Prevention of deep vein thrombosis and pulmonary embolism

Ravindra Cooray
Caroline Lake

Abstract

Venous thromboembolism is a major cause of perioperative morbidity and mortality. Immobilized medical patients are also at risk. Long-term sequelae represent a chronic health burden. Hospitalized patients should be assessed for their risk of thromboembolism and bleeding at regular intervals. Risk stratification, using recommended models can be used to guide the choice of thromboprophylaxis. Both mechanical and pharmacological interventions reduce the incidence of venous thromboembolism. Extended prophylaxis is now recommended following high-risk orthopaedic and cancer surgeries and a number of newer oral antithrombotic agents are now available for this. Anaesthesia should be tailored to minimize the risk of venous stasis and maximize early postoperative mobilization.

Keywords Bleeding risk; pulmonary embolism; risk scoring; thromboprophylaxis; venous thromboembolism; deep vein thrombosis

Royal College of Anaesthetists CPD Matrix: 1E05, 2A03

Learning objectives

After reading this article you will be able to:

- describe the aetiology, incidence and implications of venous thromboembolism
- risk stratify patients for venous thromboembolism and bleeding
- explain the benefits and limitations of the various methods of thromboprophylaxis
- formulate a thromboprophylaxis management plan for various clinical scenarios

In 1859 Rudolph Virchow not only coined the terms thrombosis and embolism, he went on to describe the essential factors of stasis, vessel wall damage and hypercoagulability. To this day these are considered not only in the aetiology but also as the cornerstones to identifying risk and preventing venous thromboembolism (VTE). Deep vein thrombosis (DVT) can occur in both the deep veins of the limbs and also in central vessels. The consequences may be immediate and life threatening if emboli enter the pulmonary circulation causing pulmonary embolus (PE), or more rarely the systemic circulation via a shunt or patent foramen ovale causing cerebrovascular or cardiac injury.

Incidence and consequences

In the USA the first-time incidence of VTE exceeds 100 per 100,000 population. The 30-day mortality for patients diagnosed with DVT is around 6% and for those developing PE it is approximately 12%. About one-third will develop a recurrence within 10 years. It accounts for approximately 25,000 deaths annually in England, which represents around 10% of all hospital deaths.[1] The financial cost of VTE in Australia for 2008 was estimated at $1.72 billion (0.15% of GDP).[2] Chronic sequelae, termed 'post-thrombotic syndrome' (PTS), include chronic pain, venous insufficiency, skin changes and ulceration. The risk of PTS at 10 years is approximately 30%.

VTE remains a major cause of morbidity and mortality in hospitalized patients, even in the developed world. Data from research and clinical audits suggest that the available preventive options are under-utilized and inconsistently applied. Prevention of VTE has been the focus of recommendations from both the UK National Institute of Health and Care Excellence (NICE) — Guidelines on Venous Thromboembolism 2010[1] and the American College of Chest Physicians (ACCP) — Antithrombotic Guidelines, 9th edition (AT9) 2012.[3]

VTE can be clinically silent and as a result is difficult to diagnose accurately. The ACCP guidelines suggest assessing the probability of suspected disease using the Wells criteria for DVT, or the Wells and Geneva criteria for PE *before* ordering investigations. Those classified low to moderate risk have a D-dimer assay and if this is positive undergo imaging. Patients with a high pretest probability proceed directly to imaging, without requiring D-dimer assay. The recommended imaging for DVT is compression duplex ultrasound, while for PE it is CT-pulmonary angiography or ventilation perfusion scanning.

