



Research Article

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## *Liver Trauma Diagnosis and Surgical Management*

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### ABSTRACT

**Background:** Liver trauma is one of the most common affected organs in blunt abdominal trauma. It is associated with a high rate of morbidity and mortality. Therefore, choosing the best modality for diagnosis and managing such high-risk patients is crucial. **Objectives:** In this study, we aim to review the literature focused on mechanism of liver trauma, pathophysiology, risk factors, diagnosis, and management with a focus on surgical approach. **Methodology:** PubMed database was used for articles selection using the following keywords: liver injury, and its management, and evaluation. **Conclusion:** Management of liver trauma patients depends on their status during the general assessment of the case. In hemodynamically unstable patients and those with gun-shot wounds, the first line is surgery. However, non-operative management remains the mainstay of therapy in blunt liver injury. The main rule dictating this decision is hemodynamic stability. Certain factors increase the risk of failed conservative therapy, and these should alert the surgeon to the possibility of conversion to the surgical intervention.

**Key words:** Liver trauma, surgical management, management.

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### INTRODUCTION

Liver trauma is an important surgical emergency that affects the liver and/or its abundant vascular supply. Considering the liver's large size, penetrating or blunt trauma can potentially harm it. Diagnostic modalities and imaging have played a tremendous role in shifting the management from operative to more conservative approach. This has been possible with the advances in critical care support through the past 30 years. Nowadays, the second most common cause of hospital admissions is trauma, and a third of these are presenting with poly-trauma. One of the leading causes of death in abdominal trauma admissions is hepatic injuries, which accounts for 16% of the

overall percentage of poly-trauma admissions [1, 2]. In this review, we will discuss the approach to managing of liver trauma with more focus on the surgical part of it.

## **METHODOLOGY**

PubMed database was used for articles selection using the keywords liver injury, and its management, and evaluation. With regard to the inclusion criteria, the articles were selected based on inclusion of one of the following topics: liver trauma management, operative, and conservative approach. Exclusion criteria were all other articles which did not have one of these topics as their primary endpoint.

## **DISCUSSION**

The clinician should take into account all potential injuries while evaluating any trauma patient with suspected major visceral injury, especially if it is abdominal. This starts with establishing the patient's status according to the trauma protocols, as this plays a major role in management as well. This is evident since a hemodynamically instable status may alert the surgeon to the necessity of immediate transfer of the patient to an operating theater.

### **Mechanism of injury**

Hepatic trauma can be divided into penetrating or blunt based on the mechanism of injury. A general concept in the pathophysiology of the liver trauma is, the higher the force of the insult, the higher the possible resulting damage [3]. In penetrating injuries (such as knife stab), the total injury is dictated by the force of the energy transferred, the entry and the exit points, and sites if applicable. Stab wounds are considered generally of low-energy mechanism injuries; however, the depth is of utmost importance, along with any blood vessel injury. Gunshot wounds are of the high-energy variant and as a result, the tissue damage reaches further than the original trauma site. Furthermore, in some cases, with significantly high levels of energy, the whole liver may explode. Fortunately, the liver tissues are somewhat elastic, and with the capsule providing a limitation for cavitation, the liver can withstand very high levels of energy transfer. Blunt trauma are usually a result of road traffic accident, and can be of low or high energy. This type of trauma may express less examination findings than the penetrating trauma. Thus, it is important to carefully rule out abdominal visceral injuries in cases of liver trauma which is crucial for choosing the management options. Following liver trauma, the spleen and small bowel are most commonly injured in blunt trauma. However, in penetrating injuries, the stomach, followed by the colon, and small bowel are mostly seen [4, 5].

