

Original Research Article

Focused assessment with sonography in trauma: experience of Al Jalla Hospital, Benghazi, Libya

Othman H. Tajoury^{1*}, Mohamed O. Benkhedoura², Hanan Al-Enezi³,
Ahmed Denaly⁴, Amna Elkoom⁴

¹Department of Surgery, Libyan International Medical University, Benghazi, Libya

²Department of Surgery, Benghazi University, Benghazi, Libya

³Department of Radiology, Benghazi University, Benghazi, Libya

⁴Department of Surgery, Al Jalla Hospital, Benghazi, Libya

Received: 02 June 2024

Revised: 03 July 2024

Accepted: 05 July 2024

*Correspondence:

Dr. Othman H. Tajoury,

E-mail: otmantaj@limu.edu.ly

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ABSTRACT

Background: Focused assessment with sonography in trauma (FAST) is a commonly used tool in the diagnosis of trauma. The objective of this study is to compare the positive predictive value (PPV) and negative predictive value (NPV) of (FAST) and abdominal-pelvic computed tomography scans (CTAP) in cases of blunt abdominal injury, as well as to assess the need for abdominal surgery. The aims to investigate if any false negative ultrasound studies were associated with significant morbidity. The findings are also compared with previous studies.

Methods: The data collected from the registry records of Al Jalla hospital over a two-year period from January 1, 2022, to December 31, 2023. Data on sonographic findings, computed tomography findings, and patient outcomes were collected. Diagnostic characteristics, including predictive values, were calculated.

Results: A total of 220 patients were included. 190 patients underwent FAST, with 25 (13%) showing positive results. Among 90 patients who underwent CTAP, 18 (20%) showed abnormalities, and 10 (5.3%) patients required surgery. When comparing FAST to CTAP in detecting abnormalities, the PPV and NPV were 0.625 and 0.857, respectively. When comparing FAST to the need for surgery, the PPV and NPV were 0.217 and 0.977, respectively. 4 patients (0.98%) had negative FAST results but still required surgery. No significant adverse outcomes or surgical interventions were observed in patients with normal vital signs, normal initial physical examination, and negative FAST findings who did not undergo CTAP.

Conclusions: In patients with an initially normal physical examination and negative FAST results, emergent CTAP may be avoided.

Keywords: Fast, Diagnostic tool, Intra-abdominal injuries, Predictive value of tests, Trauma, Ultrasonography

INTRODUCTION

Over the last three decades, focused assessment with sonography in trauma (FAST) has emerged as one of the important tools used in the assessment of the trauma patient in most trauma centers world-wide.¹ It is a bedside imaging modality that gives the emergency

physician or trauma surgeon information to guide the management of major trauma patients. The use of ultrasound (US) in trauma has gained increasing acceptance among trauma surgeons and emergency physicians. Along with this, ultrasound technology and its resolution, portability and affordability have also improved and it will be difficult to ignore this diagnostic

tool.² The rapid, non-invasive, portable nature of ultrasound evaluation makes it particularly valuable and has replaced diagnostic peritoneal lavage (DPL) to a large degree in the detection of intra-abdominal bleeding in blunt abdominal injury in our trauma center.³ However in an era where computed tomography (CT) scans are readily available and conservative management of solid organ injuries is being practiced, is the finding of intraperitoneal fluid by FAST still useful in the management of the multiply injured patient?

The objectives of this study were to: Compare the positive predictive value and negative predictive value (NPV) of FAST versus abdominal-pelvic CT scans (CTAP) in the detection of intraabdominal abnormalities after blunt abdominal injury. Compare the positive predictive value and NPV of FAST versus the need for abdominal surgery. Determine if any false negative ultrasound studies were associated with significant mortality or morbidity e.g. unexpected laparotomy. Compare the positive predictive value, NPV, and accuracy of FAST as used by our local emergency physicians and surgeons compared with those from other studies performed abroad.

