



## Effects on the Cardiovascular System: Deep Vein Thrombosis

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[Deep vein thrombosis \(DVT\) \(A -1\)](#) in pediatrics is rare, but children and adolescents with cancer are at greater risk of DVT than those without cancer. Factors that increase the risk of pediatric patients with cancer include the following.

- the presence of a central venous catheter used to administer cancer treatments
- the use of asparaginase (which can cause alterations in coagulation)
- cancer treatments, especially radiation therapy
- prolonged immobilization
- decreased hydration

Other factors that may contribute to the development of DVT include prolonged immobilization secondary to surgery, the use of oral contraceptives and [hereditary predisposition \(A - 2\)](#) (such as the presence of Factor V Leiden mutation).

### Assessment

DVT can develop in the upper and lower extremities of children and adolescents with cancer and is characterized by swelling, pain and inflammation. The presence of a positive Homan's sign (pain in the calf after a rapid dorsiflexion of the foot) may be suggestive of DVT; however, Homan's sign is only present in about 50% of the cases. In addition, Homan's sign may be present in other conditions that cause lower-extremity discomfort.

Catheter-related thrombosis accounts for approximately 40% of cases of DVT in the upper extremity. Catheter-related thrombosis is usually indicated by alterations in catheter functioning (for example, difficulty in withdrawing blood and slow infusion rates).

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[Signs and symptoms \(A – 3\)](#) of a DVT in the lower extremity include unilateral leg swelling, pain, inflammation and a positive Homan's sign. A DVT in an upper extremity may be asymptomatic because of the development of collateral circulation; however, superficial veins over the chest wall and clavicle may become prominent.

Complications of DVT include dislodgement of the clot into the circulation; dislodgement can cause thrombotic or occlusive events in organs with tiny blood vessels. Common organs where embolism can occur are the lungs ([pulmonary embolism A - 4](#)) and brain ([embolic stroke A – 5](#)). A complication that usually occurs during follow-up is [postphlebotic syndrome \(A – 6\)](#). Postphlebotic syndrome can occur weeks to months after the initial blood clot appears.

### **Planning**

A plan of care should result in the following.

- minimal complications related to DVT
- an understanding by the patient and family of the risk factors associated with DVT
- the recognition and prompt reporting by the patient and family of signs and symptoms of DVT
- the monitoring of side effects of anticoagulant therapy by the patient and family

### **Implementation**

Nursing care should be focused on prevention of DVT and assessment to detect any signs or symptoms of the condition. Patients who are immobilized (because of surgery or weakness or fatigue secondary to treatment) should be encouraged to exercise adequately. Patients should be taught to engage in active range-of-motion (ROM) exercises; if patients are unable to participate in this activity, the parents should help them do passive ROM exercises at regular intervals. The nurse must regularly assess any patient who is at risk of DVT and ensure that he or she engages in exercise and ROM exercises to decrease the risk of DVT.

[Catheter-related thrombosis \(A – 7\)](#) can be prevented by compliance and standardization of line care procedures. Prophylactic use of low-dose anticoagulants such as warfarin (Coumadin) in patients with venous access device has been successfully used to prevent thrombotic episodes in adults; studies of similar approaches for children and adolescents are underway. When caring for a patient with central line access, the nurse must carefully follow institutional procedures for flushing and using these catheters.

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In patients with venous access devices (VAD), backflow of blood can be prevented by using a positive-pressure method for flushing the catheter by clamping open-end catheters before the syringe is removed from the injection port. Also, there are positive fluid displacement devices that are designed to expel saline into the catheter upon Luer-lok disconnection. These devices are added to the hub of the VAD and should be changed according to institutional policies.

A child or adolescent with DVT will be treated initially with intravenous anticoagulation therapy that may consist of low-molecular-weight heparin. Subsequent treatment consists of anticoagulation therapy that is administered orally or subcutaneously. Therapy usually lasts for 3 months.

When the nurse is administering anticoagulation therapy, the patient must be closely monitored for [signs and symptoms of bleeding \(A – 8\)](#). Also, the child or adolescent should be prepared for regular tests of coagulation, such as those to evaluate prothrombin time (PT), activated partial thromboplastin time (APTT), and the international normalized ratio (INR). The nurse should also regularly perform tests to detect occult blood in the stool and urine (Guaiac or Hemocult test) and monitor hemoglobin and hematocrit values for patients receiving anticoagulation therapy.

