CHAPTER
DEEP VEIN THROMBOSIS AND STROKE
(1 CONTACT HOUR)
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Learning objectives

- Differentiate among the different types of venous thrombosis.
- Describe the pathophysiology of thrombus formation.
- Identify risk factors for deep vein thrombosis.
- Explain how deep vein thrombosis is diagnosed.
- Discuss treatment options for DVT.
- Identify ways to prevent the development of DVT.

Introduction

Ms. Penny is a 70-year-old retired chemist. She suffered a right hemisphere stroke two weeks ago. Her mobility and extremity movement are quite limited due to paralysis of her left arm and leg. While performing passive range of motion to affected extremities, her nurse notices that Ms. Penny’s left calf is warm to the touch and slightly swollen. Ms. Penny moans when her leg is moved and says, “It hurts.” The nurse suspects deep vein phlebitis and possibly deep vein thrombosis. She immediately calls Ms. Penny’s physician to report her findings.

About six months ago, Mr. Weaver was treated for deep vein thrombosis. He was treated successfully and returned to his normal activities. Last night, however, Mr. Weaver awakened from a deep sleep incoherent and unable to move his right arm and leg. Upon arrival at the emergency department, he is diagnosed with an ischemic stroke. It is believed that Mr. Weaver’s history of deep vein thrombosis is linked to the occurrence of his stroke.

Most strokes are associated with blood clots in arteries, not veins. However, current research indicates that deep vein thrombosis (DVT) may actually increase the risk for stroke.5 Additionally, impairment of mobility that often accompanies stroke increases the risk for DVT.1 It is important for health care professionals to recognize the implications of DVT as both a risk factor for and a consequence of stroke.

Types of venous thrombosis

Thrombophlebitis is an acute problem characterized by inflammation of veins and the formation of thrombi. Affected veins may be deep or superficial (subcutaneous).2,6 There are a number of terms that relate to this condition. Health care professionals must be able to define these terms and differentiate among the various types of venous thrombosis:

- **Phlebitis:** Phlebitis refers to inflammation of the wall of a vein. Clinically, phlebitis indicates a condition that is localized and superficial. It is generally treated by applying heat.6
- **Superficial thrombophlebitis:** Superficial thrombophlebitis is generally self-limiting and rarely causes pulmonary embolism.2 It is characterized by a clot that forms in a vein secondary to phlebitis or as the result of partial vein obstruction. Its most common sites are the greater or lesser saphenous veins in the legs.5
- **Phlebothrombosis:** Phlebothrombosis is the formation of a thrombus or of thrombi in a vein. Formation is due to stasis, vein wall damage or abnormalities, and clotting mechanism abnormalities. Phlebothrombosis may affect both superficial and deep veins, but the most commonly affected veins are deep veins of the lower extremities.2,6
- **Deep vein thrombosis (DVT):** DVT is thrombosis of deep veins that can lead to pulmonary embolism.6
- **Chronic venous insufficiency:** Chronic venous insufficiency occurs when the valves of the veins are damaged or destroyed by deep vein thrombophlebitis. It occurs most often in the iliac and femoral veins and, on occasion, in the saphenous veins. Signs include edematous chronic swelling of the affected leg, tissue fibrosis, induration, skin discoloration, and stasis ulcers around the ankle.2

Pathophysiology

DVT is usually due to three factors known collectively as Virchow’s triad.

- Damage to the blood vessel endothelium.
- Accelerated blood clotting.
- Reduced blood flow.

