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Evolution of venous thromboembolism risk assessment in trauma and surgical patients

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Introduction: Development of venous thromboembolism (VTE) is a common cause of in-hospital morbidity and mortality. The initial evaluation of VTE risk in hospitalized surgical patients has become the standard of care. In an attempt to ascertain why patients who had received adequate prophylaxis on initial evaluation had subsequently developed VTE, we hypothesized that in the absence of changing levels of care, risk of VTE does increase in the hospitalized surgical patient population. As the treatment paradigms for moderate and high risk patients are equivalent, we also hypothesized that this change resulted in under-treatment with regard to prophylaxis of VTE.

Patients and methods: A retrospective data analysis was performed on 96 adult patients admitted to our surgical service. The initial VTE risk assessment and prophylactic guidelines are based on set criteria mandated by our institution. The initial VTE risk and prophylaxis on admission was noted for each patient. The patient was then subsequently re-evaluated during the hospitalization using the same criteria. Additional information obtained included demographic data, prior surgery, hospital-length of stay, prior history of DVT, and whether or not prophylaxis was appropriate initially and on reassessment. A one-way analysis of variance was then performed.

Results: Among the 96 enrolled patients, 76 progressed in their VTE risk resulting in change of risk category. Change by one category of risk occurred in 33 patients, two categories occurred in 19 patients, and three categories occurred in 24 patients. In addition to change in risk category, the need for change in prophylaxis was also evaluated in these patients by comparing percentage of patients given appropriate prophylaxis initially and again on re-evaluation.

Discussion: We feel that repeated reassessment of VTE risk throughout a hospital stay is indicated. Prophylactic measures based on risk should also be adjusted accordingly.

Keywords: venous thromboembolism, risk assessment, re-evaluation.

Introduction

Development of venous thromboembolism (VTE) is a common cause of in-hospital morbidity and mortality. VTE is a term that encompasses the continuum of deep vein thrombosis (DVT) and pulmonary embolism (PE). Annual incidence of VTE is estimated to be 300,000–600,000 cases in the US.[1–3] Due to difficulty in documenting DVT and PE, limitations in databases, and specificity of community-based studies, this condition is seriously under-reported.[4,5] The initial evaluation of VTE risk in hospitalized surgical patients has become the standard of care in an attempt to address this issue. It is not uncommon for a hospitalized patient to develop hypercoagulability, particularly in the postoperative setting, due to a number of factors. The inflammatory response

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essential for wound healing is also causative in offsetting the balance of pro- and anti-thrombotic factors necessary for proper hemostasis.[6] In an attempt to ascertain why patients who had received adequate prophylaxis on initial evaluation had subsequently developed VTE, we hypothesized that in the absence of changing levels of care, risk of VTE does increase in the hospitalized surgical patient population. As the treatment paradigms for moderate and high risk patients are equivalent, we also hypothesized that this change resulted in under-treatment with regard to prophylaxis of VTE.

Materials and methods

A retrospective data analysis was performed on 96 adult patients admitted to our surgical service. The initial VTE risk assessment and prophylactic guidelines are based on set criteria, modified from the Wells DVT Scoring Criteria,[7] mandated by our institution. As our study pertained to evaluation of VTE risk development, patients with current or prior VTE were excluded from the analysis. This study was deemed exempt from full review according to the Institutional Review Board of SUNY Downstate Medical Center as this was a retrospective data analysis using de identified patient data. Because of this the Institutional Review Board of SUNY Downstate Medical Center also deemed patient consent unnecessary. The initial VTE risk and prophylaxis on admission was noted for each patient. The patient was then subsequently re-evaluated during the hospitalization using the same criteria. In addition to performing a chart review, each patient was evaluated at the bedside to assess for clinical status that could alter VTE risk as part of a performance improvement protocol. Our VTE assessment used a point-based system for evaluation shown in Table 1. An individual's risk is based on the cumulative points given by the presence of particular risk factors. These cumulative points then place the patient into a particular category of VTE risk, which determines the degree of prophylaxis: 0–1 points = low risk, 2 points = moderate risk, 3–4 points = high risk, 5+ = very high risk. Prophylactic measures are illustrated in Table 2. Additional information obtained included demographic data, prior surgery, hospital-length of stay, prior history of DVT, and whether or not prophylaxis was appropriate initially and on reassessment. A one-way analysis of variance was then performed using JMP Statistical Software© (SAS Institute Inc., Cary, NC, USA).