METHODS

Was a retrospective review of the trauma records in Al Jalla hospital with 24-hour emergency surgery capability in Benghazi from 1 January 2022 to 31 December 2023. Inclusion criteria included all types of blunt trauma abdomen, ages above 18 years and any genders. Exclusion criteria included penetrating trauma and burns. The emergency department prospectively kept a file on all trauma patients requiring resuscitation. The identities of trauma patients who presented to the emergency department resuscitation room were acquired from the file and verified with the hospital's trauma registry. The performance of ultrasound was a mandated field in the trauma registry. Further relevant information was obtained through the hospital's electronic medical records system. If the required data was not available electronically, the paper case files were traced from Hospital Information Management System.

The Statistical Package for the Social Sciences (SPSS17.0) database was used for data management and analysis. Data fields collected included the age of the patient, gender, mechanism of injury, whether FAST and CTAP were performed and their results, whether there was surgical intervention, disposition, and readmission of the patient. Missing data were coded separately and were excluded from statistical analysis. Where there was conflicting or ambiguous data, the findings in the patient's paper case records were traced and its results were entered as the final data.

The study was approved by the Institutional Review Board.

RESULTS

Out of the 220 enrolled patients, a majority of 178 81% were male, and the mean age was 38.9 (SD=16.2) years.

Table 1: Demographic data.

Demographic data	Count	Percentage
Total patients	220	-
Gender		
Male	178	81%
Female	42	19%
Age		
Mean	38.9	-
Standard deviation	16.2	-
Total patients	220	-

Motor vehicle accidents and falls from heights less than 3 meters were the most common mechanisms of injury (Table 2).

Table 2: Mechanisms of injury.

	Numbers	Percentage
Motor vehicle accidents	150	68.2
Falls from height >3 metres	14	6.4
Falls from height <3 metres	39	17.7
Assault from blunt trauma	5	2.3
Other trauma	12	5.4
Total	220	100

A total of 190 patients underwent FAST, and among them, 91 also received CTAP (Figure 1).

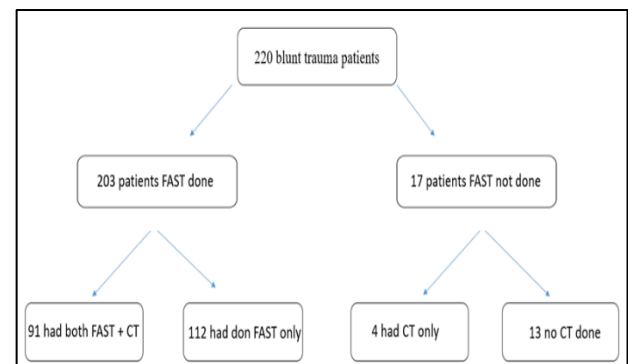


Figure 1: Distribution of patients with FAST and computed tomography CT of the abdomen-pelvis performed.

Only 17 patients did not undergo FAST, but five of them had abdomen-pelvis CT scans performed. Among the 190 patients who underwent FAST, 25 13% had positive findings. Out of the 90 patients who received CTAP, 18 20% showed abnormalities (Table 3).¹⁰

Table 3: Comparing FAST and abdominal-pelvic CT result.

		CT result			Total
		Positive	Negative	Not done	
FAST Result	Positive	10	6	7	23
	Negative	12	72	96	180
	Not done	1	4	12	17
	Total	23	82	115	220

Positive predictive value = 0.625 (95% CI 0.422, 0.740)

Negative predictive value = 0.857 (95% CI 0.802, 0.907)

Sensitivity = 0.454 (95% CI 0.335, 0.626)

Specificity = 0.923 (95% CI 0.852, 0.945)

CT = computed tomography.

Table 4: Comparing FAST and the need for abdominal surgery.

		Abdominal surgery performance		
		Yes	No	Total
FAST Result	Positive	5	18	23
	Negative	4	176	180
	Not done	1	16	17
	Total	10	210	220

Positive predictive value = 0.217 (95% CI 0.167, 0.427)

Negative predictive value = 0.977 (95% CI 0.973, 0.997)

Sensitivity = 0.556 (95% CI 0.519, 0.926)

Specificity = 0.91 (95% CI 0.888, 0.941)

5.3% underwent abdominal surgery (Table 4). The positive predictive value (PPV) of FAST in detecting

abnormalities on CTAP was 0.625 (95% CI 0.422, 0.740), while the NPV was 0.857 (95% CI 0.802, 0.907) (Table 2).