Clinical tip: In most cases, two of the three factors of Virchow’s triad are present before the development of a thrombus.5

The pathophysiological process of thrombus formation involves changes in the epithelial lining that cause platelet aggregation. Along with this aggregation, the fibrin of red blood cells, white blood cells and additional platelets becomes entrapped.2,6,7 Clot formation is quicker in locations where the flow of blood is slower because this allows for more contact between platelet and thrombin accumulation.2

As the thrombus grows, a chemical inflammatory process in the epithelium of the affected blood vessel causes fibrosis. The clot may grow to a size that enables it to partially or completely block the affected blood vessel. Or the clot may detach itself from the vessel and travel and lodge elsewhere in the circulatory system (embolism).2

Clinical tip: If the embolism travels to and lodges in the cerebral circulation, an ischemic stroke occurs.2

Incidence

It is estimated that DVT occurs in about 80 of every 100,000 persons. Risk increases with age, and incidence is slightly higher in men than in women.2

Risk factors and causes

Superficial thrombophlebitis occurs as the result of:

- Trauma.
- Infection.
- IV drug abuse.
- Chemical irritation of veins following significant use of the IV route for medications and diagnostic tests.

High risk factors for the development of DVT include:2,6

- History of venous insufficiency (abnormality of the circulatory system distinguished by a decrease in return of venous blood from the legs to the trunk of the body; signs include edema, pain, varicosities, and ulceration).5
- Trauma to the lower extremities such as fractures, cast application, and joint replacements.
- Problems that lead to protracted bed rest such as traction, end-of-life stage of diseases, heart attack, sepsis, and HIV/AIDS.
- Surgery, especially if the patient is over the age of 40.
- Obesity.
- Smoking.
- Malignancy.
- Coagulation problems.

Other problems and conditions that contribute to the development of DVT include:

- Venous stasis. Venous stasis is a condition characterized by slowed or halted blood flow through a vein.5 Factors that contribute to the development of venous stasis include surgery, childhood, or bed rest.6
- Conditions or occupations that lead to prolonged sitting.6
- Injury or trauma to veins.2,6
- Expansion of an infection of tissues that surround veins.2,6
- Continuous venous pressure exerted by tumors, aneurysms, or excessive weight gain during pregnancy.6
- Hypercoagulability.6

Complications of DVT include pulmonary embolism and chronic venous insufficiency.2

Stroke patients are also at risk for the development of DVT when their mobility is impaired or when they remain in one position for prolonged periods of time.1,5 Conversely, some researchers are investigating whether DVT may be associated with greater risk of heart attack and stroke, especially in the first year following DVT.7

A 2007 Danish study of 205,000 adults 40 years of age and older was conducted to investigate whether DVT clots can “follow” years later in arteries, leading to heart attacks and strokes. The study group consisted of 26,200 DVT patients, almost 17,000 pulmonary embolism patients, and more than 163,000 persons with no history of DVT or pulmonary embolism. Participants were followed for up to 20 years, and during the study heart attacks and strokes were most common among the patients who had had DVTs and...
pulmonary emboli. The occurrence was greatest during the first year after the DVT or pulmonary embolism. The connection between DVT and stroke risk was not clarified, but these findings suggest a need for more research on this topic.3

**Diagnosis**

**Signs and symptoms**

Diagnosis generally begins with a review of patient signs and symptoms. DVT may be asymptomatic, but more often produces recognizable signs and symptoms. It is important to be able to recognize both superficial thrombophlebitis and DVT.

Superficial thrombophlebitis causes along the length of the affected vein.2,6
- Heat.
- Swelling.
- Pain.
- Induration.
- Erythema.

DVT may be asymptomatic or cause in the affected extremity.2,6
- Significant pain.
- Fever.
- Chills.
- Malaise.
- Swelling.
- Cyanosis.

**Clinical tip:** The primary sign of DVT is sudden onset of unilateral edema of the affected extremity.6

**Assessment**

Assessment of the patient includes the following factors.2,6
- Obtain history of signs and symptoms and any risk factors for DVT.
- Observe for signs of venous obstruction, including edema, hardened skin and swelling.
- Compare affected and unaffected extremities for changes in temperature.
- Measure and record circumference of both legs to provide a baseline for comparison and a baseline of the affected extremity. Measure the circumference, at the widest portions, of the ankle, calf and thigh. Mark the leg with a black felt-tip pen or other marker so that measurements can be taken at the same points consistently. Measurements should be taken at the same time every day.
- Assess for pain in the calf when the foot is dorsiflexed (backward flexion of the foot) with the knee flexed. This procedure is referred to as the Homan’s sign. A positive sign may suggest DVT. However, Homan’s sign is not specific and has a rather low sensitivity for reliably detecting DVT.

