ORIGINAL ARTICLE

MAJOR LIVER RESECTION FOR PATIENTS WITH LIVER TRAUMA

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Abstract

Introduction: The liver is the second most commonly injured organ in abdominal trauma, but liver damage is the most common cause of death after abdominal injury. In spite of there has been a paradigm shift in the management of patients who have stable hemodynamic with marked change toward a more conservative approach in the treatment of abdominal trauma has been noted during the last decades, urgent surgery continues to be the standard for hemodynamically compromised patients with hepatic trauma.

Aim of the work: to find out and assess the role of surgery and liver resection in the management of blunt liver trauma.

Patients and Methods: this study included sixty five patients with liver trauma referred to the National Liver Institute (NLI), university of Menoufiya, Egypt, as a tertiary center in five years duration. The management option was based on hemodynamic status, radiological (ultrasound and CT) staging criteria. Analysis was done using SPSS 18. Statistical significance was set at $P<0.05$.

Results: The age of these patients ranged from 4 to 38 years, with a mean age of 20.4 years, and with male predominance (84%). Twenty seven (41.5%) patients were not previously explored and 5 (7.6%) were explored in NLI due to biliary peritonitis. Thirty eight (58.5%) were referred after primary exploration. Fourteen (21.5%) were managed conservatively and only 5 (7.6%) were opened for removal of packs after 48 hours. Twenty four (36.9%) were explored due to hemodynamic instability and CT criteria, 4 (6.1%) were managed by conservative surgery (repair of lacerations). Twenty (30.7%) patients needed major liver resection, 3 (4.6%) patients by left lateral segmentectomy, 2 (3%) patients by right posterior sector resection, and 15 (23%) patients underwent right hepatectomy with one (1.5%) perioperative mortality, one (1.5) postoperative portal vein thrombosis and 3 (4.6%) postoperative biliary complications.

Conclusion: hemodynamic stable patients can be managed safely non-operatively, while urgent surgery continues to be the standard for hemodynamic compromised patients with hepatic trauma. Non operative management doesn't lead to longer hospital stay. Low grade injuries can be managed non-operatively with excellent results.

Keywords: Liver trauma, liver resection, blunt trauma.

INTRODUCTION

Liver injury is a commonly encountered problem in trauma and is a frequent cause of morbidity and mortality in the young. With the advent of improved and expeditious imaging technologies and advances in intensive care, the diagnosis and treatment of liver injuries have gone through a paradigm shift in the past two decades. Non-operative management (NOM) has been reported to be a safe and effective strategy for selected patients in studies conducted in the last decade.[1] Many major trauma centers in Western countries have already adopted non-operative management of blunt hepatic trauma as the standard of care for hemodynamically stable patients.[2]

Recently several authors have highlighted an excessive use of NOM, which for some high grade liver injuries is pushed far beyond the reasonable limits, carrying increased morbidity at short and long term, such as bilomas, biliary fistulae, early or late haemorrhage, false aneurysm, arteriovenous fistulae, haemobilia, liver abscess, and liver necrosis. Incidence of complications attributed to NOM increases in concert with the grade of injury.[3]

In a series of 337 patients with liver injury grades III-V treated non-operatively, those with grade III had a complication rate of 1%, grade IV 21%, and grade V 63%.[4] Patients with grades IV and V injuries are more likely to require operation, and to have complications of non-operative treatment. Therefore, although it is not essential to perform liver resection at the first laparotomy, if bleeding has been effectively controlled,[5] increasing evidence suggests that liver resection should be considered as a surgical option in patients with complex liver injury, as an initial or delayed strategy, which can be accomplished with low mortality and liver related morbidity in experienced hands.[6]

Liver resection in hepatic trauma should be considered when (1) massive bleeding related to a hepatic venous injury, (2) massive destruction and devitalized hepatic tissue is present, often partially resected by the injury itself, or (3) a major bile leak coming from a proximal, main intrahepatic biliary duct are found. NOM of liver injuries grade ≥ III, especially when treated with combined Angio-Embolization (AE), is not without risks (mainly biliary leaks, liver necrosis and severe sepsis) and may lead to significant morbidity and possible mortality in up to 11% of cases due to liver related complications.[7] Although AE has been defined the logical augmentation of damage control techniques for controlling hemorrhage, the overall liver-related complication rate can be as high as 60.6% with 42.2% incidence of Major Hepatic Necrosis.[8] Early liver lobectomy in such cases required lesser number of procedures and achieved lower complication rate and lower mortality compared to less aggressive approaches such as serial operative debridement and/or percutaneous drainage.[9]

PATIENTS AND METHODS

This study included sixty five patients referred to the National Liver Institute (NLI), university of Menoufiya as a tertiary center during the 2007 till 2011.

