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Pedicled omentum hepatorrhaphy in blunt hepatic trauma

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ABSTRACT

Background: The liver is the most common solid viscera injured in motor vehicle accidents. Advances in radiological diagnostic techniques and critical care have increasing trend towards the nonoperative management. Still operative management is needed if there is continuous bleed or haemodynamic instability. The omentum commonly known as policeman of abdomen as it reaches intra-abdominal injury site. It is known to adhere to the site of injury and seals it. It increases the vascularity and starts neoangiogenesis. This produces haemostasis and promotes wound healing.
Methods: In this study 24 patients were managed by this technique of pedicled omentoplasty. These patients were in the age group of 22 to 42 years. There was male dominance, 22 patients were males (91.7%) while only 2 patients were females (8.3%). The use of omentum in packing is described here. The omentum is converted to a pedicled flap based on right omental artery by tailoring it. The active bleeding vessels can be ligated. The whole length of pedicled omentum is packed in liver cavity. Using liver sutures two or more sutures are applied for stabilization.
Results: On exploration, the hepatic injury was assigned grade as per AAST liver injury scale. Out of 24 patients included in this study; two (8.33%) were grade I patients, three (12.5%) were grade II patients, nine (37.5%) were grade III patients and ten (41.67%) were grade IV patients. Patients with grade V and grade VI were dealt by perihepatic packing as damage control surgery were excluded from this study.
Conclusions: Pedicled omentoplasty in blunt hepatic trauma can be used irrespective of the grade of liver injury. It should be used in combination with other procedures like debridement, segmental or unsegmental resection, control of active bleeding vessels, use of Pringles manoeuvre, selective hepatic artery ligation and even with deep mattress suturing. This helps in haemostasis, early healing and rapid recovery with minimum complications.

Keywords: Blunt abdominal trauma, Damage control surgery, Hepatic trauma, Hepatorrhaphy, Liver injury, Omental packing, Perihepatic packing

INTRODUCTION

Liver is the most common solid viscera involved in blunt traumatic injury of abdomen. Although liver is protected under the rib cage but gets injured because of its large size. As more young people are involved in vehicular accidents, blunt hepatic trauma is the leading cause of death in young persons. Blunt hepatic trauma can occur as isolated liver injury but usually associated with other injuries. Now there is a trend towards nonoperative management of blunt liver trauma but severe liver injuries continue to require operative treatment.[1] Old age, male patient, decreasing Glassgow Coma Scale, increasing injury severity score and hypotension are predictors of failure of nonoperative management of blunt hepatic trauma. These factors help in selection of patients for operative management.[2] Liver parenchymal injuries are most common in blunt hepatic trauma but porta-hepatis injuries, hepatic vein injuries and retrohepatic venacava injuries do occur rarely. Various surgical procedures commonly used in liver parenchymal

injuries are hepatorrhaphy with simple or deep mattress sutures, debridement hepatectomy, segmental or non-segmental resection and omental packing. Selective hepatic artery ligation can be combined with any of these procedures. Severe hepatic injuries may occasionally require specialized procedures like mesh hepatorrhaphy, transarterial embolization, atrial caval shunting and liver transplantation. Damage control surgery as perihepatic packing is used in most severely bleeding hepatic injuries.[3] These procedures are available mostly at specialized centres however use of omentum in control of bleeding in hepatic trauma has been conventionally done. The use of absorbable mesh, foam and gauges is also recommended. The pedicled omentum has been conventionally used in hepatic injuries and can be used by general surgeons. The use of this technique can be lifesaving in non-specialized centres.

This study was aimed to assess the clinical experience and outcome of pedicled omentoplasty in blunt hepatic injuries requiring exploration.

