

A Case Series on Combat-Related Liver Injuries: Intrahepatic Biloma As A Complication and Pigtail Drainage As A Solution

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ABSTRACT

Combat-related liver injuries are among the most challenging abdominal traumas due to the high risk of massive hemorrhage, complex associated injuries, and limitations in battlefield medical resources. Rapid surgical intervention remains the cornerstone of management, particularly when non-operative management is not feasible. In this case series, two soldiers with liver injuries underwent emergency laparotomy with direct repair, both later complicated by biloma formation. These were successfully treated with ultrasound-guided pigtail drainage, avoiding reoperation and facilitating recovery. Both patients were discharged in stable condition following structured multidisciplinary care. The cases underscore the critical role of timely surgical intervention, vigilant imaging surveillance, and minimally invasive drainage techniques in reducing morbidity. The integration of damage control principles, early resuscitation, and vigilant postoperative care has significantly improved survival in recent years. A notable complication in liver injuries is the development of bilomas, which may prolong recovery and increase morbidity if not promptly addressed. Minimally invasive approaches, such as ultrasound-guided pigtail catheter drainage, have proven highly effective in managing these collections, avoiding the need for reoperation and reducing patient burden. The application of such adjunctive techniques, alongside critical care support and early mobilization, reflects the evolving standards of combat trauma management. Lessons drawn from these experiences emphasize the importance of multidisciplinary collaboration, adaptability in resource-limited settings, and the translation of combat trauma strategies to civilian practice.

ARTICLE DETAILS

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INTRODUCTION

Combat-related liver injuries represent some of the most devastating injuries encountered in military medicine. The liver, being the largest solid organ in the human body, is highly vascular and situated in a position vulnerable to both blunt and penetrating injury. This vulnerability is magnified in combat situations, where explosive devices, shrapnel, and

high-velocity projectiles are common mechanisms of injury. These injuries are associated with high mortality and morbidity due to massive haemorrhage, complex associated injuries, and the challenging logistics of wartime medical care. The burden placed on surgical teams to stabilize and manage such patients effectively is immense, particularly in resource-limited, high-stress environments (1).

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Historical military conflicts have consistently demonstrated the dangers posed by liver injury. During the Croatian War (1991-1995), 2.2% of reported injuries involved penetrating hepatic injury, while the Yugoslav wars reported 93.7% of hepatic injuries caused by explosive fragments or bullets, primarily categorized as Grade I to III by the American Association for the Surgery of Trauma (AAST). The Vietnam War provided substantial insight with a study involving 254 cases of liver wounds, illustrating both the advancements and limitations in combat trauma care. Despite technological and procedural improvements, the core challenges of haemorrhage control, damage assessment, and timely surgical intervention persist (2).

The mortality associated with liver injuries in combat is directly correlated with the grade and extent of the injury. AAST Grade III injuries have a mortality rate of approximately 16.6%, while Grade IV and V injuries exhibit sharply increased mortality rates at 70% and 83.3%, respectively. Complication rates remain alarmingly high at 38.5%, encompassing bile leaks, abscess formation, secondary infections, and liver failure. In such settings, quick decision-making, operative expertise, and innovative use of available resources are critical to improving patient outcomes (3).

Modern combat medicine has embraced a paradigm shift toward damage control surgery (DCS) and selective non-operative management (NOM) when appropriate. DCS prioritizes haemorrhage control and physiological stabilization before definitive repair, especially in the face of coagulopathy, hypothermia, and acidosis—collectively known as the lethal triad. When surgical intervention is necessary, approaches such as primary repair, perihepatic packing, Pringle manoeuvre, and hepatorrhaphy are employed (4). Additionally, the role of minimally invasive interventions, such as percutaneous pigtail catheter drainage for bilomas and intra-abdominal collections, has expanded even within field settings (5).

Despite these advancements, the management of liver injuries in combat remains complex and requires a multidisciplinary approach. Effective trauma care, including early surgical intervention, appropriate imaging, and post-operative care, remains essential to improving outcomes (6). This case series presents two patients with combat-related liver injuries, both treated surgically at a military hospital in Myanmar. This case series explores the management and outcomes of two patients with severe combat-related liver injuries, highlighting the challenges of surgical treatment in a military setting and the evolving strategies in managing these high-risk cases.

