Role of Liver Resections in Management of Major Hepatic Trauma

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ABSTRACT

Background: *The liver is one of the common organs to be injuried in abdominal trauma. Emergency laparotomy must be done in the patients have major hepatic trauma with hemodynamic instability . Liver resection is one of methods of management of major hepatic trauma.* ***Objective :*** *To assess the role of liver resection in the management of major liver trauma.* ***Patients and methods:*** *Prospective study of forty cases of major hepatic trauma admitted and managed at Trauma Unit, Assiut University Hospitals between (October 2010-May 2015). Follow up every six months for one and half years. The liver injuries were graded according to the criteria published by the American Association for Surgery of Trauma Organ Injury Scaling committee (AAST) based on the most accurate assessment by laparotomy .* ***Results****: Forty patients were explored. Anatomical liver resection done in 8(20%) patients, right hepatectomy in 2(5%) patients, right posterior segmentectomy in 2(5%) patients , left hepatectomy in one (2.5%) patient and left lateral segmentectomy in 3(7.5%) patients. Non anatomical liver resection done in 32(80%) patients. Complications developed in 15(37.5%) patients and mortality of six(15%) patients, four of them died from causes directly related to the liver injury. Two patients died from associated other injuries.* ***Conclusion:*** *Liver resections are effective methods in the management of major hepatic trauma.*

Keywords: *Major hepatic trauma, anatomical liver resection, non anatomical liver resection.*

INTRODUCTION

The liver is the largest solid abdominal organ with a relatively fixed position, which makes it prone to injury . The liver is the most commonly injured organ in abdominal trauma. Road traffic crashes , antisocial and violent behaviors account for the majority of liver injuries [1]. American Association for Surgery of Trauma (AAST) proposed the standard classification of hepatic trauma. According to the classification, level I-II hepatic trauma are called minor hepatic trauma, accounting for 80% - 90% of all hepatic trauma. The hepatic trauma of level III and above is called serious hepatic trauma, with the mortality of 10% , and if patients have multiple injuries, the mortality may be elevated to as high as 25% [2].

The treatment strategies of serious hepatic trauma have been advanced for decades[3]. The clinical experience shows that early diagnosis, accurate assessment, active resistance to shock, optimal treatment plan and the organ function preservation are protective factors to reduce the mortality and enhance the treatment [4]. Introductions for hepatic resections are straightforward despite inability to decide on procedure prior to operation . Major hepatic resection should be considered for any extensive wound of the liver or one in which bleeding cannot be controlled by suture [5].

PATIENTS AND METHODS

I- Patients:

This is prospective study of 40 cases of hepatic trauma admitted and managed at Trauma Unit, Assiut University Hospitals between (October 2010-May 2015). Follow up every six months for one and half years

Inclusion criteria: Patients had major hepatic trauma due to blunt or pentrating trauma with persistent hemodynamic instability, Patients had major hepatic trauma with documented associated other injuries

Exclusion criteria: All the patients with hepatic trauma had conservative management, patients managed by simple hepatorraphy, patients with hepatic trauma died intra operative or in the Emergency department during initial resuscitation.

II- Methods:

A. **Complete evaluation and clinical examination:** All patients underwent initial

care according to the Advanced Trauma Life Support guidelines (ATLS)

B. Radiological evaluation: Plain x-ray (chest, pelvis and cervical spine), abdominal ultrasonography and post-contrast CT scan of the abdomen to assess the severity of liver injury.

