JULY - SEPTEMBER 2013

MEDICAL CHANNEL

Original Article

EVALUATION & MANAGEMENT OF PATIENTS WITH LIVER TRAUMA

1. **ALTAF AHMED TALPUR**
MBBS, FCPS
2. **MOHAMMAD SHARIF AWAN**
MBBS, FCPS ,FRCS
3. **FAZILA HASHMI**
MBBS, FCPS
4. **AKMAL JAMAL**
MBBS, FCPS**, FRCS**

1. ***Assistant Professor***
Surgery Unit – III
Liaquat University of medical and Health Sciences,
Jamshoro.Hyderabad
2. ***Associate Professor***
Department of Surgery
Peoples Medical University of Health , Nawabshah.
3. ***Assistant Professor***
Surgery Unit – I
Liaquat University of medical and Health Sciences,
Jamshoro.Hyderabad
4. ***Incharge Surgical Unit – III***
Liaquat University of medical and Health Sciences,
Jamshoro.Hyderabad

CORRESPONDENCE:
DR. ALTAF AHMED TALPUR
Flat No: A- 202, Fort Sultan Apartments, Opposite Airport Telephone Exchange,
Main Shahra-e- Faisal, Karachi, Pakistan.
Tel: 021-4570819, 0300-2185479
E-Mail: altafktalpur@yahoo.com

ABSTRACT

Background: Liver trauma is one of the commonest surgical emergencies dealt by general surgeons worldwide. The incidence of liver trauma has increased recently due to more road traffic accidents & more violence in the community. It is associated with significant morbidity & mortality. It required well defined & well designed protocols to identify liver injury & treat it accordingly at the earliest.
Materials & Methods: A prospective, descriptive study conducted at surgical ward of Liaquat university Hospital, Hyderabad, Pakistan from Jan 2009 to Dec 2012. All patients of either sex above the age of 12 years who presented with trauma to lower chest & abdomen & clinically as well as on investigations or at operation found to have liver injuries were included in the study. Variable studied in this study were age, sex, pattern of trauma, Grading of liver injuries, associated injuries to other structures, treatment applied & post treatment complications.
Results: Total 103 patients with liver injuries were evaluated. Mean age was 27.35 years with SD ± 12.23 (14-67years) with male to female ratio of 5.18: 1. RTA was the commonest cause of Liver trauma in 74 patients. 20(19.41%) of blunt trauma & 16(15.53%) patients of penetrating injury presented in profound hypotension & were directly transferred to OR & operated. Findings were grade IV & V liver injuries in 15 patients. 21 unstable patients had Grade I to III liver injuries. Associated injuries to other viscera were found in all these patients.
Remaining 57(55.33%) patients of blunt trauma & 10(9.7%) patients of penetrating injury were admitted & investigated. C.T scan Abdomen was performed in 57 (55.33%) patients. 21 patients were managed conservatively & recovered. Remaining 36 patients were operated. Postoperatively 26(25.24%) developed complications. 07(6.79%) died.
Conclusion: Liver trauma is a commonly found condition in younger age group which carries significant morbidity & mortality. It is most commonly due to RTA. It can be effectively managed if these patients are properly evaluated.

Keywords: liver trauma, evaluation, management

INTRODUCTION

The liver is second most commonly injured organ following blunt or penetrating trauma injury to the abdomen[1]. Despite its location beneath lower rib cage liver injury represents an important aspect of trauma in isolation as well as in polytrauma patients & is associated with significant morbidity & mortality[2, 3]. The incidence of liver trauma has continuously increased specially in recent years & Trauma is now recognized as the 3rd common killer overall & top most killer in younger age group[4]. Diagnosis & treatment of liver trauma is a significant challenge that requires high index of suspicion clinically, quick & effective investigations to diagnose liver trauma & asses its grades of injury. It also requires vigorous monitoring & application of well defined & well designed

