Nonoperative management in blunt liver trauma: a 10-year center experience

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Background
Conservative management nowadays takes the upper hand for liver trauma management in hemodynamically stable patients.
Aim
To evaluate the outcomes of an operative and conservative management of patients with blunt liver injury over a 10-year period.
Patients and methods
A retrospective study was conducted in the period from June 2010 to June 2020. It included 327 patients admitted with blunt liver trauma in the surgical trauma unit, Zagazig University hospital. The patients were classified according to the way of management: group I, conservative management, and group II, operative management. Variables analyzed included demographic data, injury classification, associated lesions, surgical treatment, morbid-mortality, and hospital stay.
Results
Blunt liver trauma represented 33.89% of all blunt abdominal trauma cases in our emergency department. Our study included 327 patients. More than 50% of our patients were young males. Minor liver injuries (grades I–III) were detected in 256 (78.29%) patients, and major liver injuries (grade IV and V) were detected in 71 (21.71%) patients. Conservative management was done in 228 (69.72%) patients and operative management in 99 (30.27%). Mortality rate was 7.64% (25 patients).
Conclusions
Conservative management is a safe approach for stable hemodynamic patients and surgery the choice for hemodynamic unstable patients. Conservative management patients should be under close monitoring. Failure of conservative treatment did not show a higher incidence of morbidity or mortality.

Keywords:
blunt liver trauma, conservative management, liver injury grades, operative management

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Introduction

Although the liver has a hidden location, still liver injuries are common in both blunt and penetrating trauma [1]. Most injuries need no management, being superficial or minor [2–4]. Liver trauma is the leading cause of death in trauma (20–40%), and also it comes in the second place in abdominal trauma frequency [5].

Regarding liver lobes, the right lobe is more often involved, owing to its size and position (nearby the ribs) [6]. Regarding segments, injury of segments 6, 7, and 8 accounts for more than 85%. Morbidity and mortality increase with associated injury to other organs [7]. Evidence stated that ~86% of liver injuries have stopped bleeding by the time of operative management. Moreover, 67% of explorations for blunt trauma abdomen are nontherapeutic [8].

Management differed in the past two decades, started by packing and ended nowadays with nonoperative management (NOM). Moreover, selection of operation has been done now according to computed tomography (CT) scan findings [9].

When we consider accurate diagnosis, abdominal CT scan comes in the first place in diagnosis and grading [10]. This is attributed to its ability in grading and also detection of active bleeding [11].

NOM advantages include low cost-effectiveness, low blood transfusion, early hospital discharge, decrease in nonbeneficial exploration, and decrease in intraabdominal complications [12]. Moreover, selective NOM has less mortality rate compared with operative management [13].

Operative management is used in hemodynamically unstable patients with massive injuries or used in combination with associated complications [14,15].

Nowadays, ~80% of adults and 97% of children are managed conservatively at specialized trauma centers [7].

The aim of this study to analyze the effectiveness and morbidity or mortality of both NOM and operative management among patients with blunt liver trauma who attended our causality unit.

Patients and methods

A retrospective study done in the surgical trauma unit, Zagazig University Hospital, Egypt, from June 2010 till June 2020. After getting ethical approval and all patients consent. A total of 965 patients with blunt abdominal trauma were admitted to the emergency department in this period. Our study included 327 (33.89%) patients (complained from liver trauma). Patients excluded were those who complained of penetrating abdominal injuries or who were dead on arrival. All data were collected regarding demographics and CT findings when available, blood transfusion used, liver injury grade, management plan (nonoperative or operative), hospital stay, ICU stay, and morbidity-mortality.

Advanced Trauma Life Support guidelines were used in all patients [16]. Focused Assessment with Sonography in Trauma (FAST) was used immediately for hemoperitoneum detection. The severity of liver injury was graded as I–VI based on abdominal CT scan findings [17].

Nonoperative management group

NOM was chosen in the following criteria:

(1) Hemodynamic stability.
(2) Rapid responders to fluid boluses transfusion.
(3) Rapid responders to transfusion of two packed red blood cells in relation to liver injury.
(4) Absence of signs of peritonitis.
(5) No other abdominal injuries that necessitated immediate surgery.

Patients with low-grade liver injury (grades I–III) were admitted in the ward, whereas those with high-grade liver injury (intravenous) were admitted to the ICU for closed observation and follow-up. Always operating room was ready if the patient condition deteriorated (Figs 1 and 2).

NOM follow-up was done with the following:

(1) Complete blood picture.
(2) Prothrombin concentration and international normalized ratio.
(3) Liver function.
(4) Ultrasound at the first, third, fifth, and seventh days.
(5) Abdominal ultrasound-guided drainage was done to patient with moderate to marked collection and abdominal compartment syndrome.

