

PATTERN AND MANAGEMENT OF HEPATIC INJURIES IN NORTH WEST OF PAKISTAN

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SUMMARY

Forty consecutive patients with liver injuries were studied in a period of fourteen months i.e. 1st June 1997 to 31st July 1998. Majority of the patients were young male adults with mean age of 30 years (range 16-17 years). Male of female ratio was 9:1. Thirty three patients (82.5%) had penetrating injuries and 7 had sustained blunt trauma. Twenty five (62.5%) patients were in a state of shock at the time of arrival, in emergency department, with stock index > 1. Injury severity score was 29.1. All patients had to be explored surgically in casualty operation theatre. Right lobe was injured in 67.5% while left in 30% of cases. Twenty seven patients (67.5%) had other associated injuries (other organs in addition to liver). Average number of organs injured per patient was 2.75. Twenty seven patients (67.5%) had sustained simple liver injuries and were managed by simple technique of hepatic repair. Thirteen patients (32.5%) had complex liver injuries and had to have more complex surgical procedure i.e. extensive hepatorrhaphy, resection/debridement and selective hepatic artery ligation). Post operative complications were wound infection, wound dehiscence, post operative bleeding from liver, intra-abdominal sepsis, biliary leak and jaundice. Five patients died (mortality 12.5%). Mortality was high in patients with complex liver injuries, advance age in those with blunt trauma.

INTRODUCTION

Lady Reading Hospital is a tertiary care institution; therefore this study may be

considered as representative of the North West part of Pakistan. Trauma is the leading cause of death world wide. As liver is the largest intraabdominal organ, therefore, it is commonly injured in abdominal trauma.^{1,2}

AGE DISTRIBUTION

Age Ranges	No. of patients	Percentage
16-19 Years	10	25%
20-29 "	19	47.50%
30-39 "	3	7.50%
40-59 "	3	7.50%
50-59 "	3	7.50%
60-70 "	2	5%

TABLE-1

Large size, thin capsule, friable parenchyma and fixed position anterior to vertebral column make it more susceptible to injury. More over its tissue density makes it vulnerable to cavitation effect of high velocity bullet injuries.^{3,4} Liver injury is found in 40% patients with stabbing abdominal wound gunshot wound and in 20% cases with blunt abdominal trauma. In European countries majority of liver injuries are caused by blunt trauma^{1,5,6} where as in USA liver is more commonly injured in penetrating trauma.^{7,8} In about 70-80% of cases liver injury is associated with other organ injuries.⁹ Abdominal ultrasound is more frequently used to diagnose hepatic injuries. It can show break in liver parenchyma and detect blood as little as 70 ml in the peritoneal cavity. Computed tomography has changed the management of liver injuries. It accurately delineate the extent of

TIME INTERVAL BETWEEN INJURY & PRESENTATION

Time interval	No. of patients	Percentage
Within one hour	7	17.50%
Within two hour	10	25%
Within four hour	7	17.50%
Within six hour	5	12.50%
More than six hour	11	27.50%
Total	40	100%

TABLE-2

MODE OF INJURY

Penetrating injuries	No. of patient	Percentage
FAI	30	75%
Stab wound	1	2.50%
Bomb blast	1	2.50%
Saw injury	1	2.50%
Total	33	100%

TABLE-3

injury, define severity of injury, quantify hemoperitoneum and reveal associated injuries.¹⁰ Its over all accuracy is 92-98%.¹¹ This investigation has reduced the number of surgical explorations in isolated hepatic injury.^{12,13,14,15} About 60-90% of liver injuries are simple and are managed by simple technique of repair. 140-40% are complex injuries and require one or more of a more advanced and complex surgical intervention like portal triad occlusion, mobilization of liver, extensive hepatorrhaphy, hepatotomy with selective vascular ligation, omental packing, resection-debridement, selective hepatic artery ligation, perihepatic packing, mesh wrapping, major hepatic resections, retrohepatic caval shunts and even liver

SITE OF ENTRY WOUNDS ASSOCIATED WITH LIVER TRAUMA

Site of entry wound	No. of patients	Percentage
Epigastrium	12	36.4%
Rt. upper quadrant	7	21.2%
Rt. lower chest	5	15.2%
Rt. flank	3	9.0%
Lt. upper quadrant	2	6.0%
Lt. lower chest	1	3.0%
Umbilical area	2	6.0%
Lt. lumber region	1	3.0%
Total	33	100%

