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Prevention and Clinical Outcomes in Older Inpatients with Suspected Venous Thromboembolism

ABSTRACT

Venous thromboembolism (VTE) is one of the most common preventable disorders among hospital inpatients. Advancing age is a major risk factor for VTE. The purpose of this study was to describe and compare prevention practices and clinical outcomes in older (age 65 and older) versus younger (ages 18 to 64) hospitalized patients at risk for or diagnosed with VTE. Medical charts of 210 older and 450 younger inpatients undergoing diagnostic tests to rule out VTE were reviewed at an academic medical center. Acute VTE was diagnosed in 17.1% of older and 22.7% of younger inpatients. Pharmacological prophylaxis was used in 70% of eligible older and 57% of eligible younger inpatients. Nearly one quarter of eligible older inpatients did not receive any VTE prevention measures. The 3-month mortality was higher in older inpatients (13.9%) compared with younger inpatients (9.8%) with VTE, despite the lower rate of VTE in older inpatients. Prevention measures for VTE were underused in both older and younger inpatients.

Venous thromboembolism (VTE) is manifested as deep vein thrombosis (DVT) and pulmonary embolism (PE). DVT and fatal or nonfatal PE are the third most common cardiovascular diseases after myocardial infarction and stroke (Gloviczki & Yao, 2001). VTE is one of the most common clinical conditions in hospitalized patients, and PE is the most common preventable cause of hospital death in the United States (White, 2003). VTE occurs in approximately 100 people per 100,000

annually in the United States and increases exponentially, with 500 cases per 100,000 people at age 80 and older (White, 2003). Increasing age is identified as an independent risk factor for VTE, in addition to hospitalization (Sellier et al., 2006). The hospitalized older adult population is increasing along with the overall aging of the U.S. population (Kucher et al., 2005). VTE is often underdiagnosed in older adults because of atypical symptoms of DVT/PE in older patients (Spyropoulos & Merli, 2006).

Despite the availability of evidence-based recommendations on VTE prevention by the American College of Chest Physicians (ACCP) (Geerts et al., 2004, 2008), hospital compliance with VTE prevention guidelines using pharmacological and/or mechanical prophylaxis remains low in all hospitalized patients (Cohen et al., 2008; Yu, Dylan, Lin, & Dubois, 2007).

There has been little research on VTE prevention and its clinical outcomes (e.g., bleeding, mortality after VTE) specifically focused on older hospitalized patients who are at risk for VTE. The purpose of this study was to describe and compare prevention practices and clinical outcomes in older versus younger hospitalized patients at risk for or diagnosed with VTE.

METHOD

Source of Data

This study was a part of a larger study called Partners in Patient Safety, funded by the Agency for Healthcare Research and Quality (AHRQ). The parent study developed two interventions, including a VTE Safety Toolkit and an online provider training mod-

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ule on VTE prophylaxis, and evaluated the effectiveness of the tools on improving clinical and system outcomes for patients at risk for or diagnosed with VTE. The VTE Safety Toolkit consists of VTE prevention guidelines based on ACCP recommendations (Geerts et al., 2008), DVT/PE diagnostic algorithms, and treatment guidelines for acute VTE (Zierler et al., 2008). The VTE Safety Toolkit has been disseminated nationally via the AHRQ's patient safety website at <http://www.ahrq.gov/qual/pips/grants.htm>. The methods of the parent study were described in detail elsewhere (Lee & Zierler, in press).

During the study period from October 1, 2005 to March 31, 2006, data were reviewed on patient demographics, risk factors for VTE, use of VTE prophylaxis, and treatment of VTE for patients age 18 and older who were referred to undergo a diagnostic test to rule out VTE at an academic medical center. This study used retrospective medical chart reviews to describe the current practices on VTE prevention, treatment, and clinical outcomes in patients

with suspected VTE, and particularly focused on older inpatients.

