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ORIGINAL ARTICLE

A Comparative Analysis of Diagnostic Accuracy of Focus Assessment with Sonography for Trauma Performed by Emergency Medicine Residents and Radiology Residents

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ABSTRACT

Background:
In Iraq, trauma is one of the primary causes of death. The abdomen is one of the most sensitive body areas to such injuries. Focus Assessment with Sonography in Trauma(FAST) is a noninvasive bedside method for detecting free fluid in the peritoneal and pericardial cavity.

Objective:
To assess the accuracy of free fluid diagnosis in the peritoneal cavity utilizing FAST scan conducted by Emergency Medicine physicians versus. Radiologists

Patients and Methods:
A prospective observational diagnostic accuracy research comparing FAST scan reports from emergency medicine residents versus radiology residents in the emergency department was conducted.Characteristics such as sensitivity, specificity, positive predictive value, and negative predictive value were used to compare the accuracy of the two groups by comparing them to CT scan reports and the patient's clinical status, which were considered the gold standard for diagnosing free fluid.

Results:
The sensitivity of emergency medicine residents in detecting free fluid in the abdomen by using FAST was 82% compared to 100% in radiology residents. The specificity of emergency medicine resident was 98.6% similar to that of radiology residents. We also found that there is a substantial level of agreement between both groups (Kappa= 0.789).

Conclusion:
Emergency Medicine Residents were able to execute FAST on patients with blunt abdominal trauma with excellent accuracy. We conclude that FAST scans performed by emergency medicine residents had acceptable diagnostic results

***Keywords**: Abdominal blunt trauma, FAST scan, Emergency medicine*

1. Introduction

Trauma is one of the leading causes of death in Iraq. In 2016, *Chitheer A* reported that Injury deaths are the second cause of death in Iraq; and the mortality rate from trauma has increased by 61% since 1990.[1] Erbil province is considered one of the best cities at providing adequate healthcare in both Kurdistan Regional Government and Iraq. In a study conducted in Erbil from 2007 to 2011, it was reported that the most common cause of death was from accidents and injuries, accounting for 29.1% of all deaths in this region. Among all types of injuries, death from burns, road traffic accidents and bullet injuries constituted 83.7%.[2]

One of the main body parts vulnerable to such injuries is the abdomen. There is a higher risk of mortality in blunt abdominal trauma than penetrating injuries due to the fact that multiple major intra-abdominal organs such as the liver, the spleen and the kidneys are commonly involved in a blunt abdominal trauma.[3,16] Therefore, prompt diagnosis and management is crucial for better outcome and lesser mortality rate.

Focus Assessment with Sonography in trauma (FAST) is a rapid, noninvasive bedside modality designed to detect free fluid in the peritoneal and pericardial cavity. It is a valuable tool for primary assessment of blunt abdominal trauma to provide significant information in a short period of time.[4-7,12] (FAST) assists in triaging patients for further radiological evaluation or surgical intervention depending on hemodynamic status of the patient.[8] Studies have shown that by using FAST in the Emergency Department time for appropriate intervention is reduced by 64%–76%, the requirement for computed tomography (CT) scanning declines, and complication rates and length of hospital stay decreases.[4,9] (FAST) is an operator-dependent approach, meaning the skill of the operator is crucial for accurate diagnosis. Numerous studies have concluded that trained non-radiologist physicians are competent to perform a convenient FAST scan as accurately as qualified radiologists.[10-12,15] On the contrary, some radiologists have objected to non-radiologist performed sonography stating that a good amount of knowledge and experience is required to perform an accurate FAST in trauma patients.[13,14] The aim of this study is to compare accurate diagnosis of free fluid in the peritoneal cavity using FAST scan performed by Emergency Medicine physicians vs. Radiologists.

