Prevention of Venous Thromboembolism

See the related separate articles on Thrombophilia, Pulmonary Embolism, and Deep Vein Thrombosis.

Clinicians are frequently asked to advise patients on prophylactic measures to minimise the risk of venous thromboembolism (VTE). The National Institute for Health and Care Excellence (NICE) has produced guidelines to assist in reducing the risk.\[1\]

- NICE states that approximately 30% of surgical patients develop deep vein thrombosis (DVT).
- The condition is frequently asymptomatic but can lead to sudden death due to pulmonary embolism (PE).
- The risk of fatal embolism after high-risk surgery is 1-5%.

The following surgical procedures are high-risk:

- Orthopaedic surgery (for example, total surgery for hip fracture).
- Major general surgery.
- Major gynaecological surgery (but not caesarean).
- Urological surgery (including major or open urological procedures).
- Neurosurgery.
- Cardiothoracic surgery.
- Major peripheral vascular surgery.

Assessing the risk\[1\]

Patients should be assessed individually, both considering any existing risk factors for VTE, and their risk of bleeding (ie may be already at lower risk of DVT). A decision can then be made as to whether VTE prevention should be offered and, if so, whether this should be pharmacological or mechanical. For patients with increased risk, the balance of risk versus benefits of treatment should be reassessed at regular intervals. For patients in hospital this should be 24 hours after admission or whenever there is a change in the clinical situation.

Risk factors for VTE\[1\]

- Active cancer or cancer treatment.
- Age over 60 years.
- Critical care admission.
- Dehydration.
- Known thrombophilia.
- Obesity (body mass index (BMI) over 30 kg/m\(^2\)).
- One or more significant medical comorbidities (eg, heart disease, metabolic, endocrine or respiratory illness, acute infectious diseases, inflammatory conditions).
- Personal history or a first-degree relative with a history of VTE.
- Use of hormone replacement therapy (HRT) or oestrogen-containing contraceptive therapy.
- Varicose veins with phlebitis.
- Women who are pregnant or have given birth within the previous six weeks.

Admissions to hospital\[1\]

Assess all patients on admission to hospital to identify those who are at increased risk of VTE. Regard medical patients as being at increased risk of VTE if they:

- Have had or are expected to have significantly reduced mobility for three days or more; or
- Are expected to have ongoing reduced mobility relative to their normal state and have one or more of the risk factors shown above.

Regard surgical patients and patients with trauma as being at increased risk of VTE if they meet one of the following criteria:

- Surgical procedure with a total anaesthetic and surgical time of more than 90 minutes, or 60 minutes if the surgery involves the pelvis or lower limb.
- Acute surgical admission with inflammatory or intra-abdominal condition.
- Expected significant reduction in mobility.
- One or more of the risk factors shown above.

Management\[1\]

All patients

- Avoid dehydration unless there is a specific clinical reason.
Encourage early mobilisation.
Aspirin or antiplatelet agents should not be considered adequate prophylaxis.
Consider temporary inferior vena cava filters for patients at a very high risk of VTE (eg, active malignancy or previous VTE event) if there are contra-indications to pharmacological and mechanical prophylaxis. These are devices which can be inserted into the inferior vena cava to prevent the development of a pulmonary embolus.
There are currently no randomised controlled trials or controlled clinical trials that have assessed the benefit(s) of testing for thrombophilia on the risk of recurrent VTE.\[2\]

**Choice of prophylaxis**

**Mechanical**

Several methods are available:

- Graduated compression stockings are effective in decreasing the risk of DVT, either alone or in combination with pharmacological prophylaxis in high-risk patients. Thigh-length graduated compression/anti-embolism stockings can be used unless contra-indicated (eg, in patients with established peripheral arterial disease or diabetic neuropathy). Graduated compression stockings should be used routinely for surgical inpatients. If thigh-length stockings are not appropriate (for reasons of fit or compliance) knee-length stockings may be used instead.\[3\]
  - The stocking compression profile should be equivalent to the Sigel profile (a pressure profile for elastic stockings) and approximately:
    - 18 mm Hg at the ankle
    - 14 mm Hg at the mid-calf
    - 8 mm Hg at the upper thigh

- Staff trained in the use of compression stockings should show the patient how to wear them correctly, monitor their use and provide assistance when needed.
- Patients should be encouraged to wear stockings from admission until they return to their normal level of mobility.
- Intermittent pneumatic compression or foot impulse devices may be used instead of, or as well as, graduated compression stockings while patients are in hospital. They should be used for as long as practical prior to surgery.

