The prevention and treatment of deep vein thrombosis

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Deep vein thrombosis can have serious long-term consequences and can result in fatal complications. Many patients are at increased risk of DVT, but knowledge of common risk factors and an awareness of appropriate prophylactic measures can help prevent its occurrence. An ability to recognise common clinical signs and symptoms, together with an understanding of diagnosis and treatment, benefits the nursing management of DVT.

Deep vein thrombosis is a serious condition with potentially fatal consequences. Many patients in both hospital and the community are at increased risk of DVT, and it is therefore important for nurses to understand the condition and how to recognise it. This article discusses risk factors, prevention, diagnosis, and treatment of DVT.

Veins have a hollow core (lumen) through which blood flows from the tissues back to the heart. They contain valve cusps and are composed of three layers. The inner layer (tunica intima) is composed of endothelial lining, the middle layer (tunica media) is composed of smooth muscle and elastic fibres, and the outer layer (tunica externa) is composed mainly of elastic and collagenous fibres (Fig 1).

Venous blood flow is assisted by respiration, which causes pressure changes in the thorax and abdomen, and by skeletal muscles and valve cusps. During mobilisation the skeletal muscles of the lower limbs contract, causing the valves to open and forcing blood towards the heart (the calf muscle pump). When the muscles relax, the valves close to prevent backflow.

Deep vein thrombosis

DVT is the formation of a thrombus in a deep vein. Venous thromboses are comprised mainly of fibrin and red blood cells. Although it usually affects the leg veins (Fig 2), DVT can occur in the upper extremities, cerebral sinuses, hepatic, and retinal veins. It is usually caused by a combination of predisposing factors known as Virchow’s triad after the German pathologist who discovered them:

- Venous stasis: immobility reduces the effectiveness of the calf muscle pump and can lead to stasis (slowing of blood flow) and pooling of blood behind the valve cusps;
- Vein wall trauma/dilation: local trauma (for example, orthopaedic surgery or leg fracture) to the endothelial lining of the vein wall activates clotting by triggering the release of tissue factor. Venous dilation, which may occur intraoperatively, can cause endothelial damage resulting in the exposure of collagen and activation of clotting;
- Hypercoagulability: a variety of hereditary and acquired causes of increased coagulability, such as pregnancy, malignancy, and thrombophilia.

Risk factors and assessment

All hospital patients should be assessed for clinical risk factors of DVT (Box 1). The risk in surgical and orthopaedic patients is well recognised but medical patients (for example patients with myocardial infarction, stroke, or heart failure) are also at high risk and should receive thromboprophylaxis as appropriate.

It is important to define risk levels in order to apply cost-effective prophylaxis (International Consensus Statement, 2002). The Autar risk assessment scale (Table 1) has been validated for use and is based on predisposing risk factors (Autar, 2002). It may be used within the nursing assessment to provide a risk score and make recommendations regarding prophylaxis.

Prevention of DVT

The basis of DVT prophylaxis is to target the triad of predisposing factors: venous stasis; vein wall trauma/dilation; and hypercoagulability.
**Mobilisation and breathing exercises**

Nurses can encourage mobilisation and leg exercises in at-risk patients in order to activate the calf muscle pump. Breathing exercises will also help venous return. Patients should be advised to observe for signs and symptoms that suggest DVT and inform nurses if concerned.

**Antithrombolysis stockings**

Antithrombolysis stockings (AES) provide continuous stimulation of linear blood flow, prevent venous dilation (Coleridge Smith et al, 1991), and stimulate endothelial fibrinolytic activity (Arcelus et al, 1995).

The nurse’s role is to assess for contraindications to wearing AES by physical assessment and clinical history and to measure and fit the correct stockings according to the information supplied by the manufacturer. The patient’s skin integrity should be checked regularly and the patient should be given written and verbal information on how to wear and care for AES. The patient should be told that:
- Stockings should be smooth when fitted;
- The toe hole should lie underneath the toes;
- The heel patch should be in the correct position;
- The thigh gusset should be on the inner thigh;
- Rolling down the stocking may have a tourniquet effect.

Patients should be asked to report any numbness or tingling, which may suggest arterial impairment.

A systematic review by Amarigiri and Lees (2003) stated that further research was required to ascertain the ideal length of AES, although thigh-length stockings have been shown to be clinically effective. They offer increased protection above the knee by increasing blood flow in the femoral vein and preventing dilation of the popliteal vein (Benko et al, 1999). Knee-length stockings are available for those whose thigh circumference is outside of the manufacturers’ size limit.

**Anticoagulants**

Anticoagulants such as low-molecular-weight heparin (LMWH) increase the action of antithrombin and inhibit a number of coagulation proteins. LMWH can be administered in a prophylactic dose, usually via subcutaneous injection, with a predictable anticoagulant response. In moderate-risk patients use of AES may be combined with anticoagulants to minimise risk.

Nurses need to be aware that many LMWH products are derived from pigs, and take patients’ cultural and spiritual beliefs into account.