TABLE-4

CLINICAL FEATURE

Investigations	No. of patients	Percentage
Pain	38	95.0%
Tenderness	33	82.5%
Rigidity	32	80.0%
Abdominal distention	18	45.0%

TABLE-5

transplantation.^{16,17,18} Mortality from liver trauma has decreased from 60% at the beginning of this century to 30% during world war-II, to the current rates of 0-10% for penetrating injuries and 10-20% for blunt trauma.^{20,21} In this study the pattern in which liver injuries occur in North West of Pakistan shall be presented. The management of various grades of liver injuries will also be addressed to in detail. The most appropriate way to deal with such patients will be framed for the young surgeons in this part of the country.

MATERIAL AND METHODS

This study was conducted prospectively. All patients who came to emergency with penetrating injuries to upper abdomen and thoraco-abdomen were included. Patients who came with blunt abdominal trauma and at laparotomy found to have liver laceration were also included. Patients below the age of 14 years and those who were in coma due to head injury at the time

GRADE OF INJURY

Grade-I	12	30%
Grade-II	15	37.50%
Grade-III	9	22.50%
Grade-IV	3	7.50%
Grade-V	1	2.50%
Total	40	100%

TABLE-6

NO. OF ORGANISED INJURED

Number of Organs Injured	Number	Percentage
Isolated liver injury	13	32.5%
One organ injured in addition to liver	8	25%
Two " "	7	12.5%
Three " "	7	17.5%
Four " "	4	7.5%
Five " "	1	2.5%
Six " "	1	1.5%

TABLE-7

of arrival were excluded. A proforma was prepared where all the necessary information required for the purpose was incorporated. Laparotomy findings with special reference to hepatic laceration and its grade were all recorded in the proforma. Prior to surgery all patients were vigorously resuscitated with I.V. colloid solutions and blood. A thorough

ASSOCIATED INJURIES

Diaphragm	11	27.50%
Kidney	9	22.50%
Stomach	8	20%
Colon	8	20%
Deudenum	5	12.50%
Spleen	5	12.50%
Pancrease	4	10%
Small Gut	4	10%
Ribs	5	15.50%
Extremities	4	10%
Vertebra	2	5%
Pelvis	1	2.50%
I.V.C	1	2.50%
Mesentry	1	2.50%
Gall bladder	1	2.50%
Urinary Bladder	1	2.50%

TABLE-8

OPERATIVE PROCEDURE

Operative procedure	No. of patients	Percentage
No. of intervention	3	7.50%
Simple suture	21	52.50%
Mattress suture over spongostion	8	20%
Resection debridement	2	5%
Selective hepatic artery ligation	3	7.50%
Perihepatic packing only	5	12.50%
Perihepaticpacking as an adjunctive procedure	11	27.50%

TABLE-9

examination of the whole body was performed by a senior resident on duty. Patient found unstable at preliminary assessment were shifted to casualty operation theatre immediately. In these patients recucitation and surgical exploration went side by side. Those patients who were stable has had to undergo certain baseline investigations like X-rays Chest, X-Rays abdomen erect and supine. Peritoneal diagnostic tap was also done in some patients. All patients were catheterized and nasogastric suction instituted. A midline incision of adequate length was given. The extent of liver injury was recorded in detail in the operation notes.

COMPLICATIONS TOTAL 12 PATIENTS = 30%

	No. of patients	Percentage
Haemorrhage	3	7.50%
Intra abdominal sepsis	2	5%
Wound infection	8	20%
Respiratory infection	5	12.50%
Billiary leak	2	5%
Re-exploration	2	5%
Wound dehiscence	4	10%
Jaundice	1	2.50%

TABLE-10

Grading of the injury was done as per American Association for the surgery of Trauma (AAST 1994). Post operative progress was recorded in the proforma 2 times daily. Patients were kept in the hospital till full recovery. Patients kept in ICU were shifted to the unit as and when they were declared fit to be managed in the general ward. Any complications which occurred during their stay in the hospital were recorded and managed as needed.

