The Egyptian Journal of Hospital Medicine (April 2025) Vol. 99, Page 2087-2091

Diagnostic Accuracy of Liver Enzymes Tests for Detection of Liver Injury in Adult Patients with Blunt Abdominal Trauma in The Emergency Department at Suez Canal University Hospital

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ABSTRACT

Background: Trauma remains a leading reason for death globally, with abdominal trauma responsible for 15–20% of trauma-related deaths. The hepatic is the 2nd most injured organ in blunt abdominal trauma, typically diagnosed through imaging like focused assessment with sonography in trauma (FAST) or CT.

Aim: This study aimed to evaluate the diagnostic accuracy of liver enzymes Alanine Transaminase (ALT) & Aspartate Transaminase (AST) for the detection of liver injury in adult cases with blunt abdominal trauma (BAT) in addition to determining whether it has the possible to reduce the need for CT scans in cases with BAT.

Patients and methods: This descriptive cross-sectional research was performed on 97 cases. All were blunt abdominal trauma patients who attended to the Emergency Department (ED) at Suez Canal University Hospital and fulfilled our inclusion criteria.

Results: AST showed 82.4% sensitivity and 100% specificity for detecting liver injury, with 96.7% accuracy and strong agreement with CT. ALT and FAST together had 100% sensitivity and 75% specificity, with 80.5% accuracy. ALT alone had 94.5% sensitivity and 97% specificity; AST had 94% sensitivity and 96% specificity. FAST scan alone had 90.5% sensitivity, 100% specificity, and 96% accuracy in detecting blunt abdominal trauma, showing strong agreement with CT.

Conclusion: AST ≥ 108.2 U/L & ALT ≥ 80 U/L, combined with a positive FAST can help detect hepatic injury following BAT and guide management, especially where CT scans are not available.

Keywords: Blunt abdominal trauma, Liver injury; AST/ALT; FAST scan.

INTRODUCTION

Trauma remains the leading reason for death in the initially forty years of life, representing a significant public health issue in every country, irrespective of socioeconomic progress levels. According to World Health Organization statistics, over 1.2 million individuals die from trauma each year, and an additional fifty million experience related morbidities [(1)]. Abdominal trauma accounts for fifteen to twenty percent of trauma-related deaths. Mortalities resulting from trauma of abdomen can result in either early death (Owing to bleeding) or late death (Owing to infection & sepsis) [(2)].

In BAT, hemodynamically stable cases with minor signs are frequently handled on the general ward or occasionally released. The hepatic is the 2nd most injured organ, following the spleen in the BAT [(3)]. Most liver injuries are traditionally diagnosed by imaging studies like focused evaluation with CT, sonography for trauma (FAST), or exploratory laparotomy [(4)].

FAST is a noninvasive & quick imaging method that has displayed significant accuracy and reliability for determining BAT in adults. The FAST exam can be performed dependably and swiftly by both emergency physicians and radiologists, involving minimal costs and avoiding radiation exposure to the case [(5)]. Computed Tomography scans are regarded as the definitive standard for identifying hepatic injury in blunt abdominal trauma. Computed Tomography scan will facilitate the evaluation of the hepatic as well as other correlated organ injuries [(6)]. Nonetheless, a CT scan is costly and has exposure risks. Maintaining resuscitation of the hemodynamically unstable case in the Computed Tomography scan suite can also be difficult. This may impose an extra burden on cases in both progressing countries and the healthcare system in affluent countries [(7)].

This research aimed to determine the diagnostic accuracy of the liver enzymes AST & ALT to detect hepatic injury in adult cases with BAT and to evaluate the potential of decreasing the reliance on CT scans in such cases.

PATIENTS AND METHODS

This was descriptive cross-sectional research included 97 cases. All BAT cases attending the Emergency Department (ED) at Suez Canal University Hospital & fulfilling our inclusion principles have been involved in the research.

Inclusion Criteria: Adult cases aged above or equal to 18 years attending to emergency department with blunt abdominal trauma.

Exclusion Criteria: Patients with a history of liver disease, cases transferred from another hospital, cases discharged on their own demands & cases with life-threatening conditions and extra-abdominal associated injury.

Received: 15/12/2024
Accepted: 13/02/2025

Sample size: The required sample size was 89 participants. After accounting for a 10% non-response rate, 97 participants were included.