Nursing measures to promote comfort and reduce inflammation include providing warmth (through the use of warm compresses), elevating the affected extremity on a pillow and reminding the patient and family not to massage or rub tender areas in the extremity (the movement may cause the clot to dislodge and enter the circulation). The patient and family should be provided alternative activities that can supplement play but maintain bed rest or require only limited physical activity.

### **Patient and Family Education**

The patient at risk of DVT and the patient's family should be taught to recognize early signs and symptoms of DVT and to promptly report its possible occurrence to the health care provider.

The patients who are at risk for DVT should be taught comfort measures and measures that will prevent the development of DVT such as ROM exercises. Integrating ROM exercises with play and activities of daily living may also help the patient remember to do them. The patient should be instructed to regularly move and stretch his or her legs, particularly the calf muscles. Also, taking deep breaths (deep breathing exercises) should be promoted, as the negative pressure in the thorax that develops during this exercise will promote circulation in the large veins of the extremities and regions.

If a patient at risk for DVT is receiving prophylactic anticoagulation therapy that consists of warfarin (Coumadin), the nurse should inform the family that eating foods high in vitamin K may cause fluctuations in the patient's INR levels. For this reason, the patient should be encouraged to avoid such foods or, if necessary, to eat them in moderation.

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For patients who are receiving long-term anticoagulation therapy, the patient and his or her family should be taught ways to avoid or prevent situations or injuries that will increase the risk for bleeding. For example, sharp instruments such as pencils, knives and scissors should not be used by or near the patient; even paper cuts should be avoided.

**Evaluation**

The desired outcomes of care should include the successful resolution of the thrombotic event and the absence of residual complications.

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**Helpful Web Links**

**The Rehabilitation Center – Range of Motion Exercises**

<http://www.rehab.on.ca/mobile/rom/slides/slide1.html>

**ClotCare OnLine Resource**

This web site lists foods that contain vitamin K.

<http://clotcare.com/clotcare/include/vitaminkcontent.pdf>

**RN Web, Montvale, NJ**

**Deep Vein Thrombosis**

<http://rnweb.com/rnweb/data/articlestandard/rnweb/342004/114305/article.pdf>

**Innohepusa.com, Boulder, CO**

**Deep Vein Thrombosis and Cancer**

<http://www.innohepusa.com/corporateweb/innohepus/home.nsf/Content/AboutDVTcancer>

**Genentech, Inc. South San Francisco, CA**

**Cathflo Activase**

[http://www.cathflo.com/nurses/2\\_9\\_assessment\\_occlusions.jsp](http://www.cathflo.com/nurses/2_9_assessment_occlusions.jsp)

[http://www.cathflo.com/nurses/2\\_8\\_moa\\_animation.jsp](http://www.cathflo.com/nurses/2_8_moa_animation.jsp)

**Venousaccess.com**

<http://www.venousaccess.com/complications.htm>

**Related [www.Cure4Kids.org](http://www.Cure4Kids.org) seminars**

Seminar #469 [Hypercoagulable Disorders in Children](http://www.cure4kids.org/seminar/469)

Pedro de Alarcon, MD

<http://www.cure4kids.org/seminar/469>

Seminar #423 [Coagulos de Sangre en Pacientes Pediátricos con Cáncer](http://www.cure4kids.org/seminar/423)

**Blood Clots in Pediatric Cancer Patients (In Spanish)**

Pedro de Alarcon, MD

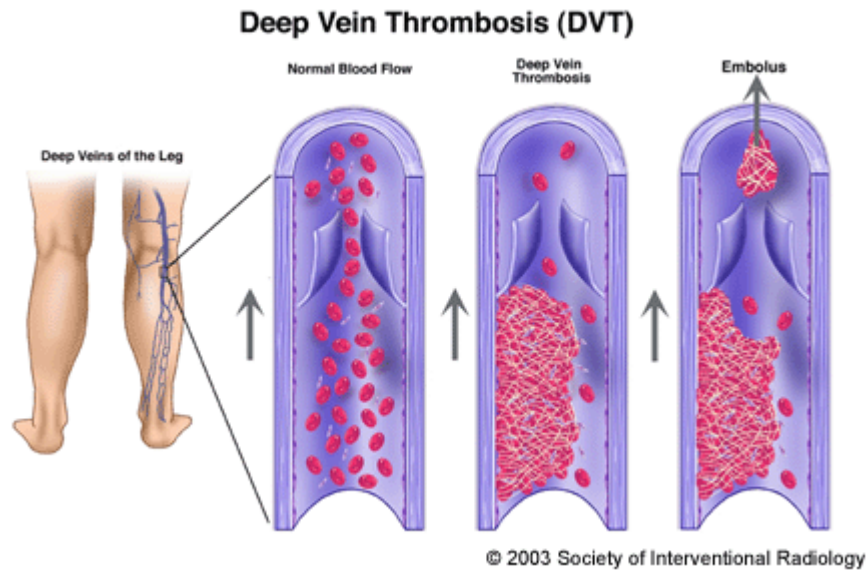
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### APPENDIX

