

Epidemiological evaluation of hepatic trauma victims undergoing surgery

Avaliação epidemiológica de vítimas de trauma hepático submetidas a tratamento cirúrgico

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A B S T R A C T

Objective: to evaluate the epidemiological variables and diagnostic and therapeutic modalities related to hepatic trauma patients undergoing laparotomy in a public referral hospital in the metropolitan region of Vitória-ES. **Methods:** we conducted a retrospective study, reviewing charts of trauma patients with liver injuries, whether isolated or in association with other organs, who underwent exploratory laparotomy, from January 2011 to December 2013. **Results:** We studied 392 patients, 107 of these with liver injury. The male: female ratio was 6.6 : 1 and the mean age was 30.12 years. Penetrating liver trauma occurred in 78.5% of patients, mostly with firearms. Associated injuries occurred in 86% of cases and intra-abdominal injuries were more common in penetrating trauma ($p < 0.01$). The most commonly used operative technique was hepatorrhaphy and damage control surgery was applied in 6.5% of patients. The average amounts of blood products used were 6.07 units of packed red blood cells and 3.01 units of fresh frozen plasma. The incidence of postoperative complications was 29.9%, the most frequent being infectious, including pneumonia, peritonitis and intra-abdominal abscess. The survival rate of patients suffering from blunt trauma was 60%, and penetrating trauma, 87.5% ($p < 0.05$). **Conclusion:** despite technological advances in diagnosis and treatment, mortality rates in liver trauma remain high, especially in patients suffering from blunt trauma in relation to penetrating one.

Key words: Liver. Abdominal Injuries. Wounds and Injuries. Firearms. Accidents, Traffic.

INTRODUCTION

Trauma is a public health problem of great magnitude in Brazil. It is one of the leading causes of death today, due to the increase in urban violence and the technological advancement of the automotive industry, which enabled the production of increased power vehicles^{1,2}.

Abdominal trauma can be classified into two distinct types: penetrating or blunt. Blunt trauma is usually due to accidents involving motor vehicles, falls, explosions and sports injuries. Penetrating trauma, on its turn, can be caused by stabbing or gunshot projectiles³.

The most commonly affected organs in the blunt abdominal trauma are the spleen (40 to 55%), liver (35 to 45%) and small intestine (5 to 10%). The injuries caused in penetrating abdominal trauma normally affect the liver (40%), small intestine (30%), the diaphragm (20%) and colon (15%). As for the injuries caused by firearm projectiles, they typically affect the small intestine (50%), colon (40%), liver (30%) and abdominal vessels (25%)^{1,4}.

The high rates of liver injury are justified by its size and anatomical position^{5,6}. The right lobe of the liver,

being the portion of the bulkier hepatic parenchyma, is the most affected region in abdominal injuries⁷.

This study aims to assess the epidemiological variables of, and the diagnostic and therapeutic modalities applied to, patients submitted to surgical treatment of liver trauma at a referral hospital for trauma.

METHODS

We conducted a retrospective review of medical records of patients undergoing laparotomy in the period from January 2011 to December 2013, at the Hospital Estadual São Lucas, a referral center for trauma, located in the Metropolitan Region of Vitória-ES.

We included trauma patients with liver injury, isolated or in association with other intra or extra-abdominal organs. We excluded surgical re-approaches in patients operated on in other services and subsequently transferred to our hospital. The sample therefore comprised 107 patients undergoing surgery for hepatic injury during this period.

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The variables analyzed were: age, gender, date and time of admission, the first operation time, length of stay, mechanism of injury, the presence of associated intra or extra-abdominal lesions, surgical technique, the intra-operative need for blood products, need for peri-hepatic drainage, postoperative complications and mortality.

The collected data were tabulated in electronic spreadsheets and statistical analyzes were performed according to Levine *et al.*, at 2012⁸. We carried out a descriptive analysis of the categorical variables, expressed in absolute numbers and percentages, and the continuous ones as position measurements. To compare the trauma mechanisms in relation to the categorical variables, we used the chi-square test. We considered a p value <0.05 as statistically significant.

