Management of Liver Injury; An Experience from Baghdad Teaching Hospital

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ABSTRACT:

BACKGROUND:

The liver is the second most commonly injured organ in abdominal trauma, liver injury could be caused by trauma to abdomen, lower chest and back (blunt or penetrating injury) and may be associated with high mortality and morbidity depending on the mechanism of injury and associated injuries.

OBJECTIVE:

Discuss the types and grades of liver injury, assess treatment modalities and identify morbidity and mortality caused by liver injury.

PATIENTS AND METHODS:

This is a prospective study; included 60 patients admitted with liver injury within period of 13 months from (1st.January 2015- 31 st. January 2016) in Baghdad Teaching Hospital, Only patients who underwent operative management were included in this study. They were analyzed according to their age, gender, and mechanism of injury, site of trauma, physical examination, investigations, and details of management which include operative management.

RESULTS:

In this study, most injured patients were male 54 (90%) patients and 6 (10%) patients were female. The peak incidence of age was in those between 20-29 years, 28 (46.67%) patients while the lowest incidence was in those between 50-60 years, 2 (3.33%) patients. 52 (86.67%) patients had penetrating liver injury making it the most common type of injury and 8(13.33%) patients had blunt liver injury. The patients in this study were diagnosed by clinical examination, imaging study and exploratory laparotomy.

23 (38.33%) patients had grade II liver injury making it the most commonly encountered grade of injury while 19 (31.67%) patients had grade III as second most common grade of injury. Diaphragmatic injury was the most common associated organ injury with liver injury 30 (50%) patients. Surgical options for treatment of liver injury depend on general condition of the patients and grade of liver injury; simple suturing (hepatorrhaphy) with gelfoam was the most commonly used modality of treatment. Regarding postoperative complications, wound infection was the most common postoperative complication 8 (13.33%) patients followed by respiratory complications in 6 (10%) patients, jaundice in 5 (8.33%) patients, bile leak in 3 (5%) patients ,subphrenic collection in 3 (5%) patients ,disseminated intravascular coagulopathy (DIC) had occurred in 3 (5%) patients, bleeding occurred in 2 (3.33%) patients, hemobilia occurred in 1 (1.67%) patient and liver abscess and necrosis occurred in 1 (1.67%) patient .

CONCLUSION:

The most common grades of liver injury were grade II and grade III. The mortality rate increases with increasing the evidence of vascular injury.

KEY WORDS: liver trauma, penetrating injury, blunt injury.

INTRODUCTION:

The liver is one of the most frequently injured organs in abdominal trauma [1,2]. The anterior location in the abdominal cavity and fragile parenchyma with easily disrupted Glisson's capsule make this organ vulnerable to injury.Motor vehicle accidents (MVA) account for the majority of blunt trauma, whereas knife and gunshot wounds (GSW) constitute the major cause of penetrating injuries.The right liver lobe is more often involved, owing to its larger size and proximity to the ribs. The incidence of liver

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trauma varies between countries due to social, regulatory and environmental conditions. In Europe, 80-90% of all hepatic injuries are due to blunt trauma, with the majority of cases being due to road traffic accidents, sporting injuries and falls [3,4].This situation is similar to that seen in Australia. In contrast, the United States and South Africa have relatively high rates of penetrating trauma [3,5]. Yet even in these countries there is evidence that the ratio of blunt to penetrating injury is increasing [5,6].Hepatic injuries are associated with high mortalities, but it remains very difficult to prognosticate for individual patients, because mortality is often determined by numerous factors including the nature of the hepatic injury itself, grade of hepatic injury, associated injuries incurred, practices and experiences of the treating institution and the physiological characteristics of the patients themselves [4,6,7]. Overall mortality from liver injuries is estimated to range from 10-17% [3,6]. However, if a patient has sustained juxtahepatic venous injury (retro hepatic inferior vena cava or central major hepatic venous injury) then mortality may be as high as 80% [8].Over 80% of patients with liver injuries may have one or more associated injuries. In blunt hepatic trauma, chest injuries are the most commonly associated injury followed by long bone and pelvis fracture, intra-abdominal solid organs (spleen) and head injuries. In penetrating trauma, the small bowel, colon, diaphragm, stomach and kidneys are commonly involved whilst the spleen and pancreas are uncommonly injured . In fact, the presence of a major abdominal vascular injury [the inferior vena cava (IVC), aorta, and porto-mesenteric vessels] is associated with a 50% increase in mortality compared to patients without such injuries [9].

