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Prevention of Venous Thromboembolism in Critical Care



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Key Messages

1. We need to *Identify* high risk patients early on during their hospital admission.
2. *Recognise* anticoagulant prophylaxis may not be suitable for all patients therefore consider other interventions to protect against VTE.
3. *Focus* on sustained education of healthcare professionals to increase

Venous thromboembolism (VTE) is commonly encountered and difficult to manage in critical care. Furthermore, pulmonary embolism (PE) is seen as a preventable cause of death in the hospital population. It is beholden to us to ensure that all steps are taken to assess the risk to patients, and once identified, ensure appropriate prophylaxis is put in place.

Why is it Important to Prevent VTE in Critical Care?

Venous thromboembolism (VTE) carries significant mortality in the critical care population, and therefore needs to be addressed both at a local hospital and at national level. The All-Party Parliamentary Thrombosis Group at the House of Commons in the UK stated: "In general, people are well aware of the risk of a form of VTE called deep vein thrombosis (DVT) which is regularly associated with air travel, however, the risk of contracting VTE during or following a hospital stay is far greater"(Morrison, 2013).

VTE is common in the ICU and potentially life threatening

Intensive care unit (ICU) patients are at an even higher risk for both deep vein thrombosis (DVT) and pulmonary embolism (PE), often due to their clinical presentation and factors associated with an ICU admission e.g. prolonged immobility, sedation and neuromuscular blockade to facilitate ventilation (Hunt 2014). For a critical care patient, developing a large pulmonary embolus occluding the pulmonary arterial bed may cause potentially irreversible right ventricular failure, an acute life-threatening condition. In a large USA study the mortality from pulmonary emboli in acute hospitalised patients was estimated to be 8.2% in 2005 (Park et al. 2009).

VTE is challenging to recognise and manage in the critical care population

Pulmonary emboli are more difficult to diagnose in this patient population, and require complex treatment. A high index of suspicion is required for early detection. Clinical and autopsy series show over 50% of cases are *not* clinically suspected, and hence not managed (Tapson 2008). Furthermore, patients with known DVT and no symptoms of PE have been diagnosed with PE on ventilation-perfusion scans (Berlot et al. 2011).

Management of critical care patients with large pulmonary emboli causing circulatory collapse requires thrombolysis; however, this may be contra-indicated. A multi-discipline approach, exemplified by the Swedish model, is needed to determine the optimal management for a given critical care patient and address challenges of transfer to a tertiary centre with appropriate cardiothoracic services and ECMO (extracorporeal membrane oxygenation) facilities if required (Svennerholm 2014).

What are the Current VTE Prevention Guidelines?

The American College of Chest Physicians (ACCP) has outlined the standard in the 9th Edition of antithrombotic guidelines published in Chest 2012 (Guyatt et al. 2012). They strongly recommend (Grade 1a evidence) anticoagulant thromboprophylaxis with unfractionated or low molecular weight heparin in high thrombosis risk patients. For high bleeding risk patients the ACCP has recommended against the use of anticoagulant drugs (Grade 1b) and optimal use of mechanical thromboprophylaxis. Despite the lack of strong clinical data in critically ill patients, graduated compression stockings (GCS) or intermittent pneumatic compression (IPCs) may be preferable to *no prophylaxis* in patients at appreciable risk for VTE who are also at high risk for bleeding (Grade 2c).

What is the incidence of VTE?

VTE is the most common preventable cause of death in hospitals. The overall incidence of VTE is 1 in 1000 cases causing significant morbidity and mortality (Park et al. 2009). The VITAE study estimated that each year in Europe almost 300,000 cases of pulmonary embolism occur (Cohen et al. 2007). However, it is widely recognised that we underestimate the burden of VTE, and for every case where PE is documented as cause of death there may well be several cases that remain undiagnosed (Berlot et al. 2011).

How Can we Prevent VTE?

National Health Initiatives

Venous Thromboembolism (VTE) Risk Assessment in England, produced by NHS England, is a new programme designed to increase hospital admission screening of patients to identify VTE risk. Questions are targeted around mobility, thrombosis and bleeding risk. Of the 3.5 million adult patients admitted to NHS-funded acute care between January and March 2014, 96% of these received a VTE risk assessment on admission (VTE Prevention England 2014)

National standards and guidelines for practice in the UK have been outlined by the NHS Modernisation Agency in the *10 High Impact Changes for Service Improvement and Delivery* (2004) and the National Institute for Health and Care Excellence (NICE) in *Venous thromboembolism* (2010). The NHS Modernisation Agency suggest that adopting VTE prophylaxis as part of ventilator care bundles in critical care could not only lower VTE incidence, but potentially reduce ICU length of stay and increase hospital bed capacity (NHS Modernisation Agency 2004)

A prospective quality improvement study at Kings College Hospital, London examined the impact of mandatory documented VTE risk assessment on hospital-acquired thrombosis (HAT) events (Roberts et al. 2012). The authors found a significant reduction in hospital-acquired thrombosis events after implementation.

However, even with greater focus on risk assessment the proportion of HAT attributable to inadequate thromboprophylaxis remained at 22.4%. This conclusion was also supported by the ENDORSE study (Kakkar et al. 2010), a multinational cross-sectional survey designed to assess the prevalence of VTE risk in the acute hospital care setting, and to determine the proportion of at-risk patients who receive effective prophylaxis. In the UK, of the patients assessed as being at risk of VTE, only approximately 60% are receiving recommended levels of prophylaxis. Germany was the only country to exceed 80% of patients receiving recommended levels of prophylaxis. Poor compliance with the ACCP guidelines is likely due to lack of education surrounding the issue, but also for many critically ill patients anticoagulation is contraindicated, and therefore alternative thromboprophylaxis measures need to be considered.