This study was approved by the Ethics in Research Committee of the Santa Casa de Misericórdia de Vitória – EMESCAM, on 30 of April 2014, under number 632.212.

RESULTS

During the study period, from January 2011 to December 2013, 392 patients underwent laparotomy, 107 of them sustaining liver injury. Of these, 93 were male (86.9%) and 14 female (13.1%). The mean age of patients suffering liver trauma was 30.12 years, ranging from 14 to 72 (median 28), and 83.2% were in the first four decades of life.

As for the mechanism of injury, the most common was penetrating trauma, which occurred in 84 patients (78.5%). Of these, gunshot wounds (GW) accounted for 72 cases (85.7%) and stab wounds (SW), for 12 cases (14.3%). Blunt trauma occurred in 23 patients (21.5%), whose origins were 12 motorcycle accidents (52.2%), six car accidents (26.1%), two falls from a height (8.7%), running over in two (8.7%) and unidentified in one (4.3%).

Considering the anatomical site of liver injury, the right lobe was the most affected (46.73%), followed by the left one (25.23%) (Table 1). The caudate lobe was less affected, only in one case (0.93%). Simultaneous injury of right and left lobes or the right and caudate lobes occurred in 5.61% and 0.93% of patients, respectively.

We found associated intra (Table 2) and extra-abdominal (Table 3) lesions in 92 patients (86%). Associated Intra-abdominal lesions occurred in 67 patients (62.6%), the most damaged organs being the diaphragm, colon and stomach. Concomitant extra-abdominal lesions were found in 77 patients (72%), mostly in the chest.

As for the associated extra-abdominal lesions (Table 3), there was a higher incidence of head injury associated with blunt trauma (30% of cases) when compared with penetrating trauma (10.9% of cases).

The days of the week with more liver trauma victims were Sunday (25.2%), Wednesday (16.8%) and Saturday (15.9%) (Table 4). The days when with less victims

were Monday (14%), Friday (10.3%), Thursday (9.3%) and Tuesday (8.4%).

The time between hospital admission and the first surgery was less than two hours in 48.8%, between two and four hours in 17.9% patients and more than four hours in 33.3%. The average hospitalization time for patients with blunt trauma was 13.96 days, and for patients with penetrating trauma, 12.23 days.

Regarding the surgical technique used to control liver bleeding, the most used was hepatorrhaphy (80.37%) (Table 5). Cauterization of the liver injury has been reported in four patients (3.74%), being a single and sufficient measure to stop bleeding in two of these patients. It was also described the use of topical hemostatic agents in two cases (1.87%) and omentum transposition in only one case (0.93%). In 12 patients (11.21%) no measures of hemostasis were necessary, since the liver injury showed no active bleeding. Segmentectomy was performed in two patients (1.87%) and only one (0.93%) required left hepatectomy. Damage control surgery was performed in seven patients (6.54%). Eighteen patients (16.82%) needed further surgical intervention, mostly to withdraw textiles from the peritoneal cavity. Laparotomy was not therapeutic in four patients (3.74%).

Table 1 - Anatomical liver lobes affected in patients sustaining liver trauma.

Hepatic lobe	Frequency	%
Right	50	46.73
Left	27	25.23
Caudate	1	0.93
Right and left	6	5.61
Right and caudate	1	0.93
Not identified	22	20.56
Total	107	100.00

Source: Medical records of Hospital Estadual São Lucas (January 2011 to December 2013).

Table 2 - Associated intra-abdominal lesions in patients sustaining liver trauma.

Injured organ	Frequency	%
Diaphragm	30	20.27
Colon	26	17.57
Stomach	25	16.89
Kidney	17	11.49
Small intestine	17	11.49
Spleen	10	6.76
Extrahepatic biliary tree	9	6.08
Great vessels	8	5.4
Pancreas	6	4.05
TOTAL	148	100.00

Source: Medical records of Hospital Estadual São Lucas (January 2011 to December 2013).

