

COMPLICATIONS OF LIVER TRAUMA: A COMPREHENSIVE ANALYSIS OF IMPACT, ASSESSMENT AND CLINICAL AND SURGICAL MANAGEMENT STRATEGIES

João Vítor Giovannini Sad Ribeiro

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)

Belo Horizonte - MG

<https://orcid.org/0009-0000-4965-5372>

Fernanda Queiroz Fonseca

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)

Belo Horizonte - MG

<https://orcid.org/0009-0001-1501-3248>

Lucas Santos Soares

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)

Belo Horizonte - MG

<https://orcid.org/0009-0000-9173-4082>

Gabriel Merrighi de Figueiredo Amaral

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)

Belo Horizonte - MG

<https://orcid.org/0009-0009-7556-8737>

Antonio Marcos Nastaszity Xavier

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)

Belo Horizonte - MG

<https://orcid.org/0009-0001-1638-0509>

All content in this magazine is licensed under a Creative Commons Attribution License. Attribution-Non-Commercial-Non-Derivatives 4.0 International (CC BY-NC-ND 4.0).



Thiago Castor Cesar

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)
Belo Horizonte - MG
<https://orcid.org/0009-0000-7348-2205>

Matheus Ornellas Costa

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)
Belo Horizonte - MG
<https://orcid.org/0009-0000-9786-1664>

Gabriela Borges de Cardoso Pena

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)
Belo Horizonte - MG
<https://orcid.org/0009-0000-0936-1636>

Isabela Borges de Cardoso Pena

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)
Belo Horizonte - MG
<https://orcid.org/0009-0000-2705-703X>

Isabella Monteiro Barbosa de Souza

Faculdade Ciências Médicas de Minas Gerais
(FCMMG)
Belo Horizonte- MG
<https://orcid.org/0000-0002-9201-3778>

Kathleen Priscila Correia Coelho

Universidad Nacional de Rosario (UNR)
Rosário - Argentina

Abstract: Objective: To explore the main complications associated with liver trauma, covering assessment, clinical and surgical management, and analyzing the impact of these complications on the patient's overall recovery. Method: After a careful selection of methodologies, excluding conflicts of interest and duplications, 15 articles were chosen to compose the narrative bibliographic review. The search was conducted blindly and independently. Results: The majority of patients included in the analysis were male. The main trauma mechanisms were gunshot wounds and traffic accidents. The right hepatic lobe was injured in 51.2% of cases, with hepatorrhaphy being the most frequently performed surgical correction. Additionally, patients undergoing embolization had a shorter duration of hemostatic treatments. Conclusion: The studies provided valuable information to deepen the understanding of complications arising from liver trauma, guiding more effective clinical and surgical management strategies.

Keywords: Liver Trauma, Complications, Assessment, Clinical Management, Surgical Management, Hepatorrhaphy, Embolization, Liver Injuries, Patient Recovery.

INTRODUCTION

Trauma represents one of the main causes of mortality on a global scale, with the most frequently affected organs in these situations being the liver and spleen, with hepatic involvement predominating in adults and splenic involvement in pediatric cases (ORDOÑEZ CA et al, 2020). The occurrence of liver trauma can result in internal hemorrhage and bleeding, threatening the patient's life and predisposing to late complications. Prompt identification and effective management of this condition are crucial to increasing survival and improving the individual's prognosis.

Liver injuries represent a significant portion

of admissions to the Emergency Department due to abdominal trauma. Trauma, whether blunt or penetrating, can cause serious damage to the liver, including significant lacerations and hepatic hematomas. Proper management of hemorrhage has the potential to reduce the incidence of mortality in these cases, as evidenced by studies carried out (FISCHER NJ, 2021).

In the management of patients with liver trauma, most trauma centers adopt standardized protocols that range from initial resuscitation to diagnostic evaluation and treatment. The urgency of surgical evaluation is evident in patients with hypovolemic shock or hemodynamic instability, while evaluation through exams such as Focused Assessment with Sonography for Trauma or computed tomography is indicated for stable patients (ROBERTS R.; SHETH RA, 2021).

This article aims to understand the main complications associated with liver trauma and their consequences in the traumatized patient. Furthermore, we seek to analyze the effectiveness of different therapeutic approaches, especially given the gradual classification of liver injuries proposed by the American Association for the Surgery of Trauma. Understanding these aspects contributes to improving clinical and surgical strategies, promoting more efficient and personalized management of these challenging cases.

METHODOLOGY

This integrative review follows the criteria of the PVO strategy, which represents Population or Research Problem, Variables and Outcome. The research was designed based on the following guiding question: "What are the main complications associated with liver trauma, how are they evaluated, managed and what is the impact of these complications on the patient's recovery??"