METHODS

This study was conducted on 24 patients presenting with blunt hepatic trauma in accident and emergency department. This study was conducted from April 2008 to April 2016. The history was recorded briefly as type of trauma, duration and mechanism of trauma. The primary survey was done and resuscitation started by using intravenous fluids. The ultrasound of abdomen was done in these patients. If the patient was haemodynamically stable, investigation like X-ray chest and ultrasound abdomen was done. In all haemodynamically stable patients CT abdomen was done. The haematological investigations like complete hemogram, blood urea, blood glucose, serum electrolytes. These haemodynamically stable patients were treated by nonoperative regimen. The following sets of patients with blunt hepatic trauma were operated.

Inclusion criteria

- Haemodynamically unstable patients.
- Non-responders to conservative treatment
- Blunt abdominal trauma patients having associated hollow viscus injury.

Exclusion criteria

- Patients in which perihepatic packing was done
- Injuries to portahepatis, portal vein and vena cava

Description of technique

Laparotomy was done in these patients under general anaesthesia by a midline incision. The free blood in peritoneal cavity was sucked and mopped. All viscera in abdominal cavity were explored to make note of other intra-abdominal injuries. The site and extent of other injuries were noted. The grading of liver injuries was done according to AAST liver injury scale (American Association for the Surgery of Trauma). Resuscitation was continued to normalize the haemodynamics of the patient. Liver injury was dealt on priority basis to stop bleeding quickly. Various surgical procedures were done according to the liver injury grade. These procedures were hepatorrhaphy using simple sutures or deep mattress sutures, debridement, temporary packing, segmentectomy or lobectomy and hepatic artery ligation. Any of these procedures was used to control bleeding followed by omentum packing.

The procedure of omentum packing is described here. The omentum is converted to a pedicled flap based on right omental artery by tailoring it (Figure 1). The active bleeding vessels can be ligated at liver injury site (Figure 2).

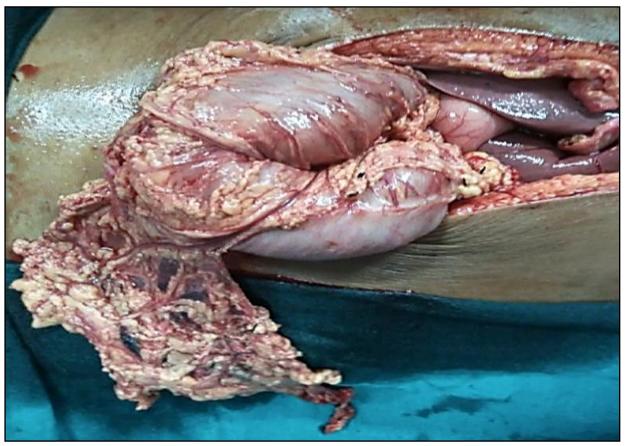

Figure 1: Tailoring of omentum.

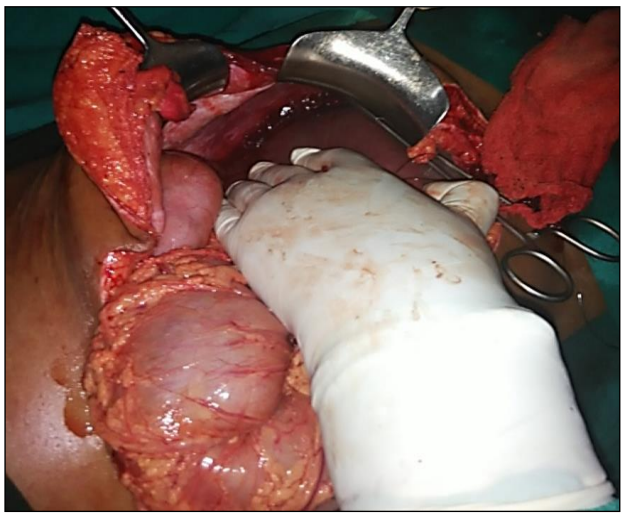

Figure 2: Liver injury.