Patients with grades I and II injuries were routinely discharged within 72 h, whereas those with grades III and IV injuries needed ICU admission for 5–7 days. Follow-up in the outpatient clinic was done by liver function, abdominal ultrasound, and CT after 1, 3, and 6 months from discharge.

We consider NOM failed and surgery indicated in the following conditions:

(1) Patients who presented with hemodynamic instability (delayed hemorrhage).
(2) Continuous reduction in hematocrit value.
(3) Patients with persistent systemic inflammatory response syndrome.
(4) Patients with clinical signs of peritonitis.

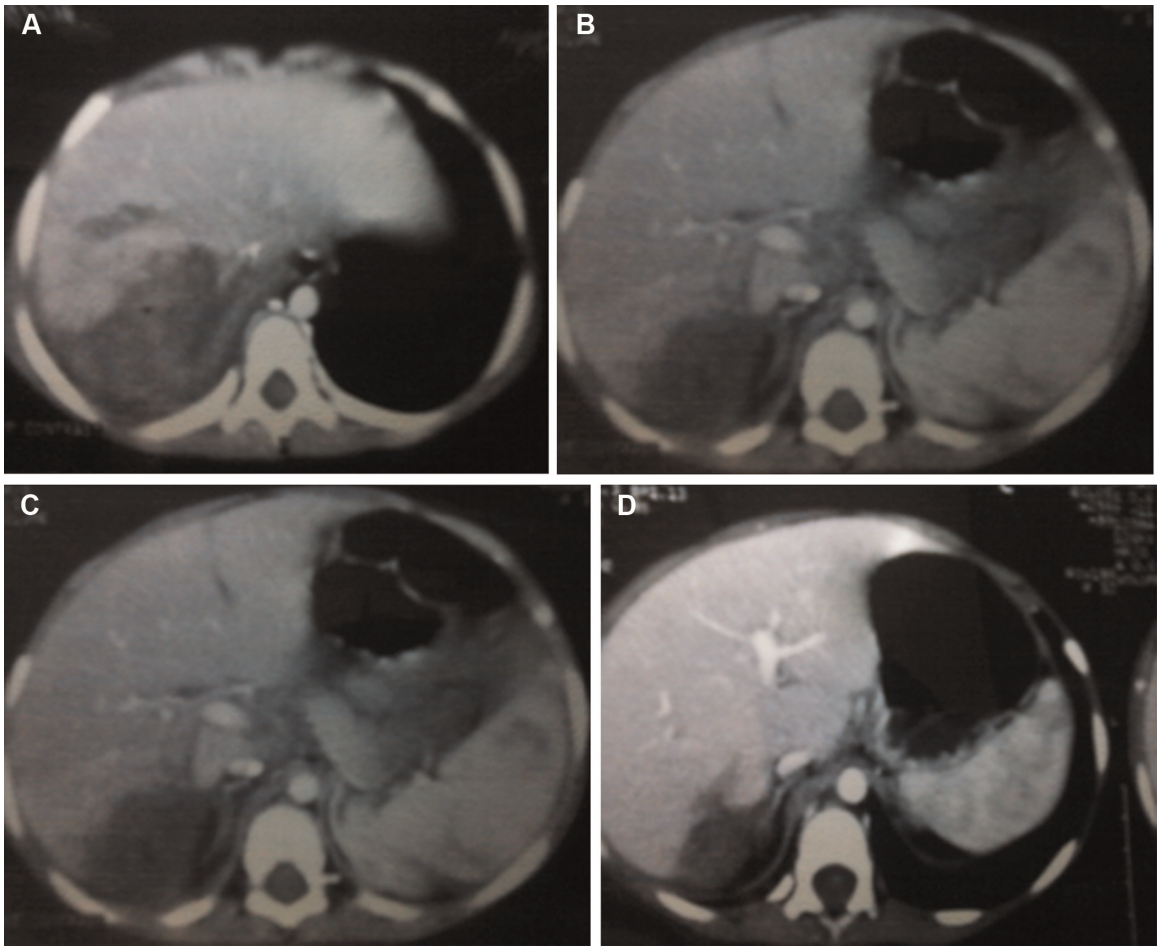
Operative management group

Surgical treatment depends upon liver injury severity and degree of instability (Figs 3 and 4).