CASE PRESENTATION

Case 1

A 21-year-old male soldier presented with severe abdominal injury following an explosive blast during active combat

(Figure 1). On admission, he was in hypovolemic shock with vital signs indicating significant hemodynamic instability, including a low blood pressure of 90/60 mmHg, a rapid pulse of 128 beats per minute, and an oxygen saturation of 96% on supplemental oxygen. Despite initial resuscitation with IV fluids and blood products, the patient remained critical, and a thorough clinical examination revealed abdominal guarding and tenderness localized to the epigastrium and right hypochondrium. There was reduced air entry in both lower lung zones.

An urgent ultrasound of the chest and abdomen demonstrated bilateral haemothorax, hepatic parenchymal injury in the right lobe of the liver, haemoperitoneum, and significant free fluid in the pelvic region. A chest X-ray confirmed bilateral haemothorax and the presence of retained foreign bodies (Figure 2). Initial management involved placing the patient nil by mouth, inserting bilateral intercostal drainage (ICD) tubes (Figure 1), and initiating nasogastric decompression with hourly Ryle's tube suction. The patient was started on intravenous ceftriaxone, metronidazole, pantoprazole, vitamins C and K, and tranexamic acid. Blood transfusion with one unit of whole blood was administered, with two additional units reserved. Given the critical nature of the injuries, the patient was immediately taken to the operating room for an emergency laparotomy.



Figure 1. Explosive blast injuries to right lower chest and abdomen with bilateral intercostal drainage (Case 1)

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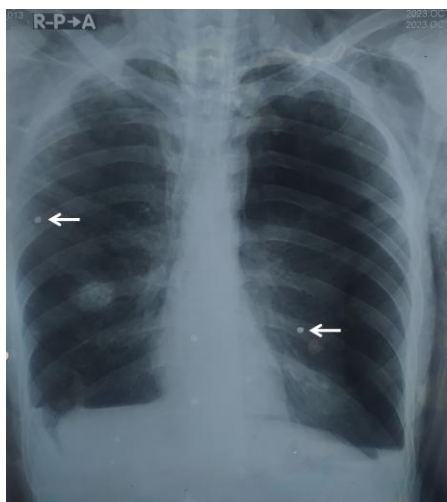


Figure 2. CXR (PA) view showed bilateral haemothorax with retained foreign bodies (white arrows) (Case 1)

Emergency laparotomy was conducted on the day of admission. Intraoperative findings included approximately 300 mL of haemoperitoneum, a liver tear at segments V and VII, and contusion with edema of the gallbladder (Figure 3 & 4). No perforations of the gastrointestinal tract were identified. The liver lacerations were repaired with suturing (Figure 5), and the peritoneal cavity was thoroughly cleaned through peritoneal toilet. After the repair, a drainage tube was inserted to facilitate postoperative fluid management. The entrance wound on the abdominal wall was also addressed (Figure 5). The patient was transferred to the surgical ICU for close monitoring.

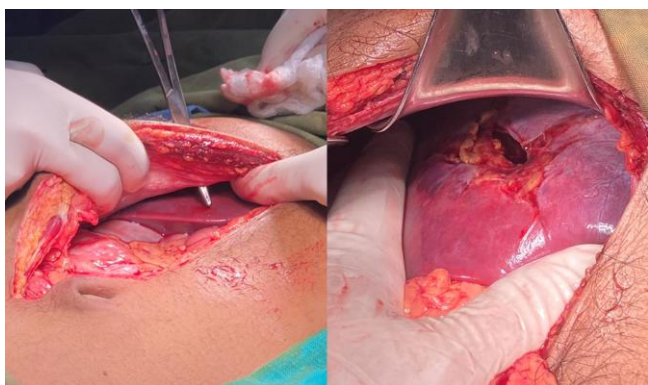


Figure 3. Operative views of entrance wound and liver tear at segment V and VII (Case 1)

Postoperatively, the patient was monitored closely in the intensive care unit (ICU) for signs of further hemorrhage or complications. Initial recovery was uneventful, and the patient was gradually weaned off oxygen. He received nutritional and liver support, and early mobilization was encouraged to reduce the risk of deep vein thrombosis and pulmonary complications. Serial imaging studies, including chest X-rays and abdominal ultrasounds, were performed regularly to monitor the status of his injuries. On the 23rd postoperative day, ultrasound revealed a liquefied hematoma

or biloma in the right lobe of the liver (segments V and VII), measuring approximately 580 mL in volume, with minimal free fluid in the perihepatic and pelvic regions. Ultrasound-guided percutaneous drainage of the biloma was performed, and a pigtail catheter was inserted, which initially drained 250 mL of bile (Figure 6).

