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Original Article

ANALYSIS OF 200 CASES OF LIVER TRAUMA: PROSPECTIVE STUDY

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Aim: *The liver is the most commonly injured abdominal organ in both blunt and penetrating abdominal trauma. Liver injuries may cause substantial mortality and morbidity and optimal management of complex injuries is controversial. We aimed to review the management and outcome of liver injuries with the objective of evaluating the efficacy of current methods of treatment.*
Methods: *Prospective study included 200 patients with liver injuries were treated during the 52 months period at Al-thawra teaching Hospital, Sana'a. Demographic, clinical and operative data, causes, liver injury grade, associated injuries, method of management, length of stay ,transfusion requirements, complications and death were analyzed.*
Results: *One hundred nineteen patients (59.5%) had blunt trauma, while 81 patients (40.5%) suffered from penetrating injuries. Most of the patients (89%) underwent operation and only 11% of the patients treated nonoperatively. Liver injury grades were, grade I, 27, grade II, 67, grade III, 52, grade IV, 42 and grade V, 11. Three hundred eighty two associated injuries occurred in 141 patients and the commonest organs affected were, chest (56 injuries) and stomach (44 injuries).The overall mortality was 23.5% (47 patients) and 73 complications occurred in 30.5% (61 patients).*
Conclusion: *Prevention of trauma itself should be a goal and early recognition of the magnitude of complex injuries and access to a tertiary facility are now regarded as essential requirements in the management of major injuries.*

Keywords: *Liver injuries, blunt, penetrating, mortality and morbidity.*

INTRODUCTION

The liver is the largest solid abdominal organ and it is the most commonly injured abdominal organ in both blunt and penetrating abdominal trauma.[1,2] However, the associated injuries contribute significantly to mortality and morbidity, and may cause the liver injury to be masked and diagnosis delayed.[3]

Fortunately, most of the liver injuries are uncomplicated and can be managed by well-established basic surgical techniques, including cautary, temporary packing, suture and vessel ligation 4. However, in patients with complex liver injuries, the operative mortality rate still exceeds 40 percent even in trauma referral centers.[4]

The principle objectives in the treatment of liver trauma are early effective control of bleeding, with preservation of hepatic function and prevention of septic and ischaemic complications.[4]

Non-operative management of selected patients with blunt liver injuries has been a standard practice in most trauma centers 5, while the role of non-operative management in penetrating liver injuries has been widely accepted, although some studies suggest that a non-operative approach may be appropriate in selected patients.[6,7] Furthermore, severe hepatic trauma remains an unresolved problem; especially retrohepatic venous injury (RHVI), main hepatic venous injury, and retrohepatic caval injury (RHCI) alone or in combination, continue to be associated with high mortality rates ranging from 50-100% in the literatures.[8] This study reviewed the management and the outcome of liver injuries treated at Al-thawra teaching Hospital during a 52 months period with the objective of evaluating the efficacy of current methods of treatment.

PATIENTS AND METHODS

Two hundreds consecutive civilian patients with liver injuries were treated at Al-thawra teaching Hospital, the major trauma referral centre in Yemen from December 1999 to March 2004. The study was prospective review and included patients with blunt and penetrating liver injuries as shown at laparotomy or ultrasound or CT scan. Victims who died in the emergency room were excluded.

Sex, age, cause of injury, shock state on admission, amount of blood transfusion, severity of hepatic injuries, associated intraabdominal and extraadominal injuries, method of diagnosis, therapeutic procedures, and the mortality and morbidity were included. The initial evaluation and management of all patients admitted with abdominal trauma was in accordance with American college of surgeons advanced trauma life support principles,[9] and liver injuries were graded according to the American Association for the surgery of trauma (AAST), Hepatic injury scale.[10] Grade III to grade V were regarded as severe liver trauma.

Non-operative treatment was confined to stable haemodynamic patients with blunt trauma, while operative treatment was performed in unstable patient, if the patient's status of stable patients worsened and in all penetrating injuries.

Non-operative management was discontinued in patients with haemodynamic instability, unresponsiveness to moderate amounts of crystalloid infusion or a significant fall in haematocrit, or if any intraabdominal injury requiring repair was suspected.