Patients require careful observation as anticoagulants can cause bleeding, and any side-effects should be reported. There is a small risk of heparin-induced thrombocytopenia (HIT) when patients are given LMWH (less so than with unfractionated heparin) so the platelet count should be checked at baseline and at one week after the first dose of LMWH. An obvious drop in the platelet count may indicate HIT. Nurses should observe for local reactions at injection sites, which may necessitate switching to another brand of LMWH.

**Intermittent pneumatic compression**

Intermittent pneumatic compression (IPC) is an established method of DVT prophylaxis with no risk of haemorrhagic complications (Geerts et al, 2001). There is a variety of devices on the market ranging from calf and thigh cuffs to foot pumps. They may be combined with the use of AES and LMWH in high-risk patients.

These devices should not be used in the presence of acute DVT due to the risk of embolisation. Checking contraindications before using these devices and ensuring that they are fitted correctly is part of routine assessment and care. In addition there should be regular physical assessment of the patient’s leg and advice given to patients on reporting new symptoms.

**Complications of DVT**

After diagnosis of DVT the thrombus may dissolve without causing any problems but in a minority of patients pulmonary embolism may occur, which can be fatal.

It occurs when a part of the thrombus becomes detached from the vein wall and lodges in the pulmonary circulation. It can cause respiratory difficulties such as shortness of breath, pain on inspiration, and haemoptysis. Studies carried out in the UK by Sandler and Martin (1989) found that pulmonary embolism was associated in a prophylactic dose, usually via subcutaneous
Signs and symptoms

Although often asymptomatic, a number of signs and symptoms are associated with DVT (Gorman et al, 2000):

- Call pain and/or tenderness;
- Swelling with pitting oedema;
- Swelling below the knee in distal DVT and up to the groin in proximal DVT;
- Increased skin temperature;
- Superficial venous dilation;
- Swelling with pitting oedema;
- Cyanosis can occur with severe obstruction.

Investigation

The diagnosis of DVT requires a combination of investigations as no single test is 100 per cent sensitive or specific (Tovey and Wyatt, 2003).

Pre-test probability

The pre-test probability (Wells et al, 1997) provides a score for the likelihood of DVT being present (Box 2).

D-dimer

D-dimers are the smallest fibrin degradation products and blood levels are raised in most patients with DVT. This test is used mainly to exclude DVT as plasma D-dimers are not specific to DVT.

Ultrasoundography

Duplex ultrasonography is a non-invasive method of detecting DVT. Proximal DVT can be detected with a sensitivity and specificity of 96 per cent and 98 per cent respectively (Lensing et al, 1993). It is, however, less sensitive for distal DVT and pelvic DVT.

Venography

This is the ‘gold-standard’ investigation for DVT but due to its invasive nature it is no longer a first-line investigation. Radiopaque contrast is injected into a dorsal foot vein to visualise thrombi under X-ray control. The procedure carries a small risk of venous thrombosis or allergic reaction to the dye, and may be technically difficult in patients who have poor venous access (De Valois et al, 1990).

Plethysmography

This non-invasive method records changes in limb size due to accumulation of tissue fluid or pooled blood. Plethysmography is of limited value in the detection of older thrombi or in cases of non-occlusive thromboses.

Magnetic resonance direct thrombus imaging

This is a novel non-invasive technique in which the thrombus is visualised by the detection of methaemoglobin. Unlike venography or plethysmography it visualises thrombi directly rather than depending on blood flow or the filling of vessels. The technique detects recent thrombi, and is therefore also useful for the diagnosis of recurrent DVT. Early data suggests that it has high sensitivity for distal, proximal, and pelvic DVT (Kelly et al, 2003).

Treatment

The objectives of treatment for DVT include the prevention of local thrombus extension, embolisation, and recurrent DVT.

### REFERENCES


Mobilisation
Mobile patients with acute proximal DVT treated with LMWH should be encouraged to walk with compression stockings. Pain and swelling resolve significantly faster, with no evidence of an associated increase in risk of pulmonary embolism (Partsch and Blattler, 2000).

Anticoagulation
Anticoagulation with heparin and warfarin is the standard treatment for DVT; LMWH has been demonstrated to be safe, effective, and convenient, and has allowed patients to be managed in an outpatient setting (Eikelboom and Baker, 2001) or with a daily subcutaneous injection of LMWH. For most patients LMWH can be administered as a weight-related dose with a predictable outcome without laboratory monitoring. In patients at high risk (such as those with renal impairment or obesity) anti-Xa levels should be measured to ensure correct dosing.

Oral anticoagulants such as warfarin inhibit the vitamin K-dependent clotting factors. In view of their delayed onset of action, heparin treatment should overlap until clotting time has been acceptable for at least two days (British Committee for Standards in Haematology, 1998).

Clot breakdown via the natural fibrinolytic system occurs slowly. It is important that this is explained to patients so that they understand the need to adhere to treatment for its duration.

