Original Research Article

Hepatic transaminases as predictors of liver injury in abdominal trauma

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ABSTRACT

Background: Our aim was to determine the usefulness of hepatic transaminases as hematological markers to predict the presence and severity of liver injury in adult patients with abdominal trauma.

Methods: This is a retrospective study of patients admitted with abdominal trauma (blunt and penetrating) over a three-year period. Grading of liver injury was based on CT-scan or surgical findings. Patients in whom liver enzymes were estimated in the first 48 hours were included.

Results: Out of the 66 patients in the study, 23 (63.89%) patients had minor liver injuries, while 13 (36.11%) had major liver injuries. Injury was blunt in 63 (95.45%) and penetrating in 3 (4.54%) patients. The mortality rate was 7.57% (n=5). The median SGOT and SGPT levels in the liver injury group were higher than those in the non-liver injury group SGOT (209LI vs. 43.5) U/L and SGPT (283.22 vs. 72.97) U/L, respectively, (p=0.001). Receiver operating characteristic (ROC) curve assessment, showed the optimum SGOT and SGPT thresholds to be >112.5 and >120.5U/L respectively, which were strongly associated with the presence of liver injuries. There was significant correlation between liver transaminases with grade of liver injury, SGOT (p=0.013) and SGPT (p=0.004).

Conclusions: SGOT and SGPT values >112.5 and >120.5U/L respectively, are strongly suggestive of liver injury. Hepatic transaminases are useful screening hematological markers for liver injuries and should be included in the initial trauma blood test panel and may guide in the decision making especially in medical centers with limited facilities.

Keywords: Abdomen, Elevated, Hepatic enzymes, SGOT, SGPT, Trauma

INTRODUCTION

Although the liver is the most frequently injured organ in polytraumatized patients with open or blunt abdominal trauma, the proper management of hepatic injuries continues to be a challenge even for experienced surgeons.[1,2]

The identification, diagnosis and treatment of liver injuries at times may be tricky as the range of injuries may vary from minor contusions to more serious lacerations or rupture, coupled with a clinical spectrum ranging from a hemodynamically stable to hemodynamically unstable patient. Various anatomical factors make the liver vulnerable to injury.[3]

Missed injuries continue to be a concern in the management of patients with abdominal trauma and delay in diagnosis is often associated with adverse outcome. Hodgsons et al in their study have shown that that

undiagnosed hepatic injuries accounted for up to 37% of deaths in the emergency department.[4]

The diagnostic modalities for abdominal trauma include Diagnostic peritoneal lavage (DPL), Focused Assessment in Sonography for Trauma (FAST) and Computed Tomography Scan (CT). CT scan is considered as the imaging work horse in abdominal trauma and is regarded as a valuable imaging tool in detecting liver injuries in hemodynamically stable patients who have sustained abdominal trauma.[5,6]

However, diagnostic modalities like the CT scan and FAST may not be readily available at all centers. Also, the CT scan is expensive, and it may be difficult to perform for patients who are unstable for transportation. Hence, the need for a simple and less sophisticated screening tool.

A few studies in children have demonstrated the usefulness of performing simple laboratory tests, such as estimating the levels of serum hepatic transaminases, to identify the presence of liver injury in abdominal trauma.[7-10] This was based on the presumptive understanding that during liver injury hepatic transaminases stored in the hepatocytes are released into the blood stream, resulting in elevated levels, whereby presence could be picked up by performing simple blood tests.

However, there are only very few studies showing the usefulness of elevated hepatic enzymes as predictors of liver injury in adult patients with abdominal trauma. This is probably because liver function tests may not be a part of routine trauma blood test panel in many centers.

The aim of present study was to determine whether hepatic transaminases namely, serum glutamic oxaloacetic transaminase (SGOT/AST) and serum glutamic pyruvic transaminase (SGPT/ALT) levels could predict the presence and severity of liver injury following abdominal trauma in adults.

METHODS

This is a retrospective study, conducted at the MOSC Medical College, Kolenchery, which is a 1200 bedded rural teaching hospital in Cochin, India. The data was obtained from the medical records of all patients admitted with blunt and penetrating abdominal trauma during this period. Adults (defined as patients above 12 years of age) who had sustained blunt or penetrating abdominal injury were included in the study. Patients in whom the required hematological tests were not obtained in the first 48 hours, patients 12years of age and below, patients with prior history of liver disease, patients who had history of alcohol consumption at the time of trauma and patients who died in the emergency department were excluded from this study.

