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SURGICAL ENDOSCOPY
and Other Interventional Techniques

Postoperative management of noniatrogenic traumatic bile duct injuries: role of endoscopic retrograde cholangiopancreaticography

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Abstract
Background: Endoscopic therapy for iatrogenic bile duct injuries is well established. Abdominal trauma–related biliary injuries, however, are complex in nature. The role of endoscopic therapy for these patients needs further evaluation.
Methods: A retrospective study investigated nine patients who had surgery for abdominal trauma (4 gunshot, 4 crush, and 1 stab injury), presented postoperatively with noniatrogenic biliary injuries, and underwent endoscopic retrograde cholangiopancreaticography (ERCP).
Results: The ERCP was successful for all the patients. Eight patients had significant bile leak at intra- or extrahepatic sites, and one patient was discovered to have complete cutoff of the common hepatic duct. All bile leaks were treated successfully using biliary sphincterotomy with or without transpapillary stenting. No complications of ERCP were observed.
Conclusions: In this case series, ERCP was found to be useful as a diagnostic and therapeutic method for managing noniatrogenic traumatic biliary injuries in patients who had undergone previous surgery for abdominal trauma. The ERCP results were similar to those for iatrogenic bile duct injuries.

Key words: Bile leak — Biliary trauma — ERCP

Iatrogenic biliary injuries are recognized postoperative complications of cholecystectomy and other hepatobiliary surgeries [1, 6, 14]. Management of these injuries involves surgical, radiologic, and endoscopic interventions. Endoscopic therapy in the form of biliary sphincterotomy, transpapillary stenting, or both are accepted interventions for these patients [1, 10]. Noniatrogenic injuries to the bile ducts from abdominal trauma can be a source of significant short- and long-term morbidity. Many of these patients undergo surgery for multiorgan injuries, and ongoing bile leaks often lead to surgical reinterventions [11]. Therapy for biliary tract injuries in these patients can be challenging and complicated because of accompanying multiorgan trauma and infection.

There is no consensus on the treatment of noniatrogenic traumatic bile leaks, and decisions often are based on the extent and mechanism of injury. Treatment also depends on associated organ injuries and local expertise [4, 12]. The outcomes of endoscopic retrograde cholangiopancreaticography (ERCP) therapy for these patients are not well defined. We present our experience with endoscopic management of biliary tract injuries resulting from abdominal trauma.

Materials and methods

At a single tertiary medical center, between January 1998 and April 2005, nine patients with complex bile duct injuries were referred to undergo ERCP by the surgical trauma service for management of bile leak after blunt or sharp abdominal trauma (Table 1). The patients consisted of five men and four women with a mean age of 32.7 ± 17 years. Five of the patients (56%) had penetrating injuries to the bile ducts (1 stab and 4 gunshot injuries), and the remaining 4 patients (44%) had crush injuries. Bile leaks were identified by the presence of bilious fluid in abdominal or chest drains, or by radiologic identification of a biloma. The majority of these patients (67%) underwent surgical intervention before ERCP, during which, except for the treatment of intraabdominal multiorgan trauma, including liver lacerations, no primary repair of the bile ducts was performed. Two patients (patients 2 and 3) were managed using radiologic interventions before ERCP.

After initial interventions, all the patients were referred for ERCP aimed at evaluation and therapy for continuing bile leak, which manifested as bilious output exceeding 500 ml per day in 55% of the patients, radiologic evidence of biloma in 22%, and the development of jaundice in the remaining patients.

The ERCP was performed to diagnose the site of bile leak. Where appropriate, therapeutic interventions (endoscopic sphincterotomy with or without transpapillary stent placement) were performed during

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Table 1. Patient characteristics and outcome

Case no.	Age (yrs)	Gender	Type of injury	Intervention before ERCP	ERCP location of bile leak	Interventions during ERCP	Days to resolution after ERCP[a]
1	18	Male	Gunshot	Exploratory laparotomy	Left hepatic duct	1st: ES and stent 2nd: Stent removal	6
2	40	Female	Crush	Mesenteric angiogram	Segments 7 and 8	1st: Cholangiogram 2nd: ES	8
3	56	Male	Crush	Interventional radiology drainage	Left hepatic duct	1st: ES and stent 2nd: Stent removal	17
4	21	Male	Crush	Laparoscopic drainage	Left lobe of liver	1st: ES and stent 2nd: Stent removal	5
5	29	Male	Stab	Two diaphragmatic and liver repairs	Segments 6 and 8	1st: ES and stent 2nd: Stent removal	7
6	19	Male	Gunshot	Hepatic artery and portal vein repair	Cutoff at CHD	1st: Cholangiogram 2nd: Cholangiogram	Surgery needed for disrupted ducts
7	67	Female	Gunshot	Liver laceration repair, right colectomy, cholecystectomy	Liver laceration repair site	1st: ES and stent 2nd: Stent removal	10
8	27	Female	Gunshot	Cholecystectomy, pancreatic and gastric repair	Cystic duct remnant	1st: ES and stent 2nd: Stent removal	2
9	17	Female	Crush	Exploratory laparotomy	Left lobe of liver	1st:ES and stent 2nd:Stent removal	4

ERCP, endoscopic retrograde cholangiopancreaticography; ES, endoscopic sphincterotomy; CHD, common hepatic duct.
[a] Resolution defined as no output of bilious fluid from percutaneous drains. Mean time to resolution was 7.4 ± 4.6 days.

