

# Hepatic trauma: a 21-year experience

## *Trauma hepático: uma experiência de 21 anos*

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### A B S T R A C T

**Objective:** To evaluate the epidemiological aspects, behavior, morbidity and treatment outcomes for liver trauma. **Methods:** We conducted a retrospective study of patients over 13 years of age admitted to a university hospital from 1990 to 2010, submitted to surgery or nonoperative management (NOM). **Results:** 748 patients were admitted with liver trauma. The most common mechanism of injury was penetrating trauma (461 cases, 61.6%), blunt trauma occurring in 287 patients (38.4%). According to the degree of liver injury (AAST-OIS) in blunt trauma we predominantly observed Grades I and II and in penetrating trauma, Grade III. NOM was performed in 25.7% of patients with blunt injury. As for surgical procedures, suturing was performed more frequently (41.2%). The liver-related morbidity was 16.7%. The survival rate for patients with liver trauma was 73.5% for blunt and 84.2% for penetrating trauma. Mortality in complex trauma was 45.9%. **Conclusion:** trauma remains more common in younger populations and in males. There was a reduction of penetrating liver trauma. NOM proved safe and effective, and often has been used to treat patients with penetrating liver trauma. Morbidity was high and mortality was higher in victims of blunt trauma and complex liver injuries.

**Key words:** Liver. Wounds and Injuries. Trauma severity indices. Wounds, non-penetrating. Emergency Treatment.

### INTRODUCTION

The main cause of death among individuals under 40 years old is traumatic injury, largely as a result of increasing numbers of motor vehicle crashes and urban violence. The abdomen is often injured by both penetrating and blunt trauma and the liver, due to its size and anatomical location, is frequently affected<sup>1-3</sup>.

Hepatic trauma corresponds to approximately 5% of admissions to emergency rooms<sup>2,4</sup>. In recent years, the diagnosis and treatment of hepatic trauma has evolved with the use of computerized tomography (CT), and the likelihood of non-operative management for selected hemodynamically stable patients has become a reality in many trauma centers worldwide. Complex hepatic injuries treated operatively have a high morbidity rate. Improvements in mortality can be achieved using damage control principles and an appropriate surgical approach<sup>5</sup>.

The use of trauma scores, as well as the classification proposed by the American Association for the Surgery of Trauma (AAST - OIS), are important for comparing results between different periods and trauma

centers<sup>6-9</sup>. Hepatic trauma research is essential in order to achieve adequate comprehension of the causes of liver injuries, the population at risk and injury related mortality.

This study aims to evaluate the epidemiological aspects of hepatic trauma in a university teaching hospital during a 21-year period, including causes of trauma, severity of injuries, treatments and outcomes.

### METHODS

A retrospective study of patients admitted to a university teaching hospital was carried out. Our institution is the referral center for trauma care, located within a metropolitan region with a population of approximately 2.8 million.

All adult trauma patients (over 13 years old) assessed by our trauma team and sustaining liver injuries were included between January 1990 and December 2010. Patients operated on in other hospitals and later referred to our hospital were excluded.

Data were obtained from the Division of Trauma Surgery database and hospital charts. The following

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parameters were analyzed: age, gender, cause of injury, systolic blood pressure (SBP), Glasgow Coma Scale (GCS) Revised Trauma Score (RTS), presence of associated abdominal injuries, Injury Severity Score (ISS), probability of survival – TRISS, AAST-OIS grade of injury, surgical management, length of hospital stay (LOS), complications related and non-related to the liver and mortality rate [6-9]. Grades IV and V lesions were labeled as complex hepatic trauma.

The non-operative treatment protocol for blunt liver injuries was introduced to our service procedures in 1996, and the one for penetrating injuries in 2004. The surgical maneuvers and procedures registered in the database were: conservative or thermo coagulation homeostasis, primary repair (suture), Pringle’s and Pachter’s maneuvers, hepatic debridement, use of intrahepatic balloon, and damage control.