The radiology electronic database at the academic medical center was used to identify patients with suspected VTE. All patients (age 18 and older) who were referred for lower extremity venous duplex ultrasonography to rule out DVT, and ventilation and perfusion scanning (V/Q scan) or computed tomographic angiography (spiral CT) to rule out PE were included in this study. Retrospective reviews of medical records for 660 consecutive hospitalized patients (age 18 and older) referred to the vascular or radiology laboratories during the study period were conducted. All inpatients suspected for VTE were classified by different age categories: older (age 65 and older) versus younger (ages 18 to 64), as well as four age categories: ages 18 to 40, 41 to 64, 65 to 79, and 80 and older.

Clinical data included patient demographic data, risk factors for VTE, VTE prophylaxis methods (including pharmacological and mechanical compression devices), VTE treat-

ment methods, and clinical outcomes associated with VTE (i.e., bleeding events within 3 months after anticoagulation therapy, mortality within 3 months after VTE diagnosis). Sixteen of 138 patients who were diagnosed with VTE did not have any follow-up data available, but the remaining patients diagnosed with VTE were followed for a minimum of 3 months.

Risk factors for VTE included prior DVT/PE, cancer, recent surgery within 4 weeks, cardiac disease, limb trauma, hormone therapy including either hormone replacement therapy or oral contraceptives, pregnancy or postpartum, morbid obesity (body mass index ≥ 40), prolonged travel (>6 hours), inherited or acquired thrombophilia, and a family history of VTE.

VTE prophylaxis included pharmacological prophylaxis using anticoagulant agents and mechanical prophylaxis. Pharmacological prophylaxis included low-dosage unfractionated heparin (UFH), low molecular weight heparin (LMWH), or warfarin (e.g., Coumadin®). Aspirin was not included for VTE prophylaxis as it was not recommended by the ACCP Consensus Panel as a VTE prevention method (Geerts et al., 2008). Mechanical prophylaxis included sequential compression devices or graduated compression stockings. The use of anticoagulation for reasons other than VTE prevention, such as for patients receiving anticoagulant agents to manage their underlying medical conditions (e.g., atrial fibrillation)

TABLE 1

PATIENT CHARACTERISTICS (N = 660)

Characteristic	Younger than Age 65 (n = 450, 68.2%)	Age 65 and Older (n = 210, 31.8%)	p Value	Ages 18 to 40 (n = 118, 17.9%)	Ages 41 to 64 (n = 332, 50.3%)	Ages 65 to 79 (n = 147, 22.3%)	Age 80 and Older (n = 63, 9.5%)	p Value for Trend
Mean age in years (SD)	47.4 (12.4)	75.4 (7.9)		29.6 (6.0)	53.8 (6.4)	71.2 (4.4)	85.4 (4.3)	
No. of women (% within age group)	237 (52.7)	108 (51.4)	0.767	80 (67.8)	157 (47.3)	66 (44.9)	42 (66.7)	<0.001
Median length of hospital stay in days (range) ^a	9 (1 to 244)	9 (1 to 96)	0.522	7 (1 to 132)	9 (2 to 244)	10 (2 to 96)	7 (1 to 65)	0.002
Risk factors for VTE ^b								
Mean number of risk factors (SD)	1.41 (0.93)	1.59 (1.0)	0.022	1.14 (0.89)	1.51 (0.92)	1.63 (1.0)	1.51 (1.01)	<0.001
Recent surgery within 4 weeks	170 (37.8%)	94 (44.8%)	0.088	32 (27.1%)	138 (41.6%)	71 (48.3%)	23 (36.5%)	0.005
Prior VTE	71 (15.8%)	25 (11.9%)	0.189	16 (13.6%)	55 (16.6%)	17 (11.6%)	8 (12.7%)	0.492
Cancer	159 (35.3%)	64 (30.5%)	0.219	22 (18.6%)	137 (41.3%)	51 (34.7%)	13 (20.6%)	<0.001
Cardiac disease	114 (25.3%)	109 (51.9%)	<0.001	16 (13.6%)	98 (29.5%)	74 (50.3%)	35 (55.6%)	<0.001
Inherited or acquired thrombophilia ^c	20 (4.4%)	2 (9.1%)	0.020	6 (5.1%)	14 (4.2%)	1 (0.7%)	1 (1.6%)	0.10
Morbid obesity (BMI ≥40)	41 (9.1%)	7 (3.3%)	0.008	3 (2.5%)	38 (11.4%)	7 (4.8%)	0 (0)	<0.001
Pregnant or postpartum	24 (5.3%)	0 (0)	<0.001	23 (19.5%)	1 (0.3%)	0 (0)	0 (0)	<0.001
Hormone therapy	13 (2.9%)	9 (4.3%)	0.352	9 (7.6%)	4 (1.2%)	4 (2.7%)	5 (7.9%)	<0.001
Immobilization due to paralysis	14 (3.1%)	8 (3.8%)	0.642	4 (3.4%)	10 (3%)	5 (3.4%)	3 (4.8%)	0.824
Limb trauma	8 (1.8%)	13 (6.2%)	0.003	1 (0.8%)	7 (2.1%)	5 (3.4%)	8 (12.7%)	<0.001
Family history of VTE	5 (1.1%)	5 (2.4%)	0.214	1 (0.8%)	4 (1.2%)	3 (2%)	2 (3.2%)	0.463
Prolonged travel (>6 hours)	6 (1.3%)	3 (1.4%)	0.922	3 (2.5%)	3 (0.9%)	3 (2%)	0 (0)	0.369

