Deep vein thrombosis (DVT) is a condition which presents a diagnostic and therapeutic challenge to all clinicians directly involved in patient care. The spectrum of acute disease ranges from asymptomatic thrombosis (typically affecting distal, calf veins) discovered incidentally at autopsy or during screening procedures, through to the classic swollen, red, painful leg, to the potentially fatal complication of pulmonary embolism. In the long term DVT may lead to the troublesome post-thrombotic syndrome of persistent swelling, pain, pigmentation and ulceration, and this can affect up to 25% of patients with DVT. It is difficult to determine a value representing the true incidence of this disease as it is well documented that many DVT are not detected clinically; however, the fact that it is a significant problem is well recognized. A study in 1988 in the UK found that 0.9% of all admissions to hospital suffered fatal pulmonary embolism as a result of DVT, and the incidence of DVT in surgical patients is 10–80%, depending on the type of surgery and individual patient risk factors.

As always, prevention is better than cure, and apart from the obvious benefit to patients, prophylactic measures against DVT are cost effective through reduction in fatal complications and treatment requirements. It has been estimated in the USA that widespread use of prophylactic measures in surgery would save $60 per operated patient. Over the course of the past 5–10 yr there has been an increasing awareness of the importance of DVT prophylaxis, stimulated in particular in the UK by the reports of the THRIFT (Thromboembolic Risk Factors) Consensus Group and the National Confidential Enquiry into Perioperative Deaths and a great deal of effort has been put into developing safe and effective methods of prophylaxis.

There are already several different, effective methods of DVT prophylaxis available, which are traditionally divided into two categories: physical and pharmacological methods. Graduated compression stockings are the most popular physical method, with intermittent compression devices being more cumbersome to use and less well tolerated. Low-dose heparin is the mainstay of pharmacological prophylaxis, with a wide variety of other drugs being used with varying degrees of success (warfarin, aspirin, dextran, dihydroergotamine). In the face of existing, effective measures, the recent advances in this field have been refinements of tried and tested methods, and they are described here.

Physical methods

INTERMITTENT COMPRESSION DEVICES

Intermittent pneumatic compression (IPC) of the lower limbs has been used over the past 30 yr, and while the original compression boots were uncomfortable and tolerated poorly, modern designs with sequential pressure application have been more widely accepted. IPC works both by eliminating venous stasis with generation of pulsatile blood flow (simulating the effect of the “muscle pump”) and by stimulating fibrinolysis. The most recent addition to the range of devices available is the arterial–venous impulse foot pump which is applied to the patient’s foot and provides compression to the plantar venous complex. This device has been used mainly in orthopaedic patients undergoing knee and hip surgery where it has significantly reduced the incidence of DVT. Its advantages include good patient tolerability compared with conventional IPC boots enabling it to be used after operation until the patient is mobile, and avoidance of the haemorrhagic complications associated with other methods of prophylaxis. So far it has been evaluated only in knee and hip surgery, and it may not be as effective as existing IPC devices.

Pharmacological methods

LOW MOLECULAR WEIGHT HEPARIN

Heparin exerts an antithrombotic effect by binding to, and accelerating the activity of, two cofactors; antithrombin III and heparin cofactor II. The rationale behind the use of low-dose heparin as prophylaxis is that only small amounts of the drug are required to inhibit the clotting cascade in its early stages, before coagulation is established, and conventional, unfractionated heparin has been used in this way since the 1960s. A meta-analysis of more than 70 randomized, placebo-controlled studies in 1988 showed that the incidence of DVT was reduced by 66% and the incidence of pulmonary embolism reduced by 50% with unfractionated heparin administered subcutaneously in low dose (5000 u. 8 or 12 hourly).

Recent interest in heparin prophylaxis has centred on low molecular weight heparins, so called because their range of molecular weight is 2000–8000 Da, compared with 5000–30 000 Da for unfractionated heparin. Low molecular weight heparins have several differences from unfractionated heparin, apart from molecular weight, which help to explain their therapeutic advantages. Low molecular weight heparins have a much greater anti-Xa than anti-IIa activity, which theoretically makes them more effective at preventing thrombin formation than unfractionated heparin with an equal anti-Xa and anti-IIa ratio, and in vivo activity certainly shows good correlation with anti-Xa activity. Low molecular weight heparins have a bioavailability approaching 100%, compared with 30% for unfractionated heparin, and a half-life after subcutaneous injection of 3–5 h, enabling a single dose to provide effective...
anti-thrombotic activity for 24 h.\textsuperscript{22,24} The smaller charge density and chain length of low molecular weight heparins decrease their binding to several proteins (platelet factor 4, lipoproteins, fibronectin and protamine), endothelial cells, macrophages and platelets.

