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Original Research Article

Evaluating the role of liver enzymes as predictors of severity of liver injury in patients with blunt abdominal trauma

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ABSTRACT

Background: Liver is the 2nd most common organ affected in patients with blunt abdominal trauma (BAT). Computed tomography (CT) is the gold standard in the initial evaluation of the hemodynamically stable patient with suspected liver trauma. However, a challenge exists in centers devoid of CT scan, where an elevation in hepatic transaminases may provide guidance for the emergency physician in seeking further imaging and/or surgical consultation.
Methods: In patients with suspected BAT blood samples were taken for estimation of liver enzymes (AST and ALT). All patients underwent contrast enhanced CT of the abdomen. Hemodynamically unstable patients were taken up for laparotomy and the findings were recorded. Based on imaging / surgery patients were subdivided into 2 groups (with and without liver injury). Liver injuries were graded according to organ injury scale by American Association of Surgery for Trauma.
Results: ALT>100 units had 100% sensitivity and specificity improved to 83.78%. The mean level of ALT in patients without liver injury was around 64. This increased to 142 in grade 1 and upto 780 units in grade 4 injury. The same rising trend was seen when AST was evaluated against grade of Liver injury. This was statistically significant ($p<0.01$).
Conclusions: ALT is the better of the transaminases in predicting liver injury. The rise in transaminases is directly proportional to grade of liver injury.

Keywords: BAT, Liver enzymes

INTRODUCTION

Blunt abdominal trauma (BAT) is a common reason for presentation to an emergency department (ED). Road traffic accidents account for the majority of blunt injuries. Injury to both solid and hollow organs may occur. The liver is frequently injured, second only in frequency to the spleen in.[1,2] Blunt liver injury can vary from minor contusions to major lacerations or avulsions, and has an associated spectrum of morbidity and mortality. Two types of blunt liver trauma have been described-deceleration (shearing) trauma and crush injury. Blunt trauma can rupture Glisson's capsule and can also lead to subcapsular or intraparenchymal haematoma formation.

Classification of liver injury

The American Association for the Surgery of Trauma has adopted for general use, the classification of liver injury described initially in 1989 by Moore and colleagues, and revised subsequently in 1994 (Table 1).[3] Grade I or II injuries are considered minor; they represent 80-90% of all cases and usually require minimal or no operative treatment. Grade III-V injuries are generally considered

severe and may require surgical intervention, while grade VI lesions are regarded as incompatible with survival. Schweizer et al have described a protocol-based liver trauma management system employing this classification system that permits lesser injuries to be treated non-operatively and allows more appropriate selection of patients for operative treatment.

Table 1: Grading system for liver injuries based on CT findings.

Grade	Description of injury
1	Subcapsular hematoma less than 1cm in maximal thickness, capsular avulsion, superficial parenchymal laceration less than 1cm deep, and isolated periportal blood tracking
2	Subcapsular hematoma 10-50% surface area, laceration 1-3cm deep, <10cm in length, and parenchymal/subcapsular hematomas 1-3cm thick
3	Subcapsular haematoma>50% surface area or expanding, laceration >3cm deep
4	Parenchymal disruption involving 27-75% of hepatic lobe or 1-3 couinaud's segments in a single lobe, lobar destruction, or devascularization
5	Parenchymal disruption >75% of lobe or >3 couinaud's segments, juxtahepatic venous injuries
6	Hepatic avulsion

Note: advance one grade for multiple injuries up to grade II.

Most liver injuries are traditionally diagnosed by imaging studies (USG, contrast enhanced CT scan) or exploratory laparotomy. Focused abdominal sonography for trauma (FAST) is able to sensitively detect free fluid in the abdomen and pelvis, but the overall sensitivity of emergency FAST for detection of blunt liver injury was reported to be as low as 64%.[4] When there are parenchymal injuries of the liver only, with no free fluid, the sensitivity is.[5] Based on detection of free fluid, parenchymal injury or both, the overall sensitivity of emergency sonography for detection of blunt hepatic injury is 72%.[6]

Computed tomography (CT) is the standard diagnostic modality for stable trauma patients with a suspected abdominal injury.[7,8] However, accurate diagnosis of significant injuries could be delayed as not all health institutions worldwide have ready access to CT scans. In addition, a CT scan suite, at times, may not provide a safe environment for resuscitation and additionally has limitations for patients who are too unstable for transportation. The high cost of a CT scan does not permit its widespread use in screening all patients with blunt abdominal trauma.

