Original Research

Comparing The Results Of Initial FAST Ultrasound And Serial FAST Ultrasound For Patients With Major Trauma: A Prospective Cohort Study

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Abstract

Background: Trauma is one of the most prevalent health problems in the world and one of the leading causes of death and disability, especially in the first decade of life. For the detection of free abdominal fluid in major trauma patients, the present study compares the results of the initial FAST ultrasound with those of the serial FAST ultrasound.

Method: The current prospective cohort study examined 100 patients with major trauma who had been referred to the emergency department of Khatam-al-Anbia Hospital, Zahedan, Iran. Patients were first subjected to the FAST ultrasound upon arrival followed by the serial FAST ultrasound. The data of the intra-abdominal free fluid volume was then analyzed.

Results: The average age of the patients was 25.4±9.7 years. In the initial FAST ultrasound, 58% of the patients were normal while 42% had free fluid in the abdomen. As for the serial FAST ultrasound, 44% of the patients were reported as normal and 56% with free abdominal fluid, a statistically significant difference.

Conclusion: The present study demonstrates that the serial FAST ultrasound significantly increases the accuracy of ultrasound in the detection of free intra-abdominal fluid.

Keywords: FAST Ultrasound, Serial Ultrasound, Major Blunt Trauma.

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Introduction

Blunt abdominal trauma poses a substantial medical challenge due to the potential for a broad spectrum of symptoms, ranging from mild to severe shock. The difficulty in accurately diagnosing internal organ damage in these cases can lead to an increased risk of mortality. Furthermore, the reliability of physical examinations may be compromised by the frequent occurrence of altered mental states among trauma patients. Although lacking specificity in the identification of intra-abdominal organ injuries, diagnostic peritoneal lavage (DPL), as an invasive diagnostic option, can detect the presence of peritoneal fluid (1). Computed tomography (CT) scans are considered the gold standard for evaluating abdominal trauma. However, since patient transfer is often necessary, the usage of CT scans may be limited, thus resulting in delayed diagnosis. Moreover, unstable patients may not be suitable candidates for this modality (2, 3). In contrast, ultrasound (USG) is a reliable, noninvasive diagnostic tool that can be readily performed at the bedside by emergency department clinicians. As a specialized technique introduced by McKenney et al in 1996, focused ultrasonography is designed to identify the presence of a hemorrhage or enteral contents in the peritoneal cavity, pleural space, or pericardium (4). Focused assessment with sonography for trauma (FAST) is a common diagnostic tool utilized in medical centers to evaluate blunt abdominal trauma and to detect the presence of free fluid within the peritoneal cavity. FAST is a rapid and efficient procedure that may be performed in the resuscitation room of emergency departments (5). In their prospective study, Kumar et al investigated 50 patients with blunt abdominal trauma. The presence of free fluid in the abdomen was confirmed by ultrasound and further validated by CECT, laparotomy, or autopsy if necessary. In comparison to CECT for the detection of free fluid, FAST demonstrated a sensitivity of 77.27%, specificity of 100%, and accuracy of 79.16%. As for surgical findings, FAST showed a sensitivity of 94.44%, specificity of 50%, and accuracy of 90%. When compared to autopsy findings, FAST had a sensitivity of 75% in determining free fluid in patients who had died. Overall, in the detection of free abdominal fluid, FAST had a sensitivity of 80.43%, specificity of 75%, and accuracy of 80%. Based on the Kumar et al study, it can be concluded that FAST conducts a reliable and rapid investigation of patients with blunt abdominal trauma. Easily and safely performed in the emergency room, FAST facilitates the initial triage of patients and the determination if urgent surgery is necessary (6). The use of bedside ultrasonography is efficient and reliable in evaluating blunt abdominal trauma, particularly for critically ill patients or those with free peritoneal fluid. However, if the initial bedside ultrasonography does not indicate trauma, studies suggest proceeding with further abdominal CT scans or serial ultrasonography scans (7). Despite its high sensitivity and specificity for detecting hemoperitoneum, FAST ultrasound cannot definitively exclude the possibility of laparotomy in cases where the results are negative. For patients with major blunt abdominal trauma, the current prospective study was conducted with the intention of evaluating the specificity and sensitivity of FAST scans when performed immediately after ED admission and comparing the results with those of serial FAST scans.

