

Venous Thromboembolism Prophylaxis in Emergency Department Admissions

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BACKGROUND: Guidelines for venous thromboembolism prophylaxis exist, yet prophylaxis is underutilized and inadequately studied in the context of emergency department admissions.

OBJECTIVE: This study aimed to measure the rate of venous thromboembolism prophylaxis in emergency department hospitalizations.

DESIGN: Prospective observational study.

SETTING: Urban, teaching hospital.

PATIENTS: Adult emergency department admissions

INTERVENTION: Alternating admissions through the emergency department over 1 month were reviewed. Exclusion criteria were: requiring full anticoagulation, hemodialysis, length of stay less than 2 days, psychiatric admission, and primary physician declined review. An established risk assessment tool classified thromboembolism risk. Appropriate prophylaxis was defined as currently accepted medical or mechanical prophylaxis if in need or no prophylaxis if not indicated.

MEASUREMENTS: Factors associated with prophylaxis were considered significant if $P < .05$.

RESULTS: Of 254 patients, 201 (79%) had indications for prophylaxis, of whom 65 (32%) received it. Seventy-eight percent of prophylaxis orders were written in the first day of hospitalization. Factors related to increased use of prophylaxis included use of standard order sets (OR = 3, $P < .009$) and increased risk of venous thromboembolism ($P < .0001$). Factors related to underuse included primary cardiovascular diagnosis (OR = 0.18, $P < .0001$) and age (OR = 0.97, $P < .0001$). Eighteen of 26 patients admitted for whom standard order sets were used (69%) received appropriate prophylaxis ($P = .01$).

CONCLUSIONS: Patients admitted through the emergency department are at high risk of venous thromboembolism. Despite this, venous thromboembolism prophylaxis is underutilized and rarely started after the first day of hospitalization. Use of admission standard order sets on admission from the emergency department may increase thromboembolic prophylaxis. *Journal of Hospital Medicine* 2007;2:79–85. © 2007 Society of Hospital Medicine.

Venous thromboembolism prophylaxis (VTE PX) has been identified as an area of primary importance to improve patient safety in research and clinical practice.^{1–3} Venous thromboembolism (VTE), including deep vein thrombosis (DVT) and pulmonary embolism (PE), is a common, often preventable life-threatening condition for hospitalized patients.⁴ Up to half of patients admitted to the hospital are admitted from the emergency department (ED). Most of these patients are acutely ill with multiple risk factors for VTE. To reduce the incidence of VTE, these patients require routine evaluation to determine if thromboprophylaxis is needed, and when indicated, therapy should be started promptly on admission. The Seventh American College of Chest Physicians

(ACCP) Consensus Conference on Antithrombotic Therapy outlines recommendations for VTE PX that reduce the development of DVT and PE.³ Despite there being effective VTE PX and the current focus on increasing its utilization to improve patient safety, VTE PX is underutilized. In particular, the subgroup of patients admitted from the ED, a group at high risk for VTE, has been neglected in the literature.

Our hypothesis was that VTE PX is underutilized in patients admitted through the ED. The specific objective of this study was to measure the rate at which hospitalized patients admitted through the ED received VTE PX.

METHODS

The study was conducted with the approval of and in accordance with the ethical standards of the Institutional Review Board of Baylor College of Medicine and Affiliated Hospitals. Prior to initiating chart review, passive consent was sought from physicians who were identified through the hospital medical records system as having admitted patients to this hospital through the ED in the preceding 6 months. Physicians were contacted twice in writing in a 1-month period prior to study inception. Those who objected to their charts being reviewed were to notify the investigators. Otherwise, they were assumed to have consented to chart review. Fifteen percent of physicians declined chart review. Physicians were not informed of the particulars of the study, only that medication use in the ED was being evaluated.

This study was conducted at a private 900-bed urban teaching hospital. The ED evaluates approximately 31,000 patients per year, predominantly a medical population. During the previous year, the ED had admitted roughly 30 patients per day, or 36% of all patients examined. Approximately 29% of admissions to this hospital (800/month) are admitted through the ED.

