Surgical Options for Haemostasis in Hepatic Trauma

N AHMAD A Z KHAN K J ABID *S T A SHAH.*
Department of Surgery, Mayo Hospital, Lahore
Correspondence to: Dr. Nazir Ahmad. Senior Registrar Surgery.

Thirty five patients with civilian trauma i.e. firearm and stab injuries were treated during the two year period i.e., from October, 1997 to September, 1999 in west surgical ward, Mayo Hospital, Lahore. Exploratory laparotomy was performed in all patients. Majority of the patients (68.57%) were between the age of 13 to 30 years with a male preponderance (97.14%). Various operative procedures which were performed after grading the penetrating hepatic trauma, included horizontal mattress suture ligation alone (37.15%) or over spongostan (17.15%), simple suture ligation (5.71%), resectional debridement with individual vascular ligation (5.71%), resectional debridement with roll gauze packing (5.71%), hepato-omentorraphy (5.71%), segmentectomy (2.86%) and peri-hepatic packing (5.71%). No operative procedure was performed in 14.29% cases. The mortality rate in the series was 20%.
Key words: penetrating hepatic trauma, resectional debridement, Hepatorraphy.

Management principles governing the care of the critically injured patients continue to evolve. Moreover, the rate of evolutionary change appears to be increasing. Technical advances with direct application to the diagnosis and treatment of trauma victims are becoming ever more frequent. Molecular biology is rapidly moving from bench to bedside with important discoveries that have advanced our knowledge of Pathophysiology of critical illness and that almost seductively, appear to hold therapeutic promise. Rapid urbanization and increase in street violence due to greater use of weapons to settle personal differences, are the leading causes of penetrating trauma, which is the challenging health problem for the general surgeon in our community. Due to its larger size and location in two upper abdominal quadrants, liver is the most frequently injured solid intra-abdominal organ in patients with abdominal gunshot and stab wounds. Firearm injuries of solid organs are more lethal as compared to stab injuries because of their blast effect.

Principles of management of liver injuries include:

- Control of bleeding
- Resection of devitalized tissue
- Establishment of adequate external drainage

Patients and methods

One of the major aims of this study was to outline the surgical options for haemostasis in hepatic trauma in our local setup and to compare them with other similar studies carried out elsewhere. The study was conducted over a period of two years i.e. from October 1997 to September 1999, in West Surgical Ward, Mayo Hospital, Lahore. All the patients who presented in Accident and Emergency Department with thoraco-abdominal firearm and stab injuries were included in the study. All the patients underwent exploratory laparotomy. Associated organ injuries were managed according to their severity. Haemodynamically unstable patients (40%) were directly shifted to operation theater for on table resuscitation and exploration while stable patients (60%) were operated after resuscitation and carrying out relevant investigations. Antibiotics, Tetanus toxoid and analgesics were given to all patients and they were kept nil by mouth postoperatively up till the time, they passed flatus. Duration of stay in the hospital varied between 5 to 36 days with the mean of 11 days.

Results

Thirty-five patients presenting with penetrating thoraco-abdominal injuries were included in the study. Age of the patients ranged from 13 to 55 years with the mean of 25 years. Thirty-four patients (97.14%) were male and there was only one female patient (2.86%). Cause of the injury in 25 patients (71.43%) was firearm and in 10 patients (28.57%) stab injury. Liver injury was graded according to the Moore's organ injury scale revised in 1994[1]. Most of the patients (80%) had grade I to III injuries as given below in table 1:

Table 1: Grades of liver injury

Grade	n=	%age
I	4	11.43
II	10	28.57
III	14	40
IV	5	14.29
V	2	5.71

Exploratory laparotomy was done for all patients. According to the severity of the liver injury, various operative procedures were performed as shown in table 2:

Table 2: Operative procedures

Grade	n=	Procedure performed with %age
I-II	5	No procedure performed (14.29)
I	2	Simple suture ligation technique (5.71)
II-III	13	Horizontal mattress sutures (37.15)
III	6	Horizontal mattress sutures over spongostan (17.15)
III	2	Resectional debridement with individual vascular ligation (5.71)
IV	2	Resectional debridement with roll gauze packing (5.71)
IV	2	Omento-hepatorrhaphy (5.71)
IV	1	Segmentectomy (2.86)
V	2	Perihepatic packing (5.71)

Associated organ injuries of G I T, kidney, spleen, gall bladder, diaphragm, abdominal aorta, inferior vena cava and extremities were managed according to their own priority. Major postoperative complications seen were hemorrhage, biliary fistula and sepsis as shown in table 3. More than one complications were seen in the same patient.

