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RISK ASSESSMENT FOR VTE: ALL ARE NOT EQUAL

Surgery

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ABSTRACT

Venous Thromboembolism [VTE] risk assessment has become common in most hospitals. However, the comparison of effectiveness between quantitative and qualitative risk assessments is sparse in the literature. We performed a comparative analysis between a quantitative and qualitative assessment in 146 consecutive adult trauma patients.

Of the 146 patients enrolled, 64 of whom had no contraindications to VTE prophylaxis, 99 were men and 47 were women. Mean population age was 52.3 years and mean injury severity score [ISS] was 20.0 (+ 9.9). ISS did not correlate with VTE risk. Elderly patients were found to be at higher risk for development of VTE. The non-quantitative risk assessment assigned 38 low risk, 80 moderate risk and 28 high risk patients. Each grouping was re-evaluated to provide a mean quantitative risk for each category of the non-quantitative assessment: 1.5 points for low risk, 3 points for moderate risk, and 3.96 for high risk. Based on recommended guidelines of the quantitative risk score, adequacy of VTE prophylaxis was assessed for each non-quantitative category: 72.2% for low risk, 64.7% for moderate risk and 58.3% for high risk. After re-evaluating all patients using the quantitative risk score, adequacy of VTE prophylaxis was assessed again: 100% for low risk, 83% for moderate risk, 74% for high risk, and 29% for very high risk. We found that the qualitative assessment tended to underscore the risk and therefore resulted in an under-treatment of the highest risk patients. Our data shows that quantitative assessment is superior to qualitative risk assessment.

KEYWORDS

Venous Thromboembolism [VTE]

INTRODUCTION:

Venous Thromboembolism (VTE) is a common complication found among the trauma patient population [1,2]. As a result of improved tracking, current estimates of annual incidence range between 300-600,000 cases in the United States [3-5]. To address this issue, the Joint Commission mandates that all hospitalized patients must undergo VTE risk assessment. Despite this, there is no consensus regarding scoring system and how scoring correlates with adequate prophylaxis. At our institution, we sought to compare the effectiveness of evaluation using quantitative and non-quantitative scoring systems. We hypothesized that quantitative scoring systems could provide a more objective risk evaluation and consequently, more effective prophylaxis could be provided.

MATERIALS AND METHODS:

We performed a retrospective analysis using data on 146 consecutive adult trauma patients admitted to our Level 1 Trauma Center. As this was a retrospective data analysis using de-identified data, we sought and obtained exemption from our institutional review board for the study of human subjects. VTE scoring systems evaluated patient risk using a modified Wells DVT Scoring Criteria [6,7] for quantitative assessment (Figure 1) and a non-quantitative assessment (Figure 2). Our point-based quantitative assessment is a 4-tier system comprised of low, moderate, high and very high risk. Cumulative points determined by predisposing and exposing risk factors differentiated these categories as well as degree of prophylaxis recommended: 0-1 points = low risk, 2 points = moderate risk, 3-4 points = high risk, 5 or greater = very high risk. Our non-quantitative assessment is a 3-tier system comprised of low, moderate and high risk. Data was obtained on VTE risk assessment from documentation and evaluated with the modified Wells scoring system to assign risk to patients previously assessed using the non-quantitative system. Additional information obtained included demographic data, Injury Severity Score (ISS), and whether or not prophylaxis was appropriate for the assigned risk category. One-way analysis of variance (ANOVA) was then performed using JMP Statistical Software ©.