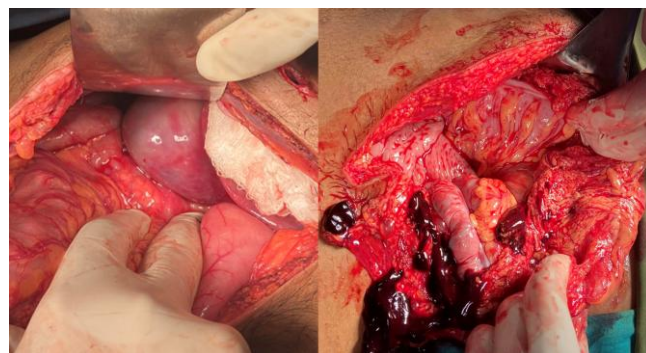


Figure 4. Operative views of gallbladder contusion, gallbladder wall oedema and haemoperitoneum (Case 1)

Further radiological investigations, including a contrast-enhanced CT scan of the chest and abdomen, confirmed that the drainage catheter was correctly positioned in the right lobe of the liver, adjacent to the right hepatic duct and right portal vein. The patient continued to improve, and the pigtail catheter was removed three weeks later after confirming the resolution of the biloma. Two weeks later, the patient was discharged from the hospital, having made a full recovery. His postoperative course was smooth, and follow-up visits showed no signs of complications or recurrence of hepatic injury. This case highlights the importance of timely operative intervention, postoperative surveillance, and adjunctive percutaneous procedures in managing liver injuries in resource-limited combat settings.

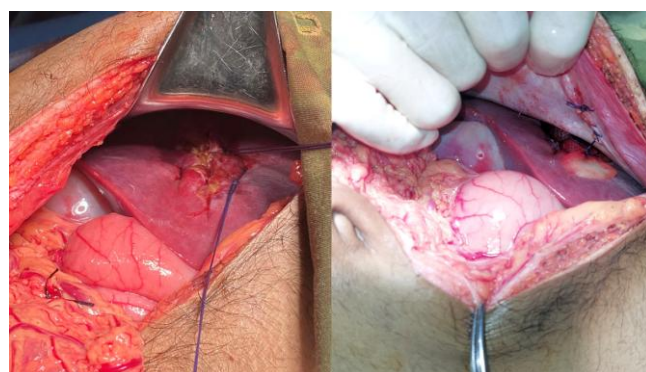


Figure 5. Operative views of primary repair of liver tear and entrance wound (Case 1)



Figure 6. Ultrasonographic views of biloma formation at right lobe of liver (~580ml) and USG-guided percutaneous drainage of biloma and pigtail catheter tube insertion (Case 1)



Figure 7. Multiple gunshot injuries to left anterior lower chest and right flank of abdomen (Through & Through) (Case 2)

CASE 2

A 42-year-old male soldier presented to the emergency department after sustaining multiple gunshot wounds during a combat operation. His injuries involved penetrating trauma to the left anterior lower chest, right flank, and right thigh (Figure 7). On admission, the patient was in hypovolemic shock with a blood pressure of 100/60 mmHg, a pulse rate of 102 beats per minute and oxygen saturation of 96% on supplemental oxygen. Despite the injuries, he was alert and oriented, with no signs of pallor or jaundice. Physical examination revealed significant guarding and tenderness in the epigastric and right hypochondrial regions. The patient underwent initial resuscitation with IV fluids and blood products, and further diagnostic workup, including urgent chest X-rays, abdominal X-rays, and ultrasonography, revealed the extent of his injuries.

Initial chest X-ray did not reveal any retained foreign body, pneumothorax, or haemothorax (Figure 8). A plain X-ray of the abdomen showed a gas-filled stomach and large bowel loops, without any retained foreign bodies (Figure 9). The ultrasound demonstrated a liver tear in segment III, IV and V, with hemoperitoneum in the pelvic region, confirming the severity of the trauma. Preoperative management included nil by mouth, nasogastric decompression, and intravenous antibiotics comprising ceftazidime, metronidazole, pantoprazole and tranexamic acid, along with vitamin supplementation (C and K). Two units of whole blood were transfused and two more reserved. The patient was referred for emergency surgical exploration.



