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ORIGINAL ARTICLE

Assessment of Non-Operative Management Outcome of Liver Injury after Blunt Abdominal Trauma

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ABSTRACT

Background: The non-operative management of liver injury after blunt abdominal trauma decreases the risk of laparotomy, as regards both the short and long-term outcomes. This work aimed to discuss the outcome of non-surgical management of liver injuries among patients with blunt abdominal trauma. M**ethods:** We performed this cohort study on 30 patients with blunt abdominal trauma with liver injury at Zagazig University Hospital's surgical emergency unit. All patients were subjected to radiological investigations including abdominal ultrasound (U/S) and abdominal Computed tomography (C.T).Hemodynamically stable patients were selected for non-operative management which included monitoring of cases closely with serial physical examinations. **Results:** Statistically significant increases in the frequency of grade 5 and frequency of severe peritoneal free fluid were found in the failed group than in the success group with p-value ($p<0.05$) for each. Seven patients (23.3%) had complications, out of them 2 patients had hepatic necrosis, 2 patients had haemobilia, 2 patients had a peri-hepatic abscess and one patient had biliary fistula, while 6 patients (20%) had failed conservative management, 2 patients out of them died. One patient had biliary peritonitis, another one patient suffered small intestinal perforation and 2 patients hepatic necrosis. **Conclusion:** Patients with stable hemodynamics can be treated with non-operative methods, whereas those with deteriorating hemodynamics or peritonitis symptoms should undergo surgery.

Keywords: Non-Operative Management, Outcome, Liver Injury, Blunt Abdominal Trauma.

INTRODUCTION

Abdominal trauma is considered one of the major causes of death accounting for twenty to forty percent of all mortality causes, while liver trauma is the second most common complication. Simple compression on the spine, fixed ribsor posterior abdominal wall injuries cause most of the liver damage (>85%) in segments 6, 7 and 8. A contusion of the right lobe of the liver's dome can also be caused by pressure that originates in the right hemithorax and spreads via the diaphragm. In addition, the liver's diaphragmatic and posterior abdominal wall ligaments might be sources of shear stress injury during deceleration[1].

Patients with traumatic liver injuries must undergo initial resuscitation regardless of whether they will ultimately be surgically managed or not. Patients who are hemodynamically stable, having no other injuries that necessitate surgery and do not have peritonitis may be candidates for non-operational management (NOM) of blunt liver damage. Patients submitted to NOM are evaluated primarily by serial physical examination and laboratory tests [2].

Non-operatively treated patients with blunt liver injury have a failure rate of about 5-10% and eventually need surgery. The inability to embolize an actively bleeding vessel, the development of peritonitis or an incorrect initial assessment of damage severity are all potential causes of failure [3].

Grade 4-5 injuries, advanced age, decreased Glasgow Coma Scale (GCS) moderate or extensive hemoperitoneum, synchronous splenic injury and a high Injury Severity Score are all risk factors for non-operative management failure. Lower hemoglobin levels, longer intensive care unit (ICU) stays, longer hospital stays and more transfusions were all linked to failure [4].

The risks associated with laparotomy are reduced by non-surgical management, both in the near term (due to anesthesia or iatrogenic problems, transfusion requirements, abdominal infections, intensive care unit stay) and the long term (bowel obstruction risks or hernia due to scarring). However, in 10%-15% of cases, surgical intervention is required because non-operative management results in prolonged bleeding or complications from untreated intestinal injuries. Besides hepatic necrosis and abscess, patients may also experience biliary peritonitis, hemobilia, bile leakage, as well as abdominal compartment syndrome [5].

Some studies show that non-operative management has a success rate of 92% for grades 1 and 2, 80% for grades 3 and 4, 72% for grades 4 and 5 and 62% for grade5. Injuries of a lesser severity can be treated successfully without surgery. Conservative care is used for most livers injured by blunt force (80% in adults and 97% in children)[6].We aimed in this work to discuss

the outcome of non-surgical management of liver injury in patients with blunt abdominal trauma.

METHODS

This cohort study was performed on 30 cases who had blunt abdominal trauma with liver injury at Zagazig University Hospital, Surgical emergency unit from March 2022 to September 2022 after protocol approval by our local ethics committee (IRB#5024/10-12-2018) and the research was conducted in accordance with the Helsinki Declaration. We included patients with isolated Liver injuries due to blunt trauma defined by radiological investigation, being above 12 years old from both sexes, hemodynamically stable and having injury severity scores from 1 to 35.We excluded all cases who had any of the following conditions: any form of abdominal trauma other than blunt form, liver trauma combined with other organ injuries defined by radiological investigation, children below 12 years old, hemodynamic unstable patients and patients who had injury severity scores above 35.