The required laboratory tests (hematological markers) serum glutamic oxaloacetic transaminase (SGOT) also known as aspartate aminotransferase (AST); serum glutamic pyruvic transaminase (SGPT) also known as alanine aminotransferase (ALT) and total white blood cell (WBC) count.

The diagnosis and grading of liver injury was based on computed tomography (CT) scan or surgical findings. In patients who were operated, the surgical findings were considered in preference to the CT findings for evidence and extent of liver injury. The classification of the grade of liver injury was based on the organ injury scale described by the American association of surgery for trauma (AAST).

The data collected included age, gender, trauma mechanisms, injury the AAST grade of liver injury, length of stay (LOS), concomitant injuries, laboratory tests results of (SGOT/AST) and (SGPT/ALT), total WBC count and the final outcome. The values were compared with reference ranges for our institution (Table 1).

Table 1: Institutional reference ranges of SGOT, SGPT and WBC values.

Laboratory investigation	Normal range
SGOT	8-40IU/L
SGPT	5-35IU/L
WBC	4000-10000

The patients who met the inclusion criteria were further subdivided into two groups: liver injury group (IL) and the no liver injury (NIL) group. The patients with liver injuries were further divided into two groups based on the grade of liver injury.

Statistical operations were performed using SPSS Statistics 21 for Windows (SPSS Inc., Chicago, IL, USA). The Mann-Whitney test was used to compare the median values among the non-parametric groups. Spearman's test was used to find association between SGOT and SGPT with grade. All p-values reported were 2 sided and were considered significant at $P<0.05$. The receiver operating characteristic (ROC) curves were plotted to identify the threshold and likelihood ratios based on the cut off values for the liver transaminase levels in patients with liver injuries were compared with patients with abdominal non-liver injury.

RESULTS

Characteristics of the study group, out of 310 charts reviewed, 66 patients who met the inclusion criteria were included in this study. The mean age was 39.68 (range 14-82) years. These patients were further sub-divided into 2 groups: patients with liver injuries IL (n=36) and without liver injuries NIL (n=30). The characteristics of the two groups are shown in Table 2.

Table 2: Patient characteristics of the two groups.

	Liver injury (N=36)	No liver injury (N=30)
Age: mean (range)	39.25(14-74)	40.2(19-82)
Male	31	26
Female	05	04
Blunt injury	34	29
Penetrating injury	02	01
Length of hospital stay mean (range)	12.33(1-37)	10.33(1-25)
Surgical intervention	10	11
Mortality	4	1

There were 36 (54.5%) patients in the liver injury group and 30 (45.5%) patients the non-liver injury group. In both groups there was a preponderance of males. There was no significant difference in the ages, length of hospital stays or need for surgical intervention or mortalities in both the groups. The overall mortality rate was 7.57 % (n=5). The injury was blunt in 63 (95.45%) and penetrating in 3 (4.54%) patients. All three cases of penetrating injuries were due to stabs.

Liver injury group

The 36 patients with liver injuries were further grouped into 2 groups namely patients with minor and major liver injuries. According to the Organ Injury Scale of the American Association for the Surgery of Trauma (AAST), 23 (63.89%) patients had minor liver injuries (grades I, II and III) while 13 (36.11%) had sustained major liver injuries (grades IV-V). There were no patients with Grade VI injuries.

Table 3: Patients according to grade of liver injury.

	Liver injury grades	Number (%)
Minor liver injury (grades 1-3)	Grade 1	03(8.3)
	Grade 2	13(36.1)
	Grade 3	07(19.4)
Major liver injury (grades 4-6)	Grade 4	11(30.6)
	Grade 5	02(5.6)
	Grade 6	0(0)

The mean SGOT and SGPT levels in the liver injury group were higher than those in the non-liver injury group (SGOT 293. vs 80.5 and SGPT 283.22 vs. 72.97U/L, respectively, (p<0.00) figures 1 and 2. The Median SGOT and SGPT levels in the liver injury group were higher than those in the non-liver injury group SGOT (209 LI vs. 43.5) U/L and SGPT (283.22 vs. 72.97) U/L, respectively, (p=0.001). There was no significant difference between WBC of liver injury patients and non-liver injury patients (p=0.057).

Table 4: Relationship between SGOT and SGPT in the two groups.

