Venous Thromboembolism in the Intensive Care Unit Patient

Ken Leeper, MD
Section Chief, Pulmonary & Critical Care Medicine, Crawford Long Hospital, Atlanta, GA

Prevalence of Venous Thromboembolism in Intensive Care Unit Patients:
Intensive care unit (ICU) patients represent a heterogeneous population, and most information about the incidence of venous thromboembolism (VTE), and its prevention is from studies in trauma or surgical patients. Studies in which patients were prospectively screened for deep vein thrombosis (DVT), and the diagnosis confirmed by objective testing, suggest that in the absence of thromboprophylaxis the incidence of DVT ranges from approximately 7% to 33%, depending on the patient population and setting (1-8). In trauma patients approximately 60% will develop DVT within the first two weeks after admission (9).

In medical ICU patients, despite varying degrees of prophylaxis for DVT, the incidence of DVT remains unacceptable high. Nearly 13 years ago, a classic study by Hirsch et.al. highlighted the prevalence of DVT in a medical ICU population and the issue of inadequate prophylaxis in these patients In 100 patients admitted to the MICU for greater than 48 hours in whom 61% received DVT prophylaxis, lower extremity ultrasound (US) was performed and found that 33% had DVT, and those who had DVT were more likely to have had prior DVT and had a slightly higher hospital mortality rate (10). Ibrahim et.al. evaluated the incidence of DVT in a cohort of 110 patients requiring mechanical ventilation for > 7 days. Prophylaxis was administered to all the patients, but despite universal prophylaxis the incidence of DVT was 23.6%. This investigation also noted that 19% were upper extremity DVTs (11). Finally, in a prospective cohort study by Cook et.al. 261 medical-surgical ICU patients underwent bilateral US within 48 hours of admission and twice weekly or when DVT was suspected. These patients also received universal protocol-driven DVT prophylaxis. The investigators found that DVT was present in 2.7% of the patients on admission
and subsequently occurred in 9.6% of patients during their ICU stay. Independent risk factors for DVT were family or personal history of DVT, end-stage renal disease (ESRD), platelet transfusions, and vasopressor use. This study also highlighted that the consequences of developing DVT during the ICU admission are longer length of stay in the ICU and hospital and longer duration on mechanical ventilation (12).

**Risks Factors of VTE in the ICU Patient:** A variety of factors may predispose ICU patients to VTE, and the majority have multiple risk factors. In one prospective study conducted in a medical-surgical ICU, the mean number of VTE risk factors was 4.3 (13). Risk factors may be present on admission to the ICU, or may be acquired during the patient’s stay in the unit as a result of invasive procedures or treatments. Pre-existing risk factors include recent surgery, immobilization, estrogen treatment, and medical conditions such as cancer, trauma, or stroke. Interventions that may lead to an acquired risk of VTE in the ICU include sedation, mechanical ventilation and insertion of central venous catheters. In one randomized prospective trial, 25% of patients in a medical-surgical ICU who underwent central venous catheterization via a femoral vein, developed DVT, whereas no cases of DVT occurred in patients catheterized via a subclavian or internal jugular vein (14).

**Diagnosis of VTE in the ICU Patient:** The clinical diagnosis of a VTE event in the ICU is largely nonspecific (15). Clinical clues such as an unexplained increase in dead space ventilation or minute ventilation in a patient on mechanical ventilation or the development of unexplained fever may lead to the investigation of VTE. There is no role for d-dimer determination to exclude the possibility of VTE in this patient population. ICU patients have a number of comorbid diseases that would make the d-dimer test useless (16). The noninvasive diagnosis of DVT in the ICU patient is primarily performed by duplex ultrasonography. Screening for DVT with the new portable US devices has been advocated, but existing data suggest that screening for DVT may not be cost effective (17). CT venography in patients with normal renal function correlates well with duplex Doppler ultrasonography of the lower extremities. Evaluation of the upper extremities for DVT can be accomplished by ultrasound. In the evaluation for acute PE, if the patient is hemodynamically stable and with normal renal function, spiral CT scanning of the chest should be performed. There are only case series describing the role of spiral CT scanning for PE in ICU patients. The diagnostic accuracy of spiral CT-pulmonary angiography and CT venography are extrapolated from the recent PIOPED II investigation (18). The CT scan of the chest can also provide alternative diagnoses to explain the clinical suspicion of pulmonary embolism. Recently, there have been investigations that have shown that once PE is confirmed by CT scan, the finding of right ventricular diameter/left ventricular diameter (RV/LV) ratio >0.9 can be used in risk stratification of PE severity (19). In the patient who is unable to be moved from the ICU and may be hemodynamically unstable, either the transthoracic or transesophageal echocardiography can be used to demonstrate acute RV
dysfunction and in some instances the presence of an acute pulmonary embolic event.