When comparing FAST results with the need for abdominal surgery, the PPV was 0.217 (95% CI 0.167, 0.427), and the NPV was 0.977 (95% CI 0.973, 0.997) (Table 4). Among the patients who underwent abdominal surgery, there were 4 cases (0.98%) with a negative FAST result (Table 5). The first patient, a 25-year-old male who fell from a height of less than 3 meters, initially presented with negative FAST and stable hemodynamics. However, persistent abdominal pain led to a CTAP, revealing an incidental finding of a perforated small bowel. The second patient, a 32-year-old man who fell from a height of more than 3 meters, had a negative FAST but was tachycardic. Considering the nature of the injury and tachycardia, CTAP was performed, showing splenic rupture. The third patient, a 35-year-old man who also fell from a height of more than 3 meters, had negative serial ultrasounds but a positive diagnostic peritoneal lavage (DPL) due to persistent hypotension. Immediate laparotomy revealed a large hematoma at the root of the mesentery and serosal tears, without solid organ injury.

The final patient, a 72-year-old man involved in a motor vehicle incident as a pedestrian, presented with hypotension despite a negative FAST result. A laparotomy without prior CTAP revealed splenic and liver lacerations. Additionally, in (table 6) the comparison of our diagnostic characteristics with other studies.

Table 5: FAST negative versus abdominal surgery performed.

No	Case no.	Comments
1	15	Patient fell from height <3 meters. CT showed a perforated small bowel
2	120	Patient fell from height >3 meters. Tachycardia, normotensive. CT was positive for splenic rupture
3	190	RTA case. FAST for 2 times negative. DPL positive, persistent hypotension. No CT done. In OT hematoma at root of mesentery serosal tear no sold organ injury
4	200	pedestrian in RTA. No CT done, hypotension laparotomy splenic and liver laceration

Table 6: Comparison of diagnostic characteristics with other studies

Author	Size	Sn	Sp	PPV	NPV	Compared to
Dolich 2001	2576	0.86	0.98	0.87	0.98	CT finding, DPL and operating finding
Tsui 2008	273	0.86	0.99	0.94	0.98	FAST positive CT FAST negative clinical observation
Natarajan 2010	2980	0.43	0.99	0.95	0.94	Combination of laparotomy, CT and observation
Wong 2014	476	0.778	0.918	0.280	0.990	Operation finding
Tajoury	220	0.556	0.91	0.217	0.977	Operation finding, DPL, CT, FAST

Sn= sensitivity, Sp= specificity, PPV= positive predictive value, CT= computed tomography, DPL= diagnostic peritoneal lavage. FAST= focused assessment with sonography in trauma

DISCUSSION

Rapid assessment of patients with blunt abdominal injury by ultrasound to complement physical examination has almost entirely replaced the DPL in the detection of intra-abdominal bleeding in our trauma centre. However, computerized tomographic examination can now be completed in minutes and even pick up small lacerations before any discernible fluid can be picked up on FAST.⁴ In the hemodynamically stable patient, performing CTAP in such patients may even allow them to be discharged from the emergency department due to its high NPV.¹ In view that CTAP has a much higher sensitivity (92-98%) and specificity (99%) as compared to FAST (sensitivity 73-88%, specificity 98-100%).^{2,3} We wanted to evaluate if ultrasound would still be reliable and useful in the management of the multiply injured patient with blunt abdominal injury in our center.

FAST has its advantages such as being cheaper, even less time consuming than CT and no radiation or contrast risk.⁵ In our center, all FAST were performed by non-radiologist physicians with variable experience in performing FAST. In a Cochrane study of four randomized controlled studies using ultrasound to aid diagnosis of patients with blunt abdominal injury, the authors found that the use of ultrasounds reduced the number of CT scans ordered, but due to the low sensitivity of ultrasound, the conclusion was that having clinical pathways using ultrasound to diagnose patients with suspected blunt abdominal injury was not justified.⁴ In another review of the use of DPL or FAST as a screening test before CT abdomen in similar patients, the use of CT was reduced and the rate of missed injuries was not higher in patients who underwent DPL but not FAST.⁶ The authors thus did not recommend using FAST as a screening test to reduce the use of CT.³ Our results are comparable to other studies.⁵⁻¹¹ except for a lower PPV (Table 5).

