

## CASE REPORT OBSERVATIONS DE CAS

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# Elevated liver enzymes as a predictor of liver injury in stable blunt abdominal trauma patients: case report and systematic review of the literature

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Liver injury secondary to blunt abdominal trauma is a well-defined entity in emergency medicine. A challenge exists in the diagnosis of liver trauma in the stable, well-appearing patient with a history of blunt abdominal trauma. In centres lacking advanced diagnostic modalities an elevation in hepatic transaminases may provide guidance for the rural emergency physician in seeking further imaging and/or surgical consultation. We present a case report and a discussion of the literature.

The literature provided a broad spectrum of results. There appears to be a direct relationship between blunt liver trauma and elevation in liver transaminases. These results are especially evident in the pediatric population. Our findings may help guide the rural emergency physician in transfer and disposition decisions in patients in this situation.

Les lésions du foie secondaires à un traumatisme fermé de l'abdomen constituent une entité bien définie en médecine d'urgence. Le diagnostic des traumatismes du foie chez le patient stable qui semble bien mais qui a subi un traumatisme abdominal fermé pose toutefois un défi. Dans les centres qui n'ont pas accès sur place à des techniques de diagnostic avancées, une élévation des concentrations de transaminase hépatique peut guider le médecin urgentiste en milieu rural qui doit décider s'il faut demander une consultation en imagerie ou en chirurgie. Nous présentons un rapport de cas et une discussion sur les écrits.

La littérature médicale présente un vaste éventail de résultats. Il semble y avoir un lien direct entre le traumatisme fermé du foie et une élévation des concentrations de transaminase hépatique. Ces résultats sont particulièrement évidents dans la population pédiatrique. Nos constatations peuvent aider le médecin urgentiste rural à prendre des décisions sur le transfert et le traitement des patients dans une telle situation.

### INTRODUCTION

Blunt abdominal trauma (BAT) is a common reason for presentation to an emergency department (ED). Injury to both solid and hollow organs may occur. The liver is frequently injured in significant BAT, second only in frequency to blunt injury to the spleen.<sup>1,2</sup> Blunt liver injury can vary from minor contusions to major lacerations or avulsions, and has an associated spectrum of morbidity and mortality. Liver

injury can be difficult to diagnose in a stable patient after BAT. Diagnostic modalities include FAST (focused abdominal sonography in trauma), CT scanning, serial clinical examinations, diagnostic peritoneal lavage, and laboratory testing (including liver enzymes). The following is a case report in which elevated liver enzymes helped in the diagnosis of significant liver injury in a stable and well-appearing patient. This is followed by a systematic review of the literature on the topic

of using liver enzymes to predict liver injury in stable patients after BAT. Specifically, in the scenario where advanced diagnostic modalities are not available, the use of liver transaminases may assist the rural physician in triage and transportation issues in BAT.

## CASE REPORT

### *The trauma*

A 25-year-old man attended our emergency department approximately 1.5 hours after falling off his bicycle during his morning commute to work. The speed of the collision was not known. During the fall he landed on the blunt end of a wooden post with impact on his anterior/inferior right chest and abdominal right upper quadrant.

### *History and physical*

The patient was previously well, had no history of liver disease or ethanol abuse, and was on no medications. His chief complaint was epigastric pain, and on questioning he also admitted to slight pleuritic right chest pain without dyspnea. He was ambulatory, appeared well, and had the following vital signs; temperature 35.6°C, heart rate 68 beats/min, blood pressure 140/74 mm Hg, respiratory rate 16, SaO<sub>2</sub> 100% on room air. He had been triaged to the non-urgent portion of the ED; our department is an urban community hospital with a full complement of trauma services and annual patient visits in excess of 40 000. Physical exam revealed no abnormalities anywhere other than the anterior chest and abdomen. There was a faint curvilinear abrasion/contusion over the right chest/abdomen. The lungs were clear with good breath sounds bilaterally, and the thorax was stable and without crepitus. Bowel sounds were slightly diminished and the abdomen was soft with no signs of peritonism. There was slight epigastric tenderness, and no mass or organomegaly was palpable. No right upper quadrant tenderness was ascertained on examination. A digital rectal exam was deferred.

### *Diagnostics*

At this point the first author (A.H.R) felt it was very unlikely that the patient had any significant injury. A chest x-ray was done to rule out intrathoracic injury, and was normal. A FAST exam was

not available at the time. Blood was taken for evaluation of liver function tests and amylase in the thought that elevated values may indicate liver and/or pancreatic injury (Table 1). The elevation in the patient's liver transaminases was surprising, and prompted a CT of the abdomen, which revealed a grade III laceration of the liver and a small amount of hemoperitoneum (Fig. 1 and Fig. 2).

### *Outcome*

The patient continued to look and feel well in the ED, and his vital signs remained normal. A general surgeon was consulted, and the patient was observed in hospital for less than 24 hours with no specific treatment. He did well and reported no complications when contacted by telephone 5 weeks later. At that time his hemoglobin and liver enzymes were repeated and had returned to normal.

