A 10-year experience with hepatic trauma in a Chinese level one trauma center

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ABSTRACT

Objectives: To analyze strategies of operative management (OM) and non-operative management (NOM), mortality, and morbidity of hepatic trauma patients.

Methods: We retrospectively reviewed 296 consecutive patients with hepatic trauma at the Department of Hepatobiliary Surgery, 101st Hospital of PLA, Wuxi, Jiangsu, China a single level one trauma center between January 2003 and December 2012. Data on demographics, mechanism of trauma, American Association for the Surgery of Trauma grade, initial management, and outcome were collected for this study.

Results: A total of 101 (34%) patients were of low-grade, while 195 (66%) were of high-grade. Hepatic trauma with associated injury of other organs was noted in 205 (69.3%) patients. The initial management was OM for 119 (40.2%) and NOM for 177 (59.8%), 12 patients later required laparotomy. Surgical intervention included perihepatic packing in 6, liver parenchyma suturing in 29, liver parenchyma suturing and hemostasis in 50, segmental resection in 19, and right hepatectomy in 2. The overall mortality rate was 9.1%, and the mortality rate of 8.4% was due to hepatic injuries.

Conclusion: All hemodynamically stable patients can be managed by NOM with excellent results, while high-grade hepatic injuries require OM due to hemodynamic instability, or concomitant injuries.

The liver is the second most commonly injured organ following abdominal trauma, and associated injuries contribute significantly to mortality and morbidity.[1,2]

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Management of hepatic trauma has changed significantly over the last 2 decades, with significant improvement in outcomes.[3] One of the most remarkable changes is non-operative management (NOM).[4,5] The indications for the operative management (OM) of hepatic trauma have gradually been restricted to the hemodynamically unstable, or concomitant injuries. However, selecting these patients, especially in the polytrauma situation remains a challenge. The purpose of this retrospective study was to analyze strategies of management, mortality, and morbidity of patients with hepatic trauma.

Methods. Between January 2003 to December 2012, 296 patients were treated for hepatic trauma at the Department of Hepatobiliary Surgery, 101st Hospital of PLA, Wuxi, Jiangsu, China, which includes a level one trauma center. The following data were collected: demographics, mechanism of trauma, grades of hepatic injury, the score on the injury scoring system (ISS), associated concomitant injuries, type of management, length of hospital stay, and outcome. The study protocol was approved by the Ethics Committee of the 101st Hospital of PLA, and prior informed consent was obtained. This study was conducted according to the principles of the Helsinki Declaration.

Hepatic trauma was diagnosed by CT scans and/or intraoperative findings. The grade of hepatic trauma was based on the revised 6-grade organ injury of the American Association for the Surgery of Trauma (AAST).[6] We defined grades I and II as low-grade injuries, and grades III to VI as high-grade injuries. We excluded patients with hepatic trauma who died either at the scene, or en route to the hospital. Eight patients were excluded.

Treatment management. Patients who were initially treated by a conservative approach were defined as the NOM group, whereas hepatic trauma requiring immediate operation was classified as the OM group. Initial NOM of hepatic trauma, which had to be converted to OM, was considered as "NOM-fail" group. We defined hemodynamically by systolic blood pressure greater than or equal to 90 mm Hg.

All statistical operations were performed using the Statistical Package for Social Sciences version 13 for Windows (SPSS Inc., Chicago, IL, USA). For continuous criteria, results are expressed as mean ± standard deviation. Relative frequencies between different groups were compared by the exact Fisher test or chi-square test. All p-values were 2-sided and considered significant at $p<0.05$.

Results. For this retrospective study, 296 patients were referred. The mean age was 35.5 (range 15-76), and male:female ratio was 2.65:1. Blunt trauma was the most frequent mechanism of injury (95.6%), penetrating injuries accounted for the remaining 4.4% (**Table 1**). The cause of the blunt trauma was road traffic accident in 170 patients (57.4%), fall in 65 (22%), assault in 25 (8.4%), and crash in 23 (7.8%), and 205 patients (69.3%) had multiple traumas. Splenic injury was the most common major associated intra-abdominal injury, followed by mesenteric contusion, renal contusion, diaphragmatic tear, pancreatic laceration, and colon perforation. Chest injuries, head injuries, and bone fractures were most often observed. Shock presented in 96 patients (32.4%) at the time of admission, or after 2 liters of crystalloids infusion as initial resuscitation.

