BLUNT TRAUMA LIVER –CASE REPORTS AND REVIEW

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ABSTRACT

Liver is the second most frequently injured organ in blunt trauma patient. Recently there is a shift from surgery to non-operative management due to the improvement of the imaging techniques and to the new concepts in the angiographic management of intra-hepatic vascular injuries. We present two cases of Poly-trauma with blunt liver injury which were managed at Sri Ramachandra Medical Centre surgically. Management of liver injuries is either surgically or non surgically depending on a variety of factors, the most important ones being the hemodynamic status and associated injuries. The operative techniques include perihepatic packing, omental packing, absorbable meshes, liver resection and even liver transplantation.

The characterization of blunt liver trauma is performed using a CT-based grading system, adopted from the American Association for the Surgery of Trauma (AAST) and adapted for CT by SE Mirvis in 1989. This 6-grades classification reflects the extent of parenchymal liver damage, but cannot reliably predict the probable clinical outcome of attempted nonsurgical management. Arterial contrast media extravasation has been reported as an helpful sign for improving the success of nonsurgical management, because it allows arterial embolization to be performed before the patient become hemodynamically unstable.

Reports suggest that an algorithm based on CT criteria, including the CT-grade of hepatic injuries (using the AAST injury severity scale classification), the presence of a contrast blush on the arterial phase and the involvement of a major hepatic vein, could help select high risk patients to angiographic procedure.

Angiographic embolization of arterial blush is not only used to improve the success of non-operative management but also as a precious adjunct to surgery to help stop hemorrhage in extended fracture of the liver. The main delayed complications of liver trauma consist in super-infection, abscess, bile leak, biloma and arterio-venous fistula and a remote post-traumatic biliary duct stenosis are generally encountered in high grade injuries. Abscess and intra-peritoneal bile leaks are most often treated by percutaneous drainage; resolution of a bile duct tear is usually a long term process. Scintigraphy and, more recently, MRI can be used to confirm and localize a bile leak. The percentage of successful non- operative management will be increased if the radiologist could help the surgeon to identify patients at risk of bleeding, to select them for angiographic embolization.

Key words: *Blunt injury, Liver, Surgical procedure*

INTRODUCTION:

The relatively fixed position of the liver and its large size makes it more prone for injury in blunt trauma of the abdomen. Liver and spleen together, account for 75% of injuries in blunt abdominal trauma. (1) Though liver is the second most commonly injured organ in abdominal trauma, it is the most common cause of death following abdominal injury. Compared to splenic injuries, management of liver trauma still remains a challenge in the best of trauma centers.

In the past, most liver injuries were treated surgically. However evidence confirms that about 86% of liver injuries have stopped bleeding by the time surgical exploration is performed and 67% of laparotomies done for blunt trauma abdomen are non-theraupetic(2) Imaging techniques especially Computerised Tomographic Scan(CT) has created remarkable impact in managing liver trauma patients by reducing the number of laparotomies.(3,4) About 80% of adults and 97% of children are presently managed conservatively world wide at high volume trauma centres.

The large size of the liver, the friable parenchyma, its thin capsule and its relatively fixed position make it prone to blunt injury. Right lobe is more often involved, owing to its larger size and proximity to the ribs. Compression against the fixed ribs, spine or posterior abdominal wall result in predominant damage to segments 6, 7 and 8 of the liver (>85%). Pressure on right hemithorax may propagate through the diaphragm producing contusion of dome of right lobe of liver. Liver's ligamentous attachments to diaphragm and posterior abdominal wall act as sites of shearing forces during deceleration injury. Liver injury can also occur as a result of transmission of excessively high venous pressure to remote body sites at the time of impact. Weaker connective tissue framework, relatively large size and incomplete maturation and more flexible ribs account for higher chance of liver injury in children compared to adults. Deceleration injuries producing shearing forces may tear hepatic lobes and often involve the inferior vena cava and hepatic veins. A steering column injury can damage an entire lobe. Liver trauma may result in subcapsular/intrahepatic hematomas, lacerations, contusions, hepatic vascular injury and bile duct injury. Most blunt trauma liver (80% in adults

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and 97% in children) are treated conservatively (2). Conservative treatment mandates repeated clinical monitoring and surgical intervention if conservative treatment fails. A comparison of patients receiving operative and non-operative treatment of liver injuries has revealed no difference in the length of hospital stay, but requirements for blood transfusion and intraabdominal complications were significantly lower in those managed conservatively. In this article, we have reviewed two challenging cases of blunt liver trauma in poly-trauma patients managed in our surgical unit of Sri Ramachandra Medical centre during the time period June – August 2007.