Note. BMI = body mass index; VTE = venous thromboembolism.

^a Length of hospital stay (LOS) was transformed to natural logarithm of LOS to compensate for the non-normal distribution and high degree of right skewing. The means of natural logarithm of LOS were compared to look at the difference in each age group.

^b Percentages for all VTE risk factors were calculated from the number of patients within the age group.

^c Inherited or acquired thrombophilia included Factor V deficiency, myelodysplastic syndrome, or protein C/S deficiency reported in this study.

was also considered in the analyses to assess whether adequate dosages of anticoagulant agents were used to prevent VTE. Patients undergoing anticoagulation treatment for known cardiac disease were also at risk for VTE if they were not adequately anticoagulated, and they were included in the study.

Acute DVT was diagnosed by venous duplex ultrasonography, which is the current test of choice for the diagnosis of DVT (Zierler, 2004). PE was diagnosed by either spiral CT or V/Q lung scanning.

Four trained research assistants abstracted data from electronic medical records, and a lead researcher

(J.-A.L.) who was well experienced in VTE research reviewed the quality of data abstracted.

Data Analysis

Categorical variables were expressed as frequencies and percentages and continuous variables as means with standard deviations or medians

TABLE 2**TYPES OF VTE PROPHYLAXIS USED (N = 660)**

VTE Prophylaxis	Younger than Age 65 (n = 450)	Age 65 and Older (n = 210)	p Value	Ages 18 to 40 (n = 118)	Ages 41 to 64 (n = 332)	Ages 65 to 79 (n = 147)	Age 80 and Older (n = 63)	p Value for Trend
Both pharmacological and mechanical	125 (27.8%)	80 (38.1%)		22 (18.6%)	103 (31%)	63 (42.9%)	17 (27%)	
Pharmacological only	114 (25.3%)	57 (27.1%)		27 (22.9%)	87 (26.2%)	36 (24.5%)	21 (33.3%)	
Mechanical only	56 (12.4%)	23 (11%)		13 (11%)	43 (13%)	18 (12.2%)	5 (7.9%)	
None	155 (34.4%)	50 (23.8%)		56 (47.5%)	99 (29.8%)	30 (20.4%)	20 (31.7%)	
			0.014					<0.001

Note. VTE = venous thromboembolism.

Percentages for all VTE prophylaxis used were calculated from the number of patients within the age group.