C. Surgical technique: in supine position, under general anesthesia, the steps as follow:

1. Incision: Midline incision with lateral extension , Mercedes star incision and J-shaped incision
2. Temporary packing: Following opening of the peritoneal cavity and initial evacuation of blood and clots, four quadrant packing employed to control hemorrhage for 15 minutes and no further attempts made to evaluate the extent of liver injury until adequate volume resuscitation and relevant blood products had been administred. When stable, the packs were gently removed from each quadrant in turn and the injuries carefully evaluated.
3. Vascular control: Pringle maneuver (Inflow control) a blunt dissector passed through the foramen of Winslow and the hepato-duodenal ligament encircled with an umbilical tape. By co-operation between surgeon and anaesthatist, intermittent clamping entails periods of 15-30 min of ischemia followed by 5-15 min of reperfusion.
4. Mobilization of the liver: The liver was mobilized by division of the falciform ligament right and left triangular ligaments, coronary ligament and the round ligament.
5. Exploration of the liver: After mobilization of the liver by division of ligaments, exploration of the liver was done to evaluate liver trauma and state of the liver parenchyma and then evaluate the injured segment which must be resected.
6. Liver resections: Method of resections: Forceps fracture method (conventional technique) or Ligasure Vessel Sealing Method .
7. Technique of resections : Anatomical liver resections were undertaken according to (Couinaud classification) or non anatomical liver resections (resectional debridement)
8. involves the non-anatomical excision of devitalized liver tissue along the lines of the previous injury. Identifying and ligating or repairing segmental bile ducts to avoid subsequent bile leak.
9. The liver resection was accomplished using crush-clamp dissection of liver parenchyma (conventional technique), or by using Ligasure Vessel Sealing System. In conventional liver resections, the liver parenchyma was crushed using Kelly forceps, residual tissue was ligated with 4-0 Vicryl or sealed by electric cautery. In the Ligasure liver resections, the liver parenchyma was dissected by Ligasure. The glissonian sheaths or hepatic veins with diameter up to 7 mm were sealed and divided by the Ligasure. Central venous pressure was maintained below 5 cm H2O during resection to reduce venous back – bleeding
10. Repair of Caval Injuries in three patients.
11. Blood transfusion: for all patients range from (1 – 8) units.
12. Drains: Two tube drains; the first at hepato-renal pouch, the second at the pelvis were inserted.
13. Closure of the wound :The end step of the operation was closure of the wound in layers.

D. Post-operative Parameters : Patients were admitted to the intermediate care unit, and monitored as regard vital signs, drains, (100 ml per hour blood is considered active bleeding), 24 hours later after stabilization of general condition, the patient was transferred to the ward .

Documented post-operative parameters consisted of post-operative results of liver enzymes on 1^{st}, 3^{rd}, and 7^{th} day after surgery, duration of hospital stay after surgery, clinically relevant complications and post-operative morbidity & mortality

E. Ethical Consideration: Approval from medical ethical committee of Assiut faculty of medicine was taken. Written consent (for inclusion in the study) was signed by each patient or his/her relatives.

F. Statistical analysis: Statistical analysis was performed with SPSS" ver. 21" Chicago.

USA. Data expressed as mean, Standard deviation and number, percentage. Chi. Square was used to determine significance for categorical variable.

RESULTS

This study included 40 patients with major hepatic trauma. Among 40 patients enrolled in this study, 29(72.5%) were males and 11(27.5%) were females. The mean age was 31.75± 18.55 years, range (3 : 75) years.

Mechanism of injury:

The mechanism of abdominal trauma was blunt trauma in 30(75%) patients that was included motor car accidents in 18(45%) patients, fall from height in 7 (17.5%) patients and heavy trauma to the abdomen in 5(12.5%) patients. Penetrating trauma in 10(25%) patients that was included firearm injuries in 7(17.5%) patients and stab wounds in 3(7.5%) patients

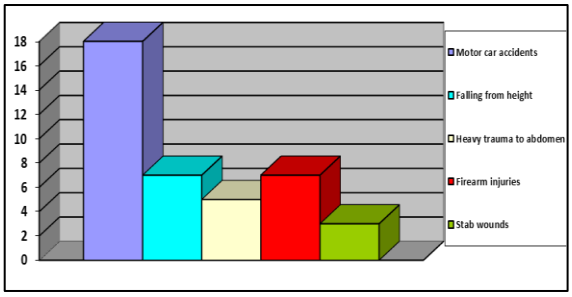

Fig 1. Mechanism of injury

Clinical assessment:

33(82.5%) patients presented with shock on admission. On clinical examination, 7(17.5%) patients had generalized abdominal rigidity.

Diagnostic modalities:

US examination to the abdomen was performed in all cases (40) patients. it was highly sensitive in detecting hemoperitoneum (100%). CT examination of the abdomen with IV contrast was performed in 19 hemodynamically stable patients. Comparing the pre-operative CT with the intra-operative findings showed that CT accurately graded the injury in 9 (47.4%) patients, overestimated it (mostly by one grade) in 6 (31.6%) patients and underestimated the grade (mostly by one grade) in 4 (21%) patients.

Grading of liver injuries:

The liver injuries were graded according to the criteria published by the American Association for Surgery of Trauma Organ Injury Scaling committee (AAST) based on the most accurate assessment by laparotomy . 10 (25%) injuries were grade III, 17 (42.5%) injuries were grade IV and 13(32.5%) injuries were grade V **.**

Site of the liver injury:

The right lobe of the liver was injured in 23 (57.5%) patients and the left lobe in 17 (42.5%) patients.

