

## Original Article



# Endoscopic Retrograde Cholangiopancreatography in Children: Feasibility, Success, and Safety with Standard Adult Endoscopes and Accessories

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## ABSTRACT

**Purpose:** The role of endoscopic retrograde cholangiopancreatography (ERCP) in the management of hepatobiliary and pancreatic diseases in the pediatric population was not well defined until recently. Our aim was to determine the feasibility, outcomes, and safety of ERCP in a local pediatric population, particularly using standard adult endoscopes and accessories.

**Methods:** This retrospective study was conducted at the National Hospital of Sri Lanka. Pediatric patients (aged <16 years) who underwent ERCP from January 2015 to December 2020 were included in the study. Data, including patient demographics, indications for the procedure, technical details, and associated complications, were collected from the internal database and patient records maintained at the hospital.


**Results:** The study included 62 patients who underwent a total of 98 ERCP procedures. All the procedures were performed by adult gastroenterologists using standard adult endoscopes and accessories. The mean age was 11.01±3.47 years. Pancreatic diseases were the major indications for most of the procedures (n=81, 82.7%), with chronic pancreatitis being the most common. Seventeen procedures (17.3%) were carried out for biliary diseases. Overall cannulation and technical success rates were 87.8% and 85.7%, respectively. Stent placement was the most common therapeutic intervention (n=66; 67.4%). Post-ERCP pancreatitis was the most common complication, occurring in eight patients (8.2%).

**Conclusion:** ERCP can be successfully and safely performed in pediatric populations using standard adult endoscopes and accessories with complications similar to those of adults. Adult ERCP services can be offered to most pediatric patients without additional costs of pediatric endoscopes and accessories.

**Keywords:** Cholangiopancreatography, endoscopic retrograde; Endoscopy; Pancreatitis

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#### Conflict of Interest

The authors have no financial conflicts of interest.

## INTRODUCTION

Since its introduction in 1968, endoscopic retrograde cholangiopancreatography (ERCP) has undergone remarkable advancements in technique and safety [1]. It has evolved from diagnostic purpose to primarily a therapeutic procedure, and is currently a well-established method for the diagnosis and treatment of hepatobiliary and pancreatic diseases in adults. Although Dr. J Wayne reported a case of ERCP in an infant in 1976, its role in the pediatric population was not well defined until recently [2]. Recent studies conducted in other parts of the world have demonstrated its safety and efficacy in children [3-6]. However, ERCP was not widely available for pediatric patients in Sri Lanka until a few years ago. Even today, the procedure is performed at very few centers in the country and by adult gastroenterologists and surgeons. Even though pediatric duodenoscopes are commercially available, they have limitations. While the endoscope alone would be an added cost, most routine adult accessories cannot be used with pediatric duodenoscopes because of its smaller therapeutic channel. Considering that pediatric ERCP is not performed as often as adult ERCP, most units would not be able to invest in pediatric ERCP equipment. Therefore, we aimed to determine the feasibility, outcome, and safety of ERCP in a local pediatric population, particularly with standard adult endoscopes and accessories.

## MATERIALS AND METHODS

### Patients and setting

This retrospective study was carried out at the gastroenterology and hepatology unit of the National Hospital of Sri Lanka. It is the leading tertiary care hospital in the country, and patients are referred from all over the country for specialized therapeutic endoscopic procedures. ERCP service was initiated in this unit in 2006, and ever since, it has undergone a significant advancement in terms of the number and complexity of procedures. Currently, the abovementioned hospital is one of the few centers providing ERCP for pediatric patients in the country.

All pediatric patients (aged <16 years) who underwent ERCP from January 2015 to December 2020, identified from the internal computer database were enrolled in the study. Data, including patient demographics, indications for and technical details of the procedure, and associated complications, were collected from the internal database and patient records maintained at the hospital.

### Procedure and equipment

All procedures were performed by one of three adult gastroenterologists experienced in ERCP under either deep sedation or general anesthesia with the help of an anesthetist. A standard adult duodenoscope (Olympus TJF 180; Olympus, Tokyo, Japan) was used for all procedures. The technique and accessories used were similar to those routinely used in adult patients. All the patients were hydrated with intravenous fluids during and after the procedure, and rectal non-steroidal anti-inflammatory drugs were administered to patients deemed to be at high risk of post-ERCP pancreatitis (PEP) [7].

### Outcomes and adverse events

Cannulation success was defined as successful deep cannulation of the desired duct, whereas technical success was defined as successful deep cannulation along with completion of

the planned therapeutic procedure. Adverse events were defined according to the criteria developed by the European Society of Gastrointestinal Endoscopy [8]. All patients were provided in-hospital care for at least 24 hours following the procedure.

### Statistical analysis

Data were analyzed using SPSS version 19 (IBM Co., Armonk, NY, USA), and the mean, median, standard deviation, and percentages were calculated to present quantitative data.