However, there was no surgical intervention or bad outcomes in the patients with normal physical examination and negative FAST but with a positive CTAP result. We have a higher rate of false positives as compared with other studies comparing FAST with CT abdomen. The variation in results has been recognized to be operator dependent.¹² We had sensitivity of 0.479, specificity of 0.908 (Table 2). The cause of this was not known although it could be related to our department's varying operator experience, physiological fluid or hypoechoic fat or some other misleading structures. As we used US as a screening examination, we tended to further evaluate any suspicious abnormalities with CT. In some reports, the cause of false positives was unknown or due to normal physiological fluid.^{13,14} The causes for false negatives were often due to gastrointestinal injury or isolated organ injury where there was minimal abdominal fluid.¹⁵ In our study, we found a high NPV for abnormal CTAP results and need for surgery. A study by Eanniello had only 16% of patients with positive CT findings who

required a laparotomy.¹⁶ Found a 58% reduction in the use of CT using a protocol where hemodynamically unstable patients or those with signs of peritonitis with positive US findings underwent laparotomy, but those with negative US and normal physical examination were admitted for observation. The rate of missed injuries was not reported higher in those who did not have a CT.⁴ It also had no impact on the duration of hospitalization. Likewise, we might translate to our patients performing CTAPs. In our series, patients with false negative FAST who required laparotomy were hemodynamically unstable, except for a patient with an incidental finding of a perforated appendix. Since there was no surgical intervention or bad outcomes in the patients with positive CTAP and negative FAST, having a clinical pathway using ultrasound may prove to be useful and justified in our hospital's setting. Such may include a period of observation in the hemodynamically stable patient with at least one serial FAST examination for follow-up.^{18,19}

This will be favorable as a FAST scan can be done in a shorter time, without any ionizing radiation and contrast associated adverse effects. Furthermore, in some institutions, the room with the CT scanner may be located a distance from the trauma resuscitation room and may not have full resuscitation capabilities. However, in centers where false negative US resulted missed injuries and thus a high rate of exploratory laparotomy (37%) CT may still be the preferred investigative tool before deciding on conservative or operative management.²⁰ It may also depend on the center's threshold for surgical intervention as nonsurgical conservative management is preferred in some trauma centers even where there is visceral trauma in a hemodynamically stable patient regardless of injury grade or degree of hemoperitoneum.²¹ In our center, only one percent of patients had a negative FAST requiring laparotomy eventually. Therefore, we believe that there is a role for the use of ultrasound to assess the need for emergent laparotomy and reduce the need for CTAP. Clear credentialing procedures such as nationally recognized ultrasound courses for the emergency physicians and trauma surgeons should be implemented to improve the sensitivity of FAST.^{22,23}

The limitations of the study were, Operator Skills: The accuracy of FAST examinations performed by emergency physicians and trauma surgeons in the emergency department may vary due to differences in operator skills. The lack of expertise compared to experienced radiologists could impact the diagnostic accuracy. Small Sample Size: The number of enrolled patients in this study was relatively small compared to other studies, which may limit the generalizability and statistical power of the findings. Selection Bias: Patient enrollment relied on the trauma file and registry database of the emergency department, which may introduce selection bias. However, it is unlikely that a significant number of missed cases occurred due to the prospective nature of data collection.

CONCLUSION

Based on our study findings, FAST demonstrated a high NPV for abnormal CTAP results and the need for surgery. As a result, we propose that in patients with an initial normal physical examination and negative FAST, the immediate need for emergent CTAP can be avoided. Instead, we recommend a period of observation with serial physical examinations and FAST as the next step in further evaluating these patients. This approach can help reduce unnecessary exposure to ionizing radiation, the risk of contrast-induced adverse events, and the overall cost of investigations.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Tajoury OH, Benkhoudra MP, Enezi HA, Denaly A, Elkoom A. Focused assessment with sonography in trauma (FAST): experience of Al Jalla Hospital, Benghazi, Libya. *Int Surg J* 2024;11:1260-4.