A rise in serum aminotransferase (AST, ALT) level has been previously shown to indicate liver injury in patients with blunt hepatic injury. Presumably, as these transaminases are present in high concentration in hepatocytes, they are released into the circulation following acute traumatic liver injury.[9,10] Therefore, in this prospective observational study of patients admitted with blunt abdominal trauma, the significance of raised serum AST, ALT for the diagnosis of hepatic injury and its severity will be evaluated.

Aims and objectives

- To determine the sensitivity and specificity of liver enzymes (AST, ALT) in liver injuries patients following BAT.
- To answer the question: Can enzyme levels at presentation predict the severity of injury?

METHODS

This study was conducted at Government Medical College, Kozhikode, Kerala, India. It was a prospective observational study conducted for a period of15 months (Feb 2013 -May 2014).

Study subjects

All adult patients with blunt abdominal trauma aged>12 years

Exclusion criteria

- Patients with penetrating abdominal trauma
- Patients with Head injury whose GCS<10
- Patients who died in the emergency dept within 12 hours of presentation
- Patients with known history of liver diseases
- Patients positive for Hepatitis B & Hepatitis C surface antigen.

Study method

52 patients with blunt abdominal trauma were studied over a period of 15 months in the Emergency department of Government Medical College, Kozhikode, Kerala, India. Following initial triage and resuscitation, for all Blunt trauma abdomen patients, appropriate history, age, mechanism of injury, time of injury, whether alcoholic or not and recent consumption before the time of injury was obtained. Vital parameters (pulse, blood pressure, respiratory rate, and abdominal girth) at admission were recorded. Blood samples were taken for estimation of hemoglobin, haematocrit, leucocyte count and liver function tests (liver enzymes serum AST and ALT). The time of sample collection was recorded. All patients underwent contrast enhanced CT of the abdomen. Hemodynamically unstable patients were taken up for laparotomy and the findings on table were recorded in detail. Based on imaging/surgery patients were subdivided into 2 groups: With and without liver injury. Liver injuries were graded according to Organ Injury

Scale by American Association of Surgery for Trauma (1994 version). Length of hospital stay and outcome were recorded.

RESULTS

Liver injury was graded in accordance with AAST (American Association of surgery for Trauma). All patients underwent imaging with CECT abdomen to grade the extent of Liver injury. 2 patients had grade 1, 1 patient had grade 2 injury, 4 and 8 had grade 3 and grade 4 injuries respectively. There were no patients with the more severe grade 5 and grade 6 injuries during the period of the study (Table 2).

Table 2: Grade of liver injury.

Liver injury	Frequency	Percent
1	2	13.3
2	1	6.7
3	4	26.7
4	8	53.3
Total	15	100.0

Serum aminotransferase estimation (ALT and AST) were done for all patients during their routine blood investigations. The time of sample collection was recorded. The reference ranges for various blood tests as per our institution protocol is given below (Table 3).

Table 3: Institutional reference value (liver function test).

Parameter	Value
Total Bilirubin	0.2-1.3mg/dl
Direct Bilirubin	0-0.4mg/dl
AST/SGOT	5-40IU/L
ALT/SGPT	5-35IU/L
Alkaline Phosphatase	38-145U/L
Total Protein	6.9-8.2g/dl
Albumin	3.5-5g/dl

Calculation of sensitivity, specificity, positive predictive value and negative predictive value was made using various cut off levels of ALT and AST by using the chi square test for a 2x2 contingency table.

Table 4: ALT>50 U/L.

ALT raised	Liver injury		
	Yes	No	Total
Yes	15	17	32
No	0	20	20
Total	15	37	52

When ALT was taken alone, irrespective of AST levels, the following result was obtained (Table 4 and 5).

Table 5: ALT>100 units.

ALT raised	Liver injury		
	Yes	No	Total
Yes	15	6	21
No	0	31	31
Total	15	37	52

Sensitivity: 15/15 i.e. 100%; specificity: 31/37 i.e. 83.78%; positive predictive value: 15/21 i.e. 71.42%; negative predictive value: 31/31i.e. 100%.