### Ethical standards

Per institutional policies, ethical approval was not required for the study because of its retrospective nature. Data were obtained from an electronic database, and no personally identifiable information was used. All procedures were part of standard clinical management, as per available evidence. This study was conducted in accordance with the principles of the Declaration of Helsinki.

## RESULTS

A total of 62 patients were included in this study: 33 (53.2%) males and 29 (46.8%) females. An equal number of ERCP procedures were performed in both groups. The ages of the patients ranged from 3 to 16 years, with a mean of  $11.01 \pm 3.47$  years. A total of 98 ERCP procedures were performed on the 62 patients and 22 patients underwent more than one ERCP procedure. Nearly half of the procedures (48 ERCPs, 49.0%) were performed on patients in the 7 to 12 years age group, while 14 ERCPs (14.3%) were performed on patients in the 3 to 6 years age group. Pediatric ERCP accounted for 5.3% of the total ERCP procedures during the study period. Pancreatic diseases were the major indications for most of the procedures (n=81, 82.7%), with chronic pancreatitis being the most common. Seventeen ERCPs (17.3%) were performed for biliary diseases, and the data are summarized in **Table 1**. All procedures were performed with therapeutic intent.

Details of the outcomes of the ERCP procedure are given in **Table 2**. Overall cannulation and technical success rates were 87.8% and 85.7%, respectively. Age-group-wise cannulation and technical success rates are shown in **Fig. 1**. The highest cannulation and technical success rates were observed in the 13 to 16 years age group. Of the 62 patients who underwent ERCP procedure for the first time, cannulation of the desired duct was achieved in 55. Of the seven patients with failed cannulation during their first procedure, four underwent repeat ERCP; however, successful cannulation was achieved only in one patient. Successful cannulation was achieved in one patient on the third attempt.

**Table 1.** Indications for endoscopic retrograde cholangiopancreatography

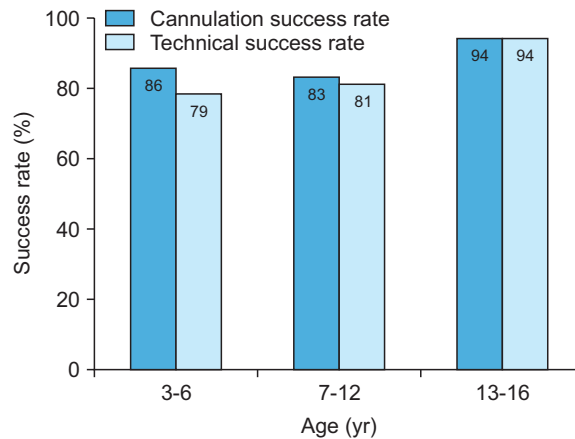
Biliary indications	Number of patients/ procedures	Pancreatic indications	Number of patients/ procedures
Choledocholithiasis	7/8	Chronic pancreatitis	32/61
Bile leak	5/6	Recurrent acute pancreatitis	9/11
Biliary stricture	2/3	Acute pancreatitis	3/3
		Drainage of pseudocyst	2/4
		Pancreatic fistula/leak/duct injury	2/2

**Table 2.** Outcome of ERCP procedures

Procedure	Value
Overall ERCP procedures (total number of patients/procedures - 62/98)	
Papilla cannulation success	86 (87.8)
Technical success	84 (85.7)
Cannulation success rate per patients	57 (91.9)
First ERCP procedure (n=62)	
Successful cannulation	55 (88.7)
Technical success	53 (85.5)
Successful cannulation with standard cannulation techniques (total number of successful cannulation - 86)	80 (93.0)
Successful cannulation with precut sphincterotomy techniques (number of patients with precut sphincterotomy - 8)	6 (75.0)

Values are presented as number (%).

ERCP: endoscopic retrograde cholangiopancreatography.



**Fig. 1.** Age group wise cannulation and technical success rates.

**Table 3.** Therapeutic interventions carried out

Intervention	Value (n=98)
Sphincterotomy	59 (60.2)
Biliary	24 (24.5)
Pancreatic at major	29 (29.6)
Pancreatic at minor	6 (6.1)
Balloon sweeping	31 (31.6)
Pancreatic stone extraction	13 (13.3)
Biliary stone extraction	3 (3.1)
Biliary stone mechanical lithotripsy	1 (1.0)
Stent placement	66 (67.3)
Biliary	6 (6.1)
Pancreatic	57 (58.2)
Both biliary and pancreatic	3 (3.1)
Dilatation of stricture (pancreatic)	2 (2.0)

Values are presented as number (%).

Stent placement was the most common therapeutic intervention; plastic stents were used almost exclusively. Fully covered self-expanding metal stents were used in two patients for the treatment of a benign biliary stricture and a pancreatic duct stricture. In all cases, stent placement was performed after biliary or pancreatic sphincterotomy. Details of the therapeutic interventions are shown in **Table 3**.

