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ORIGINAL ARTICLE

Endoscopic treatment of persistent thoracobiliary fistulae after penetrating liver trauma

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Abstract

Background: This study evaluated the outcomes of patients with complex or persistent thoracobiliary fistulae following penetrating liver trauma, who underwent endoscopic biliary intervention at a tertiary referral centre.

Methods: All patients who underwent endoscopic retrograde cholangiography (ERC) and endoscopic biliary intervention for traumatic thoracobiliary fistulae between 1992 and 2008 were evaluated. Bile duct injuries were classified according to their biliary anatomic location on cholangiography and type of pulmonary communication.

Results: Twenty-two patients had thoracobiliary (pleurobiliary, $n = 19$; bronchobiliary, $n = 3$) fistulae. The site of the bile duct injury was identified in 20 patients on cholangiography. These 20 patients underwent either sphincterotomy and biliary stenting ($n = 18$) or sphincterotomy alone ($n = 2$). In 17 patients the fistulae resolved after the initial endoscopic intervention. Three patients required secondary stenting with replacement of the initial stent. Three patients developed mild pancreatitis after stenting and one stent migrated and was replaced. All fistulae healed after endoscopic treatment. In 18 patients the stents were removed 4 weeks after bile drainage ceased. Three of the 22 patients required a thoracotomy for infected loculated pleural collections after initial catheter drainage.

Conclusions: Endoscopic retrograde cholangiography is an accurate and reliable method of demonstrating post-traumatic thoracobiliary fistulae and endoscopic biliary intervention with sphincterotomy and stenting in this situation is safe and effective. Surgery in patients with thoracobiliary fistulae should be reserved for fistulae which do not heal after endoscopic biliary stenting or for patients who have unresolved pulmonary or intra-abdominal sepsis as a result of bile leak.

Keywords

Liver injury, bile fistula, endoscopic retrograde cholangiopancreatography (ERCP), biliary stent

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Introduction

The liver is the most commonly injured solid organ in patients who sustain major abdominal trauma.[1–3] In the past decade, there has been an increasing trend towards the non-operative management of liver trauma and there is now a substantial body of evidence to support the selective non-operative management of stable patients with blunt and penetrating liver injuries.[4–6] However, liver-related complications including intra-abdominal and subphrenic abscesses, delayed bleeding from the liver, haemobilia, intraperitoneal bile collection and biliary fistulae occur in 3–5% of patients who have been treated non-operatively or in those who have undergone a laparotomy to control bleeding from the liver.[7–9] Thoracobiliary fistulae, which include pleurobiliary and bronchobiliary fistulae, are considerably less common and, to date, published data on their endoscopic management are scant.[10–12]

Advances in radiological imaging using ultrasound, computed tomographic (CT) scanning and magnetic resonance imaging have enhanced non-operative assessment of the extent and magnitude of liver injuries and broadened the indications for conservative management. Radiological intervention with percutaneous catheter drainage of intrahepatic or subphrenic abscesses and infected bile collections and selective hepatic artery angiography with embolization of bleeding intrahepatic false aneurysms have further extended the non-operative management of liver injuries.[13–15] Endoscopic biliary stenting is now the established treatment in selected patients with persistent bile duct leaks following laparoscopic cholecystectomy[16–18] and endoscopic management has been shown to be safe and effective in patients who develop bile leaks after elective liver surgery. However, the optimal mode of management of persistent bile leaks in patients who have sustained major liver injuries has not been clearly established. This study assessed the efficacy of endoscopic biliary intervention in patients with complex or persistent bile leakage caused by thoracobiliary fistulae complicating penetrating liver trauma.

Materials and methods

All patients with complicated or persistent thoracobiliary fistulae after penetrating thoracoabdominal liver trauma who were referred to the surgical gastrointestinal endoscopy unit at Groote Schuur Hospital, Cape Town, a tertiary referral centre for adult trauma and hepatobiliary diseases, between October 1992 and June 2008, were evaluated. Data were obtained from patient notes and the surgical, radiological and endoscopic retrograde cholangiography (ERC) records. Data included demographic information, the grade of liver injury, initial and subsequent surgical procedures, mode of presentation of the biliary fistula, endoscopic biliary drainage procedures performed, the site of the bile duct injury and outcome of management. Morbidity was assessed in terms of associated injuries, loculated pleural collections or empyemas, persistent biliary leaks despite intervention, and complications related to endoscopic sphincterotomy and biliary stent placement. All patients admitted to the Trauma Centre with penetrating liver injuries were resuscitated according to advanced trauma life support protocols[19] and were managed according to standard guidelines.[7,8,9,20] The extent of the liver injury was assessed either at laparotomy or on CT imaging and graded according to the organ injury scale of the American Association for the Surgery of Trauma.[21]

