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ORIGINAL ARTICLE

Operative Management of Liver Injury in Polytrauma Patients: Experience of One Trauma Center

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ABSTRACT

Introduction: The liver is one of two most frequent abdominal parenchymal organs involved in trauma. Liver injury (LI) remains an important cause of trauma-related mortality. It is often accompanied by trauma to the other organs.

Materials, methods and results: During 9 years in the Provincial Trauma Center, out of 10,191 hospitalized patients, there were 1,702 trauma-related hospitalizations and 393 multiorgan traumas; 217 patients underwent surgery due to multiorgan trauma and coexisting LI. The most frequent coinvolved organs were spleen (83.9%), colon (33.6%), kidney (18.9%), small intestine (18.9%), pancreas (17.5%), gallbladder (16.6%), diaphragm (15.7%), and ileocecal valve (12.9%), with 33.2% of rib fractures and 31.3% of pneumothorax and pneumohemothorax. Grade of liver trauma was assessed according to American Association for the Surgery of Trauma—Organ Injury Scale (AAST-OIS). Fifty-two liver injuries (24,9%) were classified as AAST-OIS grade I, 54 (24.9%) as grade II, 46 (21.2%) as grade III, 41 (18.4%) as grade IV, and 25 (11.5%) as grade V. Patients received laparotomy (n = 205, 94.5%) or thoracolaparotomy (n = 12, 5.5%). Liver injuries were managed with electrocoagulation (n = 64, 29.5%), parenchymal sutures (n = 87, 40.1%), resectional debridement (n = 12, 5.5%), and perihepatic packing (n = 54, 24.9%).

Predominance of males and young patients with a mean age of 36 corresponds to accident statistics. Among patients receiving surgery, 88.9% had blunt trauma, with a high predominance of motor vehicle accidents.

Conclusion: Liver injuries predominantly follow a blunt abdominal injury. Despite good results of nonoperative management in hemodynamically stable patients with blunt trauma, surgery is still required due to complexity and seriousness of multiorgan injuries. Complex liver injuries require surgery in a well-equipped and active trauma center, since the mortality rate of surgical management of major liver injuries remains high.

Keywords: Liver injury, Multiorgan trauma, Polytrauma, Surgery.

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INTRODUCTION

The liver is the second most frequently injured intraperitoneal parenchymal organ, next to spleen.[1,2] Liver injuries constitute 5% of all traumas.[3-5] Liver injury may occur by blunt or penetrating force. Motor vehicle accidents along with sports-related injuries are the most common causes of blunt trauma. In blunt abdominal injuries, LI is the commonest cause of mortality.[6] In majority of cases, LI is accompanied by injury to the other organs.[7]

To asses a polytrauma patient, an effective, efficient, and rapid diagnostic protocol needs to be followed. Ultrasound, including a focused assessment with sonography for trauma (FAST), and computed tomography are used for diagnosis. The FAST is noninvasive, rapid, and repeatable, but operator-dependent and positive only when intraperitoneal fluid volume exceeds 400 mL.[1,4] An invasive diagnostic peritoneal lavage may be required if noninvasive diagnostic tools are not available.[8]

Liver injuries are classified in a 6-point organ injury scale proposed by the AAST, from the least severe (grade I) subscapular, nonexpanding hematoma <10 cm surface area or capsular laceration <1 cm of parenchymal depth, to the most severe (grade VI) hepatic avulsion (Table 1).[3,7,9-11]

The majority of LIs require a nonoperative management; 50 to 85% of blunt LIs can be treated conservatively. Hemodynamically stable patients with blunt LI can be managed nonoperatively.[2,4-6,12] Grade III or higher AAST-OIS of LI and hemodynamically unstable cases require surgery (perihepatic packing, parenchymal sutures, liver resections and resectional debridement, partial hepatectomy, lobectomy, or selective vessel ligation).[3-6,9,13]

In this retrospective study, we present a series of polytrauma patients receiving surgery due to severity of either liver or other organ injury. The trauma mechanism,

Table 1: Liver injury scale according to AAST-OIS[11]

AAST-OIS grade of LI	*Type of injury*		
	Hematoma	*Laceration*	*Vascular*
I	Subscapular, nonexpanding, < 10 cm surface area	Capsular tear < 1 cm parenchymal depth	
II	Subscapular, nonexpanding, 10–50% of surface area or intraparenchymal, nonexpanding, <10 cm in diameter	1–3 cm parenchymal depth, <10 cm in length	
III	Subcapsular >50% of surface area or expanding, ruptured subcapsular or parenchymal hematoma, intraparenchymal hematoma >10 cm in diameter	>3 cm parenchymal depth	
IV		Parenchymal disruption involving 25–75% of hepatic lobe	
V		Parenchymal disruption involving >75% of hepatic lobe	Juxtavenous hepatic injuries, i.e., retrohepatic vena cava or central major hepatic veins
VI			Hepatic avulsion

Table 2: Percentages of trauma-related hospitalizations, multiorgan and liver injuries among all hospitalized patients

	No. of patients	*% of all hospitalized*	*% of trauma-related hospitalizations*	*% of multiorgan traumas*
All hospitalized	10,191			
Trauma-related hospitalizations	1,702	16.7		
Multiorgan trauma	393	3,9	23.1	
Liver trauma	217	2,1	12.7	55.2

AAST-OIS score, operative procedures, and mortality are presented. Patients treated nonoperatively were excluded from this evaluation.