In the ER the vital signs of these patients were initially assessed and those who are hemodynamically unstable are resuscitated. The liver trauma was classified according to the Hepatic Injury Scale (HIS) of the American Association for the Surgery of Trauma[10] as shown in Table 1.

Table 1. Grading of Liver Trauma (adapted from the American Association for the Surgery of Trauma (AAST) guidelines.[10]

Grade	Injury	Description
I	Haematoma	-Subscapular, less than 10% of surface area
	Laceration	-Capsular tear, less than 1 cm Parenchymal depth
II	Haematoma	-Subcapsular, 10-50% of surface area. -Intraparenchymal, less than 10 cm in diameter
	Laceration	1-3cm parenchymal depth, less than 10cm in diameter
III	Haematoma	-Subcapsular, more than 50% Surface area or expanding -Ruptured subscapsular, or parenchymal haematoma -Intraparenchymal, more than 10 cm or expanding
	Laceration	More than 3cm parenchymal depth
IV	Laceration	-Parenchymal disruption, involving more than 75% of hepatic lobe -One to three Couinaud segments within a lobe
V	Laceration	-Parenchymal disruption involving more than 75% of hepatic lobe -More than three Couinaud segments within a single lobe
	Vascular	Juxtahepatic venous injuries, i.e., retrohepatic cava/central major hepatic veins
VI	Vascular	Hepatic avulsion

The initial radiological studies were carried out using Ultrasonography & abdominal Computerized Tomography (CT) scan. In some patients CT with hepatic vascular reconstruction was performed which helped in assessing the degree of vascular injury.

Criteria of implementing the conservative treatment:

a) Hemodynamic stability or good response to plasma volume expansion.

b) Transfusion requirements < 2-3 red blood cell concentrates.

c) Absence of signs of diffuse peritonitis on physical examination; and.

d) No suspicion of associated abdominal injuries on imaging studies.

The hemodynamically stable patients remained under strict clinical observation,hemodynamic monitoring, and serial measuring of hemoglobin and absolute bed rest for a period of 48 – 72hours.

Criteria of failure of the conservative treatment:

The appearance of hemodynamic instability, clinical signs of peritonism and/or a continued reduction in hematocrit values was considered as non-surgical treatment failure with surgical exploration indicated.

Patients who become vitally stable with no signs of ongoing bleeding or peritonism were transferred to inpatient ward.

Abdominal CT was routinely performed prior to hospital discharge and was repeated after2 - 3 months to verify the resolution of the injuries.

Patients who did not fulfill any of the previously mentioned conditions were evaluated for immediate surgical treatment.

Demographic data, presentation &classification of hepatic injury, associated injuries, surgical technique, transfusion requirements, hospital stay and morbidity-mortality were studied for all patients. Analysis was done using SPSS 18. Statistical significance was set at $P<0.05$.

RESULTS

From January, 2007 to December, 2011, 65 patients with liver trauma were treated in our center. The mean age of the patients was of 20.4 years (range 4-38 years) with male to female ratio of 5.2:1(79.7% males). The injuries were due to blunt abdominal trauma in 63 patients (96.9%); 55 patients (84.6%) were due to road traffic accidents and 8 patients (12.3%) were due to direct blow to the abdomen. Penetrating injury was recorded only in 2 patients (3.1%) one injury was due to stab wound and the other was by firearms.

Among these patients 58.5% (38 patients) were previously explored before referral to our center while 41.5% (27 patients) were transferred without previous surgical interference (Table 2).

Table 2. Different presentations of referred patients.