Thoracobiliary fistulae were categorized as either pleurobiliary (when the bile leak in the chest was confined to the pleural space) or bronchobiliary (when the patient had bile-stained sputum caused by a communication between the biliary and bronchial systems). In the data analysis, the site of the bile duct injury was categorized as either intrahepatic (central or peripheral) or extrahepatic. Central intrahepatic biliary injuries were arbitrarily defined as those involving the proximal right and left hepatic or segmental ducts within 5 cm of the hepatic duct confluence

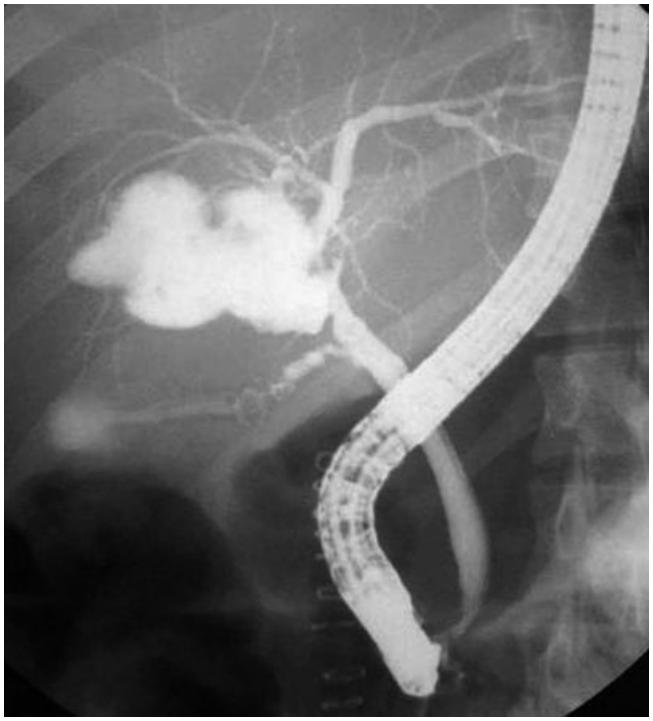

Figure 1 Endoscopic retrograde cholangiogram demonstrating a right hepatic duct injury with extensive extravasation of contrast (intrahepatic central type injury)

(Fig. 1). Peripheral biliary injuries were defined as those within the hepatic parenchyma more than 5 cm from the hepatic duct confluence (Fig. 2). If a bile leak was identified at ERC, an endoscopic sphincterotomy was performed and a 10-Fr biliary stent inserted to facilitate effective bile drainage.

Results

A total of 22 patients were referred for assessment and treatment of persistent thoracobiliary fistulae during the study period. They included 21 men and one woman. Their mean age was 27.0 years (range 13.9–56.4 years). Seventeen had sustained gunshot wounds and five had stab wounds. Twenty patients had grade 3 liver injuries and two had grade 4 injuries.

Eleven of the 22 patients were managed non-operatively after the initial liver injury. Of the remaining 11 patients who underwent urgent surgical exploration, two had active liver bleeding which was controlled by temporary packing ($n = 1$) or suturing ($n = 1$), two had major bleeding and required liver packing to stop the bleeding and subsequent re-operation for removal of packs, five had bile leakage treated with placement of external drains, and two required no further intervention at laparotomy after evacuation of blood clot. Four of these 11 patients required a second operation, and two required more than two surgical procedures. The additional procedures included removal of liver packs ($n = 2$), thoracotomy and drainage of an infected pleural collection