Results

Of the 99 patients originally screened, three patients were excluded due to the presence of VTE. The remaining 96 patients consisted of 53 males and 43 females, with a mean age of 60 years. Initial risk scores ranged from 0–7. Upon re-evaluation, scores ranged from 1–20. Re-evaluation occurred within the hospitalization period ranging from 1–78 days post-admission. Among the 96 enrolled patients, 76 progressed in their VTE risk resulting in change of risk category. Change by one category of risk occurred in 33 patients, two categories occurred in 19 patients, and three categories occurred in 24 patients (Figure 1). In addition to

Table 1 VTE risk factors and corresponding point appropriations

One point	Two points	Three points	Five points
1. Age 41–60 years	1. Age 60–74 years	1. Age 75 years and above	1. Elective arthroplasty
2. Minor elective surgery	2. Malignancy	2. Family history of VTE	2. Pelvic or leg fracture
3. Lower extremity edema	3. Arthroscopic surgery in the last month	3. Factor V Leiden	3. Stroke
4. Varicose veins	4. Major surgery in the last month	4. Lupus anticoagulant	4. Multiple trauma
5. Major surgery (over 45 mins) in the last month prior	5. Immobilized with plaster caste in the last month	5. Anti-cardiolipin antibodies	5. Acute spinal cord injury or paralysis in the last month
6. Adnormal PFT	6. Central venous access	6. HIT	
7. Obesity		7. Other thrombophilia	
8. COPD			
9. Inflammatory bowel disease			
10. AMI or CHF			
11. Sepsis			
12. Serious lung disease (eg, pneumonia) in the last month			
13. Bed rest			
14. OCP or HRT			
15. Pregnancy or 1 month post-partum			
16. Females with unexplained stillbirths, three or more recurrent spontaneous abortions, premature birth with toxemia or growth restricted infants			

Abbreviations: AMI, acute myocardial infarction; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; HIT, heparin induced thrombocytopenia; HRT, hormone replacement therapy; OCP, oral contraceptive pills; PFT, pulmonary function tests; VTE, venous thromboembolism.

Table 2 Prophylactic measures of VTE risk categories

Low risk (0–1 Points)	Moderate risk (2 Points)	High risk (3–4 Points)	Very high risk (5 or more Points)
1. Early ambulation 2. Intraoperative pneumatic compression	1. Early ambulation 2. Intraoperative pneumatic compression 3. Enoxaparin or low-dose unfractionated heparin	1. Early ambulation 2. Intraoperative pneumatic compression 3. Enoxaparin or low-dose unfractionated heparin	1. Early ambulation 2. Intraoperative pneumatic compression 3. Enoxaparin, warfarin, or intermittent pneumatic compression with unfractionated or LMW heparin

Abbreviations: LMW, low molecular weight; VTE, venous thromboembolism.

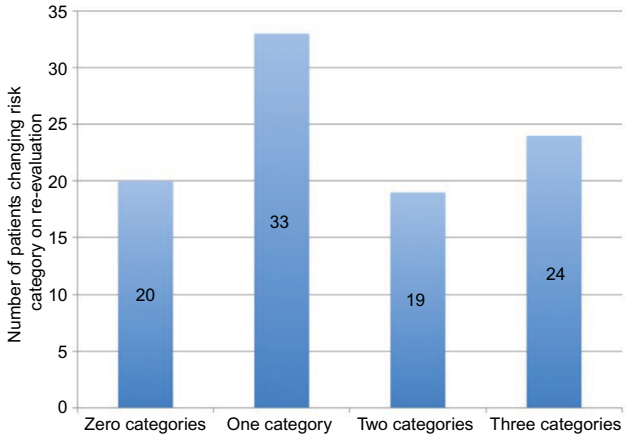

Figure 1 Number of patients changing risk category on re-evaluation vs number of VTE risk categories changed.
Abbreviation: VTE, venous thromboembolism.