One of the most widely accepted injury grading scale to grade hepatic injuries is the American Association for the Surgery of Trauma (AAST) classification system.

Grading of Liver Trauma (AAST) guidelines.

Grade	Injury	Description
I	Hematoma laceration	-Subscapular, less than 10% of surface area -Capsular tear, less than 1 cm Parenchymal depth
II	Hematoma laceration	-Sub capsular, 10-50% of surface area. -1-3 cm parenchymal depth, less than 10cm in length
III	Hematoma Laceration	-Sub capsular, more than 50% Surface area or expanding, ruptured sub capsular, or parenchymal haematoma -Intraparenchymal, more than 10 cm or expanding, more than 3cm parenchymal depth
1V	Laceration	Parenchymal disruption, involving more than 75% of hepatic lobe -One to three Couinaud segments within a lobe
V	Laceration Vascular	Parenchymal disruption involving more than 75% of hepatic lobe -More than three Couinaud segments within a single lobe -Juxtahepatic venous injuries(i.e.) retrohepatic cava/central major hepatic veins
VI	Vascular	Hepatic avulsion

* Based on most accurate assessment at laparotomy or radiological study.
Intra operative measure of liver laceration were made depending on length of scalpel handle (length= 15 cm)

PATIENTS AND METHODS:

This is a prospective study; included 60 patients admitted with liver injury from (1st.January 2015-31th.January 2016) in Baghdad Teaching Hospital, Only patients who underwent operative management (OM) were included in this study. They were analyzed regarding their age, gender, mechanism of injury, site of trauma, physical examination, investigations, details of management which include operative management; the grading of liver injury was based on contrast-enhanced CT scan or laparotomy findings, according to AAST Organ Injury Scale for hepatic injuries, associated injuries and follow up for development of complications and mortality. Initial management, resuscitation and investigations were carried out based on the guidelines of the ATLS including 100% oxygen, two wide bore cannula, aspiration of blood samples for blood group and emergency biochemical investigations (CBC, RBS, blood urea, serum electrolyte) and preparation of blood, resuscitation with crystalloid (e.g. Ringer solution) and blood and monitoring of vital signs, urine output and oxygen saturation. Adjuncts to initial resuscitation include foley catheter, gastric tube and imaging study (chest x-ray, pelvic x-ray, cervical x-ray). After initial resuscitation in the

emergency department, If the FAST scan is positive and the patient is haemodynamically unstable, then operative management must not be delayed by radiological assessment. If the FAST is positive but the patient is haemodynamically stable, CT scan is the investigation of choice, different surgical approaches are done starting by exploratory mid line laparotomy incision and four quadrant packing, assessment of extent of injury and control of bleeding and contamination. Regarding liver injury starting with mobilization of liver by division of ligaments (falciform, triangular, coronary ligaments) in complex liver injury this allow to assess the extent and degree of injury. The modality of treatments ranging from application of haemostatic(gelfoam), simple suturing by deep mattress sutures or running suture by polygygolic acid 0, hepatotomy and direct vessel ligation, angiographic embolization and packing. Postoperative complications following liver injury include wound infection, respiratory complications, jaundice, bile leak, subphrenic collection, disseminated intravascular coagulopathy (DIC), bleeding, hemobilia, liver necrosis and abscess. The complications reported in present study occur in the immediate postoperative period to delayed period up to 30 days.

