Site of Deep Venous Thrombosis and Age in the Selection of Patients in the Emergency Department for Hospitalization Versus Home Treatment

Paul D Stein, MD*, Fadi Matta, MD, and Mary J. Hughes, DO

Despite apparent advantages of home treatment of deep venous thrombosis (DVT) based upon results of randomized controlled trials, physicians maintain a conservative approach, and a large proportion of patients with DVT are hospitalized. In the present investigation we assess whether selection of patients for hospitalization for acute DVT was related to the site of the DVT or to age. This was a retrospective cohort study based on administrative data from the Nationwide Emergency Department Sample, 2016. Patients were identified by International Classification of Diseases-10-Clinical Modification codes. Most, 87,436 of 133,414 (66%), had proximal DVT. A minority of patients with isolated distal DVT were hospitalized, 10,621 of 37,592 (28%). However, hospitalization was selected for 47,459 of 87,436 (54%) with proximal DVT; 4,867 of 7,599 (64%) with pelvic vein DVT; and 611 of 788 (78%) with DVT involving the inferior vena cava. Hospitalization for patients with distal DVT, proximal DVT, and pelvic vein DVT was age-dependent. In conclusion, both the site of acute DVT and age were factors affecting the clinical decision of emergency department physicians to select patients for hospital treatment.
 (Am J Cardiol 2021;146:95−98)

Systematic review of randomized controlled trials of home treatment compared with hospital treatment of acute deep venous thrombosis (DVT) showed no clear differences in mortality, major bleeding, or minor bleeding, indicating that home treatment is no worse for these outcomes than in−patient treatment.[1] Patients preferred home treatment and total direct costs were lower for home treatment.[1] Despite advantages of home treatment of DVT, physicians maintain a conservative approach and a large proportion of patients with DVT are hospitalized.[2,3] We previously showed that hospitalization was more frequent in those with comorbid conditions than with no comorbid conditions.[2] In the present investigation, we assess practice patterns of emergency department physicians to determine if selection of patients for hospitalization for acute DVT was related to the site of the DVT or to age.

Methods

This was a retrospective cohort study based on administrative data from the Nationwide Emergency Department Sample, 2016.[4] The Nationwide Emergency Department Sample is part of a family of databases and software tools developed for the Healthcare Cost and Utilization Project. The Nationwide Emergency Department Sample is the largest all-payer emergency department database in the United States, yielding national estimates of hospital-owned emergency department visits. Unweighted, it contains data from over 30 million emergency department visits each year. Weighted, it estimates roughly 145 million emergency department emergency department visits. In year 2016, the Nationwide Emergency Department Sample included a full calendar year of data with diagnosis and inpatient procedure codes.

Patients were identified by International Classification of Diseases-10-Clinical Modification (ICD-10-CM) Codes (Table 1). Included patients were adults (≥ ages 18 years) of both genders and all races seen in emergency departments in all regions of the United States with a primary (first-listed) diagnosis of DVT at identified locations. We deleted patients who had DVT at unspecified locations. We stratified patients according to whether they had DVT at the following sites: inferior vena cava, pelvic veins including the iliac veins, proximal deep veins of the lower extremities including the femoral and popliteal veins, and distal lower extremity including the tibial veins. At each site of acute DVT, the proportion of hospitalized patients was assessed according to age. This investigation was determined by the institutional review board not to meet the definition of "human subjects" because the database includes only de-identified patients.

Statistical methods

Differences of categorical variables were calculated by the 2-tailed Fisher's exact test using MedCalc statistical software, Osland, Belgium. [medcalcviewersetup.msi (19.9 MB]. Continuous variables were expressed as mean ± standard deviation and were calculated using Graphpad Quickcalcs, Graphpad. San Diego, California. Linear regression analyses were performed using InStat 3.0, GraphPad Software. A p value ≤ 0.05 was considered statistically significant.

Department of Osteopathic Medical Specialties, College of Osteopathic Medicine, Michigan State University, East Lansing, Michigan. Manuscript received December 9, 2020; revised manuscript received and accepted January 11, 2021.

Support: None

Conflict of interest: None of the authors has any conflict of interest

Participation: All authors had access to the data and participated in preparation of the manuscript.

*Address correspondence: Tel.: 248-701 7210, fax: 517-432-1062

E-mail address: steinp@msu.edu (P.D. Stein).