A convenience sample of every other hospital admission through the ED during 1 month was prospectively identified for inclusion in the study and chart review. Data were abstracted by a single reviewer on admission and at the time of discharge. The following data were collected: demographic characteristics, anticoagulant use or existing IVC filter, diagnoses, indications for full-dose anticoagulation, indications for VTE PX (ie, immobilization, respiratory failure, congestive heart failure, limb trauma, surgery, or stroke), whether therapeutic an-

ticoagulation or VTE PX was given, and date of initiation of this regimen, contraindications to anticoagulation, primary physician, and use of a standard order set. Patients were excluded if the attending physician declined chart review via the passive consent process. Other exclusion criteria were: receiving full-dose anticoagulants before presentation to the ED, presence of an inferior vena cava (IVC) filter, indication for full-dose anticoagulation (presented with DVT, PE, acute coronary syndrome), renal failure requiring hemodialysis (controversial risk for VTE⁵⁻⁹), length of stay (LOS) less than 2 days, and admission for psychiatric evaluation or treatment.

A modified Caprini's Risk Assessment Model for Surgical and Nonsurgical Patients was used to classify VTE risk.¹⁰ This tool assigns points to VTE risk factors so that risk and the need for VTE PX can be determined. For example, major surgery, central venous access, age older than 60 years, and bed rest for more than 72 hours are each assigned 2 points; higher-risk factors such as hip or leg fractures or stroke are each assigned 5 points. This tool is generally in accord with the ACCP guidelines. Modifications made to this tool were to assign 3 points to patients in respiratory failure on ventilators and 5 points to patients who were critically ill on vasopressor medication. Decreased venous return associated with mechanical ventilation and peripheral vasoconstriction associated with the use of vasopressor medication justified the addition of these risk factors.^{11,12} Patients were assigned to one of these risk categories: no risk (0 points), low risk (1 point), moderate risk (2 points), high risk (3-4 points), or very high risk (5 or more points). As indicated by this risk assessment tool, those with moderate, high, or very high risk were considered in need of VTE PX.

Appropriate VTE PX was defined as any currently accepted medical (unfractionated heparin, low-molecular-weight heparin, or warfarin for orthopedic patients) or mechanical methods of VTE PX (sequential compression devices, and graduated compression stockings) for those in need and no VTE PX if none indicated. Aspirin, clopidogrel, or a combination of the 2 was not considered sufficient VTE PX.³ In addition, we established whether VTE PX as determined by the modified Caprini score was in line with ACCP guidelines, taking into account contraindications to anticoagulation. Pre-printed order sets were divided into those that included VTE PX and those that did not. Order sets

that included options for VTE PX were defined as standard order sets.

The primary objective of this study was to determine how frequently VTE PX was implemented in ED admissions. Secondary objectives were determining factors associated with correct VTE PX decision making and the proximity of orders for VTE PX to the time of admission.

Statistical Methods

The SAS system was used to perform chi-square analysis of independent predictors of VTE PX. The dependent variable, which was dichotomous, was whether correct VTE PX decision making had occurred. Factors associated with VTE PX were considered significant if the *P* value was less than .05. Odds ratios were calculated along with 95% confidence intervals for all significant predictors of VTE PX. Multiple logistic regression analysis was performed to provide adjusted odds ratios and to arrive at a summary risk measure. Candidate independent variables for the multiple logistic regression analysis included all variables screened in the univariate analyses. A first-pass stepwise model was developed, followed by a best-subsets run with manual stepping. Although bed rest was on the margin of statistical significance (*P* = .059), we retained it in the model because it is a well-recognized risk factor for which the other model terms needed to be adjusted, and it was nine-tenths of 1% above the critical value.

