



KOSOVA JOURNAL OF SURGERY

Volume 10, Issue 1, Part I
Focused Issue: Trauma and
Surgical Critical Care
January 2026
ISSN: 3027-5008 (Online)
ISSN: 3027-5016 (Print)

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The Management of Liver, Biliary Tree and Pancreas Injuries

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Abstract

Background:

Injuries to the liver, biliary tree and pancreas present a significant challenge due to the complexity of their anatomical location, the high density of their blood vessels, and the potential for life-threatening complications. A multidisciplinary, timely, and context-specific approach is required for their management, often in the setting of polytrauma.

Discussion

Liver Injuries: In patients with haemodynamic stability, non-operative management (NOM) is the preferred option, with angioembolization being utilised for the management of active bleeding. Operative strategies encompass a range of surgical interventions, including packing, Pringle maneuver, resectional debridement, or hepatotomy with selective ligation. Major hepatic venous injuries carry a high mortality rate and may require damage control surgery.

Biliary Injuries: It is frequently the case that the condition is iatrogenic or secondary to penetrating trauma, with the result that diagnosis may be delayed. The ERCP is a procedure that is both diagnostic and therapeutic. Operative repair is indicated in cases of high-output leaks or major ductal injuries, and is often delayed until the patient has been stabilised.

Pancreatic Injuries: Isolated minor contusions (AAST Grade I–II) are generally managed conservatively. Injuries involving the main pancreatic duct (Grade III+) may require distal pancreatectomy or drainage. Associated duodenal injuries have been shown to increase the complexity of the procedure and influence the timing and type of surgical intervention

Conclusion: How well the management works depends on how quickly the injury is recognised and graded, and on how carefully the right balance is found between NOM and operative intervention.

Introduction

Injuries to the liver, biliary tree and pancreas present a significant challenge due to the complexity of their anatomical location, the high density of their blood vessels, and the potential for life-threatening complications. A multidisciplinary, timely, and context-specific approach is required for their management, often in the setting of polytrauma.

Liver Injuries:

Liver injury is classified by American Association for the Surgery of Trauma (AAST) as Grades I–VI:
I–II: Minor (capsular tear, superficial parenchymal injury).

III–IV: Moderate to severe (deeper lacerations, major venous injury).

V–VI: Massive destruction or avulsion of hepatic veins/IVC or hepatic tissue.

The initial assessment of trauma patients is universally consistent, employing the ABCDE trauma evaluation methodology. For patients who are haemodynamically stable, focused assessment with sonography for trauma (FAST) or a CT scan is utilised. Following the completion of the initial complete blood count (CBC), the next steps in the diagnostic process should include the assessment of coagulation parameters, liver enzymes, and crossmatch.

The management of the patient is based on hemodynamic parameters. There are indications for non-operative management (NOM). In the event that the patient is deemed to be hemodynamically stable, the presence of additional abdominal injuries that necessitate surgical intervention is deemed to be absent. The evaluation of these patients is conducted within the intensive care unit (ICU) or a monitored setting. Once the patient has stabilised, they should be mobilised as soon as possible.

Angioembolization is indicated in cases where contrast extravasation or pseudoaneurysm is detected on CT imaging, with repeat imaging only being considered in cases of clinical deterioration.

The indications for operative management are haemodynamic instability despite resuscitation, peritonitis, or other surgical indications. Surgery for damage control is a procedure that can be performed on patients who are unstable. The implementation of perihepatic packing is imperative in order to achieve haemostasis. We recommend using perihepatic packing in patients with major liver injuries, especially in patients who are acidotic, coagulopathic, and hypothermic. The packs should be removed 36 to 72 hours after being placed. Temporary abdominal closure and resuscitation in ICU can be followed.