Laboratory test	Livery injury (N)	Minor liver injury	Major liver injury	No liver injury (N)	Sensitivity; specificity and predictive values
SGOT>	24	14	10(grade 4,5)	7	Positive predictive value =77.42%
SGOT≤	12	9	3(grade 4)	23	Negative predictive value=65.71%
					Sensitivity=66.7%; Specificity=76.7%
SGPT>	25	14	11(grade 4,5)	7	Positive predictive value =83.33%
SGPT≤	11	10	1(grade 4)	23	Negative predictive value=69.44%
					Sensitivity=69.4%; Specificity=83.3%

Table 5: Results of different studies from literature.

Study year	No. of patients	Cut off SGOT/AST	Cut off SGPT/ALT	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Sahdev et al	149	>130	>130	100	77	-	-
Stassen, et al	67	>360	-	78	90	-	-
Koca B et al	44	481	498	AST-86% ALT-86%	AST-73% ALT-81%	-	-
Chang et al	419	>200	>125	87.3%	80.3%	72.3%	92.2%
Bilgic I et al	96	b130	≤76	AST -80.26 ALT -77.63	AST - 94.74 ALT-100.00	AST-98.4 ALT-100.0	AST-54.5 ALT-52.8
Zachariah et al	66	>112.5	>120.5	AST-66.7% ALT-69.4%	AST-76.7% ALT-83.3%	AST-77.42% ALT-83.33%	AST-65.71% ALT-69.44%

The liver transaminase levels in patients with liver injuries were compared with patients with abdominal non-liver injury by plotting the receiver operating characteristic (ROC) curves to determine the threshold in the presence or absence of liver injury. Using the ROC curve assessment, the optimum SGOT and SGPT

thresholds were determined to be >112.5 and >120.5 U/L respectively.

SGOT levels yielded 66.7% sensitivity, 76.7% specificity, 77.42% positive predictive value, 65.71% negative predictive value. The SGPT levels yielded 69.4% sensitivity, 83.3% specificity, 83.33% positive predictive value, 69.44% negative predictive value (Table 4). Only one patient with grade 4 liver injury had SGPT levels less than the thresholds and only 3 patients had SGOT levels less than threshold values. In all these patients the liver enzymes levels were higher than the normal reference range for our hospital.

All the patients with grade 5 liver injury the enzyme levels of transaminases were higher above the threshold levels. The results of receiver operating characteristic curves analysis for liver enzymes were; SGOT: (AUC=0.817, 95% CI:0.717 -0.916, P <0.001); SGPT: (AUC=0.806, 95 % CI:0.700 - 0.913, P <0.001) respectively (Figures 3, 4 and 5).
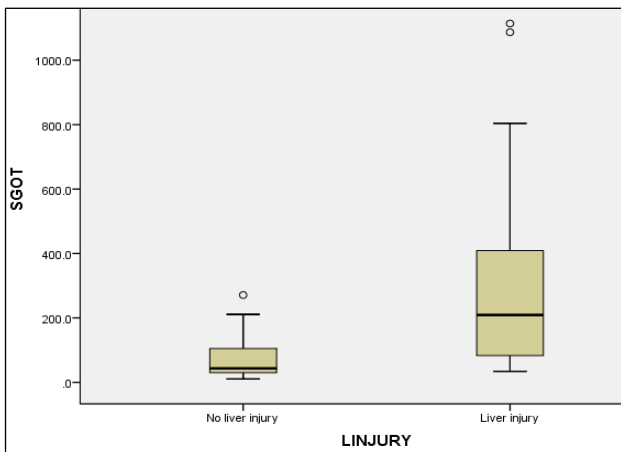

Figure 1: SGOT in liver injury and non-liver injury patients.
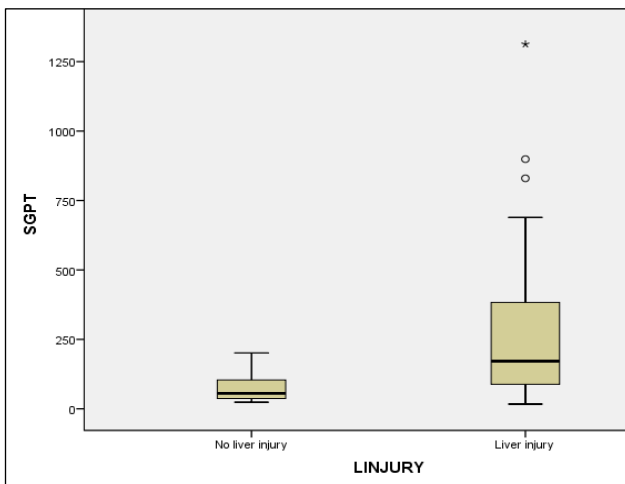

