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Purpose and Goals

The goal of this course is to educate nurses and other healthcare professionals to understand the causes, treatment, and prevention of VTE and to promote the safety of the patients under their care.

Instructional Objectives

Upon completion of this course, the learner will:

1. Define VTE, DVT, and PE.
2. Outline the pathophysiology of DVT and PE.
3. List risk factors for VTE.
4. Summarize the signs and symptoms of DVT and PE.
5. Outline diagnostic procedures for DVT and PE.
6. Compare anticoagulation therapies for DVT.
7. Explain prophylaxis treatments for VTE.
8. Utilize patient education materials to instruct patients on measures to prevent VTE incidents.
9. Summarize clinical practice guidelines established for diagnosis, therapy and prevention of DVT.

Introduction

Deep vein thrombosis, or DVT, is a blood clot that occurs in a deep vein of the body: pulmonary embolism, also known as PE, occurs when a clot breaks free from another location in the body and enters the arteries of the lungs. The consequences of VTE are staggering.

Incidence

The CDC Public Health Grand Rounds session January 2013, revealed that estimates of the number of people in the U.S. affected by a DVT/PE each year range from 350,000-900,000. DVT was diagnosed in about 350,000 hospitalizations annually, and PE was diagnosed in almost 300,000 hospitalizations each year.

Although researchers and healthcare providers have made strides in the prevention and treatment of VTE, PE remains the most common preventable cause of hospital death: More than 150,000 patients die each year in the United States from PE, and those who survive may be affected by the event for the rest of their lives. Up to one-half of all VTEs occur during or soon after hospitalizations, and VTE is one of the most frequent serious adverse events in hospitals. Many VTEs can be prevented if hospitals educate providers and patients, systematically assess risks for clotting and bleeding, and prescribe risk-appropriate prevention strategies.

Most patients (up to 75%) with DVT are asymptomatic; however, the somewhat benign nature of DVT can be misleading. One third of fatal PEs arose directly from DVT in calf veins. And 20-50% of people who experience a DVT develop long-term complications. VTE is either among the top five or top three causes of death in the United States.

As far as cost and cost-effectiveness are concerned, it is estimated that the United States spends $5–$8 billion in direct medical costs on VTE each year, not including the costs of long-term complications, according to Gary Raskob, PhD, Dean of the College of Public Health, University of Oklahoma.

VTE will continue to be a major medical concern for many healthcare professionals in the coming years. According to some experts, as the average age of the U.S. population increases, the cases of VTE will outpace the population growth, unless preventative action is taken. Therefore, it is vital that patients, healthcare providers, and other stakeholder groups work together to reduce or even eliminate the number of cases of VTE.

History

The first documented DVT is thought to have occurred in the 13th century, in the leg of a 20-year-old male. At some point, the increased incidence of DVT in women after childbirth was noticed, and in the late 1700s, a public health recommendation was issued to encourage women to breast feed as a means to prevent this phenomenon; the DVT was called “milk leg”, as it was thought to result from milk building up in the leg.

Rudolf Virchow

In 1856, German physician and pathologist Rudolf Virchow published what is referred to as Virchow’s triad, Figure I, the three major causes of thrombosis. The triad provides the theoretical framework for the current explanation of venous thrombosis, although it was focused on the effect of a foreign body in the venous system and the conditions required for clot propagation.

Multiple pharmacological therapies for DVT were introduced in the 20th century: oral anticoagulants in the 1940s.
Pathophysiology

DVT often develops in the calf veins and “grows” in the direction of venous flow, towards the heart. DVT is thought to arise from a combination of factors known as Virchow’s triad—venous stasis, vein wall injury or dilation, and hypercoagulability. Venous stasis occurs with immobility or an obstruction in the central venous system. Immobility occurs in a variety of people and situations, from healthy people who sit in one position for a length of time, such as on an airplane, to those who undergo general anesthesia for a medical procedure to those who are completely bedridden. The lack of mobility results in a slow flow of blood, which increases the viscosity of the blood. Microthrombi, which normally would be removed by fluid movement, increase in size and propagate in the vessels.

