Curr Treat Options Gastro (2019) 17:165–170
DOI 10.1007/s11938-019-00225-6

Invited Commentary

Endoscopic Retrograde Cholangiopancreatography in Pediatric Populations

Mayssan Muftah, MD[1]
Rushikesh Shah, MD[2]
Chris Fritzen, MMSc, PA-C[3]
Cary G. Sauer, MD[3]
Alvin J. Freeman, MD[3]
Field F. Willingham, MD, MPH[2,3,*]

Address
[1]Department of Medicine, Emory University School of Medicine, Atlanta, GA, USA
[*,2]Department of Medicine, Division of Digestive Diseases, Emory University School of Medicine, Atlanta, GA, USA
Email: field.willingham@emory.edu
[3]Gastroenterology, Hepatology and Nutrition, Children's Healthcare of Atlanta, Emory University School of Medicine, Atlanta, GA, USA

Published online: 12 February 2019

Keywords Pediatric endoscopic retrograde cholangiopancreatography · Pancreatic duct injury · Blunt abdominal trauma

Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) has grown in its utility in the pediatric population since it was first described. The overall number of pediatric ERCPs performed has increased due to an increased incidence of pancreatobiliary disease in the pediatric population. Despite increased use, there is limited data regarding the efficacy and safety in pediatric cohorts, and minimal data on measures to minimize post-ERCP complications in children. We aim to discuss the role and safety of ERCP in children, the use of rectal indomethacin for post-ERCP pancreatitis (PEP), and the evolving role of ERCP in managing pancreatobiliary injuries secondary to blunt abdominal trauma.

ERCP in pediatric patients

During the period between 2000 and 2009, a total of 22,153 pediatric ERCPs were performed in the USA, with an overall increase of ERCPs from 5337 to 6733 performed per year. Therapeutic procedures made up 78% of the procedures, largely due to the decline in diagnostic procedures given the increased use

of MRI and endoscopic ultrasound. Children undergoing ERCP tended to be older and were more likely to be female (OR 3.06) and Hispanic (or 1.89) [1]. Similar to adults, the most common indications for ERCP in children involve biliary obstruction and pancreatitis. In contrast, children have a lower incidence of malignancy and have unique indications related to congenital abnormalities and traumatic injuries. Overall, children ages 0 to 6 have an equal distribution of biliary and pancreatic indications, ages 7 to 12 have a predominance of pancreatic indications, and those 13 and older have a predominance of biliary indications [2].

Safety and efficacy

ERCP appears to have similar technical success, clinical success, and safety in children compared to matched adult controls [3, 4]. In a multicenter study, therapeutic pediatric ERCPs were compared to adult-matched cohorts in two high-volume centers. A total of 93 ERCPs performed in pediatric patients were compared with 145 ERCP in adult controls and demonstrated similar technical and clinical success rates. There was no difference in the complications rate, procedural duration, or the number of procedures performed for each patient. There was an increased use of general anesthesia and longer hospital stays in the pediatric cohort [5].

In children, the overall post-ERCP complication rate is reported at 6%, predominantly reflecting post-ERCP pancreatitis, bleeding, and infection [6]. The rate of PEP in children is estimated to occur at a rate of 2.8 to 9.2%, in line with reported rates of 3 to 10% in adults [7]. Risk factors increasing the risk of PEP include pancreatic duct injection (OR 30.8) and pancreatic sphincterotomy (OR 3.8) [8], similar to adults with OR 2.2 for the former and OR 3.07 for the latter [7]. While the presence of comorbid chronic pancreatitis is recognized as a protective factor in adults, the limited data in children is conflicting primarily due to the low prevalence of chronic pancreatitis in pediatric patients [8, 9]. Other risk factors for PEP established in adults such as gender, sphincter of Oddi dysfunction, normal bilirubin, and prior history of PEP have not been examined in the pediatric population.