Low molecular weight heparins are at least as effective as unfractionated heparin at preventing DVT in both general and orthopaedic surgery, and the incidence of bleeding episodes is not significantly different between the two in most studies so far.\textsuperscript{22,25–27} The one area where low molecular weight heparins show an undisputed advantage is that of convenience and patient acceptability; the once-daily dose is easier for nurses and patients, and there is significantly less bruising at injection sites.\textsuperscript{25}

**ORGARAN**

Orgaran is a low molecular weight heparinoid consisting of a mixture of heparan sulphate, dermatan sulphate and chondroitin sulphate, chemically distinct from heparin. Although not in widespread use it has been evaluated in several studies of patients at high risk of DVT, where it has been shown to be effective and comparable with low-dose heparin.\textsuperscript{28}

**Guidelines**

DVT prophylaxis is effective only if it is given to the correct patients for the correct period of time, and the development of hospital guidelines to ensure that this happens is probably as important as any therapeutic advance. A guidelines should enable classification of patients admitted to hospital as to their degree of risk, and the recent recommendation of the European Consensus Group can be summarized as follows:

- **Low-risk patients:**
  - < 40 yr old without additional risk factors.
  - Minor surgery (<30 min).
- **Moderate-risk patients**
  - > 40 yr old.
  - Oral contraceptive medication.
  - Major surgery (>30 min).
  - Immobilized medical patients with active disease.
- **High-risk patients**
  - Previous DVT/PE.
  - Major surgery for malignant disease.
  - Orthopaedic surgery to lower limbs.
  - Stroke, congestive cardiac failure and acute myocardial infarction.

(Adapted from the European Consensus Statement\textsuperscript{29}).

Low-risk patients may not benefit from prophylactic measures, but all moderate- and high-risk patients should be offered prophylaxis as a matter of routine. The preferred type of prophylaxis varies from hospital to hospital, and even between hospital departments, the most important factor being that patients are assessed correctly for risk and the relevant local policy then implemented.

**Surgical specialties**

Different specialties have particular considerations which influence the choice of prophylaxis.

**OBSTETRICS AND GYNAECOLOGY**

Young women receiving the oral contraceptive pill (OCP) are in at least the moderate-risk group and should discontinue this 6 weeks before elective surgery, or should be given subcutaneous heparin and/or compression stockings if admitted as an emergency. Hormone replacement therapy (HRT) has not been shown to increase the risk of thromboembolic disease, but patients receiving HRT are aged more than 40 yr of age and should therefore qualify for prophylaxis. Some clinicians would advise patients to discontinue HRT 6 weeks before elective surgery as for the OCP.

**UROLOGY**

Because of the endoscopic nature of most urological surgery, haemostasis is not as easily secured as during open surgery. Consequently, any drugs which predispose to bleeding are avoided as far as is possible, aspirin in particular being stopped 2 weeks before elective transurethral surgery. Heparin is avoided as a choice for prophylaxis, and mechanical methods are preferred.

**ENT**

Major head and neck surgery is performed on a part of the body renowned for vascularity, and therefore mechanical prophylaxis is preferred rather than pharmacological methods with their increased risk of postoperative bleeding.

**NEUROSURGERY**

These patients have a similar risk of DVT as general surgical patients,\textsuperscript{24} but the consequences of an intracranial bleed are so severe that, as with ENT, mechanical methods are preferred.\textsuperscript{14,30}

**Summary**

The major development in DVT prophylaxis in recent years has been the introduction of low molecular weight heparins. Their main improvement compared with unfractionated heparin is in the convenience of a once daily dosage, but they have not yet convincingly been shown to be more effective or safer.\textsuperscript{22,23} A-V impulse boots may have an impact on knee and hip surgery but still face problems with patient acceptability. Probably the best way to ensure that more DVT are prevented is by clinicians maintaining a high level of awareness of the risk, and developing, and adhering to, local guidelines.

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References