Steps of exploration

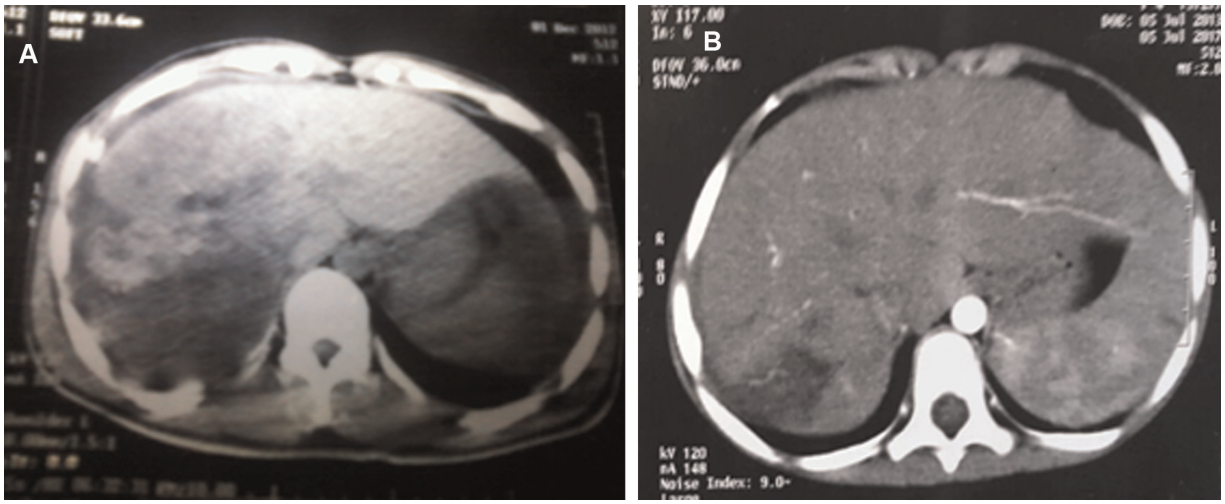
(1) Big exploratory incision was done for good exposure, either J-shaped incision from the start or right subcostal extension if we consulted to deal with liver trauma after midline incision.
(2) Liver mobilization.
(3) Pringle maneuver (not exceed 20 min intermitted with 5 min, with no limit for how many times we do Pringle maneuver) was used for control inflow.
(4) Identification of the bleeder, and dealing with the cause accordingly (either suture ligation or hemostatic diathermy when the bleeding is minimal). We never take hemostatic through-and-through sutures, for bleeding control. In major lacerations, we sometimes do nonanatomic resection.
(5) After good hemostasis, we search for biliary leak, and deal with accordingly (when the patient is stable, we do intraoperative cholangiogram to search for the bile leak cause in difficult hidden leaks).

Figure 1



NOM for a 5-year-old female child. (a) Hemoperitoneum. (b) Right lobe laceration. (c) Follow-up after 1 month. (d) Follow-up after 3 months. NOM, nonoperative management.

