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Original article

Operative and nonoperative management of blunt hepatic trauma in adults: a single-center report

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Abstract

Background/Purpose. Liver trauma, especially that as result of road traffic accidents, still remains a complicated problem in severely injured patients. The aim of this study was to extract useful conclusions from the management in order to improve the final outcome of such patients.

Methods. Details for 86 patients with blunt hepatic trauma who were examined and treated in our department during a 6-year period were analyzed. We retrospectively reviewed the severity of liver injury, associated injuries, treatment, and outcome.

Results. Forty-nine liver injuries (57%) were of low severity (grades I and II), while 37 (43%) were of high severity (grades III, IV, and V). Liver trauma with associated injury of other organs was noted in 62 (72.1%) patients. Forty-three (50%) patients underwent an exploratory laparotomy within the first 24 h of admission. Thirty-five (71.4%) of the 49 patients with low-grade hepatic injuries were managed conservatively; no mortality occurred. Six patients (14%) with liver trauma initially considered for conservative management required surgery due to hemodynamic instability. Five (13.5%) of 37 patients who were finally managed nonoperatively required adjunctive treatment for biloma, hematoma, or biliary leakage; no mortality occurred. The overall mortality rate was 9.3%; mortality rates of 5.8% and 3.5% were due to liver injuries and concomitant injuries, respectively.

Conclusions. Severe hepatic injuries require surgical intervention due to hemodynamic instability. Low-grade injuries can be managed nonoperatively with excellent results, while patients with hepatic trauma with associated organ injuries require surgery, because of the risk of increased mortality in such patients.

Key words Hepatic trauma · Management Associated injuries Mortality

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Introduction

The liver is the most commonly injured organ in patients with blunt trauma. Liver trauma has been the main cause of death in patients with severe abdominal injuries, with related mortality of 10%–15%.[1]

The prevalence of liver injury has increased during the past three decades.[2,3] Initially, due to war actions and secondly as a result of urban accidents, this increased rate represents an absolute rise of liver injuries, together with better diagnosis through the liberal use of computed tomography (CT) and more advanced trauma registries.

Until the beginning of the 1990s, liver injury cases were identified primarily by diagnostic peritoneal lavage, CT, or laparotomy. Historically, the accepted standard of care was uniform operation for suspected liver injuries, with repair of vascular, parenchymal, or biliary structures and drainage of the perihepatic spaces to control biliary leakage and to avoid potential perihepatic sepsis.[2] The advent of improved and expeditious imaging technologies for the diagnosis and treatment of solid-organ injuries, accompanied by advances in critical-care monitoring, prompted a paradigm shift toward nonoperative management for the treatment of solid-organ injuries. Subsequently, the shift toward nonoperative management yielded a decrease in total mortality rates.[2] At present, the reported success rate of nonoperative management of hepatic trauma ranges from 82% to 100%.[2–8] Furthermore, an absolute increase in the incidence of nonoperatively managed liver injuries is unequivocal.[4,5]

This study was performed to address several important issues regarding the management of liver injuries arising from blunt trauma, including total mortality with all forms of treatment, the risks from failure of nonoperative management, and the necessity for adjunctive procedures to improve the outcome of such patients.

Patients and methods

Eighty-six patients with blunt liver trauma in a 6-year period (January 1999-December 2004) were included in this retrospective study. There were 64 male (74.4%) and 22 female (25.6%) patients, with an age range of 19 to 63 years (median age, 32 years).

The medical records were reviewed for information regarding patients' sex, age, mechanism and side of injury, physical findings, laboratory findings, radiologic imaging, and operative or nonoperative management. On admission, a record of shock state, and rough determination of hepatic trauma (including grade of hepatic injury) and associated intraabdominal and extraabdominal injuries were performed. Methods of diagnosis, therapeutic procedures, adjunctive procedures, and outcome (uneventful recovery, postoperative complications, mortality, and cause of the death) were also analyzed.