CASE REPORTS OF BLUNT HEPATIC TRAUMA IN POLYTRAUMA PATIENTS:

Case1.

A 27 year old male was brought to Emergency Room(ER) with history of Road traffic accident(RTA). On examination he was conscious, oriented, tachypnoeic with pulse rate of 110/min and BP of 80/60 mm Hg. Examination of abdomen revealed diffuse tenderness. Guarding was present in the entire abdomen. He also had fracture of right lower end of radius with tenderness over the lower back. Neurological examination was normal. Ultrasound revealed free fluid in abdomen and solid viscerae were normal. X ray of lumbar spine revealed multiple transverse process fractures in L1 – L5 level. Despite adequate resuscitation with crystalloids and whole blood, patient did not improve. Emergency laparotomy was done when liver laceration 5 x 3x 2 cm on anterolateral surface with active hemorrhage was noted. Hepatic packing did not stop the bleeding and so hepatorraphy with omental packing was done to achieve hemostasis. A contusion in the neck of pancreas 2 x 2 cm was found which was left alone. The lumbar spine and radial injuries were managed conservatively. Patient was in the hospital for 2 weeks in all. He was started on oral liquids from 4th postoperative day(POD), drain removed on 6th POD and suture removal done on 10th POD. Patient did well postoperatively and was discharged on the 14th POD.

Case 2:

A 28 years old male patient was brought to ER following a RTA with BP of 80/60 mm Hg. Patient was conscious, oriented and had pallor. Urinary catheterisation revealed frank hematuria. Abdomen was distended. Guarding, rigidity and diffuse tenderness were present over the entire abdomen. Patient was resuscitated with crystalloids and whole blood when BP improved to 130/80 mm Hg and pulse rate of 100/min. Initial Ultrasound revealed grade 2 renal injury with moderate hemoperitoneum, liver and other viscerae were normal. As CT was nonfunctional on the day, urgent Intravenous Pyelogram (IVP) was done which showed a non-enhancing Right Kidney. Patient was shifted to Intensive care unit(ICU) and managed conservatively. Due to progressive drop in Hemoglobin despite adequate blood transfusion, a repeat Ultrasonogram(USG) was done which picked up an additional injury, a liver laceration of 3 x 2 cm. Contrast CT Abdomen was done (18 hours after admission) which showed liver laceration and grade 5 renal injury(Figure 1).

Figure 1. CT picture of case 2, showing extensive liver injury with Right Kidney injury

In view of increasing tranfusion requirements, emergency laparotomy through a midline abdominal incision was done. Right Kidney was shattered with renal vein injury. Right Nephrectomy was done. The laceration in segment 5 of liver on anterolateral surface of right lobe was packed with greater omentum and hemostasis was secured. Postoperatively, a right chest drain was placed for right hemothorax. On 1st Post – operative day, abdominal drain revealed 200 ml of fresh blood with elevated INR and PT. Despite adequate resuscitation with whole blood and FFP, patient did not improve. Emergency CT Angiogram was done which showed hemoperitoneum with liver laceration in the anterior and posterior surfaces(Figure 2).

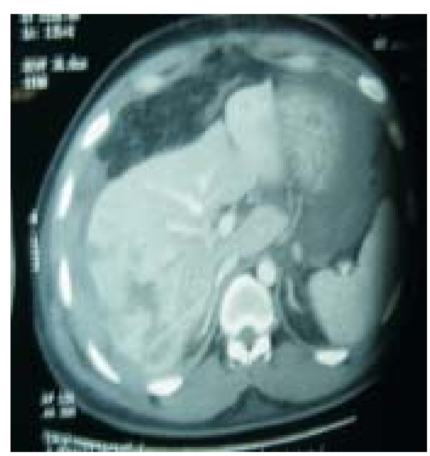

Figure 2. CT angiogram showing extensive liver damage with fresh bleeding from liver laceration

Patient was reexplored. After making a T shaped incision with horizontal limb through the right coastal margin, liver laceration in posterior surface was found actively bleeding. Greater omentum was fixed to the laceration and tagged to the diaphragm. A perihepatic pack was kept and the same brought through a separate stab incision in right hypochondrium. Post-operatively left chest drain was also placed in view of left hemothorax. He was on ventilatory support and coagulation abnormalities were corrected. Patient was reexplored on 4th day after packing and pack removal was done. Postoperatively patient developed pneumonia, anasarca with hypoalbuminemia. These were aggressively treated with infusion of IV albumin, intravenous antibiotics, chest physiotherapy and nebulisation. Patient was extubated. The chest drains were removed after the drain volume decreased and lung expansion improved. The overall transfusion requirement for the patient including all blood components was over a hundred units. The patient was in the hospital for about 5 weeks prior to discharge. Patient is doing well presently.