Table 3. Major post operative complications with management

Complication	n=	% age	Management
Respiratory tract infection	12	34.28	Conservative (25.71%) Decortication (8.57%)
Haemorrhage	3	8.57	Re-exploration (5.71%) Conservative (2.86%)
Biliary fistula	4	11.43	Conservative
Jaundice	4	11.43	Conservative
Sepsis	4	11.43	US Guided Aspiration (5.71%) Re-exploration (5.71%)
Liver abscess	3	8.57	US Guided Aspiration (8.57%) Re-exploration (2.86%)
G I Bleed	2	5.71	Conservative (2.86%) Re-exploration (2.86%)

Mortality rate in our study was 20% (7 deaths). Three deaths were per-operative due to exsanguination and other 3 patients died post-operatively in the first 24 hours because of development of irreversible shock and multiple organ failure. One patient died on the 12th post-operative day due to sepsis and upper GI bleed.

Discussion

Being a large, superficial and friable structure, liver is the most commonly injured intra-abdominal organ in penetrating upper abdominal quadrant injuries. Management of the liver trauma warrants the presence of mind, surgical expertise and knowledge of surgical anatomy of liver to apply various surgical options in a critically ill patient. Hepatic trauma runs the wide spectrum from minor capsular tears to lobar destruction. Up to 85 to 90% of liver injuries can be treated using simple technique of haemostasis i.e. active suction drainage for non-bleeding lacerations, suture hepatorrhaphy, and application of topical haemostatic agent like spongostan. Advanced techniques of haemostasis i.e. extensive hepatorrhaphy, Pringle maneuver, omental pedicle flap, resectional debridement with selective vascular ligation or roll gauze packing, segmentectomy, perihepatic packing may be required for 10 to 15% of penetrating hepatic trauma[2].

Hepatic trauma occurs predominantly in young males in their most productive years of life. In the study 24 patients (68.57%) were between the age of 13 to 30 years with male preponderance (97.14%) due to their involvement in outdoor activities[3].

Firearm injuries were the commonest mode of injuries in 25 patients (71.43%) whereas stab wounds were seen in 10 patients (28.57%).

Right lobe of the liver was injured in 20 patients (57.14%) which coincides with the study conducted by Trunkey, et. al[4], where he observed right lobe involvement in 55 to 60% patients.

In the study, there was associated organ injuries in 80% of cases which compares with the study conducted by Defore, et.al[5], where they noted associated organ injuries in 73% patients.

Hepatorrhaphy was the main way of achieving the haemostasis which included simple suture ligation, horizontal mattress sutures alone or over spongostan, and omento-hepatorrhaphy.

Horizontal mattress sutures ligation technique was the major surgical procedure applied in 13 patients (37.15%) to control bleeding in grade II to III liver injuries. Trunkey et. al[4] used this technique in 20.4% of his patients. Feliciano DV, et, al[6] noted that this method in conjunction with other methods was sufficient in 88.1% of the patients for haemostasis in hepatic trauma. Mays E T[7] condemned this technique of repairing liver injuries and called this as tradition only.

Simple suture ligation technique was applied in 2 patients (5.71%) for grade I injury in comparison with Watson C J E, et. al[8], where they used this technique in 35 patients (31.12%).

Greater omentum due to its high vascularity, rich granulocytes and macrophages content which promotes healing, was applied in two patients (5.71%) to fill the dead space in the liver parenchyma caused by injury. Simple sutures were applied to secure the placement of omentum in the wound cavity. Fabian TC et. al[9], have used omental packing in 60% of complex hepatic injuries with 8% rate of abscess formation in the study.

Topical agents like spongostan were used in 6 patients (17.15%) and reinforced with horizontal mattress sutures for grade III injuries. Richardson JD, et. al[2], favours the application of topical haemostatic agents.

Resectional debridement with individual vascular ligation was performed in 2 patients (5.71%). Richardson JD, et. al[2] and Pachter HL, et. al[10], used this procedure in their patients.

Right hepatic segmentectomy was done in one patient (2.86%) for grade IV injury and this coincides with the studies conducted by Feliciano D V, et. al[11] and Moore E E[12]. They used this technique in 2 to 4% of their patients.

Intrahepatic gauze packing after resectional debridement was done in 2 patients (5.71%) and these packs were removed after 48 hours. Fabian T C, et. al[9], used this technique with satisfactory results i.e. 30% sepsis in his study.

Perihepatic packing was applied in 2 patients (5.71%) for grade V liver injuries which coincides with the percentage seen in the studies conducted by Feliciano DV, et al[11] and Feliciano DV, et. al[13]. They used perihepatic packing in 4 to 5% of all the patients undergoing operative management for hepatic injuries. Ivatury R R, et. al[14] condemned this technique for haemostasis due to high mortality rate (57%) in his study.

No procedure was performed in 5 patients (14.29%) having grade I to II injuries. Demetriades D, et. al[15] reported their successful non-operative management in 21 haemodynamically stable patients with penetrating wounds of right upper quadrant.

