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Full Reports

Endoscopic Retrograde Cholangiopancreatography in Pediatric Patients

Esra Dişçi, MD,[1] Rıfat Peksöz, MD,[1] Metin Yıldız, MD,[1] Mehmet İlhan Yıldırgan, MD,[1] Yavuz Albayrak, MD,[1] Mesud Fakirullahoğlu, MD,[2] Binali Fırıncı, MD,[3] and Sabri Selçuk Atamanalp, MD[1]

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Abstract

Background: Endoscopic retrograde cholangiopancreatography (ERCP) is an advanced endoscopic technique used in the diagnosis and treatment of pancreaticobiliary system. ERCP is used less frequently in children than in adults due to the rarity of pancreaticobiliary diseases and technical difficulties. However, ERCP is a safe, effective diagnosis and treatment tool for children.
Methods: All patients within the age range of 1–19 years, who underwent ERCP between 2010 and 2021 at our endoscopy unit, were retrospectively examined. Patient demographics, use of imaging methods, indications, type of sedation, interventions, success of ERCP, findings, and complications were evaluated.
Results: Overall, 105 ERCPs were performed in 66 children (29 male and 37 female). The indications were choledocholithiasis, cyst hydatic, choledochal cyst, biliary atresia or anomaly, liver transplantation-related disorders, and pancreatic disorders, respectively. ERCP was finished as diagnostic ERCP in 20% and as therapeutic in 80%. Therapeutic procedures were sphincterotomy, stent placement or removal, stone or debris extraction, and balloon sweep or dilatation, respectively. The success rate in the procedures was 75.23%. The overall complication rate was 15.23%. Postprocedure pancreatitis occurred in 11.42%, hemorrhage occurred in 2.85%, and aggravation of cholangitis in 0.95%. All complications were managed conservatively.
Conclusion: ERCP in pediatric patients is a safe procedure that can be performed by adult endoscopists with high success rates. Since our region is an endemic region for hydatid cyst disease, the most common ERCP indication after choledocholithiasis is procedures related to liver hydatid cyst disease. The most common complication was pancreatitis, and complications were treated medically.

Keywords: endoscopic retrograde cholangiopancreatography, children, indications, complications, safety

Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is an advanced endoscopic technique used in the diagnosis and treatment of pancreaticobiliary system in patients.[1] ERCP is routinely used in adults. Because of the rarity of pancreaticobiliary diseases and technical difficulties in children, ERCP is used less frequently than in adults. Data on the indications and safety of ERCP in the pediatric population are scarce.[2] However, ERCP was found to be safe and effective in infants and children.[3–5] Although publications on ERCP in children have increased, data on the safety and results of ERCP are still limited, and its use is rapidly changing. With the use of magnetic resonance cholangiopancreatography (MRCP) in recent decades, the use of ERCP in therapeutic procedures has increased.[6,7]

Given the lack of evidence-based guidelines for the use of ERCPs in children, we aimed to present our ERCP experience in children ~11 years of age in a tertiary hospital to contribute to the literature in this study.

Materials and Methods

All patients younger than 18 years undergoing ERCP from 2010 to 2021 at General Surgery department of Atatürk University Faculty of Medicine were studied retrospectively. Our hospital is a tertiary level hospital, and the patient

[1]Department of General Surgery, Atatürk University Research Hospital, Erzurum, Turkey.
[2]Department of General Surgery, Erzurum City Hospital, Erzurum, Turkey.
[3]Department of Pediatric Surgery, Atatürk University Research Hospital, Erzurum, Turkey.

Table 1. Indications for Endoscopic Retrograde Cholangiopancreatography

Indications	*Patients*	*%*
Choledocholithiasis	23	34.84
Cyst hydatic	19	28.78
Choledochal cyst	9	13.63
Biliary atresia or anomaly	7	10.6
Liver transplantation-related disorders	5	7.57
Pancreatic disorders	3	4.54
Total	66	100

population consists of patients who applied by referral from an external center and who were consulted by our hospital's pediatric surgery unit. In addition, liver transplantation is performed in our hospital and some of the patients are referred from the hepatobiliary diseases unit to our endoscopy unit for ERCP. The data were collected from the patients' files and the hospital's electronic software system. Informed consent for the procedure was obtained from the parents of each patient.

