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The Prevalence and Risk Factors of Venous Thrombosis among Hospitalized Patients: Are Wells Criteria Considered by Primary Care Physicians?

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Abstract

Background: Deep vein thrombosis (DVT) is one of the main causes of hospital mortality which can easily be prevented. Three para clinical methods are used to confirm the diagnosis of DVT, which include D-dimer test, venous color Doppler ultrasonography and venography. This study has focused on the prevalence of confirmed DVT in lower limbs based on venous color Doppler ultrasonography and risk factors of this disease in patients under examination.

Methods: This study was a retrospective cross sectional research done through reviewing the medical files of adult patients hospitalized in Afzalipour Hospital/ Kerman/ Iran in 2018. The samples included 1000 medical files. First, the number of venous color Doppler ultrasonography, and then the number of cases of confirmed DVT were recorded.

Results: The prevalence of confirmed DVT in lower limbs was 17.4% or 1.74 in 1000 people. The analyses showed that the patients were different in developing DVT based on their history of surgery (P≤0001), trauma (P=0.05), history of COPD (P≤0.001) and previous DVT (P≤0.001).

Conclusion: In the present study, from 357 Doppler ultrasonography orders only 62 cases resulted in lower limb DVT diagnosis, which is equal to 17.6%. It seems that the number of Doppler ultrasonography orders is relatively high. Therefore, it is recommended that more attention be paid to the clinical examinations of patients and Wells criteria to avoid ordering unnecessary para clinical services and consequently reduce the costs and also the hospitalization length. Moreover, more effective education and training of primary care physicians is suggested.

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Introduction

Deep vein thrombosis (DVT) is, on the one hand, one of the main causes of hospital mortality, and on the other hand, one of the problems which can easily be prevented (1). The prevalence rate of DVT is 92.1 in 1000 people (2). Approximately 90% of people diagnosed with DVT show the clinical symptoms of this

disease (3). Venous thromboembolism is a major global burden with about 10 million cases occurring every year, thereby representing the third leading vascular disease after acute myocardial infarction and stroke. Just under half a million deep vein thromboses and 300000 pulmonary embolisms occur every year in six European countries with 300 million inhabitants. The yearly economic burden of venous thromboembolism in the USA has been estimated to be US$7–10 billion (4).

The sequelae of venous thromboembolism are also associated with substantial disability and include the post-thrombotic syndrome, which develops in 20–50% of patients with deep vein thrombosis (5). The great challenge in the diagnostic investigation of suspected venous thromboembolism is to identify accurately and rapidly patients needing prompt treatment to prevent thrombus extension or embolization, as well as patients without disease, for whom unnecessary diagnostic tests and anticoagulant therapy should be avoided. The diagnosis of venous thromboembolism on the basis of clinical manifestations alone is unreliable because of the poor specificity of signs and symptom (6, 7).

The typical symptoms of DVT include pain, heaviness and cramps in the lower extremity, particularly in the calf, which may slowly progress over several days and at some stage may suddenly accelerate more rapidly leading to swelling and blue-red or cyanotic discoloration. However, postoperative DVT often does not cause any symptoms and commonly, dyspnea due to pulmonary embolism (PE) may be the first symptom in those patients (8).

One of the clinical methods for DVT diagnosis is employing Wells criteria. These criteria are based on the medical history and examination of the patient. Factors such as suffering from active cancer, lack of physical activity, history of surgery, and edema of legs are significant in these criteria (9). Also, three para clinical methods are used to confirm the diagnosis of DVT, which include D-dimer test, venous color Doppler ultrasonography and venography. We have focused on the venous color Doppler ultrasonography in the present study (3). The sensitivity and specificity degree of the Doppler ultra-sonography in diagnosing DVT are 96.5% and 97.8%, respectively (10).

Some factors such as age, gender, lack of activity, history of surgery, pregnancy, trauma, coagulation disorders and history of previous DVT can increase the chance of developing DVT and are considered as risk factors in developing the disease (11-13).

Anticoagulation options for acute VTE include unfractionated heparin, low molecular weight heparin (LMWH), fondaparinux and direct oral anticoagulants (DOACs). DOACs are as effective as conventional therapy with LMWH and vitamin K antagonists. Thrombolytic therapy is reserved for massive pulmonary embolism (PE) or extensive deep vein thrombosis (DVT) (14).