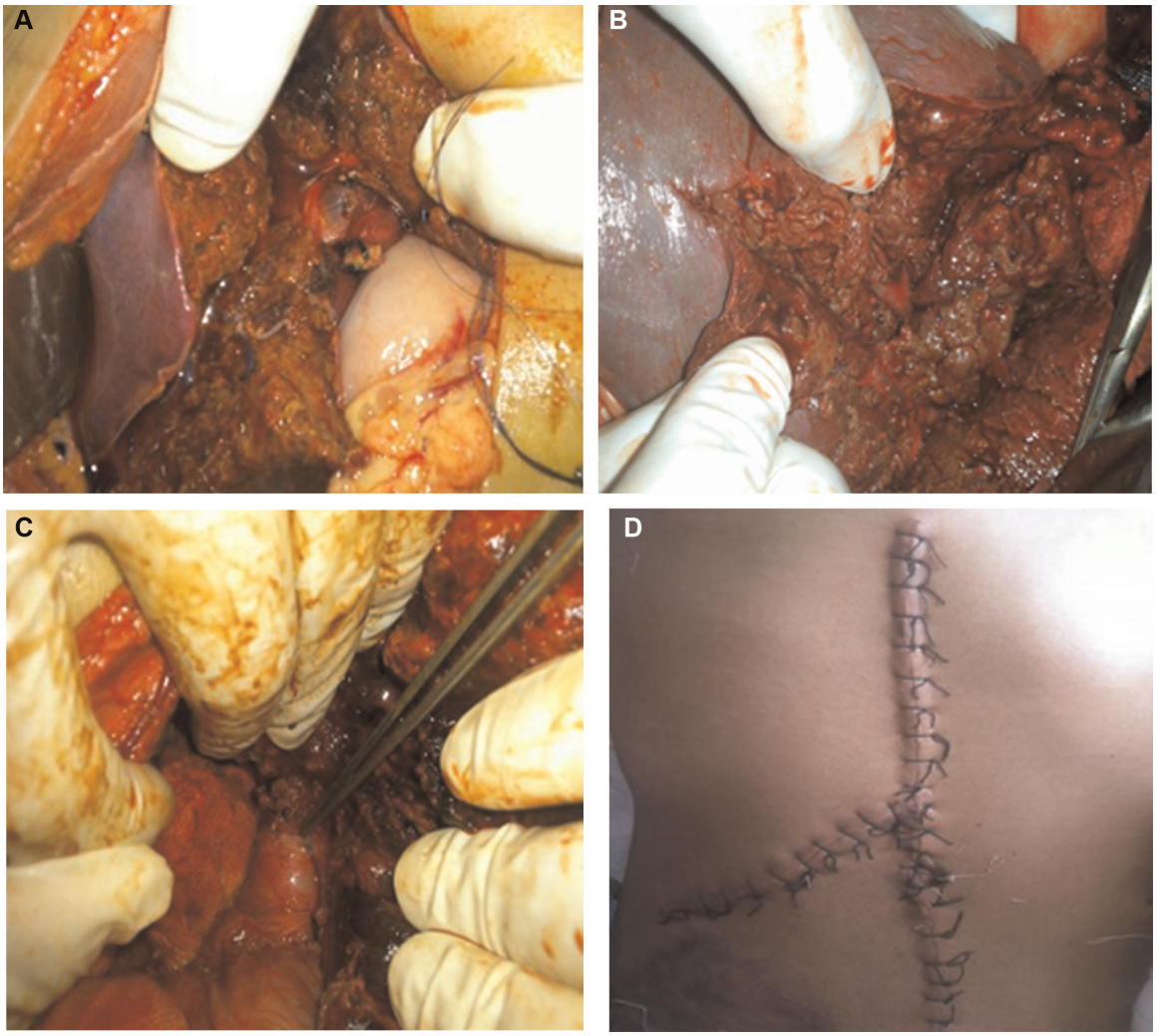
Figure 2



NOM in a male patient with grade IV liver trauma. (a) Right lobe trauma. (b) Follow-up after 3 months. NOM, nonoperative management.

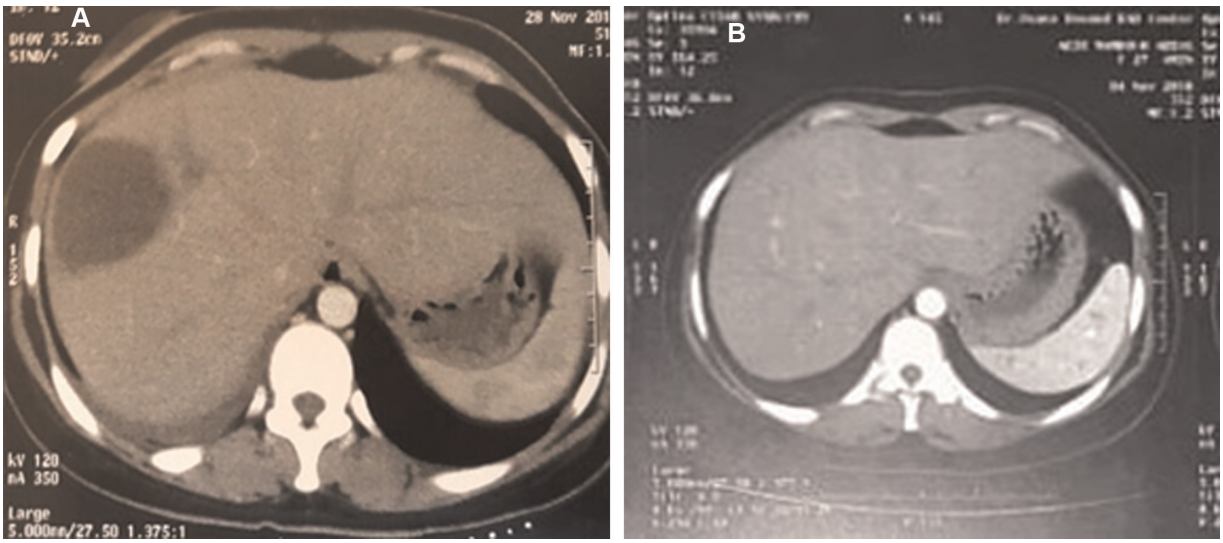
(6) We do damage control in unstable patients (to avoid lethal triad acidosis, hypothermia, and coagulopathy). Packing and reexploration was done when patient became stable.
(7) Lastly, good drainage was applied.
(8) Patients were admitted postoperatively in the ICU. Daily laboratory examinations were done (complete blood count, LFT, KFT, PT, international normalized ratio, blood gases, and lactate).

Figure 3



Operative management. (a) Open book injury. (b) Identification of intraparenchymal bleeders. (c) IVC injury. (d) Subcostal extension.