Cases admitted to the hospital after blunt liver trauma were 48 cases, initial surgical management was performed in 18 cases, while initial non-surgical management was considered in 30 cases, successful non-surgical management was reported in 24 cases and failed for 6 cases (Figure 1).

According to their hemodynamic status on admission at the emergency room, cases were separated into two groups: either stable or unstable corresponding to Advanced Trauma Life Support (ATLS) protocols. After receiving appropriate resuscitation (One liter of intravenous fluids within one hour), patients were considered to be hemodynamically stable if their heart rate was less than 100 bpm and their systolic blood pressure was greater than 90 mmHg permanently and the patients were considered unstable when their heart rate was more than 100 bpm and blood pressure lower than 90 mmHg [7]. First, a general examination of the patient; whether the patient looks ill or well, pale or not, followed by a systemic examination, The person's chest, heart, head, neck, and upper and lower limbs were all checked for injuries. After gathering the aforementioned information, a thorough abdominal examination was performed, covering all bases by inspecting the abdomen (for apparent bruises or contusions), palpating (to identify any discomfort or rigidity) and percussion (to detect dullness or shifting dullness giving impression of abdominal collection).

Blood tests were done to all patients on admission and included full complete blood count, coagulation profile and kidney as well as liver functions. Radiological imaging included plain X-rays, abdominal U/S and or

computed tomography, beside intervention radiology if needed. Focused Assessment with Sonography in Trauma (FAST) was performed daily to quantify IPF and identify complications. The patient was converted to surgical treatment if developed peritonitis, hemodynamic instability or complications at any time of NOM. Operative management of liver trauma with primary repair. Follow-up of all patients was done at the outpatient clinic after discharge from the hospital once weekly for one month then every month for 6 months by full physical examination and abdominal U/S to detect complications. Non-operative management, including close monitoring with serial physical tests, was chosen for hemodynamically stable patients. When the patient's hemoglobin level was less than 8 g/L, packed red blood cell transfusion was administered. Close attention was paid to the patient's heart rate, blood pressure, breathing rate and urine output. Prothrombin time (PT) and activated partial thromboplastin time (APTT) values were used to monitor coagulopathy. Based on these findings, an intravenous infusion of blood products such as fresh frozen plasma and platelets was performed.

Statistical Analysis: The information was analyzed using Stata (version 23.0), statistical software designed for the social sciences (SPSS Inc., Chicago, Illinois, USA). Statistics were represented graphically by means, standard deviations, and ranges. Quantitative and percentage data were also provided for qualitative characteristics. When comparing percentages across qualitative variables, the chi-square (x2) test was applied.

RESULTS

The studied cases had a mean age of (33.8 ±10.91) with a range of 13-51 years, among the studied cases there were 9 (30%) females and 21 (70%) males with the median Injuries Severity Score (ISS)of 12 (ranging from 9-14), the median GCS was 22 (ranging from 12-31) and the mean body mass index (BMI) was (24.25±4.12) with range (18.5-30). Among the studied cases, 15 patients (50%) were in motor car accidents, 10 patients (33.3%) fell from height and 5 patients (16.7%) had direct blows to the abdomen. Among the studied cases, 8 patients (26.7%) had hypertension (HTN), 5 patients (16.7%) had diabetes mellitus (DM) and 4 patients (13.3%) had chronic liver disease as a co-morbidity(Table 1).

Among the studied cases there were 5 (16.6%) with a minimal FAST score, 15 (50%) with mild FAST, 6 (20%) with a moderate FAST score and 4 (13.3%) with a marked FAST score (Table 2).

Among the studied cases there were 18 patients (60%) who needed transfusion of blood, the mean blood transfusion (6.00±1.00) with range (2-10) and 19 patients (63.3%) needed ICU, the mean ICU stay was

(6.37 ±5.43) with range (1-14)days, the mean hospital stay was(11.83±5.57) with range (3-24) day, NOM succeeded with 24 patients (80%) and failed with 6 patients (20%) and there were 2 (6.6%) cases who died (Table 3).

Among the studied cases there was a statistically significant increase frequency of grade 5 in the failed group than in the success group($p<0.05$). (Table 4). There was a statistically significant increase frequency of severe peritoneal free fluid in the failed group than success group($p<0.05$) (Table 5).