protocols of treatment to lessen morbidity & mortality[3, 5]. Over the years outcome of liver trauma patients has improved & there has been marked decrease in liver trauma related deaths to 5% in penetrating injuries & 2% in blunt trauma patients. All this is due better imaging modalities to diagnose & assess severity of liver trauma, remarkable advances in critical care, availability of multiple pints for transfusion to counterfeit profound shock & with the evolving concepts of damage control surgery & highly specialized hepatobiliary surgery units to deal with complex injuries[6-8]. There is paradigm shift in the management of liver trauma due to advancements of diagnostic & therapeutic modalities[6]. Introduction of ultrasound of trauma, computed tomography scan & availability of diagnostic & interventional angiography techniques has revolutionized the management of liver trauma[9]. C.T scan, although reflective of extent of parenchymal injury, cannot reliably predict the clinical outcome of attempted non-surgical management[10]. Though there is broader consensus regarding the nonoperative approach even in high grade injuries, however, some controversies still exist[11].It is in fact a reality that main goal in the treatment of severe liver injuries includes rapid control of bleeding from the liver along with aggressive resuscitation followed by definitive surgical therapy & dealing with all associated injuries[12].

The purpose of this study is to present our experience of dealing with liver injuries in our setup keeping in mind the available diagnostic & therapeutic modalities & comparing it with local & international literature. Our aim is to produce more evidence so that proper measures can be taken to address issue of prevention of trauma & dealing with liver trauma patients more efficiently.

MATERIALS & METHODS

This was a prospective, descriptive study conducted at a surgical ward of Liaquat university hospital, Hyderabad, Pakistan from Jan 2009 to Dec 2012. All patients of either sex above the age of 12 years who presented with trauma to lower chest & abdomen; & clinically as well as on investigations or at operation found to have liver injuries were included in the study. All trauma patients below the age of 12 years, trauma patients presented in unconscious & unstable state in whom diagnosis of liver injuries was not established, trauma patients having no liver injuries, trauma patients suspected to have vascular injuries & referred to or went to other setup & patients did not consented for study were excluded.

These patients were evaluated according to ATLS guidelines & managed accordingly. All life threatening injuries were recognized & dealt immediately. All haemodynamically unstable patients who did not responded to fluid resuscitation with fast infusion of 2 liters of crystalloid or colloid solution & on FAST found to have abdominal injury were shifted to OR & operated immediately after arranging blood. In these patients life or limb threatening injuries to other parts of body were either excluded or dealt accordingly prior to operation or at the time operation. All haemodynamically stable patients admitted in ward. Detailed history was taken especially in data related to age, sex, pattern of injury like blunt trauma, motor vehicle accident or penetrating trauma, symptomatology especially symptoms of abdominal pain, vomiting, breathlessness, symptoms of peritonitis & weakness. Thorough examination was performed with special focus on variables like pulse , blood pressure, respiratory rate, pallor, status of peripheries, and abdominal & chest examination. Investigations were performed to establish diagnosis and to assess general fitness. These include complete blood count, blood sugar, blood urea, serum electrolytes, x-rays of chest, cervical spine & pelvis. Ultrasound abdomen, chest and where required C.T scan of Abdomen & chest was performed. X- Rays of other parts of body which sustained trauma were also performed. Diagnostic peritoneal lavage was not required in any of the patient in this study. Diagnosis was made. General management of the patients was started which includes I/V fluids, I/V antibiotics, Analgesics, measurement of urinary volume after passing two ways Foley's catheter. Preoperative resuscitation performed and patient's condition was optimized. Patients were briefed about the diagnosis and treatment to be undertaken or performed which includes conservative treatment or surgical treatment.

The criterion for conservative treatment was blunt trauma to abdomen with hemodynamic stability & trauma to other viscera necessitating surgery excluded. These patients were kept under closed observation. TPR & Blood pressure chart maintained 1 hourly for initial 24 hours & 4 hourly later on until patient tolerated feed well & became mobile. They were also observed for any signs of abdominal distension or peritonitis during observation. Repeat Blood C.P with haematocrit value & ultrasound abdomen was performed if deterioration in any of the above signs arise or at 24 hours to note down status of abdomen. Patients who became unstable during conservative treatment with decreasing hemoglobin concentration attributable to the injury or developed symptoms & signs of peritonitis were operated. At laparotomy one of the following procedures was performed for liver injuries in addition to specific procedure for other abdominal injuries. These include suture hepatorraphy with or without local haemostatic agents, perihepatic packing or combination of both. Haemodynamically instability was defined as systolic blood pressure less than 90mmHg in adults at the time of presentation with no response to fast infusion of 2 liters of colloid or crystalloid solution or those whose show initial response but deteriorated again after resuscitation.