Risk Factors

The majority of DVT and PE are related to specific triggering events, such as hospitalization, major surgery, prolonged periods of immobility, and trauma.

Hospitalization is a major risk factor for preventable VTE. In fact, some experts consider hospitalization the single most important risk factor for developing DVT/PE. Much of the risk is applied to patients who undergo major surgery. In addition, many hospitalized patients have comorbidities such as cancer and infection that increase their risk for VTE. In the absence of appropriate VTE prophylaxis, 10–40% of med-surg patients and 40–60% of patients who undergo major orthopedic surgery develop thrombosis.

Surgery as well as trauma causes injury to body tissues, which causes the body’s clotting process to go into effect, increasing the risk of a blood clot. Figure 2. Blood clots caused by trauma and surgery occur relatively quickly. Some occur during or within a few hours of surgery, however, most develop within 2 weeks of surgery. DVT/PE also can occur up to several months after surgery or major trauma.

Certain medical conditions, including the following, also increase the risk of DVT:
• Prior history of these conditions
• Active cancer
• Acute infection or sepsis
• Neurological impairment with lower extremity weakness
• Long-bone fractures
• Chronic kidney disease
• Dehydration
• Acute myocardial infarction
• Congestive heart failure

Nursing home residents are more than twice as likely as nonresidents of nursing homes to have a DVT/PE. In fact, this population accounts for more than 13% of all VTE that occur outside of the hospital.

Those who have had a DVT or PE are at increased risk for another clot. Almost 30% of those who have a DVT will suffer from another clot within 10 years.

Other risk factors include age, gender, and ethnicity. People ages 60 and older are hospitalized with VTE more so than their younger peers. Gender also affects risk, although not as much as age. Women have a higher incidence of DVT during their childbearing years, and pregnant women are especially at risk. After the age of 50, men are at greater risk than women for VTE. For reasons that are not completely understood, ethnicity plays a role in risk. African Americans and Caucasians tend to have a greater risk for VTE than Asian or Native American people. Genetic conditions can increase risk of DVT/PE. Genetic thrombophilia and Factor V Leiden are inherited blood-clotting disorders that make sufferers more susceptible to DVT/PE.

Signs and Symptoms

Signs and symptoms of VTE depend on the location of the embolus. DVT produces signs and symptoms of inflammation...
and occlusion: pain, swelling, warmth, tenderness, and cyanosis or redness of the affected extremity and low-grade fever. Almost half of all DVT episodes produce few, if any, symptoms. DVT is a short-lived episode (i.e., the symptoms go away once the disease is successfully treated) for some patients; however, almost 30% of patients suffer chronic symptoms, including leg pain and swelling, recurrent skin breakdown, and painful ulcers. Of important note, Homan’s sign is no longer considered definitive for the presence or absence of a DVT.

Symptoms of PE include rapid-onset chest pain, shortness of breath with tachypnea, hemoptysis, tachycardia, syncope, and hypoxemia. Other symptoms include anxiety, hypotension, clammy skin, sweating, and leg pain. Some pulmonary emboli are small, and patients may show few or no symptoms. However, large pulmonary emboli are fatal and frequently cause sudden death. PE is considered a medical emergency.

Diagnosis

Diagnosis of DVT includes imaging tests of the affected leg with ultrasound. If ultrasound is not definitive, a venography may be done, in which dye is injected in the affected leg and x-ray images taken to reveal blood flow. In some cases, a CT or MRI may be taken. Blood may be drawn for a D-dimer, which can indicate the level of fibrin degradation products in the blood. A positive D-dimer may indicate clot formation. Other labs to assist in diagnosing DVT include a PT/INR, PTT and platelet count. Prothrombin Time/International Normalized Ratio is a measure of coagulopathy to determine the clotting tendency of blood. PT measures factors I (fibrinogen), II (prothrombin), V, VII, and X.

In the case of PE, the doctor may order a CT of the chest, a D-dimer, arterial blood gases, an ultrasound of the legs, and a lung ventilation/perfusion scan, or V/Q scan. A V/Q scan measures air and blood flow in the lungs. In the ventilation portion of the test, radioisotopes (a low-risk radioactive substance) are inhaled as a gas. For the perfusion scan, the radioisotopes are injected into a vein in the patient’s arm. Scanners use the energy released by the radioisotopes to create images of air and blood flow patterns in the lungs.