Among the studied cases there were 7 patients (23.3%) with complications, out of them 2 patients had hepatic necrosis, 2 patients were hemobilia, 2 patients had peri-hepatic abscess and one patient was biliary fistula (Table 6).

Among the studied cases there were 6 patients (20%) failed conservative management, out of them 2 patients died, one patient had biliary peritonitis, one patient missed small intestinal perforation and 2 patients had hepatic necrosis (Table7).

Table (1): Distribution of the studied cases according to demographic data

History data	**Cases (n = 30)**	
Age (years) Range. Mean ± SD.	 13 – 51 33.81 ± 10.90	
Sex	**No.**	**%**
Female Male	9 21	30.0 70.0
ISS Range. Mean ± SD.	 6 – 35 22.43 ± 11.67	
GCS Range.	 8-15	

Mean ± SD.	11.50±1.96
BMI [kg/m2]	
Range.	18.5-30
Mean ± SD.	24.25±4.12

ISS: Injuries Severity Score .**GCS:** Glasgow Coma Scale .**BMI:** Body Mass Index

Table (2): Co-morbidity distribution of the studied cases.

Co-morbidity	No.	%
HTN	8	26.7%
DM	5	16.7%
Chronic liver disease	4	13.3%

Table (3): Mechanism of trauma distribution of the studied cases.

Mechanism of trauma	No.	%
Motor car accident	15	50.0%
Fall from height	10	33.3%
Direct blow to abdomen	5	16.7%
Total	30	100.0%

Table (4): Distribution of the studied cases according to FAST

	Cases(n = 30)	
FAST	**No.**	**%**
Minimal free intra peritoneal fluid	5	16,6
Mild free intra peritoneal fluid	15	50
Moderate free intra peritoneal fluid	6	20
Marked free intra peritoneal fluid	4	13.3

FAST: Focused Assessment with Sonography in Trauma

Table (5): Interventional radiology embolization of bleeding vessels distribution of the studied cases.

Interventional radiology embolization of bleeding vessels	No.	%
Yes	7	23.3%
No	23	76.7%
Total	30	100.0%

Table (6): Distribution of the studied cases according to lab investigations.

Lab investigation	Cases(n = 30)
AST (U/L)	
Range.	167-2429
Mean ± SD	1117.67±680.4
ALT (U/L)	
Range.	135-2068
Mean ± SD.	919±591.6
Total Bilirubin (mg/dl)	
Range.	0.22-3.41
Mean ± SD	1.82±0.42
Hb (g/dl)	
Range.	4-9.9
Mean ± SD.	6.95±1.60
HT (%)	
Range.	22.6-46.1
Mean ± SD.	34.35±7.90
PT (Sec)	
Range	11.1-18.3
Mean ± SD.	14.70±3.38

Lab investigation	Cases(n = 30)	
Lab investigations	**Cases**	
PC (%)		
Range	48.7-117.4	
Mean ± SD.	83.05±19.10	
HBs antigen(+/-)	No.	%
+ve	5	16.6
-ve	25	83.3
Anti-HCV (+/-)	No.	%
+ve	12	40
-ve	18	60

AST: Aspartate Aminotransferase . ALT: Alanine Aminotransferase .Hb: Hemoglobin .HT: Hematocrit Test .PT: Prothrombin Time. PC: Platelet Count.

Table (7): Distribution of the studied cases according to Outcome.

Outcome	**Cases (n = 30) %**
Blood transfusion (unites)	18 60.0%
Range.	2-10
Mean ± SD.	6.00±1.00
Outcome	**Cases**
ICU stay (day)	
Number of patients	19 63.3%
Range.	1 – 14
Mean ± SD.	6.37 ± 5.43
Hospital stay (day)	
Range.	3 – 24
Mean ± SD.	11.83 ± 5.57
Success of (NOM)	**No. %**

Outcome	Cases (n = 30) %
yes	24 80%
No	6 20%
Mortality (No)	**No. %**
No	28 93.3
Yes	2 6.6