RESULTS

Out of a total of 184 patients with trauma dealt with during the study period; 40 were having liver injuries. Thirty five (90%) were male patients. Age ranged from 16 to 70 years (with mean 30.30 years). Thirty two (80%) patients were below the age of 40 (table-1). Out of 40 patients (24 (60%) ha come directly to emergency surgical department while 16 (40%) had been referred from other peripheral hospitals. Non of these referred cases had undergone surgical intervention prior to transfer. Seventeen patients (42.5%) had reached the hospital with in 2 hours of the injury (Table-2). Thirty three patients had penetrating injuries (82.5%) while seven (17.5%) patients came with blunt trauma to abdomen (Table-3). The site of entry wound associated with liver injuries; in descending order was eipgastrium right hypochondrium and right lower chest (Table-5). Twenty five (62.5%) patients were in a state of shock at the time of presentation (shock index greater than 1). In five patients BP was not recordable. Ninety five percent patients had diffuse abdominal pain. Abdominal tenderness and rigidity were the two most common signs present (Table-5). Plain X-rays abdomen and chest were done in all cases. Plain X-rays chest revealed rib fractures in 5 patients, and gas under diaphrain in 7 patients. Abdominal ultrasound was performed in 2 cases with blunt trauma and In both hemoperitoneum was

STUDIES	DIAPHRAGM	STOMACH	COLON	KIDNEY	SPLEEN
Present	82%	20%	20%	23%	12.5%
Satin SC et al 1988	27%	18%	9%	10%	8.5%
Pretre R. et al 1988	6.0%	10.0%	7.0%	10%	28.0%
Rajab A.E.S et al 1993	36.8	21.0%	15.7%	5%	21.0%
Shah PA et al 1993	7.2%	—	—	2.0%	22.0%
Watson CJE et al 1991	6%	—	—	—	19.0%

TABLE-11

reported, while in one patient parenchymal liver injury was also reported. Paracentesis was done in 9 cases. In 7 patients free blood was confirmed in peritoneal cavity prior to laparotomy. Diagnostic peritoneal lavage was done in 2 patients with blunt trauma. In both cases it turned out to be positive.

Liver injuries were grouped according to AAST 1994 classification after direct observation at the time of exploration. 67.5% patient had simple (Grade-I & II) and 32.5%

had complex hepatic trauma (Table-6). Right lobe was involved in 27 patients and left lobe in 13 cases. A total of seventy associated injuries occurred in twenty seven patients. Isolated liver injury was found in 13 patients (Table-7). Other organs more commonly injured were diaphragm in eleven, kidney in nine and colon in eight cases (Table-8). Long bone fractures were diagnosed in 43% cases of blunt trauma. In 3 patients (7.5%) liver injury was found to be non-bleeding at the time of exploration and so was left as such. Simple hepatorrhaphy was carried out in 21 cases (52.5%). Mattress sutures over spongoston bloster were applied in 8 cases (20%). Resection debridement, selective hepatic artery ligation and perihepatic packing were done in 5%, 7.5%, and 12.5% cases respectively (Table-9). Blood transfused

MORTALITY FROM LIVER TRAUMA

Study	No. of patients	Mortality
Moor FA et al 1985	319	6.8%
Stain SC et al 1988	233	12.0%
Hussain R. et al 1991	15	13.3%
Fabian TC et al 1991	482	5.6%
Watson CJE et al 1991	80	17.5%
Durham RM et al 1992	63	12.6%
Patcher HL et al 1992	411	7.3%
Padre LA et al 1992	313	10.5%
John TG et al 1992	73	12.3%
Schweizer W. et al 1993	175	12.0%
Shah PA et al 1993	110	18.0%
Knudson MM et al 1994	188	17.0%
Rajab AES et al 1993	100	4.0%
Khan AFA et al 1995	32	12.3%
Cheema AM et al 1995	57	18.0%

TABLE-12

MORTALITY AMONG COMPLEX HEPATIC INJURIES

Series of complex Hepatic injuries	Mortality		
	Grade-III	Grade-IV	Grade-V
Cogbit T.H et al 1988	5%	46%	80.0%
Knudson MM et al 1994	27%	46%	62.0%
Moor FA et al 1988	5.9%	43%	66.0%
Patcher HL et al 1992	—	6.5%	43.0%
Present study 1999	1%	66.6%	100.0%

TABLE-13

varied from 2-9 units in perioperative period (average 2.8). Hospital stay was one to six weeks (average 11 days). Twenty five complications occurred in 12 patients (morbidity rate 30%). Wound infection occurred in 20% cases. This was treated as culture sensitivity report. Other less common complications recorded were wound dehiscence, bleeding sepsis, biliary leak and jaundice (Table-10).