Predominant cause of blunt hepatic trauma is by road traffic accidents. A patient with a history of blunt trauma to abdomen should arise suspicion of liver injury especially if is in the right lower chest wall or right upper abdomen. Signs and symptoms of liver injury depends on the level of blood loss, peritoneal irritation and presence of associated injuries. Right upper quadrant tenderness, guarding and rebound abdominal tenderness is common, but nonspecific signs may dominate. Peritonism may be severe in case of bile leaks. Elevation of serum liver enzymes in blunt trauma abdomen suggest liver injury although pre-existing causes like fatty liver may also be responsible . Following blunt trauma of the abdomen, a conscious patient who is hemodynamically unstable and has generalised peritonitis should undergo immediate laparotomy. In the presence of neurological impairment or with equivocal physical signs, traditionally a diagnostic peritoneal lavage (DPL) used to be done. DPL being invasive, time consuming, non-specific and oversensitive to presence of blood results in higher rate of nontheraupetic laparotomies(3). DPL has largely been replaced by ultrasonography. The Focused Abdominal Sonography in Trauma(FAST) is non-invasive, repeatable and can be performed in resuscitation area/ emergency room while other assessments are carried out. Utility of FAST in high volume trauma centres is proven unlike in lower volume centres because it remains operator dependent.

If patient is hemodynamically stable following blunt injury, a thorough radiological assessment is possible. Despite the advances in radiology, plain radiography still has a role. Though non-specific, plain radiography is useful in evaluating rib and spinal injuries in patients with blunt abdominal trauma. Fractures of right lower ribs, pneumoperitoneum, major diaphragmatic injury and gross organ displacement can be identified. Ultrasound can demonstrate lesions like hematoma, contusion, bilioma and hemoperitoneum. Subcapsular hematomas appear as curvilinear fluid collections with echogenicity varying with age. Initially hematomas are anechoic becoming echogenic by 24 hours. By 4-5 days, hematoma again becomes hypoechoic or anechoic. Septa and internal echoes develop within hemorrhagic collections by 1-4 weeks. Predominant drawbacks with ultrasound are that it is an operator dependent tool and its inability to pick dome or lateral segment of left lobe injuries. Sensitivity in detecting free abdominal fluid by USG is reported to be only 44% when associated with bowel or mesentric injury (2). Associated organ injury may be missed especially of the bowel, mesentry, pancreas, adrenal gland and bone.

CT Scan has become the gold standard in diagnosis of solid organ injury. Importantly, it can assess other visceral injuries that may require operative management like an associated transection of pancreas. Contrast enhanced CT Scan is accurate in localising the site and extent of liver and associated injuries. Spiral CT is the preferred technique. Multidetector-row CT offers further advantage of faster scanning time and thinner sections. American Association for Surgery of trauma (AAST) has devised a CT criteria for severity of liver injury. (Table 1).

Table 1.

CT Criteria for Liver Injury scale (AAST)

Grade 1	Subcapsular hematoma less than 1 cm in maximal thickness, capsular avulsion, superficial parenchymal laceration less than 1 cm deep, and isolated periportal blood tracking
Grade 2	Parenchymal laceration 1-3 cm deep and parenchymal/subcapsular hematomas 1-3 cm thick
Grade 3	Parenchymal laceration more than 3 cm deep and parenchymal or subcapsular hematoma more than 3 cm in diameter
Grade 4	Parenchymal/subcapsular hematoma more than 10 cm in diameter, lobar destruction, or devascularization
Grade 5	Global destruction or devascularization of the liver
Grade 6	Hepatic avulsion

Major features of blunt liver trauma include lacerations, subcapsular and parenchyma hematomas, active hemorrhage and juxtra-hepatic venous injuries. Minor CT features include periportal low attenuation and a flat IVC. Active hemorrhage following blunt trauma is typically identified at early phase contrast enhanced CT as focal attenuation areas that represent a collection of extravasated contrast material secondary to arterial bleeding. Willman et al(5)reported that attenuation of active arterial extravasation at multi-detector row CT range from 91-274 HU (mean 155 HU) whereas clotted blood ranged from 28-82 HU (mean 54 HU). Active hemorrhage can manifest as extravasation of contrast material either locally into a parenchymal hematoma or freely into the peritoneal space as a jet. Major hepatic venous injury seen at CT should considered as indicator of severe injury. Poletti et al (6) reported that liver related surgery was 6.5 times more frequently required when laceration extended into one or more hepatic veins than when it did not. As more and more patients with complex grade IV and V liver injuries have been treated nonsurgically, prevalence of delayed complications picked up by follow up CT has increased, which can arise weeks to months after injury.(7) Prevalance of such complication in blunt liver trauma range from 5% to 23%(8, 9 &10). These include delayed hemorrhage, abscess, post-traumatic pseudoaneurysm, hemobilia and bile peritonitis. False positives in CT diagnosis of liver injury may occur as a result of beam holding artefacts from adjacent ribs mimicking a contusion or hematoma. Nasogastric tube with air fluid levels may produce streak artefacts through out the left lobe of liver. False negative finding may occur in patients with fatty liver.