RESULTS:

In this study 54 (90%) patients were male and 6 (10%) patients were female. The patients were grouped into five groups from 10 years of age to 60 years, the peak incidence of age was in those between 20-29 years, 28 (46.67%) patients while the lowest incidence was in those between 50-60 years 2 (3.33%) patients, the second commonly affected age group was between 30-39 years 17 (28.33%) patients, followed by 10 (16.67%) patients, were between 40-49 years and 3 (5%) patients were between 10-19 years. The patients were categorized in two major groups; 52 (86.67%) patients had penetrating liver injury while 8(13.33%) patients had blunt liver injury. (Table 1) .Most of the patients was military 40 (66.67%) patients and the remaining 20 (33.33%) patients were civilian.

Table 1: Incidence of liver injury according to mechanism of injury.

Mechanism of injury		
Penetrating	52	86.67
Gunshot wound (GSW)	26	43.33
Shrapnel wound	23	38.33
Stab wound	3	5
Blunt	8	13.33
Motor vehicle accident(MVA)	6	10
Fall from height	1	1.67
House fall down	1	1.67
Total	60	100 %

All of the patients presented with liver injury were diagnosed by clinical examination, imaging study and exploratory laparotomy. We had 8 (13.33%) patients with blunt trauma, 2 (3.33%) of them were vitally stable with no peritonitis and FAST was positive and CT scan was not available in the emergency department at that time and patients underwent surgery. The remaining 6 (10%) patients were vitally unstable and they had peritonitis with positive FAST and patients underwent surgery after resuscitation in the emergency room. Regarding penetrating injury, we had 52 (86.67%) patients ,36 (60%) of them who were vitally unstable and peritonitis ,they underwent surgery after resuscitation . 16 (26.67%) patients who were vitally stable with no peritonitis, were divided into three groups; 10 (16.67%) patients sent for CT scan which revealed liver injury only, 1 (1.67%) patient ,CT scan was negative for liver injury only so he kept under observation , later he developed peritonitis and hemodynamic instability and he need to be explored, laparatomy revealed liver injury. The remaining 5 (8.33%) patients, CT scan was not available at time of admission and all of those patients underwent surgery. Peritoneal tap was not done for our patients in current study. Penetrating injuries to liver occurred in 3 sites, most commonly to the abdomen in 28 (46.67%) patients followed by chest in 16 (26.67%) patients and back in 8 (13.33%) patients. In our study, 23 (38.33%) patients were grade II, 19 (31.67%) patients were grade III, 12 (20%) patients were grade I and 6 (10%) patients were grade IV .The commonest site of liver injury was the right lobe of liver, 51 (85%) patients had right lobe of liver, 21 (35%) patients of them had injury to segment 6 followed by segment 7, 8, 5

which including 15 (25%) patients, 12 (20%) patients, 3 (5%) patients respectively, 9 (15%) patients had injury to left lobe of liver. (Table 2)

Table 2: Grades of liver injury and site of liver injury.

Grade	No. of patients	Percentage (%)
I	12	20
II	23	38.33
III	19	31.67
IV	6	10
V	0	0
VI	0	0
Total	60	100%
Sites of liver injury		
Right lobe of liver	51	85
Segment 6 Segment 7 Segment 8 Segment 5	21 15 12 3	35 25 20 5
Left lobe of liver	9	15
Total	60	100