2. Methodology

This was a prospective observational diagnostic accuracy study, that compared FAST scan reports from emergency medicine residents versus radiology residents in the emergency department. This research was carried out at Rojawa Hospital in Erbil, Iraq, in a period of three months between June 2022 and August 2022. Verbal informed consent was obtained from the patients. Adults with blunt abdominal trauma and trauma mechanisms linked to high-risk injuries were eligible. The emergency residents performed FAST scans on trauma patients during the primary survey. The patient was examined in supine position with both arms abducted. Both the emergency medicine residents and the radiology residents had received adequate training in performing FAST scans as part of their residency curriculum. During the FAST scan, four standard views (Hepatorenal, splenorenal, suprapubic and pericardial) were obtained by the emergency medicine residents then the patients were transferred to radiology department to repeat the FAST scan by a radiology resident. FAST scan is used to look for intraperitoneal free fluid. A FAST scan was considered negative if there was no fluid present in the peritoneum and positive if there was fluid in the peritoneum. Patients with pericardial effusion were excluded and treated separately. Penetrating abdominal trauma and patients on whom FAST scan would delay immediate management were excluded. For the confirmation of the diagnosis three methods were used (CT scan, clinical observation, laparotomy). Patients who were highly suspected to have a positive intraperitoneal fluid even with a negative FAST scan and patients with a positive FAST scan were sent to CT scan for confirmation of the diagnosis. Patients who were hemodynamically stable were kept under observation for 8 hours to confirm the diagnosis. We also collected some baseline data like: age of the patient, mechanism of injury (motor vehicle collision, pedestrian struck, cyclist struck, Fall from a height. Physical assault) and physical condition on admission and 8 hours after presentation.

Statistical analysis: Statistical package of social sciences (SPSS) Version 25 software (SPSS, Chicago, IL, USA) was used to calculate characteristics such as sensitivity, specificity, positive predictive value, and negative predictive value. Chi square test was used for comparison. The diagnostic agreement between the FAST scan reports of the two groups of residents was determined using Kappa score. P value < 0.05 was considered statistically significant.

3. Results

The number of patients identified as eligible for this study was 80. The mean age of patients was 29.1 ±11.35 years (Range: 14-73). The most prevalent mechanism of injury was motor vehicle collision in 50 cases (62.5%). On admission, 68 (85%) patients were hemodynamically stable and only 12 (15%) patients were hemodynamically unstable. The cases were kept under observation for 8 hours. After 8 hours 71 (88.8%) patients were hemodynamically stable while 8 (7.5%) patients were hemodynamically unstable and 3 (3.8) patients passed away during this time period. In 10 (12.5%) hemodynamically unstable patients with high suspicion of a positive peritoneal fluid, FAST results were positive. CT scan was done to confirm the diagnosis. On the other hand, 69 (86.3%) hemodynamically stable patients with low suspicion of positive peritoneal fluid were kept under clinical observation for 8 hours to confirm the diagnosis. Only one (1.3%) patient underwent laparotomy to confirm the diagnosis, (**Table 1**).

The CT scan of the abdomen was performed in 10 (12.5%) patients who were hemodynamically unstable and it showed positive findings in only 7 (70%) of them. Out of 69 patients who were hemodynamically stable and kept under clinical observation, the majority (95.7%) did not have positive peritoneal fluid. The comparison between FAST scans performed by Emergency medicine residents and Radiology residents against the CT scan with no significant difference between both groups of physicians in reporting the findings , ($P>0.05$), (**Table 2**).

The sensitivity, specificity, Positive predictive value, negative predictive value for FAST performed by emergency medicine residents and radiology residents were calculated for each group of physicians against the CT scan findings. The results of FAST scans performed by these two groups of physicians were compared to the confirmed diagnosis and the results are shown in (**Table 3**).

There was no statistically significant difference between the reports of the two groups of physicians ($P>0.05$). Furthermore, there was an substantial agreement level between emergency medicine residents and radiology residents in reporting FAT findings, (Cohen's kappa= 0.789 substantial agreement), with percent agreement of 95%, ($P <0.001$). (**Table 4**).

Table 1. Description of the baseline characteristics of the study

Variable		Value
Age (year)	Mean ± SD	29.1 ± 11.35
	Median	25.5
	Range	14 - 73
Mechanism of injury No. (%)	Motor Vehicle Collision	50 (62.5%)
	Cyclist struck	2 (2.5%)
	Pedestrian struck	6 (7.5%)
	Fall from a height	19 (23.8%)
	Physical assault	3 (3.8%)
Hemodynamic status on admission No. (%)	Stable	68 (85%)
	Unstable	12 (15%)
Hemodynamic status after 8 hours No. (%)	Stable	71 (88.8%)
	Unstable	6 (7.5%)
	Passed away	3 (3.8%)

Table 2. Comparison of FAST scan reports and CT findings in the studied sample

	Ultrasound Findings					
	EMR		Total	RR		Total
CT scan Finding	Positive	Negative		Positive	Negative	
Positive	9	2	11	11	0	11
Negative	1	68	69	1	68	69
Total	10	70	80	12	68	80

EMR, Emergency medicine resident; RR, Radiology resident
Fisher exact test (two tailed) = 1.00, P. value = 0.542 not significant

Table 3. Validity parameters of diagnostic accuracy of focus assessment with sonography by emergency medicine physician and radiologist