### **Clinical Features**

On clinical evaluation, the physician can find several hints pointing toward a hepatic injury in history and clinical examination. These include fractures of one or more right lower ribs, and contusion to the right upper abdominal quadrant, right lower chest or right flank. Other findings may show right upper abdominal quadrant pain, and/or right shoulder pain (usually secondary to diaphragmatic irritation). However, generalized peritoneal signs upon examination are indicative of a general intra-abdominal injury and not specific to the liver. Also, the clinician shall keep in mind that a negative history cannot reliably exclude liver injury. The physician shall remain thoughtful of any associated injuries, as only 20% of cases are present with only (exclusive) liver trauma. In a series of 146 cases of hepatic injury, chest was the most commonly co-injured part and spleen was the most commonly co-injured intra-abdominal organ [6].

When it comes to laboratory tests, there is no specific indicator of liver injury and they cannot rule in or out any intra-abdominal injury. Some unspecific lab results seen in some cases include elevated white cell count (due to stress), and anemia. Moreover, despite that several studies have evaluated the utility of liver enzymes in liver injuries, no consensus has been made [7]. So, suspecting hepatic injury is almost entirely dependent on clinical evaluation with confirmation of the injury requiring imaging techniques.

### **Imaging Techniques**

Computerized tomography (CT) is the preferred modality if the patient with suspected hepatic injury is hemodynamically stable. However, if the patient is unstable, then ultrasound – in the form of Focused Assessment with Sonography in Trauma (FAST) – is the modality of choice. FAST is essential in emergencies with suspected internal bleeding in general. This modality can detect life threatening injuries with high volume of intra-peritoneal bleeding with sensitivity as high as 90% [8]. Some disadvantages of FAST scans include its inability to narrow

down the source of the hemorrhage, and some minor injuries can be easily missed by the clinician. Therefore, it is often difficult to stage liver trauma based on ultrasound alone. Additionally, negative FAST results do not necessarily rule out hepatic injury. Thus, stabilization of patients takes priority in order to precisely diagnose and choose the optimum management plan [8].

### Approach of Management

Management approach of hepatic injuries depends significantly on the scale that classifies different forms of injuries. However, hemodynamic status of patients is crucial in determining the optimal treatment and prognosis. Generally, when the patient is hemodynamically unstable, FAST should be performed. Then, the patient shall be shifted to the operation theater for abdominal exploration and bleeding control. Afterwards, damage-control approach or using specific techniques for liver hemostasis can be used depending on the extent of the liver injury and the presence of other co-injuries. If the patient is stable, the patient can be observed, and/or treated conservatively. Going for surgical exploration is indicated in cases of hemodynamic deterioration, continued bleeding and/or manifestation of systemic features such as fever or oliguria [9].

The American Association of Surgery and Trauma provides a grading scale to classify hepatic injuries. This scale provides 5 classes of injuries depending on the anatomical position and site of injury. Grades I, II, or III can be managed successfully and non-operatively. However, class IV and V may require operative management such as laparotomy. Since hemodynamics and associated injuries play a significant role on the outcomes of management, this grading scale should have been supported with the physiological effects of the trauma. The world society of emergency surgery (WSES) proposed a new classification after the second world WSES congress [9, 10]. WSES, supplemented the new grading scale with hemodynamic stability and diagnostic imaging modality (CT scan) findings. The new grading system proves that management decisions can be much more effective if anatomy of injury was treated with its physiological consequences [9]. Once confirmed, the injury should be graded and the most widely used grading system is that of the American Association for the Surgery of Trauma (AAST). In this system, hepatic injury is classified into one of six grades starting from grade I in which there is a sub-capsular hematoma involving less than 10% of the liver surface area to grade VI in which the liver is avulsed (the patient is unstable). Moreover, non-operative management in class I is very likely to be successful; however, in class VI for example operative intervention is required (see Table 1 for full description of the grades) [11].