TABLE 3**VTE INCIDENCE BY PHARMACOLOGICAL PROPHYLAXIS (N = 612^a)**

VTE Prophylaxis	Younger than Age 65 (n = 417)	Age 65 and Older (n = 195)	p Value	Ages 18 to 40 (n = 106)	Ages 41 to 64 (n = 311)	Ages 65 to 79 (n = 137)	Age 80 and Older (n = 58)	p Value for Trend
Pharmacological prophylaxis used ^b	238 (57.1%)	136 (69.7%)	0.003	49 (46.2%)	189 (60.8%)	98 (71.5%)	38 (65.5%)	<0.001
VTE in patients with pharmacological prophylaxis	43/238 (18.1%)	18/136 (13.2%)		6/49 (12.2%)	37/189 (19.6%)	14/98 (14.3%)	4/38 (10.5%)	
VTE in patients without pharmacological prophylaxis	56/179 (31.3%)	15/59 (25.4%)		16/57 (28.1%)	40/122 (32.8%)	11/39 (28.2%)	4/20 (20%)	
p Value (within age group)	0.002	0.037		0.045	0.008	0.057	0.320	

Note. VTE = venous thromboembolism.

^a The 48 of 660 (7.3%) patients who were contraindicated to use pharmacological prophylaxis were excluded from this table.

^b Percentages for pharmacological prophylaxis used were calculated from the number of patients within the age group.

with ranges (minimum and maximum values). In univariate analyses, the patient characteristics, risk factors for VTE, VTE prophylaxis, VTE risk levels, and clinical outcomes in each age category were compared using chi-square or Fisher's exact tests for categorical variables and Student's *t* tests or analysis of variance for continuous variables. In multivariate analyses, logistic regression was used to identify significant factors associated with VTE, controlling for other covariates. Two-sided *p* values <0.05 were considered statistically signifi-

cant. Analyses were performed using SPSS version 16 for Windows and Stata 10 (StataCorp, College Station, TX). The institutional review board approved the study.

RESULTS

Demographic and Clinical Characteristics

Age was shown by either younger (ages 18 to 64) or older (age 65 and older) adult inpatients and was then divided into four discrete groups: ages 18 to 40, 41 to 64, 65 to 79, and 80 and older.

The demographic and clinical characteristics of patients with suspected VTE according to age group are shown in **Table 1**. A total of 660 adult inpatients (age 18 and older) underwent a diagnostic test to rule out VTE: 450 younger adults (ages 18 to 64 years, 68.2%) and 210 older adults (age 65 and older, 31.8%). The mean age of all inpatients was 56 (*SD* = 17 years, age range = 18 to 99). The mean age of older inpatients was 75 (*SD* = 8 years).

Women comprised approximately 66.7% of the oldest age group

TABLE 4

VTE INCIDENCE BY LEVEL OF RISK (N = 660)

VTE Risk/Incidence	Younger than Age 65 (n = 450)	Age 65 and Older (n = 210)	p Value	Ages 18 to 40 (n = 118)	Ages 41 to 64 (n = 332)	Ages 65 to 79 (n = 147)	Age 80 and Older (n = 63)	p Value for Trend
Mean number of VTE risk factors	1.41	1.59	0.022	1.14	1.51	1.63	1.51	<0.001
Low risk (no risk factors) ^a	68 (15.1%)	23 (11%)		28 (23.7%)	40 (12%)	13 (8.8%)	10 (15.9%)	
Moderate risk (1 to 2 risk factors) ^a	332 (73.8%)	153 (72.9%)		81 (68.6%)	251 (75.6%)	110 (74.8%)	43 (68.3%)	
High risk (≥3 risk factors) ^a	50 (11.1%)	34 (16.2%)		9 (7.6%)	41 (12.3%)	24 (16.3%)	10 (15.9%)	
			0.095					0.008
VTE incidence	102 (22.7%)	36 (17.1%)	0.104	22 (18.6%)	80 (24.1%)	28 (19%)	8 (12.7%)	0.152
VTE in low risk group	13/68 (19.1%)	5/23 (21.7%)		5/28 (17.9%)	8/40 (20%)	3/13 (23.1%)	2/10 (20%)	
VTE in moderate risk group	73/332 (22%)	22/153 (14.4%)		15/81 (18.5%)	58/251 (23.1%)	18/110 (16.4%)	4/43 (9.3%)	
VTE in high risk group	16/50 (32%)	9/34 (26.5%)		2/9 (22.2%)	14/41 (34.1%)	7/24 (29.2%)	2/10 (20%)	
p Value (within age group)	0.216	0.160		0.929	0.251	0.277	0.311	

Note. VTE = venous thromboembolism.