The following result was obtained when AST alone, irrespective of ALT was considered (Table 6 and 7).

Table 6: AST>50 units.

AST raised	Liver injury		
	Yes	No	Total
Yes	15	18	33
No	0	19	19
Total	15	37	52

Sensitivity: 15/15 i.e. 100%; specificity: 19/37 i.e. 51.3%; positive predictive value: 15/33 i.e. 45.45; negative predictive value: 19/19 i.e. 100%.

Table 7: AST>100 units.

AST raised	Liver injury		
	Yes	No	Total
Yes	13	10	23
No	2	27	29
Total	15	37	52

Sensitivity: 13/15 i.e. 86.66%; specificity: 27/37 i.e. 72.97%; positive predictive value: 13/32 i.e. 40.62%; negative predictive value: 27/29 i.e. 93.10%.

Table 8: Both ALT and AST>100 units.

Both raised	Liver injury		
	Yes	No	Total
Yes	13	06	19
No	2	31	33
Total	15	37	52

Sensitivity: 13/15 i.e. 86.7%; specificity: 31/37 i.e. 83.8%; positive predictive value: 13/19 i.e. 68.42%; negative predictive value: 31/33 i.e. 93.93%.

From the Tables 4-8, it was clear that liver enzymes predicted liver injury with reasonable sensitivity and specificity. When ALT>50 alone or AST>50 units, there was 100% sensitivity, though it lacked specificity. ALT>100 units had 100% sensitivity and the specificity improved to 83.78%. AST>100 units showed sensitivity and specificity of 86% and 72% respectively. When both enzymes were taken into account, the sensitivity remained at 86% but specificity improved to 83%. Hence it showed that ALT at a cut off of 100 units was better in predicting liver injury compared to AST alone or in conjunction.

Further analysis was carried out to determine whether the degree of elevation of enzymes correlated with the severity of injury (Table 9 and 10). The Tables 9 and 10 show an increase in the level of ALT and AST with increasing grade of injury. The mean level of ALT in patients without liver injury was around 64. This increased to 142 in grade 1 and upto 780 units in grade 4 injury. The same rising trend was seen when AST was evaluated against grade of Liver injury. This was statistically significant ($p<0.01$). However, there was only 1 patient with grade 2 liver injury but no grade 5 and grade 6 injuries. Therefore, more subjects with liver injuries need to be studied to achieve an authentic conclusion for the same.

Table 9: ALT/SGPT elevation correlated with severity of liver injury.

Grade of injury	No.	Mean	Std. deviation	Std. error	Minimum	Maximum
No injury	37	64.24	63.894	10.504	13	305
1	2	142.50	37.477	26.500	116	169
2	1	328			328	328
3	4	211.75	46.679	23.339	163	270
4	8	780.50	584.923	206.802	108	1679
One way ANOVA						
	Sum of squares		**Degree of freedom**	**Mean square**	**F**	**Sig.**
Between groups	3399399.997		4	849834.999	15.665	0.000

Table 10: AST/SGOT elevation correlated with severity of liver injury.

Grade of injury	No.	Mean	Std. deviation	Std. error	Minimum	Maximum
No injury	37	77.27	63.413	10.425	16	266
1	2	138	22.627	16.0	122	154
2	1	475			475	475
3	4	211.75	142.710	71.355	65	407
4	8	696.25	471.761	166.793	60	1352
One way ANOVA						
	Sum of squares		**Degree of freedom**	**Mean square**	**F**	**Sig.**
Between groups	2608617.895		4	652154.474	17.353	0.000

DISCUSSION

The liver continues to be the second most commonly injured organ in blunt abdominal trauma. Physicians dealing with blunt abdominal trauma often use biochemical tests and radiographic imaging to aid in clinical assessment. Patients with BAT causing liver injury may present to the ED with hemodynamic instability and/or obvious signs of hemoperitoneum. These patients usually do not represent a diagnostic challenge, as they generally receive either prompt abdominal imaging (CT scan) or laparotomy or both. Usually the more difficult diagnosis is that of lesser, but still significant, liver injury in the stable patient with minimal physical findings after BAT. It should be emphasized, however, that the majority of patients with blunt liver injury do well: generally, greater than 80% of adults and up to 97% of children receive initial non-operative management and this conservative treatment is successful more than 80% of the time.[11-13]

Elevations of the serum liver enzymes aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are known to be associated with blunt traumatic liver injury.[9,10] Presumably, because these transaminases are present in high concentrations in hepatocytes, they are released into the circulation in large quantities after acute traumatic hepatocellular injury. With this knowledge, the question remains: Can elevated liver enzymes predict liver injury in stable patients after BAT?