In this series, blunt liver trauma was proved by surgical exploration, except in those patients who were treated nonoperatively whose diagnosis was defined by CT. The grade of hepatic injury was established from initial CT determination or intraoperative findings, according to the Liver Injury Scale of the American Association for the Surgery of Trauma (AAST);[9] with severity of trauma of grade III-V regarded as severe liver trauma. In some cases, trauma grade was underestimated by CT and, finally, those patients with relevant injury required an exploratory laparotomy.

In cases where the hepatic injury was defined by CT and patients were hemodynamically stable, treatment was decided to be conservative. If a patient's condition was worsening with unstable general vital signs and/or an abdominal lavage for blood was positive, an urgent laparotomy was decided on. Hemodynamic stability was defined as those patients who initially presented with, or regained, a systolic blood pressure greater than 90 mmHg and a heart rate less than 100 beats/min after initial resuscitation with 2 l of crystalloids. The management scheme was defined as operative (patients who underwent operative intervention for hepatic injury within the first 24 h of admission) or nonoperative (patients who did not undergo operative intervention for hepatic injury within the first 24 h of admission).

Results

Forty-nine patients (57%) had low-grade and 37 patients (43%) suffered high-grade injuries. Regarding the presence of associated injuries, 62 patients (72.1%) had multiple traumas. Splenic injury was the most common major associated intraabdominal injury, followed by diaphragmatic tear, mesenteric contusion, colon perforation, and renal contusion. Chest injuries, head injuries, and bone fractures were most often observed. In 21 patients (22.1%) the Glasgow Coma Score (GCS) was under 13. Shock (systolic blood pressure ≤80 mmHg) presented in 29 patients (33.7%) at the time of admission. Associated intraabdominal and extraabdominal injuries in 62 patients are shown in Table 1.

Table 1. Associated injuries in 62 patients with blunt liver trauma

Associated injuries	No. of patients
Spleen	19
Diaphragm	18
Colon	8
Renal	6
Mesentery	17
Head	35
Chest	27
Bone and joint	46

Abdominal lavage was performed in 41 (47.7%) patients. A positive lavage with aspiration of fresh blood was observed in 25 (61%) patients. All of these patients underwent exploratory laparotomy. Of the patients with positive lavage, 11 (44%) had severe hepatic trauma as the main cause of the intraabdominal hemorrhage, while in 14 (56%) patients the main cause of hemorrhage was an associated intraabdominal injury.

Forty-three patients (50%) in stable hemodynamic condition at admission were treated conservatively in the first instance. Of these, 6 patients (14%) required a laparotomy 24 h after admission because hemodynamic status worsened. The percentage of failure of nonoperative management was 14% (6/43), with 33% (1/3) grade III, 9.1% (2/22) grade I, and 16.7% (3/18) grade II injuries, respectively. In the patients with grade I and II injuries, failures were due to other than liver injuries, and the failure in the patient with grade III injury was associated with liver hemorrhage. Forty-three patients (50%) with severe blunt liver trauma were taken to the operating theater immediately after resuscitation for exploratory laparotomy. The percentage of patients managed nonoperatively decreased as the grade of liver injury increased. Table 2 shows the liver injuries stratified by grade of injury, final operative and nonoperative management, and mortality.

Surgical intervention included liver parenchyma suturing (hepatorrhaphy) and hemostasis in 28 (32.6%), liver parenchyma suturing, hemostasis by means of biologic fibrin glue and absorbable hemostatic sponge in 13 (15.1%), segmental resection and temporary perihepatic packing in 6 (7%), and right hepatectomy in 2 patients (2.3%). We performed the Pringle maneuver for 15 min during liver parenchymal dissection, followed by

10 **Table 2.** Liver injuries stratified by severity, final operative and nonoperative management, and mortality