DISCUSSION

Trauma is the leading cause of death and disability in young people both in developed and developing countries. About 50% of deaths in the age group of 10-24 years occur due to trauma world-wide.²² During a two years period, more people were killed by fire-arms in the USA than the total number of casualties during nine years Vietnam was.²³ About 33000 deaths occur annually in the USA as a result of fire-arm injuries and the use of fire-arms is a major public health threat.²⁴ Injuries with their associated direct and indirect costs cause huge financial burden on the society.²⁵ Trauma is a major cause of emergency admission in our set up. Fire-arm injuries are more common in NWFP than other provinces of Pakistan.²⁶ Homicide is usually committed on dispute over land money and woman, as the people in this part of the country prefer to settle their disputes with fire-arms rather than going to courts of law. Traditional love of the people for fire-arms, illegal arm manufacturing factories in the tribal areas, influx of illegal fire-arms from across the border, "illicit drug trafficking and increase in sectarian violence are main causes for this increase in fire-arm injuries in the Province. Although no age group in immenel majority of trauma victims are in their mprime of life. As these people are earners in the society, their disaility and death cause huge financial loss to the society both in terms of hospital care and loss of working days. Liver is he

most commonly injured organ both in blunt and penetrating abdominal trauma.¹² In this study the incidence of liver injury was 21.7%. It is conforming with that observed by Hussan et al 1991²⁴ and Shah et al.²⁷

In this study 90% of the patients were male and 10% were females. Thus male to female ratio was 9:1. A study from the Philippines shows the same ratio.²⁸ Two studies from Lahore have shown similar results.^{29,30} In a study from Egypt the ratio was 8:1³ The reason for this male preponderance is that males are more exposed and projected to trauma than females. In our study 80% of the patients were below forty years of age. A study from Edinburg documented similar results.¹ The causes of liver injury vary with the social customs of the country concerned. In this study 82.5% of the liver injuries were caused by penetrating trauma and firearm injures were responsible for more than 90% of them. Studies from some centres have shown similar results.^{2,31} Where studies from some other centers are in sharp contrast to them.^{5,6,32} Sixty percent of the patients were brought to emergency department directly by their friends and relatives and forty percent patients had been referred from other hospitals. 42.5% of the patients reached the hospital within four hours of injury. It is for better than the situation noted by Cheema et al³⁰ where only 12.3% of the patients had reached hospital within four hours of the injury. The evacuation and transit time is quite longer in our set up than that in the developed world, because there is no organised trauma service in our country¹. In a study from Switzerland the median transportation time of trauma victim was thirteen minutes.³³ This rapid evacuation and transportation of trauma victims increases the absolute survival rate, but at the same time it increases hospital mortality, as more serious patients reach hospital alive but they are unsalvageable despite heroic rsuscitation. 62.5% of our patients were in a state of

shock when they reached hospital and 37% patients were stable on arrival. Khan et al showed that 53% of their patients with liver injury were stable on arrival and 47% were in a state of shock, whereas Cheema et al documented that 75% of their patients with liver injury were in a state of shock and only 25% were stable on arrival.^{29,30} The most common abdominal signs were abdominal tenderness and rigidity occurring in 82.5% and 80% of patients respectively. Abdominal distention was noted in 45% patients. A study by Padre RA had shown similar results.²⁸ Urgent laparotomy was carried out in most of the patients with fire-arm injuries because such patients have 80-90% incidence of serious associated injuries.³⁴

