ORIGINAL ARTICLE

MANAGEMENT OF BLUNT LIVER INJURIES: ROLE OF THE CONSERVATIVE APPROACH.

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ABSTRACT: Abdominal CT scanning makes non-operative management of liver injury possible. We reviewed medical records of 112 blunt trauma patients with heeatic injury who received initial abdominal CT scan. We examined: 1) Indications for delayed surgery, 2) Disposition or cause of death, 3) Results of follow-up CT scans, 4) Long-term complications. Over a 5-year period, 1397 patients were admitted for blunt trauma, of which 152 patients were found to have hepatic injury. Forty patients presented either clinically unstable or with an acute abdomen and underwent diagnostic peritoneal lavage or immediate laparotomy without a CT scan. Abdominal CT scan was performed on 112 patients, 38 of whom had hepatic injury or associated major abdominal injury and underwent laparotomy. Two patients died of cardiac arrhythmias following CT scanning. The remaining 72 patients received initial non-operative management of their hepatic injury. Six patients in this group underwent delayed abdominal surgery. Four developed acute abdomen. Two had planned nephrectomies. No patient required surgical treatment of the liver injury at the time of laparotomy. Eight deaths occurred in the 72 patients managed non-operatively, all due to associated extra-abdominal injuries. Thirty-eight patients had 54 CT scans taken as follow-up examination at intervals of 1 to 94 days post-injury. All of the CT scans showed stabilisation or improvement of hepatic injury. Six patients who had CT scans taken at 3 months post-discharge were asymptomatic, with radiological resolution of their hepatic injury. Thirty-eight patients were followed for an average of 61.8 days (range 7-203 days) after discharge with no complications from liver injury. We conclude that non-operative management of blunt hepatic injury is an appropriate option in selected patients, and that long-term follow up CT scans may not be necessary in asymptomatic patients. (*JUMMEC 1996 1(2): 43-48*)

KEYWORDS: Liver, blunt trauma, non-operative

Introduction

The liver is the most frequently injured abdominal organ following blunt trauma. Major hepatic injury accounts for significant mortality, usually due to severe hemorrhage (1,2). Many hepatic injuries found at laparotomy are not actively bleeding and require no operative treatment (2-5). Abdominal CT scanning plays an increasing role in the initial evaluation of the haemodynamically stable patient with blunt abdominal trauma. CT scanning allows the specific diagnosis of many abdominal injuries which otherwise would go undetected, or would require laparotomy to rule out life threatening injuries. Many authors advocate non-operative management of selected groups of clinically stable patients with isolated hepatic injury diagnosed by CT scan (1,3,6-11).

In order to evaluate the outcome of non-operative management of blunt hepatic trauma and the role of CT scanning in the initial evaluation, we retrospectively reviewed 112 patients with blunt abdominal trauma who had hepatic injury diagnosed by an initial CT scan.

Methods

The in-patient records at the University Hospital Kuala Lumpur, Malaysia were reviewed for all blunt trauma patients with hepatic injury admitted to the surgical wards from January 1991 to December 1995. We examined indications for delayed surgery, disposition or cause of death, results of follow-up CT scans, and long-term complications.

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The severity of the liver injury was classified according to a useful classification developed by Shackford and colleagues (American Association for the Surgery of Trauma - Hepatic Injury Scale - Table 1)(14).

Table 1. Management classification for civilian hepatic trauma (Shackford)

Grade	Liver injury*
I	Capsular avulsion Parenchymal fracture < 1 cm deep
II	Parenchymal fracture 1-3 cm deep Subcapsular haematoma < 10 cm deep Peripheral penetrating wound
III	Parenchymal fracture > 3 cm deep Subcapsular haematoma > 10 cm in diameter Central penetrating wound
IV	Lobar tissue destruction Massive central haematoma
V	Retrohepatic vena cava injury Extensive bilobar disruption

* CT scan is used to obtain a pre-operative estimation of the injury grade. The liver injury is usually obvious following inspection or palpation at laparotomy. Capsular tears, minor parenchymal tears, simple stab wounds and low velocity gunshot wounds constitute well over half of all liver injuries and most have stopped bleeding by the time of exploration. If still oozing, capsular injuries can be controlled by mild direct pressure, with or without suturing, or by electrocautery. Sometimes topical haemostatic agents such as microfibrillar collagen may be helpful. Post-operative drainage is unnecessary for these superficial injuries except when the degree of injury present suggests a distinct possibility of post-operative bleeding or bile leak, in which case closed suction drainage is instituted and maintained as long as drainage occurs. The surface of most of these injuries should not be tightly closed, as pocket of blood or bile may collect and result in an intrahepatic abscess or subsequent haemobilia. However, in more severe cases, resection (either segmentectomy or hepatectomy) may be required to remove crushed liver tissue. Packing of the bleeding liver tissue (for 24-48 hours) is advised in the severely compromised patient, to achieve haemodynamic stability and correction of coagulopathy. Re-exploration and definitive procedure is performed when the patient has been stabilised.