Surgical procedures:

Forty patients were explored. Two surgical procedures performed for the injured livers included : Anatomical liver resection in 8 (20%) patients. Non anatomical liver rescetions (resectional debridment) in 32 (80 %) patients.

Table (1) : Types of surgical procedures

Types of liver resections	Patients (percent)	Sub-types of liver resections	Patients (percent)
Anatomical liver resection	8 (20%)	Right hepatectomy	2 (5%)
		Right posterior segmentectomy	2 (5%)
		Left hepatectomy	1 (2.5%)
		Left lateral segmentectomy	3 (7.5%)
Non anatomical liver resection	32 (80%)	Segments (VI, VII)	7 (17.5%)
		Segments (VI, VII, VIII)	11(27.5%)
		Segments (V,VI,VII , VIII),	1 (2.5 %)
		Segments (II, III)	8 (20 %)
		Segments (II, III, VI)	5 (12.5%)

IVC repair: 3 patients of IVC repair , two patient repair in infra hepatic part of IVC . one patient repair in supra hepatic part of IVC.

Peri hepatic packing: 2 patients had damage control surgery re-operated after 24 hours, 6 patients had peri-hepatic pack after liver

The mean operative time 134.25± 41.99 minutes. range (80 : 280) minutes. All the patients received blood transfusion range from (1 : 8) unit**.** Hospital stay: range from (2 : 30) days.

Associated injuries: in 18 (45%) patients.

Table (2) : Associated injuries

Injuries	Patients (%)
Splenic injuries	3 (16.7%)
Bowel injuries	4 (22.2%)
thoracic injuries	4 (22.2%)
Orthopedic injuries	4 (22.2%)
Head injuries	3 (16.7%)
Total	18 (100%)

Post operative complications:

15 (37.5%) patients developed post-operative complications. Hyperbilirubinemia appeared in one patient and resolved spontaneously within few days. Post-operative internal hemorrhage occurred in 2 patients due to coagulopathy. 4 patients developed biliary leakage three resolved spontaneously and one resolved after ERCP. Inferior vena cava (IVC) thrombus with partial obstruction of the venous return occurred in one patient with injury to the IVC that was repaired. The patient survived but suffered from bilateral lower limb oedema. The condition of the patient improved 3 months later after recanalisation of the thrombus as evidenced by Duplex imaging. 2 patients developed abdominal abscesses resolved by percutanous drainage . one patient developed pneumonia resolved by medical treatment.

Table (3) : Post operative complications.

Post-operative complications	Patients (%)
Post-operative wound infections	4 (26.6%)
Biliary fistula	4 (26.6%)
Post-operative internal hemorrhage	2 (13.3%)
Abdominal abscesses	2 (13.3%)
IVC thrombus	1 (6.7%)
Hyperbilirubinemia	1 (6.7%)
Pneumonia	1 (6.7%)
Total	15 (100%)

Patient's outcome:

Six (15%) patients died, four of them died from causes directly related to the liver injury as post-operative disseminated intravascular coagulation. Two patients died from causes not related to liver injury (from associated injuries) .

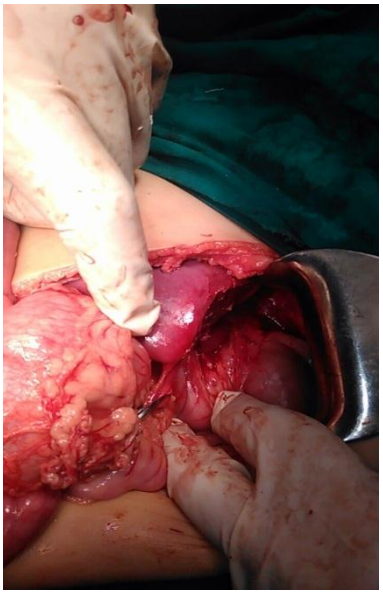

Fig 2. Anatomical liver resection

DISCUSSION

Although it is protected by the costal cage, the liver is the most frequently injured intra-abdominal organ in abdominal trauma [6]. Associated organ injuries, uncontrollable bleeding and subsequent septic complications continue to pose life-threatening challenges for the surgeons [7,8]. In our study, out of 40 patients with major hepatic trauma 29 (72.5%) patients were males and 11(27.5%) patients were females. the mean age 31.75±18.55 years, range (3–75 years). This agree with *Zargar M, Laal M* who reported that , Out of 84 patients with hepatic injury, 68(81%) patients were males and 16(19%) were females. The average age was 23.8 ± 14.4 years (range 3-67), and the male-to-female ratio was 3.9:1 [9].