Figure 1a - Quantitative Assessment: Predisposing VTE risk factors

DIAGNOSTIC SECTION-

1. PREDISPOSING RISK FACTORS [SCORES ARE ADDITIVE]= SCORE A

HYPERCOAGULABLE STATES (Thrombophilia) *Assign 3 points for each*	points	CLINICAL RISK FACTORS *(Assign 1 point each unless otherwise noted)*	points
○ Antiphospholipid syndrome (anticardiolipin antibody, lupus anticoagulant)	3	○ Abnormal pulmonary function (COPD)	1
○ Antithrombin deficiency	3	○ Age 41 to 60 years	1
○ Disorders of plasminogen or plasmin activation	3	○ Age 60-74 years	2
○ Dysfibrinogenemia	3	○ *Age 75 & above*	3
○ Elevated factor VIII/normal CRP	3	○ Collagen vascular disease	1
○ Factor V Leiden/Activated Protein C resistance	3	○ Estrogen use (OC, HRT, tamoxifen)	1
○ Hyperhomocysteinemia	3	○ Heparin-induced thrombocytopenia (< 3 months)	3
○ Hyperviscosity syndrome	3	○ History of DVT/PE	3
○ Myeloproliferative disorders	3	○ History of recent surgery (<1 month)	1
○ Protein C or S deficiency	3	○ History of unexplained stillborn infant or recurrent spontaneous abortion (>3 months),	1
○ Prothrombin gene mutation	3	○ Inflammatory Bowel Disease	1
		○ Malignancy	3
		○ Nephrotic syndrome	1
		○ Obesity (BMI >25)	2
		○ Pregnancy or post partum <1 month	3
		○ Varicose Veins	1

Figure 1b - Quantitative Assessment: Exposing risk factors and total risk calculation

2. EXPOSING RISK FACTORS [CHOOSE HIGHEST RISK CATEGORY]=SCORE B

Assign 5 Points	Assign 2 Points	Assign 1 Point
○ Acute spinal cord injury (< 1 mo)	○ Central venous access	○ Acute myocardial infarction
○ Elective hip/knee arthroplasty	○ Immobilizing plaster cast (<1 month)	○ Acute CHF exacerbation
○ Hip, pelvis, or leg fracture (<1 month)	○ Laparoscopic surgery (>45 min)	○ Acute respiratory failure
○ Multiple trauma (< 1 month)	○ Major Surgery (>45 min)	○ Infection,sorious
○ Stroke (<1 month)	○ Patient confined to bed >72 hrs	○ Medical pt at bed rest (<72 hrs)
		○ Minor Surgery (< 45 min)
Total score for any checked risk factors = 5	Total score for any checked risk factors =2	Total score for any checked risk factors =1

3. TOTAL RISK FACTOR SCORE= A_____ + B_____ =_____

TREATMENT SECTION-

Figure 1c - Quantitative Assessment: Prophylaxis Safety Evaluation

PROPHYLAXIS SAFETY CONSIDERATIONS: Check if any of the following contraindications to heparin or enoxaparin are present

○ active bleeding within 48-72 hours
○ hypertensive crisis
○ coagulopathy / severe liver disease
○ heparin induced thrombocytopenia
○ thrombocytopenia (< 20,000 if no coagulopathy; < 50,000 if coagulopathy present)
○ Recent intraocular, spinal or intracranial surgery
○ Use of TPA for stroke within 24 hours
○ Head trauma or CNS hemorrhage
○ Multiple trauma with high bleeding risk
○ Proven or suspected peri-spinal hematoma
○ Other high risk for bleeding or active bleeding conditions based on clinical judgment
If any of the above boxes are checked, the patient *is not* a candidate for anticoagulant therapy. Mechanical prophylaxis [elastic stockings (ES) or intermittent pneumatic compression (IPC)] should be used.

Figure 1d - Quantitative Assessment: Recommended Prophylaxis for VTE risk categories

NEURAXIAL ANESTHESIA CONSIDERATIONS:

○ Recent LP, spinal injection, or removal of epidural catheter: (< 12 hours)
○ Indwelling epidural catheter; indwelling or removal intrathecal catheter
If either of these boxes is checked, special precautions for use and timing of prophylactic anticoagulation are required to prevent spinal hematoma. See *Guidelines for Neuraxial Anesthesia in the Anticoagulated Patient.*

RECOMMENDED PROPHYLACTIC REGIMEN IF NO CONTRAINDICATIONS

LOW RISK (Total = 1Point)	MODERATE RISK (Total = 2 Points)	HIGH RISK (Total = 3-4 Points)	VERY HIGH RISK (Total = 5 or more Points)
○ Early Ambulation (< 72 hours)	○ Heparin 5,000 units SC q12H	○ Heparin 5,000 units SC q8H	○ Enoxaparin 30mg sc q12H (reserved for TKR, THR & hip fracture; SCI; & trauma patients only)
	○ Enoxaparin 40mg SC once daily	○ Enoxaparin 40mg SC once daily	○ Enoxaparin 40mg SC once daily
	○ *If CrCl < 30ml/min,use 30mg SC once daily*	○ *If CrCl < 30ml/min, use 30mg SC once daily*	○ *If CrCl < 30ml/min, use 30mg SC once daily*
	○ *If BMI > 50, use 40mg SC bid*	○ *If BMI > 50, use 40mg SC bid*	○ *If BMI > 50, use 40mg SC bid*
	○ Elastic Stockig	○ Elastic Stocking & SCD	○ Elastic Stocking & SCD
	○ SCD		