Administration of rectal indomethacin has been established as a standard prevention strategy in the adult population [7]; however, data on efficacy of rectal indomethacin in pediatric populations remains limited. Our group compared the outcomes of children that underwent ERCP and received rectal indomethacin vs those who did not. The study was not powered to evaluate for a reduction in the rates of PEP; however, rectal indomethacin was shown to be safe in children undergoing ERCP without an increase in bleeding risk or renal injury [10]. There was no difference in the incidence of PEP observed between the groups. In light of this and given its efficacy in adults, it is our practice to use 50–100 mg of rectal indomethacin in our pediatric patients pending further large-scale trials to assess the impact of rectal indomethacin on the incidence of PEP in pediatric populations.

In regard to pancreatic duct stent placement, which is associated with reduction in the incidence of PEP in adults [7], there is limited data on the role in preventing PEP in children [8, 9]. Other techniques found to be effective in adults including intravenous hydration and cannulation

techniques have yet to be studied in children. Our practice is to place pancreatic duct stents for prophylaxis in high risk settings such as pancreatic duct cannulation and pancreatic sphincterotomy.

Pancreatobiliary injuries secondary to blunt abdominal trauma

A relatively unique indication for ERCP in children is in the management of pancreatobiliary injuries following blunt abdominal trauma. Pancreatic duct injuries are estimated to occur in 0.6% of cases of pediatric blunt abdominal trauma and have an estimated morbidity of 26.5% and mortality of 5.3%. The most common cause is following a motor vehicle accident; however, injuries may also follow bicycle accidents, strikes to the abdomen, and falls [11]. These have been

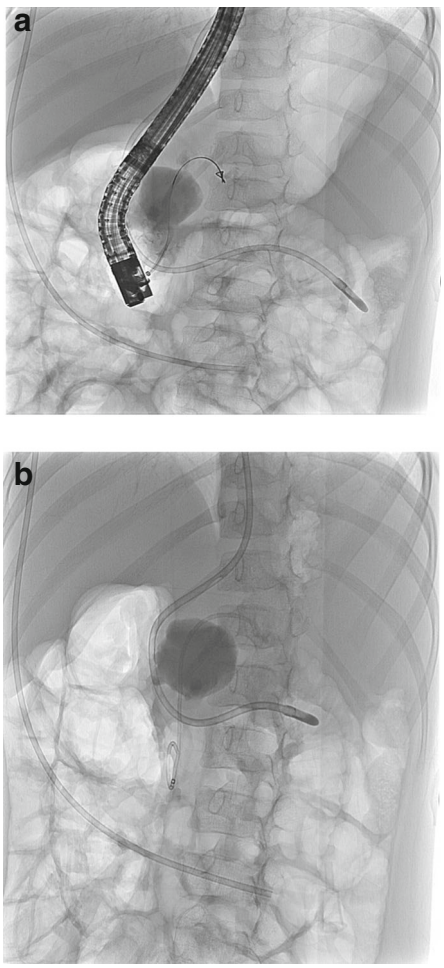

Fig. 1. ERCP in a 5-year-old female following blunt abdominal trauma causing pancreatic duct disruption and leak. **a** Pancreatogram showing contrast filling 4-cm peri-pancreatic fluid collection. **b** Placement of 5 Fr 10-cm pigtail plastic stent into the tail region of the pancreas, bridging the leak.

conventionally been managed with pancreatic resections; however, there are concerns in this setting. Splenectomy is often performed with distal pancreatectomy which may pose immunologic concerns in young cohorts. ERCP is emerging as an alternative therapeutic intervention [12, 13].

A multicenter retrospective review evaluated the use of ERCP in children with traumatic pancreatic injuries. Overall ERCP was underutilized—of the 22 centers studied, only 14 employed the use of ERCP, with a total of 26 patients over a 5-year period. This study suggested that ERCP had a role in the diagnostic evaluation of pancreatic injuries and in the management of late complications such as strictures or fistula [13]. The timing has been a major question. With pancreatic ductal injuries, while there can be concerns around intervening on a patient with a recent significant abdominal trauma, however, delaying the ERCP may have other consequences. As the injured tail segment and upstream duct begin to heal, it may become more difficult to access the upstream duct with a wire, which could preclude the best interventional approach which involves stenting across the disrupted central region of the pancreas. A study of intervention for trauma patients at our institution described early ERCP with