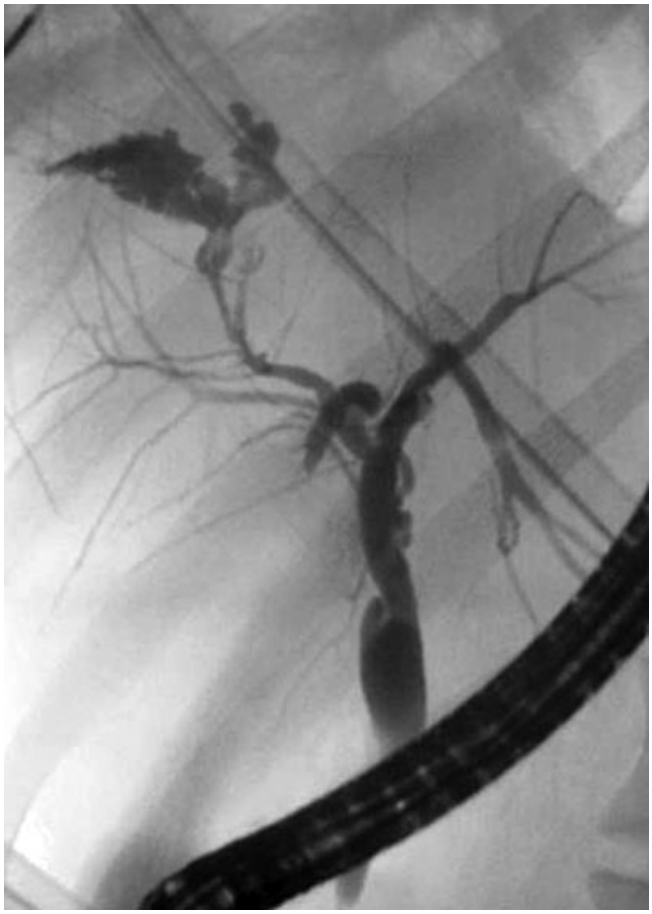

Figure 2 Endoscopic retrograde cholangiogram showing a segment 8 hepatic duct injury (intrahepatic peripheral type injury)

($n = 3$), and a laparotomy for adhesive small bowel obstruction ($n = 1$).

All 22 patients developed bile collections in the right pleural space which were drained via either an intercostal chest drain ($n = 20$) or radiologically guided catheter placement for a loculated chest collection ($n = 2$). Three of the 22 had bilioptysis resulting from bronchobiliary fistula. Seven of the 22 patients also had intra-abdominal bile collections which were drained percutaneously under radiological guidance. One patient developed a biliary–cutaneous fistula through an abdominal drain and another patient had a biliary–pleural–cutaneous fistula which decompressed spontaneously through the wound site.

The 22 patients underwent ERC at a mean of 13.2 days after the liver injury. The papilla and common bile duct were successfully cannulated in all 22 patients and the site and extent of the biliary leak were identified in 20 patients. Nineteen biliary injuries involved the intrahepatic bile ducts (17 peripheral, two central), whereas one injury was extrahepatic and involved the proximal right hepatic duct 1 cm above the hepatic duct bifurcation. No bile leak could be identified in two patients who underwent ERC; the external bile drainage in both these patients gradually diminished and stopped spontaneously within 10 days of the ERC. Twenty patients underwent a therapeutic procedure, whereas two patients underwent diagnostic procedures only as no site of injury was demonstrated. Eighteen patients underwent sphincterotomy and placement of a 10-Fr biliary stent and two patients underwent endoscopic sphincterotomy alone. No patient required surgical intervention for the bile duct injury. The bile leak in the patient with an extrahepatic proximal right hepatic duct injury resolved after endoscopic sphincterotomy. External biliary drainage resolved in 17 patients at a mean of 18 days (range 6–40 days) after biliary stenting. Three patients had persistent bile leakage despite initial endoscopic stenting and required insertion of a second biliary stent to enhance biliary drainage into the duodenum. In all three of these patients, external bile drainage stopped soon after insertion of the second biliary stent. The stents in 18 patients were removed 4 weeks after the external bile drainage had stopped. Endoscopic cholangiograms performed during stent removal confirmed resolution of the bile leaks in all patients.

Three patients developed mild post-endoscopic retrograde cholangiopancreatography pancreatitis with an elevated serum amylase which resolved spontaneously 3–5 days after stent insertion. In one patient the endoscopically placed stent migrated and lodged in the transverse colon, from which it was removed by colonoscopy and a new biliary stent was inserted. One patient presented with haemobilia caused by an arteriovenous fistula between the hepatic artery and the portal vein after a stab wound. The fistula was successfully treated via selective right hepatic artery catheterization and embolization using microcoils.

Twelve of the 22 patients developed loculated chest collections or pleural empyemas after the initial chest drainage. Nine of the 12 patients were managed conservatively with further chest drainage and antibiotics with complete resolution. Three patients ultimately required a thoracotomy and operative drainage of an infected pleural collection. There were no deaths in any of the patients in this study.