Patients were informed and permission was obtained. They were assured that their participation is voluntary with no harms to them in terms of getting due treatment. They were also given right to withdraw from study without putting any reasons.

Subject's data was collected on preformed proforma. Variable studied in this study were age, sex, pattern of trauma, Grading of liver injuries, associated injuries to other structures, treatment applied & post treatment complications. Liver injuries were classified according to American association for the surgery of trauma (AAST) on C.T scan Abdomen or at operation.

Results were compiled. Specific statistical tests were applied & P-value was calculated using SPSS version 12. These results were compared with national and international literature.

RESULTS

During the study period of 4 years a total of 103 patients with liver injuries were evaluated. Mean age of this group of patients was 27.35 years with SD ± 12.23 (14-67years). Majority of them i –e 49(47.57 %) patients belonged to the 2nd & 3rd decade of life. Amongst them 83(80.58%) were male and 16(19.42%) were female making the male to female ratio of 5.18: 1.

Road traffic accident was cause of Liver trauma in 74(71.84%) patients, fire arm injuries in 25(24.27%) & stab wound in 01(0.97%). Two (1.94%) patients gave H/O of fall from height, & 01(0.97%)

TABLE 1:
DATA OF PATIENTS WITH LIVER TRAUMA (N=103)

Data	Blunt Trauma Abdomen n= 77(74.75%)	Penetrating Trauma n=26(25.25%)	Total
AAST Classification of Liver injuries			
Grade I	07(6.8%)	00	07(6.8%)
Grade II	29 (28.15%)	04(3.88%)	33(32%)
Grade III	36(34.95%))	12(11.65%)	48(46.6%)
Grade IV	04(3.88%)	09(8.73%)	13(12.6%)
Grade V	01(0.97%)	01(0.97%)	02(1.9%)
Grade VI	00	00	00
Haemodynamically Stable	57(55.33%)	10(9.7%)	16(15.53%)
Haemodynamically unstable	20(19.41%)	67(65%)	36(35%)
Associated injuries			
Splenic injury	03((2.9%)	00	03(2.9%)
Gut injury	06(5.8%)	05(4.85%)	11(10.67%)
Mesenteric injury	05(4.85%)	03(2.9%)	08(7.76%)
Urological injury	16(15.53%)	04(3.8%)	20(19.41%)
Diaphragmatic injury	00	05(4.85%)	05(4.85%)
Pancreatic injury	04(3.8%)	02(1.9%)	06(5.8%)
Retroperitoneal injury	09(8.73%)	08(7.76%)	17(16.50%)
Chest injury	37(35.92%)	08(7.76%)	46(44.66%)
Pelvic bone injury	02(1.9%)	00	02(1.9%)
Management			
Conservative	20(19.41%)	01(0.97%)	21(20.38%)
Surgery	57(55.33%)	25(24.27%)	82(79.61%)

TABLE 2:
LIVER INJURY SPECIFIC SURGICAL PROCEDURES (N=82/ 103)

Type of procedure	Blunt trauma(n=57/77)	Penetrating injury(n=25/26)	Total n=82
Simple drain	02(1.9%)	00	02(1.9%)
Suture Hepatorraphy alone	14(13.59%)	03(2.9%)	17(16.50%)
Suture Hepatorraphy with topical Haemostatic agent	37(35.92%)	15(14.56%)	52(50.48%)
Suture Hepatorraphy with perihepatic packing	03(2.9%)	06(5.8%)	09(8.73%)
Perihepatic packing alone with drain	01(0.97%)	01(0.97%)	02(1.9%)

sustained blunt trauma to lower chest & upper abdomen.

Amongst 103 patients, 20(19.41%) of blunt trauma & 16(15.53%) patients of penetrating injury presented in profound hypotension & were directly transferred to OR for surgery after confirming diagnosis of liver injury clinically & after ultrasound abdomen & after dealing with other life or limb threatening injuries to other parts of body prior to surgery. In these patients cause of instability was found as grade IV & V liver injuries in 15(14.56%) patients. Remaining 21(20.38%) unstable patients had Grade I to III liver injuries. However associated injuries to other viscera were found in all these patients. These patients had complex injuries involving spleen in 03(2.9%) patients, kidneys in 08(7.76%) patients, retroperitoneum in 10(9.7%) patients, mesentery in 07(6.8%) patients, urinary bladder & pelvic fracture in 02(1.94%) patients, pancreas in 03(2.9%) patients & Haemothorax in 11(10.67%) patients. Treatment employed in these patients include simple drain along with splenectomy & treatment of associated injuries in 2(1.94%) patients as bleeding from liver injury was already stopped in these patients. Suturing of liver laceration was performed in 02(1.94%) patients, suturing with local haemostatic agent in 21(20.38%) patients, suturing with perihepatic packing in 09(8.73%) patients & perihepatic packing alone in 02(1.94%) patients of grade V liver injury.(Table I & II)