Presentation	No. (%)
Intraperitoneal hemorrhage with hemodynamic instability	24 (36.9%)
Stable hematoma	12 (18.5%)
Controlled biliary fistula	11 (16.9%)
Stable with pack	5 (7.6%)
Biliary peritonitis	5 (7.6%)
Infected hematoma	8 (12.5%)

The classification of the severity of the hepatic injuries according to the HIS criteria was shown in *figure 1.*

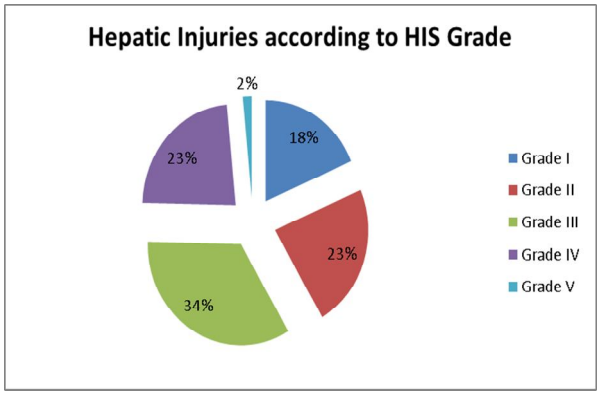


Fig 1. Classification of patients according to the HIS criteria.

Other associated injuries were presented in 26.1% of the cases (17 patients) as shown in Table 3.

Table 3. Associated other injuries.

Associated injuries	Number
Stable fracture skull base	1 (1.5%)
Lung contusion	3 (4.6%)
Hemothorax	4 (6.1%)
Splenic injury	3 (4.6%)
Pelvic fracture	2 (3%)
Fracture extremities	4 (6.1%)

After admission, thirty one of these patients (47.6%) were managed by non-operative management while 34 patients (52.4%) were managed by operative management. The non-operative management was in the form of conservative medical therapy in 19 patients (29.2%), drainage of biloma in 7 patients (10.7%) and endoscopic stenting for associated biliary injury in 5 patients (7.7%). The outcome of these non-operative measures is illustrated in *figure 2,* in which complete recovery occurred in 22 patients (71%), while biliary stricture occurred in 3 cases (10%) who managed later by surgical reconstruction in the form of bilio-enteric anastomosis, 4 cases (13%) were complicated by liver abscess secondary to infection of liver hematoma and finally 2 cases (6%) developed subphrenic abscess. These cases of liver and subphrenic abscesses were managed successfully by ultrasound–guided pigtail drainage.

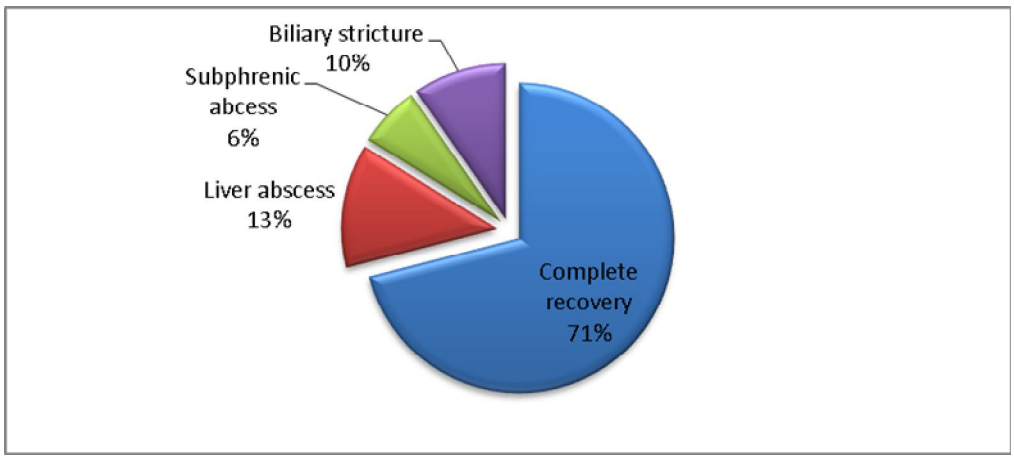
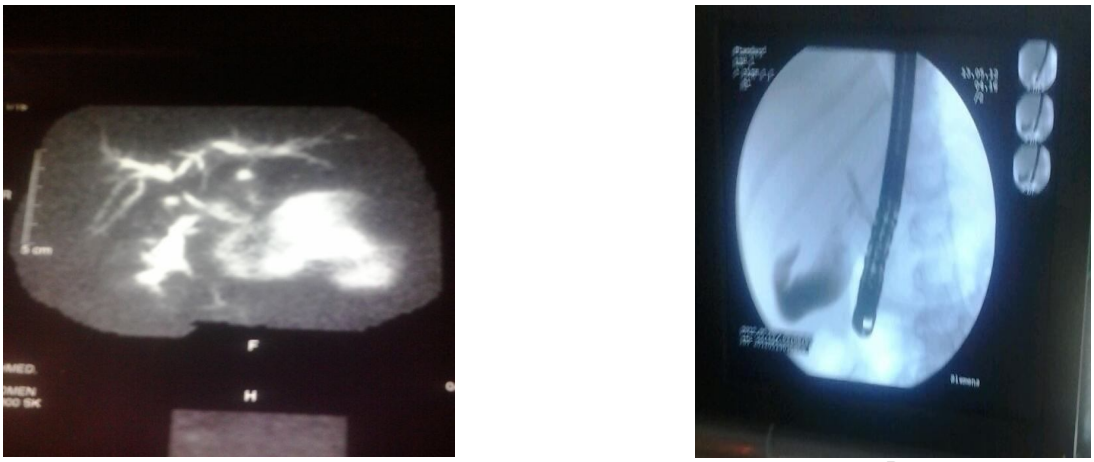


