

Do We Need a Relaparotomy to Remove the Perihepatic Packs Used to Control Bleeding? Case Series

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Abstract

Introduction: Liver injuries, often resulting from trauma, present a significant challenge in surgical management. Perihepatic packing has emerged as a critical technique in controlling bleeding and stabilising patients with severe liver injuries. This study aims to evaluate the outcomes of perihepatic packing and removing packs without relaparotomy in a cohort of eleven patients treated over two years.

Methods: We conducted a retrospective study of 11 patients with liver injuries identified at laparotomy at General Hospital Kuliapitiya from May 2020 to June 2022. Excluded were patients who managed without packing. Data were collected from operating theatre records and medical charts, including age, sex, injury mechanism, vital signs, FAST scan results, intraoperative findings, estimated blood loss, blood transfused in the first 24 hours, associated injuries, liver complications, time to pack removal, and incidence of rebleeding.

Perihepatic packing has been used for persistent hepatic haemorrhage post-suturing, unsaturable injuries, and hemodynamically unstable patients. Packs have been brought outside the abdomen through a separate incision and sutured to each other if multiple packs were used. A G28 intercostal tube has placed for drainage. Packs have been removed between 48 and 72 hours. The drain has kept for more than 48 hours post-removal to monitor rebleeding. In cases of uncontrollable haemorrhage during pack removal, plans included reopening and repacking if necessary.

Results: The study included eleven patients aged 24 to 74 years, with three female patients. The causes of liver injuries were identified as follows: road traffic accidents (63.6%), assault (18.2%), stab injuries (9.1%), and falls from height (9.1%). Pre-operative ultrasound correctly identified liver injuries in 54.6% of patients. Intraoperative findings showed right liver lobe involvement in 63.6% of cases, bilobar involvement in 27.3%, and left lobe involvement in 9.1%. Additionally, 63.6% of patients had other organ injuries. The timing of pack removal was within 48 hours for seven patients (63.6%) and within 48-72 hours for the remaining patients. Drains were removed on the fifth day in 54.50% of patients and on the sixth day in the rest. There were no cases of rebleeding and post of complications were able to be managed conservatively. There was one death with sepsis and multi organ dysfunction.

Conclusion: Perihepatic packing is a valuable technique in the management of liver injuries, demonstrating high efficacy in controlling haemorrhage and low complication rates. Removal of the pack through the pre-placed incision avoids the relaparotomy and thereby reduces the second trauma to the patient. Further studies with larger cohorts are recommended to validate these findings.

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HYPOTHESIS

1. Perihepatic packing is a valuable technique in managing liver injury.
2. Do we need a relaparotomy to remove the Perihepatic packs used to control haemorrhage
3. Measures Liver-related complications biliary leak, rebleeding, and mortality after removing the perihepatic pack without a re-laparotomy.

INTRODUCTION

Despite the liver's ostensibly protected position within the abdominal cavity, it remains the organ most susceptible to injury in abdominal trauma (1-2). Significant liver injury leading to uncontrollable haemorrhage remains a formidable challenge for trauma surgeons. In the early 20th century, intra-abdominal (perihepatic) packing emerged as a prominent therapeutic approach for managing such cases. However, its widespread adoption was hampered by high infection rates and associated morbidity. (3-5) Subsequent Madding et al showed that advancements in technique notably liver resection and drainage for major hepatic injury yielded lower infection rates and reduced overall morbidity and mortality (6). Consequently, perihepatic packing fell out of favour in surgical practice (7). However, despite all the advantages and disadvantages, nowadays this method is used in some circumstances like severely ill patients where alternative techniques are not feasible (8,9).

Advancements in imaging technology and the establishment of specialized trauma intensive care units (ICUs) have contributed to a reduction in morbidity and mortality rates, thereby enhancing the non-operative management of stable patients with low-grade liver injuries (10).

PERIHEPATIC PACKING

Perihepatic packing should be considered when other surgical techniques fail to control hemorrhage in a hemodynamically unstable patient (11). Other than the haemodynamically unstable patient indications for perihepatic packing include uncontrollable coagulopathy, bilobar liver injury, large non-expanding hematoma, and capsular avulsion. Recently, packing has been effectively used in cases involving suspected injury to the vena cava or hepatic veins (12). It also serves as a valuable tool for inexperienced surgeons when temporarily stabilizing patients for transfer to a specialized centre (13,14).

Despite ongoing reservations by some surgeons regarding

the use of perihepatic packing due to its historical association with intra-abdominal abscess and sepsis, advocates argue for its utility in severe liver injury, particularly in scenarios where patients present with intraoperative coagulopathy, hypothermia, persistent hypotension and acidosis (15).