RESULTS

Four hundred and fourteen charts of patient admissions were reviewed, of which 254 met the inclusion criteria. One-hundred and sixty patients were excluded because they received full-dose anticoagulation or had an existing IVC filter prior to admission (49 patients), received treatment with full-dose anticoagulation in the ED (42 patients), had a LOS of less than 2 days (39 patients), or had end-stage renal disease requiring hemodialysis (30 patients; Fig. 1).

Eighty percent of patients were admitted for medical problems, and 20% were admitted for surgery (Table 1). The most frequent admitting diagnoses were abdominal pain, congestive heart failure, chronic obstructive pulmonary disease, altered mental status, cerebral vascular accident, and pneumonia. The average patient had 5 comorbid conditions, the most frequently noted were hypertension, diabetes mellitus, anemia, urinary tract in-

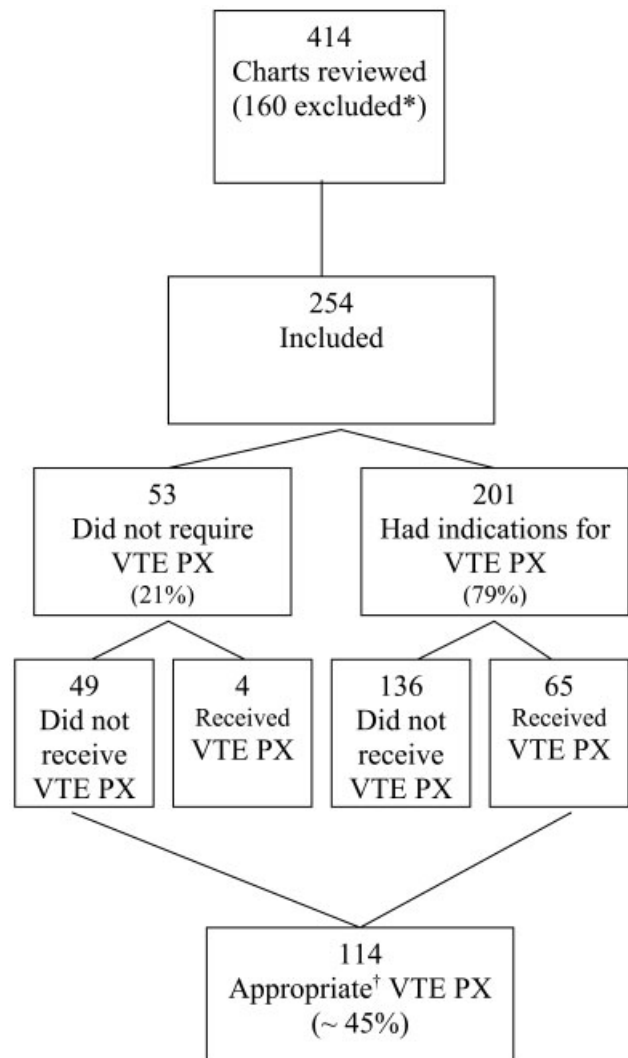


FIGURE 1. Study flow diagram (†appropriately defined as no prophylaxis when not indicated and prophylaxis when risk level indicated need; *160 excluded included 49 with full-dose anticoagulation or IVC filter in place, 42 treated with full-dose anticoagulation in the ED, 30 whose length of stay was less than 2 days, 30 with end-stage renal disease; VTE PX, venous thromboembolism prophylaxis).

fections, and coronary artery disease. The principal admitting services were general medicine, pulmonary, cardiology, hematology-oncology, neurology, surgery, and gastroenterology. Six patients died (2.4%), and 2 patients were diagnosed with pulmonary emboli (0.8%). The study group's average length of stay was 6.7 days (range 2-52 days), 48.8% were male, and average age was 61 ± 19.7 years. Overall, the correct VTE PX decision making occurred in 44.9% of patients admitted, including the