Figure 4



Operative management for grade V liver injury. (a) Follow-up after 1 month. (b) Follow-up after 1 year.

(9) Thromboprophylaxis was started 24 h postoperatively after patient drains were clear.
(10) Follow-up was via liver function, abdominal ultrasound, and CT after 1, 3, and 6 months and 1 year in outpatient clinic.

Statistical analysis

The collected data were analyzed by computer using Statistical Package of the Social Services, version 24 (SPSS) (Statistical analysis was done using IBM SPSS statistics for windows, Version 23.0. Armonk, NY: IBM Corp). Data were represented in tables and graphs. Suitable statistical tests of significance were used after checking for normality. The results were considered statistically significant when the significant probability was less than 0.05 ($P<0.05$). P value less than 0.001 was considered highly statistically significant, and P value more than or equal to 0.05 was considered statistically insignificant.

Results

Blunt liver trauma represented 33.89% of all the blunt abdominal trauma cases in our emergency department. Our study included 327 patients, with mean age of 21 ±12.9 years. Road traffic accidents were the most causative injury. Males take the first place in trauma incidence, representing 183 (55.96%) cases.

Minor liver injuries (grades I–III) were detected in 256 (78.29%) patients and major liver injuries (grades IV and V) were detected in 71 (21.71%) patients. More than 73% of the liver trauma incidence was in the right lobe. Associated injuries were presented in 134 (40.98%) patients. The most common involved extraabdominal injuries were chest (31.8%) and central nervous system (11.01%). Associated abdominal lesions were seen in 82 (25.08%) patients; the most frequent was spleen in 34 (10.4%) patients. Conservative (NOM) management was done in 228 (69.72%) patients and operative management in 99 (30.27%). Blood transfusion was used in 186 (56.88%) patients. Total mortality was 25 (7.64%) (Table 1).

Most of the liver trauma was minor lesions, grades I–III. High liver enzymes were in major liver trauma (grades IV–V). Blood and blood product transfusion were used in all patients with major liver trauma, whereas blood transfusion in minor lesions was owing to associated organ injuries and not related to liver trauma. Most of the minor liver trauma cases [204/256 (79.69%)] underwent conservative (NOM) management. All patients with grades I and II injuries who underwent surgery were owing to associated abdominal organ lesions (Table 2).

Conservative (nonoperative management) management group

A total of 228 (69.27%) patients received conservative treatment, which was effective in 212 (92.98%) patients. The mean age was 14.73±13.05 years. Most of the children (68/83, 81.93%) were managed conservatively. The morbidity in this group was 25 (10.92%) patients. Complications were conservative failure in 17 patients, biliary leak in six patients, liver necrosis in two patients, chest infection in four patients, pulmonary embolism in one patient, and paralytic ileus in one patient. The mortality in this group was in 14 patients, owing to chest and head trauma complications.

The reasons of conservative failure were as follows (Fig. 5):

(1) Biliary leak in three patients.
(2) Sepsis and peritonitis in six patients:
    (a) Liver necrosis in the right lobe laceration was managed by laparoscopy, where a big cavity was found at the site of laceration filled with necrotic materials and hematomas, the necrotic tissue inside was removed, coagulation of the bleeding points was done, clip ligation of suspected biliary small ducts or bleeding vessels was done, followed by irrigation and drainage, and then putting a drain inside the cavity.
    (b) Another patient owing to liver gangrene in the left lateral segment because of avulsed pedicle underwent left lateral hepatectomy.
    (c) The other four patients were owing to bowel injury.
(3) Hemodynamic instability was in four patients (two owing to rebleeding from grade IV liver injury and two owing to rupture splenic hematoma).
(4) A maintained low hematocrit value was seen in four patients (two with retroperitoneal hematoma and two owing to mesenteric injury).

Operative management group

It included 99 (30.27%) patients.

Causes of choice of operative management from the start were as follows:

(1) Hemodynamic instability.
(2) Signs of peritoneal irritation on physical exploration.
(3) Pneumoperitoneum.
(4) Suspicion of diaphragmatic injury.
(5) Renal injury.