The research project was approved by the Institutional Review Board (IRB number 382/2010).

## RESULTS

In the period from 1990 to 2010, 748 adult patients were admitted with hepatic trauma. Of these, 109 were female (14.6%) and 639 male (85.4%). The mean age was 29.4 years ± 11.1 years.

The most frequent type of injury was penetrating trauma (n= 461; 61.6%): gunshot wounds (310 cases; 41.5%), stab wounds (150 cases; 20.0%) and others (1 case; 0.1%). Blunt trauma occurred in 287 patients (38.4%): motor vehicle crashes (MVCs – 128 cases; 17.1%), pedestrians hit by cars (65 cases; 8.7%), motorcycle crashes (43 cases; 5.7%), bicycle accidents (6 cases; 0.8%), assaults (8 cases; 1.1%) and others (37 cases; 4.9%). A decrease in hepatic penetrating trauma admitted to our hospital, and an increase in blunt trauma secondary to MVCs have been observed over recent years (Figure 1).

In blunt hepatic trauma (BHT), the mean systolic blood pressure on admission was 105.9 ± 31.2 mmHg, and the average Glasgow Coma Scale was 11.9 ± 4. The mean RTS, ISS, and TRISS were, respectively, 6.6 ± 1.7, 22.4 ± 12.8 and 0.84 ± 0.26. In patients with penetrating hepatic trauma (PHT), the mean systolic blood pressure on admission was 110.8 ± 33.5 mmHg, the average GCS was 14.2 ± 2.3, the mean RTS was 7.3 ± 1.3, the mean ISS was 18.4 ± 10.1, and the mean TRISS was 0.92 ± 0.20 (Table 1).

According to the AAST-OIS classification for liver injuries, grades I and II were observed more frequently in blunt traumatic injuries, grade III injuries being prevalent in cases of penetrating trauma (Figure 2).

In patients with BHT, associated abdominal injuries were found in 155 cases (54%), 364 (79%) being found in patients with penetrating trauma. Regarding definitive management, 74 patients with BHT (25.7%) were submitted to a non-operative approach and only 4 patients (0.8%) with PHT were treated non-operatively. The number of patients with BHT who underwent non-operative treatment has increased over recent years (Figure 3), with a success rate of 90.8%.

As for the surgical maneuvers used, it was observed that either conservative or thermo coagulation homeostasis were performed on 28% of the 670 patients, primary repair (suture) on 41.2%, Pringle’s maneuver on 10.4%, Pachter’s maneuver on 2.4%, hepatic resectional debridement on 5.5%, use of intrahepatic balloon on 6.8% and damage control on 11.3%.

Complications related to the liver occurred in 16.7%: persistent bleeding in 9.2% (including patients treated with damage control), biliary fistula in 3.1%, biliary peritonitis in 1.6%, liver abscess in 1.3% and intra-abdominal abscess in 3.6%. Non-related liver complications were found in 38.9% of patients.

The survival rate for patients with BHT was 73.5%, and for those with PHT, 84.2% (p<0.005). The

**Table 1** - Means and percentages of aspects related to trauma.

Aspect evaluated	Blunt trauma – mean (min-max)	Penetrating trauma - mean (min-max)
Mean systolic blood pressure on admission	105.9 mmHg(0 - 200)	110.8 mmHg(0 - 200)
Mean Glasgow Coma Scale	11.9 (3 - 15)	14.2 (3 - 15)
Mean RTS	6.6 (0 - 7.84)	7.3 (0 - 7.84)
Mean ISS	22.4 (4 - 59)	18.4 (4 - 57)
Mean TRISS	0.84 (0 - 0.99)	0.92 (0 - 0.99)
Presence of associated abdominal injury	54%	79%
Non-operative treatment	25.7%	0.8%
Survival rate	73.5%	84.2%
Mean length of hospital stay	12.4 (1 - 80)	9.2 (1 - 95)

Data are presented as mean or percentages, as appropriate.

