Prevention of Deep Vein Thrombosis and Pulmonary Embolism

Samuel Z. Goldhaber, MD; John Fanikos, RPh, MBA

Venous thromboembolism comprises deep vein thrombosis (DVT) and pulmonary embolism (PE) and strikes more than 1 in 1000 adults per year, causing discomfort, suffering, and occasionally death. DVT is defined as blood clots in the pelvic, leg, or major upper-extremity veins. These clots can break off from the veins, travel through the heart, and lodge in the lung arteries, causing potentially deadly PE. Although about 300 000 new cases are diagnosed yearly in the United States, probably 3 to 4 times as many cases occur without obvious symptoms and are never detected. This illness is often “silent” and can mimic other common conditions such as heart attack, pneumonia, and anxiety. Its aftermath spans a wide spectrum, from inconsequential to fatal.

Awareness of DVT and PE is the best way to prevent this condition. Medical professionals have recognized DVT for almost 2 centuries, but until recently, only about half of Americans were informed about the disease. Without knowledge of DVT as a medical problem, the public could not engage healthcare providers to discuss lifestyle changes and more intensive measures that usually succeed in preventing this illness. Historically, many prominent public figures have been afflicted with DVT but received little attention. However, several tragic cases of fatal PE received widespread media coverage. In 2000, a 28-year-old woman who had been a spectator at the Sydney Olympics collapsed and died of PE after deplaning in London. In 2003, a renowned reporter who was embedded with a US infantry unit during the Second Gulf War complained of leg discomfort for several days and then died suddenly of PE. These events, coupled with a recent public awareness campaign, “Killer Legs,” have raised unprecedented interest in this previously overlooked but common condition.

DVT and PE were the topics of a previous Cardiology Patient Page in Circulation. Treatment of this illness was described in a separate Cardiology Patient Page. However, prevention is the best policy to combat DVT and PE. Although preventing venous thromboembolism is more mundane and less glamorous than treatment of DVT, it remains more effective than waiting for a DVT to develop, performing complex diagnostic tests, and then treating a newly established blood clot. Strategies for prevention of DVT (Tables 1 and 2) are discussed below.

DVT Prevention Strategies

Lifestyle Changes

The most common lifestyle risk factors for venous thromboembolism are the same problems that plague our Western society: obesity, inactivity, and cigarette smoking. Nevertheless, most inquiries about DVT prevention come from patients about to embark on long-haul air travel. Despite the drama of collapse and death from PE while in flight or after disembarking, the chance of this happening is only about 1 in 1 000 000 travelers.

Mechanical Measures

For many patients at low risk of DVT, graduated elastic compression stockings will suffice. Vascular compression stockings usually lose their elasticity after about 3 months and should be replaced to maintain their effectiveness. Pneumatic compression boots are not practical unless the patient is hospitalized or homebound.

Pharmacological Options

A recent survey of 183 US hospitals showed that prophylaxis remains un-
derutilized, especially among hospitalized patients with medical illnesses. For patients at medium or high risk of DVT, once-daily self-injection of a low fixed dose of low-molecular-weight heparin or fondaparinux is effective and safe. Proper injection technique requires administration into fat tissue, not muscle, and avoiding the area surrounding the belly button. Patients should “pinch an inch” of fat before injection and avoid rubbing the site with alcohol swabs after the injection. The Figure illustrates proper step-by-step technique.

Oral anticoagulation with warfarin to prevent DVT is utilized primarily in patients undergoing orthopedic surgery. Warfarin requires meticulous management and close collaboration between the patient and healthcare provider. Warfarin is administered once daily. It is not given in a fixed dose. Instead, the dose of warfarin varies and must be tailored to remain within a target range with the use of a blood test, the International Normalized Ratio. Warfarin therapy is complicated by multiple drug–drug and drug–food interactions that affect the dosing level, but most often, the dose of warfarin changes for no apparent reason. Fortunately, anticoagulation clinics have evolved to provide patients with expert dosing of this blood thinner. One baby aspirin daily for patients not on anticoagulants is sometimes recommended as prophylaxis against DVT. However, aspirin alone, although quite effective for reducing the risk of heart attack or stroke, is not very useful for preventing DVT.