**Pharmacological**

Choice should depend on comorbidities (eg, chronic kidney disease), a patient’s wishes and local policies. Options include:

- Fondaparinux sodium.
- Low molecular weight heparin (LMWH) - synthetic alternatives may be more acceptable to patients who want a non-animal based product.
- Unfractionated heparin (UFH) (for patients with chronic kidney disease).
Start pharmacological VTE prophylaxis as soon as possible after risk assessment. Always also consider the risk of bleeding. Risk factors for bleeding include:

- Active bleeding.
- Acquired bleeding disorders (eg, acute liver failure).
- Concurrent use of anticoagulants known to increase the risk of bleeding (such as warfarin with international normalised ratio (INR) higher than 2).
- Lumbar puncture/epidural/spinal anaesthesia expected within the next 12 hours.
- Lumbar puncture/epidural/spinal anaesthesia within the previous 4 hours.
- Acute stroke.
- Thrombocytopenia (platelets less than 75 x 10^9/L).
- Uncontrolled systolic hypertension (230/120 mm Hg or higher).
- Untreated inherited bleeding disorders (eg, haemophilia, von Willebrand's disease).

**Specific clinical scenarios**

**Patients having elective surgery**

- Oral contraceptives or HRT containing oestrogen should be stopped four weeks before surgery.
- For patients on antithrombotic therapy, balance the risks versus benefits of stopping one week before surgery (involve other clinical colleagues as necessary).
- Regional anaesthesia carries less risk than general; consider the patient's wishes, suitability and any other planned methods of VTE prophylaxis.
- If using regional anaesthesia consider timing of pharmacological prophylaxis to minimise risk of epidural haematoma; refer to standard product characteristics for the optimum timing of antiplatelet or anticoagulant prophylaxis with regard to regional anaesthesia.
- Prophylaxis is unnecessary in patients having local anaesthesia by local infiltration if there is no restriction in mobility.
- Choice of prophylaxis will depend on the type of surgery, suitability for the patient, and local policy.

**Patients being discharged from hospital**

Verbal and written information should be given to the patient/carer on:

- Signs and symptoms of DVT and PE.
- Correct use of prophylaxis at home.
- Implications of not using prophylaxis correctly.

**Patients already having antithrombotic therapy to treat other conditions**

- Offer prophylaxis (pharmacological or mechanical) if the risk of thrombosis outweighs the risk of bleeding.
- Prophylaxis should not be offered to patients taking vitamin K agonists who are within therapeutic range, providing anticoagulant therapy is continued.
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- Patients on full anticoagulant therapy should not be offered additional prophylaxis - pharmacological or mechanical.

**Acute stroke**

- Anti-embolism stockings should not be offered.
- If risk factors suggest high risk of VTE (eg, significant restriction to mobility, previous history of VTE, malignancy) and haemorrhagic stroke has been excluded, consider LMWH or UFH.
- If there is low risk of VTE, reassess in 24 hours.
- If risk of bleeding is low, offer foot impulse or an intermittent pneumatic compression device. Consider also as interim intervention whilst awaiting results of investigations.

**Pregnancy**

- Pre-pregnancy counselling and a management plan should be offered to all women who are at high risk of VTE.
- All pregnant women should have their risk factors assessed and documented.
- This assessment should be repeated if there is a hospital admission for any reason or if complications develop.
- Thrombophilia should be excluded in women with a previous non-oestrogen-related VTE which has been provoked by a minor risk factor.
- Prophylaxis should begin as soon as possible in pregnancy.
- LMWH is the prophylaxis of choice, being safer and equally effective as UFH.
- Any woman with three or more persistent or recurrent risk factors (see below) should be considered for antenatal prophylaxis.
- LMWH should not be given routinely to women who have had one previous VTE event, providing this is non oestrogen-related and they have no other risk factors, but they should be monitored closely.
- Women should be offered prophylaxis antenatally if they have:
  - A history of recurrent DVT.
  - An unprovoked, oestrogen-related or pregnancy-related VTE.
  - A previous VTE and a first-degree relative with a history of DVT or proven diagnosis of thrombophilia.
• Women with asymptomatic inherited or acquired thrombophilia should be monitored closely antenatally but should be referred to a local expert if:
  ♦ They have antithrombin deficiency.
  ♦ They have more than one thrombophilic defect (including homozygosity for factor V Leiden).
  ♦ They have additional risk factors.