The diagnostic modalities most commonly used were X-ray abdomen and chest, followed by abdominal paracentesis. Abdominal ultrasound was performed in two patients. It detected intraperitoneal blood in both of them. In one patient it also revealed break in liver parenchyma. It is conforming with other studies.³⁵ Majority of liver injuries (67.5%) were simple in nature (Grade-I and II). It is similar to the findings in other studies.^{1,2,3,28} Right lobe was involved in 67.5% of the patients and left lobe was injured in 30% of the cases. In a study from Lahore right lobe was involved in 59.4% of cases and left lobe in 34.4% of cases.²⁹ Another study from the USA revealed similar results.³⁷ Majority of patients had associated organ injuries were the most commonly injured organs. Other studies have shown variable results (Table-10). Majority of liver injuries (60%) were managed by simple suture of 2/0 of chromic catgut. Rajab et al used simple suture in 56% of cases.³ Shah et al employed simple sutures in 72% of cases.⁴ We used mattress sutures over spongoston bolster in 20% of the patients. Stain SC et al employed mattress sutures in 28% patients with liver injury.³⁷ Perihepatic packing as a sole procedure was employed in 12.5% of patients with 60% success rate.

Cheema et al used perihepatic packing in 21% of patients with liver injury.³⁰ Beal S used perihepatic packing in 29% of the patients with complex hepatic trauma which included six inferior vena cava injuries and fourteen hepatic vein injuries, achieving 82% success rate.²¹ Watson et al use perihepatic packing in 29% of patients with complex hepatic trauma.⁶ In 27% of the patients we used perihepatic packing as an adjunctive procedure to deal with the ooze from suture lines. In a multicentre review the packing as an adjunctive procedure was employed in 25% of patients with complex liver injuries.³⁸ We resorted to resection debridement in 5% of patients where as Khan et al performed resection debridement in 14%, Shah et al in 11% and Rajab et al in 10% of their patients with liver injury respectively.^{3,4,29} We employed selective hepatic artery ligation in 7.5% of patients and achieved 66% success rate. In a multicentre review hepatic artery ligation was carried out in 2% of patients with grade-III liver injuries. 10% of patients with grade-IV liver injuries and 6.7% of patients with grade-V injuries.³⁸ In another study of 99 patients with liver injuries, selective hepatic artery ligation was carried out in 5% of cases with 80% success rate.³³ We did not perform major resection for complex hepatic injuries because of high mortality associated with it. In a series of 128 patients with complex liver injuries Patcher et al did not perform major resection in any case.²

Twelve patients (30%) developed post-operative complications. The complications were more common among patients with multiple injuries. Ten out of twelve (83.3%) patients had multiple organ injuries. Morbidity also increased with complexity of the liver injury. Seven out of seventeen patients (41%) with complex liver injury developed complications. Knudson MM et al documented 52% complication rate among patients with complex hepatic trauma. Similarly 50% morbidity was documented by Cogbil et al in their multicentre review of severe liver injuries.³⁸

Overall complication rate in our study is conformity to that recorded by Stain SC et al.³⁷ It is higher than that of 12% and 12.7% documented by Padre et al and Shah et al respectively but it is far less than 59% observed by Khan AF et al.²⁹

Wound infection occurred in eight patients (20%). Majority of these patients had multiple organ injuries involving hollow viscera and their peritoneal cavities were contaminated with gut contents at the time of exploration. In six out of eight patients (75%) colostomy was also a contributing factor in the development of wound infection. In most of these patients operative time was quite longer due to repair of multiple associated injuries. Prolonged wound exposure was another causative factor. Khan AF et al documented 28% wound infection rate and Shah et al noted 21% wound infection rate.^{4,29} The rate of wound infection is much less in studies emanating from Western institutions.^{1,2}

Chest infection occurred in five patients (12.5%). One of them had blunt trauma to the lower chest and upper abdomen with associated long bone fractures. Four patients had sustained fire-arm injuries and two of them had diaphragmatic and chest injuries. Chest infection rate in this study is for less than 34% documented by Hohn TG et al¹ but it is higher than that observed by Cheema et al.³⁰

Haemorrhage occurred in three patients (7.5%). Bleeding in all these cases occurred within 12 hours. Durham et al documented 12% liver related haemorrhage in a series of 41 patients with blunt hepatic trauma.⁴⁰ Knudson MM et al noted 5.5% incidence of haemorrhage among 36 patients with major liver trauma.³⁹ In a multicentre review of severe hepatic trauma coagulopathy was observed in 16% of patients.⁴ Similarly Cheema et al noted haemorrhage in 14% of patients.³⁰