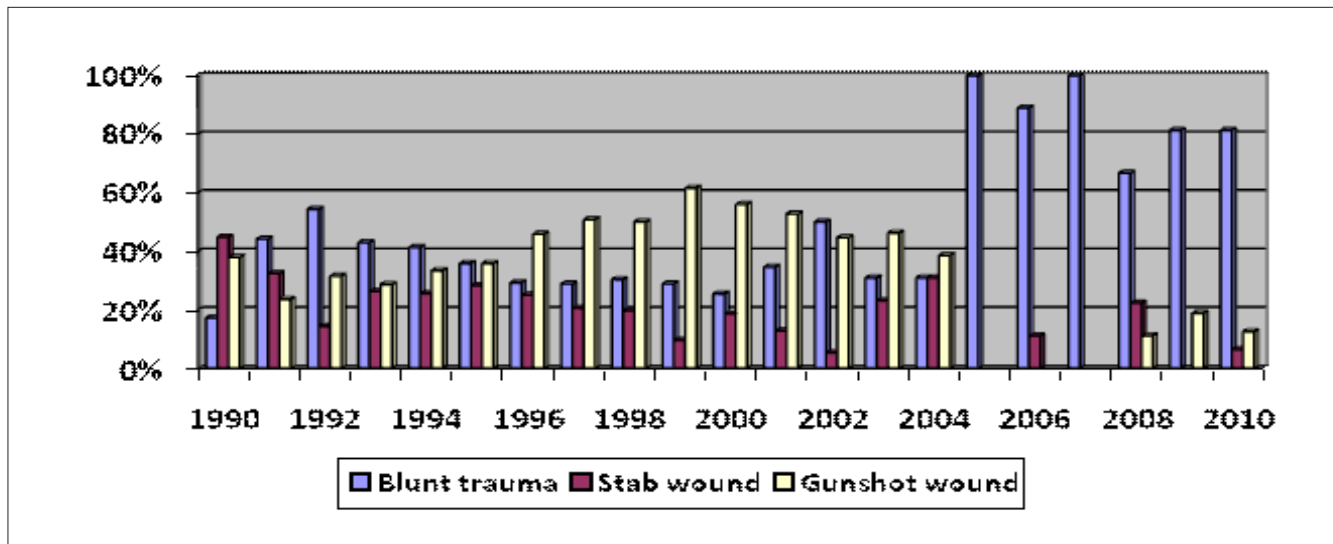


Figure 1 - Distribution of trauma causes between 1990 and 2010.

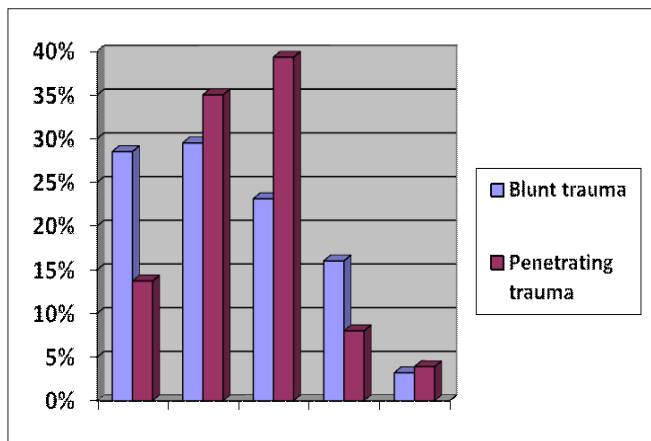


Figure 2 - Distribution of patients according to the grade of hepatic injury and the cause of trauma.

mortality rate for complex AAST-OIS grades (IV and V) was 45.9%, and for hepatic injury grades I - III, 15.7% ( $p < 0.005$ ). The mortality rate of the 74 patients with BHT treated with non-operative management was 2.5%; one patient died due to Acute Respiratory Distress Syndrome and renal failure and one due to hypovolemic shock. The mean length of hospital stay was  $12.4 \pm 13.6$  days for patients with BHT and  $9.2 \pm 11.9$  days for patients with PHT (Table 1).