Discussion

Thoracobiliary fistulae are infrequently encountered in clinical practice and usually occur as a complication of amoebic or pyogenic liver abscesses, hydatid disease or as a consequence of iatrogenic liver injuries. Although the reported incidence of external biliary fistulae after liver trauma is in the range of 2–4%,[22,23] thoracobiliary fistulae are considerably less common after trauma and result from the combination of an injured intrahepatic duct, an overlooked or inappropriately treated diaphragmatic injury and preferential leakage of bile into the pleural space or bronchial system.[10–12] The spectrum of post-traumatic thoracobiliary fistulae ranges from small bile-stained pleural effusions which resolve after chest drainage, to large symptomatic, infected, persistent pleurobiliary fistulae and rare bronchobiliary fistulae with bilioptysis caused by an associated bronchial injury.[10]

Although most low-volume biliary fistulae resolve after drainage of the pleural bile collection and treatment of sepsis, the failure rate of conservative treatment of large thoracobiliary fistulae without endoscopic or surgical intervention is reported to be as high as 38%.[12] Persistence of fistulae is the consequence of negative pressure within the pleural space during inspiration and a relatively elevated pressure within the biliary system as a result of an intact sphincter of Oddi.[10,11] Persistent thoracobiliary fistulae prolong hospitalization and may result in intractable sepsis, bile peritonitis or haemobilia and require further intervention to achieve resolution. In the past, the conventional treatment for post-traumatic thoracobiliary fistulae was operative intervention.[12] However, surgery is a major procedure and involves a thoracotomy, pleural decortication and diaphragmatic repair. Some patients may require a segmental lung resection as well as a laparotomy, which further compounds morbidity.[24,25] A substantial proportion of patients with complex persistent thoracobiliary fistulae also have major associated injuries of the head, chest, abdomen or extremities, which complicate overall management.[2,5,7] In these situations, non-operative treatment is preferable.

Endoscopic biliary stenting avoids the risks of major surgery and, with effective biliary decompression, causes the bile leak to resolve, enabling patients who have major associated injuries to recover.[26,27] Placement of an endoscopic biliary stent facilitates effective bile drainage into the duodenum by negating sphincter of Oddi resistance and reduces bile duct pressure with healing of the fistula.[28] Previous reports of endoscopic treatment of bile leaks in adults have included a variety of techniques.[26,28] Most modern techniques now use endoscopic transampullary biliary stenting with or without sphincterotomy, although sphincterotomy alone and nasobiliary intubation have been used to avoid a second endoscopy.[29] The advantages of nasobiliary tubes include the easy access they allow for follow-up cholangiography and flushing and the fact that they can be removed easily without the need for further endoscopy. Despite these benefits, nasobiliary tubes are uncomfortable, tend to dislodge easily and may cause electrolyte disturbances as a result of large-volume external bile losses and are therefore not commonly used in current endoscopic practice.[29] Two other novel techniques have been used to treat biliary fistulae that persist despite biliary stenting. The first uses endoscopic embolization of the involved peripheral intrahepatic bile duct close to the origin of the fistula with an Ivalon pledget.[30] The second technique employs percutaneous embolization of the fistula with microcoils, gelfoam and Histoacryl.[31] Both techniques require advanced interventional skills and should be considered only when conventional methods have failed and the appropriate endoscopic or radiological expertise is available.

There is no consensus regarding optimal endoscopic intervention nor is there controlled data to indicate the optimal number, configuration, size and length of endoprostheses required for successful management of post-traumatic thoracobiliary fistulae.[32] Experimental data show that flow rates are better *in vitro* through straight rather than pigtail stents, and fistula closure is more rapid in dogs with stents compared with sphincterotomy alone.[33] The ideal duration for biliary stenting is not known, and has varied from 3 to 8 weeks in previous reports.[26,29] We used single 10-Fr plastic stents in preference to the smaller 7-Fr stents, which carry the risk of early stent occlusion by inspissated bile. In this study the stents were left *in situ* for 4 weeks after external bile drainage had stopped. Using this protocol, all the fistulae in our study healed without recurrence. Endoscopic biliary intervention does, however, have complications. The major acute problems after biliary manipulation and stenting are pancreatitis, cholangitis, bleeding from the sphincterotomy site and, rarely, duodenal perforation. Later difficulties encountered are cholangitis caused by stent blockage, dislodgement or stent migration. Three patients in this study developed short-lived pancreatitis after sphincterotomy and stent placement, which resolved spontaneously, and one patient required replacement of a new stent after stent migration.

In conclusion, this study demonstrates that the application of ERC represents a significant advance in the treatment of persistent biliary fistulae associated with liver trauma. Importantly, our data demonstrate that ERC is an accurate method for identifying post-traumatic thoracobiliary fistulae and that endoscopic management is safe and effective. Equalization of duodenal and biliary pressures using biliary stenting was sufficient to allow ductal healing and closure of the fistula. We recommend that surgery should be reserved for patients with persistent thoracobiliary fistulae which do not heal after endoscopic biliary stenting or with unresolved pulmonary or intra-abdominal sepsis as a result of the bile leak.

Conflicts of interest

None declared.

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