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Impact of point-of-care ultrasound on disposition time of patients presenting with lower extremity deep vein thrombosis, done by emergency physicians

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ABSTRACT

Background: Point-of-care venous compression ultrasound (VCU) is highly accurate in deep vein thrombosis (DVT) diagnosis; however, waiting to perform this exam by radiologists, may cause delay in patients' disposition.
Objective: To compare the effect of point-of-care VCU on patients' disposition time, done by emergency physician versus radiologists.
Methods: A total of 50 patients suspected of having lower extremity DVT, were randomized into 2 equal groups and they underwent a point-of-care VCU performed either by an emergency physician (emergency medicine (EM) group) or a radiologist (radiology group). The mean time of patients' disposition and management were compared between the two groups.
Results: The EM group consisted of 16 males and 9 females while the radiology group consisted of 13 males and 12 females. The median time elapsed from triage to performing ultrasonography and the median time elapsed from triage to final disposition were significantly lower in the EM group than those in the radiology group (50 min vs. 142 min, and 69 min vs. 260 min, respectively; $p < .001$). The final diagnosis was confirmed to be DVT in 14 patients (56%) in the EM group and in 17 patients (68%) in the radiology group ($p = .38$). There was no false positive or negative diagnosis.
Conclusions: Performing VCU in patients suspected of having DVT by a trained emergency physician could significantly reduce the time of patients' disposition in the emergency setting.

1. Introduction

Events related to venous thromboembolism (VTE) is the leading cause of mortality and morbidity in adults. In 1845, Virchow explained 3 factors involving in deep vein thrombosis (DVT) formation: 1) Stasis, 2) Vascular injury and 3) Hypercoagulability state.[1]

DVT has a prevalence rate of 2.5–5% in adults in the United States. Based on the latest statistics (in 1994), the annual rate of its incidence is 5.3 cases per each 10000 hospital admissions. The mortality rate of VTE is reported to be near 2.2% in adults. In the most studies, VTE has been shown to be distributed equally between genders.[2]

In cases where DVT diagnosis has been made incorrect or delayed, it could be accompanied by a catastrophe.[3] Lots of DVT diagnosis is made in the emergency department (ED). In a review article, it has been recently declared that 236000 DVT cases were referred annually to the ED between 1997 and 2006.The authors concluded that the prevalence of DVT was increased. In the meantime, in the ED, ultrasound (US) was used in DVT diagnosis not too frequently and this rate did not change significantly within years.[4] In the most recent years, performing US by emergency physician (EP)s has gained acceptance in diagnosis of DVT.[5,6]

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US is a reliable, simple and noninvasive modality in diagnosing DVT. EPs showed that US is an accurate and fast imaging modality helping them in DVT diagnosis in the emergency setting.[5] Beside this wide acceptance,[7] performing US as a standard choice in DVT detection, still seems controversial. Limited US is the most useful tool in DVT diagnosis.[1] Direct venous compression ultrasound (VCU) is the most sensitive diagnostic tool in DVT and color Doppler US can show more detailed data from the venous structure and its opening.[8,9]

The evidence up to now, shows us that sending patients suspected of having DVT to the radiology department, in order to do the US exam, can delay the correct diagnosis. This problem leads to more elapsed time, expense, complications and morbidity and mortality.[10]

In the United States, most emergency medicine (EM) residents are trained in performing bedside US exam in the diagnosis of different diseases. In a recent study, it was found that lower extremity US exam by EPs had a perfect diagnostic value (90%).[11] These results approved the US training courses in the EM field as a core part of curriculum.

In this study, we decided to evaluate and compare the effect of point-of-care VCU on patients' disposition time, done by EP versus radiologists.

2. Materials and methods

This study was a randomized clinical study considering CONSORT guideline. Patients suspected of having DVT who were admitted to the ED of Shariati hospital (a tertiary referral center with an annual volume of 30000–40000 visits in the ED) within 12 months (2015), were enrolled in our study based on their clinical signs (using Wells score (entire leg swollen, nonvaricose vein, asymmetric calf swelling, pitting edema …). The study enrollment was open 24 h a day. The inclusion criteria were age older than 18 years old, giving consent to participate in our study and having clinical signs of lower extremity DVT within the previous month. The exclusion criteria were upper extremity suspicion of DVT, previous diagnosed DVT by a documented US exam and past medical history of old DVT.