For definitive procedures, direct suture of lacerations, hepatorrhaphy or use of topical hemostatics, ligation of bleeding vessels, partial hepatectomy for devitalized tissue can be performed. Clamping portal triad with Pringle maneuver to control inflow bleeding can be done. It is widely believed that this can be safely used on normal hepatic parenchyma for up to 90 minutes, although intermittent inflow occlusion of between 10 and 30 minutes followed by 5–15 minutes of reperfusion, has

gained popularity and is thought to extend the potential total ischaemic time to up to 120 minutes. Hepatic artery ligation or atriocaval shunting for Grade V–VI can be needed.

For postoperative care, monitor for bile leaks, abscess, or delayed hemorrhage. Drains can be used or ERCP with stenting for persistent bile leaks can be done. Broad-spectrum antibiotics for infected collections can be used. The antibiotics should cover *Enterobacteriaceae*, *anaerobes*, *Streptococci*, *Enterococci*, and *Entamoeba histolytica*. Such antibiotic regimens include cephalosporins plus metronidazole, beta-lactam/ beta-lactamase inhibitor plus metronidazole, or synthetic penicillins plus aminoglycosides and metronidazole

A gradual return to activity is recommended, with high-grade injuries potentially requiring several months of rehabilitation before a full recovery is achieved.

In the case of paediatric patients, NOM is the preferred treatment option, even in cases of higher-grade injuries. In the case of polytrauma: It is imperative to prioritise and address haemorrhage as a matter of utmost importance. Radiology plays a growing role in bleeding control and complications. Angiographic (transcatheter arterial) embolization (AE/TAE) is an important adjunct in the management of liver trauma, particularly for high-grade injuries and ongoing arterial bleeding¹ (Table 1).

Table 1: Indications and contraindications for angiographic embolization of liver trauma

Indications	Contraindications
1-Hemodynamically stable or transiently responsive patients with:	1-Persistent hemodynamic instability despite resuscitation (→ laparotomy first).
a) CT evidence of contrast extravasation (“blush”), pseudoaneurysm, or arteriovenous fistula.	a) Extensive devascularization risk if large portions of the liver would need embolization.
2-High-grade (AAST IV–V) injuries with large hematomas or ongoing blood loss.	2-Relative: lack of interventional radiology availability or expertise.
3-Post-operative or post-pack removal rebleeding after damage-control surgery.	a) Persistent hemodynamic instability despite resuscitation (→ laparotomy first).
4-Selected cases of non-operative management (NOM) failure.	b) Extensive devascularization risk if large portions of the liver would need embolization.