0002-9149/
https://doi.org/10.1016/j.amjcard.2021.01.024

Table 1
International Classification of Deseases-10th Clinical Modification codes used

Condition	ICD-10-CM Code
Acute DVT distal lower extremity	I82.4Z,I82.4Z1, I82.4Z2, I82.4Z3, I82.4Z9, I82.441,I82.442, I82.443, I82.449,
Acute DVT proximal lower extremity	I82.431, I82.432, I82.433, I82.439,I82.4Y, I82.4Y1, I82.4Y2, I82.4Y3, I82.4Y9, I82.41, I82.411, I82.412, I82.413, I82.419
Acute DVT pelvic vein	I82.421, I82.422,I82.423, I82.429, I82.890
Acute DVT inferior vena cava	I82.220

DVT = deep venous thrombosis

Results

In 2016, 133,414 patients were evaluated in emergency departments throughout the United States with a primary diagnosis of DVT at identified sites. Most, 87,436 (66%), were proximal DVT (Figure 1).

The proportion of patients according to site of DVT and gender is shown in Table 2.

Age (mean ± SD) was, 59 ± 17 years with distal DVT, 63 ± 17 years with proximal DVT, 58 ± 19 years with pelvic vein DVT and 59 ± 18 years with thrombosis involving the inferior vena cava.

Hospitalization for patients with a primary diagnosis of DVT was selected for 63,559 of 133,414 (48%). A minority of patients with isolated distal DVT were hospitalized, 10,621 of 37,592 (28%). Hospitalization was selected for 47,459 of 87,436 (54%) with proximal DVT; 4,867 of 7,599 (64%) with pelvic vein DVT; and 611 of 788 (78%) with DVT involving the inferior vena cava (Figure 2). The proportion hospitalized was higher with proximal DVT compared with distal, pelvic DVT compared with proximal, and inferior vena cava DVT compared with pelvic DVT, all $p < 0.0001$.

With distal DVT hospitalization increased from 16% in patients aged 18 to 30 years to 44% in patients >aged 80 years (Figure 3). With proximal DVT, hospitalization increased from 40% in patients aged 18 to 30 years to 67% in patients >aged 80 years. With pelvic veins, hospitalization increased from 61% in patients aged 18 to 30 years to 71% in patients >aged 80 years. Hospitalization for

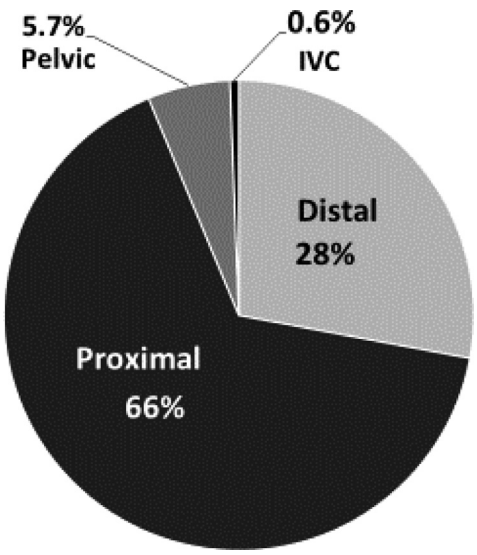

Figure 1. Sites of deep venous thrombosis (DVT) in patients evaluated in emergency departments. IVC = inferior vena cava.

Table 2
Site of deep venous thrombosis according to gender

	Total	Male	Female
Distal DVT*	37,592	19,152 (51%)	18,435 (49%)
Proximal DVT*	87,436	45,855 (52%)	41,534 (48%)
Pelvic vein DVT*	7,599	3,098 (41%)	4,497 (59%)
Inferior vena cava	788	381 (48%)	407 (52%)

* Gender not known in some patients. DVT = deep venous thrombosis

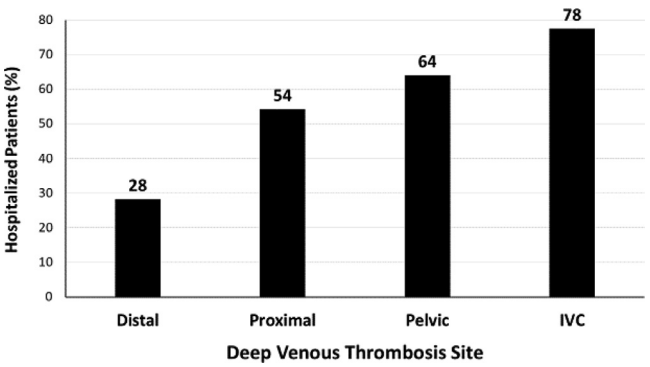

Figure 2. Proportion of hospitalized patients according to site of DVT in patients evaluated in emergency departments. The proportion differed at all sites, $p < 0.0001$.
IVC = inferior vena cava.