During the operation, bleeding from minor or superficial injuries was controlled by simple operative techniques, which included temporary compression with packs or diathermy. Mattress sutures or ligation of visible bleeding vessels within the laceration were used if manual compression failed. Profuse bleeding from deep wounds was controlled by occluding vascular inflow in the hepatoduodinal ligament below the portal hepatic with a vascular clamp (Pringle's maneuver) .Deep lacerations were inspected carefully after retraction of the edges to allow individual ligation of the bleeding vessels. Devitalized tissue was removed by non-anatomical resectional debridement using the finger fracture technique along the line of injury. For persistent bleeding packs were placed above and below the liver to provide haemostasis by tamponade. Packs removal were done after 48-72 hours.

Statistical analysis was performed using the chi-square test for discrete variables and the unpaired t test for continuous variables. Analysis was done using SPSS version.[11] Significance was set at p value < 0.05.

RESULTS

Over the 52 months period 200 patients with liver trauma who treated at Al-thawra teaching Hospital, Sana'a Yemen. Among these 200 patients there were 179 males and 21 females with age ranging from 2 to 75 years (mean= 21.24 yrs). Liver trauma from road traffic accidents accounts for 52 percent of all injuries (104 patients), gunshot wounds and stab wounds injuries were responsible for 36.5, 1.5 percent respectively. Other causes depicted in Table 1.

Sixty patients (30%) were shocked during presentation, where the blood pressure was <90 mmHg and or the pulse≥120 beat/min. Shock was present in 35 patients (29.4%) of blunt trauma and in 25 patients (31%) of penetrating trauma. There were statistically significant relationships between mechanism of injury and presence of haemodynamic stability (p=0.049).

The haemoglobin ranged from 3gm/dl to 16g/dl with a mean of 10.3 g/dl. and it was 10g/dl or less in 50.5% of the patients.

Diagnostic tools performed in liver trauma included abdominal ultrasound (US), computed tomography (CT) and diagnostic peritoneal lavage (DPL). US revealed liver injury in 16 patients out of 26 patients; CT scan showed liver injury ± bullet in all the patients (19 patients) who underwent CT assessment (Fig. 1,2). DPL was positive in all the 24 cases who subjected to DPL. In 178 patients, liver injury was confirmed only at urgent laparotomy (Fig. 3). In 29 patients with stable haemodynamics, the diagnosis of hepatic injury was obtained with computed tomography (CT) scan or ultrasound either followed by operation or without operation. The liver injury scale (AAST) was obtained by exploration and/or CT scan and/or abdominal ultrasound. 47% were minor injuries (grade I-II) and 53% were major injuries (III-V). Grade VI not recorded in our study. The number of patients in each grade shown in Table 2. There were no statistically significant relationships between mechanisms of injury and grade of injury (p=0.084).

Twenty-two patients treated conservatively, all of them were subjected to blunt trauma and there were no indications for laparotomy. Urgent laparotomy was performed in 178 patients. The indications for intervention were, penetrating injury, or blunt trauma with haemodynamic instability and/or sings of peritoneal irritation. In 89 (50% of the 178 patients who underwent laparotomy, injuries managed by simple methods such as temporary packing, diathermy, sutures or vessel ligations. Eighty three Patients (46.6%) had complex injuries and underwent one or more of the following procedures to control bleeding: Hepatotomy and intrahepatic vessel suture (60), resectional debridement (18), temporary

packing and haemostasis(48), perihepatic packing and relaparotomy (9).Three patients (1.5 percent) had packing alone and 6 (3%) had a combination of packing and another procedure. At the initial procedure, devitalized tissue was debrided in 62 (31%) patients and drains were placed in 60 patients. Of the 9 patients whose abdomen were packed with gauze at the primary operative procedures, 3 died before the packing could be removed. Eleven patents had juxtahepatic venous injuries. Primary repair was attempted in 7 patients. Eight patients died. Three hundred eighty two associated intraabdominal or extraabdominal injuries, or both in 141(70.5%) of patients are shown in Table 3. The commonest associated injury in blunt trauma was lower extremities (40), and in penetrating trauma was stomach (38). Fifty patients out of 141 patients (35.5 %) who have associated injuries were shocked.

Associated injuries and shock were present in 19 patients with minor (grade I-II) injuries and present in 31 patients with major (III-IV) injuries. There was no significant relationship between the grade of trauma and the frequency of coexisting injury (p=0.559). There was also no significant relationship between haemodynamic stability and the presence or number of coexisting injuries.

Perioperative blood transfusion ranged from 0 to 9 units (mean= 2.18 units). The intensive care unit (ICU) admission ranged from 0 to 19 days (means= 2.13 days). Patients underwent operative management stayed shorter than the conservative group in the ICU (2.1 versus 2.4 days).