Treatment

For half a century, the standard therapy for most patients with pulmonary embolism has been the administration of heparin, overlapped and followed by a vitamin K antagonist. This regimen is effective but complex.

The goal of treatment for DVT is to prevent PE and reduce related complications of the clot. Anticoagulation is the initial treatment of choice for DVT. Current evidence-based guidelines recommend one of the following short-term anticoagulation options:

- Subcutaneous (SC) low-molecular-weight heparin (LMWH)
- Intravenous (IV) unfractionated heparin (UFH)
- Fixed-dose unfractionated heparin (FDUH)
- Fondaparinux (Arixtra) SC (a factor Xa inhibitor)

Initial treatment with LMWH, UFH, or fondaparinux should continue for at least 5 days, until the international normalized ratio (INR) is ≥2 for 24 hours. Before the introduction of LMWH products, UFH was the standard of care. Heparin prevents extension of thrombi and reduces the incidence of PE. However, heparin does not eliminate the risk of PE because it does not affect the existing thrombus; it only prevents it from growing.

When intravenous UFH is initiated for DVT anticoagulation, the goal is to achieve and maintain an elevated activated partial thromboplastin time (aPTT) of at least 1.5 times control. Heparin pharmacokinetics are complex, and the half-life is 60-90 minutes (follow hospital protocol for heparin infusions). Warfarin (Coumadin) therapy is overlapped with heparin for 4–5 days until the INR is therapeutic at 2–3.

Several LMWH preparations are available, including enoxaparin (Lovenox), dalteparin (Fragmin), and tinzaparin (Innohep). Dosing of enoxaparin for treatment of DVT is 1 mg/kg SC bid, with an overlap of warfarin for at least 5 days until the patient’s INR is ≥ 2 for 24 hours. If the INR does not reach 2 within 5 days, LMWH or fondaparinux should be continued.

Warfarin should be continued for at least 3 months and possibly longer, depending on the cause of DVT/PE and underlying risk factors. Patients with cancer, whose risk for VTE is greater, should receive LMWH for the first 3 to
6 months, followed by long-term therapy with warfarin or LMWH until the cancer is resolved. After the term of therapy, risk-benefit should be evaluated to determine if continued therapy is appropriate.

During treatment for DVT, once anticoagulation is started and symptoms are controlled, patients should be encouraged to ambulate. The patient should not be on strict bed rest for the duration of inpatient treatment.

Patients may be released home with outpatient treatment for DVT. Currently, the treatment of choice is SC LMWH either once or twice a day. Outpatient management of DVT is not recommended for patients with certain comorbidities, such as renal failure, and those with a suspected PE.

Patients with a PE may be administered tPA or streptokinase to dissolve the clot. It is imperative that patients receive emergency treatment for a PE, since life-saving measures may need to be taken.

In some cases, physicians may place an inferior vena cava (IVC) filter in the patient to block any clots from entering the heart. An IVC may be placed in patients who are unable to participate in anticoagulation therapy, although the use of IVC filters is controversial.

**FDA Warning/Regulatory Alert**

Note from the National Guideline Clearinghouse: Important revised regulatory and/or warning information has been released.

December 19, 2012 – Pradaxa (dabigatran etexilate mesylate): The U.S. Food and Drug Administration (FDA) is informing health care professionals and the public that the blood thinner (anticoagulant) Pradaxa (dabigatran etexilate mesylate) should not be used to prevent stroke or blood clots (major thromboembolic events) in patients with mechanical heart valves, also known as mechanical prosthetic heart valves. A clinical trial in Europe (the RE-ALIGN trial) was recently stopped because Pradaxa users were more likely to experience strokes, heart attacks, and blood clots forming on the mechanical heart valves than were users of the anticoagulant warfarin. There was also more bleeding after valve surgery in the Pradaxa users than in the warfarin users. Pradaxa is not approved for patients with atrial fibrillation caused by heart valve problems. FDA is requiring a contraindication (a warning against use) of Pradaxa in patients with mechanical heart valves.