Validity parameter	Emergency Medicine Physician	Radiologist
Sensitivity	82.0%	100.0%
Specificity	98.6%	98.60%
Accuracy	96.3%	98.8%
PPV	90.0%	92.0%
NPV	97.1%	100.0%

PPV: Positive predictive value, NPV: Negative predictive value

Table 4. Agreement between EMR and RR in the results of FAST

	RR-performed FAST		
	EMR		Total
EMR-performed FAST	Positive	Negative	
Positive	9	1	10
Negative	3	67	70
Total	12	68	80

EMR, emergency medicine residents; RR, radiology residents
Cohen's kappa= 0.790 substantial agreement, percent agreement = 95%

4. Discussion

This study was conducted to compare the diagnostic value of FAST scan performed by emergency medicine (EMR) and radiology residents (RR). The result of this research shows that in comparison to RR- performed FAST scan ER-performed FAST scan had an acceptable diagnostic value. In order to choose an effective treatment strategy and reduce mortality in patients with traumatic abdominal injuries, quick diagnosis of intraperitoneal fluid is essential. The primary paraclinical methods to assess patients with traumatic abdominal trauma are diagnostic peritoneal lavage (DPL), CT imaging, and FAST. The gold standard is a CT scan, which offers specific information on the wounded organ as well as signs of hemorrhage. Its specificity

is 98% and sensitivity is 88%. [17] FAST is a quick, non-invasive bedside procedure. It cannot completely replace a CT scan, but it is incredibly helpful in the initial assessment of patients with abdominal injuries and could help save time and provide extremely significant information to help with patient care decisions in the emergency department.[18]

The accuracy of FAST conducted by radiologists and non-radiologists has been examined in several earlier investigations. These studies' findings showed that non-radiologists doing FAST had a sensitivity range of 52% to 100% and a specificity range of 96% to 99%. [19-23]

According to certain studies, non-radiologists (NR) and radiologists can both detect hemoperitoneum using the FAST Scan with the same level of accuracy.[13,18-21] The findings of our investigation indicate that trained EMRs can conduct FAST with accuracy that is comparable to RRs. Some studies have specifically evaluated FAST performed by EMRs or emergency physicians. Brenchley et al. reported a sensitivity of 78% and specificity of 99% for FAST performed by UK emergency physicians.[10] Ingeman et al. reported that FAST performed by emergency physicians had a sensitivity of 75%, a specificity of 96% and an accuracy of 91%. [22] In studies conducted in Iran, Zamani et al. reported 84% specificity and 97% sensitivity of fast scan performed by emergency medicine residents. [23] Shojaee et al. reported 60% sensitive and 99% specificity for both RR and EMR-performed FAST scans. In the current study, we discovered a sensitivity of 82% for EMR-performed FAST scan and a specificity of 98.6%. Meanwhile, For RR-performed FAST scan the sensitivity was calculated to be 100% and the specificity 98.6%. Our findings are in line with those of Kakaei et al., who assessed the use of FAST in determining the severity of injuries sustained in the Iran earthquake of 2012 and found that while its specificity increased when carried out by RRs, its sensitivity remained constant (compared to EM and surgery residents). [24] Our study also showed that the level of agreement between EMRs and RRs were substantially good (Kappa=0.789). This finding was comparable with Heydari et al.'s research in which they reported an excellent level of agreement between EMRs and RRs (Kappa= 0.865). Overall, the results of our study are in line with previously conducted studies in Iran and other countries. After receiving training, EMRs were able to execute FAST on patients with blunt abdominal trauma with excellent accuracy. There is a definite need for increased emphasis on teaching as the comparatively poor sensitivity of FAST implies low competence of

ERs in recognizing abdominal free fluid.

Limitations

Emergency medicine residents performed the FAST scan shortly after the patient arrived at the emergency department, during the primary survey. The patients were then transferred to the radiology department. This could have influenced the outcome of the FAST scan. EMRs had more information on the patients and were more involved with them, which could have an impact on how well they performed in FAST. Additionally, we were unable to use CT scan as the gold standard for all patients. Furthermore, larger-sample studies will allow us to better compare the results of FAST scans performed in trauma patients by emergency medicine and radiology residents.

5. Conclusion

In this study, we conclude that FAST scans performed by emergency medicine residents had acceptable diagnostic results. In patients with blunt abdominal trauma, a sufficiently trained emergency medicine resident can perform FAST with high diagnostic value, similar to Radiology residents.

Ethical Approval:

All ethical issues were approved by the author. Data collection and patients enrollment were in accordance with Declaration of Helsinki of World Medical Association , 2013 for the ethical principles of researches involving human.

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