This study has focused on the prevalence of confirmed DVT in lower limbs based on venous color Doppler ultrasonography, the number of Doppler ultrasonography orders prescribed by medical doctors and comparing the results

with the studies published worldwide, and risk factors of this disease in patients under examination.

Materials and Method

The present cross-sectional study was conducted in a six-month period, aiming to analyze the prevalence of DVT in the patients hospitalized in the pulmonology ward of Afzalipour Hospital/ Kerman/ Iran. At fist a review was done on the files related to the patients hospitalized in the adults' pulmonology ward in 2018. The samples included 1000 hospital files. First, the number of the cases of venous color Doppler ultrasonography, and then the number of cases of confirmed DVT were recorded. Afterwards, through reviewing the cases with confirmed DVT, the ratio of the people with DVT was measured based on their age, gender, and hospitalization time, past history of trauma, chronic obstructive pulmonary diseases, history of surgery, previous DVT, hypertension.

Ethical approval

This study was approved by ethics committee of Kerman University of Medical Sciences (ethic number: IR.KMU.REC.1396.2530).

Data analysis

In this study, mean (standard deviation), frequency and confidence interval were used to describe the data. Also, the single-variable logistic regression was used to compare the variables, and the multi-variable logistic regression (Backward: Wald) was used to estimate the probability of DVT. The significance level was $P<0.05$ in all tests. SPSS 23 was used to analyze the data.

Results

Among the 357 patients who underwent venous color Doppler ultrasonography, 195 were male (54.6%), and the rest were female. The mean and standard deviation of their age was 63.26±15.07 years ((the age range: 20-95 years)). DVT in lower limbs was seen in 62 patients or 17.4% (6.21– 5.13= CI 95 %). These patients had been hospitalized in the pulmonology ward for 6.92±4.75 days on average. More than half of them (211, 59.1%) were suffering from hypertension. Less than a third of them (105, 29.4%) were cigarette smokers while more than a half of them (202, 56.6%) reported opium usage (Table1).

Table 1. The prevalence of deep venous thrombosis based on demographic characteristics among hospitalized patients

Variable	levels of variables	Number of patients	DVT prevalence	95% Confidence Interval
Age group	<64	178	24 (13.6)	8.5-19.2
	≥64	176	37 (21)	14.8-26.7
	unknown	3	1 (33.3)	0-100
Gender	male	195	32 (16.4)	11.3-21.5
	female	161	29 (18.1)	12.5-24.4
	unknown	1	1 (100)	--
Surgery	negative	248	34 (13.8)	9.6-18.5
	Positive	106	28 (26.4)	18.7-34.6
	Unknown	3	0	--
History of trauma and accident	Negative	294	3 (1)	0-2.4
	positive	62	3 (4.8)	0-11.2
Inactivity for more than 3 days	negative	303	51 (16.9)	12.9- 21.2
	positive	48	11 (22.9)	12.5-35.4
	unknown	6	0	--
History of previous DVT	negative	314	40 (12.8)	9.3-16.6
	positive	43	22 (51.2)	34.9-65.1
History of COPD	negative	147	35 (23.8)	17-31.3
	positive	209	27 (12.9)	8.6-17.2
History of DVT and COPD simultaneously	negative	340	54 (15.9)	12.1-19.8
	positive	17	8 (47.1)	23.5-70.8
Pregnancy	negative	148	26 (17.6)	11.5-23.8
	positive	5	1 (20)	0-60
	unknown	8	2 (25)	0-50
Childbirth	negative	147	26 (17.7)	11.6-24.2
	positive	7	2 (28.6)	0-71.4
	unknown	7	1 (14.3)	0-42.9
Oral contraceptive pills	negative	151	27 (17.9)	11.9-24.3
	positive	4	1 (25)	0-75
	unknown	6	1 (16.7)	0-50
History of hypertension	negative	143	25 (17.2)	11-24.1
	positive	211	37 (17.5)	12.3-22.7
	unknown	3	0	--
Cigarette smoking	negative	252	42 (16.7)	12.4-21.5
	positive	105	20 (19)	12.4-25.7
Opium addiction	negative	155	24 (15.6)	10.4-21.4
	positive	202	38 (18.8)	13.9-24.3
Long trips	negative	355	61 (17.1)	13.8-21.5
	positive	0	0	--
	unknown	2	1 (50)	0-100
History of coagulation disorders	negative	352	60 (17.1)	13-20.9
	positive	3	1 (33.3)	0-100
	unknown	2	1 (50)	0-100