Percentages may not equal 100 due to rounding.

^a Percentages were calculated from the number of patients within the age group.

(age 80 and older, $p < 0.001$). Older inpatients (ages 65 to 79) had the longest median length of hospital stay (10 days, $p = 0.002$). The mean number of risk factors for VTE was significantly highest in the older adult group (ages 65 to 79) compared with other age groups (mean = 1.63, $SD = 1.0$, $p < 0.001$). Older inpatients (age 65 and older) were more likely to have cardiac disease ($p < 0.001$) or limb trauma ($p = 0.003$) than younger adult inpatients (ages 18 to 64).

VTE Prophylaxis

The types of VTE prophylaxis used in inpatients with suspected VTE are presented in Table 2. Both pharmacological and mechanical prophylaxes were used in approximately 38.1% of older inpatients and 27.8% of younger inpatients.

Mechanical prophylaxis, including graduated compression stockings and/or sequential pneumatic compression devices, were applied in 48.1% of older inpatients and 40.2% of younger inpatients prior to the diagnosis of VTE. Further, 23.8% of eligible older inpatients and 34.4% of eligible younger inpatients did not receive any form of prophylaxis measures (pharmacological or mechanical) to prevent VTE.

Table 3 displays VTE incidence by use of pharmacological prophylaxis. Approximately 7.3% (48 of 660) of hospitalized patients were not eligible to receive pharmacological prophylaxis due to contraindications (e.g., bleeding tendency, coagulopathy). No significant association was found between having a contraindication to pharmacologi-

cal prophylaxis and age group in this study. Pharmacological prophylaxis was used for 69.7% of eligible older inpatients and 57.1% of eligible younger inpatients. The incidence of VTE was significantly higher in patients who did not receive pharmacological prophylaxis (older inpatients $p = 0.037$, younger inpatients $p = 0.002$).

VTE Incidence by Risk

Table 4 displays VTE incidence by the level of VTE risk. The overall VTE incidence was 17.1% in older inpatients and 22.7% in younger inpatients ($p = 0.104$). The level of VTE risk was significantly different among the four age groups ($p = 0.008$). In univariate analysis, however, the incidence of VTE was not affected by age ($p = 0.152$). In addition, no statistical difference was

TABLE 5

CLINICAL OUTCOMES BY AGE GROUP (N = 660)

Outcome	Younger than Age 65 (n = 450)	Age 65 and Older (n = 210)	p Value	Ages 18 to 40 (n = 118)	Ages 41 to 64 (n = 332)	Ages 65 to 79 (n = 147)	Age 80 and Older (n = 63)	p Value for Trend
Acute DVT	58 (12.9%)	25 (11.9%)	0.722	8 (6.8%)	50 (15.1%)	22 (15%)	3 (4.8%)	0.021
• Calf vein/distal extremity (% of patients with acute DVT)	14/58 (24.1%)	10/25 (40%)	0.144	1/8 (12.5%)	13/50 (26%)	9/22 (40.9%)	1/3 (33.3%)	0.417
PE	66 (14.7%)	17 (8.1%)	0.018	18 (15.3%)	48 (14.5%)	12 (8.2%)	5 (7.9%)	0.128
VTE (DVT and/or PE)	102 (22.7%)	36 (17.1%)	0.104	22 (18.6%)	80 (24.1%)	28 (19%)	8 (12.7%)	0.152
Anticoagulation treatment in patients with VTE	95/102 (93.1%)	35/36 (97.2%)	0.367	22/22 (100%)	73/80 (91.3%)	27/28 (96.4%)	8/8 (100%)	0.337
Intra vena cava filter placement	15/102 (14.7%)	5/36 (13.9%)	0.905	3/22 (13.6%)	12/80 (15%)	3/28 (10.7%)	2/8 (25%)	0.786
Bleeding within 3 months after anticoagulation treatment	4/95 (4.2%)	1/35 (2.9%)	1.0	2/22 (9.1%)	2/73 (2.7%)	1/27 (3.7%)	0 (0)	0.537
Death within 3 months after VTE diagnosis	10/102 (9.8%)	5/36 (13.9%)	0.538	4/22 (18.2%)	6/80 (7.5%)	4/28 (14.3%)	1/8 (12.5%)	0.318

Note. DVT = deep vein thrombosis; PE = pulmonary embolism; VTE = venous thromboembolism.

