

Evaluation of the accuracy of E-FAST ultrasound in blunt trauma patients referred to the Emergency Department

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Abstract: *Introduction: Trauma is one of the most common causes of death in the world. E-Fast ultrasound can detect the haemoperitoneum, intravenous pneumothorax, and hemothorax. In this study, we evaluated the accuracy of E-FAST focused ultrasound in blunt trauma patients referred to the Emergency Department.*

Methods: In this study 167 blunt trauma patients were included. E-FAST is performed from four standard spaces in terms of free fluid, chest in terms of hemothorax, and pneumothorax. Ultrasound is performed on the trauma patient and the obtained results were compared with the result of the standard gold CT scan test. All patient information including age, sex, mechanism of trauma, patient ISS, E-FAST result, and CT scan result were registered.

Results: Overall, 174 patients were included that 45 (25.9%) of them were females. The mean age of the patients was 38.39±12.31 years. E-FAST had a sensitivity of 66.7 and a specificity of 100% in the diagnosis of hemothorax. Also, a positive predictive value of 100% and a negative predictive value of 99.4% were detected for 120 people in both normal tests.

Conclusion: The results show E-FAST is a suitable alternative to CT scan in the diagnosis of hemothorax, pneumothorax, and free fluid in the abdomen, vulva, and pericardial cavity. Due to portability, safe body, no need for contrast, fast performance, as well as cheapness, and reproducibility, it will be a great help in diagnosing trauma-related lesions and prompt and timely treatment. CT scan should be used only in limited cases and special indications.

Keywords: *E-Fast ultrasound, blunt trauma, accuracy*

INTRODUCTION

Trauma is one of the most common causes of death in the world. Sometimes due to accompanying trauma and distracting pain, our findings in physical examinations are limited. In trauma patients, internal bleeding is life-threatening and requires prompt and timely action [1-3].

E-Fast ultrasound can detect the haemoperitoneum and intravenous pneumothorax and hemothorax. It can be performed in traumatic patients with symptoms of

hemorrhagic shock or evidence of intra-abdominal injury [1]. The features of FAST have led to this practice being adopted as an international standard of care in most developed countries of the world [2].

The benefits of this method can be noninvasive, portable; the low cost can be done in less than 5 minutes, repeatable without the need for radiation and counter, and can be performed by an emergency medicine specialist or surgeon [3-5].

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Studies have shown that E-Fast has a sensitivity of between 99-86% compared to other imaging and diagnostic modalities in the presentation of haemoperitoneum [7]. Laparotomy requires early diagnosis to minimize mortality and morbidity, and FAST can also be a reliable surrogate for CT scans in the diagnosis of intra-abdominal fluid [8-13]. The use of CT is limited due to its high cost and its harms.

In this study, we evaluated the accuracy of E-FAST focused ultrasound in blunt trauma patients.

METHODS

The study was performed on 167 blunt trauma patients referred to the three emergency departments of Baqiyatallah, Shohadae 7th Tir and Imam Hussein Hospital. The statistical population was Multiple Traumatic Blunt Patients and referred to those three emergency departments. E-FAST is performed from four standard spaces in terms of free fluid, chest in terms of hemothorax, and pneumothorax. Ultrasound is performed on the patient's bed and the obtained results are compared with the result of the standard gold CT scan test.

All patient information including age, sex, mechanism of trauma, patient ISS, E-FAST result, and CT scan result are entered in the questionnaire form. In this study, patients are examined for the presence of free fluid in the pelvic abdomen, pericardium, and the presence of free fluid in the pleural cavity on both sides. Patients who are admitted to the emergency room as blunt triage trauma, which includes car accident, motor accident, and fall from a height, and a fight, all-penetrating trauma, were excluded from the study. At the beginning of hospitalization and in the primary survey stage, the E-FAST blunt trauma patients were operated on from the pelvic abdomen and chest (Morrison Patch,

Splenorenal free fluid around the bladder, pericardium, and pleural cavity on both sides).