REMOVAL OF PERIHEPATIC PACKING

Historically, a surgical practice involved the use of long gauze for perihepatic packing, which was brought out through an incision in the lateral abdominal wall during the initial operation. This technique was intended to facilitate the subsequent removal of the packing without necessitating a relaparotomy. However, this method has fallen out of favour over time due to several significant disadvantages. Rebleeding was a common issue, and the inability to thoroughly inspect for missed injuries posed substantial risks. Additionally, this approach precluded subsequent irrigation of the abdominal cavity, further complicating patient outcomes.

In addition to various drawbacks, the requirement for a relaparotomy introduces its own set of complications. A relaparotomy necessitates an additional trip to the operating room, the administration of a second general anaesthetic, and further manipulation of the already injured liver and oedematous midgut. These factors contribute to what is known as the "second hit" phenomenon, where the additional surgical intervention exacerbates the patient's condition, potentially leading to adverse outcomes.

Given these considerations, determining the timing of a relaparotomy becomes a critical decision for the trauma surgeon. Identifying the optimal timing is essential to balance the risks and benefits of further surgical intervention. Unfortunately, there is a lack of scientific evidence to support the identification of an ideal postoperative day that would be suitable for all patients. Each case must be assessed individually, considering the specific circumstances and needs of the patient.

The present study aims to reaffirm the viability of perihepatic packing as a therapeutic option for managing patients with uncontrolled haemorrhage resulting from major liver injury. Additionally, our objective is to underscore the feasibility of pack removal without the need for relaparotomy and to ascertain the rates of rebleeding and the incidence of postoperative liver-related complications such as biloma, bile leak, and intra-abdominal abscess, without the requirement for a second laparotomy.

PATIENTS AND METHODS

We performed a retrospective case study of 11 consecutive patients with liver injuries identified at laparotomy who had been admitted to General Hospital Kuliyaipitiya for the period of two years (2020 May to 2022 June). The patients managed without packing (eg. Suturing) were excluded from the study. We collected clinical information from both the operating theatre registry and from each patient's medical record. The details of liver and other injuries were gathered by reviewing the operative records of patients.

We recorded the following information: age, sex, mechanism of injury (blunt vs penetrating), vital signs on admission, FAST scan report, intraoperative findings, estimated blood loss, amount of blood transfused in the first 24 hours after injury, associated injuries, liver complications (such as bile leak, and hepatic or subphrenic abscess), time to pack removal, and incidence of rebleeding, rebleeding indicated a liver haemorrhage that required replacement of perihepatic packs.

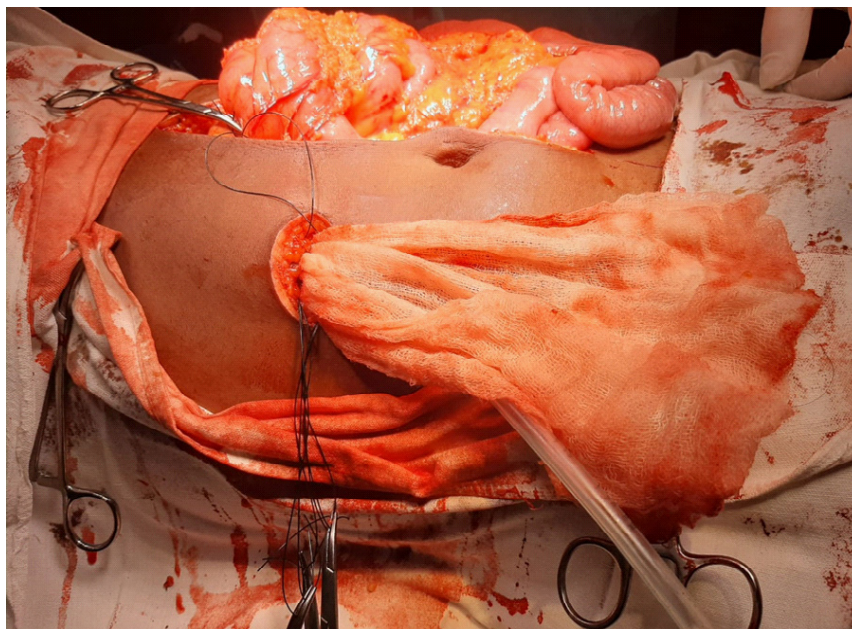
The decision to use perihepatic packs has been made by the attending trauma surgeon on a case-by-case basis. In general, the attending team opt to pack liver injuries in patients with hepatic haemorrhage that persists even after suturing, the injuries not possible to suture and haemodynamically unstable. Gauze packs have been used to pack liver injuries in all patients treated with perihepatic packing. The technique of perihepatic packing involves manually closing or approximating the liver parenchyma, followed by placing dry abdominal packs