The whole length of pedicled omentum is packed in liver cavity (Figure 3). Using liver sutures two or more sutures are applied for stabilization (Figure 4). A tube drain was inserted in Morrison pouch. When drainage of blood and

serosanguinous fluid stopped pouring, the drain is removed by 5-10th post-operative day.

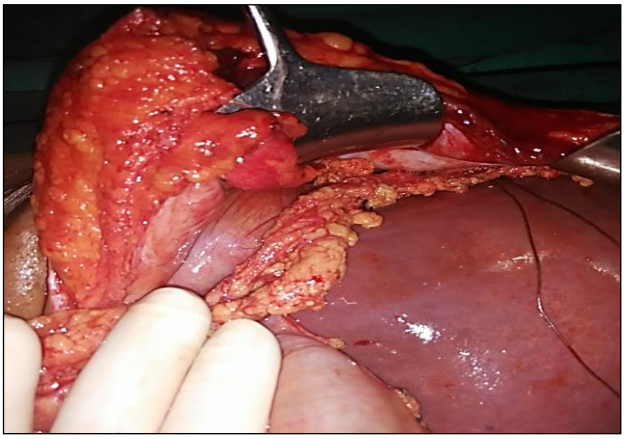

Figure 3: Liver cavity filled with omentum.

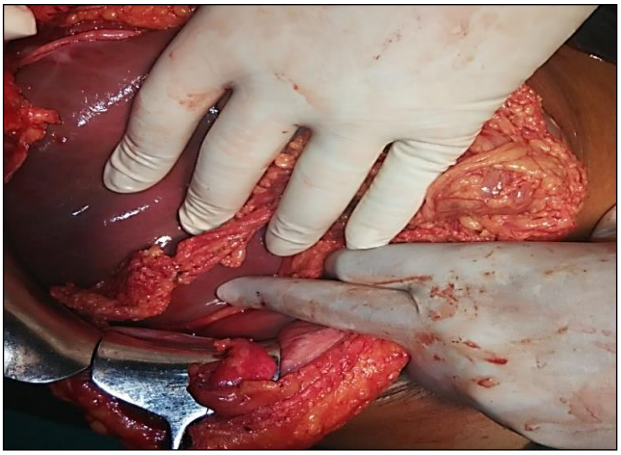

Figure 4: Suturing complete.

With this technique pedicled omentoplasty is completed (Figure 5). Complication like continuing haemorrhage, liver abscess formation and haemobillia are observed. Other intra-abdominal injuries were managed accordingly. In immediate postoperative period, these patients were observed either in postoperative ward or in intensive care unit.

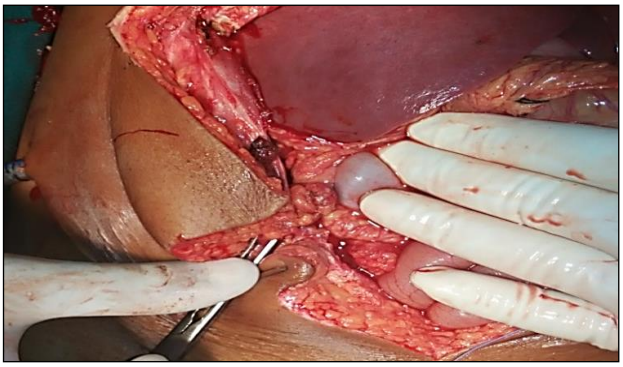

Figure 5: Omentoplasty of liver completed.

These patients were given intravenous fluids, blood transfusion and antibiotics. The vital sign monitoring and hourly urine output were used for maintenance of haemodynamics. Monitoring was also done by biochemical investigations like complete haemogram, blood glucose, blood urea, serum creatinine, liver function tests including coagulogram. Postoperative ultrasonography was done in all the patients. follow up was done for at least three months. The simultaneous treatment of chest injuries, head injuries, pelvic and long bone fractures if present was continued.