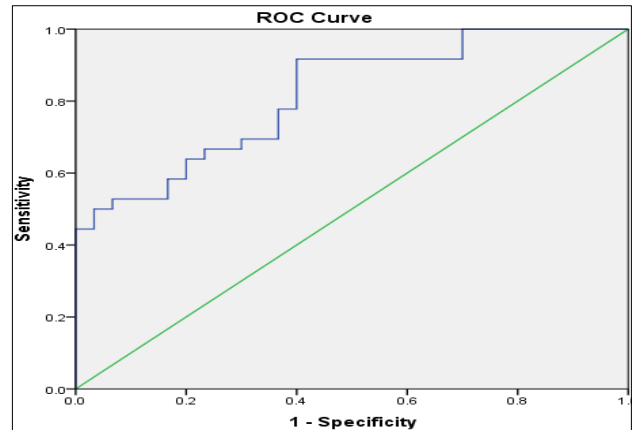**Figure 2: SGPT in liver injury and non-liver injury patients.**

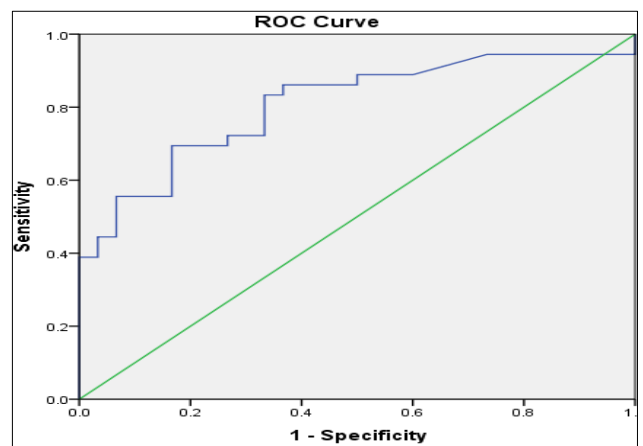**Figure 3: Receiver operating characteristic (ROC) for SGOT.**

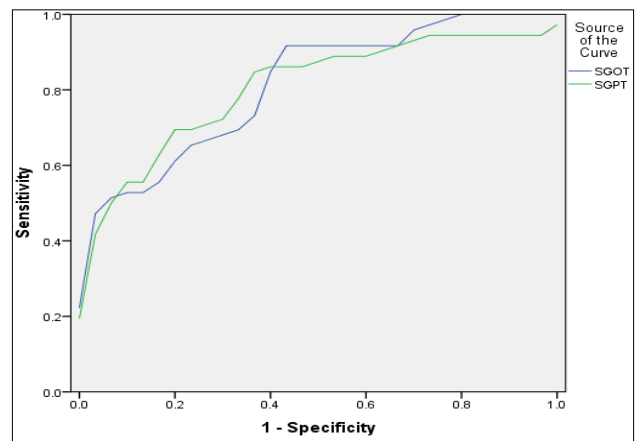**Figure 4: Receiver operating characteristic (ROC) for SGPT.**

Figure 5: Receiver operating characteristic (ROC) for SGOT and SGPT levels to predict liver injury.

DISCUSSION

Advances in imaging techniques along with better in hospital intensive care monitoring facilities have brought about a paradigm shift in the diagnosis and management

of patients with liver injuries. There is a recent trend towards non-operative management in hemodynamically stable patients who have sustained liver injury, in the absence of injury to other organs. About two decades ago, most of the liver injuries were subjected to surgical exploration. However, it was observed that about 86% of liver injuries had stopped bleeding at the time of surgical exploration and 67% of operations performed for blunt abdominal trauma were nontherapeutic.

Abdominal CT scanning has become the imaging tool of choice in patients who have sustained abdominal trauma. However, it can be only performed if the facility is available and the patient is hemodynamically stable.[11] Also, at times it may be difficult to decide whether (CT) scans are required to rule out liver laceration in patients who have sustained minor blunt abdominal trauma or less severe injuries.