PEP was the most common complication following the procedure, occurring in eight patients (8.2%). Details of the complications are shown in **Table 4**. All cases were mild in severity

**Table 4.** Complications of ERCP

Complication	Value
Pancreatitis	
3–6 yr (n=14)	2 (14.3)
7–12 yr (n=48)	2 (4.2)
13–16 yr (n=36)	4 (11.1)
Overall	8 (8.2)
Post ERCP bleeding	1 (1.0)

Values are presented as number (%).

ERCP: endoscopic retrograde cholangiopancreatography.

and were resolved with conservative measures. The highest incidence of pancreatitis was observed in the 3 to 6 years age group. Only one case (1.0%) was complicated by bleeding, which was mild and self-limiting. No procedure-related cholangitis or anesthesia-related complications were observed. In the long term, two patients retained pancreatic stent fragments that could not be retrieved using standard measures. However, no complications related to the retained fragment were encountered for more than 2 years of follow-up.

## DISCUSSION

ERCP is often underutilized in pediatric populations, particularly in low-income and middle-income countries [3]. It is technically more difficult and requires a greater amount of training and skills [2]. Lack of experience, as well as the uncertainty of its efficacy, could be the main reasons behind its underutilization in children. Our findings support the claim that ERCP can be safely performed in this potentially high-risk patient population using standard adult endoscopes and accessories, with comparable success rates and adverse events reported in adults.

Most previous pediatric ERCP studies were conducted in Western populations, and data from the rest of the world are limited [9]. Choledocholithiasis and pancreatitis are the most common indications for pediatric ERCP in the western part of the world [9,10]. In contrast, choledochal cysts are the most common indication for pediatric ERCP in the eastern part of the world including Asia [10]. Indications for ERCP also differ according to the age group. Limketkai et al. [11] reported a similar number of pancreatic and biliary cases in children aged <6 years, predominance of pancreatic cases in the 7–12 years age group, and an excess number of biliary cases in the 13–17 years age group. However, in our study, chronic pancreatitis was the most common indication for ERCP in all the age groups. This could be due to the high prevalence of chronic pancreatitis in the local pediatric population as well as bias related to patient referral, because our center is a tertiary care unit with more complex pancreatic cases being referred for intervention.

Although most of the previous pediatric ERCP studies reported cannulation and technical success rates exceeding 90%, biliary diseases, including choledocholithiasis and choledochal cysts, were the most common indications for ERCP in those studies [3–5,10,12]. In adults, the overall cannulation success rate was approximately 86% [13]. In our study, high cannulation and technical success rates, comparable to those reported for adults, were achieved exclusively using standard adult scopes and accessories. The slight reduction in cannulation and technical success rates compared with those from previous studies on pediatric ERCP could have been due to the predominance of children with chronic pancreatitis in our study population.

ERCP is often performed in children using adult duodenoscopes and standard equipments. Even though it is generally recommended to use a pediatric duodenoscope in children weighing less than 10 kg, pediatric duodenoscopes and compatible smaller accessories are not widely available in most endoscopy units, particularly in low- and middle-income countries [14,15]. Furthermore, ERCP is often performed by adult gastroenterologists because pediatric gastroenterologists with experience in performing ERCP are not widely available. Yildirim et al. [10] previously reported that ERCP can be safely and successfully performed in this patient population by adult gastroenterologists using standard scopes. Our study further supports this observation, as all interventions were performed by adult gastroenterologists using standard adult endoscopes and accessories.

PEP was the most common complication following ERCP in both adult and pediatric populations [2,16]. This was evident in our study, with an overall incidence of 8.2%. The incidence of PEP varied according to the definition used and was estimated to be 3% to 10% in adults [16]. A recent meta-analysis reported an overall incidence of 9.7% in adults, which can be as high as 14.7% in high-risk patients [16]. Previous studies on pediatric ERCP have reported a PEP incidence of 3–17% in children [2,4,10]. The PEP rates in our study were comparable to those reported for both adults and children. In addition, most of the procedures were performed while the children were deeply sedated using propofol, and general anesthesia and intubation was not needed frequently. No case of anesthesia-related complications was encountered, supporting the fact that deep sedation can be safely utilized in children and adults [3,10].

This study has several limitations. First, regarding the study sample, only three patients were under five years of age, which limits the applicability of our findings to children of age under five years. Second, our study was retrospective and conducted at a single center, a tertiary referral center for complex cases. Therefore, our findings may not be generalizable to all endoscopic units. Furthermore, the risk factors associated with the complications of the procedure could not be identified due to the small number of complications and limited data available.