RESULTS

The study was conducted in a prospective way over a period of eight years in Department of Accident and Emergency. These patients presented with haemoperitoneum. The diagnosis of haemoperitoneum was made by FAST or ultrasonography. Patients with blunt hepatic trauma which were managed by non-operative are kept out of this study. Those patients who were operated with this technique of pedicled omentoplasty are included in this study. The blunt hepatic trauma patients operated but without pedicled omentoplasty are also not included in this study. In this study 24 patients were managed by this technique of pedicled omentoplasty. These patients were in the age group of 22 to 42 years. There were no patients in paediatric and geriatric age group. There was male dominance, 22 patients were males (91.7%) while only 2 patients were females (8.3%). All the patients had suffered blunt hepatic trauma. The commonest mode of blunt trauma was motor vehicle accidents. The other modes of blunt trauma are pedestrian hit and fall from height. The penetrating injuries like gunshot and stab injuries were kept out from the purview of this study. There were no blast injury victims in this study. The clinical indications of operative treatment were haemodynamically unstable patients in five patients (20.83%), non-responders to conservative treatment eleven patients (45.84%), blunt abdominal trauma patients having associated hollow viscus injury eight patients (33.33%). On exploration, the distribution of patients as per grade of injury is depicted in Table 1.

On exploration, the hepatic injury was assigned grade as per AAST liver injury scale. Out of 24 patients included in this study; two (8.33%) were grade I patients, three (12.5%) were grade II patients, nine (37.5%) were grade III patients and ten (41.67%) were grade IV patients. Patients with grade V and grade VI were dealt by perihepatic packing as damage control surgery were excluded from this study. The procedures performed is also shown Table 1. Combinations of procedures were performed in every grade of injury. However, pedicled omentoplasty was performed in every grade of liver injury. There was no mortality in grade I-III. Only two patients died in grade IV patients with mortality rate of 8.33%. The cause of mortality in these two patients was irreversible shock.

Associated injuries were present in 12 patients out of 24 patients included in this study. The distribution of other intra-abdominal injuries is depicted in Table 2.

Table 1: Distribution of patients according to AAST liver injury scale.

Injury grade	No. of patients n=24 (%)	Procedure Performed	Mortality (%)
I	2 (8.33%)	Hepatorrhaphy + Omentoplasty	0
II	3 (12.5%)	Hepatorrhaphy + Omentoplasty	0
III	9 (37.5%)	Debridement + segmentectomy + Omentoplasty	0
IV	10 (41.67%)	Pringle manoeuvre + Segmentectomy + Lobectomy + Omentoplasty	2 (8.33%)
V	-	-	-
VI	-	-	-

The associated injuries were dealt accordingly at time of surgery. In rest of 12 patients isolated liver injury was present. The main complication in these patients was deranged liver functions and wound infection. None of these patients had a serious complication related to hepatic trauma.

Table 2: Associated other abdominal injuries.

Associated injuries	No. of patients N=12
Duodenum	1
Small and large intestine	2
Spleen	7
Pelvic fracture with retroperitoneal haematoma	1
Urinary bladder rupture	1

DISCUSSION

The liver is the most common solid viscera injured in motor vehicle accidents. Advances in radiological diagnostic techniques and critical care have increasing trend towards the nonoperative management. Still operative management is needed if there is continuous bleed or haemodynamic instability. Nonoperative treatment is considered safe in haemodynamically stable patients with blunt hepatic trauma irrespective of injury severity grade. It is not possible to predict failure of nonoperative management based only on CT findings. Intensive monitoring is required to detect haemodynamic instability and shift to operative treatment.[4] Nonoperative management of blunt liver trauma has become the standard treatment with a success rate of 80 to 100% in haemodynamically stable patients.

