CLINICAL VIGNETTE

Designing Systems to Deliver Optimal VTE Prophylaxis

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Venous thromboembolism (VTE) represents a major public health issue that impacts 350,000 to 600,000 people with 100,000 associated deaths[1]. VTE is the most common cause of preventable hospital death[1]. Patients who are hospitalized or recently hospitalized for acute medical illness or surgery are at risk for deep vein thrombosis (DVT) and pulmonary embolus (PE). Most hospitalized patients have at least one risk factor for VTE. Common risk factors for VTE include advanced age, malignancy, acute myocardial infarction, inflammatory bowel disease and congestive heart failure. While PE is a leading cause of preventable hospital death, only a small percentage of eligible patients receive appropriate prophylaxis[2-5].

The American College of Chest Physicians (ACCP) provides clear guidelines outlining appropriate use of VTE prophylaxis. However, many studies indicate prophylaxis rates for medical patients remain low[3-5]. In the subset of the ENDORSE trial evaluating VTE prophylaxis practices in US medical patients, fewer than 50% of patients received appropriate VTE prophylaxis[4]. This trial included 358 medical centers in 32 countries, and found only 58.5% of surgical patients and 39.5% of medical patients were prescribed appropriate VTE prophylaxis[4]. In the DVT FREE registry study, patients with diagnosed DVT during hospitalization had sub-optimal rates of appropriate VTE prophylaxis prior to diagnosis with only 42% of patients receiving prophylaxis in the thirty days prior to diagnosis[6]. In the IMPROVE trial, only 60% of medical patients received appropriate VTE prophylaxis per ACCP guidelines[7]. This study also demonstrated significant heterogeneity in medical practices concerning DVT prophylaxis. The CURVE study evaluated use of VTE prophylaxis in Canadian patients and found only 16% of patients received appropriate VTE prevention[8]. VTE prophylaxis was indicated in 90% of all medical patients in this trial with only 23% of patients receiving some type of VTE prophylaxis[8].

Failure to provide appropriate VTE prophylaxis has a high monetary toll on the health system. Additional health care costs estimates associated with VTE ranged from $7,594 to $16,644 per event[9]. National groups are proposing increased VTE monitoring to improve prophylaxis rates. The National Quality Forum recommended that VTE risk assessment be performed on admission and at regular intervals during the hospitalization[10]. The Joint Commission considers VTE prophylaxis as a new core measure.

Many hospitals have difficulty tracking the number of patients receiving appropriate VTE prophylaxis. Historically, lower rates of VTE prophylaxis have been attributed to physician concerns about prophylaxis-related bleeding, heparin-induced thrombocytopenia (HIT), lack of knowledge or agreement with guidelines and system-based issues. Hospitals with standardized VTE admission order sets have demonstrated improved compliance with VTE prophylaxis. Maynard et al demonstrated increased use of VTE prophylaxis after adopting order sets with no associated increase in heparin-induced thrombocytopenia or prophylaxis-associated bleeding[3]. Other studies found improved VTE prophylaxis with use of decision support tools such as hospital-wide protocols and order sets[11]. Other methods to improve VTE prophylaxis include admission and transfer order sets, education, audit and feedback and computerized decision support. Incorporating VTE risk assessment models into order sets have been highly effective. However, use of VTE risk assessment models has been limited by lack validated risk assessment models and problems integrating models into physician work flow. Many VTE risk assessment models are too complex and can impede physician efficiency, limiting adoption. Also any system that is

implemented needs to be monitored to assess compliance and appropriate use.

Most VTE risk assessment tools are based upon global risk assessment or point-based systems, but few have been validated until recently. Two point-based models which, have been validated are the Caprini risk assessment model and the Padua prediction score model. The Caprini model creates an individualized risk assessment for VTE. Each risk factor is assigned from one to five points and the total score determines the risk level and the recommended prophylaxis regimens. Patients are classified as mild, moderate, high and highest risk of VTE[12, 13].

