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## Deep Vein Thrombosis

Joint replacement surgery, especially in the lower extremities, is becoming more common. Orthopaedic surgeons performed about 520,000 hip replacements and about 581,000 knee replacements in 2006 (Source: National Center for Health Statistics; Centers for Disease Control and Prevention; 2006 National Hospital Discharge Survey.) The vast majority of these surgeries are very successful, and patients go on to live fuller, more active lives without pain.

But no operation is without risks. One of the major risks facing patients who undergo surgery in the lower extremities is a complication called deep vein thrombosis, a form of venous thromboembolic disease.

### Cause

Deep vein thrombosis (DVT) refers to the formation of a thrombus (blood clot) within a deep vein, commonly in the thigh or calf.

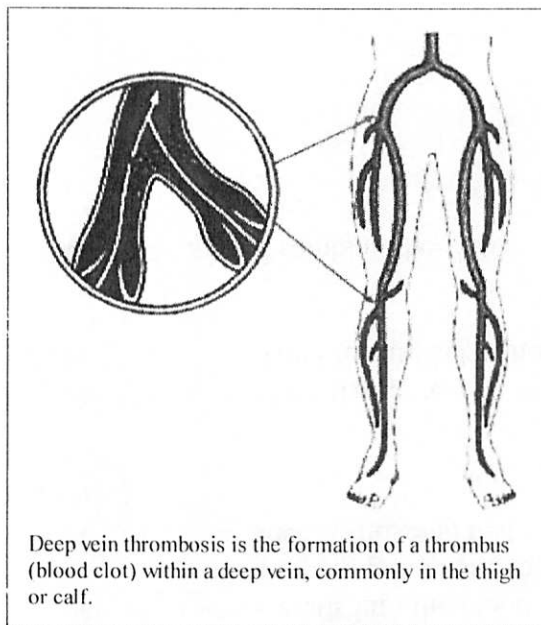
### Contributing Factors

Although venous thromboembolic disease can develop after any major surgery, people who have surgery on the lower extremities are especially vulnerable.

Three factors contribute to formation of clots in veins:

#### 1. Stasis, or stagnant blood flow through veins

This increases the contact time between blood and vein wall irregularities. It also prevents naturally occurring anticoagulants from mixing in the blood. Prolonged bed rest or immobility promotes stasis.



## **2. Coagulation**

Coagulation is encouraged by the presence of tissue debris, collagen or fats in the veins. Orthopaedic surgery often releases these materials into the blood system. During hip replacement surgery, reaming and preparing the bone to receive the prosthesis can also release chemical substances (antigens) that stimulate clot formation into the blood stream.

## **3. Damage to the vein walls**

This can occur during surgery as the physician retracts soft tissues as part of the procedure. This can also break intercellular bridges and release substances that promote blood clotting.

Other factors that may contribute to the formation of thrombi in the veins include:

- Age
- Previous history of DVT or PE
- Metastatic malignancy
- Vein disease (such as varicose veins)
- Smoking
- Estrogen usage or current pregnancy
- Obesity
- Genetic factors

## **Consequences**

The formation of blood clots can have two serious consequences:

1. If the thrombus partially or completely blocks the flow of blood through the vein, blood begins to pool and build-up below the site. Chronic swelling and pain may develop. The valves in the blood vessels may be damaged, leading to venous hypertension. A person's ability to live a full, active life may be impaired.
2. If the thrombus breaks free and travels through the veins, it can reach the lungs, where it is called a pulmonary embolism (PE). A pulmonary embolism is a potentially fatal condition that can kill within hours.

## **Symptoms**

After hip surgery, thrombi often form in the veins of the thigh. These clots are more likely to lead to PE. After knee surgery, most thrombi occur in the calf. Although less likely to lead to PE, these clots are more difficult to detect.

Fewer than one third of patients with DVT present with the classic signs of calf discomfort, edema, distended veins, or foot pain.