TABLE 1
Patient Mix

Category	Primary Diagnosis	Number of Patients	Percent
Medical (80%)	Neurological	47	19%
	Cardiovascular	39	15%
	Pulmonary	35	14%
	Gastrointestinal	27	11%
	Other medical	22	9%
	Renal	9	4%
	Cancer	7	3%
	Hematological	7	3%
	Musculoskeletal	6	2%
	Endocrine	3	1%
Total Medical		202	
Surgical (20%)	Gastrointestinal	28	11%
	Orthopedic/spine	11	4%
	Other surgical	8	3%
	Neurosurgical	3	1%
	Cancer	1	0%
	Genitourinary	1	0%
Total Surgical		52	
Total (100%)		254	100%

TABLE 2
Rate of Prophylaxis

	Patients	Percent
Appropriate decisions made regarding VTE PX*	114/254	44.9%
Indications for VTE PX	201/254	79%
Required active VTE PX and received it	65/201	32%
Utilized SOS and ordered VTE PX	18/26	69%

*Appropriate decision was defined as those who needed VTE PX receiving it and those with no indications for VTE PX not receiving it.

VTE PX = venous thromboembolism prophylaxis.

SOS, standardized order set.

49 of 254 patients who did not require and did not receive VTE PX. Of the 254 patients, 201 (79%) had indications for VTE PX, 65 of whom (32.3%) received it (Table 2). For those receiving VTE PX, 78% of orders were written within the first day of hospitalization.

When the data were reanalyzed per ACCP guidelines using the modified Caprini's risk assessment tool, the results were consistent with the initial findings. Overall, 46% of all patients (116 of 254) received prophylaxis in compliance with ACCP guidelines. In this group, 52 of 116 patients (44.8%) did not require and did not receive VTE PX. Sixty-four patients (32% of those with indications for prophylaxis) had indications for VTE PX, were in compliance with ACCP guidelines, and received the indicated prophylaxis (30 patients received me-

chanical prophylaxis, 19 patients received medical prophylaxis, and 15 patients received both medical and mechanical prophylaxis). The difference between the assessments was explained by high-risk patients with no contraindications to medical prophylaxis who received only mechanical prophylaxis but required medical prophylaxis through ACCP guidelines. Note, the Caprini tool recommended medical prophylaxis for these high-risk patients; however, our original application was simply to assess if prophylaxis was employed. In addition, several patients with a prolonged INR suggestive of bleeding risk or "autoprophyllaxis" were reclassified as compliant and not needing prophylaxis.

Fifty-five patients with indications for VTE prophylaxis had contraindications to medical prophylaxis: 44 had bleeding risk, 8 had spine injury or surgery, and 3 had brain metastases and thrombocytopenia. Twenty of the 55 patients (36%) received mechanical prophylaxis; they were considered in compliance with ACCP guidelines and were included in the "appropriate decisions regarding VTE PX" count. Prophylaxed patients at moderate to high risk were more likely to receive mechanical prophylaxis, whereas two-thirds of those prophylaxed patients who were at very high risk received medical prophylaxis or a combination of medical and mechanical prophylaxis.

Standard order sets increased the likelihood of appropriate VTE PX. Increasing age and a primary cardiovascular diagnosis (chest pain, congestive heart failure, syncope/near-syncope, chronic ischemic heart disease, sinus tachycardia) decreased the likelihood of VTE PX (Table 3). VTE PX was not significantly related to bed rest (OR = 1.46, $P = .14$). In 26 of the 254 patient admissions, standard order sets that included VTE PX were utilized. Of these 26 patients, 69.2% (18; $P = .01$) received appropriate VTE PX compared with the overall rate of 44.9% receiving appropriate VTE PX. The use of VTE PX was significantly associated with level of risk: from 0% in patients at no or low risk of VTE to 47% in patients at very high risk ($P = .0001$). This significance persisted when controlling for age greater than 60 years (Table 4).

