Liver Injury After Blunt Abdominal Trauma: Role of Nonoperative Management

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Nonoperative management is presently considered the treatment modality of choice for hemodynamically stable patients sustaining blunt liver trauma. This report describes the outcome of nonoperative management decided for forty (40) patients who sustained blunt liver injury. Those patients were admitted to the Surgical Department atof Al-Adan Hospital in Kuwait between January 1997 and December 2003. Thirty six males (90%) and four females (10%), aged 4 – 63 years (average age 31.9 years), sustained blunt abdominal trauma due to different accident mechanisms but mostly (75%) due to road traffic accidents. According to the American Association for the Surgery of Trauma – computerised axial tomography grading of liver injury, there were 7 cases of grade _ (17.5%), 17 cases of grade _ (42.5%), 12 cases of grade _ (30%), and 4 cases of grade IV injuries (10%). Blood transfusion units needed ranged between 0 – 5 units with an average of 1.075 units/ patient. Length of hospital stay was 7 to 30 days with an average of 12.625 days. No mortality in our series and three cases (7.5%) required operative intervention, two of which were operated on within the first 24 hours of admission for bleeding. A Rt. thoracotomy for hemothorax and ruptured diaphragm in one case and a laparotomy for ruptured spleen in the other case. The third case was operated on for a small bowel injury diagnosed three days after admission. One case (2.5%) developed perihepatic abscess ten days after admission and was treated successfully by percutaneous drainage. Nonoperative management of blunt liver trauma is safe, effective, and is clearly the treatment modality of choice in hemodynamically stable patients. Failure of nonoperative management in our series was due to associated other injuries and not the liver.

Introduction

Pediatric surgeons were the first to demonstrate that the liver is capable of not only spontaneous hemostasis but also spontaneous healing. The initial report on conservative management of blunt liver injury in four pediatric patients was published in 1972 by Richie and others. Since then several other published studies have supported this approach, which has become the treatment of choice for stable patients of all ages with blunt liver injury . .

Before considering nonoperative management of blunt hepatic injury, the following criteria must be met:

1) Hemodynamic stability
2) No demonstrable peritoneal signs on abdominal examination

3) The absence of any intraperitoneal or retroperitoneal injuries on computerised Axial tomography scans requiring operative intervention

We consider that only hemodynamic instability, rather than grade of injury, hemoperitoneum, or the presence of associated injuries, is a reliable predictor of the failure of nonoperative management. However several recent studies have recognised that active extravasation of intravenous contrast, which often is referred to as a blush, noted on computed tomography may predict early or late failure of nonoperative therapy for blunt liver injuries.

Patients and Methods:

From January 1997 till December 2003 forty patients who sustained blunt liver trauma as detected by computerised Axial Tomography Scanning were selected for nonoperative management. There were thirty six males (90%) and four females (10%) with aged 4 – 63 years – an average age of 31.9 years - were involved in different accident mechanisms with road traffic accidents were responsible for 75% of the injuries (Table I).

Mechanism of Accident	No. of patients
Road traffic collision	24 (60%)
Pedestrian struck	
By motor vehicle	6 (15%)
Fall from Height	6 (15%)
Trauma by heavy object	1 (2.5%)
Jet ski trauma	1 (2.5%)
Buggy accident	1 (2.5%)
Horse kick	1 (2.5%)

Table 1

Patients who presented shock symptoms, signs of peritonitis, or ongoing hemorrhages were not considered candidates for nonoperative management. All patients underwent thorough emergency evaluation on admission according to the guidelines of Advanced Trauma Life Support. Ultrasound abdominal scan is routinely done for patients who sustain blunt abdominal trauma in the Resuscitation Room. Hemodynamically stable patients are then transferred to do abdominal Computerised Axial Scan which is performed after administration of both oral and intravenous contrast. All injuries were then stratified by grade of hepatic injury, as outlines in the liver injury scale devised by the American Association for the Surgery of Trauma (Table II). Quantification of the degree of hemoperitoneum on computerised scan is based on the seven intraperitoneal spaces described by Federle and Jeffrey, with each space having the capacity to maintain a minimal volume of 125 ml. Knudson and others further categorised intraperitoneal fluid collection as small, moderat, and large (Table III).