In conclusion, the results of our study demonstrated the feasibility, efficacy, and safety of pediatric ERCP, using standard adult duodenoscopes and accessories. In most pediatric patients, ERCP services can be offered without additional costs for pediatric endoscopes and accessories. Therefore, clinicians should be aware of this therapeutic modality and when relevant, it should be offered to patients.

## REFERENCES

1. Kozarek RA. The past, present, and future of endoscopic retrograde cholangiopancreatography. *Gastroenterol Hepatol (N Y)* 2017;13:620-2.  
[PUBMED](#)
2. Fox VL, Werlin SL, Heyman MB. Endoscopic retrograde cholangiopancreatography in children. Subcommittee on Endoscopy and Procedures of the Patient Care Committee of the North American Society for Pediatric Gastroenterology and Nutrition. *J Pediatr Gastroenterol Nutr* 2000;30:335-42.  
[PUBMED](#) | [CROSSREF](#)
3. Dahale AS, Puri AS, Sachdeva S, Srivastava S, Kumar A. Endoscopic retrograde cholangiopancreatography in children: a single-center experience from Northern India. *Indian Pediatr* 2019;56:196-8.  
[PUBMED](#) | [CROSSREF](#)

4. Felix J, Sturm E, Busch A, Zerbruck E, Graepler F, Stüker D, et al. ERCP in infants, children and adolescents is feasible and safe: results from a tertiary care center. *United European Gastroenterol J* 2017;5:1024-9.  
[PUBMED](#) | [CROSSREF](#)
5. Keane MG, Kumar M, Cieplik N, Thorburn D, Johnson GJ, Webster GJ, et al. Paediatric pancreaticobiliary endoscopy: a 21-year experience from a tertiary hepatobiliary centre and systematic literature review. *BMC Pediatr* 2018;18:42.  
[PUBMED](#) | [CROSSREF](#)
6. Agarwal J, Reddy DN, Talukdar R, Lakhtakia S, Ramchandani M, Tandan M, et al. ERCP in the management of pancreatic diseases in children. *Gastrointest Endosc* 2014;79:271-8.  
[PUBMED](#) | [CROSSREF](#)
7. Dumonceau JM, Andriulli A, Elmunzer BJ, Mariani A, Meister T, Deviere J, et al. Prophylaxis of post-ERCP pancreatitis: European Society of Gastrointestinal Endoscopy (ESGE) Guideline - updated June 2014. *Endoscopy* 2014;46:799-815.  
[PUBMED](#) | [CROSSREF](#)
8. Dumonceau JM, Kapral C, Aabakken L, Papanikolaou IS, Tringali A, Vanbiervliet G, et al. ERCP-related adverse events: European Society of Gastrointestinal Endoscopy (ESGE) Guideline. *Endoscopy* 2020;52:127-49.  
[PUBMED](#) | [CROSSREF](#)
9. Jang JY, Yoon CH, Kim KM. Endoscopic retrograde cholangiopancreatography in pancreatic and biliary tract disease in Korean children. *World J Gastroenterol* 2010;16:490-5.  
[PUBMED](#) | [CROSSREF](#)
10. Yıldırım AE, Altun R, Ocal S, Kormaz M, Ozcay F, Selcuk H. The safety and efficacy of ERCP in the pediatric population with standard scopes: does size really matter? *Springerplus* 2016;5:128.  
[PUBMED](#) | [CROSSREF](#)
11. Limketkai BN, Chandrasekhara V, Kalloo AN, Okolo PI 3rd. Comparison of performance and safety of endoscopic retrograde cholangiopancreatography across pediatric age groups. *Dig Dis Sci* 2013;58:2653-60.  
[PUBMED](#) | [CROSSREF](#)
12. 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;52:1148-51.  
[PUBMED](#) | [CROSSREF](#)
13. Sheppard DP, Craddock SJ, Warner BD, Wilkinson ML. ERCP cannulation success benchmarking: implications for certification and validation. *Frontline Gastroenterol* 2015;6:141-6.  
[PUBMED](#) | [CROSSREF](#)
14. ASGE Standards of Practice Committee, Lightdale JR, Acosta R, Shergill AK, Chandrasekhara V, Chathadi K, et al. Modifications in endoscopic practice for pediatric patients. *Gastrointest Endosc* 2014;79:699-710.  
[PUBMED](#) | [CROSSREF](#)
15. Tringali A, Thomson M, Dumonceau JM, Tavares M, Tabbers MM, Furlano R, et al. Pediatric gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) and European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) Guideline Executive summary. *Endoscopy* 2017;49:83-91.  
[PUBMED](#) | [CROSSREF](#)
16. ASGE Standards of Practice Committee, Chandrasekhara V, Khashab MA, Muthusamy VR, Acosta RD, Agrawal D, et al. Adverse events associated with ERCP. *Gastrointest Endosc* 2017;85:32-47.  
[PUBMED](#) | [CROSSREF](#)