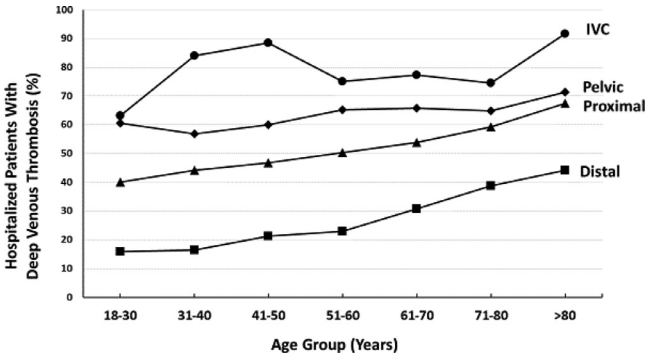

Figure 3. Proportion of patients hospitalized according to site of DVT and age. Hospitalization for patients with distal DVT was age-dependent, $p = 0.0003$, $r^2 = 0.9425$ as was hospitalization for patients with proximal DVT, $p < 0.0001$, $r^2 = 0.9684$, and hospitalization for patients with pelvic vein DVT, $p = 0.01$, $r^2 = 0.7723$. Hospitalization for patients with DVT involving the inferior vena cava was not age-dependent, $p = 0.3$, $r^2 = 0.1949$. IVC = inferior vena cava.

patients with DVT involving the inferior vena cava was not age-dependent.

Discussion

The site of primary DVT affected the choice of emergency department physicians for hospitalization. Hospitalization was selected more frequently in patients with proximal DVT than with distal DVT, more frequently with pelvic vein DVT than proximal DVT and more frequently with DVT involving the inferior vena cava than with pelvic vein DVT. Age also affected the choice of emergency department physicians for hospitalization in those with distal DVT, proximal DVT and pelvic vein DVT.

Systematic review by Othieno et al[1] identified 6 studies that reported death in patients with DVT with follow−up ranging from 3 months to 1 year.[5-10] Meta−analysis showed relative risk 0.69, 95% CI 0.44 to 1.09 indicating no clear difference in numbers of deaths between home and hospital−treated groups.[1] These 6 studies also reported recurrent venous thromboembolism (PE or recurrence of DVT) in 3 months to 1 year.[5-10] Home treatment carried less risk of recurrent venous thromboembolism, relative risk 0.58, 95% CI 0.39 to 0.86.[1] Major bleeding in these studies showed relative risk 0.67, 95% CI 0.33 to 1.3 indicating no clear differences between home and hospital treatment.[1] Minor bleeding showed relative risk 1.29, 95% CI 0.94 to 1.78, also indicating no clear difference between hospital and home treatment.[1]

Exclusions in randomized controlled trials resulted in a narrower spectrum of patients with acute DVT than seen in emergency departments. Most randomized controlled trials included patients with DVT limited to the proximal veins of the lower extemity.[7−10] DVT limited to distal veins of the lower extremity was excluded.[7-10] Boccalon et al included patients with iliac DVT as well as proximal DVT, but excluded patients with DVT involving the IVC.[5] Ramacciotti et al excluded patients with bilateral DVT.[10] Chong et al excluded those with clinically significant medical conditions other than DVT.[6]

We previously showed that more patients with DVT who had comorbid conditions were hospitalized than those with no comorbid conditions, 84.5% compared with 42.0%.[2] Among patients with DVT who had diabetes mellitus, chronic obstructive pulmonary disease, any neoplasm, leukemia, lymphoma, rheumatologic disease and paraplegia, 77% to 89% were hospitalized.[2] Among patients with DVT who had peripheral vascular disease, human immunodeficiency virus, heart failure, acute or chronic liver disease, dementia, moderate or severe renal disease, cerebral vascular disease, ulcer disease, acute myocardial infarction, hemiplegia and hemiparesis, 90% to 100% were hospitalized.[2]

The results of the present investigation suggest that physicians have a perceived risk for home treatment of patients with DVT that is partially dependent upon the site of the DVT and upon age. A strength of the present investigation is that it shows the selection of patients for hospitalization with acute DVT based on the actual experience of emergency department physicians in patients with a broad spectrum of clinical findings. A weakness, as with any retrospective investigation based on administrative data, is the accuracy of ICD-10-CM codes. We do not know the positive predictive value of ICD-10-CM codes for primary DVT, but ICD-9-CM codes for primary DVT had positive predictive value 95%.[11]

In conclusion, both the site of acute DVT and age were factors affecting the clinical decision of emergency department physicians to select patients for hospital treatment. The conservative approach to home treatment of acute DVT partially reflects concerns of physicians about the site of the DVT and the age of the patient.