Figure 2a - Non-Quantitative Assessment: Risk Categorization and Prophylaxis

VTE PROPHYLAXIS SCREENING AND ORDERING FORM

Date_____ Time_____ Age_____ Weight _____ SCr_____ GFR _____ml/min

MEDICAL CONDITIONS ASSOCIATED WITH RISK FOR VTE

□ Active malignancy	□ Hormonal Replacement	□ Nephrotic Syndrome
□ Acute Chronic Lung Disease	□ Impaired Mobility	□ Obesity
□ Age greater than 50 years	□ Inflammatory Bowel Disease	□ Prior History of VTE
□ Central Venous Catheter	□ Known Thrombophilic State	□ Recent Post Partum & Immobile
□ Congestive Heart Failure	□ Moderate to Major Surgery	□ Sepsis/Infection
□ Dehydration	□ Myeloproliferative	□ Sickle Cell Disease
□ Estrogen Contraception	□ Myocardial infarction	□ Varicose veins / chronic stasis

CONTRAINDICATIONS TO PHARMACOLOGICAL PROPHYLAXIS FOR VENOUS THROMBOEMBOLISM (VTE)

ABSOLUTE	RELATIVE (weigh risk or benefit)	OTHER CONDITIONS
□ Active bleeding	□ Intraocular Surgery within 2 wks	□ Thrombocytopenia (HIT)
□ Hemorrhagic Stroke	□ GI/GU Bleed within 1 month	□ Epidural/Spinal Catheter
□ Head/Spinal Cord Trauma within 4wks	□ Intracranial Hemorrhage within 1 year	
□ Anticoagulant Allergy	□ Coagulation Disorder	
□ Medical Contraindication	□ Post Op Bleeding Concerns*	
□ Surgical Contraindication	□ End Stage Liver Disease	
	□ Intracranial Lesions	
	□ PLT Count less than 50K	
	□ Craniotomy within 2 weeks	
	□ Hypertensive Urgency	

* Scheduled return to OR within the next 24 hours; major ortho: 24 hrs leeway; spinal cord or ortho spine: 7 days leeway; General surgery, status post transplant, status post trauma admission: 48 hours leeway

ORDER SET

LOW RISK	MODERATE RISK	HIGH RISK
• Ambulatory patient without additional VTE risk factors	• Patients with Medical conditions associated with risk for VTE (above)	• Elective hip or knee arthroplasty • Acute spinal cord injury with paresis • Multiple major trauma
• Minor surgery in patient without additional VTE risk factors	• Patients who aren't in either Low Risk or High Risk group	• Abdominal / pelvic surgery for cancer
	Select one pharmacologic option:	**Select one pharmacologic option:**
□ Early Ambulation	□ **Enoxaparin 40mg q 24 hours** (only SCr less than 2.0 mg% or GFR more than 30mL/min and no epidural catheter in place)	□ **Enoxaparin 40mg q 24 hours** (only SCr less than 2.0 mg% or GFR more than 30mL/min and no epidural catheter in place)
	□ **UFH 5,000 units SQ q 8 hours** □ **UFH 5,000 units SQ q 12 hours** (only if wt under 50kg or age over 75 years)	□ **Enoxaparin 30mg SQ q 12 hours** (knee replacement) □ **Warfarin** ____ **mg PO daily** (target INR 2-3; hold if INR more than 30)
	OR	**OR**
	□ **No pharmacologic prophylaxis** because of contraindication:	□ **UFH 5,000 units SQ q 8 hours** (only if SCr more than 2.0 or GFR less than 30mL/min and Warfarin is not an option)
	PLUS	**OR**
	□ GCS □ IPC	□ **No pharmacologic prophylaxis** because of contraindication:
		PLUS
		□ GCS □ IPC

Figure 2b - Non-Quantitative Assessment: Surgical Risk Evaluation and Recommended Prophylaxis