**Bleeding Precautions**

Patients on anticoagulation therapy should be educated on bleeding precautions. To reduce the risk of bleeding, instruct patients to:

- Shave with an electric razor
- Use only a soft-bristle toothbrush
- Floss with waxed, rather than unwaxed, floss
- Avoid activities that may cause trauma
- Avoid taking aspirin or other NSAIDs unless directed to do so by a healthcare provider

**Complications**

Although people can recover fully from DVT, they may suffer long-term complications from the damage to the vessels caused by the clot. One third of people who have a DVT will be diagnosed with post-thrombotic syndrome (PTS), a condition in which damaged valves in the affect extremity lead to venous stasis. People with PTS have symptoms such as swelling, pain, and discoloration in the affected limb, and they may develop varicose veins. In severe cases, they develop thickened skin and ulcers on the extremity. In some cases, the symptoms can be so severe that a person becomes disabled. Some studies showed that one third of patients who experience DVT develop PTS within 5 years.

PE too often takes the lives of people suddenly; however, if the clot is small and the patient receives appropriate medical treatment, the patient can recover from the PE. However, PE can leave the lungs damaged. Survivors of PE must be vigilant for PE later because they are more likely to suffer another occurrence of PE than DVT.

A complication of heparin therapy is heparin-induced thrombocytopenia (HIT). In this condition, platelet aggregation triggers venous or arterial thrombosis. Any patient who develops thrombocytopenia during heparin therapy is at risk for HIT and alternatives to heparin should be considered.

**Prevention Is Key**

Depending upon the risk for DVT, different preventative measures are used. In ambulatory patients, exercise that contracts the leg muscles, such as walking, should be encouraged. Those with limited mobility, such as travelers on long flights, should be encouraged to perform chair exercises, such as raising and lowering heels from the floor while sitting in a chair. Have patients evaluate their lifestyle choices and make changes to lose weight, quit smoking, and maintain a healthy blood pressure. Patients should always take medications as directed by their physicians, and if they are on warfarin they should monitor their diet for foods high in Vitamin K, which can counteract the effects of the drug.

Nurses have a special role in prevention of VTE in hospitalized patients and those with limited mobility. Promote ambulation in all patients, and ambulate surgical patients soon after surgery. Encourage patients to engage in foot and ankle exercises if they are on bed rest and there are no contraindications to exercise.

Many DVT and PE events can be prevented in high-risk patients through appropriate administration of prophylaxis, which might include pharmacologic agents (e.g., antithrombotic agents) or mechanical devices, depending on the patient’s medical condition. Sequential compression devices (SCDs), foot pumps, or compression hose may be ordered for the patient. Remind patients to wear SCDs and foot pumps when they are in bed and remove them before ambulating.

Dosing of enoxaparin for prophylaxis in nonpregnant adults is either 30 mg SC bid or 40 mg SC daily, depending on the patient’s medical status, with adjustments made for renal patients. Rivaroxaban (Xarelto) is an oral factor Xa inhibitor indicated for prophylaxis of DVT and PE in patients following hip or knee replacement surgery. Be sure to assess for signs of bleeding in patients receiving pharmaceutical prophylaxis.

**Recent Medication Options**

Recently developed oral anticoagulants that are directed against factor Xa or thrombin, overcome some limitations of standard therapy, including the need for injection and for regular dose adjustments on the basis of laboratory monitoring.
Xarelto (Rivaroxaban)
A fixed-dose regimen of rivaroxaban, an oral factor Xa inhibitor, has been shown to be as effective as standard anticoagulant therapy for the prophylaxis of deep vein thrombosis (DVT), which may lead to pulmonary embolism in patients undergoing knee or hip replacement surgery; to reduce the risk of stroke without the need for laboratory monitoring. This approach may also simplify the treatment of pulmonary embolism. For details go to http://www.drugs.com/ppa/rivaroxaban.html

In a randomized, open-label, trial of 4832 patients with acute symptomatic PE, with or without DVT, compared rivaroxaban (15mg PO, BID, x 3 weeks, followed by 20mg QD) with standard therapy with enoxaparin followed by an adjusted-dose vitamin K antagonist for 3, 6, or 12 months. Conclusions: A fixed-dose regimen of rivaroxaban alone was non-inferior to standard therapy for the initial and long-term treatment of pulmonary embolism and had a potentially improved benefit–risk profile.