In many hospitals which do not have access to CT scan, the initial assessment is usually done using FAST, which has advantages of being noninvasive and also can be performed as a bedside procedure in trauma patients, with a reported sensitivity and specificity of 63-100% and 95-100%, respectively. However, there are certain limitations. Its sensitivity for small amounts of fluid is low and volumes less than 400 ml cannot be readily detected. In the absence of free fluid, FAST may not be sensitive for parenchymal liver injuries.[12,13] The primary purpose of FAST is to detect the presence of intraperitoneal fluid. It is not designed to identify the degree of organ injuries. Hepatic injuries over the dome or lateral segment of the left lobe of the liver can easily be missed on ultrasonography. The main limitations of FAST are that it may not be available in all centers and requires adequately trained staff and, may not be effective at grading liver injuries.

Studies in animal models and humans have shown that the levels of hepatic transaminases enzymes increase within a few hours after blunt liver trauma, and their magnitude correlated with the severity of liver injury. Various studies in children have demonstrated the usefulness of elevated hepatic enzymes as markers for hepatic injury. Homes et al also demonstrated that high AST, ALT levels on admission are highly suggestive of hepatic injury and may be a warning sign for the clinician, even in the absence of obvious clinical findings.[14] The same rationale could be implicated for adults who have sustained abdominal trauma. However, there are very few studies demonstrating this association.

Bilgic et al in their study on 96 patients, suggested that elevated hepatic transaminases as valuable biological makers for predicating the presence and severity of liver injury. According to their findings the optimum threshold levels were determined to be <76 U/L, and ≤130 U/L for minor liver injuries.[15] Lee et al reported that a elevations of serum AST greater than 100 IU/L, ALT greater than 80 IU/L, and WBC count greater than 10000/mm^3 had a

sensitivity and specificity of 90.0% and 92.3%, respectively and are strongly associated with liver laceration and these patients are candidates for further imaging studies.[16] Stassen et al have shown that in patients who had sustained abdominal trauma, those with negative FAST but AST >360 IU/L had a 88% chance of having hepatic injury and a 44% chance of having a hepatic injury of grade III or greater.[17] Patients with an AST level of <360 IU/L, only had a 14% chance of having a liver injury and no chance of having an injury of grade III or greater. Similarly, Srivas-tava et al; Tan et al; Tian et al; and Sahdev et al have demonstrated a strong association of elevated hepatic transaminases with the occurrence of liver injury (Table 5).[18-21]

However, others such as Al-Mulhim and Mohammed are of the opinion that the initial serum SGPT values were not useful in determining the presence of hepatic injury in adults with CT proven hepatic injury.[22]

In this study we found that hepatic enzymes SGOT and SGPT to be reliable indicators for the presence of liver injury. We also observed that SGPT was a more reliable predictor than SGOT, since it had a higher sensitivity, specificity, positive predictive value and negative predictive value. Although 11(30.3%) of the patients with liver injuries had SGPT less than their thresholds in our study, most of them only minor liver injuries. only 1(2.7%) patient had major liver injury. Similar observations were made by Tian et al in their study of 182 patients with abdominal trauma. They demonstrated that 7 (7.8%) and 23 (25.6%) of the patients with liver injuries had ALT (SGPT) and AST(SGOT) levels less than their thresholds most of them only had minor liver injuries.[20]

Limitation of the present study was a retrospective study with a small the sample size. In our hospital routine estimation of liver enzymes are not ordered as a part of routine blood test panel for abdominal trauma, by all admitting units. Moreover, we included patients whose liver function tests were done only during the first 48hrs following trauma in order to standardize the timing and reduce bias. Moreover, as this is a rural institution there is a low threshold for ordering CT scan, as majority of the patients may not be able to afford the investigation.

We therefore feel that estimation of liver enzymes may be useful screening tool in patients with abdominal trauma. Patients in whom ultrasonography may be inconclusive, estimation of serum transaminases may indicate the presence of liver injury. In hemodynamically stable patients, initial evaluation of liver transaminase levels may be useful in determining the need for computed tomography (CT).

CONCLUSION

SGOT and SGPT values >112.5 and >120.5U/L respectively, are strongly suggestive of liver injury.

SGPT is a better predictor of liver injury than SGOT. Hepatic transaminases are useful screening hematological markers for liver injuries and should be included in the initial trauma blood test panel and may guide in the decision making especially in medical centers with limited facilities. Larger prospective studies are needed to determine their optimal cutoff values and the true potential of these biological markers.

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