Hepatic trauma occurred predominantly in males (85.4%). This is in concordance with other published studies, and with the paradigm that men are often more exposed to traumatic injuries<sup>2,10,11</sup>.

The young population is most affected, with an average age of 29.4 years, following the worldwide averages of 35, 32, 31 and 30 respectively in Germany, South Africa, Scotland and the USA<sup>12-15</sup>.

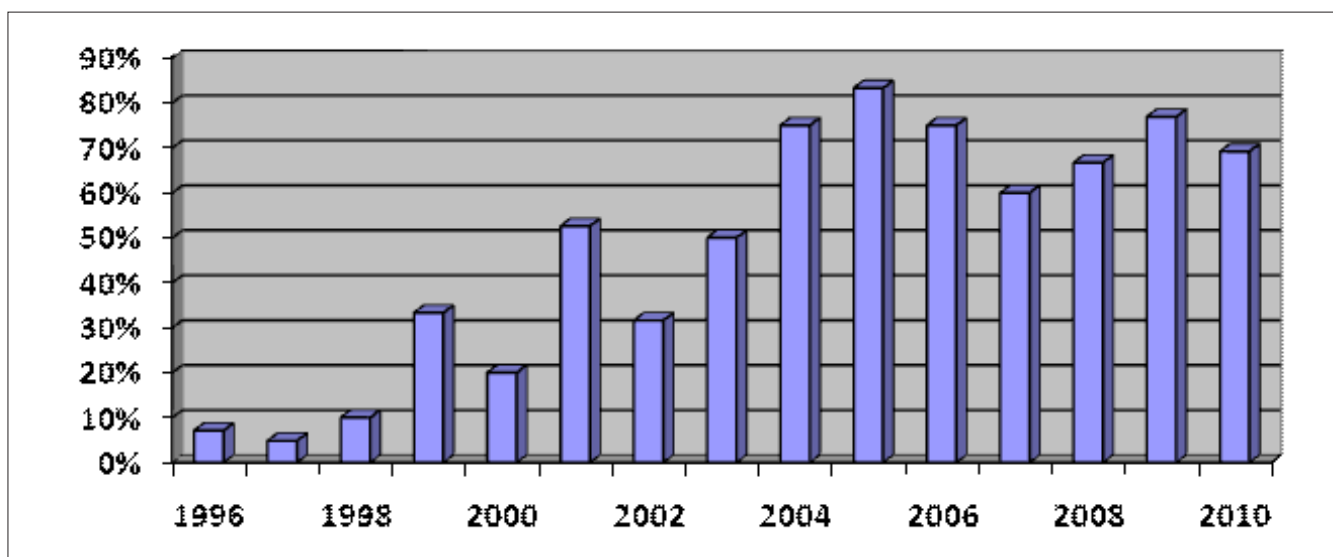


Figure 3 - Percentage of non-operative treatment for blunt trauma.

Blunt and penetrating injuries vary according to the studied geographic region. Studies performed in high income countries such as Scotland and Sweden demonstrated incidences of 69% and 91% of BHT, respectively<sup>1,14</sup>. Low income countries demonstrate a higher incidence of penetrating trauma; 66% in South Africa and 61.6% in our study, performed in Brazil<sup>13</sup>.

Regarding the AAST-OIS hepatic trauma classification, this study observed a predominance of grades I, II and III injuries. Literature demonstrates a predominance of lower complexity lesions (grades I, II and III), with a proportion of 73% in a study of 154 patients with hepatic trauma and 84% in a study of 783 such patients<sup>10,14</sup>.

Major hepatic trauma (grades IV and V) is an uncommon event, even in trauma centers with high volumes of patients. Most hepatic injuries are minor, requiring minimal or no surgical intervention. However, major hepatic injuries are associated with a high rate of morbidity and mortality<sup>2,15-18</sup>.