Wound dehiscence occurred in four patients (10%). It is higher than that in other suties. Two patients (5%) developed biliary leak which stopped spontaneously within two weeks. Both these patients had grade-III liver injuries. Rajab et al documented 4% fistula rate.³ Two studies from Lahore have shown 5.2% and 6.2% biliary fistula rate.^{29,30}

Two patients developed perihepatic collections (5%). A report from India showed 7.2% intra-abdominal abscess rate.⁴ Patcher HL et al from New York observed 8.2% abscess rate in patients with complex liver injury² and Fabian TC et al from Tennessee documented 7% abscess rate.⁸ The incidence of intra-abdominal abscess is slightly lower than that noted in other suties. The reason for this low incidence of infection may be:-

- i. Use of broad spectrum antibiotics starting at the time of admission and continuing it post-operatively. Studies have shown that the use of appropriate antibiotics at the time of admission decreases inter-abdominal abscess rate.²³
- ii. Removal of perihepatic packs within 24 hours. Decrease in intra-abdominal sepsis has been noted with early removal of packs.

The overall mortality in our study was 12.5%. It is comparable with that in other studies (Table-12). Mortality in hepatic trauma is influenced by a number of factors. These include severity of hepatic trauma, duration between injury and presentation, hemodynamic condition of the patient at the time of admission, age of the patient and other associated organ injuries. In general hepatic trauma resulting from high speed vehicular accidents, high velocity gunshot injuries and closed range shotgun injuries are more devastating and carries higher mortality.

In this study two out of seven patients with blunt hepatic trauma died. Thus

mortality among this group of patients was 28%. Blunt trauma accounted for 17.5% of total patients but it was responsible for 40% of the mortality. Pretre R et al documented 36% mortality among patients with blunt hepatic trauma and 14% mortality rate among patients with penetrating liver injuries.³³ Two factors may be responsible for the higher mortality among patients with blunt hepatic trauma.

- i. Delay in definitive treatment due to diagnostic difficulties.
- ii. High number of associated organ injuries in these patients.

Increased mortality has been noted among patients with concomitant organ injuries.⁵

Mortality among patients with penetrating liver injuries was 9%. It is conforming to that of Stain SC et al who noted 11% mortality with gunshot wounds.³⁷ Four out of five patient who died were in profound shock at the time of admission. Other studies have shown higher mortality in patients with severe shock at the time of admission.³³

Grade of hepatic injuries is an important determining factor in the mortality of patients. IN this study mortality among patients with grade-I and II liver injuries was 3.7%. However mortality among patients with complex liver injuries (grade-III-V) was 30.7%. John TG et al documented 6% mortality among patients with simple liver injuries and 40% mortality in patients complex hepatic trauma.¹ One out of nine patients with grade-III liver injuries died. Thus the mortality in this group was 11%. It was also non-liver related death. Watson CJE noted 12.5% mortality among patients with grade-III liver injury⁶ Cogbil et al documented 25% mortality among patients with grade-III liver injuries. However liver related mortality in this group was 6.5%.³⁸ Two out of three patients with grade-IV liver injury died. Thus mortality in this

group was 66.6%. This is depressingly high as compare to other studies. Knudson MM et al observed 46% mortality among patients with grade-IV liver injuries.³⁹ Moor FA et al observed 43% mortality rate among patient with grade-IV liver injury.³¹ In this study one patient had sustained grade-IV liver injury and he died due to continuous haemorrhage from the liver wound. Thus mortality was 100% in Grade-V injury. In multicentre review Cogbil et al documented 80% mortality in patients with grade-V liver injuries (Table-13).

About 10-40% of patients with liver injuries presents with complex hepatic trauma and need advanced technique of hepatic repair. Mortality increases with complexity of hepatic trauma, presence of associated organ injuries, and advanced age. In complex hepatic trauma extensive hepatorrhaphy, resection debridement, selective hepatic artery ligation and perihepatic injuries have highest mortality in our set up, which need to be addressed. Most of these patients reach hospital in profound shock, field trauma service may alleviate this problem. Establishment of intensive care unit close to emergency surgical ward will decrease mortality substantially.

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