The over all mortality rate in this series was 23.5 % (47 patients), and the mortality rate increased as the severity of the grade of hepatic injury increased: grade I, 2 of 27 patients died, grade II, 4 of 67 patients died, grade III, 5 of 53 patients died, grade IV, 28 of 42 patients died and grade V, 8 of 11 patients died. Forty one deaths (87%) were directly attributable to the liver injury. Twenty six deaths (55.3 %) were due to exsanguinating bleeding from the liver or juxtahepatic major venous injuries. The liver injury related mortality rate injuries (grade I-II) were 0 percent compared with 87 percent with major injuries (grade III-V). Thirteen per cent of the deaths were due to associated lethal injuries. The mortality was after blunt injury 19 (40.4%) compared with gunshot 27 (57.4%) and stab wounds 1(2.2%).Three patients died of head injuries. Different factors related to mortality shown in Table 4. There was no significant correlation between the presence or absence of coexisting injuries and mortality or morbidity (p=0.083), but there were significant correlation between injury grade, injury mechanism, RHVI and haemodynamic instability and mortality (p=0.000001, 0.017, <0.000001and0.001 respectively).

Seventy-three complications occurred in 61 of 153 survivors. Fourteen patients developed a bile leak, 3 of them developed biliary fistula, one cured spontaneously after 3 weeks, one cured after ERCP and sphincterotomy and the third one submitted to relaparotomy for closure of the fistula and stayed in the hospital for 180 days then discharged after cure. Other complications included, wound infection,(21) coma,(9) haematemesis,(8) melena,(7) abdominal pain,(6) jaundice(6) and hiccough.(2)

The mean hospital stay ranged from 0 to 180 days (mean=14.72 days). Length of stay was calculated only for patients without significant head injury.

Table 1. Mechanism of liver injuries in 200 patients.

Type of injury	Number	Percent
Blunt trauma:	119	59.5
Car accidents	104	52.0
Fall from height	011	05.5
Hit by heavy object	002	01.0
Hit by a fist	001	00.5
Hit by cow	001	00.5
Penetrating:	081	40.5
Gunshot wounds	073	36.5
Stab wounds	003	01.5
Bomb explosion	003	01.5
Iatrogenic (surgical)	002	01.0
Total	200	100

Table 2. Grade of injury, mortality and causes.

Grade	Number	Mortality (percentage)	Cause of injury
I	27	2 (7.4)	GSW
II	67	4 (6)	GSW
III	53	5 (9.4)	CA
IV	42	28 (67)	GSW (21), CA (6), SW (1)
V	11	8 (73)	CA
Total	200	47 (23.5)	

GSW= gunshot wounds, CA= car accident. SW= stab wound.

Table 3. Associated injuries and mortality in blunt and penetrating trauma (n= 141 patients).

Organ affected	blunt trauma Number (death)	penetrating tr. Number (death)	Total ass. Injuries	total death (%)
Chest	19 (5)	37 (21)	56	26 (46.4)
Colon	17 (6)	30 (6)	47	12 (25.5)
Stomach	6 (0)	38 (19)	44	19 (43.0)
Lower extremities	40 (0)	3 (0)	43	0 (0.0)
Head	29 (0)	9 (0)	38	0 (0.0)
Spleen	20 (0)	18 (10)	38	10 (26.0)
Kidney	08 (5)	20 (2)	28	7 (25.0)
Upper extremities	8 (0)	14 (8)	22	8 (36.3)
Diaphragm	1 (0)	19 (11)	20	11 (55.0)
Gall bladder	5 (4)	10 (0)	15	4 (27.0)
Small intestine	1 (0)	11 (2)	12	2 (17.0)
Maxillofacial	11 (0)	0 (0)	11	0 (0.0)
Pancreas	6 (4)	0 (0)	6	4 (67.0)
Pelvic fracture	2 (0)	0 (0)	2	0 (0.0)
Total	173	209	382	103 (27.0)

Table 4. Factors related to mortality.

Factor		No. of patients	death	x2	p
AAST grade	I-II	094	06	chi2=18.5	0.000001
	III-V	106	41		
Injury mechanism	Blunt	119	19	chi2= 5.6	0.017
	Penetrating	081	28		
RHVI	NO	189	3	chi2=49.6	< 0.000001
(=retrohepatic venous injury)	YES	011	08		
	NO	059	08	chi2=3	0.083
Associated injuries	YES	141	39		
	NO	140	21	chi2=10.8	0.001
Shock	YES	060	26		

AAST=American Association for the Surgery of Trauma.