Table 1 Differences between liver injury grades

Injury type (*N*=327)	Grade I (*N*=72) [*n* (%)]	Grade II (*N*=108) [*n* (%)]	Grade III (*N*=76) [*n* (%)]	Grade IV (*N*=56) [*n* (%)]	Grade V (*N*=15) [*n* (%)]	*P* value
Age (years)						
Mean±SD	18.4±9.7	17.65±10.2	19.5±8.4	15.7±11.4	20.3±7.4	0.45
Median (range)	20 (8–35)	18 (4–55)	17 (7–41)	19 (5–39)	22 (25–56)	
Sex						
Male [183 (55.96%)]	34 (47.22)	65 (60.18)	41 (53.95)	31 (55.36)	12 (80)	0.000
Female [61 (18.65%)]	17 (23.61)	19 (17.59)	13 (17.1)	9 (16.07)	3 (20)	
Child [83 (25.39)]	21 (29.17)	24 (22.23)	22 (28.95)	16 (28.57)	–	
Associated injuries (134 patients)	34 (47.22)	43 (39.81)	29 (38.16)	21 (37.5)	7 (46.67)	0.35
CNS (36 patients)	13 (18.06)	15 (13.89)	5 (6.58)	3 (5.36)	–	
Facial trauma (5 patients)	3 (4.17)	2 (1.85)	–	–	–	
Chest (104 patients)	27 (37.5)	33 (30.56)	23 (30.26)	14 (25)	7 (46.67)	
Diaphragm (2 patients)	–	–	2 (2.63)	–	–	
Spleen (34 patients)	11 (15.28)	12 (11.11)	7 (9.21)	4 (7.14)	–	
Pancreas (4 patients)	–	3 (2.78)	1 (1.32)	–	–	
Kidney (22 patients)	4 (5.56)	8 (7.4)	6 (7.89)	4 (7.14)	–	
Small bowel (11 patients)	4 (5.56)	5 (4.63)	2 (2.63)	–	–	
Stomach (3 patients)	1 (1.39)	–	1 (1.32)	1 (1.78)	–	
Large bowel (6 patients)	1 (1.39)	2 (1.85)	2 (2.63)	1 (1.78)	–	
Retroperitoneal hematoma (27 patients)	4 (5.56)	9 (8.33)	6 (7.89)	5 (8.93)	3 (20)	
Thoracolumber	5 (6.94)	4 (3.7)	7 (9.21)	4 (7.14)	–	
Spine (20 patients)	9 (12.5)	16 (14.8)	8 (10.53)	5 (8.93)	–	
Pelvis (38 patients)	7 (9.72)	6 (5.56)	2 (2.63)	4 (7.14)	3 (20)	
Extremities (22 patients)						
Liver enzymes						
ALT	256±57.3	512±239.4	1425±402.9	1850±270.3	2015.2±282.7	0.000
AST	210±63.2	394.1±283.2	980.7±279.5	1412±262.1	1784±245.6	
Blood transfusion						
No (141 patients)	59 (81.94)	71 (65.74)	11 (14.47)	0	0	0.000
1–2 (90 patients)	10 (13.89)	28 (25.92)	39 (51.32)	13 (23.21)	0	
3–6 (68 patients)	3 (4.17)	9 (8.34)	24 (31.58)	32 (57.14)	0	
>6 (28 patients)	0	0	2 (2.63)	11 (19.64)	15 (100)	
Management						
Conservative	63	94	47	24	0	0.000
Operative	9	14	29	32	15	
Mortality (25)	4	7	5	5	4	0.13

ALT, alanine transaminase; AST, aspartate transaminase; CNS, central nervous system.

In 10 patients of major liver injuries grade (IV–V), we used damage control system after control of major bleeding; we packed the patient with towels and sent the patient to ICU for stabilization. Then reoperation again was done after 24–48 h for removal of the pack and performing definitive management. Failure of damage control system was seen in three patients and was successful in seven patients.

Postoperative complications arose in 24 (24.24%) patients (more than one complication could present in one patient) and included biliary leak (six), localized collection (four), chest infection (six), pleural effusion (seven), ascites (six), pulmonary embolism (two), wound infections (10), and burst abdomen (three). Long-term complications during the follow-up period included incisional hernia in five patients and biliary stricture in one patient (hepaticojejunostomy done for him after 1 year of the trauma).

Mortality was seen in 11 patients: four patients from intraoperative bleeding, two patients with failure of damage control, two patients with massive pulmonary embolism, and three patients owing to lung contusion. When comparing both NOM and operative management, high injury grade, more blood transfusion, more ICU, and hospital stay and more morbidity were in operative group.