Unless otherwise indicated, percentages were calculated from the number of patients within the age group.

found between VTE incidence and the level of risk in each age group. In multivariate analysis, no statistically significant risk factors were associated with developing VTE in older inpatients. However, pharmacological prophylaxis was highly associated with prevention of VTE in older inpatients and all hospitalized inpatients in this study ($p < 0.001$ for both).

Clinical Outcomes

Table 5 describes the clinical outcomes, including the incidences of DVT and PE, bleeding after anticoagulation treatment for VTE, and death after diagnosed VTE. The incidence of DVT was not different between older and younger inpatients. However, when age was categorized into four groups, the incidence of DVT was significantly different; inpatients ages 41 to 64 or ages 65 to 79 were more likely to have DVT than other age groups ($p = 0.021$). Older

inpatients were more likely to have DVT in their calf veins/distal extremities (40%) than younger inpatients (24.1%). PE was diagnosed in 8.1% of older inpatients and 14.7% of younger inpatients ($p = 0.018$).

All eligible older inpatients with VTE received standard treatment using anticoagulant agents (UFH, LMWH, and/or warfarin). Three-month follow-up data on bleeding or death were not available in 11.6% (16 of 138) of patients with VTE. Complications such as gastrointestinal bleeding or heparin-induced thrombocytopenia within 3 months after therapeutic anticoagulation were reported in 4.3% (5 of 115) of patients with VTE. Bleeding within 3 months after anticoagulation treatment was reported in 1 older inpatient and 4 younger inpatients. The 3-month mortality rate was 13.9% in the older inpatients and 9.8% in the younger inpatients. Five older inpatients died within 3 months after

their VTE was diagnosed: 4 had PE, and 1 had cancer and PE.

DISCUSSION

In this study, we described the use of VTE prevention and clinical outcomes in older hospitalized patients compared with younger inpatients who underwent a diagnostic study to rule out VTE at an academic medical center. The overall incidence of VTE in older inpatients age 65 and older was 17.1%, and the standard prevention methods using anticoagulant agents was used in 69.7% of eligible older inpatients in this study.

VTE Incidence in the Older Adult Population

It is well known that advancing age is an independent and major risk factor for the development and recurrence of VTE (Geerts et al., 2008; Heit, 2006, 2008; Heit, Melton, et al., 2001). Hospital confinement is also an independent risk factor for VTE,

KEYPOINTS

Lee, J.-A., & Zierler, B.K. (2010). **Prevention and Clinical Outcomes in Older Inpatients with Suspected Venous Thromboembolism.** *Journal of Gerontological Nursing*, 36(4), 40-48.

- 1 Venous thromboembolism (VTE) is one of the most common preventable disorders among hospital inpatients, and advancing age is a major risk factor for VTE.
- 2 This study describes current VTE prevention practice and clinical outcomes of VTE in older inpatients compared with younger inpatients at risk for or diagnosed with VTE.
- 3 Mortality was higher in older inpatients compared with younger inpatients with VTE, despite the lower rate of VTE in older inpatients.
- 4 Prevention measures for VTE were underused in both older and younger inpatients.

in addition to advanced age (Heit, 2008). The incidence rate (17.1%) of VTE in older hospitalized patients (age 65 and older) in this study was similar to that reported in the literature (Heit, Melton, et al., 2001; Sellier et al., 2008). Unlike the trends of increasing VTE rate according to advanced age (Heit, Melton, et al., 2001; Stein et al., 2004), the incidence of VTE was not increased in the oldest age group (age 80 and older) when compared with the next oldest age group (ages 65 to 79) in this study. The oldest age group had more cardiac-related comorbidities than the other age groups. Anticoagulation therapy for patients with cardiac disease (e.g., atrial fibrillation) might prevent potential VTE, although our data have shown that VTE still occurs in patients receiving pharmacological prophylaxis if the dosage was not adequate for preventing VTE.

