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Treatment and outcome of traumatic biliary injuries in children

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ABSTRACT

Background/Purpose: Traumatic biliary tract injuries in children are rare but may result in significant morbidity. The objective of this study was to review the occurrence of traumatic biliary tract injuries in children, management strategies, and outcome.

Methods: We conducted a retrospective review of patients with biliary tract injury using the trauma registry at our level 1 pediatric trauma center from 2002–2012.

Results: Twelve out of 13,582 trauma patients were identified, representing 0.09% of all trauma patients. All were secondary to blunt trauma. Mean age was 9.7 years [range 4–15], and mean Injury Severity Score was 31 ± 14, with overall survival of 92%. Biliary injuries included major ductal injury (6), minor ductal injury with biloma (4), gallbladder injury (2), and intrahepatic ductal injury (1). Major ductal injuries were managed by endoscopic retrograde cholangiopancreatography (ERCP) and biliary stent (5) and Roux-en-Y hepaticojejunostomy (1). Associated gallbladder injury was managed by cholecystectomy. In addition, the associated biloma was managed with percutaneous drainage (7), laparoscopic drainage (2), or during laparotomy (3). Two patients with ductal injuries developed late strictures after initial management with ERCP and stent placement. One of the two patients ultimately required a left hepatectomy, and the other has been managed conservatively without evidence of cholangitis. Two patients required placement of additional drains and prolonged antibiotics for superinfection following biloma drainage.

Conclusion: Biliary tract injuries are rare in children, and many are amenable to adjunctive therapy, including ERCP and biliary stent placement with or without placement of a peritoneal drain. Patients with a discrete ductal injury are at higher risk for stricture and require close follow up. Hepaticojejunostomy remains the definitive repair for large extrahepatic biliary tract injuries or transections.

Traumatic biliary tract injuries in children are rare but may result in significant morbidity [1–4]. Injuries can involve intrahepatic or extrahepatic ducts, or the gallbladder, and range from minor ductal injuries to complete transection. Historically, laparotomy and hepaticojejunostomy has been the gold standard for treatment of biliary injuries [5]. Recently, reports in the adult literature advocate for conservative measures such as placement of endoscopic stents and peritoneal drains to facilitate healing [6,7]. Injuries are commonly associated with other intraabdominal injuries, including blunt liver trauma and pancreatic and duodenal injuries [5,8]. Biliary injury may be diagnosed early, but is more commonly identified in a delayed fashion as a postoperative biliary fistula, bile peritonitis, biloma, or biliary stricture [5,9]. Most of the literature on biliary injuries is in adults after laparoscopic cholecystectomy [8], and is sparse for traumatic injuries in children [1–4]. The objective of this study was to review the occurrence of traumatic biliary tract injuries in children, management strategies, and outcome.

1. Methods

We conducted a retrospective review of all children with injury to the biliary tract at our level 1 pediatric trauma center from 2002 to 2012. Patients were identified using our trauma registry, and charts were reviewed to confirm and characterize the nature of the biliary injury. Patient information including demographics, mechanism of injury, associated injuries, Injury Severity Score (ISS), methods and timing of diagnosis, operative and nonoperative treatment, complications and long-term follow-up were collected from inpatient records and outpatient follow-up charts. Approval was obtained from our institutional review board.

2. Results

During the study period from 2002 through 2012, there were 13,582 trauma admissions. Twelve patients were identified with biliary injury, representing 0.09% of all trauma patients, and 2.6% of patients with hepatic trauma. A total of 462 patients sustained liver injury, including 237 with severe liver injuries (grade III–V). Patient characteristics, management and outcomes are summarized in Table 1.

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Table 1
Summary of patient characteristics, management, and outcomes.