Within these parameters, the population or problem of this research covers patients with liver trauma who developed complications, investigating therapeutic approaches for the management of these complications aiming at the patient's overall recovery, taking into account clinical outcomes, quality of life and survival. The searches were conducted in the PubMed Central (PMC) database, using the descriptors combined with the Boolean term "AND": Hepatic Trauma [MeSH] AND Complication Assessment [MeSH]. The initial search resulted in 138 articles, which were subsequently submitted to the selection criteria. The inclusion criteria covered articles in English published between 2019 and 2023, which explored the themes proposed for research, including systematic reviews (meta-analyses), cohort studies, clinical trials and original articles, all available in full. Duplicate articles, abstracts that did not directly address the proposal studied and those that did not meet the inclusion criteria were excluded. A total of 15 articles were selected to compose this review.

DISCUSSION

COMPLICATIONS

The assessment of complications related to liver trauma is essential to understand the impact of this type of injury. Tang WR et al. (2023) conducted a retrospective observational study, analyzing 270 patients with traumatic liver laceration between 2002 and 2020 in a hospital. The research compared outcomes before and after implementing a trauma team. The benefits observed in the group treated by the trauma team included a shorter interval between arrival at the emergency room and care, a reduction in the duration of hemostatic treatments and more ICU-free days until day 28. The results indicated that the trauma team's approach

Trauma contributed significantly to survival, reducing the risk of death within 72 hours by 65% and in-hospital mortality by 55%.

Another relevant study on the management of liver trauma was carried out by Keizer AA et al. (2021), using a retrospective observational design. The research involved 808 patients with liver trauma between 2012 and 2018, comparing blunt and penetrating liver injuries. A higher incidence of intra-abdominal injuries was observed in the penetrating trauma group, especially in hollow organs. In the penetrating group, 84% of patients underwent laparotomy, while in the blunt group, only 33% underwent this procedure. Despite improvements in mortality rates from liver trauma in recent decades, the study highlighted that mortality rates between blunt and penetrating liver trauma remain similar.

Finally, Pillai AS et al. (2021) conducted a literature review addressing the clinical presentation, classification and management of patients with liver injury. The classification of liver injuries is based on the 2018 AAST scale (Table1), considering imaging, operative and pathological criteria. Nonoperative management is the primary approach in 80% of blunt liver trauma. Angiographic embolization is preferred for hemodynamically stable patients with evidence of active extravasation, pseudoaneurysm, or arteriovenous/arterioportal fistula. Operative management is reserved for cases with hemodynamic instability. These studies provide valuable insights to understand the complications of liver trauma and guide more effective clinical and surgical management strategies.

PATIENT MANAGEMENT

The scientific literature predominantly recommends conservative treatment for hemodynamically stable patients with liver trauma, aiming for stability and recovery. However, situations that require an operative

approach include hemodynamic instability, resistance to conservative treatment and signs of peritonitis (TAMURA S. et al., 2021; ZHANG D. et al., 2023; YAZICI H.; VERDIYEV O., 2023). Among the surgical alternatives, the laparoscopic route stands out for its effective, safe and minimally invasive nature (YAZICI H.; VERDIYEV O., 2023; ZHANG D. et al., 2023).

The Major Trauma Center (MTC), located in England, implemented a unified and standardized system for trauma care, establishing a flow that improves patient care. Accurate identification of the type of trauma, including mechanism, location and extent of injuries, has been shown to be crucial for improving treatment indicators, resulting in greater efficiency and reduced mortality (BROOKS A. et al., 2023). In more complex cases, patients who have recovered from liver trauma generally do not require more than 14 days of intensive treatment, especially when first-level injuries predominate (ALEJO DRC et al, 2021).

Studies indicate that the age group most affected by liver trauma is between 20 and 40 years old, mainly in men. The trauma mechanisms, blunt and penetrating, are not mutually exclusive. For blunt traumas, non-operative treatment is predominant, while for penetrating traumas, the surgical approach is more common (TRINTINALHA OP et al., 2020). The initial management of liver trauma aims to contain bleeding, promoting homeostasis to prevent hemorrhagic shock, the main cause of death in these cases. Therefore, the preferred treatment is non-surgical, considering the possible complications associated with surgery (empyema, dehiscence, septic shock), which increase the risk to life and delay the patient's recovery process (ALEJO DRC et al., 2021). However, in more complex cases, more invasive approaches may be necessary.

