute pulmonary embolism

Clinical presentation and diagnosis of the nonpregnant adult with suspected deep vein thrombosis of the lower extremity

Approach to thrombolytic (fibrinolytic) therapy in acute pulmonary embolism: Patient selection and administration

Placement of vena cava filters and their complications

Prevention of venous thromboembolism in adults undergoing hip fracture repair or hip or knee replacement

Epidemiology and pathogenesis of acute pulmonary embolism in adults

Overview of the causes of venous thrombosis

Heparin and LMW heparin: Dosing and adverse effects

Treatment, prognosis, and follow-up of acute pulmonary embolism in adults

Chronic thromboembolic pulmonary hypertension: Pulmonary thromboendarterectomy

Overview of the treatment of proximal and distal lower extremity deep vein thrombosis (DVT)

Venous thromboembolism: Initiation of anticoagulation

The following organizations also provide reliable health information.

- National Library of Medicine

(<https://medlineplus.gov/healthtopics.html>)

- National Heart, Lung, and Blood Institute

(www.nhlbi.nih.gov/)

- American Heart Association

(<https://www.heart.org/>)

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GRAPHICS

Tips to avoid lower leg swelling and deep vein thrombosis during prolonged travel

All travelers should consider the following recommendations for flights longer than six to eight hours:

- Stand up and walk around every hour or two
- Wear loose-fitting, comfortable clothing
- Flex and extend the ankles and knees periodically, avoid crossing the legs, and change positions frequently while seated
- Consider wearing knee-high compression stockings
- Avoid medications (eg, sedatives, sleeping pills) or alcohol, which could impair your ability to get up and move around

Graphic 71028 Version 7.0