The most commonly injured organ in association with liver injury was the diaphragm in 30 (50%) patients followed by chest injury and pleura in 21 (35%) patients, small bowel injury (jejunum and ileum) 13 (21.67%) patients, colonic injury 11 (18.33%) patients, renal injury 11 (18.33%) patients, stomach injury 11 (18.33%) patients, duodenal injury was seen in 5 (8.33%) patients, head trauma was 4 (6.67%) patients, splenic injury in 3 (5%) patients, gall bladder injury in 3 (5%) patients, pancreatic injury was 3 (5%) Patients, vascular injury was 4 (6.67%) patients, including 1 (1.67%) patient had descending thoracic aorta, 1(1.67%) patient had common femoral vein injury, 1(1.67%) patient had common hepatic artery and 1 (1.67%) patient had infra renal IVC injury, extremity injury was 7 (11.67%) patients, including 1(1.67%) patient had fracture neck femur, 1 (1.67%) patient had fracture tibia and 5 (8.33%) patients had superficial shrapnel injury. All of the mentioned associated injuries occur in both penetrating and blunt trauma (Table 5). Isolated injury occurred in 9 (15%) patients, 6 (10%) of them caused by penetrating injury and 3(5%) of them caused by blunt injury.

Surgical options for treatments of liver injury depend on general condition of the patients and the grade of liver injury. For patients that presented with grade I injury, including 12 (20%) patients, in 5 (8.33%) of them none was done for the liver injury and 7 (11.67%) patients were treated by haemostatic agents (gelfoam). For patients with grade II, including 23 (38.33%) patients, 13 (21.67%) of them were treated by simple suturing (Hepatorrhaphy) by absorbable suture and haemostatic agents as gelfoam, 5 (8.33%) of them were treated by gelfoam alone, 3 (5%) of them were treated by simple suturing alone, 2 (3.33%) of them were treated by perihepatic packing. Patients presented with grade III, including 19 (31.67%) patients ,10 (16.67%) of them were treated by suturing and gelfoam, 6 (10%) of them were treated by suturing alone, 3 (5%) of them were treated by perihepatic packing. patients presented with grade IV, including 6 (10%) patients, 3 (5%) of them were treated by perihepatic packing, 2 (3.33%) of them were treated with simple suturing and gelfoam,1 (1.67%) patient was treated with hepatotomy with direct suture ligation. 1 of the patients with grade IV liver injury had common hepatic artery injury treated by vascular repair. Patients treated with perihepatic packing were 8 (13.33%), 4 (6.67%) of them relaporotomy was done for removal of packing after stabilization and warming in respiratory care unit (RCU) within 48 hr. and 2 (3.33%) of them achieved good homeostasis and abdomen closed successfully, 2 (3.33%) of them achieved good homeostasis after application haemostatic agents and abdomen closed successfully, the remaining 4 (6.67%) patients with perihepatic packing relaporotomy was not done because they deteriorated in RCU and died because of DIC, sepsis and multi organ failure . (Table 3)

Table 3: Grading and modality of treatment.

Grades	No. & %	None	Gel foam	Simple suturing	Gel foam& suturing	Packing	Hepatotomy& Angioembolizatio
I	12 (20%)	5(8.33%)	7 (11.67%)				
II	23 (38.33%)		5 (8.33%)	3 (5%)	13 (21.67%)	2(3.33%)	
III	19 (31.67%)			6 (10%)	10 (16.67%)	3 (5%)	
IV	6 (10%)				2 (3.33%)	3 (5%)	1 (1.67%)
V							
VI							
Total	60 (100%)	5(8.33%)	12 (20%)	9 (15%)	25 (41.67%)	8 (13.33%)	1 (1.67%)