**Combined Mechanical Plus Pharmacological Approaches**

Combining vascular compression stockings with low-dose heparin is an effective strategy for patients at high or very high risk of venous thromboembolism. An example is the combination of 10- to 18-mm Hg graduated compression stockings, pneumatic compression boots, and heparin 5000 U every 8 hours in patients undergoing high-risk surgeries.

**Why Are Some Anticoagulants Administered Orally Whereas Others Require Injection?**

Unfractionated heparin and low-molecular-weight heparin are made from sugars. Like most sugars, when given orally, they are digested by stomach acid and no longer maintain their anticoagulant properties. These drugs are only
Effective when given by injection. Oral heparin is under development.

**What Should We Do If Preventive Efforts Fail?**

The failure rate is low, less than 10%. Nevertheless, if preventive efforts do not succeed, effective therapy exists to manage successfully most cases of DVT and PE. The cornerstone of therapy after failed prophylaxis is intensive anticoagulation, administered in doses higher than those used for prevention.

**How Can I Start Preparing My Individualized Prevention Strategy?**

We encourage our patients to collaborate with us to optimize prophylaxis against DVT. Your healthcare provider can discuss your risk level with you and help you develop an appropriate level of preventive effort.

**References**


**TABLE 2. How to Design a Personal Prevention Strategy**

<table>
<thead>
<tr>
<th>I. Determine risk of developing DVT: outpatient setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Is there a prior history of DVT or PE?</td>
</tr>
<tr>
<td>B. Is there a family history of DVT or PE?</td>
</tr>
<tr>
<td>C. Are there poorly controlled lifestyle factors?</td>
</tr>
<tr>
<td>i. Obesity</td>
</tr>
<tr>
<td>ii. Lack of exercise</td>
</tr>
<tr>
<td>iii. Cigarette smoking</td>
</tr>
<tr>
<td>iv. Hypertension</td>
</tr>
<tr>
<td>D. Is long-haul air travel planned?</td>
</tr>
<tr>
<td>II. Determine the risk of developing DVT: inpatient setting</td>
</tr>
<tr>
<td>A. Is major elective surgery planned, such as cardiac, thoracic, or orthopedic surgery?</td>
</tr>
<tr>
<td>B. Has major trauma occurred?</td>
</tr>
<tr>
<td>C. Is oral contraception, pregnancy, or postmenopausal hormonal therapy a factor?</td>
</tr>
<tr>
<td>D. Has cancer developed or is cancer chemotherapy under way?</td>
</tr>
<tr>
<td>E. Has hospitalization occurred for medical illnesses such as congestive heart failure or pneumonia?</td>
</tr>
<tr>
<td>III. Match risk of DVT with intensity of prophylaxis</td>
</tr>
<tr>
<td>A. Discuss with healthcare provider what preventive measures are appropriate for a given level of risk</td>
</tr>
<tr>
<td>B. Be proactive; consider obtaining additional reliable information at web sites such as <a href="http://www.clotcare.com">www.clotcare.com</a> and joining the Coalition to Prevent Deep-Vein Thrombosis (<a href="http://www.preventdvt.org">www.preventdvt.org</a>)</td>
</tr>
</tbody>
</table>

Proper injection technique for low-molecular-weight heparin or fondaparinux. Top row, left: Select injection site and swab with rubbing alcohol. Top row, right: “Pinch an inch” of the belly, forming a skin-fold. Avoid the belly button area. Center row, left: While pinching, insert needle at a 90° angle directly into the skin. Center row, right: Push syringe plunger down, injecting drug into the skin. Bottom row, left: Release skin-fold and pull back syringe. Bottom row, right: Dispose of syringe in coffee can or “sharps” container.
Prevention of Deep Vein Thrombosis and Pulmonary Embolism
Samuel Z. Goldhaber and John Fanikos

doi: 10.1161/01.CIR.0000145141.70264.C5

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2004 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
http://circ.ahajournals.org/content/110/16/e445

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published
in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial
Office. Once the online version of the published article for which permission is being requested is located,
click Request Permissions in the middle column of the Web page under Services. Further information about
this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org//subscriptions/