

**E**ach year, between 350,000 and 600,000 people develop deep vein thrombosis (DVT) or pulmonary embolism (PE), which are collectively known as venous thromboembolism (VTE). Deaths from VTE or PE, estimated at 100,000 per year, were shown to be the most common type of preventable hospital deaths according to the CDC, federal Department of Health and Human Services, FDA, and the Surgeon General.<sup>1,2</sup> Autopsy results show that as many as 60% of patients dying in the hospital have had a PE, but the diagnosis has been missed in about 70% of these cases. Hospitalized patients, depending on the acuity and diagnosis, have a 10% to 48% chance of developing a DVT if no prophylaxis is given.<sup>3</sup>

Because VTE has a huge effect on outcomes for patients and crosses the spectrum of age, sex, and gender, prevention truly is the best intervention. Screening patients and initiating prophylaxis appropriately is crucial. Prevention can cost about \$50 a day, and could save a life, or thousands of dollars spent on the ICU care, radiological studies, medication, monitoring, equipment, and increased length of stay required to treat VTE. Every member of the healthcare team should ensure that patients are screened daily, those at risk are identified, the appropriate healthcare providers are aware of which patients are at risk, and that orders for VTE prophylaxis are received and carried out.

In spite of all of the research, education, and media attention regarding VTE over the past several years, only one-third of the patients at risk for developing VTE receive thromboprophylactic treatment.<sup>3</sup> In this article, I'll review the pathophysiology of VTE, the latest prevention guidelines from the American College of Chest Physicians (ACCP), and nursing implications for preventing VTE.

# The latest on preventing venous thromboem

**Learn about the newest  
guidelines for striking back  
against a silent killer.**

By Karen Ruffin, RN, MSN Ed



**2.0**  
ANCC  
CONTACT HOURS

Inferior  
vena cava

Common  
iliac vein

External  
iliac vein

# bolism

● Common sites of deep vein thrombosis include deep veins in the legs and pelvis. A thrombus in one of those sites may embolize to the pulmonary arteries.

### Pathophysiology of VTE

A DVT is a blood clot that develops in the deep veins in the body, most commonly in the legs and thighs. When this clot breaks off it becomes an embolus that can travel to the lungs, causing a PE. Virchow identified three main factors that predispose individuals to thrombus formation—changes in the vessel wall, changes in blood flow, and changes in blood composition. These factors contribute to the development of a DVT. Let's take a closer look at each of Virchow's triad:

- *Changes in the vessel wall/vascular wall injury.* The endothelial cells lining the walls of blood vessels let blood flow with ease through the vascular system without clotting. In addition to modulating blood flow and vascular tone, these cells are involved in the immune response, coagulation, growth regulation, and production of extracellular matrix components.<sup>4</sup> One very important molecule that is synthesized in the endothelium is von Willebrand's factor, which facilitates platelet adhesion and serves as a plasma carrier of factor VIII, a critical coagulation protein essential for hemostasis.

Damage to or inflammation of the endothelial lining can cause platelet activation, platelet adhesion, platelet aggregation and clot formation. Past VTE, smoking, atherosclerosis, varicose veins, trauma or surgery, venipuncture, indwelling venous catheters, and vasculitis can damage or inflame the vessel wall, leading to VTE.

Elevated blood glucose causes platelet activation, inflammation of the vascular system, and activation of the renin-angiotensin-aldosterone system (which narrows blood vessels), increas-

ing a patient's risk for VTE.

- *Changes in blood flow/circulatory stasis.* Venous insufficiency, restricted mobility/paralysis, atrial fibrillation, venous obstruction secondary to obesity or tumor, and anesthesia induction cause vasodilation and decreased blood flow, which can lead to venous stasis and clotting. Other factors that contribute to slow blood flow include age over 40, myocardial infarction (because of decreased cardiac output), left ventricular dysfunction (because of decreased cardiac output), and stroke (because of immobility).