A very important concept that has emerged in the management of major hepatic trauma is that direct suture of severed blood vessels and bile duct is the most effective treatment. This technique proved to be useful for parenchymal fractures, but has a limited role in achieving hemostasis in central transfixing wounds because of the risk of severe bleeding from the divided parenchyma, bile leaks and perihepatic collection. Furthermore, the suturing of entrance and exit wounds or the superficial tamponade may lead to intrahepatic accumulation of blood, abscess formation or hemobilia. In recent years some authors have applied a variety of strategic devices, such as the intrahepatic balloon, for deep hepatic wounds, with promising results<sup>19</sup>.

The mean ISSs in this study were 22.4 and 18.4 for patients with blunt and penetrating trauma, respectively. The mean ISS for BHT varied between 17 and 22 in several studies<sup>4,15,20-22</sup>.

Non-operative treatment, performed on 74 of the 288 patients with BHT, has become the treatment of choice for patients with BHT admitted with hemodynamic stability. Important points to highlight in non-operative treatment are fewer complications, less need for blood transfusions and lower mortality, even for higher grade injuries of the liver<sup>15,22-27</sup>. The support of interventional radiology can be necessary, with advantages in patient prognosis<sup>27</sup>.

The decrease in incidence of penetrating trauma in Brazil can be explained by an improvement in the political control of urban violence in some regions, and the relative prevalence of blunt trauma is associated with an increased number of motor vehicles and motorcycles circulating in the country in recent decades, with a higher incidence of traffic victims<sup>28</sup>. Mortality from liver trauma ranges from 9 to 42%, and in most studies is close to 20% when considering all cases admitted to hospital<sup>2,4,5,10,11,14,18,20</sup>. In this study the mortality rate of 19.9% is in accordance with the literature.

In conclusion, at our hospital trauma remains highly prevalent among the young and male population. During the period of the study, there was a decrease in incidence of penetrating liver injuries. Non-operative treatment for selected patients with blunt hepatic trauma proved to be safe and effective, and was frequently used. Morbidity was high and mortality was higher in victims with blunt trauma and complex liver injuries.

## R E S U M O

**Objetivo:** avaliar os aspectos epidemiológicos, conduta, morbidade e resultados do tratamento trauma hepático. **Métodos:** estudo retrospectivo de doentes com mais de 13 anos de idade admitidos em um hospital universitário de 1990 a 2010, submetidos ao tratamento cirúrgico ou não operatório (TNO). **Resultados:** foram admitidos 748 pacientes com trauma hepático. O mecanismo de trauma mais frequente foi o trauma penetrante (461 casos; 61,6%). O trauma fechado ocorreu em 287 pacientes (38,4%). De acordo com o grau de lesão hepática (AAST-OIS), no trauma fechado foi observada uma predominância dos graus I e II e no trauma penetrante, uma predominância do grau III. O TNO foi realizado em 25,7% dos pacientes com trauma hepático contuso. Entre os procedimentos cirúrgicos, a sutura foi realizada com maior frequência (41,2%). A morbidade relacionada ao fígado foi 16,7%. A taxa de sobrevida para pacientes com trauma hepático fechado foi 73,5% e no trauma penetrante de 84,2%. A mortalidade no trauma complexo foi 45,9%. **Conclusão:** o trauma permanece mais incidente nas populações mais jovens e no sexo masculino. Houve uma redução dos traumas hepáticos penetrantes. O TNO se mostrou seguro e efetivo, e, frequentemente, foi empregado para tratar os pacientes com trauma hepático penetrante. A morbidade foi elevada e a mortalidade foi maior em vítimas de traumas contusos e em lesões hepáticas complexas.

**Descritores:** Fígado. Ferimentos e lesões. Índices de gravidade do trauma. Ferimentos não penetrantes. Tratamento de emergência.

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