The OM group. A total of 119 patients (40.2%) underwent immediate operation: 94 patients were hemodynamically unstable. Twenty-four patients had CT findings of concomitant injuries: small bowel and colon injuries in 9 (7.6%); spleen, kidney, pancreas, renal, diaphragm injuries in 12 (10.1%); and in 3 (2.5%) the laparotomy, which was performed due to clinical peritonitis or penetrating injuries was non-therapeutic.

The NOM group. A total of 177 patients (59.8%) were initially managed with NOM. As shown in **Table 2**, the greater the grade of hepatic injury, the fewer patients could be enrolled for NOM. The NOM was successfully carried out in 165 patients, and 12 patients required laparotomy. The percentage of failure of NOM was 6.8% (12/177) with 22.2% (2/9) grade V, 16% (4/25) grade IV, 8.7% (4/46) grade III, and 3% (2/67) grade II injuries. In patients with grade II injuries, failures were due to some injuries other than liver injuries, and the failure in patients with grade III to grade V injury was associated with liver hemorrhage. The percentage of NOM decreased as the grade of liver injury increased. One hundred and thirty-one patients underwent surgical treatment (119 of these belong to the OM group, and the remaining 12 underwent surgical treatment after the failure of NOM). Twenty-six patients did not require any hemostatic procedure to the liver, this was because in 11 cases, the other abdominal organ injury required surgical repair, and in 12 cases because the bleeding source was from elsewhere other than the liver. Three patients with grade V hepatic injury needed liver hemostasis, but died in the operating room before any procedure could be carried out. A total of 103 patients underwent 106 liver-related surgical procedures. Hemostasis and hepatorrhaphy were the main operative procedures for grades II or III injury, whereas anatomical resection and hepatorrhaphy were the main operative procedures for grades IV or V. Surgical intervention included perihepatic packing in 6, liver parenchyma suturing in 29, liver parenchyma suturing, hemostasis by means of biologic fibrin glue and absorbable hemostatic sponge in 50, segmental resection in 19, and right hepatectomy in 2.

Table 1 - Demographic data and injury severity by grade of hepatic trauma among the studied group.

AAST grade	n (%)	Age	Male	Female	Blunt	Penetrating	Injury Scoring System	Mortality n (%)
I	30 (10.1)	35.9 ± 12.8	25	5	28	2	10.6 ± 5.3	0 (0.0)
II	71 (24.0)	35.1 ± 10.7	47	24	68	3	21.5 ± 6.1	1 (1.4)
III	106 (35.8)	35.3 ± 11.7	78	28	102	4	21.4 ± 6.2	6 (5.7)
IV	63 (21.3)	37.4 ± 11.2	47	16	60	3	35.4 ± 5.5	12 (19.0)
V	26 (8.8)	32.1 ± 7.3	18	8	25	1	42.4 ± 8.7	8 (30.8)
Total	**296**	**35.5 ± 11.2**	**265**	**1**	**283 (95.6)**	**13 (4.4)**	**25.2 ± 10.8**	**27 (9.1)**

AAST - American Association for the Surgery of Trauma

Table 2 - Final operative management (OM) and non-operative management (NOM) results by grade of hepatic injury among the studied group.

AAST grade	N=296	OM n=119 (40.2)	OM-success n=101 (84.9)	NOM n=177 (59.8)	NOM-success n=165 (93.2)
			n (%)		
I	30 (10.1)	0 (0.0)	0 (0.0)	30 (100.0)	30 (100.0)
II	71 (24.0)	4 (5.6)	4 (100.0)	67 (94.4)	65 (97.0)
III	106 (35.8)	60 (56.6)	56 (93.3)	46 (43.4)	42 (91.3)
IV	63 (21.3)	38 (60.3)	30 (78.9)	25 (39.7)	21 (84.0)
V	26 (8.8)	17 (65.4)	11 (64.7)	9 (34.6)	7 (77.8)

AAST - American Association for the Surgery of Trauma

Table 3 - Patients' mortality by operative management (OM) and non-operative management (NOM) among the studied groups.