Magnetic Resonance Imaging(MRI) has limited role in evaluating blunt abdominal trauma and no added advantages over CT though theoretically it can be used in follow up monitoring without radiation exposure especially in young and pregnant women.

Radio-nucleotide Scanning in Tc99m sulfur colloid or Tc99m labeled denatured red blood cell studies were widely used in evaluation prior to widespread availability of CT scanning. Despite the disadvantages in the form of nonspecific findings and inability to evaluate intraperitoneal and retroperitoneal organs, it is useful especially when contrast use is contraindicated, in patients who cannot hold their breath or in patients with metallic objects or surgical clips in the abdominal cavity. Tc99m IDA uptake imaging scan is especially useful when a bile leak or bilioma is suspected.

Dynamic angiography has no role in patients presenting with hemodynamic instability. It is useful in demonstrating the site of active bleeding providing an opportunity for trans-catheter embolisation.

The decision to manage a patient with blunt trauma liver surgically or conservatively is made based on hemodynamic status and not on CT severity scoring. Yet, it is seen that CT is occasionally helpful in predicting success of non-operative management and utility of angiographic embolisation(6,11). CT may influence decision for surgical exploration in case of associated finding like bowel perforation and major vascular injury.

Non-operative Management of blunt hepatic trauma:

There has been a significant increase in the number of non-operative management following the publication of the first retrospective series of adult liver patients managed conservatively by Knudson and colleagues(4). Several prospective randomized trials have confirmed the same.(12 ,13). The results have showed that conservative management is associated with fewer liver related and intraabdominal complications and lesser mortality compared to operative management. (14) Conservative management does not result in a greater need for blood transfusion. Overall success of non-operative treatment in appropriately selected patients exceeds 95%(15,16). If conservatively managed, it should be borne in mind that risk of hollow organ injury, though small, is increased. There is a significant risk of increase in delayed hemorrhage. Patients who fail with an initial conservative approach despite close supervision should be detected and treated accordingly.

Operative management of blunt liver trauma:

Primary operative intervention is indicated for liver injury if patient is hemodynamically unstable despite adequate initial resuscitation. Prefered incision in emergency is a long midline, although access can be improved by converting into a “T” by adding a right transverse component. Subcostal incision can be used in patients operated after initial conservative management.

Laparotomy for liver injuries is no different from any other trauma laparotomy. Liver hemorrhage can usually be initially controlled by direct pressure using packs. Additional techniques include the Pringle manoeuvre, bimanual compression of liver or manual compression of aorta above the coeliac trunk. Intravascular volume replenishment and coagulopathy correction with packed cells, platelets, fresh frozen plasma and cryoprecipitate is crucial. After adequate resuscitation and adequate mobilization of liver a useful assessment of the injury if necessary after a Pringle manoeuvre by applying a vascular clamp should be done (Figure 3). Depending on the injury and experience of surgeon following methods may be used.

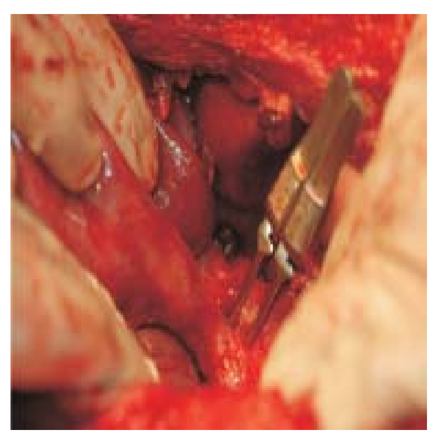

Figure 3. Pringle s manoeuvre done with bull dog vascular clamps applied over the epiploic foramen

Perihepatic packing:

When definitive control of hemorrhage cannot be obtained, liver injury should be packed, incision closed and patient referred to a specialized centre for definite treatment. Even in high volume centres, packing can be employed as a damage control strategy in patients who are critically unstable, coagulopathic or acidotic. Packing is effective at controlling major hemorrhage from liver injuries even in patients with caval or hepatic venous injuries.