Methods

The present prospective cohort study included 100 patients with major blunt trauma. The patients were selected by simple randomization in a single center teaching hospital and those with absolute indication for surgery or minor trauma were excluded. Also patients with subcutaneous emphysema or patients who left the ER in less than 6 hours were excluded from the study. The patients were recruited continuously with census method till desired sample size is reached. Patients were referred to the emergency department of Khatam-al-Anbia Hospital, Zahedan, Iran from 2017-2018. All the Fast scans were performed by one general surgery assistant, who utilized the

same machine for all the patients (Siemen`s 3.5 MH and curvilinear probe). The Morison pouch, perisplenic view, Douglas pouch, bilateral hemithoraces, and interloop and upper anterior chest wall spaces were examined and documented in all patients. The first FAST study was immediately performed upon patient admission and the approval of the inclusion criteria. Six hours later, the second study took place if the patient was stable and showed no indication of laparotomy. Intra-abdominal free fluid detection was considered positive if the diameter of the space with fluid echogenicity was reported as more than 2 mm. Demographic data, including age, sex and GCS, was collected in the ED setting. The written informed consent was obtained from all patients to perform the imaging and collecting the data. This investigation is approved by the ethics committee of the Zahedan University of Medical Science by number: Ir. Zaums.REC.1396.249. Data were analyzed using spss 16 software and Mcnemar test.

Results

The current study included 100 patients with major blunt trauma who had been referred to Khatam-Al-Anbia Hospital, Zahedan, Iran. The median age of the subjects was 25.4±9.7. Seventy-three patients (73%) in the study group were male while 27 patients (27%) were female. The median age in the male group and the female group was 25.3±8.9 and 25.7±11.7, respectively and there was no significant statistical difference between the two (p=0.883) (Table 1). The median GCS of the patients was 9.9±2.9, with a GCS of 10.0±3.1 and 9.7±2.3 for the male and the female groups, respectively. The median GCS in the male and female group was 10.0±3.1 and 9.7±2.3 respectively, with no significant statistical difference between them. (p=0.641) (Table 1).

The current study conducted the first abdominal ultrasonography immediately after the patient's admission to the emergency department. In this step, a normal Fast scan was reported for 58 patients (58%), while 42 patients (42%) showed free intra-abdominal fluid in their FAST scan report. The serial FAST ultrasound conducted six hours later reported normal results for 44 patients, whereas 56 patients had intra-abdominal fluid. Statistical analysis found a significant difference between the FAST ultrasound results at hospital admission and those of the serial FAST ultrasound six hours later. (P<0.0001) (Table 2).

In the present study, the frequency of free fluid reported by the FAST ultrasound at the time of admission was as follows: 58 patients with no free fluid in the abdominal cavity, 26 patients with a mild amount of free fluid, 14 patients with a moderate amount of free fluid, and 2 patients with a massive amount of free fluid. In contrast, the serial Fast ultrasound conducted six hours later reported the following frequency of free fluid: 44 patients with no free fluid in the abdominal cavity, 27 patients with a mild amount of free fluid, 24 patients with a moderate amount of free fluid, and 5 patients with a massive amount of free fluid. (Table 3).

Discussion

Due to its increased efficiency, the FAST ultrasound is most commonly used today in the triage of trauma patients with unstable hemodynamics.(8) There are several factors that can affect the sensitivity of the FAST scan. For example, it is well known that ultrasound is operator dependent. Although the FAST scan is an easy ultrasound method, emergency department physicians need extensive training to improve their skills in this area.(9) In addition, as shown in many studies, FAST ultrasound has limitations for detecting certain types of damage, such as intestinal damage of the mesentery, diaphragm, solid organs, and retroperitoneal lesions (10, 11). Other causes of FAST scan false negative results are: obesity, an empty bladder, and the failure to detect a clot inside the abdominal cavity (12). The purpose of FAST ultrasound is to detect free intra-abdominal fluid caused by damage to intra-abdominal organs. Studies show that the average volume of fluid that can be detected by the FAST ultrasound ranges from 100 to 600 ml (13). For an ultrasound to see a measurable amount of blood in