When compared with the younger group (ages 18 to 64), the incidence of VTE in older inpatients was lower in this study after controlling for covariates in the multivariate analysis. This may be because the two groups varied greatly in size and in underlying conditions such as cancer or previous VTE.

The mean number of VTE risk factors in older inpatients was significantly higher than in younger inpatients in this study. In particular, the oldest age group (age 80 and older) had more limb trauma compared with other age categories. The results were similar to a case-control, prospective, multicenter study conducted to examine independent risk factors for DVT in inpatients age 65 and older (Weill-Engerer et al., 2004). In the prospective multicenter study, six factors, including immobilization, age 75 and older, history of VTE, acute heart failure, chronic edema of the lower limbs, and paralysis of a lower limb, were identified as being independently related to the development of DVT in older inpatients in 19 geriatric university hospitals with long-intermediate and short-term care facilities (Weill-Engerer et al., 2004). Another recent multicenter study using a 1-day cross-sectional review reported that the independent risk factors in multivariable analyses adjusting for prophylaxis against VTE were age 80 and older, history of VTE, a Katz Index of Independence in Activities of Daily Living score greater than 3, presence of pressure

ulcers, and regional or metastatic cancer shown in 812 older patients in 42 post-acute care hospital-based facilities (Sellier et al., 2008).

In this study, the proportion of calf DVT in distal lower extremities was higher in older inpatients (40%) compared with younger inpatients (24%). The study by Sellier et al. (2008) identified the presence of isolated distal DVTs compared with proximal DVTs in the older patients in post-acute care facilities, respectively 10% versus 4% of those diagnosed with DVTs. PE is underdiagnosed in older patients, while its incidence and risk increases steadily with age, because older patients have nonspecific and atypical presentation of PE (Masotti et al., 2008). This study showed that PE diagnoses were lower in the older inpatients than the younger inpatients.

VTE Prevention and Management in the Older Adult Population

Despite the availability of evidence-based prevention guidelines for VTE, prophylaxis of VTE has been underused or often inappropriately used for all patients at risk (Cohen et al., 2008; Jaffer et al., 2008; Sellier et al., 2006; Yu et al., 2007). Very few studies have looked at VTE prevention focusing on the older population. A recent multicenter study (Sellier et al., 2006) was conducted to determine whether a multifaceted intervention, including pharmacological and mechanical prophylaxis, decreased the incidence of DVT in elderly post-acute care patients. The results from Sellier et al.'s (2006) study showed that DVT occurred in 12% of older adults during the preintervention phase and 8% during the postintervention phase ($p = 0.002$). Of note, there was a significant decrease in calf DVT (7% in preintervention versus 3.6% in postintervention). Sellier et al. (2006) examined the appropriateness of graduated compression stockings in older adults; almost 50% of gradu-

ated compression stocking were used inappropriately in preintervention and 45% in postintervention phases.

Another study by South, Iverson, and Harbison (2007) reviewed the medical records of inpatients older than age 75 in 10 hospitals and showed that 29% of patients with indications for thromboprophylaxis received some form of prophylaxis. They concluded that thromboprophylaxis was underused in older medical inpatients despite the increased risk of VTE due to advancing age.

In the current study, approximately 30% of eligible older inpatients did not receive pharmacological prophylaxis to prevent VTE, and the incidence of VTE was significantly higher in those without pharmacological prophylaxis compared with those with pharmacological prophylaxis (25.4% versus 13.2%). Mechanical prophylaxis was used in only half of the older patients. Nearly one quarter of the older inpatients in this study did not receive any form of VTE prophylaxis.