All patients were admitted to the surgical intensive care unit for at least the first 24 - 48 hours. Vital signs were moni-

Grade *	Type of Injury	Description of Injury
–	Hematoma	Subcapsular, <10% surface area.
	Laceration	Capsular tear,< 1 cm parenchymal depth.
–	Hematoma	Subcapsular,, 10% to 50% surface area or intraparenchymal, < 10 cm in diameter.
	Laceration	1-3cm parenchymal depth, less than 10cm in length .
–	Hematoma	Subcapsular,>50% surfac area, expanding ruptured subcapsular or parenchymal hematoma with active bleeding, or intraparenchymal hematoma >10cm or expanding.
	Laceration	> 3 cm depth
IV	Laceration	Parenchymal disruption involving 25% to 75% of hepatic lobe or one to three Couinaud segments within a single lobe.
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe or more than three Couinaud segments within a single lobe .
	Vascular	Juxtahepatic venous injuries; ie, retrohepatic vena cava/major hepatic veins.
VI	Vascular	Hepatic avulsion

* Advance one grade for multiple injuries .

* Quoted from Moore and others. (15)

Table 2 - American Association of the Surgery of Trauma Organ Injury Scaling: Liver

7 Intraperitoneal Spaces:	
Right subphrenic	1-2 spaces – small (250 cc)
Right Subhepatic	2-4 spaces – Moderate (250-500cc)
Left Subphrenic	> 4 space – Large (>500 cc)
Left Paracolic	
Right Paracolic	
Pelvis (Paravesicular spaces)	
Intramesenteric	

* Quoted from Knudson and others. (9)

Table 3 - Method of estimating intraperitoneal blood

Figure 1 *- Grade I liver injury with small amount of hemoperitoneum in 45 years old male patient.*

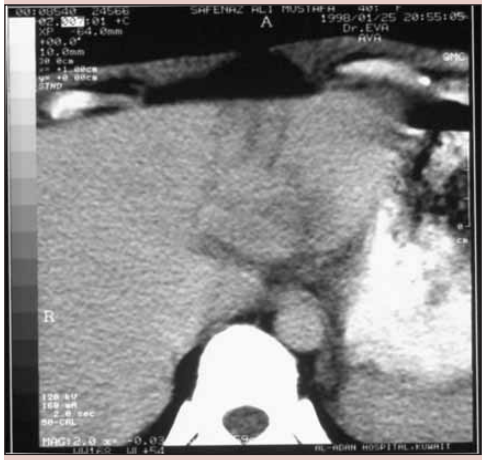

Figure 2 *- Lt. Lobe hepatic contusion in 40 years old lady.*

tored hourly and serial hemoglobin level and hematocrits were measured every 6 hours. Repeated abdominal computerised tomography scans were performed at various intervals depending on the patient's condition.

Results:

The initial physical examination detected abdominal tenderness in thirty four patients (85%), while six patients (15%) had unremarkable abdominal findings. There was elevated serum alanine transaminase (ALT) and aspartate transaminase (AST) in 30 cases (75%), but returned to normal levels within a week in most of the cases. Elevated bilirubin was detected in 12 cases (30%) and serum albumin was low in 16 cases (40%).

Associated injuries are listed in Table IV, most commonly involving the chest.

No free intraperitoneal fluid detected in four cases (10%), small amounts in 9 cases (22.5%), moderate amounts in 20 cases (50%) and large amounts in 7 cases (17.5%) according to Knudson classification.

According to the American Association of Surgery of Trauma's Computerised Scan grading of liver injury, there were as follows 7 cases of Grade I (17.5%), 17 cases of Grade II (42.5%), 12 cases of Grade III (30%) and 4 cases of Grade IV (10%).(Figures 1-8).

Blood transfusions were given to 16 of the 40 patients during their hospital stay (Table V). No patient in our series was

Injury	Number of the patients
Fractured right lower ribs	32 (80%)
Right hemo-pneumothorax necessitated chest tube	6 (15%)
Splenic injury	4 (10%)
Right kidney injury	3 (7.5%)
Fractured pelvis	4 (10%)
Fractured long bones	4 (10%)

Table 4 - *Associated Injuries*

Number of Patients	Units transferred
24 cases	No transfusion needed
3	One unit/patient
5	Two units/patient
4	Three units/patient
2	Four units/patient
2	Five units/patient

Table 5 - *Blood Transfusion Units given*

felt to have ongoing hemorrhage from the liver requiring transfusions. The associated injuries that likely contributed to blood loss in transfusion group were mainly hemothorax, fracture pelvis, and extremity fractures. Average number of transfusions was 1.075 unit/patient.

The length of intensive care unit stay was 1-14 days with an average of 2.95 days. The length of hospital stay was 7-30 days with an average stay of 12.625 days.