Thiago M. reported the high incidence of liver trauma in this young age group can be attributed to the high activity and lack of wisdom and experience present in this age group [10].

As regard to the etiology, in our study , blunt trauma in 30 patients (75%) that was included motor car accidents in 18(45%) patients, fall from height in 7(17.5%) patients and heavy trauma to the abdomen in 5(12.5%) patients. Pentrating trauma in 10 patients (25%) that was included firearm injuries in 7(17.5%) patients and stab wounds in 3(7.5%) patients. *This agree with Reddy, et al.* that reported liver injuries encountered in their series were due to road traffic accidents in heavy motor vehicles were 54 (54.0%). And due to fall from a height in 6% of their patients [11]. *And also agree with Zargar M, Laal M* who reported, Most hepatic trauma patients had blunt injury 63(75%). Fifty-three (63.1%) were due to MVCs including car drivers, pedestrians and motorcycles. Non-traffic causes including falls and bicycles were the etiology in 10(11.9%) patients of blunt hepatic trauma. Penetrating injuries 21(25%) included: knives, gunshot and others [9].

In our study, it was found that US examination was 100% sensitive in detecting hemoperitoneum, CT examination of the abdomen with IV contrast was performed in 19(47.5%) hemodynamically stable patients. Comparing the pre-operative CT with the intra-operative findings showed that CT accurately graded the injury in 9(47.4%) patients, overestimated it (mostly by one grade) in 6(31.6%) patients and underestimated the grade (mostly by one grade) in 4(21%) patients. *This disagree with Taourel et al* . assigned at operation a liver injury scale to each case and this was correlated to the pre-operative CT findings. They found accurate estimation in 6(16%) patients out of 37 blunt hepatic trauma, overestimation in 51% and underestimation in 33% [12].

As regard grading of liver trauma, in our study, we found that grade IV was the commonest grade of liver injury 17(42.5%) patients, followed by grade V in 13(32.5%) patients and grade III in 10 (25%) patients. This disagree with *Schweizer et al.* found that grade IV was the commonest grade of liver injury in their study including 175 patients, this was followed by grade I in 26% and grade II or III in 22% of the cases [13].

As regard to liver resection, in our study, we found that, anatomical liver resection done in 8(20%) patients , right hepatectomy 32 patients. *This agree with Michael J. et al.* reported that , there were resectional debridement was the most common form of resection employed and was performed in 35 patients. (14) patients grade VI , (21) patients grade V. Anatomic hepatic resections done in 7 patients [14]. *And also agree with Jing-mou Gao, et al.* reported that, There were 14 anatomic hepatic resections (all cases were grade V) including right hemihepatectomy (9), left hemihepatectomy (1), left lateral segment resection (1), and segmentectomy (3) . 25 debridemental resections were done , Grade V (12) , grade IV (9) and grade III [15].

As regard the associated injuries, *In our study* , we found associated injuries in 18 (45%) patients, GIT injuries in 4 patients, splenic injuries in 3 patients , thoracic injuries in 4 patients, Orthopedic injuries in 4 patients and head injuries in 3 patients. *This disagree with Zargar M, Laal M* reported that , associated traumas 66(78.6%) included both intra and extra-abdominal injuries. Spleen trauma was the most common associated injured organ seen in 46 (54.8%) patients [9].

As regard the complications, in our study we found, 15(37.5%) patients developed post-operative complications. *This agree with Krige JE et al.* reported that, complications occurred in 151 of 392 survivors (38.5%) [16].

As regard mortality rate, in our study we reported, there were six patients (15%) died, four of them died from causes directly related to the liver injury as post-operative irreversible shock and/or disseminated intravascular coagulation . Two patients died from causes not related to liver injury (from associated injuries). *This agree with Helling TS, et al.* who reported that, mortality rate is 10-15 percent [17]. *And also Doklesti_c K, et al.* repoted that, the hepatic trauma of level III and above is called serious hepatic trauma, with the mortality of 10%, and if patients have multiple injuries, the mortality may be elevated to as high as 25% [2].

CONCLUSION

Major hepatic trauma patients with hemodynamic instability require surgical intervention. liver resections are effective methods in management of major hepatic trauma. Non anatomical resection (resectional debridement) is recommended when there is unviable parenchyma. Anatomical resection is

generally reserved for a devascularised lobe with a major ductal injury.

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