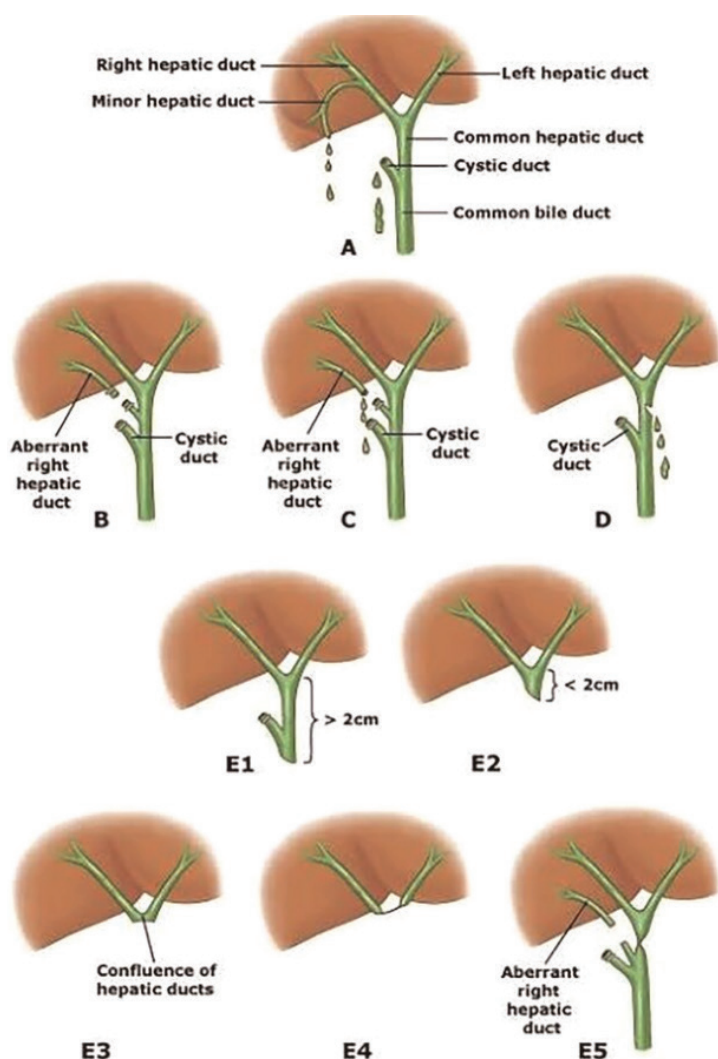


Figure 1: Biliary tract injury Strasberg classification

The initial recognition of the condition is facilitated by the presence of intraoperative signs, including persistent bile leakage in the operative field and unclear anatomy. Postoperative indications may include the following:

- the presence of bile in the drainage system
- the presence of bilious ascites
- jaundice
- abdominal pain
- sepsis

For investigations LFTs, bilirubin, for imaging: ultrasound, CT, and MRCP are the main imaging modalities employed in this context. It is imperative that ERCP or PTC is performed for the purpose of diagnosis and potential therapy.

In the event of minor leaks or partial injuries, the following protocol is to be observed for the purpose of

immediate intraoperative management. The primary repair should be performed over a stent (T-tube or internal). In the case of small ducts, ligation may be considered if the ducts are non-critical.

In circumstances involving major duct transection or uncertain anatomy, it is imperative to exercise caution and refrain from undertaking blind repairs in the absence of requisite expertise. Instead, the focus should be on the management of sepsis, the placement of drains, and the subsequent referral to a hepatobiliary (HPB) surgeon. In cases where expertise is available, the preferred reconstruction is one of Roux-en-Y hepaticojejunostomy. The following surgical procedures are performed during a Roux-en-Y hepaticojejunostomy: mobilisation of the jejunum, identification and dissection of the bile ducts, and creation of a loop of jejunum. Anastomosis of the bile ducts to the jejunum is then carried out.

In cases where there is delayed recognition and the patient is stable, minor leaks (Strasberg A/D) should be treated with ERCP, which involves sphincterotomy and the placement of a stent to decrease intraductal pressure. If necessary, collections should be drained percutaneously.

In cases of major injury (Strasberg E or complete transection), the following treatment is recommended:

- Control of sepsis through the administration of broad-spectrum antibiotics
- Drainage of the biloma or abscess
- Delay of definitive reconstruction for a period of 6–8 weeks to allow inflammation to subside
- Performance of a Roux-en-Y hepaticojejunostomy by an experienced HPB surgeon

In cases of biliary strictures, the preferred treatment is endoscopic balloon dilation ± stenting in cases of low strictures, while high or recurrent strictures are treated with surgical revision (redo hepaticojejunostomy).

Repairs should be performed expeditiously by a qualified professional or delayed until the inflammation has subsided. Intermediate timescales of 2–6 weeks have been shown to result in suboptimal outcomes. A multidisciplinary approach involving HPB surgery, interventional radiology and endoscopy is of paramount importance. In order to prevent critical incidents during cholecystectomy, it is imperative that intraoperative cholangiography is performed when there is uncertainty. Early referral to a tertiary HPB centre has been shown to improve long-term outcomes².

Pancreas Injury

Classification AAST Pancreas Injury Scale(American Association for the Surgery of Trauma) as;

Grade I–II: Minor contusion or superficial laceration without duct injury.

Grade III: Distal transection or parenchymal injury with duct involvement.

Grade IV: Proximal transection (to the right of SMV) or major head injury.

Grade V: Massive disruption of pancreatic head.