Table 3 - Associated extra-abdominal lesions in patients sustaining liver trauma.

Injured region	Frequency	%
Chest	64	54.7
Limbs	37	31.62
Head	13	11.11
Neck	3	2.56
Total	117	100.00

Source: Medical records of Hospital Estadual São Lucas (January 2011 to December 2013).

Table 4 - Days of the week on which medical care was provided to patients sustaining liver trauma.

Weekday	Frequency	%
Sunday	27	25.2
Monday	15	14
Tuesday	9	8.4
Wednesday	18	16.8
Thursday	10	9.3
Friday	11	10.3
Saturday	17	15.9

Source: Medical records of Hospital Estadual São Lucas (January 2011 to December 2013).

Twenty-eight patients required blood products transfusion during surgery (26.2%) and the average amount of blood products used was 6.07 units of packed red blood cells and 3.01 fresh plasma units. Perihepatic drains were placed in 27 cases (25.2%), a Penrose drain being the most commonly used (n=15).

The incidence of postoperative complications was 29.9%, and the most frequent were infectious, including pneumonia, peritonitis and intra-abdominal abscess, which

represented 73.9% of complications. Hemobilia occurred in one patient, who was treated with hepatic artery embolization.

The survival rates were 60% in patients with blunt trauma, and in patients with penetrating trauma, 87.5% ($p < 0.05$) (Table 6). The mortality rate was 17.8% (n=19), the most common causes of death being hemorrhagic shock, responsible for ten deaths (52.6%), and septic shock, amounting to four deaths (21%).

DISCUSSION

Hepatic trauma occurred more frequently in males (86.9%) in the first four decades of life (83.2%). These results are similar to those reported by many researchers^{2,3,9,10}. The highest incidence of trauma in young adult males is associated with increased risk behavior due to exposure to alcohol and illicit drugs¹⁰.

Due to the increase of traffic accidents and violence in Brazil, the proportion of trauma admissions has gradually increased and hence the proportion of government spending. Likewise, hospital costs are directly proportional to the length of hospital stay¹⁰. In this study, the average hospitalization time for patients with blunt trauma was 13.96 days, and for patients with penetrating trauma, 12.23 days, agreeing with the average found in the literature⁹.

Lima *et al.* studied the epidemiology of abdominal trauma undergoing laparotomy and, as well as in our work, observed that there was a higher prevalence of trauma on weekends¹⁰.

Mortality in hepatic trauma in most studies is close to 20%, considering all cases admitted to hospital⁹. The mortality rate in this study was 17.8%. Of the eleven deaths from penetrating trauma, ten were the result of gunshot wounds.

Other intra-abdominal injuries concomitant with liver lesions were more common in penetrating trauma ($p < 0.01$), as shown in table 6. In penetrating abdo-

Table 5 - Surgical techniques applied in the treatment of patients sustaining liver trauma.

Technique*	Patients	%
Hepatorrhaphy	86	80.37
Segmentectomy	2	1.87
Left hepatectomy	1	0.93
Electrocauterization	4	3.74
Topical hemostatic agents	2	1.87
Epiploplasty	1	0.93
Damage Control	7	6.54
No action (liver damage with no active bleeding)	12	11.21
Nontherapeutic laparotomy	4	3.74

Source: Medical records of Hospital Estadual São Lucas (January 2011 to December 2013).

* In some patients, more than one approach was performed

Table 6 - Associated intra-abdominal lesions and survival rate in blunt and penetrating trauma in patients sustaining liver trauma.

	Blunt trauma(n=20)	Penetrating trauma (n=64)
Associated intra-abdominal lesions*	6 (30%)	46 (71.9%)
Survival rate **	12 (60%)	56 (87.5%)

Source: Medical records of Hospital Estadual São Lucas (January 2011 to December 2013).