• Women given LMWH should be warned that if they have vaginal bleeding or go into labour they should not have any more LMWH injections.

• After delivery:
  ♦ Women should be assessed for the risk factors as listed below.
  ♦ Mobilisation should be encouraged during and after labour.
  ♦ Fluid intake should be encouraged.
  ♦ Women with two or more risk-persisting risk factors should be considered for LMWH for seven days postnatally.
  ♦ Women with three or more such factors should be given graduated compression stockings as well as LMWH.
  ♦ Women with BMI >40 kg/m² should be considered for LMWH prophylaxis for seven days postnatally.
  ♦ GPs may find that women who have had an emergency or elective caesarean section are discharged on LMWH. The decision to initiate this and the duration of treatment will depend on what risk factors are present (eg, age, weight, comorbidities, family history of thrombophilia).
  ♦ Women who have had a VTE before the current pregnancy should be considered for LMWH for six weeks postnatally. If they are receiving LMWH before pregnancy, preventative doses of LMWH should be given until six weeks postpartum. A postnatal risk assessment should then be made. Patients on long-term warfarin can recommence this when the risk of haemorrhage is low.
  ♦ Breast-feeding is no contra-indication to either warfarin or LMWH.
  ♦ Repeated risk assessments for VTE should be carried out if women develop intercurrent problems, or they require surgery or re-admission for any reason in the puerperium.
  ♦ For women with additional risk factors lasting more than seven days postpartum (eg, wound infection, prolonged admission), thromboprophylaxis should be continued for up to six weeks or until the risk factors have resolved.
Antenatal assessment and management (to be assessed at booking and repeated if admitted)

Obstetric thromboprophylaxis risk assessment and management

Single previous VTE:
- Thrombophilia or family history
- Unprovoked/estrogen-related
- Previous recurrent VTE (> 1)

Single previous VTE with no family history or thrombophilia
- Thrombophilia + no VTE
- Medical comorbidities, e.g., heart or lung disease, SLE, cancer, inflammatory conditions, nephrotic syndrome, sickle cell disease, intravenous drug user
- Surgical procedure, e.g., appendectomy

Age > 35 years
Obesity (BMI > 30kg/m²)
Parity ≥ 3
Smoker
Gross varicose veins
Current systemic infection
Immobility, e.g., paraplegia, SPD, long-distance travel
Pre-eclampsia
Dehydration/hyperemesis/OGHSS
Multiple pregnancy or ART

Antenatal and postnatal prophylactic dose of LMWH
- Weight < 50 kg = 20 mg enoxaparin/2500 units dalteparin/3500 units tinzaparin daily
- Weight 50-90 kg = 40 mg enoxaparin/5000 units dalteparin/4500 units tinzaparin daily
- Weight 91-130 kg = 60 mg enoxaparin/7500 units dalteparin/7000 units tinzaparin daily
- Weight 131-170 kg = 80 mg enoxaparin/10000 units dalteparin/9000 units tinzaparin daily
- Weight ≥ 170 kg = 0.6 mg/kg/day enoxaparin; 75 units/kg/day dalteparin/75 units/kg/day tinzaparin

Key
- ART = assisted reproductive therapy
- BMI = body mass index (based on booking weight)
- Gross varicose veins = symptomatic, above the knee or associated with phlebitis/oedema/skin changes
- Immobility ≥ 3 days
- LMWH = low-molecular-weight heparin
- OGHSS = ovarian hyperstimulation syndrome
- PPH = postpartum haemorrhage
- SLE = systemic lupus erythematosus
- SPD = symphysis pubis dysfunction with reduced mobility
- Thrombophilia = inherited or acquired, long-distance travel = > 4 hours
- VTE = venous thromboembolism
Postnatal assessment and management (to be assessed on delivery suite)