Hommes et al, expressed their concern about overuse of nonoperative management. They concluded that nonoperative management of blunt liver trauma should be considered in patients who respond to resuscitation, irrespective of the grade of liver injury. The need for operative management was decided by physiological behaviour and CT findings.[5]

Cirocchi et al, did a systemic review of Cochrane database to compare nonoperative management with operative management in high grade blunt hepatic trauma. Minor grade I and II are most frequent hepatic injury while rest are severe injuries grade III to V. Grade VI injuries are incompatible with life. No comparative studies were available in high grade trauma for this study.[6]

In liver trauma, during surgery various methods are available for haemostasis. The common method is primary closure using liver sutures. It produces haemostasis by approximation of liver surfaces. The use of absorbable foams and gauzes is also recommended. If bleeding is severe, packing with sponges is used. The reoperation is after 48 hours as a part of damage control surgery. Bajee et al, in a retrospective study of 197 patients of liver trauma who were managed by surgical treatment concluded that multidisciplinary approach can decrease the mortality and complication rate in these patients. The significant decrease in mortality is also attributed to improved methods of management of haemorrhage.[7] Hemostatic biological agents are required as adjunct in operative treatment of hepatic injuries. Bio-glue which is a combination of bovine serum albumin and gluteraldehyde adhesive has been successfully used as hemostatic agent and helps in prevention of bile leakage.[8]

The omentum commonly known as policeman of abdomen as it reaches intra-abdominal injury site. It is known to adhere to the site of injury and seals it. It increases the vascularity and starts neoangiogenesis. This produces haemostasis and promotes wound healing. There are many instances where pedicled omentum is used for example in healing of arterial ulcer in lower limb ischemia.[9] Omentum is also used in salvage of traumatic spleen injury, eye ball injuries, bone fractures and spinal cord injuries.[10]

Those patients require surgery can be managed by packing, damage control and early angiography and embolization. Liver resection whether anatomic or nonanatomic has a minimum role in management of blunt

hepatic trauma because of high mortality rate. However, a study by Polanco et al, demonstrated that liver resection should be considered as option in patient with complex blunt trauma with a low mortality and liver related morbidity.[11] Trnkey et al, described that complications following nonoperative treatment are unacceptable. He described strategies for operative management but believed that there are equally good or better strategies in literature.[12] Massive haemorrhage in hepatic trauma is generally due to disruption of hepatic veins which are deeply situated. Repair or resection may not be possible. This type of diffuse venous haemorrhage can be stopped by packing the liver cavity with pedicled omentum.

The omentum acts as hemostatic agent. It heals the liver cavity by neoangiogenesis promoting growth of liver tissue and rapid healing of cavity. The use of omentum in traumatic liver injuries has been authenticated by Singh et al.[13] They investigated the mechanism of liver regeneration induced by fusing the omentum to small traumatic liver injury in rats. They concluded that omentum activated by polydextran particles facilitates liver regeneration in traumatic liver injury by a mechanism which largely depends on oval cell proliferation. Liver is known to regenerate to its original size after partial hepatectomy. Vigorous regeneration of liver occurred after omentum was attached to the site of injury. Fibrosis is highly coordinated protective response to tissue injury. Immune cells are the key players in this process of fibrosis to exert either injury-inducing or repair promoting effect for healing in liver injuries.[14] Perihepatic packing used for uncontrolled haemorrhage in severe liver injuries does not alters the mortality rate but appears to increase the incidence of abdominal sepsis.[15]

Stone et al, published an experience in 37 patients with liver trauma. They used omentum based on respective gastroepiploic vessels for packing into hepatic fracture crease. The liver edges were oversewn and a sump drain was placed. They reported uniform success in all the patients.[16] Lin et al, studied outcome of damage control laparotomy with perihepatic packing in major blunt liver injuries in 58 patients with grade III, IV and V injuries. There was mortality rate of 52% in these 58 patients; twenty-eight survivors and thirty deaths.[17]