- *Changes in blood composition/hypercoagulable state.* Any condition or state that decreases blood volume or increases blood viscosity, such as dehydration or thrombocytosis raises the patient's risk for VTE. Medications such as oral contraceptives or hormone replacement therapy can affect blood viscosity, as can medical conditions such as cancer, sepsis, inflammatory bowel disease, or hematologic disorders, such as deficiencies of antithrombin III; and a blood glucose level over 200 mg/dL. Blood transfusions, obesity, and high estrogen states such as pregnancy and the postpartum period also contribute to hypercoagulation.<sup>4</sup>

Additional risk factors include advanced age, family history of VTE, and smoking. Risk factors for VTE are cumulative—the more the patient has, the greater his risk for developing VTE.

The ACCP guidelines describe three levels of VTE risk:<sup>5</sup>

- Low (less than 10% risk of DVT if no prophylaxis is given)—mobile patients undergoing minor surgery, and medical patients who are fully mobile.

- Moderate (10% to 40% DVT risk without prophylaxis)—general surgery patients, or those undergoing gynecologic or urologic surgery, and medical patients who are sick or on bedrest.

- High (40% to 80% DVT risk without prophylaxis)—patients undergoing hip or knee arthroplasty or hip fracture surgery, and patients with major trauma or spinal cord injury.

Signs of DVT of the iliac, femoral, or popliteal veins include unilateral leg swelling, warmth, and erythema. The patient may also complain of tenderness of the involved veins. In some cases, the patient may be asymptomatic. Use care in assessing your patient, as palpation can dislodge a DVT, causing thromboembolism.

When a DVT dislodges from its site of formation, it travels to the pulmonary arterial circulation, becoming a PE, a potentially fatal complication of a VTE. Often the diagnosis of a PE is delayed or missed because the signs and symptoms are vague and mimic other conditions. The most common symptom of PE is dyspnea and the most common sign is tachycardia. Other signs and symptoms of a small PE may include dry cough, pleuritic pain, or hemoptysis. Syncope, cyanosis, or hypotension are associated with a massive PE. Additional signs and symptoms may include feeling anxious, a low-grade fever, or neck vein distension. These signs and symptoms may mimic heart failure, chronic obstructive pulmonary disease, influenza, and pneumonia, and may explain why the diagnosis of PE is missed about 60% of the time.

Although a full discussion of diagnostic studies is beyond the scope of this article, studies to confirm a diagnosis of DVT include venous ultrasonography, quantitative plasma D-dimer enzyme-linked immunosorbent assay (ELISA), duplex venous ultrasonography, magnetic resonance imaging, and venography. Diagnostic studies for PE include the ELISA D-dimer, ECG, chest X-ray, chest computed tomography scan, ventilation/perfusion lung scan, magnetic resonance pulmonary angiography, echocardiography, and pulmonary angiography.

### Preventive strategies

The evidence-based practice guidelines published by the ACCP in June 2008 incorporated data obtained from a comprehensive literature review of the most recent studies available. Each recommendation carries a number grade as well as a letter indicating the quality of the evidence on which it's based: A (high quality), B (moderate quality), or C (low quality). The numeric grades for the ACCP recommendations are:

- Grade 1: Benefits outweigh risks
- Grade 2: Less certain about the magnitude of benefits versus risk. (See *Recommended VTE prophylaxis*) for a selection of the ACCP's Grade 1A recommendations.

### Nursing implications

The ACCP guidelines recommend that every healthcare facility have a written policy on continuous quality improvement related to VTE risk assessment, prophylaxis, diagnosis, and treatment. The Joint Commission and the Centers for Medicare and Medicaid Services (CMS) have implemented VTE quality measures for surgical

## Recommended VTE prophylaxis

Following are selected ACCP Grade 1A recommendations for preventing VTE:

### General patient population

- Every hospital should have a formal strategy for addressing VTE prophylaxis.
- Mechanical methods of thromboprophylaxis should be used primarily in patients who have a high risk of bleeding.
- Aspirin alone isn't recommended as thromboprophylaxis for VTE for any group of patients.

### General surgery patients

- For low-risk general surgery patients undergoing minor procedures with no additional thromboembolic risk factors, the use of specific thromboprophylaxis other than early and frequent ambulation isn't recommended.
- For moderate-risk general surgery patients undergoing a major procedure for benign disease, the ACCP recommends thromboprophylaxis with low-molecular-weight heparin (LMWH), low-dose unfractionated heparin (LDUH), or fondaparinux.
- For high-risk general surgery patients undergoing a major procedure for cancer, the recommended thromboprophylaxis is LMWH, LDUH, or fondaparinux.