## **Diagnosis**

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Diagnosing DVT is difficult. Current diagnostic techniques have both advantages and disadvantages. The most commonly used diagnostic tests include venography, duplex or Doppler ultrasonography, and magnetic resonance imaging (MRI).

## **Venography**

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Venography uses a radiographic material injected into a vein on the top of the foot. The material mixes with blood and flows toward the heart. An X-ray of the leg and pelvis will then show the calf and thigh veins and reveal any blockages.

Although venography is very accurate and can detect blockages in both the thigh and the calf, it is also costly and cannot be repeated often. In addition, the injected material may actually contribute to the creation of thrombi.

### ***Duplex Ultrasonography***

Duplex ultrasonography can also be very accurate in identifying clogged veins. Projected sound waves bounce off structures in the leg and create images that reveal abnormalities. The addition of color Doppler imaging improves accuracy.

This test is noninvasive and painless, requires no radiation, can be repeated regularly, and can reveal other causes for symptoms. It also costs substantially less than venography. However, it is technically demanding and requires a skilled, experienced operator to obtain the most accurate results.

Ultrasonography is less sensitive in detecting thrombi in the calf and it has limited ability to directly image the deep veins of the pelvis.

## **Prevention**

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Both DVT and PE may be asymptomatic and difficult to detect. Thus, physicians focus on preventing their development by using mechanical or drug therapies. Without this preventive treatment, as many as 80 percent of orthopaedic surgical patients would develop DVT, and 10 percent to 20 percent would develop PE. Even with these preventative therapies, DVT and subsequent PE remain the most common cause for emergency readmission and death following joint replacement.

Prevention is a three-pronged approach designed to address the issues of stasis and coagulation. Usually, several therapies are used in combination. For example, a patient may be fitted with graded compression elastic stockings and an external compression device upon admittance to the hospital; movement and rehabilitation begin the first day after surgery and continue for several months; anticoagulant therapy may begin the night before surgery and

## **Early Movement and Rehabilitation**

With hospital stays averaging just four to seven days after an arthroplasty on the lower extremity, early movement is imperative as well as beneficial. Physical therapy, including joint range of motion, gait training and isotonic/isometric exercises, usually begins on the first day after the operation. Pain relievers administered intravenously also facilitate early mobilization.

## **Mechanical Prophylaxis**

Mechanical preventatives are usually used in combination with other therapies. They include:

- Lower extremity exercises such as simple leg lifts, elevating the foot of the bed, and active and passive ankle motion to increase blood flow through the femoral vein.
- Graded compression elastic stockings, which are more effective in preventing thrombi formation in the calf than in the thigh.
- Continuous passive motion, which is a logical treatment, but has not been proven effective in preventing the development of DVT.
- External pneumatic compression devices that apply pulsing pressures similar to those that occur during normal walking. They can help reduce the overall rate of DVT occurrence when used with other therapies, but they are difficult to apply and patient compliance is often a problem.
- In rare cases, a filter device may be placed in one of the large veins to prevent migration of clots..

## ***Pharmacologic Prophylaxis***

The use of anticoagulant pharmacologic agents includes an inherent risk of increased bleeding, which must be measured against their effectiveness in preventing clot formation. The most common anticoagulants are aspirin, warfarin (also called coumadin), and heparin.

### ***Aspirin***

Aspirin is easy to administer, costs little, has few bleeding complications, and does not need to be monitored. However, it has not been proven more effective than other agents and may not be advisable for all patients. Studies have shown that aspirin has a greater protective effect for men than for women.

### ***Warfarin (also called Coumadin)***

Warfarin is the most commonly used agent for hip and knee replacement patients. Warfarin interferes with vitamin K metabolism in the liver to prevent formation of certain clotting factors. Because warfarin takes at least 36 hours to start working, and four to five days to reach its maximum effectiveness, it is usually started the day before surgery. Low doses are used because higher doses can cause episodes of bleeding, but the dose response is difficult to predict and warfarin must be administered through an outpatient clinic. Warfarin can cause fetal damage.