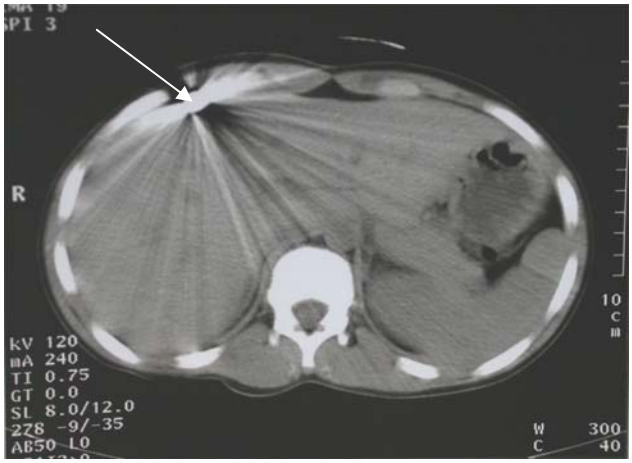

Fig 1. CT scan shows a bullet shadow in the liver (arrow).

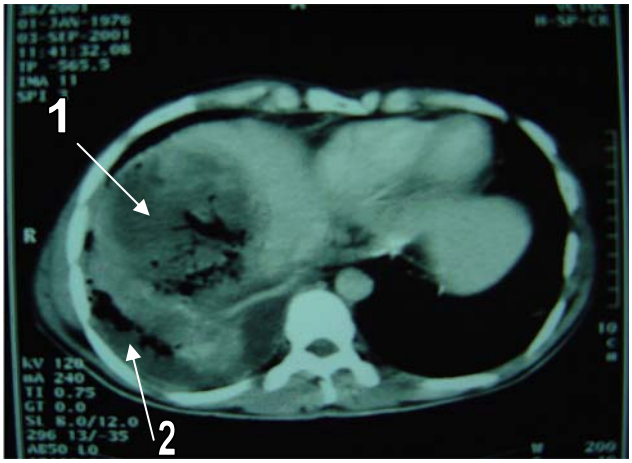

Fig 2. CT scan delineating a grade IV injury sustained during a motor vehicle accident (arrow no.1 indicate intraparenchymal haematoma and arrow no.2 indicate subcapsular haematoma). The patient treated conservatively and discharged in good general condition.

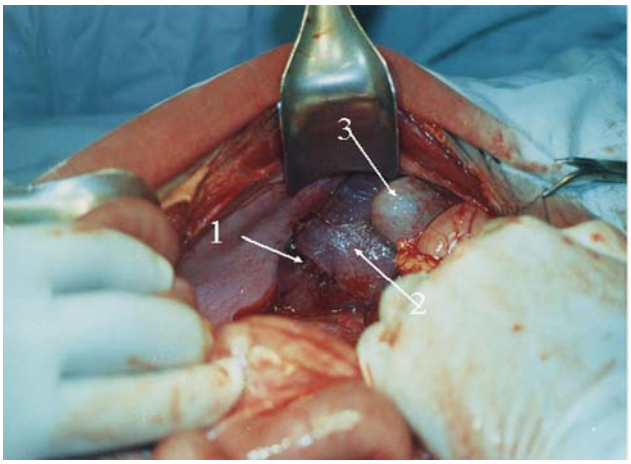

Fig 3. Arrow no. 1 shows grade II liver injury, arrow no. 2 shows segment 5 of the liver and arrow 3 shows the gall bladder.

DISCUSSION

This study involved 200 patients over 52 months. Penetrating trauma from gunshot and knife wounds account for 66-88% of all liver injuries in series reported from South Africa 11and USA,[12] but for only 40 percent of injuries in the present series. Road traffic accidents resulting in blunt trauma made up the largest group of injuries (52%) as reported in other series.[13]

The availability of good-quality images will facilitated the diagnosis and organ injury scoring, and aid discussion and transfere to a specialist centre.[3] Ultrasonography is favoured by many,[14,15] because of its portability but over the past 10 years CT has become widely available and is relatively quick, with a high sensitivity 16. Computerized tomography scan is the best diagnostic modality in the haemodynamically stable, as it will assess both the extent of injury and subsequently the progress of injury resolution.[17]

In this study, the patients with severe liver trauma account for 53 %. This percentage is lower than that reported by Gao et al[8] (63%). Surgical intervention in the patients with grade I or II injury in this study was due to severe injury to other organs requiring laparotomy and this is consistent with other reports.[8]