Results

Over a 5-year period, a total of 1397 patients were evaluated by the trauma service following blunt trauma. One hundred and fifty-two of these patients were found to have hepatic injury. Forty patients presented with hypotension (systolic blood pressure less than 100) or had acute abdominal findings and underwent diagnostic peritoneal lavage or immediate laparotomy without a CT scan. The majority of these patients (77.5%) had grade IV liver injuries noted at laparotomy (Table 2). The remaining 112 patients received an abdominal CT scan as part of their initial evaluation (Table 3). Thirty-eight of these patients (33.9%) underwent immediate laparotomy based on hepatic injury, associated intra-abdominal injury, or large haemoperitoneum diagnosed by CT scan (Table 4). The liver injuries of these patients were estimated to be of grade III by pre-operative CT scan. However, in 16 patients (42.1%), the liver injuries were found to be more severe intra-operatively (grade IV) than estimated by CT scan. Twenty-three out of the 38 patients (60.5%) who underwent immediate laparotomy had liver resections (Table 4).

Two patients died in the emergency department from cardiac arrhythmias. The remaining 72 patients received initial non-operative management of their hepatic injury. The liver injuries in this group were either grades I or II (Table 3). Thirty-four males and 38 females made up this group, with a mean age of 31 years. The most common cause of trauma was a motor vehicle accident (Table 5). All but two of the 72 patients treated non-operatively had at least one major associated injury (Table 6). The most common extra-hepatic injuries were extremity fractures (40 patients), closed head injury (36 patients), and rib fractures (24 patients). Six patients in the non-operative group underwent delayed abdominal surgery at 48-72 hours later. Four developed an acute abdomen, and two had a planned nephrectomy (for persistent gross haematuria with decreasing haemoglobin level). No patient required surgical treatment of the liver injury at the time of laparotomy. Two of the four patients with an acute abdomen underwent cholecystectomy, and the other 2 had a negative laparotomy. Eight of the 72 patients managed non-operatively had died, each due to associated injuries (4 had died secondary to severe head injury, and 4 succumbed to respiratory failure). No patient had died as a result of the liver injury.

In the non-operative group (n=64 patients who survived), only 38 patients (59.4%) returned for follow-up (The remaining 26 patients were either from other states, uncontactable at their given addresses or had follow-ups at other hospitals). All these patients had 54 follow-up CT scans at intervals of 7 to 94 days post-discharge. All of the CT scans showed stabilisation or improvement of hepatic injury. Six patients who had CT scans at 3 months post-discharge showed complete radiological resolution of their injury. Of the 64 patients discharged from the hospital, 50 were discharged home, 8 were transferred to an acute rehabilitation facility, 4 were transferred to another hospital, and 2 left against medical advice. Thirty-eight patients were seen in follow-up, an average of 61.8 days (range 7-203 days) after discharge, with no long-term complications from liver injury.

Table 2. Intra-operative liver injuries noted in haemodynamically unstable patients (N=40) who underwent immediate laparotomy without a CT scan.

Liver injury (patients in subgroup)	Grade*	Number of patients
Parenchymal fracture > 3 cm deep (11) Subcapsula haematoma > 10 cm (20)	III	7 (17.5%)
Lobar tissue destruction (6) Massive central haematoma (1)	IV	31 (77.5%)
Retrohepatic vena cava injury	V	2 (5.0%)

*According to Shackford *et al* 1989(14)

Table 3 CT scan findings of 112 patients with liver injuries.

Liver injury (patients in subcatogery)	Grade*	Number of patients
Capsular avulsion (34) Parenchymal fracture<1cm (10)	I	44
Parenchymal fracture 1-3cm (6) Subcapsular haematoma<10cm (24)	II	30**
Parenchymal fracture >1-3cm (10) Subcapsular haematoma >10cm (15) Central penetrating wound (13)	II	30**

*Injury grade by CT scan estimation

**2 patients died of cardiac arrhythmias after CT scan

***These 38 patients underwent laparotomy after initial CT evaluation (Details in Table 4)

Table 4. Details of 38 patients who underwent laparotomy after initial CT scan evaluation.