Aspirin and other antiplatelet medications (clopidogrel, dipyridamole, and cilostazol) were ordered for 22 and 5 patients, respectively, of the 39 patients with primary cardiovascular diagnosis who had indications for VTE PX but did not receive it. Forty-seven percent (17 of 36 with activity orders) of those in our cardiovascular at-risk but not pro-

TABLE 3
Predictors of Appropriate Prophylaxis

Variable	Patients		Received Appropriate PX		Odds Ratio*	95% CI†	P‡
	n	%	n	%			
Overall	254	(100.0)	114	(44.9)			
Age (years)							
16-47	59	(23.2)	37	(62.7)	0.97	0.96-0.98	.0001
48-64	68	(26.8)	38	(55.9)			(.0001)
65-78	61	(24.0)	17	(27.9)			
79-95	66	(25.0)	22	(33.3)			
CV diagnosis							
Yes	39	(15.4)	6	(15.4)	0.18	0.07-0.45	.0001
No	215	(84.6)	108	(50.2)	1		
Bedrest							
Yes	125	(49.2)	62	(49.6)	1.46	0.89-2.40	.14
No		129	(50.8)	52	(40.3)	1	
Standardized orders							
Yes	26	(10.2)	18	(69.2)	3.09	1.29-7.41	.009
No	228	(89.8)	96	(42.1)	1		

*For dichotomous variables, the odds ratio represents a test against a reference category whose referent odds ratio is equal to 1. For continuous data, the odds ratio refers to the increase in odds associated with a one-unit increase in the variable value. Although continuous data are presented in quartiles, the odds ratios are against the continuous variable.

†95% CI, 95% confidence interval. This reflects the units against which its companion odds ratio is computed. Confidence intervals are test-based.

‡P = probability of type I statistical error (common P value). Values without parentheses are Pearson chi-square probabilities. Probability values in parentheses are univariate logistic regression likelihood ratio P values.

CV diagnosis, cardiovascular diagnosis.

PX, venous thromboembolism prophylaxis.

phylaxed group had activity orders of ambulatory ad lib or had physical therapy ordered.

DISCUSSION

An estimated 200,000-300,000 cases of VTE with 60,000-200,000 fatal pulmonary emboli occur annually.¹³⁻¹⁶ The inpatient fatality rate due to PE is estimated to be 12%.¹³ The frequency of VTE varies with risk that relates to the population studied and the diagnosis. VTE rates range from 3%-55% for medical patients to 80% for patients who receive total hip replacement or have multiple trauma, though the higher numbers cited are based on studies using fibrinogen uptake scanning or venography, with the true rates probably between the extremes noted.^{3,4,17,18} Many of these acutely ill patients are admitted through the ED. Though VTE is common in patients admitted through the ED,

with respect to VTE PX, this population is understudied.

In this study, the first to our knowledge to focus on VTE PX in an unselected cohort of ED admissions, the most significant findings were: 79% of ED admissions had indications for VTE PX, yet only 32% of those received it, and 78% of these orders were written within the first day of hospitalization. We also noted a direct association of the use of VTE PX with the level of risk, which increased from 9% in the moderate-risk group to 23% for high-risk patients and 47% for very-high-risk patients ($P < .0001$; Table 4.). Thus, most of our patients, including those at highest risk for VTE never received prophylaxis at any time during their hospitalization. Also explored in this study was the relationship of risk factors for VTE with the use of prophylaxis. These risk factors were age, cardiovascular diagnosis, and use of standard order sets. Increasing age and having a primary cardiovascular diagnosis (ie, congestive heart failure, atrial fibrillation) were the risk factors that increased the likelihood of receiving VTE. Therefore, it was expected that the rate of VTE PX would be higher for patients who were older or had these diagnoses. However, in the current study, increasing age alone did not influence the likelihood of physicians ordering VTE PX. In addition, we found markedly decreased rates of VTE PX in cardiac patients.