The Caprini model for VTE risk assessment was developed and validated in surgical patients. The Caprini model uses an individualized patient scoring system. VTE risk factors were evaluated in 8,216 surgical inpatients and individual odds ratio for VTE were created based on the risk factors that were present. Recent sepsis, malignancy, history of VTE and central venous access were correlated with VTE risk. VTE risk was classified into four categories with a significant correlation between risk of VTE and increasing individual risk score. Poor compliance with VTE prophylaxis guidelines was also associated with increased risk of hospital-acquired VTE[13].

The Caprini model was tested and validated in the plastic and reconstructive surgery patients, who have high risk of VTE. In these patients the model found scores above>8 (patients at highest VTE risk) predicted risk of a postoperative VTE event with 11.3% of patients developing VTE when no pharmacologic prophylaxis was administered[14]. Risk of VTE was directly correlated with each of the Caprini risk factors. and the total score was used to determine appropriate prophylaxis.

The Padua prediction model was developed using 1,180 internal medicine patients over a two-year period. This model also uses a point score to assigned either a low or high-risk designation, with a score of four or greater defining high risk. Points were assigned for presence of malignancy, decreased mobility, advanced age, myocardial infarction, CVA and infection. The study outcome was the adjusted hazard ratio of VTE in high-risk patients who had appropriate VTE prophylaxis as compared with patients who did not. In the high-risk group, VTE developed in 2.2% of patients who received appropriate VTE prevention and 11% of those patients who did not[15]. To use this point-based model, physicians need to calculate BMI, be aware of ambulation status and review chronic medical conditions to calculate the risk of VTE[15].

Maynard et al created a VTE prophylaxis protocol that has been validated as a tool to assess and implement appropriate VTE prophylaxis[3,10]. This system categorizes three levels of risk for VTE and links risk to treatment modalities. When this protocol was implemented, the percentage of patients on appropriate prophylaxis increased from 58% to 93% over three years, without increase in prophylaxis-related bleeding or HIT rates. Rates of hospital-associated VTE declined[3]. Hospitalized patients were grouped into low, moderate or high VTE risk categories based upon a global assessment of risk rather than an individualized one. The low-risk category included ambulatory patients with zero-one risk factors for VTE and patients hospitalized for same day or minor surgery. The high-risk category includes patients with lower extremity arthroplasty, spinal cord injury, major trauma and hip or pelvic fracture. The moderate-risk category includes all other patients and typically includes many hospitalized medical and surgical patients. This model provides an easy to employ assessment of VTE that is directly linked to pharmacologic options.

Primary pharmacologic prophylaxis prevents VTE. Common pharmacologic options for prevention of VTE include LMWH and UFH. ACCP guidelines do not recommend chemical prophylaxis or sequential compression devices (SCDs) in low-risk patients. Intermediate-risk patients should have chemical prophylaxis, or if there are contraindications to chemical prophylaxis, SCDs should be employed. High-risk patients should be provided with both pharmacologic prophylaxis and SCDs.

Contraindications to pharmacologic prophylaxis include active hemorrhage, post-operative bleeding concerns and known bleeding disorders. Chemical prophylaxis may be held due to coagulopathy or thrombocytopenia. Concerns over CNS bleeding can also limit prophylaxis. Mechanical prophylaxis should be held with peripheral arterial disease, open wounds or ulcerations of lower extremity. Patients who

have contraindications to pharmacologic prophylaxis should be treated with mechanical prophylaxis unless contraindicated. Overuse of mechanical prophylaxis can impede ambulation and add unnecessary medical costs.

In summary, rates of appropriate VTE prophylaxis have been sub-optimal in the US. This may be due to deficits in knowledge, concerns for bleeding or system-based problems. Failure to provide appropriate VTE prophylaxis is costly and is increasingly being recognized by regulatory bodies. Efforts to improve rates of appropriate VTE prophylaxis include use of order sets, education and computerized decision support tools. Several validated risk-assessment tools are incorporated into systems to deliver improved VTE prophylaxis. Institutions need a streamlined system of VTE assessment, delivery and monitoring to ensure adequate VTE prophylaxis for optimal patient care.

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