Original Article

Diagnostic values of bedside ultrasonography for vascular injury in cases admitted to Emergency Department with blunt limb trauma

Saeid Abbasi[1], Anahita Rezai[2], Mahdi Rezai[1], Babak Mahshifar[1], Davood Farsi[1], Peyman Hafezimoghadami[1], Mani Mofidi[1], Leila Azizkhani[3,*]

[1]Associate Professor, Emergency Medicine Management Research Center, Iran university of Medical Sciences, Tehran, Iran, [2]Trauma and Injury Research Center, Iran University of Medical Sciences, Tehran, Iran, [3]Assistant Professor, Department of Emergency Medicine, School of Medicine, Kurdistan University, Sanandaj, Iran.

Correspondence: Leila Azizkhani, Assistant Professor, Department of Emergency Medicine, School of Medicine, Kurdistan University, Sanandaj, Iran. E-mail: Leila433@gmail.com

ABSTRACT

Background: Vascular duplex ultrasound is a noninvasive and rapid bedside assessment tool in Emergency Department (ED). The aim of present study was to determine the diagnostic value of vascular bedside ultrasonography in patients admitted to ED with blunt limb traumas. Methods and materials: In this observational study that was performed as a diagnostic survey, 103 consecutive subjects with limb trauma admitted to two academic EDs in 2017 were enrolled. The diagnostic values of bedside duplex ultrasonography were determined. The standard criterion was CT-angiography. Results: The bedside ultrasonography done by emergency medicine attending showed vascular injury in 23 patients (22.3%). The CT-angiography reports were positive for injury in 26 cases (25.2%). There was significant association between results of bedside ultrasonography and reports of CT-angiography (P<0.001). The sensitivity and specificity were 88.5% and 100%, respectively and the diagnostic accuracy was 97.1%. Conclusion: We concluded that a diagnostic value of bedside ultrasonography in cases with blunt limb trauma seems to be reliable and use of this method is applicable for detection of vascular damages.

Keywords: Diagnostic value, Bedside ultrasonography, Limb trauma, vascular injury.

Introduction

Trauma is the leading cause of death among people aging from 1 to 44 years, worldwide [1]. Massive burden is imposed to health care systems and governments due to high occurrence of mortality and morbidity [2, 3]. A quick, rapid and precise definite diagnosis would result in better therapeutic strategies [4-6]. The diagnostic methods are starts from clinical history, physical exams, and para-clinic assessments such as laboratory tests and imaging studies [7-10]. Appropriate and suitable usage of these diagnostic modalities is related to the general conditions of patients, their vital signs, and presence of important injuries such as vascular damages [11-13].

The more accurate and faster diagnosis and treatment would be life or limb saving in cases with severe injuries of vessels [13-16]. Vascular injuries are occurred in about 3% of all traumatic patients [6], one percent of limb injuries with long bone fractures and in 16% of cases with knee dislocation, thus misdiagnosis may lead to devastating outcome [17], in such a cases shock index can has predictive value in patients with multiple traumas and can be used in the initial assessment and management of patients before any other diagnostic [18]. It is important that paying more attention to traumatic injuries in young patients, the most active potential forces of our society, be in the priority [19]. In this matter, some markers are helpful to be potent prognostic factors as predictors of mortality such as serum levels of lactate, bicarbonate and glucose [20]. Imaging methods are among these

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diagnostic methods [17, 21]. Computed Tomography (CT) angiography, Magnetic Resonance (MR) angiography and duplex ultrasound have been proposed as valid diagnostic modalities in recent years [15]. Ultrasonography is more feasible and non-expensive leading to more applicability [17, 22]. In certain studies, duplex ultrasound had high sensitivity (95–97%), specificity (95–98%), and accuracy (98%) in assessment of peripheral vascular injuries [15, 16]. The aim of this study is to explore the diagnostic value of duplex ultrasound in diagnosing extremity vascular injuries in trauma patients

Materials and Methods

In this observational study that was performed as a diagnostic survey, 103 consecutive subjects with blunt limb trauma was enrolled the study. The patients admitted to two academic Hospitals in 2017. This study was approved by ethic committee of Iran University of Medical Sciences. Informed consent was obtained from all of the participants.

The trauma patients over 18 years old with suspected vascular injury in upper or lower extremities were entered the study between February 2017 and December 2017.

Inclusion criteria included patients over 18 years that had suffered from upper and lower extremity trauma associated with pain, tenderness or swelling. Exclusion criteria included patients requiring emergency procedures, and refused to sign the consent form.