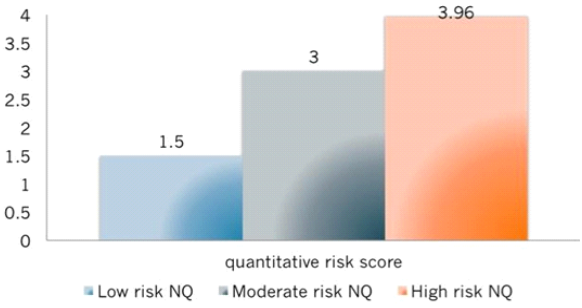
Surgical Guidelines for VTE Prophylaxis By Thrombosis Risk Category

	Minor	Moderate	Major
General Surgery	No other risk factors □ early ambulation	□ LMWH [1] □ UFH [2] tid □ Fonda [3]	□ LMWH □ GCS [4] □ UFH tid **PLUS** □ Fonda □ IPC [5]
Vascular Surgery	No other risk factors □ early ambulation	□ LMWH □ UFH tid □ Fonda	
GYN Surgery	No other risk factors □ early ambulation	□ LMWH + □ IPC □ UFH tid	
Obstetrics	**C - Section :** □ IPC + □ UFH tid **Vaginal Delivery:** □ IPC + □ UFH tid *: **if additional risk factor**		
Thoracic Surgery	□ LMWH □ UFH tid □ Fonda		
Urologic Surgery	Transurethral No other risk factors □ early ambulation	**OPEN** □ LMWH □ GCS □ UFH tid **PLUS** □ Fonda □ IPC	
Laparoscopic Surgery	No other risk factors □ early ambulation	**Any other Risk Factors: one or more of:** □ LMWH □ GCS □ UFH tid □ IPC □ Fonda	
Orthopedic Surgery Total Hip Replacement	□ LMWH □ Fonda □ Coumadin		
Hip Fracture Surgery	□ LMWH □ Fonda □ Coumadin □ UF tid	**If Surgery Delayed:** □ LMWH **from admission** □ UFH tid **until surgery**	
Spine Surgery	No other risk factors No anticoagulation	**Postoperative** □ UFH tid □ UF tid **PLUS** □ GCS □ LMWH **OR** □ LMWH □ IPC □ GCS □ IPC	
Neurosurgery	□ GCS **PLUS** □ UFH bid □ IPC □ LMWH		
Major Trauma	**As soon as is safe:** □ LMWH + / - □ GCS □ IPC	**If AC contraindicated :** □ GCS **until risk** □ IPC **resolves**	
Spinal Cord Injury	**If no contraindication:** □ LMWH **PLUS** □ GCS □ UF bid □ IPC	**If AC contraindicated :** □ GCS ***No UH bid alone*** □ IPC ***No IVC filter***	

1 Low Molecular Weight Heparin
2 Unfractionated Heparin
3 Fondaparinux
4 Graduated Compression Stockings
5 Intermittent Pneumatic Compression

RESULTS:

Of the 146 patients enrolled, 64 of whom had no contraindications to DVT prophylaxis, 99 were men and 47 were women. Mean population age was 52.3 years and mean ISS was 20.0 (+ 9.9). ISS did not correlate with VTE risk. Elderly patients were found to be at higher risk for development of VTE. The non-quantitative risk assessment assigned 38 low risk, 80 moderate risk and 28 high risk patients. Each grouping was re-evaluated to provide a mean quantitative risk for each category of the non-quantitative assessment: 1.5 points for low risk, 3 points for moderate risk, and 3.96 for high risk (Figure 3). Based on recommended guidelines of the quantitative risk score, adequacy of VTE prophylaxis was assessed for each non-quantitative category: 72.2% for low risk, 64.7% for moderate risk and 58.3% for high risk (Figure 4). After re-evaluating all patients using the quantitative risk score, adequacy of VTE prophylaxis was assessed again: 100% for low risk, 83% for moderate risk, 74% for high risk, and 29% for very high risk (Figure 5).