We followed up our patients for 6 months in minor liver injuries and for 1 year in major liver injuries. The hemoglobin and liver function returned to normal after

Table 2 Comparison between conservative and operative groups

Variables	Conservative group (*N*=228) [*n* (%)]	Operative group (*N*=99) [*n* (%)]	*P* value
Age			
Mean±SD	14.73±13.05	21.6±14.9	0.035
Median (range)	16 (2–55)	19 (5–56)	
Sex			
Male	116 (50.88)	67 (67.68)	0.000
Female	44 (19.3)	17 (17.17)	
Child	68 (29.82)	15 (15.15)	
ISS			
Mean±SD	19.2±10.3	22.5±12.6	0.11
GCS <8			
Number of patients	22 (9.65)	11 (11.11)	0.35
HB			
Mean±SD	10.2±1.6	7.1±1.9	0.023
Median (range)	10.4 (7.6–15)	7.5 (6.3–10.5)	
ALT			
Mean±SD	527.8±400.1	650.1±341.6	0.1
Median (range)	500 (39–2100)	480 (159–2200)	
AST			
Mean±SD	496.1±331.5	628.3±328.7	0.21
Median (range)	495(36–1925.6)	448 (250–1970)	
Associated injury			
No [193 (59.02%)]	153 (67.1)	40 (40.4)	0.000
Yes [134 (40.98%)]	75 (32.9)	59 (59.6)	
CNS (36)	24 (10.53)	12 (12.12)	
Facial (5)	4 (17.54)	1 (1.01)	
Chest (104)	57 (25)	47 (47.47)	
Spleen (34)	20 (8.77)	14 (14.14)	
Kidney (22)	13 (5.7)	9 (9.09)	
Pancreas (4)	–	4 (4.04)	
Small bowel (11)	2 (0.87)	9 (9.09)	
Large bowel (11)	2 (0.87)	4 (4.04)	
Stomach (3)	–	3 (3.03)	
Diaphragm (2)	–	2 (2.02)	
Thoraco-lumbar spine (20)	17 (7.46)	3 (3.03)	
Retroperitoneal hematoma (27)	18 (7.89)	9 (9.09)	
Pelvis (38)	27 (11.84)	11 (11.11)	
Extremities (22)	15 (6.58)	7 (7.07)	
Liver grades			
Grade 1 [72 (22.02%)]	63 (27.63)	9 (9.09)	0.000
Grade 2 [108 (33.03%)]	94 (41.23)	14 (14.14)	
Grade 3 [76 (23.24%)]	47 (20.62)	29 (29.29)	
Grade 4 [56 (17.12%)]	24 (10.52)	32 (32.32)	
Grade 5 [15 (4.59%)]	0	15 (15.16)	
FAST US			
Minimal [21 (6.42%)]	21 (9.22)	0	0.000
Mild [121 (37%)]	112 (49.12)	9 (9.09)	
Moderate [110 (33.64%)]	62 (27.19)	48 (48.48)	
Marked [75 22.94%)]	33 (14.47)	42 (42.43)	
ICU stay			
No [179 (54.74%)]	159 (69.74)	20 (20.2)	0.000
Yes [148 (45.26)]	69 (30.26)	79 (79.8)	
ICU stay			
Mean±SD	5.84±2.11	7.6±5.4	0.003
Median (range)	4 (3–11)	8 (5–12)	
Hospital stay			
Mean±SD	6.97±3.15	12.5±7.9	0.003
Median (range)	6 (3–18)	11 (1–27)	

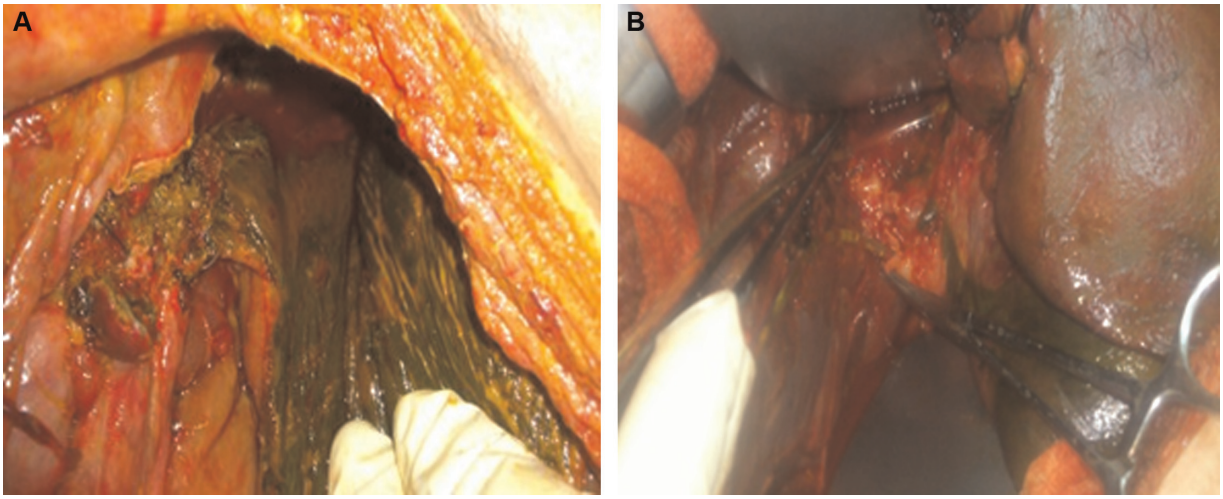
(*Continued*)