Patient	Haemoperitoneum*	Associated injuries	Operative grade of liver injury	Liver operation
Parenchymal fracture (n=10)**				
1	++	Splenic tear	Same as CT	Suture
2	++	Perforated stomach	"	Suture
3	+++	Splenic tear	"	Suture
4	+	Splenic tear	"	Suture
5	+++	-	IV (Lobar tissue destruction)	(L) lateral segmentectomy
6	+++	Bowel perforation	IV (Massive central haematoma)	Resection segments V-VI
7	++	Splenic tear	Same as CT	Suture
8	+++	Perforated stomach	V (Lobar tissue destruction)	Resection segments VII-VIII
9	++	Splenic tear	Same as CT	Suture
10	++	Bowel perforation	Same as CT	Suture
Subcapsular haematoma (n=15)**				
11	+++	-	IV (Massive central haematoma)	Resection segments VI-VII
12	+	Bowel perforation	Same as CT	Nil (haematoma intact)
13	+++	Duodenal tear	Same as CT	Nil (haematoma intact)
14	+++	-	IV (Lobar tissue destruction)	(L) lateral segmentectomy
15	++	Splenic tear	Same as CT	Suture
16	+++	-	IV (Massive central haematoma)	Resection segments VI
17	+	Splenic tear	Same as CT	Nil (haematoma intact)
18	+++	-	IV (Lobar tissue destruction)	(L) lateral segmentectomy
19	+	Bowel perforation	Same as CT	Nil (haematoma intact)
20	++	Bowel perforation	Same as CT	Nil (haematoma intact)
21	++	Duodenal tear	Same as CT	Suture
22	++	Splenic tear	Same as CT	Suture
23	+++	Splenic tear	Same as CT	Suture
24	+++	Splenic tear	Same as CT	Suture
25	+++	Splenic tear	Same as CT	(L) lateral segmentectomy
Central penetrating wound (n=13)**				
26	+++	Splenic tear	Same as CT	Nil (haematoma intact)
27	+++	-	IV (Lobar tissue destruction)	(L) lateral segmentectomy
28	+++	-	IV (Lobar tissue destruction)	(L) lateral segmentectomy
29	+++	-	IV (Massive central haematoma)	Resection segments VI-VII
30	+++	Bowel perforation	Same as CT	Suture
31	+++	Perforated stomach	Same as CT	Suture
32	+++	Perforated stomach	Same as CT	Suture
33	+++	-	IV (Massive central haematoma)	Resection segments V-VI
34	++	-	IV (Massive central haematoma)	Resection segments V-VI
35	+++	-	IV (Lobar tissue destruction)	(L) lateral segmentectomy
36	+++	-	IV (Lobar tissue destruction)	(L) lateral segmentectomy
37	+++	-	IV (Lobar tissue destruction)	(L) lateral segmentectomy
38	+++	-	IV (Lobar tissue destruction)	Resection segments V-VI

*Haemoperitoneum – mild (+), moderate (++), large (+++)

**3 types of grade III liver injuries (n=38) noted at initial CT evaluation prior to laparotomy

Table 5. Group Characteristics

	Non-operative group	Total blunt trauma patients
Male:Female	1:1 (34/38)	3:1 (1048/349)
Mean Age	31(4-91 years)	34(0-94 years)
Causes		
Motor vehicle accident	64	823
Pedestrian	2	154
Fall	2	228
Others	4	326

Table 6. Associated Injuries

Chest (26 patients with 54 injuries)	
Hemo/pneumothorax	14
Flail chest/Rib fractures	24
Pulmonary contusion	6
Myocardial contusion	6
Sternal fracture	4
Abdomen (22 patients with 26 injuries)	
Renal injury*	14
Spleen injury	6
Duodenal injury (<1cm haematoma)**	2
Gallbladder injury**	2
Adrenal injury	2
Head or Spine (42 patients with 48 injuries)	
Closed head injury	36
Spine fracture	8
Facial fracture	4
Orthopaedic (46 patients with 54 injuries)	
Pelvic fracture	12
Extremity fracture	40
Shoulder dislocation	2
Soft Tissue (6 patients with 6 injuries)	
Complex laceration	4
Full thickness burn	2