MATERIALS, METHODS, AND RESULTS

Out of a total of 10,191 patients treated in the Department of General and Vascular Surgery in the Provincial Trauma Center, Czestochowa, Poland, over a period of 9 years, 217 (2.13%) patients had sustained LI along with other thoracoabdominal injuries. A retrospective study was done in these 217 patients (Table 2). Of these, 137 (63.1%) were males and 80 were (36.9%) females. Their age ranged from 18 to 81 years with an average age of 34 years for males, 39 years for females, and 36 years for the combined group. In 193 patients (88.9%), cause was blunt trauma, majority (72.4%) due to motor vehicle accidents. In 24 patients (11.1%), injuries were caused by penetrating trauma.

Liver injuries were classified as per AAST-OIS scale: 52 (24%)—grade I, 54 (24.9%)—grade II, 46 (21.2%)—grade III, 41 (18.4%)—grade IV, and 25 (11.5%)—grade V (Table 3). Other organ injuries were spleen in 182 patients (83.9%), colon (33.6%), kidney (18.9%), small bowel (18.9%), pancreas (17.5%), gallbladder (16.6%), diaphragm (15.7%), and inferior vena cava (12.9%). Besides, 72 patients (33.2%) had associated rib fractures and 68 patients (31.3%) had pneumothorax/hemopneumothorax (Table 4).

Table 3: Grading of liver injuries based on AAST-OIS[11]

AAST-OIS LI scale	*n (%)*
I	52 (24.0)
II	54 (24.9)
III	46 (21.2)
IV	41 (18.4)
V	25 (11.5)

Table 4: Organs coaffected with LI in polytrauma patients

	n (%)	*AAST-OIS for organ-specific injuries*[11]
Spleen	182 (83.9)	I (n = 48); II (n = 56); III (n = 18); IV (n = 34); V (n = 26)
Colon	73 (33.6)	Ascending n = 7; transverse n = 34; descending and sigmoid n = 32
Rib fracture	72 (33.2)	
Pneumothorax and pneumohemothorax	68 (31.3)	
Kidney	41 (18.9)	I (n = 13); II (n = 9); III (n = 8); IV (n = 4); V (n = 7)
Small intestine	41 (18.9)	
Pancreas	38 (17.5)	I (n = 10); II (n = 15); III (n = 9); IV (n = 2); V (n = 2)
Gallbladder	36 (16.6)	
Diaphragm	34 (15.7)	
Inferior caval vein	28 (12.9)	
Pelvis fracture	27 (12.4)	
Bladder	23 (10.6)	
Stomach	12 (5.5)	
Esophagus	7 (3.2)	
Pericardial tamponade	4 (1.8)	
Ovary	3 (1.3)	

A total of 205 patients (94.5%) underwent laparotomy and in 12 patients (5.5%), laparotomy was combined with thoracotomy. Operative procedures carried out for liver injuries consisted of perihepatic packing, parenchymal sutures, resections (partial hepatectomy or lobectomy), and selective vessel ligation. Other organ injuries were treated as per general surgical principles; 23 patients (6%) died intraoperatively. Overall, in-hospital mortality was 16.6% (36 cases).

DISCUSSION

Liver injuries constitute an important component of multiorgan injuries. Motor vehicle accidents are the commonest cause of these injuries. Grading of liver injuries as per AAST-OIS is carried out by using three parameters: (i) extent and location of hematoma, (ii) length and depth of laceration, and (iii) severity and location of vascular trauma. These are shown in detail in Table 1. Higher the grade of injury, worse is the prognosis. Grade VI liver injuries rarely reach the hospital alive as in the present study.

Right lobe injuries are more common than left lob injuries in blunt trauma, as seen in this study (right lobe 74.6% *vs* left lobe 49.3%). Male preponderance (63.1%) as seen this study corresponds to accident statistics as expected. Majority of the injuries are caused by blunt trauma (88.9% in this study) and most of these are due to motor vehicle accidents. These figures correspond to data published in literature.[1,5,6] Incidence of gunshot injuries in our study was only 1.8%, which corresponds with the data of other countries where possession of firearms is illegal. Splenic injury was the commonest one associated with liver injuries in our series (83.9%). Similar incidence has been reported by other authors.[1,5,13]

Bleeding from major liver injuries remains an important cause of mortality. The trauma surgeon has to be familiar with all methods of controlling bleeding from liver. In our series, bleeding from liver injuries was controlled by electrocoagulation in 29.5% cases, parenchymal sutures in 40.1%, resectional debridement in 5.5% and perihepatic packing, followed by relook laparotomy. Procedure to be used depends upon hemodynamic status of the patient, severity of LI, presence of other organ injuries (which need to be treated simultaneously), and expertise of the trauma center.[3-6,9,13] Mortality rate of liver injuries remains high. Higher AAST-OIS grade, prolonged prothrombin time, and decreased platelet count are associated with higher mortality.[13]

CONCLUSION

Liver injuries predominantly occur due to blunt trauma. When associated with other organ injuries, surgery is required in all cases. Mortality of major liver injuries remains high. Trauma surgeons must be familiar with various modalities of management of liver injuries. The aim should be to stop bleeding as expeditiously as possible. They also must possess expertise to deal with other injured organs in a polytrauma patient.

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