In the patients treated non-operatively who survived,[2] had grade IV injuries unlike Gao et al 8 who reported that 6 had grade IV injuries and 2 had grade V injuries8. It has been shown that if the patient is hemodynamically stable, nonoperative management can be used even in certain cases with grade IV or grade V injury.[8]

Rapid control of liver bleeding is critical and temporary liver packing with manual compression in this situation is now an established life saving maneuvered while resuscitation is continued. When conventional haemostatic procedures fail to control bleeding in a patient with recalcitrant coagulopathy, hypothermia and acidosis, perihepatic packing has an important role as a definitive procedure. Intra-abdominal packing of major liver injuries also facilitates transfer from a peripheral hospital to a tertiary centre for definitive management.[4]

To expose the liver fully, the ligamentous attachments (falciform, right triangular and coronary) should be divided to allow rotation of the liver to the incision as the majority of severe liver trauma involves right lobe 8. When the Pringle's maneuver fails to control bleeding from the retrohepatic area, it is unwise to turn the liver over for inspection of the site of RHVI; such handling will lead to life-threatening exsanguinations. The correct approach is to push back and up (spine and diaphragm) the liver to stop the hemorrhage temporarily.[8]

Perihepatic packing is a well-accepted technique for severe liver trauma with or without RHVI when routine procedures cannot control the bleeding.[8]

In this study, nine patients had resectional debridement of non-viable liver adjacent to the injured site.[4]

There were two reasons for the increasing number of patients managed non-operatively; the shift away from DPL to CT as the method of evaluation and the increasing comfort with nonoperative management of these patients.[18]

Brasal et al[18] reported that nonoperative management is not only beneficial for patients, as they are not exposed to the risk of blood transfusion, but beneficial for the health care system with decreased resource use.[18]

Marr et al[4] added that most gunshot injuries of the liver required no-treatment at laparotomy or could be managed successfully with minimal surgical intervention. In major liver gunshot injuries, however, the greatest immediate threat of life is exsnguinating haemorrage. Rapid control of bleeding is the priority.[4]

In the other hand, some authors[17] reported that weakness of nonoperative management of blunt adult hepatic injuries remains the possibility of missing an associated intraabdominal injury, or the threat of immediate or late haemorrhage.[17] Parks and some other surgeons mentioned that non-operative management should be initiated only for injuries bellow grade III in patients with stable haemodynamics, grade III to grade IV injuries usually requires surgical intervention.[3] Liver trauma does not usually occur in isolation, and 70.5 % of the 200 patients reported here had associated injures, a rate similar to that of other series.[18]

Dicker and associates[19] found associated intraabdominal injuries requiring surgical repair in 106 (80%). We support the viewpoints of Dicker and associates[19] who concluded that because of the high incidence of associated injuries, routine laparotomy should be the standard of care for paediatric patients. In contrast, some mentioned that the absence of coexisting abdominal injuries might provide the surgeon with the confidence to manage injuries conservatively as the primary management.[20]

Not surprisingly, massive blood transfusion was required in the operative group more than in the group who received non-operative management (NOM).[21] Gao et al 8 in their study mentioned that the perioperative blood transfusion ranged from 2 to 60 units (mean= 12 units) 8. Also Demetriades et al[5] in their study reported that the mean blood required was 1.510 L (range 0 to 12.650 ml).[5] In our study the mean blood required was 2.18 units (range 0 to 9 units) that looks less than the other studies, which could be explained by the shortage of the blood in most of the occasions.

Marr et al 4 reported that the over all mortality rate in 153 consecutive adult civilian liver injuries in their study was 17% and the number and severity of associated injuries as well as liver and juxtahepatic venous bleeding were the major factors determining outcome.[4]

Gao et al[8] reported an over all mortality (12.1%) which was greatest after blunt injury (27%) compared with gunshot (11%) and stab wounds (2%).[8] In this study the overall mortality reached 23.5% and 87% of the deaths were directly attributable to the liver injury, and the reminder[13] were due to associated injuries. This rate is higher than those of liver injuries from other studies 4,8, but less than that reported by Al-Gari et al[21] 67%. The mean hospital stay in this study was 14.72 days. This is shorter than that recorded by Gao et al 8 (26.5 days) and Marr et al[4] (22 days), but nearly similar to that reported by Demetriades et al[5] (11.7 days).

In Conclusion, Prevention of trauma itself should be a goal and improvement in management of liver injury patients and trauma victims in general are necessity. Early recognition of the magnitude of complex injuries and access to a tertiary facility with a dedicated hepatobiliary surgical team experienced in liver trauma are now regarded as essential requirements in the management of major injuries.

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