**Thromboprophylaxis in ICU Patients:** Although data specific to critical care patients are limited, the available evidence suggests that VTE thromboprophylaxis is often under-prescribed, or used suboptimally in ICU patients (20). ACCP guidelines include general recommendations for the prevention of VTE in ICU patients, but make no specific recommendations for medical ICU patient. It is recommended that all patients should be assessed for their risk of VTE on admission to the ICU, and that most patients will require some form of thromboprophylaxis. Medical ICU patients are generally considered to be at moderate risk of VTE, and either LMWH or low-dose UFH is recommended for such patients (Grade 1A recommendation). If the risk of bleeding is considered to be high, mechanical prophylaxis with graduated compression stockings, intermittent pneumatic compression, or both, can be used until the risk decreases. The available data suggest that the efficacies of UFH and LMWH in the prevention of VTE in ICU patients are comparable. Moreover, the incidence of major bleeding appears to be similar with the two agents. It should be noted that thromboprophylaxis is not always effective, and that a proportion of high-risk patients may develop DVT despite prophylaxis. In a recent study, 23.6% of mechanically ventilated patients in a medical ICU developed DVT despite prophylaxis (11). Such findings suggest that some conditions common in the ICU setting, such as cardiac impairment or vasopressor use, might reduce the efficacy of thromboprophylaxis. (21,22).

**Non-Pharmacological Thromboprophylaxis:** The use of mechanical devices such as intermittent pneumatic compression (IPC) or sequential compression devices (SCD) are used primarily when there is a high risk of bleeding. Robust evidence supporting its efficacy as the only prophylaxis measure preventing DVT is lacking. If the risk of bleeding is considered to be high, mechanical prophylaxis with graduated compression stockings, intermittent pneumatic compression, or both, can be used until the risk decreases or resolves.

**Treatment of Acute VTE in ICU Patients:** Evidence-based consensus guidelines and individual studies have recommended that patients with confirmed VTE should receive either subcutaneous LMWH or intravenous UFH, together with vitamin K antagonists (20). If a patient presents to the ICU or develops a massive acute pulmonary embolism during their ICU stay, thrombolytic therapy should be considered if there are no contraindications. Surgical options are usually considered when there is a contraindication to more aggressive medical approach Heparin induced thrombocytopenia (HIT) is another source of venous thrombosis in ICU patients. HIT is characterized by a reduction in the platelet count by 50%, usually after five days of unfractionated heparin exposure, but rarely after LMWH exposure. The frequency in the cardiac surgical population can be as high as 1- 3% (23). Nearly 50% with documented HIT will develop either venous or arterial thrombosis. The treatment of HIT is the discontinuation
of heparin and the treatment with direct thrombin inhibitors. Inferior vena cava filters are sometimes used in the treatment of VTE in cases where contraindications to anticoagulants exist. However, current guidelines recommend against the routine use of such devices in the majority of VTE patients (20), and it seems appropriate to adopt this recommendation in ICU patients.

**Summary:** Venous thromboembolism is a common problem in the intensive care unit. The occurrence of DVT, or acute pulmonary embolism in the ICU patient is associated with additional morbidity and increased cost. The clinical diagnosis of VTE in critically-ill patients is so nonspecific that the prevalence is underestimated. We need to ascertain whether DVT screening is justified and cost effective in this patient population. Diagnostic and treatment strategies need to be further studied on large groups of ICU patients with the appropriate stratification. Thromboprophylaxis in the ICU population must be universal, although it may not be as effective when compared to the non-ICU populations. Truly, prophylaxis against VTE in the ICU is the last frontier in our quest to appropriately protect our acutely ill hospitalized patients from VTE events (24).

**References**