## DISCUSSION AND SYSTEMATIC LITERATURE REVIEW

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 (ultrasound or 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.

### *Treatment*

It is important to identify significant liver injury because such patients are at risk for short and long-

Table 1. Results of liver function and amylase tests

| Test                       | Values                   |         |
|----------------------------|--------------------------|---------|
|                            | Patient                  | Normal  |
| Hemoglobin                 | 133 g/L                  | 138–164 |
| White blood cell count     | 8.1 × 10 <sup>9</sup> /L | 2.0–8.7 |
| Platelets                  | 141 × 10 <sup>9</sup> /L | 150–400 |
| Amylase                    | 100 U/L                  | <200    |
| Alanine aminotransferase   | 249 U/L                  | <40     |
| Aspartate aminotransferase | 295 U/L                  | <35     |
| Lactate dehydrogenase      | 427 U/L                  | 99–250  |
| Gamma-glutamyl-transferase | 27 U/L                   | <50     |
| Alkaline phosphatase       | 66 U/L                   | 30–105  |
| Bilirubin                  | 6 µmol/L                 | <21     |

term sequelae and thus require appropriate observation and follow-up. Although rare (i.e.,  $\leq 5\%$  of blunt liver injury patients in total), delayed hemorrhage, hepato-vascular fistula, biliary fistula, abscess and hepatic cyst are all recognized complications of blunt liver injury.<sup>1,5,4</sup> 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.<sup>1,5-7</sup> In the less common instances when hemorrhage after blunt liver injury requires intervention, surgery may still not be necessary. Radiological transcatheter arterial embolization has been shown to be effective in managing such cases.<sup>8</sup>

### Liver transaminases

Elevations of the serum liver enzymes aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are known to be associated with blunt traumatic liver injury.<sup>9-15</sup> 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. It has been shown in animal models and human studies that not only does increase in the enzyme occur within a few hours after blunt liver trauma, the amount of the increase in the enzyme also correlates to the severity of liver injury.<sup>12-15</sup> For example, transaminase rise was found to peak at 3 hours in rabbit models with induced hepatic trauma.<sup>1</sup> With this knowledge the question remains: Can elevated liver enzymes predict liver injury in stable patients after BAT?

### Literature review

To examine this topic, a systematic English language literature review was conducted. The PubMed/Medline database was searched for all articles with a title and/or abstract containing the words "trauma," and "liver" or "hepatic," and "enzymes" or "transaminase" or "function." The literature review included all articles that matched the search terms as well as others identified from individual papers' reference lists. Table 2 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.<sup>16-20</sup>

Five other articles were of interest, although they did not allow for formal statistical analysis as above. 1) Grisoni and associates<sup>21</sup> documented a group of 9 stable children with liver injury diagnosed by ultrasound after BAT. All 9 had elevated liver enzymes. 2) An article by Coant and colleagues<sup>22</sup> showed that routine testing revealed 5 out of 50 "children without suspected abdominal injury who were being evaluated for possible physical abuse" had elevated liver enzymes and that 4 of the 5 had liver lacerations seen on CT scan. One of the children with a liver laceration "was awaiting discharge pending liver enzyme results." 3) Holmes and coworkers<sup>23</sup> demonstrated CT-scan proven liver injuries in 10 children "who had neither abdominal tenderness, femur fracture, nor low systolic blood pressure, and had a GCS [Glasgow Coma Scale] score of more than 13." Nine of these 10 patients had an AST  $>200$  U/L or ALT  $>125$  U/L. 4) Al-Mulhim and Mohammed<sup>24</sup> published a report of 63 adult blunt trauma patients with multiple



Fig. 1. CT scan without contrast displaying liver laceration in patient with blunt abdominal trauma.

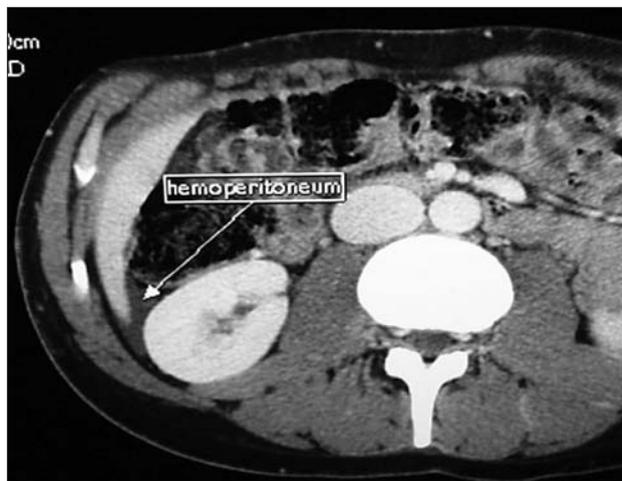


Fig. 2. CT scan without contrast showing hemoperitoneum secondary to above liver laceration.