Regarding major post-operative complications, respiratory tract infection was observed in 12 patients (34.28%). Four patients (11.43%) developed biliary fistula and were managed conservatively. Haemorrhage was observed in 3 patients (8.57%). Two (5.71%) of these patients were re-explored to control haemorrhage and one patient (2.86%) was managed conservatively in comparison with the study of Patcher HL, et. al[16]. They re-explored 1.9% patients to secure haemostasis. Intra-abdominal sepsis developed in 4 patients (11.43%), which coincides with the study conducted by Bender JS, et. al[17], where 10% of his patients developed intra-abdominal sepsis.

Mortality rate in our study was 20%. This is in comparison with the study conducted by Marr JDF, et. al.[18] where mortality rate was 17%. This high mortality rate was due to exsanguination, severity of liver injury grade IV to V, multiple associated organ ninjuries and non-availability of blood at the time of resuscitation and exploration.

Among operative options to secure haemostasis for penetrating hepatic trauma of grade II to IV, hepatorrhaphy in the form of horizontal mattress sutures ligation technique alone or in combination with other procedures after debridement of devitalized liver tissue is the most quick, effective and simple method especially in haemodynamically unstable patients. Most of the trauma surgeons use this technique with good results. Hepatorrhaphy has fallen out of favour due to its ischemic effect on liver parenchyma that predisposes to extensive necrosis and sepsis. This effect can be overcome by keeping the sutures loose and wound edges open for free drainage of blood and bile. Drain should be placed. Due to recent advances in trauma management, more advanced procedures are becoming popular by most authors i.e. hepatotomy with direct suture ligation, resectional debridement and segmentectomy. But in our local setup and keeping in view the facilities available at our trauma centers, hepatorrhaphy is still the most effective surgical option to control the haemorrhage for penetrating liver injuries with good results.

References

1. Moore E E, Cogbill T H, Malangoni M A, et al. Organ injury scaling. Horizon in trauma surgery. Surg Clin Nor Am. 1995; 75: 293-303.
2. Richardson J D, Flynn W J. Hepatic Trauma. Trauma series. Surgical rounds. May 1992: 417-429.
3. John T G, Greig J D, Johnstone A J, et al. Liver trauma. A ten years experience. Br J Surg 1992; 79: 1352-1356.
4. Trunkey D D, Shires G T, McClelland R. Mangement of liver trauma in 811 consecutive patients. Ann Surg 1974; 179: 722-728.
5. Defore W W Jr, Mattox K L, Jordan G L Jr, et al. Management of 1590 consecutive cases of liver trauma. Arch Surg 1976; 111: 493-497.
6. Feliciano D V, Mattox K L, Jordan J L Jr, et al. Management of 1000 consecutive cases of hepatic trauma. Ann Surg 1986; 204: 438-445.
7. Mays E T. The hazards of suturing certain wounds of liver. Surg Gynaecol Obstet 1976; 143: 201-204.
8. Watson C J E, Calne R Y, Padhani A R, et al. Surgical restraints in the management of liver trauma. Br J Surg 1991; 78: 1071-1075.
9. Fabian T C, Croce M A, Stanford G G, et al. Factors affecting morbidity following hepatic trauma. A prospective analysis of 482 liver injuries. Ann Surg 1991; 213: 540-548.
10. Patcher H L, Feliciano D V. Complex hepatic injuries. Complex and challenging problems in trauma surgery. Surg Clin Nor Am. 1996; 76: 763-782.
11. Feliciano D V, Patcher H L. Hepatic trauma re-visited. Curr Probl Surg 1989; 26: 453.
12. Moore E E. Critical decisions in the management of hepatic trauma. Am J Surg 1984; 148: 712-716.
13. Feliciano D V, Mattox K L, Burch J M, et al. Packing for control of hepatic haemorrhage. J Trauma 1986; 26: 738.
14. Ivatury R R, Nallathambi M, Gunduz Y, et al. Liver packing for uncontrolled haemorrhage. A reappraisal. J Trauma 1986; 26: 744-753.
15. Demetriades D, Rabinowitz B. Non operative management of penetrating liver injuries. Br J Surg. 1986; 73: 736-737.
16. Patcher H L, Spencer F C, Hofstetter S R, et al. Significant trends in the treatment of hepatic trauma. Experience with 411 injuries. Ann Surg 1992; 215: 492-502.
17. Bender J S, Geller E R, Wilson R F. Intra-abdominal sepsis Following liver trauma. J Trauma. 1989; 29: 1140-1145.
18. Marr J D F, Krige J E J, Terblanche J. Analysis of 153 gunshot wounds of the liver. Br J Surg 2000; 87: 1030-1034.