ICU: Intensive Care Unit .NOM: Non-Operative Management

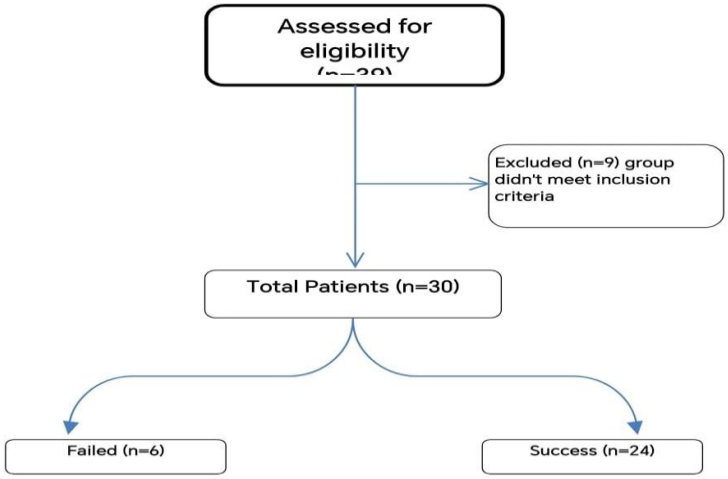

Figure (1): Flow Chart

DISCUSSION

The treatment of liver trauma has shifted away from operations and toward more conservative methods during the past few decades. Almost half of liver injuries in older studies had stopped bleeding by the time surgery was performed. Most injuries are either superficial or small and so require no treatment. Liver trauma is the second most common type of abdominal trauma, but the major cause of death among trauma victims (20-40 percent) [8].

Liver trauma is more common in young men since they are more physically active and have less life experience than older men. Liver injuries have been on the rise in Egypt over the past decade and the rise in car accidents is likely to be responsible [9].In our study, the predominant cause of injury was motor car accidents in (50%) of our patients the second cause of injury was fall from height (33.3%) and the last cause was the direct blow of the abdomen (16.7%).

The selection and treatment of patients who are treated without surgery have been simplified and enhanced by the advent and improvement of the computed tomography (CT) scan. When possible, patients with blunt liver trauma are now given non-operative management (NOM) instead of surgery.

Abdominal computed tomography (CT) scans are the gold standard for diagnosis and grading. This is because of its efficacy in grading and detecting bleeding in progress [10].

For mild splenic injuries, nonoperative management (NOM) is the standard of care at the moment in hemodynamically stable patients with blunt abdominal trauma (grades I-II according to the American Association for the Surgery of Trauma-AAST), the gold standard for both mild and severe liver damage and the primary treatment for severe splenic lesions (AAST grades III-V) [11].

In our study the cases had a mean age of (33.81 ± 10.90), with a range from 13 to 51 years old, (70%) of the studied patients were male and (30%) of the studied patients were female.In accordance with our findings, Sreeramulu et al. [12] stated in their study that the mean age of the patients was (30.41) years (range 7-65 years) with males predominant (42%), another study by Brillantino et al. [10]showed that the mean age was (39) and (69.6%) was male of their patients. The increased activity and lack of experience in this age group can be blamed for the disproportionately high number of liver trauma cases among young males. In the study of Mansy et al. [9] Liver injuries were caused in over 50% of patients, with a higher incidence in males.

In our study, the predominant cause of injury was motor car accidents in (50%) of our patients and the cause of (33.3%) was a fall from height and the cause of (16.7%) was a direct blow abdomen. Brillantino et al. [10]reported that 56 % of injuries were caused by automobile accidents, 20% by violent attacks and 12.1 % by falling from a great height. Sreeramulu et al. [12] reported also that vehicle collisions and falls from height were the most common causes of injury. 41.3% of patients also presented with abdominal lesions.

In our study, the FAST was minimal in 5 patients (16.6%) mild in 15 patients (50%) moderate in 6 patients (20%), and marked in 4 patients (13.3%). For CT grading, 8 patients (26.6%) were grade one and 10 patients (33.3%) were grade two and 8 patients (26.6%) were grade three and 2 patients (6.6%) were grade four and 2 patients (6.6%) were grade five. Compatible with our study Coccolini et al. [2] showed that A total of 256 (78.29%) individuals were found to have mild liver damage (grades I-III), whereas 71 (21.7%) patients were found to have severe liver damage (grades IV and V).The right lobe of the liver was the most common site of injury. One hundred thirty-four (40.98%) patients showed signs of associated injuries.

Kozar et al. [13]showed that Mild injuries were defined as those receiving a grade I-III from the American Association for the Study of Trauma, while serious injuries were defined as those receiving a grade III or higher. Twenty-four percent of patients with splenic injury, nineteen percent of patients with hepatic injury and thirty percent of patients with hepato-splenic injury had serious injuries according to the 1994-(AAST) classification, while the 2018-(AAST) update shows that 35.1%, 20% and 36.3% of those injured suffered serious complications.