The overall postoperative complications rate related to liver trauma were 32 patients (53.33%). Postoperative wound infection was the most common complication in 8 patients (13.33%), all those patients were treated by drainage and antibiotic. Respiratory complications 6 patients (10%) that included (atelectasis, pleural effusion, and chest infection) were treated conservatively with physiotherapy, oxygenation and antibiotic. Jaundice found in 5 patients (8.33%) temporary associated with transient elevation of liver enzymes and treated conservatively with hydration and antibiotic. Bile leak was seen in 3 patients (5%) and treated conservatively and there was no need for intervention. Subphrenic collection in 3 patients (5%) and diagnosed clinically and radiologically by ultrasound and CT scan of abdomen and treated by percutaneous drainage under ultrasound guidance. DIC occurred in 3 patients (5%) after massive blood transfusion intraoperatively and postoperatively and the patients died. Bleeding occurred in 2 patients (3.33%) postoperatively within 24 hours and re-exploration was done and bleeding controlled by simple suturing. Hemobilia occurred in one patient (1.67%) caused by MVA and treated conservatively and after 2 weeks the patient developed shock with intraperitoneal bleeding, exploratory laparotomy was done with hepatotomy with direct vessel ligation, postoperatively bleeding stopped for one month and later on patient develop aneurysm treated by angiography and angioembolization. Liver necrosis and abscess occurred in one patient (1.67%) postoperatively in patient with penetrating injury grade III, treated by exploratory laparotomy and drainage of abscess. (Table 4)

Table 4: Postoperative complications of liver injury.

Complications	No. of patients	Percentage (%)
Wound infection	8	13.33
Respiratory complication	6	10
Jaundice	5	8.33
Bile leak	3	5
Sub phrenic collection	3	5
Disseminated intravascular coagulopathy	3	5
Bleeding	2	3.33
Haemobilia	1	1.67
Liver necrosis and abscess	1	1.67
Total	32	53.33

Overall mortality rate after liver trauma was 5 patients (8.33%), 3 Of them (5%) had penetrating injury ,the first patient (1.67%) had grade III liver injury associated with common femoral vein injury and died due to DIC, the second one (1.67%) had grade III liver injury associated with IVC injury and died due to sepsis and DIC, the third patient (1.67%) had grade IV liver injury associated with descending thoracic aortic injury and died due to DIC, the remaining 2 patients (3.33%) who died had blunt trauma ,the first patient (1.67%) with history of motor vehicle accident had grade III injury associated with basal skull fracture and patient died due to intracranial hemorrhage, the second patient (1.67%) with history of fall from height had grade IV liver injury associated with skull fracture and patient died due to intracranial hemorrhage. (Table 5).

Table 5: Mortality rate.

Grade	No. of patients & %	Mechanism	Cause of death	Timing
III	3 (5%)	Penetrating injury	DIC	Day one
	1 (1.67%)	Shrapnel injury	Sepsis and DIC	Day three
	1 (1.67%)	Gunshot wound	DIC	Theatre
	1 (1.67%)	Shrapnel injury		
IV	2 (3.33%)	Blunt injury	Intracranial hemorrhage	Day two
	1(1.67%)	Motor vehicle accident	Intracranial hemorrhage	Day three
	1(1.67%)	House fall down		

In our study, there was a significant association between grading and mortality (P value = 0.009) according to Fisher Exact Test, and no significant association between mechanism of injury and mortality (P value = 0.1) according to Fisher Exact Test (Table 6)

Table 6: Association between grading, mechanism of injury and mortality.

Grade	Died		Active	
	No.	%	No.	%
I	0	0.0	12	100.0
II	0	0.0	23	100.0
III	3	15.8	16	84.2
IV	2	33.3	4	66.7
TOTAL	5	8.3	55	91.7
Mechanism of injury				
blunt	2	25.0	6	75.0
penetrating	3	5.8	49	94.2
TOTAL	5		55	

DISCUSSION:

In our study, the peak age of patients was between 20-29 years , this goes with a study by Hussain et al in Saudi Arabia [10]and another study in Iraq by Abed et al showed the peak age of patients was also between 21-30 years old [11] .In our study most of the patients were male 54 (90%) and 6 patients (10%) were female this is due to outdoor activity of males in our society making them more vulnerable to violent activities and current situation in Iraq and participation in war, this coincide with most studies in the world [12] [13] [14].In our study fifty two patients (86.67%) had penetrating liver injury while eight patients (13.33%) had blunt liver injury because most of our patients in this study were military 40 (66.67%) patients and the remaining 20 patients (33.33%) were civilian. In studies from Europe, the blunt trauma account for (80%-90%) of liver injury mostly due to motor vehicle accident, Langrehr et al [15] and Gackowski et al [16]. While a study from South Africa, penetrating injury was commoner than blunt trauma in causing liver injury and constitutes 66% of 446 patients by Krige et al[17]. In study done in Iraq showed that (97.6%) of patients included in their study were victims of penetrating liver injuries by Kadhim et al[18]. In diagnosis of liver injury , if FAST is positive and the patient hemodynamically unstable, operative management should not be delayed by radiological assessment [8], if FAST scan is positive but the patient hemodynamically stable , CT scan is the gold standard investigation of choice to detect organ injury , free intraperitoneal air and blood, associated injuries [3].In this study the most common grade of injury was grade II in twenty three (38.33%) patients followed by grade III in nineteen (31.67%) patients, this goes with study in Iraq showed that grade II most common injury followed by grade III, Abed et al [11]. Scollay et al.[19] found that most patients (69%) in Scotland with traumatic liver injury had grade II injuries. Another study by Hussain et al in Riyadh, Saudi Arabia [10] showed grade III most common injury followed by grade II. In the present study the most common associated injuries were the diaphragm

involved in 30 patients (50%) followed by chest injury and pleura 21 patients (35%). In a study done in Iraq, the result did not coincide with our study showed that stomach injury was most frequently injured organ followed by diaphragm, Abed et al [11]. A study of patients with liver injury treatedin surgical ward at King Edward VIII Hospital, We lile et al [20] over a 7-year period, the result did not goes with our study showed there were 31 patients (30%) with isolated livertrauma and 74 with associated injuries (70%), common associated organ injuries were colon (36%),stomach (35%), diaphragm (27%), small bowel (24%),spleen (13%) and kidney (12%). This is did not cope with our results in isolated injury because in present study most of the patients involved in shrapnel injuries in war zone that involve multiple organs in the same time. A study done in AL-Yarmook Teaching Hospital by Dhergham et al [21], the result goes with our study showed that diaphragm most commonly injured organ followed by lung. Surgical options for treatment of liver injury, in our study gel foam with simple suturing (hepatorrhaphy) were the most common surgical modality employed to control bleeding. Peri-hepatic packing was used in unstable patients. A study of 10-year experience in Riyadh, Saudi Arabia [10] showed hepatorrhaphy was the most common surgical technique used followed by peri-hepatic packing. In study done in Iraq showed that the simplest the grade, the less complex the procedure done [11]. Regarding postoperative complication following liver trauma, postoperative wound infection was the most common complication 8 patients (13.33%). In a study done in Iraq at 2008 showed that post-operative complications goes with our study that most common complication was wound infection followed by chest infection, bile leak and fistula and uncontrolled hemorrhage [18] . A study of patients with liver injury treated in surgical ward at King Edward VIII Hospital [20] showed that post-operative complication include pulmonary infection(16%),multiple organ dysfunction syndrome(13%), peritonitis (13%), wound sepsis(6%), fistula (6%), these figures overlaps as some patients developed more than one complications. In our study, overall mortality rate after liver trauma was 5 patients (8.33%), three patients with penetrating injuries died due to DIC and sepsis, two patients with blunt trauma died due to intracranial hemorrhage. Another study in AL-Yarmook Teaching Hospital did not coincide with our study, showed that the overall mortality were 15.38%, all of them caused by penetrating injuries ' mortality occur duo to DIC in 4 patients , decompensated shock in 3 patients , multiple organ failure in 3 patients and bleeding from severe liver injury in 2 patients [21].

CONCLUSION:

Penetrating injuries were more common than blunt injuries and gunshot wounds and shrapnel injuries were more than stab wounds. The most common grades of liver injury were grade II and grade III. gelfoam and suturing were mostly done as surgical procedure. The mortality rate increases with increasing the evidence of vascular injury.

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