Table 11 shows data from all articles that either published, or allowed for the calculation of, the sensitivity and specificity of elevated liver enzyme levels as a predictor of blunt liver trauma as well as data from the present study. The question not addressed by the mentioned studies (Table 11) is the exact cut-off point for AST and/or ALT over which BAT patients need a CT scan to rule out liver injury. This study specifically attempted to answer this question by calculating sensitivities and specificities at various cut off points. These are further tabulated (Table 12).

Table 11: Comparative studies.

Study, Year	No. of patients	Diagnostic method	AST	ALT	Sensitivity %	Specificity %	Notes
Oldham et al[14]	95	CT, ultrasound	>200	>100	100	84	Paediatric; prospective
Hennes et al[15]	43	CT	>450	>250	100	92	Pediatric; retrospective; stable (all had AST and ALT >35)
Sahdev et al[16]	149	CT, ultrasound, DPL	>130	>130	100	77	Adult; retrospective; stable + unstable
Puranik et al[9]	44	CT	>450	>250	93	100	Pediatric; retrospective; stable
Stassen et al[10]	67	CT	>360	-	78	90	Adult; retrospective; stable; one penetrating
Present study	52	CT		>100	100	83.78	Adult; prospective; stable

AST=Aspartate aminotransferase; ALT=Alanine aminotransferase; DPL=diagnostic peritoneal lavage.

Table 12: Sensitivities and specificities at various cut off points.

AST	ALT	Sensitivity %	Specificity %
-	>50	100	54.1
-	>100	100	83.78
>50	-	100	51.3
>100	-	86.66	72.97
>100	>100	86.7	83.8

From the Table 12, it is clear that Serum ALT alone had a sensitivity of 100% and specificity of 83.7% at a cut-off point of 100IU/l in comparison to Serum AST alone or both enzymes combined together($p<0.001$). When both ALT and AST were raised above 100 units, there was a slight decrease in sensitivity with no change in specificity ($p<0.001$). Similarly, statistically significant and increasing enzyme levels were observed among patients with increasing grade of liver injury (Table 13).

Table 13: For ALT/ SGPT.

Grade of injury	Present study			Srivastava et al[17]	Tian et al[18]
	No of patients	Mean ALT (U/L)	Mean AST (IU/L)	Mean ALT (IU/L)	Mean ALT (IU/L)
No injury	37	64.24	77.27	-	35
1	2	142.50	138	259	96
2	1	328	475	341	306
3	4	211.75	211.75	1067	263
4	8	780.50	696.25	1622	628
5	-	-	-	-	681

p-value<0.001(one way ANOVA).

Srivastava et al found that ALT level was a powerful predictor of the severity of liver injuries, with there being a drastic increase in ALT with higher grades of Liver injury.[17] However, no patients with grade 5 and 6 liver trauma, which includes extremely serious and vascular injuries, reported during the period of study. A study conducted by Tian et al found a trend that the more severe the liver injury of the patients, the higher the liver enzyme levels, but their study further demonstrated that patients with elevated ALT>100 U/l, AST>113 U/l did not necessarily have major liver injury.[18] This study is in agreement with the latter study, with mean ALT levels increasing with increasing grade of injury. But further studies with a larger sample size and inclusion of patients with grade 5 and 6 liver injuries are needed to achieve an authentic conclusion for the same.

No patients with grade 5 and 6 liver trauma, which includes extremely serious and vascular injuries, reported during the period of study.

The time interval between injury and specimen collection could not be standardized. This can be attributed to delayed referrals from less specialized centers and late presentations from accidents occurring at remote areas. But in spite of this, all specimens were collected within

48 hrs of the injury, and no patient with liver trauma was missed on this account.