Finger fracture method:

Hepatotomy by finger fracture with direct suture ligation to achieve hemostasis is a useful technique. Diathermy coagulation or Argon beam coagulator use is invaluable.

Omental Packing:

Stone and Lamb(17) in 1975 reported using greater omentum as a pedicled flap to fill the defect in liver parenchyma. This fills the dead space and stops venous oozing.(Figure 4)

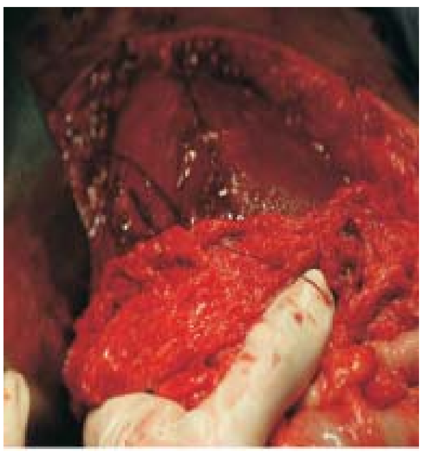

Figure 4. Liver laceration being packed with greater omentum

Use of absorbable polyglactin mesh to wrap the parenchyma disruption:

Advantages include need for a second laparotomy is almost nil and ease of abdominal closure. Disadvantage is that it is a time consuming procedure.

Resectional Debridement:

It involves removal of devitalised liver tissue using lines of injury as boundaries of resection. It is usually done at the time of removal of pack, as necrotic tissue will be well demarcated by 48 hours after injury.

Anatomical Resection:

It is practically difficult due to associated shock, coagulopathy and organ injuries. Excellent results are reported from experienced centres.(18) Selective ligation of hepatic artery is useful when other measures have failed, especially so when pedicle clamping has demonstrated to arrest hemorrhage. To prevent acute gangrenous cholecystitis, a cholecystectomy must be performed.

Suspicion of hepatic venous and retrohepatic caval injuries should arise whenever Pringle manoeuvre fails to arrest hemorrhage. Options available are total vascular exclusion clamping IVC, suprahepatic cava in addition to Pringle manoeuvre), venovenous bypass or atriocaval shunting via a chest tube through the right atrial appendage into the IVC(Shrock in 1968) (19). Packing can effectively control bleeding from retrohepatic caval injuries (20), only using vascular exclusion as a last resort.

Liver transplantation may be considered as an option for very severe hepatic trauma only in very high volume centres with expertise for liver transplantation.(21 & 22).

Interventional Radiology in blunt hepatic trauma:

The development of non-surgical interventional techniques to treat the complications of liver trauma (i.e. CT-guided drainage, angiographic embolization, percutaneous balloon dilatation of a biliary duct stenosis) have fostered the trend toward non-operative management. Angiography and embolisation are the most traditionally used adjuncts to nonoperative management of liver trauma. Angiography is recommended in hemodynamically stable patients where initial CT Scan show a "blush". Pooling of contrast within the liver parenchymal is amenable to angioembolisation unlike those pooling into the peritoneal cavity. Trans-catheter embolisation is technically successful in about 80% of appropriately selected cases(23&24). Angiographic embolization of arterial blush is not only used to improve the success of non-operative management but also as a precious adjunct to surgery to help stop hemorrhage in extended fracture of the liver. Abscess and intra-peritoneal bile leaks are most often treated by percutaneous drainage.

Complications of Management of hepatic trauma:

Coexisting intraabdominal complications may be missed at initial presentation and may become apparent after initial delay. Septic complications such as intraabdominal abscess and bile leak are recognized late complications and may require radiological, surgical or endoscopic interventions. Hemorrhage, coagulopathy including DIC, hemobilia, arterioportal fistulas and sepsis due to infection of bile collection, blood or devitalised liver tissue are other late complications.

CONCLUSION:

Blunt hepatic injuries even though statistically less common than splenic blunt injuries, account for more than 50% of morbidity and mortality The advancements in radiology both as a diagnostic and as an interventional tool, together with the improvement in intensive care mean that more and more hepatic blunt trauma are now managed conservatively. Surgical exploration in hemodynamically stable patients is more of an exception than the rule. It does not mean the end of the road for the surgeon though, surgeries ranging from very simple perihepatic packing to liver transplantation are required in selected cases especially in unstable patients where one cannot depend on the radiology tools. This paper is meant to revisit the older techniques as well as look to the future in the management of blunt hepatic trauma.

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