Obstetric thromboprophylaxis risk assessment and management

- Any previous VTE+
- Anyone requiring antenatal LMWH
- Caesarean section in labour
- Asymptomatic thrombophilia (inherited or acquired)
- BMI > 40 kg/m²
- Prolonged hospital admission
- Medical comorbidities, e.g., heart or lung disease, SLE, cancer, inflammatory conditions, nephrotic syndrome, sickle cell disease, intravenous drug user
- Age > 35 years
- Obesity (BMI > 30kg/m²)
- Parity ≥3
- Smoker
- Elective caesarian section
- Any surgical procedure in the puerperium
- Gross varicose veins
- Current systemic infection
- Immobility, e.g., paraplegia, SPD, long distance travel
- Pre-eclampsia
- Mid-cavity rotational operative delivery
- Prolonged labour (> 24 hours)
- PPH > 1 litre or blood transfusion

High risk
At least 6 weeks postnatal prophylactic LMWH

Intermediate risk
At least 7 days postnatal prophylactic LMWH
Note: if persisting or > 3 risk factors, consider extending thromboprophylaxis with LMWH

< 2 risk factors

Lower risk
Mobilisation and avoidance of dehydration

Key
ART = assisted reproductive therapy, BMI = body mass index (based on booking weight), gross varicose veins = symptomatic, above the knee or associated with phebitis/oedema/skin changes, immobility = ≥ 3 days, LMWH = low-molecular-weight heparin, OHSS = ovarian hyperstimulation syndrome, PPH = postpartum haemorrhage, SLE = systemic lupus erythematosus, SPD = symphyysis pubis dysfunction with reduced mobility, thrombophilia = inherited or acquired, long distance travel = > 4 hours, VTE = venous thromboembolism

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High-risk patients

High-risk patients (eg, multiple risk factors, especially previous DVT/PE) should be offered:

Mechanical prophylaxis

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  - The stocking compression profile should be equivalent to the Sigel profile (a pressure profile for elastic stockings) and approximately:
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- Staff trained in the use of compression stockings should show the patient how to wear them correctly, monitor their use and provide assistance when needed.
- Patients should be encouraged to wear stockings from admission until they return to their normal level of mobility.
- Intermittent pneumatic compression or foot impulse devices may be used instead of, or as well as, graduated compression stockings while patients are in hospital. They should be used for as long as practical prior to surgery.

Pharmacological prophylaxis

- Patients with high risk and those having orthopaedic surgery should also be offered LMWH. Fondaparinux, within its licensed indications, is an effective and safe alternative.\(^4\)
- The oral anticoagulants apixaban, dabigatran etexilate, and rivaroxaban are indicated for thromboprophylaxis following hip or knee replacement surgery.\(^4\)
- Consideration should be given to the risks and benefits of stopping pre-existing anticoagulation or antiplatelet therapy before surgery.
- Pharmacological prophylaxis may need to be stopped if regional anaesthesia is employed in order to minimise the risk of haematoma.\(^6\)

Other options

- Patients should be encouraged to maintain their fluid intake and not become dehydrated during their stay in hospital.
- Regional anaesthesia is to be preferred if possible as it is less of a risk for VTE than general anaesthesia.
- Vena cava filters should be considered for patients who have existing or recent (within one month) VTE and anticoagulation therapy is contra-indicated. These are devices which can be inserted into the inferior vena cava to prevent the development of a PE.
- Patients should be encouraged to mobilise, or leg exercises should be arranged if they are immobile, as soon as possible after surgery.