**Clinical tip:** Be sure to observe all IV peripheral sites for symptoms of infection and infection and signs of superficial phlebitis.8

**Diagnostic tests**

- Coagulation profiles are performed to assess coagulation status. Studies include PT, PT/INR, circulating fibrin, antithrombin III levels, serum fibrin, and monomer complexes.6
- Impedance plethysmography: Plethysmography is usually done to rule out occlusive disease of the lower extremities.9 Impedance plethysmography is a noninvasive assessment or measurement of alterations in calf volume that correspond to alterations in blood volume caused by temporary venous occlusion. This temporary venous occlusion is produced by the application of a high-pneumatic cuff. Electrodes measure electrical impedance while the cuff is being deflated, and a slow decrease in impedance suggests diminished blood flow linked to thrombus.6
- RF testing: RF testing involves the intravenous administration of radioactive fibrinogen (RF). Nuclear scanning is conducted at 12 to 24 hours. If a thrombus is present, RF is concentrated at the location of clot formation.6
- Venography: Venography is an x-ray with contrast dye. It is performed to identify and locate thrombi in the venous circulation.9 Contrast dye is injected intravenously. Venous circulation is visualized and thrombi are noted and their location identified.8
- Venous duplex/color duplex ultrasound: This is a commonly performed, noninvasive procedure that facilitates visualization of thrombi. It is called duplex because it combines the advantages of Doppler with B-mode scanning.9 This diagnostic test is most useful in the detection of thrombi in the lower extremities.6

**Comparison of venous and arterial occlusion obstruction**

It is important for the clinician to be able to differentiate between venous and arterial occlusion obstruction. The 9th edition of The Lippincott Manual of Nursing Practice offers the following differentiation factors.6
- Venous obstruction: Venous obstruction can have a gradual onset, causing the skin to become warm and slightly cyanotic. There is no change in the hair and nails of the affected leg, but it may become enlarged. Edema is generally found in the calf to the mid-foot. Sensation and arterial pulses remain normal. Elevating the affected leg results in slight improvement of clinical signs.
- Arterial obstruction: Arterial obstruction may have an abrupt onset, causing the skin to become pale at first, and as the obstruction persists, leads to a mottled and cyanotic appearance. The size of the affected leg may actually be reduced, hair is decreased, and nails become thick and brittle. There is no or only mild edema. There are sensory changes in the affected leg and deficits in arterial pulses. Elevating the affected leg makes the problem worse.

**Treatment**

Desired treatment outcomes are to control development of thrombi, prevent complications, prevent additional thrombus formation, relieve pain, and limit valvular damage.2,6

**Anticoagulation therapy**

Anticoagulation therapy is administered to increase clotting time. Initial treatment with heparin is begun, followed later with warfarin.2 Unfractionated heparin (UFH) may be administered intravenously initially, followed by three to six months of oral anticoagulant therapy. Low molecular weight heparin (LMWH) is given in cases of “isolated” DVT, and if patients and family members are adequately educated, LMWH may be administered at home. This, too, is followed by three to six months of oral anticoagulant therapy.6

Both UFH and LMWH may be administered via the subcutaneous route as a prophylactic initiative to prevent DVT. This is especially likely following surgery or for patients who are immobile.6

**Clinical tip:** Fondaparinux may also be used for treatment and is administered subcutaneously.6,10

**Clinical tip:** Streptokinase, once used in life-threatening situations or when patients were in danger of losing limbs, is not used in current practice because of the associated risk of complications.11

**Supportive measures**

Bed rest, once a common mandate for patients with DVT, is now used primarily when the patient is receiving UFH. Otherwise, after acute concerns have subsided, when LMWH is used or in cases of superficial thrombosis, the patient is encouraged to walk.6