While remaining 57(55.33%) patients of blunt trauma & 10(9.7%) patients of penetrating injury were admitted initially in ward. Further workup was done to assess grade of liver injury, any associated injuries to other viscera of abdomen & other parts of body through ultrasound Abdomen & C.T scan of Abdomen & chest x-ray.

Ultrasound of Abdomen & chest was performed in 94(91.26%)

TABLE 3:
COMPLICATIONS IN PATIENTS TREATED FOR LIVER TRAUMA (N=26/103)

Complications	Blunt Trauma n= 10/77(9.7%)	Penetrating injury n=16/26(15.53%)	Total n=26/103(25.24%)
Postoperative bleeding	02(1.9%)	03(2.9%)	05(4.85%)
Biliary leakage	01(0.97%)	01(0.97%)	02(1.9%)
DIC	02(1.9%)	01(0.97%)	03(2.9%)
Intra-abdominal Abscess	01(0.97%)	01(0.97%)	02(1.9%)
Wound infection	02(1.9%)	01(0.97%)	03(2.9%)
Faecal fistula	00	02(1.9%)	02(1.9%)
Pancreatic fistula	00	01(0.97%)	01(0.97%)
Burst Abdomen	00	02(1.9%)	02(1.9%)
Empyma thoracis	00	01(0.97%)	01(0.97%)
Urinary fistula	00	01(0.97%)	01(0.97%)
Pneumonia	01(0.97%)	01(0.97%)	02(1.9%)
Bronchopleural fistula	01(0.97%)	00	01(0.97%)
	00	01(0.97%)	01(0.97%)
Mortality Rate	03(2.9%)	04(3.88%)	07(6.8%)

patients. It showed Liver injury in 81(78.64%), Splenic injury in 03(2.9%), retroperitoneal haematoma 05(4.78%), kidney injury in 05(4.78%) & Haemothorax in 29(28.15%) patients. Ultrasound also showed free fluid in peritoneal cavity with internal echoes in all these patients.

C.T scan Abdomen was performed in 56 (54.36%) patients with blunt trauma & in 01 (0.97%) patient with penetrating injury. It showed grade I Liver injury in 5(4.78%), Grade II & III injury in 28(27.18%) & 24(23.30%) patients respectively. Associated injuries detected on C.T scan include: Chest injuries in 32(31.06%), Pancreatic injury in 03(2.9%) patients, gut injury in 06(5.8%) each, Mesenteric injury in 01(0.97%), Urological injury in 10(9.70%) & retroperitoneal haematoma in 04(3.8%) patients.

Chest x- ray performed in 97(94.17%) patients who show rib fractures in 3 (35.92%) patients, Pneumothorax & Haemothorax in 11(10.67%) patients each & Haemopneumothorax in 18(17.47%) patients.

Five (4.85%) patients of Grade I & 15(14.56%) patients of grade II blunt liver injury & 01(0.97%) patients of grade II penetrating injury to liver were managed conservatively & recovered. These patients had no associated injury to abdominal viscera. However 16(15.53%) patients had chest trauma that was managed with chest intubation under local anesthesia. In remaining 15(14.56%) patients of grade II liver injury suturing of laceration was performed & in 31(30.09%) patients of Grade III liver injury suturing over local haemostatic agent was performed. Associated injuries in these patients include gut injuries in 06(5.8%) patients, chest injuries in 13(12.6%) patients, Diaphragmatic injuries in 05(4.85%) patients, kidney injury in 04(3.8%) patients & pancreatic with retroperitoneal injury in 03(2.9%) patients.(Table I & II)

Postoperatively 10/77(9.7%) patients of blunt trauma & 16/26(15.53%) of penetrating injury developed complications. 03(2.9%) patients of blunt injury & 04(3.88%) of penetrating injury died due to uncontrolled bleeding, DIC & sepsis. (Table III)

DISCUSSION

Incidence of liver trauma has increased considerably in recent years as is depicted in study by Trunkey DD et al[4] from United States in which he stated that 137,000 people were injured daily. Most of the fraction of these injuries is due to road traffic accidents followed by violence induced trauma & gunshot injuries respectively. Exact data of liver injuries is not available in our country due to lack of trauma registry, however many studies shows same pattern as the RTA are the main reason of liver injuries in our part of world[2, 13,14]. Same pattern of injuries are also found in this study which shows blunt abdominal trauma as cause of liver injury in 74.75% patients.