DEGREE	TYPE OF INJURY	DESCRIPTION OF THE INJURY
I	Bruise	<10% of the subcapsular surface
	Laceration	Capsular rupture <1cm parenchymal depth
II	Bruise	10-50% of subcapsular surface, intraparenchymal, <10 cm in diameter
	Laceration	1-3 cm parenchymal depth, < 10 cm long
III	Bruise	> 50% of surface area or in expansion, rupture of subcapsular or parenchymal hematoma
	Laceration	> 3 cm parenchymal depth
IV	Laceration	Parenchymal rupture involving 25-75% of the hepatic lobe
V	Laceration	Parenchymal rupture involving more than 75% of the hepatic lobe
	Vascular	Juxtavenous liver lesions, i.e., retrohepatic vena cava/main central hepatic veins
VI	Vascular	Liver avulsion

Table 1. AAST classification of liver trauma.

Source: ALEJO, DRC, et al. (2021).

The evaluation of liver trauma, to determine the best treatment, involves imaging tests, such as Computed Tomography or Doppler Ultrasonography, considering local availability and resources. These exams make it possible to identify hemorrhages, contusions, lacerations, vessel avulsions and other conditions that may require invasive interventions (MAHMOOD I. et al., 2021). Furthermore, it is crucial to identify injuries to organs and structures adjacent to the liver for the patient's overall well-being. Special attention to biliary injuries is essential due to the mechanism of trauma, considering possible future complications to determine treatment and reduce adverse consequences arising from incomplete assessments (MITRICOFF B. et al., 2023). The right lobe is the most frequently affected area in liver trauma, and the majority of these first-level injuries do not require surgical treatment (TRINTINALHA OP et al., 2020).

Available surgical procedures include hepatorrhaphy, damage control, electrocauterization, intrahepatic balloon and hepatectomy (TRINTINALHA OP et al., 2020). In extreme cases, liver transplantation is considered, taking into account the availability of the organ, surgical feasibility and markers of compatibility between donor and recipient (MITRICOFF B. et al., 2023). Delicate conditions, such as hematomas,

require careful analysis due to the high risk of complications and rapid patient decline, especially when associated with hepatic pseudoaneurysm, which can result in hemorrhagic shock (MAHMOOD I. et al., 2021). Avulsion-related injuries require accurate identification of the affected vessels and adequate containment (MITRICOFF B. et al., 2023).

Tri TT et al. (2022) illustrates the success of conservative treatment in a pediatric patient with a rare complication of liver trauma: intrahepatic pseudoaneurysm. After trauma with intrahepatic hematoma and rupture of segments IVA and VIII, the patient was treated conservatively with 3rd generation cephalosporin and analgesics. Follow-up revealed the subsequent detection of the pseudoaneurysm, which was treated with imipenem for the infection, resulting in an uncomplicated recovery until discharge, reinforcing the feasibility of non-invasive treatment for hemodynamically stable patients.

Additionally, the retrospective cohort by Tamura S. et al. (2021), involving 62 participants, highlighted favorable results of non-operative treatment (NOM) compared to surgical intervention for liver trauma. The NOM modality, consisting of transcatheter arterial embolization, presented statistically

similar mortality rates between the groups. Furthermore, patients undergoing embolization required fewer transfusions and had a shorter hospital stay ($p=0.03$). Thus, the choice between interventions was not decisive for the outcome, showing that the option for NOM did not increase mortality rates and provided a more efficient postoperative recovery.

The retrospective observational research by Fernandes SG et al. (2022) also corroborated the satisfactory results of NOM in the clinical context of liver trauma. Of the 114 patients analyzed, 88 (77.2%) were treated with NOM, with a failure rate of 11.36%. However, when considering only liver-related complications, the failure rate decreased to 1.75%, indicating a small failure rate for NOM when focusing on liver injuries.

In contrast to NOM, the case report by Yazici H. and Verdiyev O. (2023) demonstrated therapeutic success of laparoscopic intervention in an adult patient with liver trauma. Given signs of hemodynamic instability and peritonitis, the option for a laparoscopic surgical approach proved to be effective, revealing liver laceration in multiple segments. The patient underwent local hemostasis and evolved without complications, demonstrating favorable results from laparoscopy in the treatment of liver trauma.

Additionally, the case report by Zhang D. et al. (2023) reinforced the effectiveness of the laparoscopic approach in the management of liver trauma in an adult patient. The technique, involving Pringle's maneuver, hepatic hemorrhagic compression and partial clamping of the inferior vena cava, proved to be successful. The minimally invasive intervention allowed the correction of liver lacerations, resulting in minimal blood loss and recovery without complications, once again demonstrating the good outcomes of

laparoscopy in liver trauma.

To strengthen treatment strategies in cases of liver trauma, Tang WR et al. (2023) conducted a retrospective study covering five cases of severe blunt liver injuries over eight years. Being run over was the most common mechanism, predominantly resulting in grade V liver injuries. During surgical interventions, the mortality rate reached 20%, while in-hospital complications were observed in half of the surviving cases, requiring reoperation in three cases.