*2 patients with renal injury had nephrectomies due to persistent gross haematuria

**These 4 patients underwent laparotomy for acute abdomen

Discussion

Hepatic trauma is responsible for significant mortality and morbidity among blunt trauma patients. Life-threatening liver injuries include large stellate fractures in the liver parenchyma, injuries involving the hepatic veins, retrohepatic vena cava, or vessels of the porta hepatis. These injuries can result in rapid exsanguination. However, subcapsular and intra-hepatic haematomas or simple lacerations are usually associated with little blood loss and may be managed non-operatively (2-5). Many workers advocate non-operative management of selected patients with liver lacerations found on CT scan (1,3,6-11). Selective non-operative treatment of liver laceration in children has been successful in the last few years(12) and is now becoming more popular in adult trauma. However, when management is non-operative, there is increased risk of delayed detection of associated abdominal injuries, primarily bowel perforation, that might not be revealed by CT scan. Therefore, some workers still advocate diagnostic peritoneal lavage (DPL) as the method of choice in evaluating abdominal trauma(13).

In the stable patient, the CT scan offers advantages over DPL. The CT scan is rapidly available, non-invasive and reveals the extent of hepatic and other abdominal injuries. It can define the extent of a haemoperitoneum or a retroperitoneal haematoma. DPL does not identify retroperitoneal injury or the source of intraperitoneal blood. It is also possible to produce a positive lavage with a relatively small amount of intraperitoneal blood (6). DPL continues to play a significant role in the evaluation when the patient is unstable, when a CT scanner is not readily available, in an uncooperative patient with a contraindication to sedation, or in a patient allergic to contrast agents(8). The choice of diagnostic procedures should be made on an individual basis, using the clinical information available.

Several workers advocate non-operative treatment in the haemodynamically stable patient with a benign abdominal examination and each of the following CT scan findings: single hepatic parenchymal laceration, intrahepatic haematoma, or subcapsular haematoma; no evidence of active bleeding; intraperitoneal blood less than 250mL (restricted to Morrison's pouch); absence of other intra-abdominal injury requiring surgery (7,8,15-18).

Our series showed that the majority of the liver trauma patients who were haemodynamically unstable had grade IV injuries (77.5%). CT scan findings of the liver injuries in the other 38 patients who underwent immediate laparotomy after the initial imaging are shown in Table 4. Pre-operatively, these patients were estimated to have grade III injuries. They had laparotomies based on presence of other abdominal visceral injuries (bowel or stomach perforations, splenic tears) and presence of significant moderate to large haemoperitoneum (Table 4). Majority of these patients (24/38=63.2%) had associated injuries. However, a significant proportion of these patients (42.1%) had more severe injuries (grade IV) noted intra-operatively. In this group of patients, the pre-operative CT scan grading of liver injuries may not be accurate due to the presence of significant haemoperitoneum and pneumoperitoneum (due to bowel/gastric perforations) that could mask the actual liver injuries. Nearly a third of the parenchymal fractures of the liver (3/10 patients=30%), 26.7% (4/15 patients) of the subcapsular haematoma and 69.2% (9/13 patients) of the central penetrating wound were re-assessed at laparotomy to be of grade IV injury. These patients needed major liver resections to secure haemostasis.

It is our experience that patients with either grades I or II liver injuries (Table 3) can be successfully managed non-operatively provided no other indication for surgery is present and close monitoring is available. Non-operative management of these patients includes bed rest, nil orally, the nasogastric decompression when ileus is present, serial abdominal examinations, serial blood counts, and a repeat abdominal CT scan within the first 7 days. During the observation period, indications for laparotomy were: 1) Signs of an acute abdomen (4 patients in our series), 2) Haemodynamic instability or continued requirements for transfusion that cannot be accounted for by an extra-abdominal site of blood loss, 3) Progressive expansion of haematoma without encapsulation on CT scan, 4) Abdominal sepsis (8). The overall clinical picture of the patient, both at the initial evaluation and during the observation period, should dictate the need for laparotomy (3,15,16). In our series, none of the patients who were treated conservatively had laparotomy due to liver injuries. The 6 laparotomies were for gallbladder injuries in 2 cases, two nephrectomies and the other 2 patients were found to have only a 1cm haematoma over the anterior second part of duodenum (no perforation and no further intervention needed). All 6 patients recovered well.