In our study among our patients, 18 (60%) required blood transfusion, with a mean of (6.00±1.00) and a range of (2-10) units. Also, Saviano et al. [14]illustrated that blood transfusions were necessary for 12 patients (66.7% of the total), with an average of 2.26 ±1.57 packed red blood cells per patient. In alignment with our study, Buci et al.

[15]reported that all patients with serious liver trauma required transfusions of blood and blood products, while patients with small lesions required transfusions of blood and blood products due to injuries to other organs unrelated to the liver. Brillantino et al. [10] reported that patients with less severe trauma (AAST grades I-II) required fewer blood transfusions than those with more severe trauma (AAST grades III-V).

In our study, the mean of hospital stay was (11.83 ± 5.57) with a range of (3 – 24) days and the ICU stay mean was (6.37 ± 5.43) with a range of (1 – 14) days. Also, Pereira et al. [16]noted that cases who were managed nonoperatively stayed less durations in the hospital (P = 0.011), in the surgical ward (P = 0.033) as well as the intensive care units (P < 0.001).Our study was on 30 patients managed only by conservative management, our management succeeded on 24 (80%) patients and failed on 6 (20%) the mortality was 2 (6.7%) the mortality was due to pulmonary embolism in one patient, and liver cell failure of the other patient who had a history of liver cirrhosis.

In our study the first cause of the failed conservative management was biliary peritonitis in one patient (3.3%), it was due to (CBD) perforationand ERCP was done for a stent and exploration was done to the abdomen for drainage of the abdominal collection. the second cause of the failed conservative management was missed intestinal perforation in one patient (3.3%), exploration was done to the abdomen for drainage of the abdominal collection and primary repair of the perforation. the third cause of the failed conservative management was hepatic necrosis in two patients(6.7%), exploration was done to the abdomen and debridement of the necrotic tissue of the liver.

In accordance with our findings, Winata et al. [17]stated that 228 patients (69.72%) were treated with conservative management, whereas 99 patients (10.38%) underwent surgical intervention (30.28 percent). One hundred eighty-six (56.08%) patients required a blood transfusion. There were 25 deaths in total (7.64 percent).

Kaptanoglu et al. [18] revealed that Eleven patients died; four from bleeding during surgery, two from damage control failure, two from major pulmonary embolism and three from lung contusions. High injury grade, more blood transfusions, longer (ICU) and hospital stays and greater morbidity were observed in the operative group when comparing both (NOM) and operative care.

Cerit et al. [19]showed that out of 300 patients (63% stable, 37% unstable), 108 had surgery whereas 192% received (NOM). High liver damage grade and hemodynamic instability at admission accounted for 13% of deaths.

Anand et al. [20]reported that patients who were initially managed without surgery had fewer transfusions needed, lower average transfusion needs, fewer complications, shorter total LOS and fewer days in the (ICU) than those in the (OM) group. Patients in the OM group were more severely injured, as seen by their lower systolic blood pressure at admission, greater ISS and higher frequency of related injuries, so a direct comparison between the two groups is impossible. However, (NOM) does not appear to have a negative effect on results.

In our study the complications were hepatic necrosis in two patients (6.7%), exploration was done to the abdomen and debridement of the necrotic tissue of the liver and hemobilia in two patients (6.7%),for follow-up and conservative management, and peri-hepatic

abscess in two patients (6.7%),percutaneous drainage was done ultrasound-guided and biliary fistula in one patient (3.3%),ERCPwas done for stent and exploration was done to the abdomen for drainage the abdominal collection.

Brillantino et al [22] reported that the morbidity rate was 7.4% (13/175) among those patients whose conditions improved while under NOM's care. Three patients experienced pleural effusions, three patients experienced bronchitis and two patients experienced bacteremia caused by a bladder catheter.Two bilomas, one hemangioma and two abscesses of the liver were the most serious consequences. Ultrasound (US) or computed tomography (CT) guided drainage was used to successfully manage these problems, avoiding the need for surgical intervention.

Our study had some limitations. Our follow-up time was not long enough, and the study was a single-center study so we cannot do generalization to the data. To generalize the results, we suggest doing longer-term, multi-center research. The sample size was small as we included 30 cases so further research with a larger sample size is required.

CONCLUSIONS

Hemodynamically stable cases can be treated with non-operative management, but those who are not or who show indications of peritonitis will need surgery.The liver injury is usually not the root cause of NOM failure, but it is usually due to the associated injuries. Patients with blunt liver trauma NOM should be admitted to high-quality hospitals for close monitoring.

Conflict of Interest: the authors declare no conflict of interest.

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