Methods: All patients were subjected to full history, data of the trauma and clinical examination. All the patients were evaluated by the primary survey (ABCDE) laboratory investigations: Complete blood picture, ALT, AST, blood typing and cross matching. Blood samples were additionally obtained for standard testing. Following the coordination with the laboratory, the concentrations of AST and ALT were determined. Subsequently, according to the laboratory kits, findings over 40 u/l and 50 u/l were regarded as indicative of aberrant AST and ALT concentrations correspondingly. The FAST US has been performed by an attending emergency doctor, along with abdominopelvic CT scans. Radiological examinations FAST and abdominopelvic CT scans were conducted for all cases with BAT who met the inclusion criteria. The ultrasound device utilized for cases examination was the Phillips HD11EXm. Linear probe operating at a frequency of 3.5-7.5 MHz, while the computed tomography apparatus utilized was the ALEXION Toshiba multidetector with sixteen slices. CT scan statements have been prepared by a supervising radiologist. Ultimately, we compared the results of the CT scan with those of the AST and ALT experimental tests in cases with hepatic injury and those without. FAST tests indicated the presence of free intraperitoneal fluid collection. Computed tomography showed classification of liver injury depending on CT findings determined by the American Association for the Surgery of Trauma (AAST) Liver Injury Scale - 2018 Revision [8].

Ethical Consideration: Study protocol was approved by IRB of the Department of Emergency Medicine, Faculty of Medicine, Suez Canal University. Also, approval by the Managers of the Health Care Facilities in which the research was performed. Informed written consent was attained by each participant sharing in the research. Confidentiality and personal privacy were accepted in all concentrations of the research. Gathered data were not employed for any other purpose. The Helsinki Declaration was followed throughout the study's duration.

Data collection and management: Data was collected through questionnaires and clinical assessment, coded, entered, and analyzed using Microsoft Excel. Normally distributed continuous information has been represented as mean ± SD. Non-normally distributed information as range, median and absolute numbers. Categorical data were represented as proportions. Outcome percentages were expressed as percentages. Clinical profiles have been compared utilizing the Fisher's exact test. Data analysis has been conducted utilizing SPSS version 22 and SPSS 26.0 for Windows (SPSS Inc., Chicago, IL) using the Chi-square test for comparing frequencies and the T-test for mean correlation, with a significance concentration set at $p \leq 0.05$.

RESULTS

Table (1) illustrated that cases age range was from eighteen to sixty years old. Most of cases injured aged from 18 to 29 was 35.1%, while at the age of 50-60 was 15.5%, with male predominance (67%). Most of patients' injuries resulted from RTA (64.9%).

Table (1): baseline characteristics of the examined patients.

	(Num.=97)
Age (years)	34 (35.1%) 24 (24.7%) 24 (24.7%) 15 (15.5%)
Gender	
Male	65 (67%)
Female	32 (33%)
Cause	
Fall	18 (18.6%)
RTA	63 (64.9%)
Direct trauma	8 (8.2%)
quarrel	8 (8.2%)

RTA: Road Traffic Accident.

Table (2) showed that 58.8% of patients had liver injury grade 1, while 23.5% of cases had liver injury grade 2 and 17.6% of them had liver injury grade 3.

Table (2): Distribution of patient with liver injury grading C.T findings (n=17)

	n=17	Percentage
liver grade 1	10	58.8%
liver grade 2	4	23.5%
liver grade 3	3	17.6%

Table (3) showed that the FAST sensitivity scan in the observation of hepatic injury in cases with reference to CT was 100% (17/17*100), the specificity was 100% (80/80*100), the positive predictive value was 100 % (17/17*100) and the negative predictive value was 100% (80/80*100). Accuracy was 100%. There was great agreement between CT findings and FAST findings with high significance in detection of liver injury.

Table (3): Accuracy of FAST scan in the observation of liver injury in cases regarding CT (n =97).

	CT findings			Kappa	P value
FAST findings	Abnormal	Normal	Total	1	**≤0.001***
Abnormal	17 (TP)	0 (FP)	17		
Normal	0 (FN)	80(TN)	80		
Total	**17**	**80**	97		

FP: false positive TP: true positive FN: false negative TN: true negative *: statistically non-significant p ≥ 0.05, FAST: Focused Assessment with Sonography for Trauma, CT: Computed Tomography.

Table (4) showed that the sensitivity of elevated level of ALT in the detection of liver injury in cases with reference to CT was 70.6% (12/17*100), the specificity was 100% (80/80*100), the +ve predictive value was 100% (12/12*100) and the -ve predictive value was 94% (80/85*100). Accuracy was 94%. There was substantial agreement between CT findings and ALT with highly significance in detection of liver injury.

Table (4): Accuracy of assessed hepatic enzymes (ALT) in the observation of hepatic injury in cases regarding CT (n =97).