BOXED WARNING
Discontinuing rivaroxaban places patients at an increased risk of thrombotic events such as stroke. If anticoagulation with rivaroxaban must be discontinued for a reason other than pathological bleeding, consider administering another anticoagulant. Epidural or spinal hematomas, which may result in long-term or permanent paralysis, have occurred in patients treated with rivaroxaban who are receiving neuraxial anesthesia or undergoing spinal puncture. Factors that can increase the risk of developing these hematomas include: use of indwelling epidural catheters, concomitant use of drugs affecting hemostasis such as NSAIDs, platelet inhibitors, or other anticoagulants, or history of traumatic or repeated epidural or spinal puncture, spinal deformity, or spinal surgery. Monitor patients frequently for neurological impairment. If neurological compromise is noted, urgent treatment is necessary. Consider risks/benefits before neuraxial intervention in patients anticoagulated or to be anticoagulated for thromboprophylaxis.

Patient Education
While in the hospital, patients should be educated about signs and symptoms of VTE and prophylaxis, if ordered. At discharge, patients should be educated on the signs and symptoms of VTE and told to consult a doctor immediately if they believe they have a DVT. If they feel sudden onset shortness of breath, experience a cough with bloody sputum, develop sudden onset chest pain or syncope, they should be instructed to call 911 for emergency assistance.

National efforts are aimed at reducing DVT in specific people. For example, a national campaign to reduce DVT in women, This Is Serious, was developed in partnership with the Vascular Disease Foundation and the Centers for Disease Control and Prevention.

Research Directions
Healthcare provider knowledge, beliefs, and attitudes play a significant role in the application of evidence-based guidelines. Provider-related barriers that contribute to the gaps in translation of guidelines into clinical practice include the following:

- Variability in knowledge of risk assessment and appropriate prophylaxis strategies
- Lack of belief and acceptance that the evidence presented in the guidelines for VTE prophylaxis is appropriate in all clinical situations (with a preference toward individualization of care). The perceived need for individualization is especially true in the care of medical patients.
- The patient can play an important role in the prevention of VTE; however, a US national survey reported that 74% of adults have little to no knowledge of DVT and its effects on health.

AHRQ Clinical practice guidelines reported in 2012, suggested the following:

**Guideline Objective(s)**
- To update evidence-based recommendations for the use of anticoagulant therapy for the management of thromboembolic conditions
- To offer guidance for many common anticoagulation-related management problems
- To optimize patient-important health outcomes and the processes of care for patients who have experienced or are at risk for thrombotic events
- To identify optimal strategies for the diagnosis of deep vein thrombosis (DVT) in ambulatory adults

Target Population
Ambulatory adult patients at risk for deep vein thrombosis (DVT), including pregnant women

Interventions and Practices Considered
1. Clinical assessment of pretest Probability of deep vein thrombosis (DVT)
2. D-dimer testing (moderately sensitive or highly sensitive)
3. Compression ultrasonography (CUS) of the proximal veins
4. Venography
5. Whole-leg ultrasound
6. Doppler ultrasound of the iliac veins
7. Magnetic resonance imaging
8. Considerations for pregnancy-related DVT and upper extremity DVT

Major Outcomes Considered
- Accuracy (sensitivity and specificity of diagnostic tests)
- Incidence of false-positive and false-negative results
- Fatal and nonfatal pulmonary embolism (PE)
- Fatal bleeding
- Nonfatal intracranial bleeding

Major, nonfatal, non-intracranial bleeding

For the complete guide visit www.guidelines.gov.

Also in 2012, two separate studies documented in the New England Journal of Medicine found a clinical benefit in taking aspirin to prevent recurrent VTE. For more information please see studies from New England Journal of Medicine in references and suggested readings.