ERCP. Bile leak resolution was defined as stoppage of bilious output from abdominal or chest drains without elevation of liver function tests, and by no radiologic evidence of intraabdominal fluid collection. Resolution of leak was further confirmed by a repeat ERCP 6 weeks later, during which the previously placed transpapillary stent was removed.

The Human Research Review Committee of the Medical College of Wisconsin approved this study.

Results

The use of ERCP was successful for all the patients (representative patient 5, Figs. 1 and 2). Technical difficulties were encountered in four of nine patients (44%) secondary to altered anatomy and fresh surgical wounds necessitating limited options in positioning of the patients.

Five patients (56%) had injury of the intrahepatic bile ducts, and in the remaining patients, extrahepatic biliary injuries predominated. Eight patients underwent endoscopic sphincterotomy, and seven of these also had transpapillary stent placement. In one patient (patient 6), ERCP was diagnostic, guiding subsequent surgical management.

In eight of the nine patients (89%), endotherapy (endoscopic sphincterotomy and stent for 7 patients and sphincterotomy alone for 1 patient) applied during ERCP was successful in managing the bile leaks. The time to resolution of bile leak after endotherapy, as determined by stoppage of bilious output from abdominal or chest drains without elevation of liver function tests and by no radiologic evidence of intra-abdominal fluid collection, was 7.4 ± 4.6 days.

In one patient (patient 6), no endotherapy was applied, and the cholangiogram obtained during ERCP directed subsequent surgical management for repair of his obstructed common bile duct. This patient was a 19-year-old man with a gunshot injury to the abdomen who had undergone stomach repair, partial left liver lobotomy, and repair of the hepatic artery and portal vein. Because ERCP demonstrated a complete cutoff at the upper level of the common hepatic duct with no leakage, a percutaneous cholangiography was performed, which showed a bilioduodenal fistula. This fistulous opening stenosed 3 months later, requiring surgical correction.

Patient 2 was unique in not having a focal site for her leak. She had diffuse seepage of bile from debrided, necrotic segments 7 and 8 of the liver, as seen on ERCP. She also responded to the traditional approach of endoscopic sphincterotomy. Patient 5 had two definitive focal sites of leak (Fig. 1) and also responded to therapeutic ERCP (Fig. 2).

The pancreaticogram was normal for all the patients. No immediate or late complications of ERCP were observed in any patient.

Discussion

In this retrospective review, we report the results for nine patients treated endoscopically for abdominal trauma–related biliary injuries who initially had

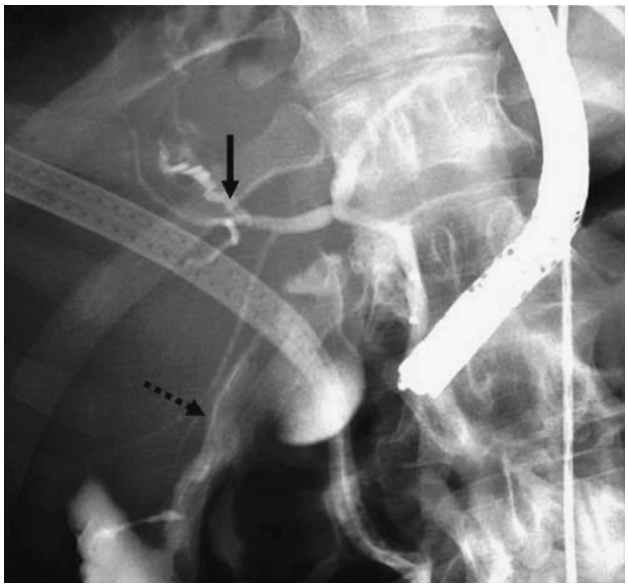

Fig. 1. Cholangiogram showing two biliary leaks: the first from segment 8 of the bile duct branch with contrast extravasation into the pleural space (*solid arrow*), and the second from segment 6 flowing into the subhepatic region (*dashed arrow*).

