Volume 12
Issue 4
2008
ISSN: 1329-1874

Best Practice
Evidence based information sheets for health professionals

Graduated compression stockings for the prevention of post-operative venous thromboembolism

Recommendations

- Patients should be assessed to identify their risk factors for developing VTE **(Grade A)**
- Inpatients having surgery should be offered thigh-length GCS from the time of admission to hospital unless contraindicated. If thigh-length stockings are inappropriate for a particular reason of compliance or fit, knee-length stockings may be used as an alternative. **(Grade A)**
- The stocking compression profile should be equivalent to the Sigel profile, and approximately 18 mmHg at the ankle, 14 mmHg at the mid-calf and 8 mmHg at the upper thigh. **(Grade A)**
- Patients using CGS should be shown how to wear them correctly by healthcare professionals trained in the use of that product. Stocking use should be monitored and assistance provided if they are not being worn correctly. **(Grade A)**
- In addition to mechanical prophylaxis, patients at increased risk of VTE because they have individual risk factors and patients having orthopaedic surgery should be offered low molecular weight heparin (LMWH). Fondaparinux, within its licensed indications, may be used as an alternative to LMWH. **(Grade A)**
- Low molecular weight heparin or fondaparinux should be continued for 4 weeks after hip fracture repair surgery. **(Grade A)**
- Healthcare professionals should encourage patients to mobilise as soon as possible after surgery. **(Grade A)**
- Regional anaesthesia reduces the risk of VTE compared with general anaesthesia. Its suitability for an individual patient and procedure should be considered, along with the patient's preferences, in addition to any planned method of thromboprophylaxis. **(Grade B)**
- Patients should be given verbal and written information, before surgery, about the risks of VTE and the effectiveness of prophylaxis and after discharge about use of prophylaxis and risk of non-compliance. **(Grade B)**
- Intermittent pneumatic compression or foot impulse devices may be used as alternatives or in addition to GCS while surgical patients are in hospital. **(Grade B)**

Information Source

This Best Practice information sheet, which updates and supersedes the JBI information sheet of the same title published in 2001,[1] has been developed based on the 'Venous Thromboembolism' guideline commissioned by the National Institute for Health and Clinical Excellence and published in 2007.[2]

Background

Venous thromboembolism (VTE) is the forming of a blood clot in a vein. Most thrombi (clots) occur in the deep veins of the legs and this is called deep vein thrombosis (DVT). Formation of a DVT is associated with inactivity and certain surgical procedures. The risk of DVT formation rises with the duration of operation and period of immobility.

DVT occurs in more than 20% of patients having major surgery and more than 40% of patients having major orthopaedic surgery. DVT will often show no signs or symptoms, however, symptoms may include pain, tenderness, swelling, warmth, discolouration of the skin or enlarged or protruding leg veins. The condition can lead to sudden death due to pulmonary embolism (PE), or cause long-term morbidity due to venous insufficiency and post-thrombotic syndrome (PTS), potentially leading to venous ulceration. It has been estimated that the risk of pulmonary embolism following high-risk surgery to be up to 5% in the highest risk groups. DVT is a usual precursor of both fatal PE and PTS.

Grades of Recommendation

These Grades of Recommendation have been based on the JBI-developed *2006 Grades of Effectiveness*[3]

Grade A Strong support that merits application

Grade B Moderate support that warrants consideration of application

Grade C Not supported

Definition of terms

For the purposes of this *Best Practice* information sheet the following definitions are used:

Deep-vein thrombosis (DVT) Venous thrombosis that occurs in the "deep veins" in the legs, thighs or pelvis.

Graduated compression stockings (GCS) also known as anti-embolism stockings. Stockings manufactured to provide compression around legs at gradually increasing pressures. There are different standards for graduated compression stockings, therefore it is suggested that mmHg (millimetres Mercury) be checked in preference to compression classes.

Fondaparinux anticoagulant (blood thinner) administered as a subcutaneous (under the skin) injection.