Its positive and negative results were recorded in a specific form. All patient characteristics by trauma time, "time of visit", age, sex, "trauma mechanism", are recorded in the patient's specific form and patient records.

ISS under 16 is excluded from the study because they do not need a CT scan. Patients with ISS above 16 are visited by a surgeon after the initial procedures. If the patient is hemodynamically unstable and undergoes laparotomy and thoracotomy without a CT scan, the patient's laparotomy and thoracotomy results are compared with the E-FAST result. For other patients, if they had a CT scan of the abdomen and chest, the results would be recorded in the desired form. Finally, only 176 patients who had a CT scan of the abdomen and chest, or a laparotomy and thoracotomy are included in this study. Their results are compared with the E-FAST result

Data presented as frequency, percent, mean and standard deviation. An Independent T-test was used for comparing data between various levels. Finally, accuracies indices such as sensitivity, specificity, positive and negative predictive values were assessed for determining the accuracy of E-FAST diagnostic value compared to CT scan as a standard gold test. P-value <0.05 was considered significant.

RESULTS

Overall, 174 patients were included that 45 (25.9%) of them were females. The mean age of the patients was 38.39 ± 12.31 years. Among the total number of people, 61 (35.1%) referred to pedestrians due to a vehicle accident. The relationship between gender and the mechanism of trauma was statistically significant ($P < 0.001$) (Table 1).

Table 1: Distribution subject respect to the mechanism of trauma and sex

		Mechanism of trauma						Total	
		Car accident	Vehicle accident with pedestrians	Car overturning	Falling from a height	Falling from a motorcycle	Conflict		
Gender	Female	Count	5	29	2	4	5	0	45
		% of Total	2.9%	16.7%	1.1%	2.3%	2.9%	0.0%	25.9%
	Male	Count	24	32	26	13	33	1	129
		% of Total	13.8%	18.4%	14.9%	7.5%	19.0%	0.6%	74.1%
Total		Count	29	61	28	17	38	1	174
		% of Total	16.7%	35.1%	16.1%	9.8%	21.8%	0.6%	100.0%

The mean ISS in all patients was 29.65 ± 10.25 . The mean ISS was 28.15 ± 10.93 in females and 30.05 ± 9.99 in males

(P=0.28).

E-FAST showed normalized outcomes in 125 patients (71.8%), 2 patients (1.1%) hemothorax, 4 patients (2.3%) pneumothorax and 18 patients (3.10% morison pouch fluid, 13 cases (7.7%), 5% splenorenal free fluid, 11 cases (3.6%) of free fluid in pelvis.

One case of free fluid in the pericardial was observed that

was not confirmed by CT scan. Two patients were diagnosed with hemothorax in both tests and 3 patients were diagnosed with pneumothorax in both tests.

Out of 176 patients, CT-SCAN results for 133 (76.4%) normal, 3 (1.7%) hemothorax, 4 (2.3%) pneumothorax, 31 (17.8%) free fluid in the abdominal and the pelvis, and 3 patients were found to have retroperitoneal fluid (Table 2).

Table 2: Distribution of results according to E-FAST and CT-SCAN tests

		CT.SCAN					Total (%)	
		Hemothorax	Pneumothorax	Free fluid in the abdominal and pelvic		Retroperitoneal fluid		Normal
E-FAST	Hemothorax	2	0	0		0	0	2 (1.1%)
	Pneumothorax	0	3	0		0	1	4 (2.3%)
	Pericardial effusion	0	0	0		0	1	1 (0.6%)
	Morison pouch fluid	0	0	14		0	4	18 (10.3%)
	Splenorenal free fluid	0	0	9	31	0	4	13 (7.5%)
	Free fluid in the pelvic	0	0	8		2	3	11 (6.3%)
	Normal	1	1	3		1	120	125 (71.8%)
Total (%)		3 (1.7%)	4 (2.3%)	31 (17.8%)		3 (1.7%)	133 (76.4%)	174

E-FAST had a sensitivity of 66.7 and a specificity of 100% in the diagnosis of hemothorax. Also, a positive predictive

value of 100% and a negative predictive value of 99.4% were detected for 120 people in both normal tests (Table 3).