Fig 2. Outcome of non-operative management.

Thirty four patients (52.4%) underwent operative management; 5 patients (7.7%) were re-explored to remove packs put in the primary exploration, also 5 patients (7.7%) were for drainage of biliary peritonitis and no intervention done for the present liver injury and 24 patients (37%) explored due to hemodynamic instability supported by both laboratory and radiological data.

Four patients (6.2%) were explored and conservative surgery was done by hemostasis using combination between haemostatic stitches, diathermy (mono & bipolar) and argon beam. The remaining 20 cases (30.8%) underwent liver resection; left lateral segmentectomy was done in 3 cases (4.6%), right posterior sectionectomy in 2 patients (3.1%) and right hepatectomy in 15 patients (23.1%) with one (1.5%) perioperative mortality, one (1.5%) postoperative portal vein thrombosis and 3 (4.6%) postoperative biliary complications. The overall outcome of cases managed by operative exploration was shown in (Fig. 4).

From the previous data, 24 patients (36.9%) were hemodynamically unstable with a significantly greater proportion of these patients with a high grade (Grade IV& V) liver injury (p=0.018). Also as shown in table 3 there is a significant increase in operative management in these patients (p=0.022) without any significant difference as regard overall morbidity, mortality and hospital stay.



A B

Fig 3. a) Posttraumatic biliary stricture.
b) Biliary obstruction in same patient left & right duct dilatation (MRCP)(ERCP).

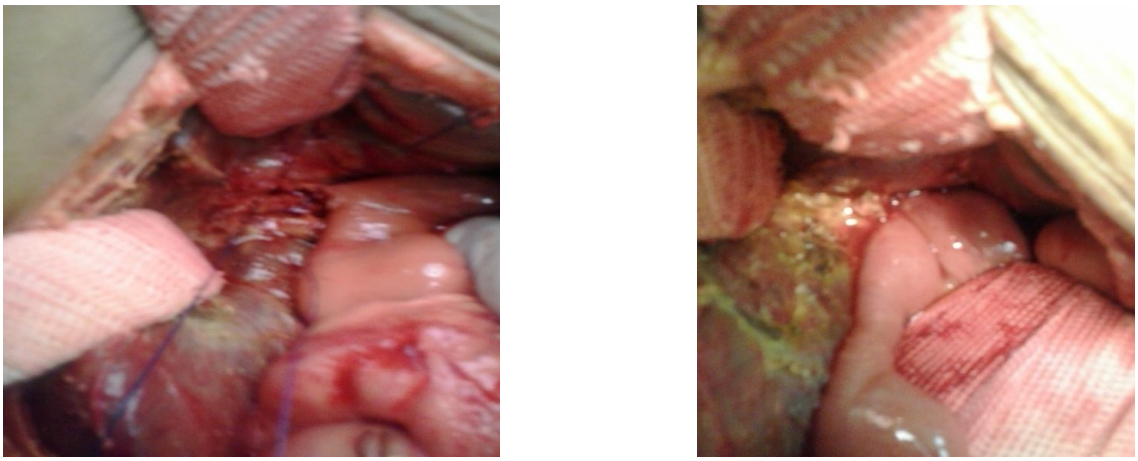


Fig 3. c) Surgical reconstructions by biliary-enteric anastomosis for posttraumatic biliary stricture.