Gur et al, analyzed the results of surgical treatment in 244 patients with traumatic liver injury in a retrospective study. There were 217 males and 27 females. Based on grade of liver injury these patients were divided in two groups; Group A (n=238) having minor hepatic injuries with grade I and II, Group B (n=6) having major hepatic injuries with grade III, IV and V injuries. Out of 238 patients of group A, primary suturing of liver tear was done in 187 patients, in 50 patients only perihepatic drainage was done and resectional debridement in one patient. In all the 6 patients of Group B, hepatic resection was done. They concluded that mortality rate was 16.3%; in group A 66.6% and in group B 15.1% of patients.[18] Sadullah et al, evaluated the surgical methods, morbidity and mortality in 159 patients of blunt liver trauma. In this retrospective study there were 116 males and 43 females; mean age was 33.6 years with range of 15 to 67 years. In minor hepatic injuries grade I and II simple hepatorrhaphy was done. In severe hepatic injuries grade III-V the surgical procedures done were debridement, selective hepatic artery ligation and omental packing of laceration; resectional debridement with direct control of bleeding vessels within liver using Pringle maneuver; deep mattress suture; and perihepatic packing. Omental packing was used in maximum number of patients. The overall mortality using all these methods was 21.3%. Omental packing combined with any liver procedure does not increase operation time. They cause less morbidity and mortality.[19]

Mir et al, conducted a retrospective and prospective study and analyzed results of 200 patients of liver injuries. In this study, mainly young patients were involved and right lobe of liver was the commonest site of blunt trauma. These patients had grade I injuries in 11.5%, grade II in 12%, grade III in 35% and grade IV in 41.5% patients. Small gut and colon injuries were the commonest associated injuries. The mortality rate in grade IV trauma had 38.55% mortality whereas grade I had 0% mortality. Liver injuries have multiple factors as cause of death.

This study concluded that liver injuries are difficult to deal with; early resuscitation, proper application of surgical options and good postoperative care can improve the outcome.[20] In a study of 78 patients with liver trauma the operative management was done according to the grade of injury. These patients were classified into simple injuries (grade I to II) having 110 cases and complex injuries (grade III to V) having 68 patients.

They managed majority of simple liver injury patients by simple suturing, electrocautery and hemostatic agents. The complex injury group patients were managed by hepatotomy, direct vessel ligation and deridement of necrotic tissue is the method of choice (Patchter's procedure). Perihepatic packing was used was done in patients with uncontrolled bleeding. This study had overall mortality rate of 32% while the true hepatic injury mortality rate was 15.7%. The complications were intrahepatic haematoma (12.9%), postoperative bleeding (9.6%) and intrabdominal abscess formation (2.8%) in these patients.[21]

Gao et al, did a retrospective study of 348 patients with hepatic trauma over a period of 12 years. Out of these 259 (74.4%) were operated by techniques like packing of laceration with omentum, segmental resection, control of bleeding using Pringle manoeuvre, hepatectomy, selective hepatic artery ligation and perihepatic packing. The results of this study suggested that severe hepatic injuries especially grade III-V require surgical management. Reasonable surgical procedure can be based on grade of liver trauma but combination of techniques can increase survival rate.[22]

In summary pedicled omentoplasty in blunt hepatic trauma can be used irrespective of the grade of liver injury. It should be used in combination with debridement, segmental or unsegmental resection, control of active bleeding vessels, use of Pringles manoeuvre, selective hepatic artery ligation and even with deep mattress suturing. This helps in haemostasis, early healing and rapid recovery with minimum complications.

CONCLUSION

The use pedicled omentum in blunt abdominal trauma helps in early control of haemostasis. The drainage and blood loss in postoperative period is decreased. The number of blood transfusion units transfused and operative time does not increase with pedicled omentum packing. This procedure decreases morbidity and mortality in blunt hepatic trauma. So pedicled omentoplasty combined with any other procedure for liver injury is a simple procedure to be done in any liver injury grade.

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