Grade	No. of patients $n = 86$	OR $n = 49$ (57)	NOR $n = 37$ (43)	OR-M $n = 8$ (9.3)	NOR-M $n = 0$
I	26 (30.2)	6 (23)	20 (77)	0	0
II	23 (26.7)	8 (34.8)	15 (65.2)	0	0
III	21 (24.5)	19 (90.5)	2 (9.5)	3 (14.3)	0
IV	13 (15.1)	13 (100)	0	2 (15.4)	0
V	3 (3.5)	3 (100)	0	3 (100)	0

The values in parentheses are percentages
OR, operative management; NOR, nonoperative management; OR-M, mortality with operative management; NOR-M, mortality with nonoperative management

11 **Table 3.** Surgical procedures by grade of blunt hepatic injury

Grade	HE + HS ($n = 28$)	HE ($n = 13$)	SR + TP ($n = 6$)	RH ($n = 2$)
I	4	2		
II	5	3		
III	12	4	3	
IV	7	4	1	1
V			2	1

The values in parentheses are percentages
HE, hepatorrhaphy; HE + HS, hepatorrhaphy + hemostatic substances; SR + TP, segmental resection + temporary packing; RH, right hepatectomy

Table 4. Patients' outcome by operative and nonoperative management groups

	NOR ($n = 37$)	OR ($n = 49$)
Morbidity (n)		
Biloma/hematoma	3	
Biliary leakage	2	
Subphrenic abscess		4
Pulmonary atelectasis		6
Wound infection		8
Mortality (n)	0	8

OR, operative management; NOR, nonoperative management; n, number of patients

5 min of unclamping, for temporary control of hemorrhage in 8 operated patients who required segmental resection or right hepatectomy. Table 3 shows the surgical procedures stratified by the grade of hepatic injury.

Five (13.5%) of the 37 patients managed nonoperatively required adjunctive treatment. A percutaneous drainage of biloma or hematoma was done in 3, while endoscopic retrograde cholangiopancreatography (ERCP) was performed in 2 patients and biliary leakage was successfully treated with stenting.

Four patients (8.2%) of those managed surgically had subphrenic abscess, which required percutaneous 7 drainage. Minor complications included pulmonary atelectasis in 6 and wound infection in 8 patients. Eight patients (9.3%) died. No fatality occurred in the nonoperative management group. Three patients with grade III hepatic trauma died due to associated organ injuries (head and chest). Five patients died on the table due to uncontrollable bleeding from severe liver trauma (grades IV and V). Patients' outcomes, stratified by operative and nonoperative management groups, are shown in Table 4.

Hospital stay ranged from 9 to 37 days (median, 23.5 days). Forty one patients (83.7%) with blunt liver trauma treated by surgery were followed for 6 months, and the 37 patients (100%) treated nonoperatively were followed for 3 months after discharge. A full blood count and liver function tests, together with an ultrasound scan, were used to evaluate the general condition of the followed patients, and the vast majority did not present with or complain of any serious problem.

Discussion

The liver remains the most commonly injured abdominal organ in patients with blunt trauma.[1,2] Historically, nonoperative management of grade I and II hepatic injuries has been widely successful.[6–8,10–12] Subsequently, the nonoperative management of high-grade injuries has been supported more widely because approximately 60% of cases are managed in this fashion.[9,13]

The role of the grade of hepatic injury in deciding whether a patient needs surgery is more controversial. Whereas some surgeons are reluctant to manage high-grade liver injury nonoperatively, others do not consider a high grade of injury an indication for surgery.[8,10,14] Although paradoxical, most patients with a high-grade hepatic trauma selected for nonoperative management will still not require a delayed surgical intervention. Embolization through digital selective angiography of-

fers an effective way to control hemorrhage in the early stages of high-grade injuries.[15,16] Although some institutions have expanded the concept of nonoperative management to include angiography and embolization in hemodynamically unstable patients requiring ongoing resuscitation, this is not practiced routinely at our institution. All patients who did not regain hemodynamic stability after initial resuscitation underwent operative intervention for the assessment of injuries.