The analyses showed that the patients were different in developing DVT based on their history of surgery (P≤0001), trauma and accident (P=0.05), history of COPD (P≤0.001) and previous DVT (P≤0.001). According to this study, those who had surgery, compared to those who did not, were 2.24 times more prone to developing the disease OR= 2.24 (1.28-3.95=CI 95 %). Also, patients with a history of trauma and accident, compared to those without, were 4.93 times more prone to developing DVT OR=4.93 (0.97-25.03=CI 95 %). Moreover, patients who had a history of COPD, compared to those who did not, were less likely to develop DVT OR=0.47 (0.23-0.82 CI95%), while the patients who had a history of previous DVT, compared to those who did not, were 7.15 times more likely to develop DVT OR=7.15(3.60-14.16 CI95%) (Table 2).

Table 2. The crude odds ratio of deep venous thrombosis among hospitalized patients in pulmonary ward

Variable	Levels of variables	Crude odds ratio (95% Confidence interval)	P-value
Age (year)	Under 64	1	
	Over 64	1.69 (0.96-2.97)	0.06
gender	female	1	
	male	0.88 (0.51-1.54)	0.67
Surgery	negative	1	
	positive	2.24 (1.28-3.95)	≤0.0001
History of trauma and accident	negative	1	
	positive	4.93 (0.97-25.03)	0.05
Inactivity for more than 3 days	negative	1	
	positive	1.46 (0.70-3.05)	0.31
History of COPD	negative	1	
	positive	0.47 (0.23-0.82)	≤0.0001
History of previous DVT	negative	1	
	positive	7.15 (3.14-60.16)	≤0.0001
Pregnancy	negative	1	
	Positive	1.17 (0.12-10.92)	0.88
Childbirth	negative	1	
	positive	1.86 (0.34-10.12)	0.47
Oral contraceptive pills	negative	1	
	positive	1.53 (0.15-15.25)	0.71
History of Hypertension	negative	1	
	positive	1.12 (0.57-1.76)	0.97
Cigarettes smoking	negative	1	
	positive	1.17 (0.65-2.11)	0.60
Opium addiction	negative	1	
	positive	1.25 (0.71-2.15)	0.42
History of coagulation disorders	negative	1	
	positive	2.42 (0.21-27.17)	0.47

According to the findings of the multi-variable logistic regression, factors such as lack of activity for more than 3 days OR=5.26 (1.40-19.79 CI95%), and history of previous DVT OR=16.36 (5.68-47.05 CI95%) predicted the occurrence of DVT (table 3).

Table 3. The predicting factors of deep venous thrombosis among hospitalized patients in pulmonary ward

Variable	Level of variable	Adjusted odds ratio (95% Confidence interval)	P-value
Inactivity for more than 3 days	Negative	1	0.01
	Positive	5.26 (1.40-19.79)	
History of previous DVT	Negative	1	≤0.0001
	Positive	16.36 (5.68-47.5)	

Discussion

In the present study, the prevalence of confirmed DVT in lower limbs, based on venous color Doppler ultrasonography was 17.4% or 1.74 in 1000 people, which is close to 1.92 in 1000 people, reported in previous studies (2). Among the 1000 files which were studied, there were 357 venous color Doppler ultrasonography orders, 62 of which resulted in final diagnosis of DVT.

In one study, the prevalence of confirmed DVT in lower limbs based on color Doppler ultrasonography was reported to be 0.1% (15), which is significantly lower compared to the present study. The reason is that in the present study, only the files related to the patients hospitalized in the adults' pulmonology ward, who were older patients with more diseases and inactivity and were consequently more prone to DVT, were studied.

In another study, in Nanjing, China, the prevalence of confirmed DVT in lower limbs, in patients who had a history of neck of femur fracture surgery, based on color Doppler ultrasonography, was 32.8 (16), which is significantly higher compared to the findings of the present study. This is because of the history of surgery and trauma, which are DVT risk factors. In our study, those who had a history of surgery were 2.24 times more likely to develop DVT. Also, the people with a history of trauma were 4.86 times more likely to develop DVT. In a study conducted in Portland, US, in 2014, the prevalence of confirmed DVT in lower limbs in patients with a history of surgery and trauma, based on venous color Doppler ultrasonography, was 15.8 (17), which is similar to our findings.