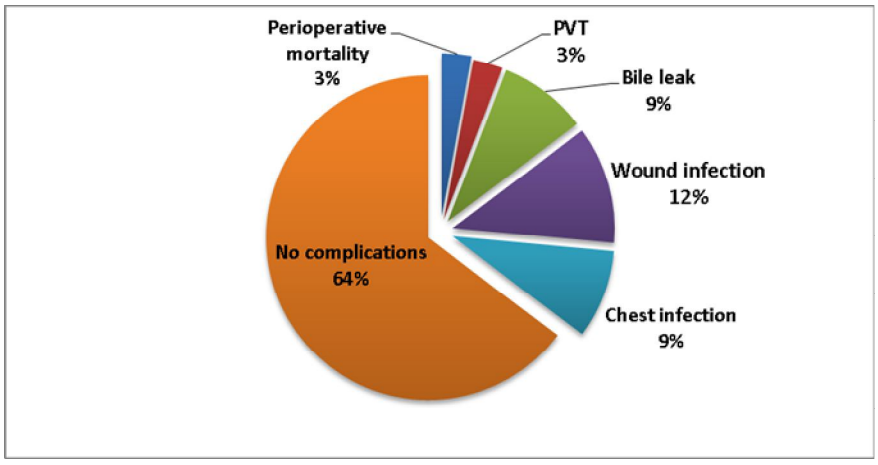


Fig 4. The outcome of operative management.

Table 4. Patient characteristics and outcomes of management.

		Hemodynamic stability		P value
		Stable	Unstable	
		41	24	
Severity of trauma	Isolated liver injury Multiple trauma	31 (75.6%) 10 (24.4%)	17 (70.8%) 7 (29.2%)	1
Liver injury grade	Low high	39 (95.1%) 2 (4.9%)	10 (41.6%) 14 (58.4%)	0.018*
Management strategy	Operative Nonoperative	10 (24.3%) 31 (75.7%)	24 (100%) 0 (0%)	0.027*
Median hospital stay (days)		10 (5-21)	12 (7-24)	0.345
Mortality		0 (0%)	1	0.132

Fig 5. Stab injury in the left lateral segment managed by haemostatic stitches.

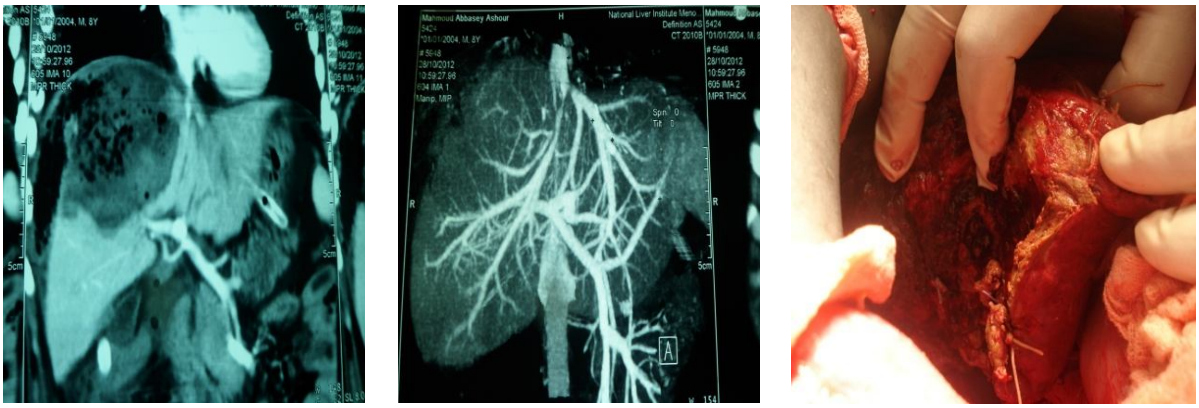


Fig 6. Sever liver injury with retrohepatic caval injury managed by right hepatectomy.

DISCUSSION

In the last 15 years, the treatment of liver trauma has progressively evolved.[11] At the beginning of the 1990'sseveral articles reported the possibility of non-surgical treatment in patients with hemodynamic stability similar to what is carried out by pediatric surgeons in cases of hepatic or splenic injuries.[12] The aim of this type of treatment is to thereby not only decreases the number of non-therapeutic laparotomies[13] but also to achieve a reduction in the values of morbi-mortality. In this group of patients immediate surgery is substituted by initial non-surgical treatment with close patient supervision. Surgery is indicated in cases of continued hemorrhage or the suspicion of the presence of determined associated lesions. Fortunately, a high percentage of injuries, around 85%, are not severe (HIS < grade IV),[14] which previously were treated with electro-coagulation, topical hemostatic agents or superficial ligature. In these injuries the hemorrhage had ceased at the time of surgery in a considerable number of cases.[13] It is in this group of patients that conservative treatment undoubtedly achieves the greatest percentage of success. However, in the remaining 10% - 20% of the severe hepatic injuries the decision as to whether surgery is necessary represents a difficult challenge for the surgeon. Therapeutic evolution has become possible thanks to the diffusion of imaging techniques such as echography and abdominal CT which are more rapid, sensitive and specific in the diagnosis of abdominal injuries,[11] and they have replaced peritoneal lavage because of its low specificity and bad prediction of the need for laparotomy,[15] despite its high sensitivity and speed of application. In our center we believe that an abdominal CT with contrast should be carried out within the first 24 hours on suspicion of hepatic injury. CT scanning has become the gold standard for diagnosis of solid organ injury and allows reasonably accurate grading of organ injuries and provides crude quantization of the degree of hemoperitoneum.