Mortality of 8 out of 72 patients (11.1%) in the non-operative group was due to associated injuries to the thorax and head. This highlights the important fact that injuries to other vital organs contribute significantly to the final outcome of a patient with liver injuries.

It was unfortunate that only 38 of the 64 patients (59.4%) who survived in the non-operative group came for follow-up. Although this figure represents only about half of our patients, their follow-up CT scans with no long-term complications provide encouraging supporting data that non-operative approach is safe in patients with grade I or II liver injuries, provided that there is no associated significant haemoperitoneum and other abdominal visceral injuries that warrant immediate operative treatment.

Conclusion

Non-operative management of liver injuries due to blunt trauma, as detected by CT scan, is appropriate and successful in selected patients (grade I or II liver injuries) who are haemodynamically stable, without signs of an acute abdomen or massive intra-abdominal blood loss, and without other abdominal injury requiring laparotomy. The availability of frequent abdominal examinations by a surgeon and serial laboratory studies, as well as close monitoring in an intensive care unit is essential. Emergency laparotomy must be readily available should the need arise. Repeat ab dominal CT scans can verify resolution of the hepatic injury and should be performed before discharge or when clinically indicated. Long-term complications are rare (15-18), and none occurred in our group of patients seen in follow up. A prospective study is needed to determine the appropriate use of follow up CT scans in patients with blunt hepatic trauma.

References

1. Moore EE. Critical decisions in the management of hepatic trauma. Am J Surgery 1984; 148: 712-716.
2. Feliciano DV, Jordan GL, Bitondo CG. Management of 1000 consecutive cases of hepatic trauma (1979-1984). Ann Surg 1986; 204: 438-445.
3. Hiatt JR, Harrier HD, Koening BV, Ransom KJ. Non-operative management of major blunt liver injury with hemoperitoneum. Arch Surg 1990; 125: 101-103.
4. Bass BL, Eichelberger MR, Schisgall R, Randolph JG. Hazards of non-operative therapy of hepatic injury in children. J Trauma 1984; 24: 978-982.
5. Cox EF, Flancbaum L, Dauterine AB, Paulson RL. Blunt trauma to the liver: analysis of management and mortality in 323 consecutive patients. Ann Surg 1988; 207: 126-134.
6. Moon KL, Federle MP. Computed tomography in hepatic trauma. AJA 1983; 141: 309-314.
7. Meyer AA, Crass RA, Lim RC. Selective non-operative management of blunt liver injury using computed tomography. Arch Surg 1985; 120: 550-554.
8. Feliciano DV. Immediate and follow-up management of hepatic trauma. Compr Ther 1991; 17: 51-56.
9. Foley WD, Cates JD, Kellman GM, Langdon T, Aprahamian C, Lawson TL, Middleton WD. Treatment of blunt hepatic injuries: Role of CT. Radiology 1987; 164: 635-638.
10. Vock P, Kehrer B, Tschaeppeler H. Blunt liver trauma in children: The role of computed tomography in diagnosis and treatment. J Pediatr Surg 1986; 21: 413-418.
11. Oldham KT, Guice KS, Ryckman F. Blunt liver injury in childhood: Evolution of therapy and Moar JJ. Autopsy assessment of liver lacerations. S Afr Med J 1985; 68: 180-182.

13. Harris LM, Booth FVM, Hassett JM. Liver lacerations - A marker of severe but sometimes subtle intra-abdominal injuries in adults. J Trauma 1991; 31: 894-901.

14. Shackford S, Moore E, Pachter H. Organ injury scaling-spleen, liver, kidney. J Trauma 1989; 29: 1664-1666.

15. Sherman HF, Savage BA, Jones LM, Barrette RR, Latenser BA. Non-operative management of hepatic injuries: safe at any grade? J Trauma 1994; 37(4): 616-621.

16. Meredith JW, Young JS, Bowling J, Roboussin D. Non-operative management of blunt hepatic trauma: the exception or the rule? J Taruma 1994; 36(4): 529-534.

17. Davis KA, Brody JM, Cioffi WG. Computed tomography in blunt hepatic trauma. Arch Surg 1996; 131(3): 255-260.

18. Croce MA, Fabian TC, Menke PG, Waddle-Smith L, Minard G. Non-operative management of blunt hepatic trauma is the treatment of choice for haemodynamically stable patients. Results of a prospective trial. e Ann Surg 1995; 221(6): 744-753.