around the liver and directly over the injury to tamponade the bleeding site. To avoid compressing the vena cava, the fewest number of dry laparotomy pads needed to stop the bleeding have been used. One end of the pack has brought outside of the abdomen through a separate incision lateral to the laparotomy incision. A few loose stitches have been placed in the rectus sheath to facilitate closure during pack removal. When it became necessary to use multiple packs, each pack has sutured to the next using nylon thread. Additionally, every patient had a G28 intercostal tube positioned at the hepatic bed to serve as a closed drain.

Perihepatic packs have been removed once the patient's hypothermia, acidosis, and coagulopathy had resolved and the surgeon felt the patient was ready to return to the operating room. All patients had their packs removed between 48 and 72 hours after injury without relaparotomy.

The pack has extracted through a separate incision made at the time of the original surgery, and saline irrigation has been utilized to facilitate its removal. The procedure has performed under sedation in the operation theatre. Upon completion of the pack removal, the previously placed loose stitches have been used to close the abdominal wall. A wide-bore tube (G 28 Intercostal tube) drain placed ;has been left to monitor for rebleeding and maintained for more than 48 hours after the pack removal.

If uncontrollable haemorrhage was encountered at the time of pack removal, planned to reopen and repack if needed.



RESULTS

This study examines the outcomes of eleven patients with liver injuries treated with perihepatic packing over two

years. The patients' ages ranged from 24 to 74 years with mean age 49.91 ± 16.6 years. Out of the eleven patients 8 were males 72.7% and the remaining 3 were females 27.3%

Tabel 1. *Demographics details of the patients.*

Study variables	n%
Age in years (Mean $\pm$ SD)	49.91 $\pm$ 16.6
Sex	
Male	8(72.7%)
Female	3(27.3%)

The most common cause of liver injury was road traffic accidents, accounting for 63.6% of cases. Other causes included assault (18.2%), stab injuries (9.1%), and falls from height (9.1%).

Tabel 2. *Mechanism of injury*

Variables	n%
Assault	2(18.2%)
Fall	1(9.1%)
RTA	7(63.6%)
Stab	1(9.1%)

Pre-operative ultrasound scans accurately detected liver injury in 54.6% of patients, alongside the presence of free fluid in the abdomen.

Tabel 3. *Scan findings*

Variables	n%
Free fluids	
Mild	1(9.1%)
Moderate	1(9.1%)
Mild-Moderate	1(9.1%)
Moderate	2(18.2%)
Liver with free fluids in abdomen	6(54.6%)

Intraoperative findings revealed that 63.6% of patients had right liver lobe involvement, 27.3% had Bilobar involvement, and 9.1% had left lobe involvement. As understood by anatomy right lobe is open and vulnerable to injury compared to left lobe.

Tabel 4. *Lobe of the liver involved*

Variables	n%
Right lobe	7(63.6%)
Left lobe	1(9.1%)
Bilobe	3(27.3%)

Additionally, seven patients (63.6%) had injuries in organs other than the liver.

Tabel 5. *Injuries other than liver*

Variables	n%
Hepatic flexure colon contusion	1(9.1%)
Jejunal injury	2(18.2%)
Mesenteric injury	2(18.2%)
Right renal contusion	1(9.1%)
Stomach injury	1(9.1%)
No other injury	4(36.4%)

The perihepatic packs were removed within 48 hours in seven patients (63.6%), while the remaining packs were removed within 48-72 hours. Drains were removed on the fifth day in 54.5% of patients, and on the sixth day in the rest. Four patients (36.4%) developed complications

following surgery. Among them one patient (9.1%) developed bile leak and two patients (18.2%) developed lower respiratory tract infection. Other than the patient (9.09%) died due to sepsis and multiple organ dysfunction, rest of the three patients have been managed successfully.

Tabel 6. *Complications following surgery*

Variables	n%
Bile leak	1(9.1%)
lower respiratory tract infection	2(18.2%)
Death due to sepsis with multi-organ dysfunction	1(9.1%)
No complications	7(63.6)

DISCUSSION

Liver trauma is one of the most common abdominal lesions in severely injured trauma patients (16). Diagnosis and treatment of hepatic trauma has evolved with the use of modern diagnostic and therapeutic tools (17,18). Until two to three decades ago, most cases with abdominal trauma and possible injury in parenchymatous organs were managed by exploratory laparotomy (19). Several innovative multimodal approaches as EVTm (endovascular trauma and bleeding management) have allowed to greatly increase the likelihood of non-operative management (NOM) for selected patients.