* The result of the chi-square test indicated rejection of the null hypothesis at a significance level of <1% ($p < 0.01$).

** The result of the chi-square test indicated rejection of the null hypothesis at a significance level of <5% ($p < 0.05$).

minal trauma, the injuries of large intra-abdominal vessels stand out¹¹. In this study, all eight injuries of large intra-abdominal vessels were caused by penetrating trauma, seven of them by firearms. The vessels involved were: inferior vena cava, middle hepatic vein, splenic artery, right common iliac artery and vein, superior mesenteric vein and artery.

Hepatorrhaphy was the most used surgical technique to control liver bleeding. Other techniques include direct ligation of bleeding vessels, cauterization, the use of topical hemostatic agents, partial liver resection and hepatic artery ligation. In selected cases, refractory bleeding can be controlled with liver packing, the damage control surgery⁶.

The damage control surgery was performed in seven cases (6.54%) and patient survival was 100%, which confirms damage control as a measure which increases the survival rate of seriously injured patients who face the so-called triad of death – hypothermia, coagulopathy and metabolic acidosis^{6,11,12}.

Research on the surgical treatment of hepatic injury began to grow in the early twentieth century. The maneuver of Pringle and liver packing technique were described in 1908, giving rise to the concept of damage control surgery^{11,13}. Liver packing became a common practice a few years later, during the two Great World Wars. At that time, mortality related to hepatic trauma was 60%^{13,14}.

After World War II, the mortality of liver trauma decreased due to increased experience in the repair of injuries. This led to the abandonment of surgery for damage control, which at the time was associated with a high incidence of late onset sepsis and rebleeding after packing removal. From the 70s on, surgery for damage control regained its importance in selected patients¹⁴.

Until the early 90s, surgical treatment was the standard treatment of liver injury¹⁵. Since then, the diagnostic and therapeutic approach to abdominal trauma victim suffered intense changes⁶. Initially, it was found that most liver injuries spontaneously stopped bleeding^{6,16}. In 1908, Pringle had suggested that minor liver damage occasionally could heal without surgical intervention¹³. However, little had been published about non-operative treatment until the 80's and the surgeons were resistant to conservative treatment, especially in blunt trauma^{16,17}.

This resistance resulted primarily from three factors: the belief that liver bleeding would not cease unless surgically controlled; the concern that the lack of bile drainage would result in biliary fistulas and infectious complications; and the concern about associated lesions in face of a positive peritoneal lavage¹⁷.

With technological advances in imaging and greater accessibility to computed tomography and FAST (Focused Assessment with Sonography for Trauma), conservative treatment has become possible for patients with hemodynamically stable hepatic trauma^{15,18}, which contributed to reduce unnecessary laparotomy^{7,12,18-21}. Thus, there is a tendency to avoid routine laparotomy, especially for patients with hepatic trauma who are hemodynamically stable and display signs of peritonitis¹⁹.

Besides the advantage of avoiding the morbidity of an unnecessary laparotomy¹⁵, conservative treatment has shown other advantages over the surgical one, such as lower complication rates, less need for blood products transfusions, shorter hospital stay, especially in Intensive Care Units, and lower mortality^{15,16,19,21}.

FAST is an exam with high sensitivity for the diagnosis of hemoperitoneum in hemodynamically unstable patients, as well as to identify liver damage^{18,22}. A major advantage of this test is that it can be done at the bedside, without the need to move the patient from the emergency room¹⁸.

On the other hand, when the patient is hemodynamically stable, triple contrast CT is the method of choice in patients with blunt abdominal trauma. Computed tomography allows to determine the extent of liver damage, document the presence of active bleeding and detect associated lesions²². It is very useful in defining the severity of liver injury and the decision of conservative treatment¹⁸.

The diagnostic peritoneal lavage (PL) is a useful test for the diagnosis of hemoperitoneum when the patient is hemodynamically unstable and has sensory changes, and when there's no ultrasonography and CT available in the institution. Therefore, the PL can be replaced by ultrasound and, in more stable patients, CT²².