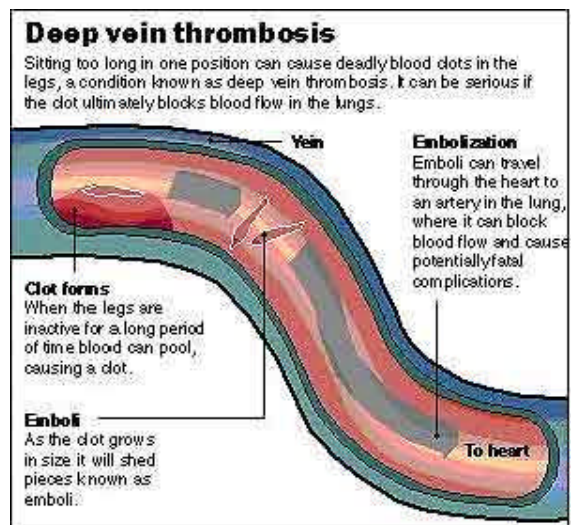
#### A – 1 Venous Thrombosis – Pathophysiology

- damage to the venous wall, such as that caused by inflammation or central lines
- a change in flow caused by factors such as immobility, a change in local pressure, shock, congestive heart failure, venous obstruction, a change in hydration, hypovolemia, the use of a particular chemotherapeutic agent (asparaginase)
- blood hypercoagulability (related to asparaginase use)



Society of Interventional Radiology, Fairfax, Virginia

<http://www.sirweb.org/patPub/DVTOverview.shtml>



CNN.com

<http://edition.cnn.com/2001/WORLD/asiapcf/01/24/dvt.medical/>



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### A – 2 Hereditary Predisposition to DVT

The **Factor V Leiden** mutation is the most common hereditary blood coagulation disorder in the United States. It is present in 5% of the Caucasian population in this country and in 1.2% of the African American population. In persons who are heterozygous for the Factor V Leiden mutation (i.e., in persons who inherited only one altered copy of the Factor V gene), the risk of venous thrombosis is increased by a factor of 3 to 8. In patients who are homozygous for this gene (i.e., in persons who inherited two altered copies of the Factor V gene), the risk is increased by a factor of 30 to 140.

The **prothrombin 20210** mutation is the second most common inherited clotting abnormality. It is more common than the protein S and C deficiency and the antithrombin deficiency combined; 2% of the general population is heterozygous for the prothrombin 20210 mutation. Alone it is associated with only a small increase in the risk of clots, but together with other risk factors (such as the use of oral contraceptives, surgery, trauma, high blood pressure, obesity or smoking) or with other clotting disorders (such as the Factor V Leiden mutation), the risk of clotting is dramatically greater.

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### A – 3 Signs and Symptoms of DVT

- Swelling of the affected extremity or asymmetry of the extremities
- Tenderness
- Warmth
- Redness



The image above of a DVT was  
provided by

<http://medicine.ucsd.edu/clinicalmed>

University of California, San Diego School of Medicine

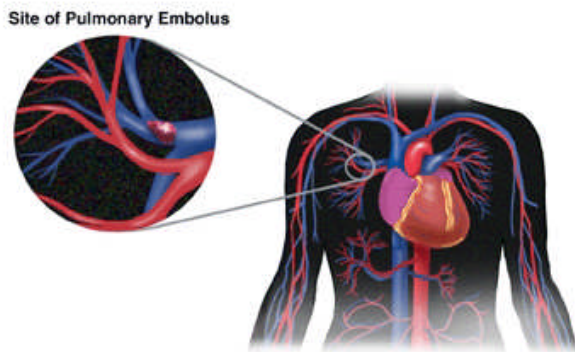
<http://medicine.ucsd.edu/clinicalimg/extremities-DVT.html>

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### A – 4 Pulmonary Embolism

A pulmonary embolism is a blockage of an artery in the lungs. This type of clot is often caused by DVT, and sometimes, the embolus can resolve on its own; however, depending upon the size of the embolus, it can also cause sudden death. Signs and symptoms of a pulmonary embolus are chest pain worsened by breathing, a cough that eventually produces blood-streaked sputum, a sudden onset of shortness of breath, splinting of ribs when breathing and anoxemia (lightheadedness, dizziness, tachycardia).