Before enrolment, a 6-hour-training workshop was held by the chief investigator (EM attending physician) for all EM residents. They passed a 2-month-pilot course on real patients in order to gain enough experience and skill in normal and abnormal (DVT) VCU.

All patients clinically suspected of having DVT, were randomly divided in to 2 groups based on their patient IDs; in group 1 patients underwent VCU by the EM residents in the ED (EM group) and in group 2 patients underwent VCU by the radiologist residents in the ED (radiology group). Finally, 5 chief (PGY3) EM residents and 3 PGY2 radiology residents did all the US exams on patients. Informed written consent was taken of all patients and the whole process was explained to them. Our sampling method was convenient sampling and we used block randomization. Point-of-care VCU was done by Sonoace X8, Medison (Medison Company, South Korea). The linear high frequency US probe was used. All patients in the both groups underwent US exam in the ED.

The triage time was considered zero because all our patients were visited by the triage nurse at the time of arrival at the ED. The mean time of medical visit, US diagnosis and disposition from the triage time were recorded in both groups. The disposition time was the time of either discharging patients or admitting them to other special services.

Standard point-of-care VCU (scanning common femoral, superficial femoral and popliteal veins) (3-point VCU) was done based on previous guidelines.[12,13] Both specialties performed the same protocol and only vein compressibility was assessed. If DVT was not confirmed by VCU, routine US exam with linear probe was performed to find other diagnosis like cellulitis. The method and the training course used for this purpose were not our study goals. Below knee DVT was not evaluated by 3-point VCU thus we did not focus on its diagnosis in our study and we reported its number under the category of “undetermined edema”.

In both groups, all patients whose DVT diagnosis was determined, received appropriate treatment (anticoagulant) but the ones whose DVT diagnosis was not confirmed, were discharged from the ED if there were no other admission indications. If other diagnosis were suggested by US exam except DVT and patients also had some admission criteria, they were admitted to other special services and received appropriate treatment. In the EM group, all the patients with positive VCU results underwent VCU exam by the radiologist too. All the discharged cases underwent the follow-up VCU exam by the radiologist one week later.

The study did not cause any additional charges for patients except their routine admission expenses. All patients signed the consenting letter to participate in our study and the study was approved by the Ethics Committee of Tehran University of Medical Sciences. The IRCT registration number is IRCT2016101229220N2.

3. Primary and secondary outcomes

Our primary outcome was comparing the disposition time between the two groups. Our secondary outcomes were determining and comparing demographic data, the time of patients' waiting in the ED and the compatibility rate of DVT diagnosis in both groups. We only aimed to evaluate femoral and popliteal veins.

4. Statistical analysis and sample size calculation

All data were extracted from patients' files and they were analyzed by SPSS USA, v. 22. Based on Theodoro et al. study, the disposition time between the two groups had a difference of 125 min.[14] By considering $\alpha = 0.05$ and $\beta = 0.9$ and standard deviation of 10 min, we calculated a sample size of 15 patients in each group, but we considered 25 for better precision.

$$n = \frac{2\left(Z_{1-\alpha/2} + Z_{1-\beta}\right)^2 \sigma^2}{d^2}$$

$$d = \frac{|\overline{X}_1 - \overline{X}_2|}{\sigma}$$

Data are presented as mean values, proportions or median and Interquartile range (IQR). Variables were tested for normality (Shapiro-Wilks test) before analysis. Analytical statistical tests included the unpaired, two-tailed *t*-test for continuous normally distributed data and the Mann–Whitney *U* test for non-normal and ordinal data. The chi-square and Fisher's exact tests were used to compare proportions of the qualitative variables. The level of significance was 0.05.

5. Results

We evaluated 25 patients in each group. In the EM group, there were 16 males (64%) and 9 females (36%). In the radiology group, there were 13 males (52%) and 12 females (48%). The mean age range of patients in the EM group was 53.9 ± 14.1 and in the radiology group was 56.8 ± 16.0 years old. Demographic data are shown in Table 1. All patients had a standard clinical examination. Patients' clinical manifestations are shown in Table 2.

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