In the present study, only 3 of 52 blunt trauma patients had given history of recent alcohol consumption at the time of their injury. Hence further studies are needed to rule out whether alcohol is an independent and significant cause of liver enzyme elevation in the patients.

CONCLUSION

The present study supports the hypothesis that raised Liver enzymes (AST and ALT) successfully predict hepatic injury in stable patients of blunt abdominal trauma. Of these enzymes, ALT>100 IU/L has a higher sensitivity and specificity when compared to AST levels. Higher levels of transaminases, following blunt trauma, may also suggest a higher-grade liver injury.

In addition, benefits like easy availability, low cost, and quick results may make screening by serum ALT an extremely valuable tool in the work up of patients with blunt abdominal trauma, especially at remote centres of developing countries that do not have easy access to expensive/expert radiological evaluation.

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REFERENCES

1. Carrillo EH, Wohltmann C, Richardson JD, Polk HC. Evolution in the treatment of complex blunt liver injuries. Current problems in surgery. 2001;38(1):A3-60.
2. Marx JA. Rosen's emergency medicine: concepts and clinical practice. 5th ed. St. Louis: Mosby; 2002:415-420.
3. Moore EE, Cogbill TH, Jurkovich GJ. Organ injury scaling: spleen and liver (1994 revision). J Trauma. 1995;38:323-4.
4. Kirkpatrick AW, Sirois M, Laupland KB. Prospective evaluation of hand-held focused abdominal sonography for trauma (FAST) in blunt abdominal trauma. Can J Surg. 2005;48:453-60.
5. Richards JR, McGahan JP, Pali MJ. Sonographic detection of blunt hepatic trauma: hemoperitoneum and parenchymal patterns of injury. J Trauma. 1999;47:1092-7.
6. Piper GL, Peitzman AB. Current management of hepatic trauma. Surg Clin North Am. 2010;90:775.
7. Richards JR, Derlet RW. Computed tomography for blunt abdominal trauma in the ED: a prospective study. Am J Emerg Med. 1999;16:338-42.
8. Kreimeyer S, Grenacher L. Modern imaging techniques for liver trauma. Chirurg. 2009;80:896.
9. Puranik S, Hayes J, Long J. Liver enzymes as predictors of liver damage due to blunt abdominal trauma in children. South Med J. 2002;95:203-6.
10. Stassen NA, Lukan JK, Carrillo EH, Spain DA, Norfleet LA, Miller FB, et al. Examination of the role of abdominal computed tomography in the evaluation of victims of trauma with increased aspartate aminotransferase in the era of focused abdominal sonography for trauma. Surgery. 2002;132(4):642-7.
11. Knudson M, Maull K. Nonoperative management of solid organ injuries. Surg Clin North Am. 1999;79:1357-71.
12. Pachter H, Knudson M, Esrig B. Status of nonoperative man- agement of blunt hepatic injuries in 1995: a multicenter experience with 404 patients. J Trauma. 1996;40:31-8.
13. Richardson J, Franklin G, Lukan J. Evolution in management of hepatic trauma: a 25-year perspective. Ann Surg. 2000;232:324-30.
14. Oldham K, Guice K, Kaufman R. Blunt hepatic injury and elevated hepatic enzymes: a clinical correlation in children. J Pediatr Surg 1984;19:457-61.
15. Hennes HM, Smith DS, Schneider K, Hegenbarth MA, Duma MA, Jona JZ. Elevated liver transaminase levels in children with blunt abdominal trauma: a predictor of liver injury. Pediatrics. 1990;86(1):87-90.
16. Sahdev P, Garramone R, Schwartz R. Evaluation of liver function tests in screening for intra-abdominal injuries. Ann Emerg Med. 1991;20:838-41.
17. Srivastava AR, Kumar S, Agarwal GG, Ranjan P. Blunt abdominal injury: serum ALT—a marker of liver injury and a guide to assessment of its severity. Injury. 2007;38(9):1069-74.
18. Tian Z, Liu H, Su X, Fang Z, Dong Z, Yu C, Luo K. Role of elevated liver transaminase levels in the diagnosis of liver injury after blunt abdominal trauma. Exp Therap med. 2012;4(2):255-60.

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