Table 3 Percentage of patients receiving appropriate VTE prophylaxis vs VTE risk category

	Percentage of appropriate prophylaxis	
Risk category	**Initial evaluation**	**Re-evaluation**
Low risk	100	100
Moderate risk	87±7.1	60±16.3
High risk	95±4.3	80±13.3
Very high risk	21±11.3	6.8±2.9

Note: Data shown as % ± SD.
Abbreviation: VTE, venous thromboembolism.

the change in risk category, the need for change in prophylaxis was also evaluated in these patients by comparing the percentage of patients given appropriate prophylaxis initially and again on re-evaluation. Most notably, an appropriate level of prophylaxis was achieved 21% of the time initially in the very high risk group–dropping to 6.8% on re-evaluation. A similar trend was noted in the high risk group (from 95% initially to 80% on re-evaluation) and the moderate risk group (from 87% initially to 60% on re-evaluation). The low risk group had achieved appropriate levels of prophylaxis 100% of the time initially and on re-evaluation (Table 3).

Discussion

VTE is defined by presence of PE and/or DVT and is the leading cause of preventable hospital mortality in the US. The primary cause of mortality in VTE is due to PE, accounting for one third of VTE cases, commonly resulting in sudden death.[8,9] While at least 50% of patients with VTE will have risk factors, occurrence is commonly idiopathic.[10,11]

Major predisposing factors are characterized by Virchow's Triad–venous stasis, hypercoagulability, and intimal damage. Lower extremity DVT most commonly develops from deep leg veins.[12] The formed thrombus then begins to progress proximally resulting in symptoms of pain, edema, tenderness, and erythema.[13–15] This condition can progress to development of emboli, resulting in dyspnea and chest pain associated with PE. As a thrombus ages beyond 5–10 days, fibrin polymerization and cross-linking decreases probability of embolization.[16]

As this condition can commonly be idiopathic, it is important to have a high index of suspicion, particularly in the postoperative patient. Trauma and major surgery classically include multiple risk factors for development of DVT–collectively responsible for 40% of VTE. Rate of postoperative DVT in non-anticoagulated patients is 70% for nonelective hip surgery, 48% for elective orthopedic surgery, and 12% for elective general surgery. Of these postoperative DVT, 20% develop into PE with a 30% mortality rate. Despite prophylaxis, 5–10% of orthopedic patients develop PE postoperatively.[11,17]

Duplex ultrasound is the most common test ordered for DVT, evaluating for vein collapsibility, blood color on spectral doppler, and blood flow. Although this modality is user dependent, accuracy is reported up to 98%.[18] Initial interventional therapy entails use of anticoagulation with heparin.

A patient's post-hospitalization VTE risk has traditionally been assumed to be static. The aim of our study was twofold. First was to ascertain whether or not a static VTE risk was a reasonable assumption to make over a patient's hospitalization course. Second was to evaluate if this change in VTE risk also resulted in the need for more aggressive prophylaxis. The data in our study suggest that rather than being static, a patient's VTE risk is a dynamic process. As this risk continues to evolve, so does the need for more aggressive prophylactic measures. As moderate and high risk

categories have the same prophylactic measures, changes in these measures were most important when moving from low to moderate/high risk and from moderate/high risk to very high risk. The change in an appropriate level of prophylaxis achieved in the very high risk category (initially 21% and 6.8% on re-evaluation) is evidence in support of this–as patients changed their VTE risk category, the initial measures for prophylaxis were no longer appropriate. One of the major limitations of our study was the significant range of time for re-evaluation. As this was variable with a wide range, this may have been a confounding factor. This issue was unavoidable as the chart review took place on patients with a varying length of stay. Our paper is the first to show a change in risk category for patients being provided the same level of care during their hospitalization. In conclusion, we feel that repeated reassessment of VTE risk throughout a hospital stay is indicated. Prophylactic measures based on risk should also be adjusted accordingly.

Disclosure

The authors report no conflicts of interest in this work.

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