Author Agreement

This statement is to certify that all authors have seen and approved the manuscript being submitted, have contributed significantly to the work, attest to the validity and legitimacy of the data and its interpretation, and agree to its submission to The American Journal of Cardiology.

We attest that the article is the Authors' original work, has not received prior publication and is not under consideration for publication elsewhere.

On behalf of all Co-Authors, the corresponding Author shall bear full responsibility for the submission. Any changes to the list of authors, including changes in order, additions or removals will require the submission of a new author agreement form approved and signed by all the original and added submitting authors.

1. Othieno R, Okpo E, Forster R. Home versus in-patient treatment for deep vein thrombosis. *Cochrane Database Syst Rev* 2018;1:CD003076.
2. Stein PD, Matta F, Hughes MJ. Home treatment of deep venous thrombosis according to comorbid conditions. *Am J Med* 2016;129:392–397.
3. Stein PD, Matta F, PG, Ghiardi M, Marsh JH, Khwarg J, Brandon MS, Fowkes HAN, Kazan V, Wiepking M, Keyes DC, Kakish EJ, Hughes MJ. Home treatment of deep venous thrombosis in the era of new oral anticoagulants. *Clin Appl Thromb Hemost* 2015;21:729–732.
4. Overview of the Nationwide Emergency Department Sample (NEDS). https://www.hcup-us.ahrq.gov/nedsoverview.jsp. Accessed Feb 11, 2021.
5. Boccalon H, Elias A, Chale JJ, Cadene A, Gabriel S. Clinical outcome and cost of hospital vs home treatment of proximal deep vein thrombosis with a low-molecular-weight heparin: the Vascular Midi-Pyrenees study. *Arch Intern Med* 2000;160:1769–1773.
6. Chong BH, Brighton TA, Baker RI, Thurlow P, Lee CH, ASTH DS Group. Once-daily enoxaparin in the outpatient setting versus unfractionated heparin in hospital for the treatment of symptomatic deep-vein thrombosis. *J Thromb Thrombolysis* 2005;19:173–181.
7. Daskalopoulos ME, Daskalopoulou SS, Tzortzis E, Sfiridis P, Nikolaou A, Dimitroulis D, Kakissis I, Liapis CD. Long-term treatment of deep venous thrombosis with a low molecular weight heparin (tinzaparin): a prospective randomized trial. *Eur J Vasc Endovasc Surg* 2005;29:638–650.
8. Koopman MM, Prandoni P, Piovella F, Ockelford PA, Brandjes DP, van der Meer J, Gallus AS, Simonneau G, Chesterman CH, Prins MH. Treatment of venous thrombosis with intravenous unfractionated heparin in hospital as compared with subcutaneous low molecular weight heparin at home. *N Engl J Med* 1996;334:682–687.
9. Levine M, Gent M, Hirsch J, Leclerc J, Anderson D, Weitz J, Ginsberg J, Turpie G, Demers C, Kovacs M. A comparison of low molecular weight heparin administered primarily at home with unfractionated heparin administered in the hospital for proximal deep vein thrombosis. *N Engl J Med* 1996;334:677–682.
10. Ramacciotti E, Araujo GR, Lastoria S, Maffei FH, Karaoglan DM, Michaelis W, Sandri JL, Dietrich-Neto F, CLETRAT Investigators.

An open-label, comparative study of the efficacy and safety of once-daily dose of enoxaparin versus unfractionated heparin in the treatment of proximal lower limb deep-vein thrombosis. *Thromb Res* 2004;114:149–153.

11. White RH, Garcia M, Sadeghi B, Tancredi DJ, Zrelak P, Cuny J, Sama P, Gammon H, Schmaltz S, Romano PS. Evaluation of the predictive value of ICD-9-CM coded administrative data for venous thromboembolism in the United States. *Thromb Res* 2010;126:61–67.