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Facilitating the Diagnostic Process of the Patients with Complaint of Acute Limb Swelling in Emergency Room; a Brief Report

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Abstract

Introduction: Limb swelling is among the frequent complaints of patients referring to the emergency room (ER).

Objective: We decided to take a step towards facilitating the diagnostic process of patients who refer to ER with such complaint, and find out whether emergency medicine physicians (EMPs) can play an effective role in this regard.

Methods: This was a diagnostic accuracy study in which all patients who referred to the ER with a complaint of unilateral leg swelling were studied. The patients underwent bedside sonography by the researchers, who were emergency medicine physicians (EMPs), and also underwent a second sonography by the in-charge radiologist using the same device and probe. The accuracy of the diagnoses made by researchers was evaluated using the radiologists' opinion as the gold standard.

Results: In this study, the data of 52 patients were analyzed. In general, the agreement rate between the EMPs and radiologists was 0.863, which indicates a proper agreement. Based on the findings, Kappa agreement for the four differential diagnoses ranged from 0.639 to 0.919 and the AUC was between 0.750 and 0.976.

Conclusions: In this study, the overall agreement between the EMPs and radiologists was appropriate.

Key words: Acute; Edema; Emergency Room; Extremities; Point-of-Care Testing

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INTRODUCTION

Limb swelling is among the frequent complaints of patients referring to the emergency department (ED), which can be the result of an acute or chronic illness. Its acute form is usually more worrying for patients and leads them to visit an ED. The cause of acute limb swelling is simple edema, cellulitis, collection, or deep venous thrombosis (DVT) most of the time (1). Although the clinical presentations of DVT and cellulitis can be similar, their management is completely different. Cellulitis may progress to sepsis, while DVT can lead to pulmonary embolism, which can be fatal, or chronic post-thrombotic syndrome, which can be debilitating (2). The presence of emergency medicine specialists in most referral hospitals and their rapid attendance to the patient in the ED can be of great help in accelerating the decision-making process for many patients, including patients with limb swelling. At present, when a patient enters the ED with complaint of unilateral limb swelling, the course of management begins with multiple tests, soft tissue ultrasound by a radiologist, symptomatic treatment of the patient and sometimes limb x-rays. Therefore, a considerable amount of time and money is required for diagnosis and treatment of the disease (3).

In the present study, we decided to take a step towards facilitating the diagnostic process of patients who refer to ED with complaint of acute limb swelling, and find out whether emergency medicine physicians (EMPs) can play an effective role in this regard.

Methods

This was a diagnostic accuracy study in which all patients who referred to the ED of Imam Hossein Medical Center in Tehran, Iran, from October 2016 until February 2017 with a complaint of unilateral swelling of the lower limbs were studied. No age or sex restrictions were imposed. If any proof regarding the diagnosis was available on admission or in case of discharge against medical advice from the hospital, the patient was excluded.

Participants were selected using convenience

sampling during the shifts of the researchers (one PGY-3 emergency medicine resident who had been previously trained in superficial ultrasound and whose qualifications had been approved by professors of radiology and emergency medicine as well as an emergency medicine attending physician) in the ED.

The eligible patients underwent bedside sonography performed by the researchers using a linear probe for 2D imaging, which had a wide printer (footprint) with a center frequency of 2.5-12 MHZ. This probe can be used for various purposes including vascular tests and measuring body fat thickness. The patients underwent a second sonography by the in-charge radiologist, with the same device and probe. The accuracy of the diagnoses made by researchers was evaluated using the radiologists' opinion as the gold standard. We also calculated the time from admission until performance of bedside sonography and reaching a diagnosis by EMPs, and also from admission until the sonography report was written by the radiologist. Then we compared both the final diagnosis and the time it was reached.

The ethical principles and confidentiality of information were observed during collection and analysis of the information and presentation of the results and reports. The purpose of the study was explained to all patients in a comprehensible manner and written consent for entering the study was obtained from them. The necessary permits for conducting research was received from the ethics committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.MSP.REC.1395.231).

In this study, statistical analysis was done using SPSS-22, evaluating Kappa agreement coefficient and performing ROC curve analysis tests.

Results

In this study, the data of 52 patients were analyzed, 36 (69.2%) of which were male. The mean age of the patients was 51.9 years (SD=16.8). Based on radiologists' diagnosis, 31 patients (59.6%) had cellulite, 10 patients (19.2%) had simple edema, 6 patients (11.5%) had DVT, and 5 patients (9.6%) had collection.