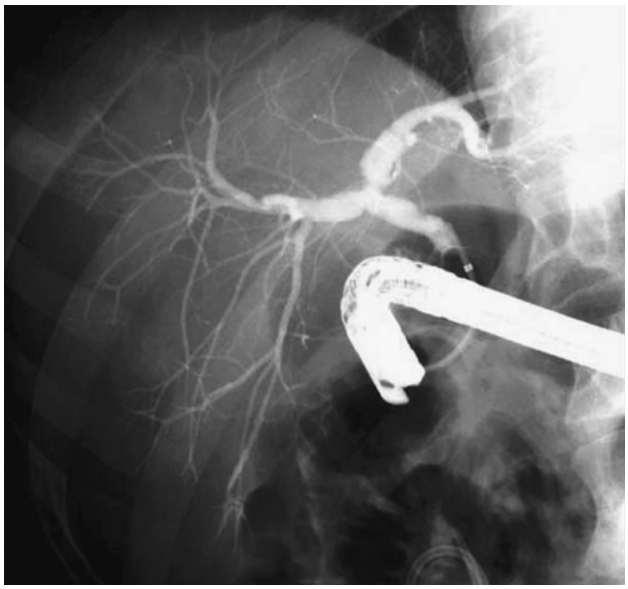

Fig. 2. The biliary stent was removed 6 weeks after performance of a 10-mm sphincterotomy and placement of a 10-Fr transpapillary stent during endoscopic retrograde cholangiopancreaticography (ERCP), and cholangiogram did not demonstrate any leak.

undergone surgery for multiple intraabdominal organ trauma and continued to have bile leaks postoperatively. Endoscopic management of iatrogenic bile duct injuries associated with hepatobiliary surgeries (e.g., postcholecystectomy leaks and strictures) is well established [1, 6, 14]. The procedures include endoscopic sphincterotomy and/or stenting for biliary leaks as well as dilation and stenting for strictures [10]. Noniatrogenic injuries in the form of blunt and sharp trauma to the abdomen also can result in bile duct injuries because the liver is the most common organ affected with abdominal trauma [5]. These injuries can be a significant source of morbidity because they are frequently associated with other organ injuries and infection [11]. Surgical treatment, especially reoperation to manage biliary injuries, for these patients is difficult and can result in complications such as stricture formation and cholangitis [12]. Endoscopic treatment of noniatrogenic, traumatic bile duct injuries may be as effective as treatment of iatrogenic injuries.

Initial reports in the surgical literature highlighted the role of ERCP only in the diagnosis of bile duct leaks [4, 11]. Subsequent case reports of adult and pediatric patients showed that in selected cases, ERCP with biliary stenting could help in resolving bile leaks [3, 7, 9]. D'Amours et al. [4] presented five patients with major bile duct injuries. Three of these patients were treated with sphincterotomy and stenting, whereas two underwent ERCP-assisted nasobiliary drain placement. All the patients were successfully managed nonoperatively.

Subgroup analysis of a large retrospective study on liver trauma patients by Carrillo et al. [2] demonstrated that 8 of the 135 patients in their series were managed using ERCP with sphincterotomy and stenting. Of these eight patients, two required arterial embolization in addition to the endoscopic procedures.

Sugiyama et al. [13] reviewed their experience with six patients who had blunt liver trauma. The majority of their patients had not undergone surgical exploration before endoscopic intervention. Five of the six patients were treated using only biliary stent placement, and only one underwent sphincterotomy. The authors were concerned about possible bleeding complications from endoscopic sphincterotomy in this setting.

In contrast, we performed sphincterotomy of 1 cm or more for eight of nine patients without any complications. In fact, for one patient, sphincterotomy alone was adequate to provide biliary drainage. Patient 6 had complete bile duct cutoff with no leak. Therefore, neither sphincterotomy nor stent placement was performed, and percutaneous transhepatic cholangiography was recommended. Stents were placed across the papilla in seven of the eight patients, who also underwent endoscopic sphincterotomy at the discretion of the endoscopist to "ensure" drainage in the event of papillary edema after sphincterotomy.

From this study, it is not possible to determine whether endoscopic sphincterotomy alone or transpapillary stent alone would have sufficed. In the endoscopic management of iatrogenic biliary tract injuries, experience with endoscopic sphincterotomy and transpapillary stent placement has had equivalent results. The current literature suggests that large bile leaks require stent placement, whereas endoscopic sphincterotomy alone can suffice for the management of small leaks in a postcholecystectomy setting [8, 10].

The patients in our series had extensive surgical exploration and therapy for the treatment of multiple nonbiliary organ injuries before referral for ERCP. In these patients, biliary tree injuries were recognized by the bilious fluid in abdominal or chest drains or by identification of a biloma. Patients were referred for ERCP after biliary leak continued despite the initial

surgical approach. As a result of the therapeutic ERCP intervention, none of the patients required surgical repair of their bile ducts. The mean time for resolution, as defined by resolution of bilious output from abdominal or chest drains, for our patients was 7.4 ± 4.6 days after ERCP. For patient 6, ERCP was helpful in identifying complete cutoff at the common hepatic duct, thereby directing further therapy. These outcomes are similar to outcomes achieved for iatrogenic bile leaks using ERCP interventions [10].

In summary, as with the management of iatrogenic bile duct injuries, ERCP is a safe and efficacious technique for managing patients with biliary injuries resulting from blunt or sharp abdominal trauma to the abdomen. The use of ERCP was not associated with a higher risk of complications in patients with such injuries. Although the majority of patients will undergo surgery for multiorgan trauma, as with the management of iatrogenic biliary injury, continuing bile leak in these patients can be managed effectively using therapeutic ERCP.

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