**Table 1:** American Association for the Surgery of Trauma (AAST) classification system for hepatic injury

Grade	Description
I	<ul style="list-style-type: none"> <li>• <b>Hematoma:</b> subcapsular less than 10% surface area.</li> <li>• <b>Laceration:</b> capsular tear is less than 1 cm of parenchymal depth.</li> </ul>
II	<ul style="list-style-type: none"> <li>• <b>Hematoma:</b> subcapsular between 10 to 50% surface area.</li> <li>• <b>Intraparenchymal</b> is less than 10 cm in diameter.</li> <li>• <b>Laceration:</b> capsular tear between 1 to 3 cm parenchymal depth, and less than 10 cm in length</li> </ul>
III	<ul style="list-style-type: none"> <li>• <b>Hematoma:</b> subcapsular is less than 50 % of surface area, or ruptured subcapsular, or parenchymal hematoma; and/or Intraparenchymal hematoma of more than 10 cm or expanding.</li> <li>• <b>Laceration</b> is more than 3 cm in depth</li> </ul>
IV	<ul style="list-style-type: none"> <li>• <b>Laceration:</b> parenchymal disruption involving 25 to 75% of a hepatic lobe, or one to three segments in the same lobe.</li> </ul>
V	<ul style="list-style-type: none"> <li>• <b>Laceration:</b> parenchymal disruption of more than 75% of a hepatic lobe, or more than 3 segments within a single lobe.</li> <li>• <b>Vascular:</b> juxtahepatic venous injuries.</li> </ul>
VI	<ul style="list-style-type: none"> <li>• Hepatic avulsion.</li> </ul>

Recent papers have shown positive progression after introduction of WSES to health care centers. A descriptive analysis study done in level one trauma centers confirmed that repeating CT scan had significant role in utility of angioembolization, and decreasing rates of late failures of non-operative management. However, larger studies are needed on multicenter with a larger population to confirm their findings [10].

While most patients are now conservatively managed, there are certain criteria that prevent such non-operative approach. These criteria include: hemodynamic instability, uncontrolled patients, and abdomen trauma with penetrating gunshot wounds [12]. Other factors with higher mortality and morbidity such as high-grade liver injury, head injury (most associated with bad outcome), and the combination of a major visceral injury and systemic injury can hinder such approach. However, there are some cases associated with better outcome like lower amounts of blood transfusion, early ambulation post-admission, and less days at the intensive care unit [13, 14].

If surgery was decided, the surgeon should wisely choose the most effective approach to control the damage in a short period of time. In minor hepatic lacerations, a single suture is enough to control the bleeding as well as reduce the damage. Large lacerations and contusions need deep mattress suture. Putting hemostatic gauze is recommended in deep lacerations with unstoppable bleeding. In case of the presence of a necrotic tissue, it should be removed and debridement should be done accompanied by ligation of the affected vessels and ducts [15, 16]. In addition, Hickam's dictum is practiced, and the clinician should be alert to the possibility of other injuries co-existing in a patient with liver trauma. The most commonly co-affected areas include chest, head, and extremities. This may distract the clinician when approaching such patients, masking the underlying insidious liver injury, and delaying diagnosis and care [17].

Unfortunately, hepatic trauma patients with multi-injuries frequently present relatively unstable, despite that some are eligible for conservative management [18]. These extra hepatic injuries result in higher morbidity and mortality than in patients with isolated hepatic injury. On the other hand, liver trauma patients with stable hemodynamics who had received adequate conservative management have shown much more promising outcomes [19]. Over the past 10 years, progression and development of conservative liver trauma management was noted. In developing countries, studies were done to analyze and assess the rate of succession of liver trauma conservative management. The results show a significantly better outcome with factors like the grade of liver injuries and the associated other intra-abdominal injuries correlating to its success. Negative impact on success rate was encountered mainly due to the limited hospital resources and low level of consensus on the conservative treatment among clinicians [20].

## CONCLUSION

Nowadays, the hemodynamic status of the patient is the central part to the approach along with the estimated grade of injury. Recent radiological advances in trauma diagnosis such as FAST and the modern CT scans, provided an accurate and precise diagnosis modality in many trauma cases. With these factors in mind, the conservative option rose up as the modality of choice in vitally stable liver injury whether the trauma was blunt or penetrating. One must keep in mind that the operative approach is still the first-line in unstable patients. Further studies, with larger population, into the new diagnostic, as well as therapeutic means (especially non-operative options) with the aim to reduce surgical patients' morbidity and mortality can provide more effective methods.

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