Diagnosis of most penetrating injuries to the abdomen doesn't pose any problem specially when peritoneum is breached & these patients are operated & exploratory laparotomy is performed. However in cases when doubt exists about peritoneal violation, exploration of local wound is made under local anesthesia & if confirmed formal laparotomy is performed under general anesthesia. Patients sustaining blunt trauma are evaluated clinically for symptoms & signs of intra-abdominal visceral injury such as rigidity, distension or unstable vital signs with no evident blood loss from any other site. If clear cut signs of intra abdominal injuries are found exploratory laparotomy is performed. However, if doubt exists & Hemodynamic status allows than patient is evaluated with different investigation techniques like FAST scan, CT scan or DPL to confirm diagnosis. Once diagnosis is confirmed decision is made for further line of treatment [15 - 17]. In this study 46.75% of blunt trauma patients had grade I & II liver injuries while 15.38% 0f penetrating injuries had same type of injuries. Grade III injuries were found in same percentage (46%) in both types of injuries. Grade IV & V injuries were noted in 6.39% patients of blunt trauma & in 38.45% patients of penetrating injuries indicating higher percentage of high grade injuries in penetrating injuries.

In our study 20/77 (25.97%) patients of blunt trauma & 16/

26(61.50%) of penetrating injury presented with hemodynamic instability & were operated immediately. It shows higher percentage of patients of penetrating injury present in unstable status suggesting more severe form of injury in this type of injury. In this study 74.02% patient of blunt trauma & 38.46% patients of penetrating injuries presented with stable vital status. They were admitted & investigated with ultrasound Abdomen, CT scan Abdomen & chest x ray.

25.98% patients of blunt trauma & 3.84% patients of penetrating injury were managed conservatively in this study which is considerably low to international studies. This may be due to lack of facilities to properly diagnose liver trauma & to grade it. At the same time there is deficiency of proper monitoring of these critical cases in public sector hospitals. In the western countries there is shift towards non operative treatment of patients with liver trauma. It is safe & efficient way & associated with lower mortality rate but still have a significant percentage of complications[18 - 19]. However for non operative management to be safe strict monitoring of condition of patient is advisable to avoid risk to life & at the same time trauma surgeon should be available to monitor progress of patient & to intervene if non operative treatment fails. Alert patients with persistent hemodynamic status are ideal candidates for conservative treatment[1].

Among the stable patients 74.02% of blunt trauma & 34.61% patients of penetrating injury underwent surgery which is considerably higher than international studies. This may be due to fact that most patients in stable category were operated for non liver injuries & liver injuries were dealt also accordingly at the same time.

Most common procedure performed in this study was suturing of liver laceration over topically applied haemostatic agent that was performed in 62.40% patients, followed by simple suturing of laceration in 18.28% patients. Packing with or without suturing was performed more in penetrating injuries(28%) in comparison to 7.04% patients of blunt injury. In study by Trunkey DD et al[4] at USA used simple drainage was the commonest procedure performed i-e in 69.1% patients of his study while lacerations were sutured in 20.4% patients, debridement of laceration with ligation of bleeding vessel or sub-lobar or lobar resection was contemplated in 6.5% patients. In another local study conducted by Saaiq m et al[2] perihepatic packing was performed in 38.05% patients followed by suturing with topical haemostatic agent in 34.51% patients. They performed right hepatic artery ligation in 5.30% patients.

In blunt trauma 9.7% & in penetrating injury 15.53% patients developed postoperative complications with postoperative bleeding as most common complication found in 4.85% patients. Mortality rate was 3.88% in penetrating injury & 2.9% in blunt injury which makes a total of 6.8% in this study. In study by saaiq M et al[2] 23.89% patients developed complications. While study by Bala M et al[20] showed 5% complications in with high grade liver injuries.