Table 3: Sensitivity, specificity, positive predictive value, and negative E-FAST predictive value

Items	Sensitivity	Specificity	Positive predict value	Negative predictive value
Hemothorax	66.7%	100%	100%	99.4%
Pneumothorax	75.0%	99.4%	75.0%	99.4%
Normal	90.2%	87.8%	96.0%	73.4%
Free fluid in the abdominal and pelvic	91.1%	88.0%	63.2%	97.7%

DISCUSSION

In this study, 174 patients were included. The mean ISS in all patients was approximately 30 and the mean was not significant in both sexes. The mean ISS indicates the severity of considerable. In this study, E-FAST had a sensitivity of 91% and a specificity of 88% in the diagnosis of normal and normal individuals. E-FAST obtained 66% sensitivity and 100% positive predictive value and 4.99% negative predictive value in the diagnosis of hemothorax. In this study, this test had a sensitivity of 75% and a specificity of 2.99% in the diagnosis of pneumothorax, and a positive predictive value of 74% and a negative predictive value of 4.99% were obtained. Results showed all items are almost equal and even better in some respects. The results indicate that FAST is a very good alternative to CT scan in the diagnosis of hemothorax, pneumothorax, free fluid in the

abdomen, vulva, and pericardium. There were several cases of retroperitoneal bleeding that could not be detected by FAST but were detected by CT scan.

In a study by Porter et al. on a large number of patients (2576 patients), FAST achieved a sensitivity of 93% and a specificity of 90% in the diagnosis of hemoperitoneum. In another study by MT.MILLER on 359 patients Sensitivity was 68%, specificity was 98%, positive predictive value was 67% and negative predictive value was 93% in the diagnosis of hemoperitoneum [14].

In another study by Porter et al., It was observed that among 1631 people with abdominal trauma, fast ultrasound is one of the main methods with high sensitivity and specificity. This sonography can discuss the complications of the disease [15].

In another report by McKenney et al., 899 ultrasounds of abdominal trauma were performed, of which 101 were positive and 783 were negative. Among the negative cases, 768 patients were confirmed by CT scan, surgery, and subsequent follow-up. Among the positive cases, 95 patients were confirmed. In this report, 86% sensitivity and 99% specificity were calculated [16].

However, it seems that in our study, due to the high accuracy of E-FAST in intra-abdominal, pelvic, and thoracic lesions in blunt trauma patients, it is recommended that more training be given to emergency medicine students and surgeons by a radiologist. Now it is preferable to use high-quality methods and high resolution and at frequent and regular intervals without hasty action.

Also, if E-FAS are performed at regular intervals (4-6) hours for hemodynamically stable trauma patients, its results will be much better, but its false positive and negative cases will be minimized and its sensitivity will be more than 98. And due to its advantages such as portability, safe body, no need

for contrast, fast performance, as well as cheapness and reproducibility will help in the diagnosis of trauma lesions and prompt and timely treatment. And CT scans should be used only in limited cases and special indications.

CONCLUSIONS

The results show E-FAST is a suitable alternative to CT scan in the diagnosis of hemothorax, pneumothorax, and free fluid in the abdomen, vulva, and pericardial cavity. The reason for decreased sensitivity and specificity of E-FAST in the diagnosis of abdominal bleeding in this study was mostly due to several cases of retroperitoneal bleeding that could not be detected by FAST but were observed by CT scan. Due to portability, safe body, no need for contrast, fast performance, as well as cheapness, and reproducibility, it will be a great help in diagnosing trauma-related lesions and prompt and timely treatment. CT scan should be used only in limited cases and special indications.

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