In a multicenter study which was conducted in 2011, the relation between the length of hospital stay and chance of DVT was analyzed, and the prevalence was reported to be 20%. This is because the study merely included the critically ill and ICU patients, who suffered from inactivity and disabilities more than the patients of the internal ward did (18).

In a research by Kensuke Fukushima *et al*. on the incidence of deep vein thrombosis in patients undergoing hip arthroscopic surgery in Japan, the mean age of the patients with identified deep vein thrombosis was 62±1 years and the mean age of the patients without deep vein thrombosis was 45.1± 1.7 years, which proved the influence of increasing age on the development of deep vein thrombosis (19). In the present research, the mean age of patients with DVT was 63.26 ± 15.07 years, which is compatible with the results of the mentioned study.

In another study, Gregory Cheng et al investigated the incidence of deep vein thrombosis in patients at a hospital in Hong Kong, China as well as the impact of prophylaxis. In the mentioned study, 3938 Doppler ultrasounds studies had been performed to diagnose deep vein thrombosis. Deep vein thrombosis had been diagnosed in 687 patients and about 17.45% of patients had been confirmed to have DVT. This rate is approximately equal to the one reported in the present study which proves the use of similar diagnostic criteria.

Furthermore, in the mentioned study, 63% of patients with confirmed deep vein thrombosis had been afflicted with this complication during hospitalization that shows the impact of the length of hospital stay on deep vein thrombosis (20) and it was confirmed in the present study as well.

In another research in Iran, which focused on risk factors of thromboembolism, age over 40 in 45%, long-term inactivity in 29%, childbirth in 28%, surgery in 16%, and history of previous thromboembolism in 16% of the patients with thromboembolism were reported (21). Gregory Cheng, *et al.* in a research done in 2010 in Hong Kong, reported risk factors such as old age in 40%, infection in 21%, heart disorders in 13%, and brain stroke in 7% of the patients with VTE. Also, the prevalence of DVT in people over 64 was reported to be 21% (20).

In another research done by Hotoleanu, *et al.* in Romania, patients were divided into the three groups of low, medium, and high probability of developing DVT, based on Wells criteria. The prevalence of DVT in these groups was 14.63%, 50%, and 70 %, respectively. The prevalence in the low probability group is quite close to the prevalence reported in our study (17.4). This shows that their studied patients did not have a proper screening in order to be referred to Doppler ultrasonography (22).

In a study conducted by Paul D. Stein, *et al.* in the US, similar to the findings of our study, it was found that age is a significant DVT risk factor (23). Also, in studies related to trauma and DVT, similar to the findings of our study, trauma has been reported as a significant DVT risk factor (24, 25). In addition, in studies focused on the effect of history of previous DVT on developing DVT, the DVT history has been claimed to be an effective factor in developing this disease for the second time, which is in accordance with the findings of the present study (26, 27).

Limitations

The present study had two main limitations. The main limitation of this study, with regard to the use of hospital records, was that the records were incomplete and in some cases illegible. The second limitation of this study was the Berkson's bias, which made it impossible to generalize the results to all patients with venous thrombosis since the hospital samples were used for comparison.

Conclusion

In the present study, from the 357 Doppler ultrasonography orders, only 62 cases resulted in lower limb DVT diagnosis, which is equal to 17.6%. It seems that the number of Doppler ultrasonography orders is relatively high, because if the patients had been clinically examined properly and more attention had been paid to the clinical symptoms and proper examination of the patients regarding the chances of VTE, the ratio of confirmed DVT cases to the number of Doppler ultrasonography orders should have been higher. Therefore, it is recommended that more attention be paid to the clinical examinations of patients and Wells criteria before ordering venous Doppler ultrasonography, so as to avoid ordering unnecessary para clinical services, which can reduce the costs imposed on the government and patients and also lessen the hospitalization length due to para clinical services. Furthermore, more effective education and training of primary care physicians regarding Wells criteria assessment is suggested.

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Conflict of interest

None

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