	Patient and mechanism	ISS	Injury	Evaluation, management and Outcome
1	5 yo F MVA, ejected, rollover	35	LHD injury (and delayed stricture)	HIDA PTD 5, ERCP/stent & IR drainage (PTD 6 and 7). Injury: LHD obstruction and leak. Complicated by infected biloma (IR drain ×3) and subsequent stricture (ERCP ×2, PTC ×1). Persistent stricture but normal LFTs and no cholangitis. Stent removed. Managed with observation. *Initial normal bilirubin, rise with delayed stricture.
2	15 yo M Trampled by bull	16	Biloma	PTD 6 laparoscopic washout and drainage of biloma prior to transfer to our facility. Persistent biloma on CT scan PTD 10. IR drainage PTD 11. Complicated by infected biloma (IR drain ×2) and pelvic abscess (laparotomy washout). *Normal bilirubin.
3	14 yo M Bicycle crash	18	Gallbladder	Initial CT with concern for gallbladder disruption. Confirmed by HIDA and underwent laparotomy and cholecystectomy. No complications. *Normal bilirubin.
4	4 yo F Non-accidental trauma	54	CBD/ampulla disruption	Emergent laparotomy and packing: mesenteric injury with exsanguination, duodenal perforation, and complete disruption of ampulla. Cannulation of the transected ampulla to an external drain. Profound hemodynamic instability/CPR. Died PTD 1 of head injury/hypoxic brain injury with herniation. *Bilirubin not checked.
5	4 yo F Filing cabinet fell on abdomen	26	CBD transection	PTD 5 HIDA, PTD 6 ERCP suggesting CBD/CHD disruption, unable to stent. Temporary IR drain placed. PTD 7 laparotomy and IOC confirmed complete transection of RHD and LHD from CHD. Hepatico-jejunostomy performed. Complicated by residual biloma (POD 17 IR drain). 8 month follow-up normal. *Elevated bilirubin.
6	5 yo M Rolled over by vehicle in driveway	50	Biloma	PTD 14 laparoscopic washout & drainage of biloma, no discrete injury visualized. No complications. *Normal bilirubin.
7	8 yo M ATV crash	29	CBD injury	PTD 3 HIDA, PTD 5 ERCP/stent. Injury: CBD/CHD leak. PTD 7 IR drain. Follow-up ERCP normal, stent removed. No complications. *Elevated bilirubin.
8	15 yo M Trampled by bull	25	Gallbladder avulsion & CBD injury (and delayed stricture)	Emergent laparotomy and packing. PTD 2 reexploration with cholecystectomy for gallbladder avulsion, washout and drainage of biloma. PTD 5 ERCP/stent. Injury: CBD/CHD leak. Complicated by delayed LHD stricture (rising bilirubin and biloma on CT, PTD 45 IR drain, PTD 46 ERCP LHD occlusion/leak, PTD 48 PTC unable to cannulate, L hepatectomy PTD 55). Three subsequent laparotomies for SBO. *Initial normal bilirubin, rise with delayed stricture.
9	9 yo M Bicycle crash (handlebar injury)	9	No known injury initially (delayed CBD/ampullary stricture)	Duodenal hematoma, blunt pancreatic injury, initial discharge PTD 4. Complicated by delayed CBD/ampullary stricture (rising bilirubin, PTD 27 MRCP, PTD 29 ERCP/sphincterotomy/stent, PTD 34 ERCP for cautery of sphincterotomy bleeding, PTD 137 ERCP for persistent stricture, and normal follow-up ERCP at 11 months for stent removal. *Initial normal bilirubin, rise with stricture.
10	13 yo F ATV crash	43	Biloma	PTD 7 HIDA. PTD 9 IR drain of biloma. No long-term follow-up. *Elevated bilirubin.
11	12 yo M ATV crash	33	Intrahepatic duct injury	PTD 5 CT scan with biloma. PTD 7 HIDA, PTD 9 ERCP/stent left intrahepatic duct leak. Follow-up ERCP normal, stent removed. No complications. *Elevated bilirubin.
12	12 yo M Pedestrian struck	38	Biloma	PTD 6 HIDA, PTD 8 Exploratory laparotomy, washout & drainage of biloma. No ductal injury visualized. No complications. *Elevated bilirubin

MVA, motor vehicle accident; LHD, left hepatic duct; HIDA,; PTD, post-trauma day; IR, interventional radiology; ERCP, endoscopic retrograde cholangiopancreatography; PTC, percutaneous transhepatic cholangiography; CT, computed tomography; CBD, common bile duct; CPR, cardiopulmonary resuscitation; POD, post-operative day; CHD, common hepatic duct; SBO, small bowel obstruction; MRCP, magnetic resonance cholangiopancreatography.

All biliary injuries were secondary to blunt trauma, including bicycle crash (2), ATV crash (3), trampled by bull (2), pedestrian struck (2), non-accidental trauma (1), struck by falling object (1), and motor vehicle crash (1). Mean age was 9.7 years [range 4-15] and mean injury severity score was 31 ± 14. Eight (67%) patients were male. Ninety-two percent of patients had an associated liver injury (grade 1 = 1; grade 3 = 1; grade 4 = 3; grade 5 = 6). The remaining patient never underwent abdominal CT before urgent laparotomy, and therefore hepatic trauma could not be fully assessed. The most common associated abdominal injuries included 2 duodenal injuries (one hematoma and one perforation), 6 pancreatic injuries, 4 splenic injuries, and 1 intestinal injury. Three patients underwent immediate laparotomy for exploration and hemorrhage control. One patient died of associated injuries prior to definitive repair with an overall survival in our cohort of 92%.

The diagnostic evaluation of biliary injury included HIDA scan in 7 patients and ERCP in 6 patients. One patient who initially presented with a duodenal hematoma, developed delayed jaundice and underwent magnetic resonance cholangiopancreatography (MRCP) on post-trauma day (PTD) 26, followed by ERCP and stent of a common bile duct (CBD) stricture. Two other patients underwent percutaneous transhepatic cholangiogram (PTC) for delayed presentation of CBD stricture after unsuccessful ERCP and biliary stent. Initial diagnostic studies were prompted by clinical indications including rising bilirubin levels, persistent bilious output from drains after laparotomy, or free fluid on repeat imaging (ultrasound or CT scan) of the abdomen. One patient with ampullary disruption was diagnosed on initial laparotomy. One patient underwent HIDA scan within 24 hours to confirm findings on CT concerning for gallbladder disruption. The remainder presented in a delayed fashion after a mean of 7.6 (range 0–26) days following trauma.

Five (42%) had a normal bilirubin level at the time of diagnosis. Total bilirubin levels at diagnosis in the remaining patients were 9.0 ± 6.6 mg/dL with a direct bilirubin of 4.5 ± 4.7 mg/dL. Hepatic transaminases were universally elevated early post-injury with mean AST 998 [80–4256] U/L and ALT 1036 [39–2548] U/L. Similarly pancreatic enzymes were commonly elevated post-injury with lipase 545 [201–1505] U/L, and subsequently decreased thereafter.

Classification of biliary injuries is shown in Fig. 1. Major ductal injuries involved the common bile duct (2), common hepatic duct (2), left hepatic duct (1) and a common bile duct/ampullary avulsion (1). Five major ductal injuries were managed by ERCP and biliary stent.