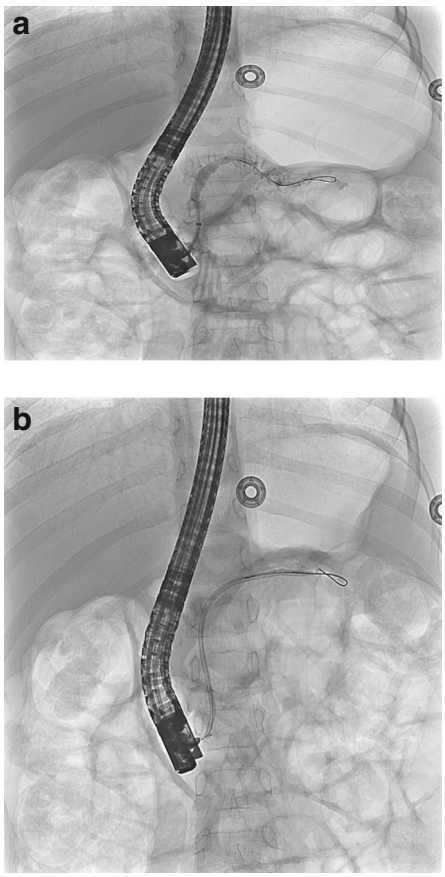

Fig. 2. Repeat ERCP 3 weeks later showing resolution of fluid collection. **a** Pancreatogram with resolution of peri-pancreatic fluid collection. **b** Placement of 7 Fr 10 cm straight plastic stent.

pancreatic sphincterotomy, wire placement, and pancreatic duct stenting. In this setting, ERCP was an effective and safe therapeutic intervention in patients with grade 3 or higher pancreatic duct injury, allowing the children to avoid major abdominal surgery and associated complications [14]. Another retrospective study found that ERCP successfully managed grade 3 or higher pancreatic duct injuries in 50% of patients [12]. This procedure is highly operator dependent as ERCP with wire placement across a disconnected duct is among the most technically challenging approaches. Larger studies and clear guidelines on the role of ERCP in this setting are needed. With increasing availability of advanced endoscopic interventions at pediatric centers, its use may become more widespread (Figs. 1 and 2).

Figures 1 and 2 demonstrate ERCP performed on a 5-year-old girl with hereditary pancreatitis and a traumatic pancreatic duct disruption. She was unable to tolerate an oral diet. A nasojejunal feeding tube is visible in the first image. Fluid collection can be seen filling with contrast, confirming a pancreatic duct disruption. On follow-up imaging, the nasojejunal tube had been removed, and the leak had completely resolved.

Biliary tract injuries are a rare occurrence that can range from minor injuries to complete ductal transections and are estimated to occur at a rate of 0.09% [15]. ERCP has a more established role in managing these types of injuries in children, particularly in patients with biliary leaks requiring stenting. This intervention reduces the need for laparotomy and hepaticojejunostomy with success rates reported to range from 60 to 100% [15–17].

Conclusion

The utility of ERCP has grown in the pediatric population with the increase in pancreatobiliary indications. Increases in childhood obesity may be impacting the incidence of stone formation and stone-related complications. The increasing availability of genetic testing may identify more pediatric patients with hereditary pancreatitis. Increased use of imaging may detect more pathologies that are amenable to ERCP-based interventions. Continued advances in therapeutic endoscopic approaches may enable more children to benefit from minimally invasive interventions. ERCP in the pediatric population has shown to be safe and effective with comparable technical and clinical success compared to adult populations. Clear data and guidelines regarding specific indications and prophylactic measures to prevent complications with ERCP in the pediatric population are in evolution. At this time, the use of rectal indomethacin appears to be safe in children without increased rates of bleeding or renal dysfunction. ERCP appears to be underutilized in the management of pancreatobiliary injuries following blunt abdominal trauma in children, and early intervention may be favored before access to the injured upstream duct is impaired by the healing process. Greater awareness of the availability and greater understanding of the role and capabilities of these approaches may increase utilization and hopefully improve outcomes in pediatric populations.