All cases of edema and cellulite were correctly diagnosed by the EMPs; while in terms of diagnosis of collection and DVT, EMPs truly diagnosed 80% and 50% of the cases, respectively, and missed the others. In general, the agreement rate between the EMPs and radiologists was 0.863, which indicates a proper agreement.

Table 1 shows the details of agreement between EMPs and radiologists (gold-standard) and accuracy of the diagnosis. Based on the findings, Kappa agreement for the four differential diagnoses ranged from 0.639 to 0.919 and the AUC was between 0.750 and 0.976. Considering the diagnosis of radiologists as the gold standard, the sensitivity of EMPs for diagnosis of edema, cellulite, collection and DVT via bedside sonography was 100, 100, 80 and 50 percent, respectively.

The time interval between patient's admission and the delivery of radiologists' report regarding their diagnosis was between 1.5 to 740 hours and its average was 72.30 hours (SD=150.96); while, it took the EMPs less than 30 minutes from admission to perform the bedside sonography and make a diagnosis ($p < 0.001$).

Discussion

The results of the present study indicated that we can trust the results of sonography performed by EMPs regarding edema and cellulite. But when it comes to diagnosis of collection and DVT, there are still missed diagnoses.

In systematic reviews previously conducted on the accuracy of sonography performed by EMPs in diagnosis of DVT, sensitivities of 95.0 and 96.1%, and also specificities of 96.0 and 96.8% have been reported (4, 5). It seems that wider use of bedside sonography by EMPs might increase the rate of early diagnosis of DVT, which can lead to early

Table 1: Agreement rate between emergency medicine physicians (EMPs) and radiologists (gold-standard) and EMPs' accuracy of diagnosis

Diagnosis			Radiologists		Kappa	AUC	Sensitivity	Specificity	PPV	NPV
			P	N		(95% CI)				
Edema	EMPs	P	40	0	0.885	0.976 (0.890, 0.99)	100 (69.2, 100)	95.2 (83.8, 99.4)	83.3 (51.6, 97.9)	100 (91.2, 100)
		N	2	10						
Cellulitis		P	19	0	0.919	0.952 (0.855, 0.992)	100 (88.8, 100)	90.5 (69.6, 98.8)	93.9 (79.8, 99.3)	100 (82.4, 100)
		N	2	31						
Collection		P	47	1	0.879	0.900 (0.785, 0.966)	80.0 (28.4, 99.5)	100 (92.5, 100)	100 (39.8, 100)	97.9 (88.9, 99.9)
		N	0	4						
DVT		P	46	3	0.639	0.750 (0.611, 0.860)	50.0 (11.8, 88.2)	100 (92.3, 100)	100 (29.2, 100)	93.9 (83.1, 98.7)
		N	0	3						

EMPs: emergency medicine physicians; P: Positive; N: Negative in retest; EM: Emergency medicine; CI: Confidence interval; AUC: Area Under an ROC Curve; PPV: Positive predictive values; NPV: Negative predictive values

initiation of anticoagulation therapy and prevention of future complications such as pulmonary thromboembolism (6).

On the other hand, the limited and short training of EMPs in performing sonography might have led to the intermediate diagnostic accuracy, and therefore the sensitivity and specificity of the diagnoses made by EMPs being insufficient to rule out/in the diagnosis of DVT (7). In the current study, the accuracy of performed sonography by EMPs in terms of diagnosis of DVT was 75%, which was lower than the accuracies reported in previous similar studies, such as the one performed by Garcia J et al., in which ultrasound of the lower extremity performed by EMPs had a sensitivity of 93% and a specificity of 90%, with an accuracy of 92% (8).

In this study, although the time EMPs took to reach a diagnosis was significantly shorter than that of the radiologists, there were errors that cannot be ignored. On the other hand, if the existing inadequacies are eliminated, proper management of these patients will undoubtedly be possible by spending less time in the ED. The solution is to increase the experience and skills of EMPs in this field.

Limitations

The experience of the EMPs who participated in this study was not the same and this might have affected the results. Regarding the time variable, it should be noted that the researchers might have inadvertently paid more attention to patients with complaint of acute limb swelling, trying to take care of them as soon as possible.

Conclusions

In this study, the overall agreement between the EMPs and radiologists was appropriate. Although, EMPs were 100 percent accurate in making the diagnosis of edema and cellulite via bedside sonography, when it came to diagnosis of collection and DVT, there were missed diagnoses by EMPs. Including the topic of lower extremity ultrasound in curriculum of emergency medicine residency programs as one of the necessary training courses would be helpful in improving the experience and skill of EMPs.

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Authors' contribution

All the authors met the standards of authorship based on the recommendations of the International Committee of Medical Journal Editors.

Conflict of interest

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