In this study, a minority of patients with grade III, IV, or V injuries underwent nonoperative management, whereas more than two-thirds of the patients with grade I or II injuries were managed nonoperatively. The treatment of blunt hepatic injuries, including nonoperative management for the minority (43%) and operative treatment when appropriate (57%), yielded a low liver-related mortality rate of 5.8% and a total mortality rate of 9.3%. Half of the patients required surgery within the first 24 h of admission due to hemodynamic instability from liver and associated organ injuries. Fourteen per cent of patients initially managed nonoperatively ultimately required laparotomy 24 h after admission; subsequent operation was performed in 1 patient to treat liver injury and in 5 patients to treat associated intraabdominal injuries. The operative mortality increased as the grade of hepatic injury increased, from 0% in grade I injuries to 100% in grade V injuries. Of patients with grade IV and V injury ultimately treated by surgery, one-third died of excessive hepatic hemorrhage, while none of the patients with grade III injury treated operatively died due to hepatic hemorrhage; 3 patients died due to concomitant injuries.

Temporary control of hemorrhage and thorough exposure of the injured liver are the preconditions for success. Occlusion of the hepatic pedicle by the Pringle maneuver can provide a relatively nonvascular field. In our series, the Pringle maneuver was performed for 15 min during liver parenchymal dissection, followed by 5 min of unclamping, whereas some have reported that no hepatic functional injury was found with hepatic portal blocking of over 110 min.[17] However, we prefer to keep the time of occlusion as short as possible, because the tolerance of the liver to hypoxia decreases in hemorrhagic shock.

Temporary perihepatic packing with swabs and sponges is particularly useful for patients with blood clotting disturbances. Packing can be freed gradually in theater 48 to 72 h later, according to the patient's condition. The most common complication associated with perihepatic packing is subdiaphragmatic abscess. Special attention should be given to prevention or early detection and drainage. Other complications have been mentioned by some surgeons, including renal failure from excessive compression of the inferior vena cava, due to packing or cardiopulmonary dysfunction because of the rise of the diaphragm.[18] In addition, the abdominal compartment syndrome has been reported by many surgeons in recent years, and this can lead to similar and other complications.[19] In our opinion, these complications could be avoided or decreased by proper techniques. In our group of patients treated with perihepatic packing, one patient developed abdominal compartment syndrome. In every case the complications were relieved by immediate removal of the packing. Finally, although the infection rate is directly correlated with packing duration, no death from perihepatic sepsis has been reported.[20]

Hepatic resection plays a major role in the treatment of severe liver contusion, especially for patients with severe contusions in multiple places, and injuries in bile ducts, hepatic veins, and the inferior vena cava in combination with extensive parenchymal damage. The benefit of anatomic resection has been proved by Strong et al.[21] In the present study, anatomic resections were used in all grade V injuries, and the survival rate was not ideal. We have also reported that different methods of operation should be selected according to the AAST grade of liver trauma, and in many cases, more than two procedures could be used. In our series, the efficacy of hepatic artery ligation was not confirmed, because hemorrhage could be stopped without that maneuver. When the bleeding is mainly from retrohepatic veins or the portal vein, however, hepatic artery ligation alone will fail to control bleeding, unless adjunctive procedures such as packing are added.

Carrillo et al.[22] showed that 24% of patients managed nonoperatively required additional treatment secondary to complications. In this study, 13.5% of those managed nonoperatively required adjunctive treatment procedures; all had a high degree of success. We also observed 4 major and 14 minor complications among patients treated operatively. All these complications were managed successfully.

In conclusion, the mortality rate after blunt hepatic trauma is highly associated with the severity of hepatic injuries at the time of admission; the concomitant intraabdominal and extraabdominal injuries, particularly head and chest injuries; and the rapidity of deciding on a surgical approach. Although low-impact liver injuries can be managed without operation with excellent results, high-grade injuries requiring operation continue to yield a high mortality rate. For those patients who can be managed nonoperatively, adjunctive procedures may be required selectively for successful management.

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