CONCLUSION:

Liver trauma is a commonly found condition in younger age group which carries significant morbidity & mortality. It is most commonly due to RTA. It can be effectively managed if these patients are properly evaluated.

REFERENCES:

1. Hamdy H, Nasr MM, Eisha HA, Sherif O, Elsebae M. Evaluation of Management options for trauma liver injuries. Egyptian J of Surg. 2012; 31(1): 16 -23.
2. Saaiq M, Din N, Zubair M, Shah SA. Presentation & outcome of surgically managed liver trauma; experience at a tertiary care teaching hospital. J Pak Med Assoc. 2013; 63(4): 436 – 439.
3. Badger SA, Barclay R, Campbell P, Mole DJ, Diamond T. Management of liver trauma. World J Surg. 2009; 33: 2522 – 37.
4. Trunkey DD, Shires GT, McClelland R. Management of liver trauma in 811 consecutive patients. Ann. Surg. 1974; 179(5): 722 – 728.
5. Van vugt R, Bosscha K, Olsmann J, Jager GJ, de lager CP. Management of Hepatic trauma: A 9 years experience in s'Hertogenbosch. Acta Chir Belg. 2009; 109: 42 – 46.
6. Ahmed N, Vernick JJ. Management of liver trauma in adults. J Emerg Trauma shock. 2011; Jan – March, 4(1): 114 – 119.
7. Chiara O, Cimbanassi S, Bini R, Pavesi L, Rampoldi A, Colombo F, et al. Nonoperative management of traumatic liver injuries. Ann Ital Chir. 200; 76: 161 – 5.
8. Tinkoff G, Esposito TJ, Reed J, Kilgo P, Flides J, Pasquale M, et al. American association for the surgery of trauma organ injury scale I: Spleen, liver & kidney, validation based on the national trauma data bank. J Am Coll Surg. 2008; 207: 646 – 55.
9. Pachter HL, Hofstetter SR. The current status of non operative management of adult blunt hepatic injuries. Am J Surg. 1995;169: 442 – 54.
10. Yoon W, Jeong YY, Kim JK, Seo JJ, Lim HS, Shin SS. CT in blunt liver trauma. Radiographics. 2005; 25: 87 – 104.
11. Pachter HL, Knudson MM, Esrig B, Ross S, Hoyt D, Cogbill D, et al. Status of non operative management of blunt hepatic injuries in 1995: A multicentre experience with 404 patients. J Ttrauma. 1996; 40: 31 – 8.
12. Parks RW, Chrysos E, Diamond T. management of liver trauma. Br J Surg. 1999; 86: 1121 – 35.
13. Muizuddin M, Rehman A, Alam SN, Manzar S. Intra-abdominal visceral injuries in blunt abdominal trauma. Pak j surg. 2009; 25: 29 -32.
14. Khan JS, Iqbal N, Gardezi JR. Pattern of visceral injuries following blunt abdominal trauma in motor vehicle accidents. J Coll Phys Surg. 2006; 16: 645 - 47.
15. Thal ER, Shires GT. Peritoneal lavage in blunt abdominal trauma. Am J Surg. 1973; 125: 64.
16. Scalea TM, Rodriguiz A, Chiu WC, Brenneman FD, fallon WF, Kato K, et al. Focused assessment with sonography for trauma(FAST): Results from international consensus conference. J trauma. 1999; 46: 466 – 72.
17. Poletti PA, Mirvis SE, Shanmuganathan K, Killeen KL, Coldwell D. CT criteria for management of blunt liver trauma: correlation with angiographic & surgical findings. Radiology. 2000; 216: 418 - 27.
18. Velamhoas GC, Konstantinos T, Radan R, Chan L, Rhee P, Tillou A, demetriaades D. High success with nonoperative management of blunt hepatic trauma. Arch Surg. 2003; 138: 475 – 81.
19. Norman G, Tingstedt B, Ekelund M, Anderson R. Non operative management of blunt liver trauma: feasible & safe also in centres with a low trauma incidence. HPB (oxford). 2009; 11: 50 – 6.
20. Bala M, Gazalla SA, Faroja M, Bloom AI, Zamir G, Rivkind AI, et al. Complications of high grade liver injuries: management & outcome with focus on bile leaks. Scandinavian J Trauma Resuscit Emerg Med. 2012; 1741 – 1757.