	CT findings			Kappa	P value
ALT	**Abnormal**	**Normal**	Total	0.786	**≤0.001***
Abnormal	12 (TP)	0 (FP)	12		
Normal	5 (FN)	80 (TN)	85		
Total	**17**	**80**	97		

ALT: Alanine Aminotransferase.

Table (5) showed that the sensitivity of elevated level of AST in the detection of liver injury in cases with reference to CT was 82.4% (14/17*100), the specificity was 100% (55/55*100), the +ve predictive value was 100% (14/14*100) and the -ve predictive value was 69.4% (80/83*100). Accuracy was 96.7%. There was great agreement between CT findings and AST with highly significance in detection of liver injury.

Table (5): Accuracy of assessed hepatic enzymes (AST) in the detection of hepatic injury in cases regarding CT (n =97).

	CT findings			Kappa	P value
AST	Abnormal	Normal	Total		
Abnormal	14 (TP)	0 (FP)	14	0.877	**≤0.001***
Normal	3 (FN)	80 (TN)	83		
Total	**17**	**80**	97		

Table (6) showed that the sensitivity of both FAST scan and elevated level of ALT in the liver injury detection in patients with reference to CT was 100% (17/17*100), the specificity was 75% (60/20*100), the positive predictive value was 45.9% (17/37*100) and the negative predictive value was 100% (60/60*100). Accuracy was 80.5%. There was moderate agreement between CT findings and FAST, and elevated liver enzymes with high significance in the detection of liver injury.

Table (6): Accuracy of both FAST scan & higher liver enzymes in the observation of hepatic injury in patients with reference to CT (n =97).

	CT findings			Kappa	P value
FAST and elevated liver enzymes	Abnormal	Normal	Total	0.580	**≤0.001***
Abnormal	17(TP)	20 FP)	37		
Normal	0 (FN)	60 (TN)	60		
Total	**17**	**80**	**97**		

Table (7) showed that ALT had specificity of 97% and sensitivity of 94.5%. AST had sensitivity of 94% and specificity of 96%, with highly significance for the detection of liver injury.

Table (7): ROC analysis for AST, ALT for the detection of liver injury

	Area	Cutofpoint	Sensitivity	Specificity	Std. Errora	Asymptotic Sig.b	Asymptotic 95% Confidence Interval	
							Lower Bound	Upper Bound
ALT	0.983	80	94.5%	97%	0.013	0.001	0.958	1
AST	0.976	108.2	94%	96%	0.024	0.001	0.93	1

AST: Aspartate Aminotransferase.

Table (8) showed that the sensitivity of FAST scan in the BAT detection in cases with reference to CT was 90.5% (38/42*100), the specificity was 100% (55/55*100), the positive predictive value was 100% (38/38*100) and the negative predictive value was 93.2% (55/59*100). Accuracy was 96%. There was great agreement between CT findings and FAST findings with highly significance in detection of BAT.

Table (8): Accuracy of FAST scan in the detection of BAT in cases regarding CT (n =97)

	CT findings			Kappa	P value
FAST findings	Abnormal	Normal	Total	0.915	**≤0.001***
Abnormal	38 (TP)	0 (FP)	38		
Normal	4 (FN)	55(TN)	59		
Total	**42**	**55**	97		

DISCUSSION

The current research included 97 cases more than or equal to 18 years of age attending the Emergency Department in Suez Canal University Hospital with BAT. This research aimed to evaluate the diagnostic accuracy of liver enzymes tests for the detection of hepatic injury in adult cases with BAT.

In the current research, the majority of frequent reason for the BAT was road traffic accidents (64.9%), afterward falls from height (18.6%), direct trauma (8.2%), and quarrels (8.2%). Similarly, in the research of **Mehta *et al.*** [9] stated that the most common cause for BAT is road traffic accident accounted for 53% of cases.

In the present study, out of 97 patients 17 (17.5%) cases with liver injury, 10 (58.8%) of patients had liver injury grade I, 4 patients (23.5%) patients had liver injury grade II and 3 patients (17.6%) had liver injury grade III. No other grades reported in our study**.** On the contrary, **Shrestha *et al.*** [10] showed that among the ninety-six cases admitted with BAT, thirty-eight cases had hepatic injury. There were four (10.5%) cases with grade I injuries, eleven (28.9%) with grade II injuries, eighteen (47.4%) with grade III injuries, in addition to five (13.2%) with grade IV injuries. There was no grade V injury stated in their research.