Early treatment failure may occur due to subtherapeutic anticoagulation or HIT. Later recurrences of DVT while taking treatment can occur in patients with underlying carcinoma or antiphospholipid syndrome (Ginsberg, 1996). Switching to LMWH may have the desired response for patients with carcinoma, while increasing the target clotting time in those with antiphospholipid syndrome may be effective (Bates and Hirsh, 1999).

Compression stockings
Once a patient has been diagnosed with a DVT, compression stockings (Class I, II, or III) are applied to reduce the risk of recurrence and the development of post-thrombotic syndrome. The optimal stocking compression profiles and duration of application are not yet known (Kolbach et al, 2004). Some manufacturers of high compression stockings (20–40mmHg at the ankle: Class I, II, and III) recommend that an ankle:brachial ratio check (the ratio of ankle systolic pressure to highest brachial systolic pressure) should be performed before fitting.

TABLE 1. AUTAR DVT RISK ASSESSMENT SCALE (REVALIDATED) (AUTAR, 2002)

<table>
<thead>
<tr>
<th>NAME:</th>
<th>DATE OF BIRTH: AGE:</th>
<th>DIAGNOSIS:</th>
<th>TYPE OF ADMISSION:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group</td>
<td>Score</td>
<td>Mobility score</td>
<td>Build/BMI score</td>
</tr>
<tr>
<td>10–30</td>
<td>0</td>
<td>Ambulant</td>
<td>0</td>
</tr>
<tr>
<td>31–40</td>
<td>1</td>
<td>Limited</td>
<td>1</td>
</tr>
<tr>
<td>41–50</td>
<td>2</td>
<td>Very limited, needs help</td>
<td>2</td>
</tr>
<tr>
<td>51–60</td>
<td>3</td>
<td>Chairbound</td>
<td>3</td>
</tr>
<tr>
<td>61–70</td>
<td>4</td>
<td>Complete bedrest</td>
<td>4</td>
</tr>
<tr>
<td>&gt;70</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ASSESSMENT: within 24 hours of admission
SCORING: ring out appropriate item(s) from each category column, add scores and record:
Total score: Assessor: Date:

ASSESSMENT PROTOCOL

SCORE RANGE. Risk categories ● 10 Low risk ● 11–14 Moderate risk ● 15 High risk
VENOUS PROPHYLAXIS ● LOW RISK: early ambulation + graduated compression stockings ● MODERATE RISK: graduated compression stockings + low-dose heparin or intermittent sequential compression ● HIGH RISK: graduated compression stockings, low-dose heparin + intermittent sequential compression
The nurse’s role

Many centres now have specialist nurse-led DVT services to manage patients on an outpatient basis. This development incorporates many of the 10 key roles for nurses suggested by the chief nursing officer (Department of Health, 2000).

- Managing patient caseload;
- Ordering diagnostic investigations;
- Making and receiving direct referrals;
- Admitting and discharging patients;
- Prescribing medications and treatments under patient group directions (NHS Executive, 2000);
- Running clinics;
- Performing outpatient department procedures;
- Taking a lead in the way local health services are organised and managed.

Direct referrals to the DVT nurse mean that patients can be rapidly assessed. Those who are unsuitable for outpatient treatment can be identified and referred appropriately. The diagnostic pathway can be implemented and DVT treatment commenced if necessary. Those without DVT can be discharged back to the care of the referring doctor, hence improving service delivery and patient satisfaction (Eikelboom and Baker, 2001).

Patients need information about DVT, anticoagulation, compression stockings, and the possible complications of these. They also need to be aware of how and when to access help. The diagnosis of DVT may also mean a change in lifestyle and this information should be given verbally and reinforced with written information to increase concordance with treatment (Arthur, 1995).

Travel

Recently there has been much media interest in the relationship between flying and DVT. Long-haul air travellers are often exposed to cramped seating with reduced mobility and may also suffer vein wall damage from compression against the seat edge. Alcohol may cause dehydration, while low cabin oxygen concentrations may also activate the blood clotting system (Shepherd and Edwards, 2004).

The risk of DVT can be reduced if travellers take a number of precautions, such as:

- Walking around as often as possible;
- Carrying out leg and breathing exercises when seated;
- Avoiding alcohol, caffeine, and carbonated drinks;
- Drinking plenty of water;
- Consulting their GP before flying if at risk of DVT.

It is not only air travellers who are at risk of DVT – travel for more than four hours in any form is associated with an increased risk (Samama, 2000).

The risk to healthy individuals is small but is substantially increased by having additional risk factors (Arya et al, 2002).

Conclusion

DVT can be associated with significant morbidity. Nurses should focus on prevention by the early recognition and adequate prophylaxis of those at increased risk.

Patients should be actively involved in their care wherever possible. An awareness of diagnostic and treatment strategies will enable nurses to inform patients.

This will help to improve both concordance with treatment and disease outcome.

In the outpatient setting this information can be imparted gradually and reinforced on each clinic visit. The nurse can observe and assess how the patient is managing her or his treatment and adapting to lifestyle changes, leading to an improved quality of life.

REFERENCES