Intermittent pneumatic compression (IPC) uses inflatable garments wrapped around the legs, inflated by a pneumatic pump providing intermittent cycles of compressed air which alternately inflates and deflates the chamber garments, enhancing venous return.

LMWH Low molecular weight heparin.

Mechanical prophylaxis physical (as opposed to chemical) agent used to reduce likelihood of thrombosis.

Venous thromboembolism (VTE) The blocking of a blood vessel by a blood clot dislodged from its site of origin. It includes both DVT and PE.

Objectives

The purpose of this information sheet is to report the effectiveness of graduated compression stockings in preventing post-operative venous thromboembolism.

Types of Intervention

Interventions of interest were the use of GCS alone, and in combination with mechanical devices or pharmacotherapy for the population of inpatients over 18 years of age undergoing surgical procedures including: orthopaedic; general; gynaecological (not elective or emergency Caesarean); urological; neurosurgery; cardiothoracic; and peripheral vascular surgery.

Quality of the research

The highest available level of evidence formed the basis of this information sheet. The literature included systematic reviews, meta-analysis, evidence-based guidelines and randomised controlled trials.

Risk Factors

The types of surgery with the highest risk of DVT and symptomatic PE were (major) orthopaedic surgery followed by (major) general surgery and then neurosurgery. The risk of VTE was estimated for different surgery categories. Hip surgery (both elective and hip fracture) was considered to be highest risk. Other high-risk categories were found to be cardiothoracic, vascular, urological, neurological and general surgery. Except for cancer-related surgery, gynaecological surgery was found to have lower rates of VTE, however this could in part be due to these patients being younger on average than some other patient groups. Gynaecological surgery had the highest risk of major bleeding.

As regional anaesthesia reduces the risk of VTE compared with general anaesthesia, its suitability for an individual patient and procedure should be considered.

Patient Education

Patients should be given verbal and written information before surgery and on discharge about the risks of VTE, the effectiveness of prophylaxis, signs and symptoms of DVT and PE, the correct use of prophylaxis at home and the implications of not using the prophylaxis correctly.

Thigh vs knee length stockings

Two RCTS comparing thigh with knee length stockings in a total of 496 patients were inconclusive due to a limited number of reported events (RR=1.01, 95% CI: 0.43-2.39). One RCT comparing thigh with knee length stockings in 294 patients who were also receiving LMWH found that thigh length stockings reduced the risk of DVT by 63% compared to knee length (RR=0.37, 95% CI: 0.15-0.89).

Inpatients having surgery should be offered thigh-length graduated compression stockings from the time of admission to hospital unless contraindicated (eg. patients with established peripheral arterial disease or diabetic neuropathy). If thigh length stockings are inappropriate for a particular reason of compliance or fit, knee length stockings may be used as a suitable alternative.

Patients should be encouraged to wear GCS until they return to their usual level of mobility.

Size and Fitting

It is important to ensure that stockings are fitted and worn correctly, that the patient's skin condition and perfusion are monitored and protocols for using stockings are followed. To ensure correct fit, measurement and fitting should follow the manufacturer's recommendations. Leg measurements and stocking size should be documented to serve as a baseline for future assessment of the patient's legs and appropriateness of the size of the stocking. The Sigel profile recommends pressures of approximately 18 mmHg at the ankle, 14 mmHg at the mid-calf and 8 mmHg at the upper thigh.

Complications may arise from extended periods of sitting whilst wearing compression stockings and the tourniquet effect of multiple layers of bunched-up stocking combined with a swelling of the leg.

Once fitted, stockings should be checked frequently to ensure they are worn correctly, and that there is no bunching-up of the stocking. Leg measurements may need to be reviewed regularly, particularly when leg swelling is present, as an increase in leg circumference of 5cm can double the amount of pressure being applied by the stocking.

Skin care is important during the period that stockings are in use. Stockings must be removed to assess skin condition and to provide skin care. While there is no evidence on the optimal frequency for providing skin care and monitoring the skin condition of patients wearing stockings, expert opinion suggests this should be undertaken at least once per day. However, for some patients, more frequent care may be required depending on the condition of their skin. The feet and legs should be dried before application of stockings. Regular monitoring of perfusion is required. This can be undertaken during skin care and at other times through the inspection hole in stockings. Ensuring adherence to prophylactic regimes is also important.