Grade of injury	N =296	Overall mortality n=27 (9.1)	Liver-related mortality n=25 (8.4)	OM-mortality n=19 (16.0)	NOM-mortality n=8 (4.5)	NOM-mortality liver-related n=6 (3.4)
				n (%)		
Low-grade	101	1	1	1	0	0
I	30	0	0	0	0	0
II	71	1 (1.4)	1 (1.4)	1 (1.4)	0	0
High-grade	195	26	24	18	8	6
III	106	6 (5.7)	5 (4.7)	4 (3.8)	2 (1.9)	1 (1.9)
IV	63	12 (19.0)	11 (17.5)	8 (12.7)	4 (6.3)	3 (6.3)
V	26	8 (30.8)	8 (30.8)	6 (23.1)	2 (7.7)	2 (7.7)

Mortality and morbidity. The overall mortality was 9.1% (27/296). Liver-related mortality was 8.4% (25/296). The mortality in operated patients was 16.% (19/119), and liver-related mortality was 16% (19/119). The mortality in the NOM group was 4.5% (8/177), and liver-related mortality was 3.4% (6/177). Two patients in the NOM group died due to associated organ injuries (head and chest). Mortality (p=0.02) and liver-related mortality (p<0.001) were higher in the OM group than the NOM group, and were statistically significant (**Table 3**). Twelve (7.3%) of the 165 patients that were NOM-treated with success required intervention procedures. Two patients with liver abscess and 6 patients with biloma, or hematoma underwent percutaneous drainage. Four patients who had biliary leakage underwent endoscopic retrograde cholangiopancreatography (ERCP) with stenting. Seven (5.3%) of the 131 patients managed surgically had subphrenic abscess, which required percutaneous drainage. Two patients died due to acute renal failure. Minor complications included pneumonia in 12, and wound infection in 14 patients. Hospital stay ranged from 12-34 days (median: 21.9 days). In 107 patients treated by OM, and 170 patients NOM-treated were followed-up for 6 months after discharge. Most did not present with, or complain of any serious problem.

Discussion. Hepatic injury is a common but serious consequence of blunt abdominal trauma.[1] The primary focus of trauma surgeons was to find out the most appropriate technique in patients with hepatic injuries.[7] The literature now reports over 80% of blunt hepatic injuries can be NOM.[8,9] It has been reported as safe and effective regardless of the grade of hepatic trauma.[10]

We have greatly improved our experience in the management of hepatic trauma during the last 10 years. We shifted to NOM in hemodynamically stable patients regardless of the grade of hepatic injuries resulting in improved survival. In the present study, 97 of the 101 patients with grades I or II injury, and 80 of the 195 patients with grades III, IV, or V injury were treated with NOM, which was successful in 93.2%, with 4.5% mortality. Our data suggest that low-grade hepatic injuries are more suitable for NOM than high-grade injuries.

The main indications for surgery were hemodynamic instability, intra-peritoneal bleeding, biliary complications, and intra-abdominal collections and liver abscess not amenable to percutaneous interventions. For 119 patients, this was dictated by hemodynamic instability or concomitant injuries. In the remaining 12 patients laparotomy was performed after NOM failure. The most appropriate surgical procedures for complex hepatic injury remain controversial.[11] Some surgeons perform aggressive anatomical hepatic resection,[12] whereas others perform damage control surgery, such as perihepatic packing.[13] In most cases, definitive hemostasis can be achieved with simpler surgical techniques, such as suturing, topical hemostats, use of an omental flap or hepatotomy, and selective vascular ligation.[14] Hepatic resection plays a major role in the treatment of severe liver contusion, especially for patients with severe contusions in multiple places, and injuries in bile ducts, hepatic veins, and the inferior vena cava in combination with extensive parenchymal damage.[11] When should one consider resection in a hepatic trauma patient? In our experience, resection was carried out when: 1) findings of massive destruction and devitalized hepatic tissue; 2) massive bleeding related to a hepatic venous injury; and 3) the presence of a major bile leak coming from a proximal, main intrahepatic biliary duct. In our series, perihepatic packing was used in 6 patients who ultimately survived reflecting

the usefulness of this operation as a damage control procedure to stop the vicious circle of uncontrollable bleeding, severe coagulopathy, and hypothermia. There were 29 patients requiring only local hemostasis between January 2003 to October 2006. We found that 80% of those patients stopped bleeding spontaneously during the operation. This evidence prompted us shift to NOM in hemodynamically stable patients regardless of the grade of hepatic trauma.

All hemodynamically stable patients can be managed with NOM with excellent results, while high-grade hepatic injuries often require surgical treatment ranging from packing to complex hemihepatectomy due to hemodynamic instability, or concomitant injuries, which continue to have significantly higher mortality. The adjunctive interventional procedures have expanded the scope of NOM, and will have an increasing role in the future.

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