In this study, bedside duplex ultrasonography was performed by trained board certified emergency medicine attending. The results of ultrasound were compared with radiologist CT angiography reports. The vessels of trauma limb were examined by duplex ultrasound to find out probable injuries seen in blunt limb trauma such as partial or complete vascular occlusion, arterial dissections, vascular disruption, and intimal flaps. The vessels (arteries and veins) of injured limb were scanned with B-mode and then color duplex ultrasound.

The standard criterion for vascular injury was computed tomography angiography reported by radiologist attending who was blinded to ultrasound report.

All participants underwent an ultrasound examination using a portable SonoSite Edge II ultrasound machine with 7.5-10 MHZ linear probe.

Statistical analysis

Data analysis was performed using SPSS version 18.0 software (Statistical Procedures for Social Sciences; Chicago, Illinois, USA). Chi-Square, independent t, and Fisher-Exact tests were used. Level of significance was considered less than 0.05. The sensitivity, specificity, and accuracy for bedside ultrasonography were calculated in comparison with radiologist CT-angiography reports as a gold standard using two by two tables and related formulas.

Results

The mean age in patients was 35.3 ± 14.5 years old ranging from 9 to 73 years. Among them 85 patients (82.5%) were male. The car accident was the most common trauma mechanism (82.5%) followed by falling from height (13.6%). The location of injuries was as follow: lower right extremity (38 cases, 36.9%), lower left extremity (28 cases, 27.2%), upper right extremity (21 cases, 20.4%), upper left extremity (13 cases, 12.6%) and in three trauma patients more than one limbs had injured. Among patients, 94 bone (91.3%) fractures were seen.

The bedside ultrasonography was done by emergency medicine attending showed injury in 23 patients (22.3%). The CT-angiography was positive for vascular damage in 26 cases (25.2%). There was significant association between results of bedside ultrasonography and reports of CT-angiography ($P<0.001$). The sensitivity and specificity, positive predictive value and negative predictive value of bedside ultrasonography were 88.5%, 100%, 100% and 96.3% respectively and the diagnostic accuracy was 97.1%.

Table 1. The diagnostic values of bedside ultrasonography in comparison with CT angiography

Variable		Bedside Ultrasound		Total
		Positive	Negative	
Report of CT Angiography	Positive	23	3	26
	Negative	0	77	77
Total		23	80	103

Discussion

Although duplex vascular ultrasound is often underused in ED, it does have the advantages of being easily accessible, noninvasive, and rapid bedside assessment tool. In this study the diagnostic value and sensitivity of bedside ultrasonography was determined in cases with limb trauma admitted to two university hospitals and it was found that diagnostic value of bedside ultrasonography is acceptable for diagnosis of vascular injuries. In Johansen et al study [21], 100 patients were assessed and the sensitivity and specificity of ultrasound were 95 and 97 percent, respectively which was similar to our findings. Lynch and colleagues [23] reported the sensitivity and specificity of 87 and 97 percent, respectively for bedside ultrasonography. Kuzniec et al [24] reported 90.5 and 100 percent for sensitivity and specificity respectively for bedside ultrasonography and the accuracy was 96.1 percent in their study which was similar to our findings too.

Schwartz et al [25] reported 75 percent diagnostic accuracy which was less than above studies [18, 23, 24]. However, they reported also good prognostic ability for bedside ultrasonography. This matter was not assessed in the present study due to the cross-sectional design of our study. Gagne and colleagues [26] reported good diagnostic accuracy of 88 percent for bedside ultrasonography in venous injuries but it was less in arterial injuries. We did not assess the difference between arterial and venous injuries. In contrast to findings of our study and the majority of mentioned studies, Mollberg et al [27] identified only

4.9% of vascular injuries on duplex ultrasound. These differences may be due to various enrollments of patients in different studies.

The progress in the field of imagining start many years ago, and advanced technology, the use of emergency ultrasonography is extended a lot. The term 'Focused Assessment with Sonography for Trauma was coined by Rozycki et al. in 1996 and it is fundamental to improve this technique and must be more focused to prevent other complications [28].

In conclusion, vascular injuries may be hidden from eyes of emergency physicians and especially trauma care physicians and they should be aware of the advantages of ultrasound and should receive appropriate training courses for better managing of trauma patients. Based on our results, it may be concluded that diagnostic values of bedside ultrasonography in cases with limb trauma seems to be reliable and use of this method is applicable for detection of vascular damages. Ultrasound could achieve better patient care and clinical decision making. However further studies with larger sample size and multi-center sampling with consideration of other contributing factors should be carried out to attain more definite outcomes.

Conclusion

According to the results of the study, it is concluded that a diagnostic value of bedside ultrasonography in cases with blunt limb trauma seems to be reliable and use of this method is applicable for detection of vascular damages. But further studies are necessary to evaluate in detail using large sample size.

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Conflict of interest

The authors declare that there is no conflict of interest in this study.

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