Figure 8. CXR (PA) view without pneumothorax, haemothorax and without any retained foreign bodies (Case 2)



Figure 9. Plain X-ray abdomen showed gas-filled stomach and large bowel loops, without any retained foreign bodies (Case 2)

The patient was taken to the operating room for an emergency laparotomy. Intraoperative findings included

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about 500 mL of hemoperitoneum, a laceration of the liver in both lobes, and contusion of the transverse colon (Figure 10). Additionally, rib fractures were noted, suggesting blast impact and multiple organ involvement. The liver was repaired using direct suture repair (Figure 11), and the transverse colon was also repaired. The entrance and exit wounds were closed, and the peritoneal cavity was irrigated thoroughly. Drainage tubes were placed in the peritoneal cavity. The patient's ongoing bleeding was controlled through careful gel foam packing and hemostasis.

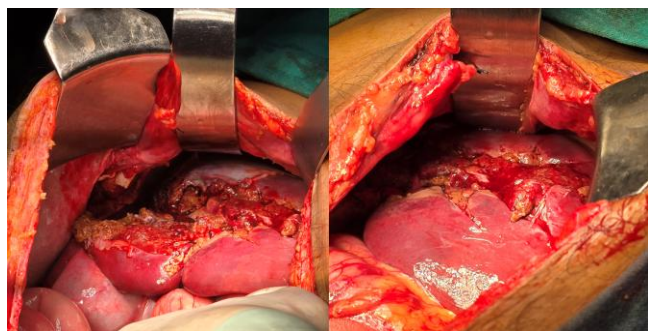


Figure 10. Operative views of large liver laceration at segment III, IV and V from left to right lobe of liver (Case 2)

Postoperatively, the patient was transferred to the ICU for further monitoring. His recovery was complicated by the need for frequent imaging to assess the liver injury and the possibility of complications. The patient was kept in the ICU and managed with supportive care in consultation with general physicians, hepatologist, orthopaedics, and physiatrist. Nutrition and liver support were provided, and early mobilization was encouraged.

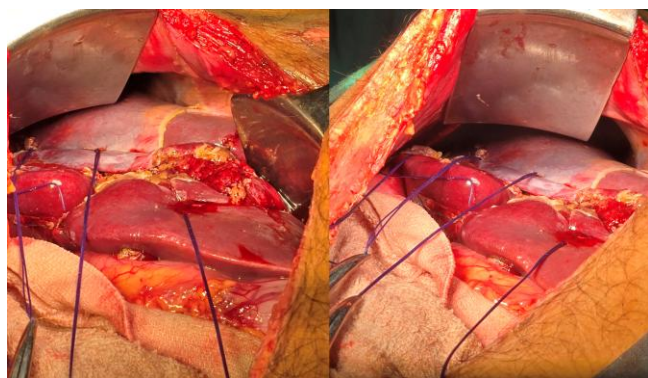


Figure 11. Operative views of primary repair of liver tear (Case 2)

A non-contrast-enhanced CT scan performed on the 13th postoperative day and revealed hepatic lacerations in segments III, IVa, and V, with an adjacent right sub-diaphragmatic fluid collection measuring about 540mL. Differential diagnoses included intrahepatic biloma and liquefied sub-diaphragmatic hematoma, which required percutaneous drainage. A pigtail catheter was inserted under

ultrasound guidance, and 100 mL of the bile was initially drained. The patient was managed conservatively with close monitoring and supportive care. Over the next few days, further ultrasound studies showed a reduction in the size of the biloma, and the pleural effusion that had developed was also monitored.



Figure 12. Ultrasonographic views of intrahepatic biloma formation (~540ml) and USG guided percutaneous drainage of biloma and pigtail catheter tube insertion (Case 2)

As part of his ongoing care, the patient received multidisciplinary support, including physiotherapy to aid in early mobilization and reduce the risk of complications like deep vein thrombosis. After several weeks of intensive care and observation, the patient's condition stabilized, and follow-up imaging confirmed the resolution of the liver injury and biloma. The pigtail catheter was removed one week later after confirming that no further bile drainage was necessary.