Publisher's Note

References and Recommended Reading

1. Pant C, Sferra TJ, Barth BA, Deshpande A, Minocha A, Qureshi WA, et al. Trends in endoscopic retrograde cholangiopancreatography in children within the United States, 2000-2009. J Pediatr Gastroenterol Nutr. 2014;59(1):57–60.
2. Limketkai BN, Chandrasekhara V, Kalloo AN, Okolo PI. Comparison of performance and safety of endoscopic retrograde cholangiopancreatography across pediatric age groups. Dig Dis Sci. 2013;58(9):2653–60.
3. Mekaroonkamol P, Shah R, Nieto J, Chawla S, Freeman AJ, Sauer CG, et al. Sa2079 efficacy and safety of rectal indomethacin for prevention of post endoscopic retrograde cholangiopancreatography pancreatitis in a pediatric population. Gastrointest Endosc85(5):AB287-AB8.
4. Rosen JD, Lane RS, Martinez JM, Perez EA, Tashiro J, Wagenaar AE, et al. Success and safety of endoscopic retrograde cholangiopancreatography in children. J Pediatr Surg. 2017;52(7):1148–51.
5. Shah R, Mekaroonkamol P, Taylor A, Freeman AJ, Fritzen C, Chawla S, et al. Tu1988 safety and efficacy of endoscopic retrograde cholangiopancreatography in pediatric patients: an 8 year experience from a multicenter study. Gastrointest Endosc 2018;87(6):AB610-AB1.
6. Usatin D, Fernandes M, Allen IE, Perito ER, Ostroff J, Heyman MB. Complications of endoscopic retrograde cholangiopancreatography in pediatric patients; a systematic literature review and meta-analysis. J Pediatr. 2016;179:160–5 e3.
7. Committee ASoP, Chandrasekhara V, Khashab MA, Muthusamy VR, Acosta RD, Agrawal D, et al. Adverse events associated with ERCP. Gastrointest Endosc. 2017;85(1):32–47.
8. Troendle DM, Abraham O, Huang R, Barth BA. Factors associated with post-ERCP pancreatitis and the effect of pancreatic duct stenting in a pediatric population. Gastrointest Endosc. 2015;81(6):1408–16.
9. Iqbal CW, Baron TH, Moir CR, Ishitani MB. Post-ERCP pancreatitis in pediatric patients. J Pediatr Gastroenterol Nutr. 2009;49(4):430–4.
10. Mekaroonkamol P, Nieto J, Chawla S, Freeman AJ, Alnoah Z, Keilin S, et al. Sa2065 a multicenter evaluation of therapeutic endoscopic retrograde cholangiopancreatography in pediatric populations. Gastrointest Endosc83(5):AB303-AB4.
11. Englum BR, Gulack BC, Rice HE, Scarborough JE, Adibe OO. Management of blunt pancreatic trauma in children: review of the National Trauma Data Bank. J Pediatr Surg. 2016;51(9):1526–31.
12. Garvey EM, Haakinson DJ, McOmber M, Notrica DM. Role of ERCP in pediatric blunt abdominal trauma: a case series at a level one pediatric trauma center. J Pediatr Surg. 2015;50(2):335–8.
13. Rosenfeld EH, Vogel AM, Klinkner DB, Escobar M, Gaines B, Russell R, et al. The utility of ERCP in pediatric pancreatic trauma. J Pediatr Surg. 2017.
14. Naseemuddin R, Fritzen CS, Freeman AJ, Keilin S, Cai Q, Willingham F. Tu1989 endoscopic retrograde cholangiopancreatography (ERCP) with pancreatic duct (PD) stent placement for the management of grade 3 or higher pancreatic injuries in children with blunt abdominal trauma. Gastrointest Endosc. 2018;87(6):AB611.
15. Soukup ES, Russell KW, Metzger R, Scaife ER, Barnhart DC, Rollins MD. Treatment and outcome of traumatic biliary injuries in children. J Pediatr Surg. 2014;49(2):345–8.
16. Kulaylat AN, Stokes AL, Engbrecht BW, McIntyre JS, Rzucidlo SE, Cilley RE. Traumatic bile leaks from blunt liver injury in children: a multidisciplinary and minimally invasive approach to management. J Pediatr Surg. 2014;49(3):424–7.
17. Keil R, Drabek J, Lochmannova J, Stovicek J, Rygl M, Snajdauf J, et al. Endoscopic treatment of bile duct post-traumatic and post-operative lesions in children. Scand J Gastroenterol. 2017;52(8):870–5.