Elevation of the affected extremity to at least 10 to 20 degrees above the level of the heart is recommended. Such elevation should improve venous return as well as decrease swelling of the affected limb.2,6 The popliteal space (space at the back of the knee) should never be constricted. Instead, it should be gently supported. If an upper extremity is affected, a sling may be used to help elevate the arm.6

Warm moist soaks, hydrotherapy and whirlpool baths may be used as supportive measures. Dry heat in the form of ultrasound, heating pad, or warm water bottles may be used.2,6

**Clinical tip:** When applying moist or dry heat, clinicians must monitor the temperature of the heat being applied with extreme care to avoid burning the patient. Careful monitoring of the skin exposed to the heat must also be monitored.11

Compression is applied to enhance venous return and reduce swelling as well. There are a few options for compression. These include:2,6
- Application of pneumatically or electrically controlled stockings or boots, or if the arm is affected, the application of a sleeve.
- Compression stockings or garments may be applied after the acute phase of DVT is resolved. These are generally used for patients who are at high risk and immobile or at restricted mobility. Stockings apply 20 to 30 mm Hg pressure at the ankle, 15 to 20 mm
Hg pressure at the lower calf, 12 to 18 mm Hg at the upper calf, and five to 10 mm Hg at the upper thigh.

Analgesics may be administered for pain relief. Reduction of pain will not only make the patient more comfortable but enhance his or her ability to actively participate in the plan of care.

Complications
Patient care providers must be aware of the potential for bleeding with anticoagulant therapy as well as the development of a pulmonary embolus. The patient should be monitored for signs and symptoms of bleeding, such as dark, tarry stools, coffee-ground vomitus, and ecchymoses. Patients and their families should be taught to watch for signs of bleeding and to avoid analgesics that contain aspirin, which increases the risk for bleeding.2

Patients must also be monitored for signs of pulmonary embolus, such as:2

- Dyspnea.
- Anxiety.
- Alterations in mental status.
- Restlessness.
- Hypotension.
- Crackles upon respiratory auscultation.

Prevention of DVT
The best way to treat DVT is to prevent it! Anyone can develop DVT, but high-risk populations, including recovering stroke patients, should be stringently monitored and taught ways to avoid DVT.

Here are some tips for preventing DVT:2,4,6

- Following major abdominal or pelvic surgery, administer, as ordered, prophylactic doses of anticoagulants.
- Encourage ambulation.
- Teach patients to avoid prolonged periods of standing or sitting.
- If mobility is compromised, help patients change position at least every two hours.
- Assist patients with range of motion exercises. Teach patients and families how to perform range of motion. If, as in the case of stroke patients, paralysis or weakness of extremities is present, patients and families should be taught how to perform passive range of motion on those limbs.
- Apply compression stockings or garments as ordered as a prophylactic measure.
- Teach patients and families how to properly apply compression stockings or garments.
- Recognize other risk factors for DVT and help patients to reduce modifiable risk factors. For example, facilitate weight reduction programs if patients need to lose weight. Help patients to access programs designed to help them stop smoking.
- Be alert for the development of DVT in patients who have experienced leg trauma.

Conclusion
Stroke patients are at risk for the development of DVT because of the compromised mobility that is often a consequence of stroke. Their risk is further increased if they are obese or smoke.

Health care providers should obtain measurements at the widest points of extremities to have a baseline reading. Such a baseline will help if DVT is later suspected.

It is also important that patient care providers be able to differentiate among the different types of thrombosis and between arterial and venous obstruction.

When administering anticoagulant therapy, patient care providers should monitor patients for signs of bleeding and teach patients and families how to recognize such signs. Many ischemic stroke patients go home on anticoagulant therapy and need to know how to recognize the signs of bleeding.

Finally, patients and families should be taught about the risk factors for the development of DVT and how to reduce their risks.

References