Anti-Coagulation Therapy

Numerous factors surrounding anticoagulation in critical care patients are debated including type, duration and dose of drug. The current evidence suggests low molecular weight heparin (LMWH) is the most cost-effective thromboprophylaxis in the acutely ill patient based on 30 day DVT, PE and mortality rates in a population of over 10,000 patients (McGarry et al. 2004; Cook et al. 2011) However, it is well understood that the bioavailability of LMWH is difficult to predict in critically unwell patients, and therefore unfractionated heparin with regular monitoring may allow greater control over the patient's coagulation. Duration of anticoagulation should be planned as part of the ongoing VTE risk assessment. It should be noted VTE up to 90 days post hospital discharge is termed as a hospital-acquired thrombosis; therefore a VTE plan on discharge should be clearly documented (National Institute for Health and Care Excellence 2010). The dosing of anticoagulation is challenging in this population, and should be ideal body weight based for LMWH and monitored carefully with regular activated partial thromboplastin time (APTT) testing for unfractionated heparin.

However, anticoagulation is not always appropriate in the critical care population; approximately 10% of the ENDORSE trial patients were contraindicated to anticoagulation (Kakkar et al. 2010). Absolute contraindications include: active haemorrhage, acquired bleeding disorders, concurrent use of anticoagulants e.g. warfarin, lumbar puncture/epidural/spinal anaesthesia expected within the next 12 hours or within previous 4 hours, acute cerebrovascular accident, thrombocytopenia (platelets < 75 x 10⁹/l), uncontrolled systolic hypertension (230/120 mmHg or higher) and untreated inherited bleeding disorders (National Institute for Health and Care Excellence 2010). Furthermore, some critical care patients who are anti-coagulated appropriately still develop VTE (Berlot et al. 2011), perhaps due to a hyper-coagulant state or because they are refractory to anticoagulant therapy. Hence, we should aim to modify our VTE prevention and not only rely upon pharmacological prophylaxis.

Mechanical Prophylaxis and IVC Filters

What are the options for high- risk patients with an absolute contraindication to anticoagulation or who are awaiting surgical procedures for which

we have temporarily stopped anticoagulation? The ACCP suggests a role for mechanical prophylaxis, graduated compression stockings (GCS) and intermittent pneumatic compression (IPC) devices in this instance. Whilst there is only Grade 2C evidence, a non-harmful intervention that may prevent VTE in a high risk population is recommended by the the ACCP and National Institute for Health and Care Excellence (NICE) (Guyatt et al. 2012; National Institute for Health and Care Excellence 2010).

Alternatives to pharmacological prophylaxis include traditional inferior vena cava (IVC) filters. However, difficulty inserting the filter in high-risk patients, safe retrieval of the device and short- or long-term traceability have limited their use. MHRA Regulating Medicines and Medical Devices issued an alert in 2012 concerning serious complications related to IVC filter retrieval, and strongly recommend planned retrieval of the device as soon as possible once clinically not required (MHRA Regulating Medicines and Medical Devices 2013).

More recently a triple lumen CVC catheter with an added IVC filter attached has been developed for the same cohort of patients. The catheter can be inserted through femoral access at the bedside. and placement confirmed on x-ray imaging with an uncomplicated retrieval (Angel 2014). However, as this is a novel device there is limited data on long term outcomes. Both IVC filters and Angel® catheters are only temporising measures until a more permanent method of thromboprophylaxis can be implemented.

Ventilator Care Bundles and Critical Care Rehabilitation

Ventilator care bundles, including graduated compression stockings or intermittent pneumatic compression devices, anticoagulant therapy, elevation of the head of the bed to reduce aspiration risk and effective sedation management all lead to enhanced patient safety, reduced hospital standardised mortality ratios and lowering the risk of VTE (NHS Modernisation Agency 2004).

When considering VTE prevention we need to look closely at whole body rehabilitation, including optimal and appropriate use of sedation, physical and occupational therapy in the earliest days of critical illness to aid better functional outcomes at hospital discharge and increased ventilatorfree days (National Institute for Health and Care Excellence 2009; Schweickert et al. 2009).

The PROTECT study (PROTECT Investigators et al. 2011) highlighted that over one-third of PEs diagnosed in clinical practice occur in patients admitted to the ICU without PE or DVT, and that most pulmonary emboli happen during the initial days of hospitalisation, with peak incidence at day 6. Therefore we need to protect patients as early as possible to avoid the implications of VTE in the critical care population.

Conclusion

The impact of venous thromboembolism in the critically ill patient is a significant problem. Whilst there are several national health initiatives and standards outlined for the prevention and management of VTE the number of patients receiving adequate thromboprophylaxis is poor. Furthermore, the critical care population poses a difficult challenge to balance the risk of bleeding against thrombosis. New options are needed to decrease the risk of VTE when anticoagulation is contraindicated. Pulmonary embolism is more common than clinically recognized, and it happens early in the course of the hospitalisation. Incorporating VTE prophylaxis into ventilator care bundles, improving healthcare professional awareness of the issue and optimising critical care rehabilitation are all measures that will improve adequate thromboprophylaxis provision on an individual patient basis.

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