injuries who were hemodynamically stable, either initially or after limited fluid resuscitation. All 63 patients had CT scan confirmation of liver injuries. Fifty-six (88.9%) had elevated ALT values (average  $\sim 272 \pm 115$ ), and 7 had normal values. 5) Finally, Karduman and colleagues<sup>25</sup> described a prospective study of 87 consecutive hemodynamically stable pediatric multiple trauma patients. All children had AST and ALT tests done on admission. Forty-nine of these children had a history and/or physical findings of BAT and went on to have abdominal CT investigation. The average AST and ALT levels of children with BAT (AST 145, ALT 84) were significantly higher than the average levels in the 38 children without BAT (AST 35, ALT 25). Twelve of the 49 children with BAT had intra-abdominal injury seen on CT scan: liver (3 children), kidney (3), spleen (1) and hemoperitoneum only (5). The average AST and ALT levels in these 12 children (AST 334, ALT 198) were significantly higher than the levels in the 37 children with negative CT studies (AST 84, ALT 43). In the 3 patients with liver injury seen on CT, the average AST and ALT levels were significantly higher than any other group (AST 721, ALT 472).

### Limitations

Some problems do exist in the generalization of the above findings. First, there is not only a semantic but also a logistical dilemma in defining patients with stable versus normal vitals signs. Second, when looking at this literature there is a preponderance of pediatric studies. One could ask, do elevated liver enzymes give the same predictive value in diagnosing pediatric as well as adult blunt liver

injury? A third problem is what is the exact cut-off point for AST and/or ALT over which BAT patients need a CT scan to rule out liver injury? Also, should these values be the same for children and adults? Fourth, many blunt trauma patients have recent alcohol consumption at the time of their injuries and one study showed that this was an independent and significant cause of liver enzyme elevation in these patients.<sup>18</sup>

Future prospective studies are warranted to assess the true reliability of using liver enzymes as a predictive test for liver injury in stable BAT patients. In doing so, the above issues would need to be addressed. This may prove helpful in centres where bedside ED ultrasound (FAST) is not yet being used, or even when such exams are negative.<sup>20,26</sup>

If low liver enzyme levels were found to be reliable predictors of the absence of significant liver trauma in stable BAT patients, then a beneficial decrease in the number of abdominal CT scans may be possible in this patient group. In the authors' hospital, testing serum AST and ALT costs approximately \$13 and abdominal CT scanning costs approximately \$210. One must also consider that the risk of radiation-induced neoplastic disease is also a concern.<sup>27</sup>

### CONCLUSION

The impetus to write this paper came from the case study described, i.e., the lack of clinical findings in a well-appearing patient with normal vital signs possessing a relatively high-grade liver laceration. This patient's injury could easily have gone undiagnosed. It is suggested that liver enzymes may prove to be a

**Table 2. Data from the 5 articles in the literature review 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**

| Study, year                       | No. of patients | Diagnostic method                | AST  | ALT  | Sensitivity, % | Specificity, % | Notes  |
|-----------------------------------|-----------------|----------------------------------|------|------|----------------|----------------|--|
| Oldham et al, <sup>16</sup> 1984  | 95              | CT, ultrasound                   | >200 | >100 | 100            | 84             | Pediatric; prospective; stable patients                    |
| Hennes et al, <sup>17</sup> 1990  | 43              | CT                               | >450 | >250 | 100            | 92             | Pediatric; retrospective; stable (all had AST and ALT >35) |
| Sahdev et al, <sup>18</sup> 1991  | 149             | CT, ultrasound, DPL, laparoscopy | >130 | >130 | 100            | 77             | Adult; retrospective; stable + unstable                    |
| Puranik et al, <sup>19</sup> 2002 | 44              | CT                               | >450 | >250 | 93             | 100            | Pediatric; retrospective; stable                           |
| Stassen et al, <sup>20</sup> 2002 | 67              | CT                               | >360 | –    | 78             | 90             | Adult; retrospective; stable; one penetrating              |

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

useful diagnostic tool in this relatively narrow clinical scenario: the well-appearing BAT patient with normal/stable vital signs and a low clinical probability of liver injury. It is appreciated that the vast majority of such patients who do have a liver injury will do well with conservative management, as in the case described. However, it is still prudent to diagnose these liver injuries during the initial ED visit, to allow for proper follow-up and management of the rare but potentially serious complications. Also, once the diagnosis of liver injury is made it alerts the clinician to search for other occult abdominal injuries that have been shown to be associated more frequently with hepatic rather than splenic trauma.<sup>5</sup> It should be noted that the finding of normal liver enzymes in hemodynamically stable BAT should not prevent the clinician from investigating other potential intra-abdominal injuries (e.g., spleen, kidney), if clinically warranted.

Elevated liver enzymes have been shown to aid in the diagnosis of liver injury in stable patients after BAT. If found to be reliable, using liver enzymes to predict the need for CT scanning could result in time, cost and safety benefits in the work-up of stable patients with potential blunt liver injury. Thus, the rural physician may be able to utilize liver transaminase testing in triage and transportation decisions in patients with BAT who may require additional imaging and surgical care.

**Competing interests:** None declared.

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