Furthermore, a multidisciplinary approach is crucial for hemodynamically unstable patients with penetrating liver injuries, aiming to optimize the prognosis. To reduce overall mortality in these seriously injured patients, adequate triage, implementation of transfusion protocols and early control of hemorrhage are essential elements (KEIZER AA et al., 2021).

Finally, Saviano A. et al. (2022) emphasize that after each severe abdominal trauma, performing a laparotomy and CT scan is imperative to determine the optimal management strategy. Furthermore, they emphasize that, with the exception of complete vascular avulsions, no liver trauma rules out the possibility of non-operative treatment. Consideration of techniques such as embolization for bleeding control, procedures such as percutaneous drainage of collections, endoscopic retrograde cholangiopancreatography (ERCP) with papilla sphincterotomy or stent placement, and percutaneous transhepatic biliary drainage (PTBD) may be valuable in preventing or delaying need for surgical reconstruction or resection until inflammatory remodeling is resolved.

FINAL CONSIDERATIONS

Studies on traumatic liver injuries highlight the importance of evaluating complications to understand their impact. A comparative research showed that the implementation of a trauma team resulted in benefits, such as a shorter interval to care, a reduction in the duration of hemostatic treatments and more ICU-free days up to

the 28th day. Nonoperative management is predominant in 80% of blunt liver trauma, while angiographic embolization is preferred for hemodynamically stable patients. While operative management is reserved for cases of hemodynamic instability. These studies provide essential insights to guide effective clinical and surgical management strategies in the context of traumatic liver injuries.

REFERENCES

- ALEJO, D.R.C, et al. Complications and treatment of liver wounds by gunshot: a retrospective approach. *Cir Cir.* 2021; v. 89, n. 3, p. 354-360, 2021.
- BROOKS, A. et al. Improvements over time for patients following liver trauma: A 17-year observational study. *Frontiers in Surgery*, v. 10, p. 1124682, 2023.
- FERNANDES, G. S. et al. Experience of non-operative management of blunt liver trauma at Hospital das Clínicas de Uberlândia: 114 cases. *Revista Do Colegio Brasileiro De Cirurgioes*, v. 50, p. e20233424, 2023.
- FISCHER, N. J. Mortality following severe liver trauma is declining at Auckland City Hospital: a 14-year experience, 2006-2020. *The New Zealand Medical Journal*, v. 134, n. 1540, p. 16–24, 2021.
- KEIZER, A. A. et al. Blunt and penetrating liver trauma have similar outcomes in the modern era. *Scandinavian Journal of Surgery*, v. 110, n. 2, p. 208-213, 2021.
- MAHMOOD, I. et al. Late development of giant hepatic artery pseudoaneurysm following abdominal trauma due to tire blast: case report and literature review. *Journal of Surgical Case Reports*, v. 2021, n. 12, 2021.
- MITRICOFF, B. et al. Severe liver trauma with complex portal and common bile duct avulsion: A case report and review of the literature. *World Journal of Clinical Cases*, v. 11, n. 16, p. 3837–3846, 2023.
- ORDOÑEZ, C. A. et al. Control de Daños en Trauma Hepático Penetrante: El Miedo a Lo Desconocido. *Colombia Médica*, v. 51, n. 4, p. 4134365-NA, 2020.
- PILLAI, A. S. et al. Hepatic trauma interventions. In: *Seminars in interventional radiology*. 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA: Thieme Medical Publishers, Inc., 2021. p. 096-0104.
- ROBERTS, R.; SHETH, R. A. Hepatic trauma. *Annals of Translational Medicine*, v. 9, n. 14, 2021.
- SAVIANO, A. et al. Liver Trauma: Management in the Emergency Setting and Medico-Legal Implications. *Diagnostics*, v. 12, p. 1456, 2022.
- TANG, W.R. et al. Impact of trauma teams on high-grade liver injury care: a two-decade propensity score approach study in Taiwan. *Scientific Reports*, v. 13, n. 1, p. 5429, 2023.
- TAMURA, S. et al. Transcatheter arterial embolization for severe blunt liver injury in hemodynamically unstable patients: a 15-year retrospective study. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, v. 29, n. 1, 2021.
- TRI T.T., et al. Post-traumatic intrahepatic pseudoaneurysm: A case of successful conservative treatment. *Radiol Case Rep.* v. 18, n. 3, p.895-898, 2022.
- ZHANG, D. et al. Management of liver trauma by laparoscopy using infrahepatic inferior vena cava partial clamping: A case report. *Frontiers in Surgery*, v. 9, p. 1018953, 2022.