Two months later, the patient was discharged from the hospital. Although the injury had been severe, the patient's overall recovery was considered successful. The follow-up visits revealed that the rib fractures were healing well, and there were no signs of liver dysfunction or long-term complications from the trauma. The patient was advised to continue with rehabilitation and follow-up care, which included regular imaging and blood tests to monitor his liver function. This case emphasizes the vital importance of comprehensive trauma care, timely imaging, and the use of minimally invasive drainage techniques in managing high-grade liver injuries in combat scenarios.

DISCUSSION

Combat-related liver injuries often present with a combination of blunt and penetrating trauma, which can result in severe hemorrhage and multi-organ involvement. The liver, due to its high vascularity, is especially susceptible to traumatic injury, and its management requires careful decision-making regarding surgical intervention and conservative measures. In both cases presented, the initial step of resuscitation was critical in stabilizing the patients and preventing further complications. These cases

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underscore the critical importance of early resuscitation, rapid surgical decision-making, and comprehensive postoperative care.

The first case demonstrated a classical presentation of segmental hepatic laceration with associated haemoperitoneum and bilateral haemothorax, managed effectively with primary repair and later supplemented by ultrasound-guided percutaneous drainage of a liquefied biloma. The second case highlighted the challenges of managing a more extensive injury involving both lobes of the liver, colonic contusion, rib fractures, and evolving pleural effusions. Both cases required ICU admission, serial imaging, nutritional support, and multidisciplinary input, reinforcing the necessity of an integrated approach to trauma care.

The choice of surgical approach—such as direct suture repair, perihepatic packing, or hepatic resection—depends on the severity and location of the injury. In the cases presented, primary repair was employed effectively, along with the Pringle maneuver to control hepatic blood flow. Both cases involved postoperative drainage of biloma, demonstrating the role of percutaneous procedures in managing complications.

Liver injury severity is graded according to the American Association for the Surgery of Trauma (AAST) classification. In severe cases, damage control surgery, including temporary packing and vascular control, is often employed in the first stages of management. Advances in imaging techniques, such as ultrasonography and CT scans, allow for early detection of complications like biloma or abscess formation. These tools were crucial in both cases for guiding therapeutic decisions and interventions.

The role of percutaneous pigtail catheters in managing post-traumatic liver injuries has become more prominent in recent years. These minimally invasive procedures are beneficial in draining bilomas and hematomas, which would traditionally require more invasive surgery. They are associated with shorter hospital stays, reduced morbidity, and faster recovery times. Moreover, the use of antibiotics, nutritional support, and multidisciplinary care, including input from physiatrists and orthopedic surgeons, has contributed to improved patient outcomes.

Despite advancements in both surgical techniques and postoperative care, the mortality rate for combat-related liver injuries remains high. Challenges such as delayed interventions, inadequate resources, and multi-organ involvement complicate the management of these injuries. Additionally, the psychological impact on patients, especially soldiers returning from combat, requires ongoing care and rehabilitation.

Current literature supports that non-operative management (NOM) is feasible in hemodynamically stable patients with low-grade liver injuries. However, in combat zones, NOM is frequently limited by diagnostic uncertainty, ongoing

bleeding, and associated injuries. Therefore, exploratory laparotomy remains a cornerstone of management in unstable patients. In both cases, surgical exploration was warranted and provided direct control over bleeding and organ repair, aligning with current trauma surgery protocols in high-acuity environments.

Ultimately, these cases underscore the evolving standards of care for liver injury in combat settings. The integration of advanced imaging, surgical techniques, and critical care has dramatically improved survival rates. However, the need for continued training, protocol development, and resource allocation in military field hospitals remains pressing. These reports contribute to the evidence base supporting the multifaceted approach required to manage complex liver injuries effectively in high-risk environments.

CONCLUSION

Combat-related liver injuries continue to pose significant challenges in surgical practice due to the complex nature of the trauma and the high mortality rates associated with severe injuries. This case series illustrates the importance of prompt resuscitation, effective imaging, and timely surgical intervention in improving patient outcomes. The evolving role of percutaneous drainage techniques, along with advancements in trauma care and multidisciplinary management, offers hope for better recovery and survival rates in soldiers sustaining these life-threatening injuries. These experiences reaffirm the capability of well-trained military surgical teams to deliver high-quality care under duress and offer valuable insights for improving outcomes in both military and civilian trauma systems.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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