the abdominal cavity, a time delay is required. Therefore, a critical factor in better diagnosing free intra-abdominal fluid is repeating the ultrasound after a period of time. Even though several articles have recommended secondary ultrasound in patients with abdominal trauma, the value of secondary ultrasound has not yet been fully investigated (14). The present study conducted FAST ultrasound on patients upon arrival and then serially, with the results showing 42% of patients with free abdominal fluid in the FAST scan upon arrival and 56% of patients with free abdominal fluid in the serial FAST scan. In their 2023 prospective study, Yazıcı et al performed an Extended FAST ultrasound on 84 patients and then repeated it on Days 3 and 6. Their results indicated that the sensitivity and specificity of the initial EFAST for hemoperitoneum was 66.7% and 100% respectively. In contrast, the sensitivity and specificity of the repeated EFAST for hemoperitoneum was 100% and 97.8% respectively. Consistent with the current study's findings, the work by Yazici et al suggested that a repeated EFAST can successfully detect all cases of hemoperitoneum (15). A 1997 study found that FAST ultrasound upon admission may misdiagnose the presence of free abdominal fluid in about 29% of patients with blunt abdominal trauma (16). In Rajabzadeh et al's study in 2014, 331 patients underwent both an initial and a delayed FAST ultrasound. The sensitivity of the first FAST ultrasound for free fluid was 70.7%, while the delayed FAST ultrasound reported a significant increase in free fluid reaching 92.7%. Furthermore, the delayed FAST scan also showed a significant rise from 95.7% to 98.9% in the predictive negative value, but no significant change in the specificity value. The average score of free fluid in patients in the early and delayed FAST ultrasound was 0.2 and 0.34 respectively, a statistically significant rise. The P-value was less than 0.0001. According to these results, the passage of time made it possible for more blood to accumulate in the peritoneal spaces, thus augmenting the diagnostic capability of the delayed FAST ultrasound when compared to that of the initial FAST ultrasound (8). Additionally, in the study by Blackbourn et al conducted in Texas, USA, 547 patients received both an initial ultrasound (US) and a secondary ultrasound (SUS). The sensitivity of the initial US for detecting intra-abdominal injury or fluid was 31.1%, whereas, with the SUS, this sensitivity increased significantly to 72.1% ($p < 0.001$). The specificity for both tests was high, at 99.8%. The negative predictive value of the initial US was 92.0%, a value which rose to 96.6% with the SUS ($p = 0.002$). Accuracy also improved significantly from 92.1% with the initial US to 96.7% with the SUS ($p < 0.002$) (9). Delayed ultrasound, therefore, significantly increases sensitivity in the detection of intra-abdominal damage. It then follows that delayed or secondary ultrasound is useful in detecting free abdominal fluid, as was clearly shown in the current paper and similar studies. It should be noted that, in previous reports, the timing of when to conduct the secondary FAST ultrasound ranged from 30 minutes to 12 hours after the initial FAST scan. However, the optimal time for the secondary FAST ultrasound has yet to be defined in any study and further research is required to determine it.

Conclusion

The present study demonstrates that the FAST scan is a dependably sensitive diagnostic tool for patients with blunt abdominal trauma. Repeating the FAST ultrasound augments its sensitivity and specificity even further, proving it to be an efficient tool for successfully determining those patients in urgent need of surgery.

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Ethical considerations:

The present thesis was carried out after receiving permission from the Ethics Committee of Zahedan University of Medical Sciences under the number IR.ZAUMS.REC.1396.249

limitations:

The non-cooperation of patients to perform ultrasound or the impossibility of performing a second ultrasound due to overload of the emergency room was one of the limitations of the study.

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Tables

Table 1: Comparison of age and GCS between the male and female groups

Variable	Male (SD±mean)	Female (SD±mean)	P-value
Age	25.3±8.9	25.7±11.7	0.883
GCS	10.0±3.1	9.7±2.3	0.641

Table 2: Comparison of FAST ultrasound results upon admission and those of the serial FAST ultrasound six hours later

	Normal (N, %)	Free Fluid (N, %)	P-Value
FAST Ultrasound upon admission	58	42	<0.0001
Serial FAST Ultrasound 6 hours later	44	56	

Table 3: Comparison of the amount of free fluid in the FAST ultrasound upon admission and 6 hours later

Free Fluid FAST	Normal (N, %)	Mild (N, %)	Moderate (N, %)	Severe (N, %)
TOA*	58	26	14	2
Serial	44	27	24	5

*TOA: Time of Admission