In the series published, the applicability of conservative treatment in patients with liver injury has varied from 35% to 82%[16] according to the year, the selection criteria and the number of patients studied. The two main variables guiding the therapeutic approaches were hemodynamic instability and the need for transfusion.[12] In our center conservative treatment was implemented in 31 patients (47.6%) without mortality but with recorded morbidity of 13.8%. which is lower or nearly similar to what has been reported in the literature which in many series approximate to 15%[16] which may be attributed to the application of non-operative management to cases of low grade injury. There are no predictive criteria to allow either the selection of the type of adequate treatment or to predict the failure of conservative treatment. Thus, the application of conservative treatment in cases of liver trauma obliges the surgeon to perform continuous monitoring of the patient during the first 48 hours and to have adequate infrastructure to allow immediate surgery on observation of clinical deterioration of the patient.[17] Currently most authors consider that the decisive factor in deciding the implementation of conservative treatment should be hemodynamic stability after initial recovery independently of the grade of the injury and the quantity of hemoperitoneum estimated by CT.[18] In two cases (8.3%) conservative treatment was implemented but failed due to hemodynamic instability. Nonetheless, in a series of 500 patients who received conservative treatment, Malhota et al described a failure rate of only 23 % in the group of patients (n=30) with grade V lesions.[19] Other series show that Non operative management of high-grade liver injuries have been successful[13] but are associated with significant morbidity and correlates with the grade of liver injury.[20] Complications require a multidisciplinary treatment and a strategy should be anticipated in grade IV and V injury.[21] High-grade injuries can be managed non-operatively, if operative interventions not required for hemodynamic instability or associated injuries, with a low mortality. [13] In this subgroup with high risk of conservative treatment failure, the use of angiography with selective embolization of the hepatic injuries may be useful.[14] The main cause of the low use of angiography is that the majority of vascular injuries are venous.[22]

In a series of 337, patients with grades IV and V injuries are more likely to require operation, and to have complications of non-operative treatment. Therefore, although it is not essential to perform liver resection at the first laparotomy, if bleeding has been effectively controlled,[4] increasing evidence suggests that liver resection should be considered as a surgical option in patients with complex liver injury, as an initial or delayed strategy, which can be accomplished with low mortality and liver related morbidity in experienced hands.[16] In the present series all the patients with grade IV &V and 8 patients of grade III injury underwent surgery. Only 4 patients (16.6%) out of the 24 patients underwent operative exploration for hemodynamic instability underwent conservative surgery without evident morbidity. Twenty patients (83.4%) underwent liver resection with very low mortality and morbidity that may be referred to early detection and grading of the liver injury, the use of refined and meticulous surgical techniques, and application of formal hepatectomies.

In summary, conservative treatment of hepatic injury is applicable (83.1%) in patients presenting hemodynamic stability, although in grade V injuries there is a high risk of conservative treatment failure and, in our opinion, these patients should undergo surgical treatment after diagnosis. Early liver lobectomy in such cases required lesser number of procedures and achieved lower complication rate and lower mortality compared to less aggressive approaches such as serial operative debridement and/or percutaneous drainage.

In conclusion Hemodynamic stable patients can be managed safely non-operatively. Urgent surgery

continues to be the standard for hemodynamic compromised patients with hepatic trauma. Major liver resection can be done safely in hemodynamically unstable patients without significant increase in morbidity or mortality.

CONCLUSION

Hemodynamic stable patients can be managed safely non-operatively. Urgent surgery continues to be the standard for hemodynamic compromised patients with hepatic trauma. Major liver resection can be done safely in hemodynamically unstable patients without significant increase in morbidity or mortality.

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