Conclusion
VTE can devastate patients and their loved ones, and at times can even take their life. As healthcare providers, it’s frustrating to send a medical or surgical patient home, thinking they are cured, only to see the patient develop a DVT or die from a subsequent PE. An overall awareness in the general public as well as in patients and healthcare professionals can help to reduce or even eliminate VTE. DVT can be debilitating and costly, and at its worst it can lead to a fatal PE. Education and prevention techniques can preserve quality of life, and nurses play a key role in the effort.
References


Notes
What is DVT?
Deep vein thrombosis (DVT) occurs when an abnormal blood clot forms in a large vein. These clots usually develop in the lower leg, thigh, or pelvis, but can also occur in other large veins in the body. If you develop DVT and it is diagnosed correctly and quickly, it can be treated. However, many people do not know if they are at risk, don’t know the symptoms, and delay seeing a healthcare professional if they do have symptoms.

Can DVT Happen to Me?
Anyone may be at risk for DVT but the more risk factors you have, the greater your chance of developing DVT. Knowing the risk factors can help prevent DVT.

- Hospitalization for a medical illness
- Recent major surgery or injury
- Personal history of a clotting disorder or previous DVT
- Increasing age
- Cancer and cancer treatments
- Pregnancy and the first 6 weeks after delivery
- Hormone replacement therapy or birth control products
- Family history of DVT
- Extended bed rest
- Obesity
- Smoking
- Prolonged sitting when traveling (longer than 6 to 8 hours)

DVT symptoms and signs:
The following are the most common and usually occur in the affected limb:

- Recent swelling of the limb
- Unexplained pain or tenderness
- Skin that may be warm to the touch
- Redness of the skin

Since the symptoms of DVT can be similar to other conditions, like a pulled muscle, this often leads to a delay in diagnosis. Some people with DVT may have no symptoms at all.

DVT and Pulmonary Embolism (PE):
DVT can cause a life-threatening complication called pulmonary embolism (PE). Part or all of a clot can break off and travel through the bloodstream and into the lungs. A blood clot in the lungs can be life threatening and can cause death.

Symptoms of possible PE include:

- Recent or sudden shortness of breath
- Chest pain or discomfort, which worsens with a deep breath or coughing
- Coughing up blood
- Sudden collapse

If you have any of these symptoms, it is an emergency and you should seek medical help immediately.

What Can be Done to Prevent DVT and PE
Most DVT and PE can be prevented.

In General:
- Exercise regularly
- Maintain a healthy weight
- Don’t Smoke
- When sitting for long periods of time or when traveling for more than 6 hours:
- Exercise your legs frequently while you are sitting
- Get up and walk around every 2 to 3 hours
- Wear loose-fitting clothes
- Drink plenty of water, limit caffeine and alcohol

Before and during hospitalization:
- Before surgery, talk to your health provider about prevention of blood clots
- Tell your healthcare provider if you have any risk factors for DVT
- Ask questions
- If you have been confined to bed, move around as soon as possible
- After surgery or hospitalization for a medical illness, a small dose of anti-coagulant medication is often given to prevent DVT and PE

Diagnosing DVT and PE:
DVT is generally diagnosed using:

- Venous Doppler ultrasound—using sound waves to check the flow of blood in the veins

PE is generally diagnosed using:

- Computerized tomography (CT scan) of the lung, a special type of X-ray that can provide pictures of structures inside the body
- Ventilation-perfusion lung scan, a special test that shows how much blood is getting into the lungs

What is the treatment of DVT and PE?

DVT Treatment:

- Anticoagulants are also used to treat PE. In cases of severe PE, medicines (thrombolytics) may be given to dissolve the clot, followed by anticoagulants to prevent more clots from forming.
- Compression stockings, also called elastic stockings, are sometimes recommended to relieve pain and swelling after DVT.

PE Treatment:

- Anticoagulants are also used to treat PE. In cases of severe PE, medicines (thrombolytics) may be given to dissolve the clot, followed by anticoagulants to prevent more clots from forming.

More information about DVT symptoms, treatment and prevention and to take a free risk assessment visit www.thisisserious.org.