### Orthopedic surgery

- For patients undergoing total knee replacement, the ACCP recommends LMWH, fondaparinux, or a vitamin K antagonist. Aspirin or LDUH alone isn't recommended.
- For patients undergoing elective total hip replacement, the ACCP recommends LMWH, fondaparinux, or an adjusted-dose vitamin K antagonist started preoperatively or the evening of the surgical day (international normalized ratio [INR] target, 2.5; INR range, 2.0 to 3.0).

### Trauma

All major trauma patients should receive routine thromboprophylaxis, if possible. In the absence of a major contraindication, LMWH thromboprophylaxis should be started as soon as it is considered safe to do so.

### Acutely ill medical patients

These are patients admitted with congestive heart failure or severe respiratory disease, or who are confined to bed and have one or more additional risk factors, including active cancer, previous VTE, sepsis, acute neurologic disease, or inflammatory bowel disease. They should receive thromboprophylaxis with LMWH, LDUH, or fondaparinux.

### Critical care

All patients admitted to critical care should be assessed for VTE risk and most should be given thromboprophylaxis. Patients at moderate risk for VTE should be given LMWH or LDUH. Patients at high risk for VTE should be given LMWH. Mechanical thromboprophylaxis is recommended for patients at high risk for bleeding.



patients, including the Surgical Care Improvement Project (SCIP). The two SCIP-VTE measures address whether at-risk patients were identified and whether prophylaxis was appropriately ordered and administered to the patient. The SCIP surgical types include orthopedic, gynecologic, urologic, elective spine, and intracranial. Appropriate prophylaxis includes early and aggressive ambulation, low-dose unfractionated heparin, fondaparinux, low-molecular-weight heparin, and oral vitamin K antagonist (warfarin), as well as mechanical thromboprophylaxis.

As advocates for our patients, we should ensure that our facilities are following best practices. The CMS has created payment guidelines that use evidence-based practice to promote the best possible patient outcomes.

Recent CMS changes mean that Medicare won't pay for treating certain conditions that develop during a patient's hospitalization. Among those conditions are DVT or PE in a patient who's had total knee or hip replacement surgery, and manifestations of poor glycemic control (a risk factor for VTE).<sup>6</sup> And although nurses historically have had little responsibility regarding billing, in today's difficult economic times, we must all be good stewards of the budget while continuing to follow evidence-based practice.

By understanding the latest guidelines on VTE prevention and incorporating them into our practice, we can help reduce costs and improve patient outcomes. ♦

#### REFERENCES

1. Galson SK. The Surgeon General calls to action to prevent deep vein thrombosis. U.S. Department of Health and Human Services, Office of the Surgeon General. <http://www.surgeongeneral.gov/topics/deepvein>.

[www.surgeongeneral.gov/topics/deepvein](http://www.surgeongeneral.gov/topics/deepvein).

2. Centers for Disease Control and Prevention. Are you at risk for deep vein thrombosis? <http://www.cdc.gov/features/thrombosis>.

3. Feied CF, Handler JA. Pulmonary embolism. <http://emedicine.medscape.com/article/759765-overview>.

4. Sumpio BE, Riley JT, Dardik A. Cells in focus: endothelial cell. *Int J Biochem Cell Biol*. 2002;34(12):1508-1512.

5. Hirsh J, Guyatt G, Albers GW, Harrington R, Schuenemann HJ. Antithrombotic and thrombolytic therapy: American College of Chest Physicians evidence-based clinical practice guidelines. *Chest*. 2008;133(suppl 6):110S-112S.

6. Center for Medicare and Medicaid Services. CMS improves patient safety for Medicare and Medicaid by addressing never events. CMS Manual System, 2008.

#### RESOURCES

National Institutes for Health. What is a deep vein thrombosis? [http://www.nhlbi.nih.gov/health/dci/Diseases/Dvt/DVT\\_WhatIs.html](http://www.nhlbi.nih.gov/health/dci/Diseases/Dvt/DVT_WhatIs.html).

Sanofi-Aventis. The Coalition to Prevent Deep-Vein Thrombosis. <http://www.preventdvt.org>.

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The author has disclosed that she has no financial relationships related to this article.

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