Individual patient-related risk factors for venous thromboembolism:[2]

- Active cancer or cancer treatment
- Active heart or respiratory failure
- Acute medical illness
- Age over 60 years
- Antiphospholipid syndrome (an immune system disorder)
- Behcet's disease (disturbance in the immune system)
- Central venous catheter in situ
- Continuous travel of more than 3 hours approximately 4 weeks before or after surgery
- Immobility (for example, paralysis or limb in plaster)
- Irritable bowel disease (for example, Crohn's disease or ulcerative colitis)
- Myeloproliferative diseases (conditions that cause an overproduction of blood cells)
- Nephrotic syndrome (damaged kidneys leaking protein from the blood into the urine)
- Obesity (body mass index ≥ 30 kg/m^2)
- Paraproteinaemia (increase in the amount of 'antibody' protein that normally helps our body fight infection)
- Paroxysmal nocturnal haemoglobinuria (red blood cell breakdown)
- Personal or family history of VTE
- Pregnancy or puerperium
- Recent myocardial infarction or stroke
- Severe infection
- Use of oral contraceptives or hormonal replacement therapy
- Varicose veins with associated phlebitis
- Inherited Thrombophilias for example:
  - High levels of coagulation factors (for example, Factor VIII)
  - Hyperhomocysteinaemia (an amino acid present at a high level in the blood)
  - Low activated protein C resistance (for example, Factor V Leiden)
  - Protein C, S and antithrombin deficiencies
  - Prothrombin 2021A gene mutation

GCSs should not be used if the patient has:

- peripheral arterial disease
- arteriosclerosis
- severe peripheral neuropathy
- massive leg oedema or pulmonary oedema
- oedema secondary to congestive cardiac failure
- local skin/soft tissue diseases such as recent skin graft or dermatitis
- extreme deformity of the leg
- gangrenous limb
- doppler pressure index < 0.8
- gross limb cellulitis

Patients should be shown how to wear GCS correctly by healthcare professionals trained in the application and management of that product and advised of the risks of discontinued or incorrect use.

Other mechanical prophylaxis

Two studies added GCS to an IPC device with no significant difference between groups (RR=0.49, 95% CI: 0.06-4.02). In 9 studies GCS were added to a pharmacological prophylaxis producing a 56% reduction in risk of DVT (RR=0.39m 95% CI: 0.23-0.66).

Three studies with 280 participants compared IPC devices with GCS (in two of the studies patients also received pharmacological prophylaxis), no significant difference between the groups was found in relation to DVT (RR=0.57, 95% CI: 0.12-2.71).

Intermittent pneumatic compression or foot impulse devices may be used as alternatives or in addition to graduated compression stockings while surgical patients are in hospital. When used on the ward, IPC or foot impulse devices should be used for as much of the time as is possible and practical while the patient is in bed or sitting in a chair.

Pharmacological prophylaxis

In addition to mechanical prophylaxis, patients at increased risk of VTE because they have individual risk factors and patients having orthopaedic surgery should be offered low molecular weight heparin (LMWH). Fondaparinux, within its licensed indications, may be used as an alternative to LMWH.

Low molecular weight heparin or Fondaparinux should be continued for 4 weeks after hip fracture surgery.

Risks and benefits of stopping pre-existing established anticoagulation or antiplatelet therapy before surgery should be considered.

Other strategies

Advise patients to consider stopping oral contraceptive use 4 weeks before elective surgery.

Patients having surgery should not be allowed to become dehydrated during their stay in hospital.

Patients should be encouraged to mobilise as soon as possible after surgery and immobile patients should have leg exercises.

Conclusion

Graduated compression stockings are recommended for surgical patients as they are effective and do not increase the risk of bleeding. Patients at higher risk of VTE should be offered graduated compression stockings and either LMWH or Fondaparinux. However, risk of bleeding must be considered.