Our research illustrations that the FAST scan sensitivity in the detection of hepatic injury in patients with reference to CT was 100% (17/17*100), the specificity was 100% (80/80*100), the positive predictive value was 100 % (17/17*100) and the negative predictive value was 100% (80/80*100) Accuracy was 100%. There was great agreement between CT findings and FAST findings, with high significance in the detection of liver injury.

The current research illustrations that the sensitivity of elevated level of ALT > 50 in the detection of liver injury in cases. Regarding CT, sensitivity was 70.6% (12/17*100), the specificity was 100% (55/55*100), the +ve predictive value was 100% (12/12*100), the (-ve) predictive value was 94% (80/85*100). Accuracy was 94% with statistical significance (p<0.001).

The sensitivity of elevated level of AST > 40 in the detection of liver injury in cases with reference to CT, sensitivity was 82.4% (14/17*100), the specificity was 100% (55/55*100), the +ve predictive value was 100% (14/14*100) and the -ve predictive value was 96.4% (80/83*100). Accuracy was 96.7% with statistical significance (p<0.001). Also, regarding the ROC curve, the cut-off values for the hepatic injury were 108 U/l & eighty U/l for ALT & AST correspondingly. Similar to **Shrestha *et al.*** [10] study, which found that the sensitivity and specificity for the liver injury were AST (71.7% and 90%) and ALT (77.8% and 94.1%) respectively. Also, found that the cut-off values for the hepatic injury were 106 U/l & eighty U/l for ALT and AST correspondingly. In agreement with **Koyama *et al.*** [11] research, which stated that the best cut-off value of ALT and AST was 109 U/l & ninety-seven U/l correspondingly, for cases with hepatic injury in BAT. Also stated that AST ≥ 109 U/l had a specificity of 82 %, a sensitivity of 81 %, a +ve predictive value of thirty-two percent, and a -ve predictive value of ninety-eight percent. Whereas for ALT ≥ 97 U/l, specificity was 88 %, sensitivity of 78%, +ve predictive value of 41% and -ve predictive value of ninety-eight

percent correspondingly, and for the combination of ALT ≥ 97 U/l and/or AST ≥ 109 U/l were 84, 32, 81, 98 % correspondingly. Other research of **TIAN *et al*. [(12)]** illustrated that ALT > 57 had specificity of 84.8%, sensitivity of 92.2%, +ve predictive value of 85.6% and -ve predictive value of 91.8%. It also showed that AST below 113 had sensitivity of 74.4%, specificity of 91.3%, -ve predictive value of 78.5% and +ve predictive value of 89.3%.

The recent study showed that the FAST scan sensitivity in the observation of BAT in cases with reference to CT was 90.5% (38/42*100), the specificity was 100% (55/55*100), the positive predictive value was 100% (38/38*100) and the negative predictive value was 93.2% (55/59*100). Accuracy was 96% with statistical significance (p<0.001). Similarly, **Pokhariya *et al*. [(13)]** study showed that FAST sensitivity was 87.5% and FAST specificity was seventy-five percent. NPV of FAST was eighty percent compared to CT-scan. Unlike **Baghi *et al*. [(14)]** research, illustrated that the specificity, sensitivity, +ve and -ve predictive value of the FAST test were 23.3%, 52.4%, 60% & 84.4% respectively.

RECOMMENDATION

It is suggested to perform this research with a greater sample size & widely to attain more reliable outcomes. We recommend the routine use of serum transaminase levels in association with FAST as diagnostic tests in blunt abdominal trauma patients. Follow up lab measures should be considered as it rise with higher grades of liver injury.

LIMITATIONS

The research sample size was relatively small. Cases of liver injury are few. We couldn't measure a follow up ALT and AST levels. Patients may have elevated serum liver enzymes and they don't know that so, the doctor will not know.

CONCLUSION

The study reported that the best cut-off values of ALT & AST for hepatic injury in blunt abdominal trauma were ≥108.2 U/l & eighty U/l correspondingly. There was a critical relationship between AST and ALT and hepatic injuries after BAT. All cases with enhanced AST and ALT in correlation with +ve FAST must be excluded from having hepatic injuries & should be managed accordingly, based on the presented resources. In Egypt, where Computed Tomography scan is not presented in every center, the high concentration of ALT & AST in correlation with +ve FAST might enable the surgeons to timely refer suspected cases with hepatic injury to a tertiary center. In tertiary centers, it could assist surgeons in going for conservative treatment & monitoring of mild hepatic damage that resulted from BAT.

Conflict of interest: None to declare.
Funding: None to declare.

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