According to Zago *et al.*, there has been a decrease in the incidence of penetrating trauma and increased incidence of blunt trauma in Brazil in recent years⁹.

However, this study found a higher prevalence of penetrating trauma (76.2%). This discrepancy can be explained by the fact that our study only examined the operated patients, and patients treated conservatively – most victims of blunt trauma – were not counted. It is noteworthy that the conservative treatment of hepatic trauma in patients with hemodynamic stability has become standard in most trauma centers^{16,22}.

In this study, the right lobe of the liver was the most affected, which was also demonstrated by Talving *et al.*²³. According to Romano *et al.*, the right lobe is the most affected because it is the most voluminous part of the hepatic parenchyma⁷. Associated lesions were found in 72 patients (85.7%). The high number of associated injuries is a major challenge for the management of patients because their presence hinders the decision of conservative treatment^{2,3} and often determines the evolution of the patient¹².

We observed a low incidence of postoperative complications (29.9%). This complication rate obtained is below the parameters found in some studies on the epidemiology of liver trauma, the rates varying from 36 to 38.9%^{9,24}.

We found (Table 6) that the mortality rate for patients with hepatic injury was greater for blunt trauma (40%) than for penetrating one (12.5%), possibly due to the higher rates of cranial injuries associated with blunt trauma. Zago *et al.* found similar results, with a mortality rate of 26.5% for blunt trauma and 15.8% for the penetrating one⁹.

Despite technological advances in diagnosis and treatment, and the systematization of care for polytrauma proposed by the Advanced Trauma Life Support (ATLS®), morbidity and mortality rates in liver trauma remain high^{7,24,25}. Therefore, liver trauma is a serious public health problem with significant social and economic costs, especially since it affects people of working age.

R E S U M O

Objetivo: avaliar as variáveis epidemiológicas e as modalidades diagnósticas e terapêuticas relacionadas ao trauma hepático de pacientes submetidos à laparotomia exploradora em um hospital público de referência da Região Metropolitana de Vitória-ES.

Métodos: estudo retrospectivo de revisão de prontuários dos pacientes vítimas de trauma com lesão hepática isolada ou associada a outros órgãos, submetidos à laparotomia exploradora, no período de janeiro de 2011 a dezembro de 2013. **Resultados:** foram estudados 392 pacientes submetidos à laparotomia, dos quais 107 com lesões hepáticas. A relação masculino:feminino foi 6,6:1 e a média de idade dos pacientes foi 30,12 anos. O trauma hepático penetrante ocorreu em 78,5% dos pacientes, principalmente por arma de fogo. Lesões associadas ocorreram em 86% dos casos e as lesões intra-abdominais foram mais comuns no trauma penetrante ($p<0,01$). A técnica operatória mais utilizada foi a hepatorrafia, e a cirurgia para controle de danos foi feita em 6,5% dos pacientes. A quantidade média de hemoderivados utilizados foi 6,07 unidades de hemoconcentrado e 3,01 unidades de plasma fresco. A incidência de complicações pós-operatórias foi 29,9%, e as mais frequentes foram as infecciosas, incluindo pneumonia, peritonite e abscesso intra-abdominal. A taxa de sobrevida dos pacientes acometidos de trauma contuso foi 60% e de trauma penetrante, 87,5% ($p<0,05$). **Conclusão:** apesar dos avanços tecnológicos de diagnósticos e tratamentos, as taxas de morbimortalidade nos traumas hepáticos permanecem elevadas, especialmente nos pacientes acometidos de trauma hepático contuso em relação ao trauma penetrante.

Descritores: Fígado. Traumatismos Abdominais. Ferimentos e Lesões. Armas de Fogo. Acidentes de Trânsito.

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Received: 13/08/2015

Accepted for publication: 30/11/2015

Conflict of interest: none.

Funding source: Bolsa de PIBIC do Fundo de Apoio à Ciência e Tecnologia – Facitec.

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