Despite recent advancements in non-operative approaches to managing liver trauma, certain patient cohorts still necessitate immediate surgical intervention to address exsanguination from hepatic injury. Failure to promptly manage bleeding may result in the onset of coagulopathy, acidosis, and hypothermia—three potentially fatal complications that are not amenable to conservative management and can ultimately lead to mortality. In such cases, perihepatic packing remains a crucial strategy for mitigating the morbidity and mortality associated with uncontrolled hemorrhage. This technique is particularly vital in settings with minimal facilities, as it affords

optimal preparation for effectively treating these patients. (20,21).

Although previous studies had reported some complications like subphrenic or hepatic abscess, bilomas, bile fistulas or sepsis (22) none of them have been occurred in our patients. This could be due to the early intervention, appropriate timing for packing removal as well as proper antibacterial coverage.

We concluded that delay in performing perihepatic packing may contribute to higher mortality and the trauma surgeon should consider the option of perihepatic packing as a primary therapeutic option to decrease morbidity and mortality where there is less facilities.

In the 1990s, an “inflammatory” theory was proposed to explain the occurrence of multiple organ failures (MOF) in the absence of infection. This theory encompasses two models: the “one-hit model” and the “two-hit model.” The “one-hit model” accounts for early MOF following massive trauma. In contrast, the “two-hit model” describes how patients with initially less severe injuries become susceptible to an amplified systemic inflammatory response syndrome (SIRS), eventually leading to MOF. Patients who experience a severe primary insult, such as infection or trauma, can develop rapidly progressive

multiple organ dysfunction syndrome (MODS) if subjected to a subsequent immune stimulus, referred to as the "second hit." (23). The initial serious injury primes the immune system for an exaggerated inflammatory response to subsequent stimuli, such as nosocomial infections or surgical trauma, giving rise to the "two-hit hypothesis" (THH) (24). Due to the scarcity of competing theories and their apparent alignment with clinical observations, these models have gained widespread acceptance in trauma, general surgery, and intensive care (25,26).

In the one-hit model, the initial injury is so severe that it triggers a significant systemic inflammatory response syndrome (SIRS), often leading to early and frequently fatal multiple organ failure (MOF), typically independent of infection. Conversely, the two-hit model proposes that a less severe initial surgical or traumatic insult (the first hit) induces a moderate SIRS. Subsequent insults (the second and sequential hits), whether infectious or non-infectious, can amplify the pre-existing inflammatory state, resulting in an exaggerated SIRS that is sufficient to cause delayed multiple organ dysfunction (MOD).

The clinical appeal of the two-hit model appears to arise from the common observation in surgical intensive care units: critically ill patients experience various insults that contribute to deteriorating organ function and, occasionally, fatal outcomes (27).

In the later stages of the clinical course, several possibilities should be considered, including the necessity for a re-look laparotomy. Other significant events may involve delayed fracture fixation in polytrauma patients, the onset of an intercurrent infection (such as pneumonia or catheter-related septicemia), or complications arising from invasive monitoring.

The one-hit and two-hit models have been proposed to explain the development of post-injury multiple organ failure (MOF) in the absence of sepsis. Within this context, by removing the pack without performing a re-look laparotomy, we can potentially prevent the occurrence of a second hit, thereby reducing the risk of multiple organ dysfunction (MOD) in certain patients.

Prevention of MODS should be in the highest priority in all clinical settings, which is possible through avoidance of secondary insults. At present, MODS remains the most common cause of death in the surgical intensive care units (ICU). Halting the progression of existing organ dysfunction while preventing the development of new organ dysfunction should be approached through

optimisation of haemodynamic, metabolic, and immune homeostasis (28). Avoidance of relaparotomy is one the way to prevent MODS.

CONCLUSION

Perihepatic packing is an effective technique in managing liver injuries, particularly in controlling hemorrhage. In our case series it has shown high efficacy with minimal complication rates, making it a valuable tool in trauma surgery. The notable advantage of removal of the pack through a pre-placed incision is obviate the need for a relaparotomy, thereby reducing the risk of secondary trauma to the patient. This approach not only enhances patient recovery by minimizing additional surgical interventions but also potentially reduces overall morbidity.

Despite the promising outcomes, further research is necessary to validate these findings. Larger cohort studies are recommended to comprehensively evaluate the long-term benefits and any potential risks associated with this technique.

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