Patients with no risk factors

Patients having hip replacement, surgical treatment of hip fractures and other kinds of major orthopaedic surgery should be offered mechanical and pharmacological prophylaxis. Otherwise, only mechanical prophylaxis is required.
Travel-related deep vein thrombosis[7]

Assessing risk
The absolute risk of an individual developing a travel-related DVT remains low even if they are at high risk. For continuous journeys lasting more than six hours, the risk of travel-related DVT can be classified as:

- **Low risk**: no history of DVT or PE, and has not undergone surgery in the previous four weeks, and no other risk factors to indicate moderate or high risk.
- **Moderate risk**:
  - Previous history of DVT or PE (people with a recent DVT or PE who are on anticoagulant treatment are considered to be at low risk).
  - Has undergone surgery under general anaesthesia lasting more than 30 minutes in the previous two months but not in the last four weeks.
  - Pregnant or postpartum, taking combined oral contraceptives or HRT.
  - Clinically evident heart disease (eg, recent myocardial infarction or uncontrolled heart failure) or other major acute illness.
  - Obesity (BMI greater than 30 kg/m$^2$).
  - Varicose veins with phlebitis.
  - Family history of VTE in a first-degree relative.
  - Has polycythaemia.
  - Has a lower-limb fracture in plaster.
- **High risk**:
  - Has undergone surgery under general anaesthesia lasting more than 30 minutes in the previous four weeks.
  - Has known thrombophilia.
  - Has cancer (untreated or currently on treatment).

Management

**General advice**

- Avoid periods of prolonged immobility; take occasional short walks around the cabin whilst the aircraft is cruising at altitude.
- Wear loose-fitting clothing. Sit comfortably in the seat and recline as much as possible.
- While seated, bend and straighten legs, feet, and toes every 30 minutes during the flight. Press the balls of the feet down hard against the floor or footrest to increase the blood flow in the legs and reduce clotting. Do upper body and breathing exercises to further improve circulation.
- Maintain a normal fluid intake and avoid excessive alcohol. Avoid taking sleeping pills.
- Seek urgent medical advice if they develop the following after the trip: swollen, painful legs, especially where one is more affected than the other, and/or breathing difficulties.
- For people assessed as having relatively moderate or high risk (see below), advise the use of graduated compression stockings. Advise the use of below-knee graduated stockings with an appropriate compression.
- Aspirin is not recommended for the prevention of travel-related DVT. People already taking aspirin should not increase their dose.

**People at low risk**: advice on general measures to reduce the risk of travel-related DVT. No specific treatment is required.

**People at moderate risk**
Provide advice on general measures to reduce the risk of travel-related DVT. Advise graduated compression stockings: class 1 stockings or proprietary flight socks are generally sufficient. Measure the ankle-brachial pressure index (ABPI) if the person has symptoms of arterial disease. If the ABPI is less than 0.5, compression stockings should not be worn.
People at high risk
Assess the person's suitability for long-distance travel. Consider seeking specialist advice, or recommend delaying or cancelling the trip (eg, postpone a long-haul flight for three months after a hip or knee replacement). If travelling is unavoidable and involves continuous travel lasting more than six hours:

- Provide general advice on general measures and the use of graduated compression stockings as for people at moderate risk.
- Seek specialist advice from a haematologist regarding whether the use of LMWH is indicated:
  - LMWH should be administered before departure.
  - Provide the person with a letter that explains why they have to carry needles and syringes while travelling, to show to security, immigration, and customs officials. Warn about the increased risk of bleeding and bruising.
  - Advise the person to seek urgent medical advice if there is uncontrolled or excessive bleeding or bruising, or if they have a sudden severe headache or gastrointestinal pain.

Joint replacement or fracture
Advise to postpone long-haul flights until three months after surgery.

Fracture
Advise people with a plaster cast to have this changed to a split cast to reduce the risk of compression.

Recent DVT
- If the person has a new diagnosis (within two weeks) of DVT or PE, seek specialist advice.
- If the person has been taking anticoagulants for two weeks or more: reassure that they are at low-risk of developing a further thrombosis. Provide advice on general measures to reduce the risk of travel-related DVT. Consider prescribing graduated compression stockings.

Further reading & references
- The Geko device for reducing the risk of venous thromboembolism, NICE Medical Technology Guidance (June 2014)

1. Venous thromboembolism in adults admitted to hospital: reducing the risk; NICE Clinical Guideline (January 2010)
4. British National Formulary
5. Reducing the Risk of Thrombosis and Embolism during Pregnancy and the Puerperium; Royal College of Obstetricians and Gynaecologists (November 2009)
7. DVT prevention for travellers; NICE CKS, March 2013 (UK access)

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