Q risk score – 1=Low risk, 2=Moderate risk, 3-4 =High risk, 5=Very High risk

Figure 3 - Average Quantitative Risk Per Non-Quantitative Risk Category

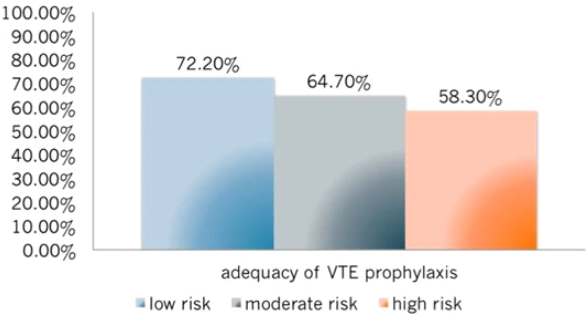


Figure 4 - Prophylaxis Adequacy Per Non-Quantitative Risk Category

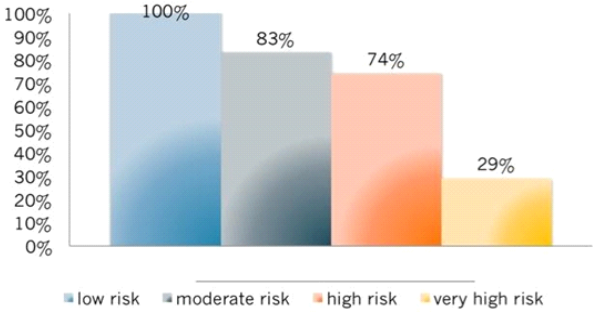


Figure 5 - Prophylaxis Adequacy Per Quantitative Risk Category

DISCUSSION:

VTE is a leading cause of in-hospital morbidity and mortality defined by the occurrence of Deep Vein Thrombosis (DVT) and/or Pulmonary Embolism (PE) [1,2]. Trauma and major surgery collectively account for approximately 40% of all cases[8,9]. Although this condition is commonly idiopathic (at least 50%)[8,10], classic risk factors are described by Virchow's Triad: venous stasis, hypercoagulability and intimal damage. The deep veins of the legs are the most common location for thrombus formation resulting in inflammatory changes (edema, erythema, pain) with proximal progression[10-13]. Embolization is most likely within 5 days of thrombus formation - prior to fibrin polymerization which occurs on days 5-10 [14]. Chest pain and dyspnea can be suggestive of subsequent PE. Duplex ultrasound is the most common test ordered for DVT[15]. Intervention requires use of anticoagulation with Heparin.

After establishment of required VTE risk assessment for all hospitalized patients, many risk assessment systems developed that were both quantitative and non-quantitative in nature. In 1997, Wells et al. established the first quantitative and most well studied scoring system for VTE risk. This assessment provided point based evaluation on a scale of -2 to 9. For each of the following with 1 point added for each to a cumulative risk assessment: Active cancer (treatment within last 6 months or palliative), calf swelling $\geq$ 3 cm greater than asymptomatic calf (measured 10 cm below tibial tuberosity), swollen unilateral superficial veins, unilateral pitting edema, previously

documented DVT, entire leg swelling, tenderness of deep venous system, lower extremity immobilization, bed ridden within 3 days or recent major surgery/anesthesia in past 12 weeks. If an alternative diagnosis is also likely 2 points are subtracted from the total [5,16]. Risk is considered high if cumulative score is over 2 points (57% risk of DVT), moderate if 1-2 points (17% risk of DVT) and low if less than 1 point (5% risk of DVT) [6,17]. A more recent meta analysis revealed a 98% negative predictive value when an unlikely probability scoring (≤ 1 point) was used in combination with a negative d-dimer [7].

With the development of a multitude of variable VTE risk assessments, our study sought to compare 2 major categories: quantitative versus non-quantitative assessments. The resulting data seems to suggest that quantitative assessments are not only more accurate in categorization of risk but also in provision of adequate prophylaxis. Comparison of each system shows that although adequate prophylaxis was provided in low risk category, as VTE risk climbed, adequacy of prophylaxis waned. Most notably, at very high risk, our data suggests that adequate prophylaxis was provided 29% of the time. One major limitation of the study is on the inherent correlation of risk assessment and prophylaxis adequacy. As there are currently no recommendations on how to provide prophylaxis for each risk category, a relative evaluation of prophylaxis adequacy was provided. Our paper is the first critical assessment of quantitative versus non-quantitative risk. In conclusion, we feel that a quantitative risk assessment provides a more accurate evaluation of patient VTE risk in comparison to non-quantitative risk assessment.

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