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Figure 3 *- Grade II liver laceration in 15 years old male patient.*

Figure 4 *- Horse kick to 20 years old male ,resulted in grade III liver injury.*

There was no mortality in our series and three cases (7.5%) required operative intervention. Two cases were operated on within 24 hours from admission for bleeding. In one case, an Rt. thoracotomy was done for hemothorax and ruptured Rt. Copula of diaphragm. In the second case a laparotomy was done for ruptured spleen for which a splenectomy was done. The third case was operated on for a small bowel injury diagnosed three days after admission,(Figure 9) and for which resection and anastomosis was done and passed an uneventful postoperative course. One case (2.5%) developed perihepatic abscess ten days after admission and was successively treated by percutaneous drainage.

Reports in the early 1970's detailing the successful nonoperative management of patients sustaining blunt hepatic injuries were for the most part ignored

Figure 5 *- Grade III liver injury in eight years old girl , No hemoperitoneum detected in CT.*

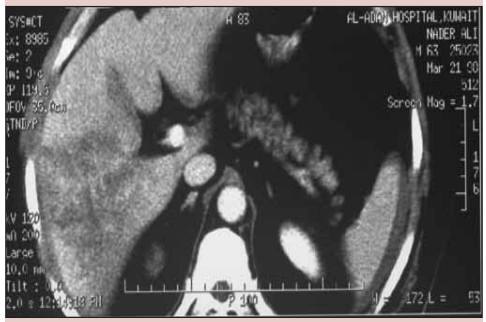

Figure 6 *- Grade IV liver injury in four years old boy.*

Discussion

Pringle, in his 1908 classic paper on Liver injuries, has inadvertently misled subsequent generations of surgeons into believing that significant lacerations of the Liver would continue to bleed because the structural integrity of the Liver was incapable of achieving spon-

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taneous hemostasis. As late as 1977, operative intervention was considered the only acceptable treatment of blunt hepatic injuries. Reports in the early 1970's detailing the successful nonoperative management of patients sustaining blunt hepatic injuries were for the most part ignored. The technological breakthrough in radiologic imaging techniques specially in the field of computerised Axial Tomography Scans were principally responsible for the subsequent change in surgical philosophy. Advanced high-speed Computerised Tomography scanners were able to not only delineate the severity of hepatic injury and quantitate the degree of hemoperitoneum, but it could also provide a reliable evaluation of the gastrointestinal tract and retroperitoneal structures.

The weakness of nonoperative management of blunt hepatic injuries is the possibility of missing an associated intraabdominal injury

The additional realisation that up to 67% of all operations performed for blunt traumatic abdominal injuries have been nontherapeutic, as well as a substantial body of literature confirming that as many as 86% of all hepatic injuries have already stopped bleeding at the time of surgery and in combination with the recent successive studies which revealed a high success outcome of nonoperative management for blunt liver trauma reaching above 90% in most published reports, suggested that nonoperative management of stable patients with blunt hepatic injuries should be considered the treatment modality of choice.

The two major objections to routine nonoperative management of blunt hepatic injuries - the unnecessary use of excessive blood transfusion and the prolonged length of stay - have never materialised . Pachter and others report of multicenter (14 institutions) experience with 495 patients and croce and others report documented mean transfusion rate 1.9 unit/ patient . In our series the mean transfusion rate was 1.075 unit/patient . Similarly, the length of stay for patients treated nonoperatively did not prove to be excessive. Mean hospital stay in reports by pachter and others, with 495 and 404 patients in two successive studies was 13 days. In our series the mean hospital stay was 12.625 day. In instances where in comparable groups of patients underwent operative intervention, three authors (Boone and others, Sherman and others, and Meredith and others,) noted that intensive care unit stay and mean length of hospitalisation for these patients were either comparable or exceeded that of patients managed nonoperatively.

The weakness of nonoperative management of blunt hepatic injuries is the possibility of missing an associated intraabdominal injury. The rate of missed injuries in published literature is about 3% mainly being small bowel injury and diaphragmatic tear. In our series there were two cases of missed injuries (5%). One case suffered from a ruptured right copula of the diaphragm and the other case suffered from a small bowel injury, but there was no significant influence on the morbidity nor the hospital stay. The risk of missed injuries should not influence the decision to undertake nonoperative management in suitable candidates.

Less common complications such as bilomas and perihepatic abscesses can almost always be treated by percutaneous drainage.

Conclusion

Nonoperative management of blunt liver injury is safe, effective, and clearly the treatment modality of choice in hemodynamically stable patients.

Failure of nonoperative management in our series was due to associated other injuries and not the liver.

Figure 7 *- Grade IV liver injury with moderateamount of hemoperitoneum in 14 years old boy.*

Figure 8 *- 32 years old male patient struck by a car with grade IV liver injury and abluch with large amount of hemoperitoneum.*

Figure 9 *- I6 years old girl involved in RTA with grade II liver injury and bowel injury .*