Other investigators have reported similar findings in selected groups of hospitalized patients.¹⁹⁻²² A retrospective chart review of internal medicine discharges from 2 Italian hospitals determined that VTE PX was prescribed in 46.4% and 58.3% of at-risk patients in nonteaching and teaching hospitals, respectively.²⁰ In a retrospective study of surgical patients in 20 hospitals, 38% of patients received VTE PX.²¹ Similar results were found in a registry of hospitalized patients who developed VTE, in which only 42% of patients who developed VTE received VTE PX within 30 days prior to diagnosis.²³

Bosson et al. reported no increased use of VTE PX in patients with myocardial infarction, similar to that in the current study, though they did find VTE PX administered more frequently to patients with congestive heart failure.²² Antiplatelet medications and activity orders are commonly prescribed for cardiac patients. According to reports that indicated a degree of protection from antiplatelet agents,^{24,25} frequent use of activity orders, and the belief that ambulation eliminates the risk of VTE, it is possible physicians believed patients were suffi-

TABLE 4
VTE PX by Risk Level and Age Group

Risk Level ^f	Age < 60 Years		Age > 60 Years		Total Percent VTE PX
	Number Prophylaxed/ Number at Risk Level	Percent Prophylaxed	Number Prophylaxed/ Number at Risk Level	Percent Prophylaxed	
Very high (93)	10/20	50%	34/73	47%	47%
High (71)	10/35	29%	6/36	17%	23%
Moderate (53)	4/25	16%	1/28	4%	9%
Low (29)	0/29	0%	0	0%	0%
None (8)	0/8	0%	0	0%	0%
Total (254)	24/117		41/137		65/254*

*Two hundred and one of 254 patients had indications for VTE PX, and 65 of the 201 patients, or 32%, actually received VTE PX.

^fRisk level was highly associated with the probability of VTE PX ($P < .0001$).

VTE PX, venous thromboembolism prophylaxis

ciently prophylaxed. However, although early ambulation and antiplatelet medications decrease risk of VTE, neither is sufficient to prevent it.³ The administration of aspirin and other antiplatelet medications implies that in our study group bleeding risk was not the primary deterrent to ordering VTE PX. Furthermore, bleeding risk would not be a deterrent to mechanical VTE PX.

In the current study, use of standard order sets was associated with correct decision making and increased use of VTE PX. Risk of VTE might be decreased through the use of standard order sets that result in increased utilization of VTE PX. However, despite evidence that standard order sets can successfully modify prescribing patterns,²⁶⁻²⁹ Cook et al. found that only 5 of 29 Canadian ICU directors surveyed for their approach to VTE prevention and diagnosis in critically ill patients used preprinted orders.³⁰

The present study had several limitations. First, determination of VTE was not an end point. As a single-center study of prospectively selected subjects, this would have required too large a sample to be feasible. Our data may be biased by not including patients admitted by physicians who declined to allow their charts to be reviewed. However, although physicians were informed that we were examining drug use of patients admitted through the ED, they were not aware that the study focused on VTE PX. Our results are consistent with results of inpatient studies citing inadequate VTE PX.^{19,21,31,32} Using the modified Caprini Scoring System, we found that only 32% of patients with indications for VTE PX received it. This result was unchanged when stratifying

using ACCP guidelines. Finally, we found that prophylaxed patients who were at moderate to high risk were more likely to receive mechanical prophylaxis, whereas two-thirds of patients who received prophylaxis who were at very high risk received medical prophylaxis or a combination of medical and mechanical prophylaxis.

CONCLUSIONS

Most patients needing VTE PX did not receive it, and those who did receive VTE PX usually had it prescribed in the first 24 hours. As risk factors increased, patients were more often prophylaxed, though fewer than 50% of those in the very-high-risk group received VTE PX. This study suggests that in hospital systems similar to ours with 30% or more of hospital admissions coming from the ED implementing a standard order set for patients admitted through the ED may increase VTE PX, which, in turn, could have a major impact on their course. Future studies need to determine the best way to implement these changes.

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