Extended postdischarge prophylaxis has been recommended for older patients (age 75 and older) who have major orthopedic surgery (e.g., hip fracture, hip or knee replacement) and those with cancer or a previous history of VTE (Jaffer et al., 2008). Nutescu et al. (2008) reported that approximately 4% of patients with major orthopedic surgery had DVT at 1 month after discharge. We found that 23 of 28 (82%) older patients with orthopedic surgery received pharmacological prophylaxis, and 7 of 28 (25%) older patients developed VTE during their hospitalization. We did not have postdischarge information on the incidence of VTE in the older inpatients who underwent orthopedic surgery, but they had no evidence of VTE during their hospitalization. Follow-up evaluation for VTE occurrence after hospital discharge is essential because almost one third of all VTE cases in the community occur within 1 month

after discharge (Heit, Melton, et al., 2001). Screening for DVT before hospital discharge is recommended in the most recent ACCP guidelines on VTE prevention (Geerts et al., 2008).

In addition, stays in a nursing home or other chronic care facility are also considered an independent risk factor for VTE, with an 8-fold increased risk (Heit, Silverstein, et al., 2001). In this study, more than half of the older inpatients were discharged to skilled nursing homes or other long-term care facilities.

We did not focus on the adequacy of anticoagulation dosing in this study. However, appropriate anticoagulation dosing is important in the prevention of VTE. The 2008 ACCP guidelines recommend that renal function be considered in older patients and those who are at high risk for bleeding. Using a lower dosage of the anticoagulant agent and/or monitoring the drug level are recommended options in this condition (Geerts et al., 2008).

Clinical Complications After a VTE Event

Bleeding is a complication for anticoagulation for both prophylactic and therapeutic purposes in VTE management in the older adult population (Spyropoulos & Merli, 2006). Clinicians may be reluctant to order anticoagulant agents for older patients at risk for VTE because they tend to have reduced renal clearance and a hypersensitivity to oral anticoagulant agents. In this study, we identified only 1 patient (age 67) who had a bleeding episode within 3 months after VTE treatment. This particular patient had an underlying bleeding tendency of leucopenia but received anticoagulation treatment for VTE anyway. Few guidelines exist for the use of thromboembolic prevention specifically focused on the older adult population. The ACCP guidelines (Geerts et al., 2008) recommend renal function be considered when making decisions

about the use and/or dosage of anticoagulant agents that are cleared by the kidneys, particularly by older patients, with monitoring the drug level.

Mortality after VTE is strongly associated with age, particularly in older patients with PE, cancer, and/or underlying cardiovascular diseases (White, 2003). This study showed a high mortality rate (13.9%) after VTE in older inpatients, and those patients had PE and cancer or underlying cardiac disease.

LIMITATIONS

This study has some limitations due to the study design, which was a descriptive-observational study using retrospective medical chart reviews. First, the quality of information abstracted from the medical records depended on the charting by physicians and nurses, which is often incomplete. Second, data were from an academic medical center, which has a high population of cancer patients, so the results may not be generalizable to other academic medical centers with different kinds of populations. However, this study was conducted to provide evidence of current practices related to VTE prevention in older inpatients and to compare their clinical outcomes with those of younger inpatients.

CONCLUSION AND CLINICAL IMPLICATIONS

This study shows that the incidence of VTE in older inpatients with suspected VTE was not statistically different compared with younger adult inpatients. However, the mortality after VTE was higher in the older inpatients than the younger age groups. This study confirmed the underuse of pharmacological and mechanical prophylaxis for VTE prevention in older adult inpatients.

Health care providers, including nurses, nurse practitioners, physicians, and pharmacists, are involved in the care of older inpatients at risk

for VTE. Nurse practitioners working at clinics, long-term facilities, or nursing homes should be aware of the increased risk for VTE in their older clients. Nurses are also responsible for the daily assessment of VTE risks and for ensuring the appropriate use of VTE prevention measures in older patients during their hospitalization. In hospital settings, RNs are part of an interdisciplinary team working to decrease hospital-acquired VTE. They are responsible for assessing patients for VTE risk, ambulating patients to prevent venous stasis, or using mechanical prophylaxis to improve venous flow.

Recent hospitalization is a major risk factor for developing VTE, and thus patients need to be educated about their ongoing risk of developing VTE once they are discharged from the hospital setting. Therefore, nurses are responsible for discharge planning that includes patient education about the risk of VTE. The VTE Safety Toolkit, which was developed in the parent study and disseminated nationally via the AHRQ, provides educational material for patients on the treatment and prevention of VTE.

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