Prevention of VTE

Prevention of VTE requires us to both identify which patients are at risk and choose an appropriate method of prophylaxis. Before pharmacological prophylaxis is instituted, the risk of VTE must be weighed against the risk and consequences of any increased bleeding in relation to both the patient and the procedure. NICE recommends assessing a patient's risk of bleeding and VTE within 24 hours of hospital admission and whenever the clinical situation changes.[1]

Identifying the 'at risk' patient

All immobilized patients are at risk, both medical and surgical. The Padua score (Table 1) is a risk prediction tool widely used in acute medical patients. In the perioperative setting, the risk of VTE is determined by both patient risk factors and risks from the surgical procedure itself. The ACCP uses the Caprini score (Table 2) to risk stratify surgical patients. NICE surveillance updates suggest that all of these risk assessment tools, despite having good predictive value in some patient groups, need more robust validation. As a result, no national tool for risk

Ravindra Cooray *FANZCA is a Consultant Anaesthetist at Mount Gambier and District Health Service, Australia. Conflicts of interest: none declared.*

Caroline Lake *FRCA FANZCA is a Consultant Anaesthetist at Flinders Medical Centre, Adelaide, Australia. Conflicts of interest: none declared.*

Padua prediction score: for hospitalized medical patients

Risk factor	Points
Active cancer	3
Previous VTE (exception of superficial vein thrombosis)	3
Reduced mobility (at least 3 days)	3
Diagnosed thrombophilia	3
Recent trauma and/or surgery (<1 month)	2
Age (>70 years)	1
Heart and/or respiratory failure	1
Acute myocardial infarction or ischaemic stroke	1
Acute infection and/or rheumatological disorder	1
Obesity (BMI >30 kg/m^2)	1
Ongoing hormonal treatment	1

Patients at high risk if score >4.
BMI, body mass index; VTE, venous thromboembolism.

Table 1

Risk factors for bleeding

- Active bleeding
- Acquired bleeding disorders (such as liver failure)
- Untreated inherited bleeding disorders
- Concurrent use of anticoagulants known to increase the risk of bleeding
- Thrombocytopenia (platelet count <75 × 10^9/litre)
- Uncontrolled hypertension (>230/120)
- Acute stroke
- Lumbar puncture, spinal or epidural anaesthesia within the previous 4 hours
- Lumbar puncture, spinal or epidural anaesthesia expected within the next 12 hours

Box 1

assessment is currently recommended by NICE and this has been highlighted as a focus for the next edition of the guideline.

Box 1 lists factors associated with an increased risk of perioperative bleeding which should be considered when planning VTE prophylaxis. Major bleeding is defined by NICE to be an episode resulting in a decrease in haemoglobin concentration of 2 g/dl or more, transfusion of two or more units of blood, bleeding into a retroperitoneal, intracranial or intraocular site, a serious or life-threatening clinical event or one that requires surgical or medical intervention.

VTE prophylaxis

Prevention of VTE can include one or both of mechanical or pharmacological measures. Early mobilization following surgery is paramount and any intervention that facilitates this will help reduce perioperative DVT and PE. Adequate analgesia, preventing and treating postoperative nausea and vomiting, adequate hydration, minimizing the motor block associated with using regional anaesthesia and good nursing care are all fundamental.

Caprini risk assessment model: for surgical patients

1 Point	2 Points	3 Points	4 Points
Age 41–60 years	Age 61–74 years	Age >75 years	Stroke <1 month
Minor surgery	Arthroscopic surgery	History of VTE	Elective lower extremity arthroplasty
BMI >25 kg/m^2	Major open surgery >45 minutes	Family history of VTE	Hip, pelvic or leg fracture
Swollen legs	Laparoscopic surgery >45 minutes	Any thrombophilia	Acute spinal cord injury <1 month
Varicose veins	Bed rest >72 hours	Elevated serum homocysteine	
Pregnant or post partum	Immobilizing plaster cast	Heparin-induced thrombocytopenia	
History of miscarriage	Central venous access		
Oral contraceptive pill or hormone replacement therapy			
Sepsis <1 month			
Serious lung disease <1 month			
Abnormal pulmonary function			
Acute myocardial infarction			
Congestive cardiac failure <1 month			
History of inflammatory bowel disease			
Medical patient on bed rest			

Score <2 low risk, 3–4 moderate risk, 5–8 high risk, >8 very high risk.
BMI, body mass index; VTE, venous thromboembolism.

Table 2