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**Society of Interventional Radiology, Fairfax, Virginia**

<http://www.sirweb.org/patPub/DVTOverview.shtml>



**Discovery Home & Health Online**

<http://www.discoveryhealth.co.uk/encyclopaedia/default.asp?cat=Cardiovascular&storyid=117817>

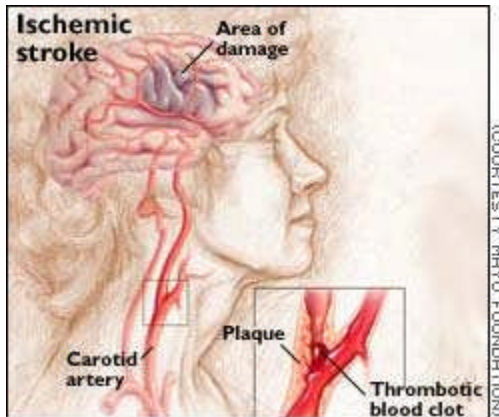
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**A – 5 Embolic Ischemic Stroke**

**An embolic ischemic stroke is a condition in which a blood clot (embolus) blocks a blood vessel supplying the brain.**



**CNN.com**

<http://www.cnn.com/HEALTH/9901/05/alcohol.stroke/link.ischemic.stroke.jpg>

**Symptoms of an Embolic Stroke:**

- Irritability
- Sudden confusion or trouble speaking or understanding speech
- Sudden problems in vision (in one or both eyes) – bumping into objects
- Loss of balance or coordination (falling or clumsiness)
- Sudden numbness or weakness (falling, clumsy behaviors, dropping toys)

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**A – 6 Symptoms of Postphlebitic Syndrome**

- Pain
- Redness
- Glossy appearance of the skin
- Skin ulcers
- Swelling that increases when the extremity is in a dependent position for a prolonged period of time

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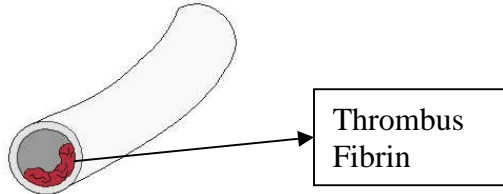
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**A – 7 Catheter-Related Occlusion**

**Venousaccess.com**

<http://www.venousaccess.com/complications.htm>

**Luminal Thrombosis:**



The accumulation of fibrin or thrombus within the lumen of the catheter causing partial (slow flow or poor blood return) or total occlusion (inability to withdraw or infuse). Contributing Factors – Luminal Thrombosis:

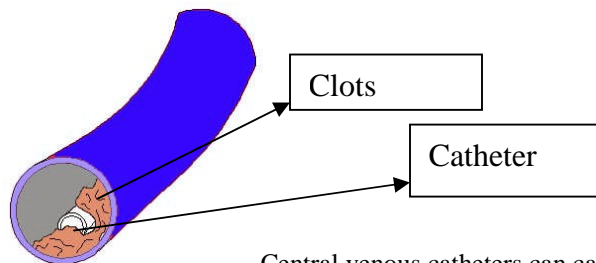
- Inappropriate Flushing technique
- Increased venous pressure causing reflux into the catheter – coughing, sneezing, crying or vomiting
- Pump Malfunction or slowed infusion rates
- Inadvertent disconnection of IV lines

**Debris in the Port**



The port's reservoir serves as a "dead space" where residual thrombosed blood and drugs gets built-up overtime resulting to occlusion of the port catheter. Occurs approximately 25% to 35 % of the time

**Clot in the Vein, around the catheter**



Central venous catheters can cause endothelial injury from puncture of the vein and also constant contact and movement against the endothelium. The endothelium is a single layer. Any irritant that causes an endothelial cell to die or slough exposes a site for platelet aggregation. Platelets adhere to the site and release numerous factors, which recruit other platelets to begin the clotting cascade.

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**A – 8 Signs and Symptoms of Bleeding**

**Early Warning Signs:**

- bruises that develop without a cause or bruises that tend to grow or expand
- nose bleeds
- bleeding gums (more apparent when brushing teeth or eating hard foods)
- prolonged menstrual periods in adolescent females

**Signs that indicate more serious bleeding:**

- pink or brown urine
- red or black (tarry) stools
- coughing up blood
- vomiting blood or “coffee-ground” colored material

**Additional Symptoms that may indicate bleeding secondary to anemia**

- headaches
- dizziness
- fatigue
- weakness





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## **Acknowledgments**

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