The preliminary evaluation of pancreatic trauma is analogous to the preceding case descriptions. The most prevalent etiological factor is blunt trauma. Elevated levels of amylase and lipase can be observed. The utilisation of contrast-enhanced CT, MRCP, or ERCP for duct evaluation constitutes a range of diagnostic tools. It is important to note that there is a possibility of injury to the vascular structures in the pancreas, duodenum and biliary tree.

In the event of haemodynamic instability, the recommended course of action for the management team is to perform a damage control laparotomy. It is imperative to exercise control over haemorrhaging and contamination. A wide drainage system is required, and it is advisable to defer definitive repair.

For patients with haemodynamic stability and grades I–II (absence of duct injury), the treatment options for the management of such cases include non-operative management or simple drainage, with observation in a setting that is subject to monitoring. Repeat imaging may be indicated should there be any clinical changes. In the case of Grade III (distal duct injury), distal pancreatectomy, either with or without splenectomy, or drainage of the remaining pancreas, may be performed. In cases of Grade IV–V (proximal duct/head injury), external drainage may be indicated in instances where anatomical structures are obscured or the patient is unstable. In the event of an acute presentation, the following definitive surgical procedures are offered by the experienced HPB surgeon: Roux-en-Y pancreaticojejunostomy and pancreaticoduodenectomy (Whipple). It is often the case that delayed reconstruction is a safer option subsequent to damage control.

Pancreatic injuries are frequently associated with concomitant damage to the biliary tract, major vascular structures, or the duodenum. In the presence of

multiple organ involvement, the pancreatic injury grade is generally advanced by one level, up to grade III. The complex duodeno-pancreatic anatomy and retroperitoneal location, contributes to the high likelihood of missed injuries or delayed diagnosis in such cases. Historically, duodenal diverticulization and triple-tube decompression were employed in the management of combined pancreatic and duodenal injuries; however, these approaches are no longer recommended. Contemporary evidence strongly favors primary repair of the duodenum, accompanied by nasogastric decompression and the placement of external drains, even in patients presenting with extensive and high-grade injuries.

Postoperative care monitoring is of paramount importance in cases of pancreatic fistula, abscess, pseudocyst, or haemorrhage. In the treatment of high-output fistulas, the use of octreotide has been suggested as a selective approach. In cases where ERCP with stenting is deemed feasible, this may be recommended for the management of ductal leaks. Furthermore, the administration of broad-spectrum antibiotics has been proposed as a treatment for infected collections. In order to provide the most effective nutritional support, it is recommended that early enteral feeding is initiated at the earliest opportunity.

For Children: In the absence of major ductal injury, the NOM is the preferred option. In the event of associated duodenal injury, the necessity for pyloric exclusion or duodenal diversion may be indicated. A multidisciplinary approach, incorporating surgery, interventional radiology and gastroenterology, is of paramount importance. In the context of follow-up, close monitoring is imperative for the identification of potential late complications, including but not limited to pseudocyst formation and stricture development³.

Conclusion: How well the management works depends on how quickly the injury is recognised and graded, and on how carefully the right balance is found between NOM and operative intervention(Table 2). There are now more ways to treat these injuries than ever before. Damage control principles, interventional radiology, and endoscopy are now playing a very important role in the treatment of these conditions. It is still very important to bring healthcare services together and make the best use of trauma services to improve outcomes.

Table 2: Management of Liver, Biliary Tree and Pancreas Injuries

Organ	AAST Grade	Stable Patient	Unstable Patient	Adjuncts
Liver	<i>I–III</i>	NOM ± embolization	Packing, Pringle, etc.	IR, DCS
Biliary Tree	<i>All</i>	ERCP for leaks	Delayed repair if needed	Drainage
Pancreas	<i>I–II</i>	Conservative	Rare surgery	Imaging, drains
Pancreas	<i>III–V</i>	± Surgery (distal pan.)	DCS, Whipple in select	ERCP, Duct stents

IR: Interventional radiology DCS: Damage control surgery

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