Table 2 (*Continued*)

Variables	Conservative group (*N*=228) [*n* (%)]	Operative group (*N*=99) [*n* (%)]	*P* value
Blood transfusion			
No [141 patients (43.12%)]	141 (61.84)	0	0.000
1–2 [90 patients (27.53%)]	68 (29.82)	22 (22.22)	
3–6 [68 patients (20.79%)]	19 (8.34)	49 (49.49)	
>6 [28 patients (8.56%)]	0	28 (28.29)	
Morbidity			
49 (14.98%) patients	25 (10.92)	24 (24.24)	0.000
Mortality			
25 (7.64%) patients	14 (6.14)	11 (11.11)	0.22

ALT, alanine transaminase; AST, aspartate transaminase; CNS, central nervous system; FAST, Focused Assessment with Sonography in Trauma; HB, hemoglobin; US, ultrasound.

Figure 5



Failure of NOM. (a) Liver gangrene in left lateral owing to avulsed pedicle after 1 week of NOM. (b) Biliary leak owing to right and left hepatic duct injuries after 10 days of NOM. NOM, nonoperative management.

1 month. Complete healing of liver injuries was detected by triphasic CT within 3 months in grades I and II, within 6 months in grade III, and within 6 months to 1 year in grades ?V and V.

Discussion

The liver comes in the second place in solid organ trauma incidence. Tremendous bleeding is usually the cause of death following liver trauma owing to its anatomical location. Most of the liver injury is caused by blunt trauma [18,19]. In Egypt, the number of liver trauma increased in the last decade due to increase the number of motor vehicles crashes. In our study, the higher rate of liver injury was in male, which occurred in more than 50% of the patients. NOM was the option in more than 65% of the adult patients and more than 80% of the pediatric patients.

The way of thinking in the past 15 years regarding liver trauma management has changed progressively. The spark started in 1990 papers which offer the chance of NOM in hemodynamic stable patients as pediatric surgeons do in liver and splenic injuries [20].

NOM choice not only decreases the number of unnecessary operations but also decreases the incidence of morbidity and mortality [21]. Luckily, ~85% of liver injury cases (<grade IV) are minor [22]. Previously, these patients were managed via simple liver sutures, diathermy, or hemostatic agents, which usually stop bleeding in these patients. So, NOM in these patients will be perfect. Still in the remaining 10–20% of the severe liver injuries, the decision of surgery is a big challenge [23].

In the study by Beardsley and Gananadha [22], there was failure in ~25% of cases during NOM, mostly owing to rebleeding, bile leak, liver necrosis, or secondary sepsis. Failure of NOM in our study was in 17 (7.46%) patients, most of them owing to associated organ injuries not related to liver injuries.

This matches the study from Albania, with successful NOM rate of 83% [11]. Moreover, in another study from Turkey with 300 patients (63% stable and 37% unstable), NOM was used in 192 patients, whereas surgery was in 108 patients. Mortality was seen in 13%, which was attributed to hemodynamic instability on admission and high liver injury grade [24].

In our NOM, biliary leak took the upper hand in morbidity incidence in six cases (managed by surgery in three patients and ERCP in one patients). Moreover, in the series by Carrillo *et al.* [25], biloma was seen in 2.8% of cases with complex blunt hepatic injuries. Again, biloma and bile leak present were present in the study by Bala *et al.* [26], who studied 398 patients with liver trauma, of whom only 16 patients had complications. Bile leak was treated with drainage and ERCP. Other complications were rebleeding from pseudo-aneurysm that required angioembolization.Previously NOM was limited to low-grade liver injury (grade≤III), but nowadays, most surgeons consider NOM the treatment of choice in hemodynamically stable patients, regardless of liver injury grade or hemoperitoneum amount calculated by CT [27]. In our study, NOM was succeeded in 39.29% patients of grade IV, but in our limited experience, all the 15 patients with grade V required operative management. Regarding operative management, the aim is to control bleeding and bile leak, remove dead tissues, control infection, and to drain the abdomen wall [28].

In our study, the overall mortality rate was 7.8%, usually from head or chest region and tremendous bleeding at presentation. This matches the reported mortality rate in patients with liver injury, ranging from 9 to 42% [12].

Conclusion

NOM is the treatment of choice in hemodynamically stable patients, whereas surgery is indicated in hemodynamically unstable patients or if there are signs of peritonitis. Usually failure of NOM is caused by associated injuries not the liver injury. In NOM of blunt liver trauma, patients should be admitted in well-equipped hospitals with very precise follow-up.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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