Ultrasonography (USG) or MRCP was available for all patients before ERCP. Patient demographic features, use of imaging methods, indications, type of sedation, interventions, type and number of additional therapeutic endoscopic procedures, success of ERCP, findings, and complications were evaluated. All of the ERCP procedures were performed by trained surgeon adult endoscopists. Standard adult-sized duodenoscopes were used in children. The following devices were used for ERCP and other endoscopic procedures: Fujinon ED-530 XT flexible duodenoscope and erbe APC-2 electrocauters, with various ERCP catheters, balloons, sphincterotomes, forceps, lithotripters, and coagulation electrodes. After an 8-h starvation period, midazolam and pethidine were administered intravenously before ERCP, and additional doses were applied when needed.

All the procedures were done under sedation by anesthesiologist and the procedures were performed in the prone position. General anesthesia was not used in any patient. Cardiorespiratory follow-up for all patients was performed with electrocardiogram and pulse oximeter.

Pancreatitis was defined as an increase in amylase-lipase values three times higher than normal with abdominal pain after ERCP. No routine post-ERCP pancreatitis (PEP) prophylaxis was performed in our study. Continuous clinical follow-up was available for all patients for at least 24 hours. Success of the intervention was defined as allowing accurate diagnosis or adequate therapy as to the prespecified indication. Failed cannulation or other failure to complete the planned procedure was defined as a failure. The retrospective chart analysis was approved by the ethics committee of Erzurum Atatürk University Faculty of Medicine (NO: 2021/04-21).

Table 2. Therapeutic Procedures

Therapeutic interventions	*Patients*	*%*
Sphincterotomy	41	44.08
Stent placement or removal	26	27.95
Stone or debris extraction	21	22.58
Balloon sweep or dilatation	5	5.37
Total	93	100

Table 3. Success Rate Demographic Features

	Successful	*Unsuccessful*	*Total*	P
Sex male/ female	30/49	10/16	40/65	.965
Age	10.77 ± 4.46	11.65 ± 3.28	10.99 ± 4.2	.285

Statistical analysis

The software package SPSS 21.00 was utilized for the statistical analysis. Results were presented as numbers for categorical variables, and as mean ± standard deviation for continuous percentage variables. For the comparison of means of the groups, the Student's-*t* test has been utilized for the variables that demonstrated a normal distribution, and the Mann–Whitney *U* test was used for the variables that did not demonstrate normal distribution. A P value <.05 was considered significant.

Results

Overall, 105 ERCPs were performed in 66 children (29 male and 37 female). Patient age ranged from 1 to 17 years (mean 11.62 ± 4.12 years). More than one procedure was performed on 22 patients. Since multiple procedures performed on the same patient would change the indication rates, the indications were evaluated on 66 patients. The indications were choledocholithiasis 23, cyst hydatic 19, choledochal cyst 9, biliary atresia or anomaly 7, liver transplantation-related disorders 5, and pancreatic disorders 3, respectively (Table 1). ERCP was finished as diagnostic ERCP in 21 interventions (20%) and as therapeutic in 84 (80%). Indications were defined as therapeutic ERCP when a pancreatic or biliary system disease treatable by ERCP was suspected based on laboratory findings, imaging methods, and clinical symptoms.

Diagnostic ERCP was defined as the procedure when a pancreatic or biliary system disease was suspected with no additional therapeutic intervention. Therapeutic interventions were performed in 80% of all interventions (84 interventions), including sphincterotomy in 41 interventions (48.8%), stent placement or removal in 26 interventions (30.95%), stone or debris extraction in 21 interventions (25%), and balloon sweep or dilatation in 5 interventions (5.95%) (Table 2). In some patients (9 patient), more than one therapeutic procedure was performed at the same time. The success rate in the procedures was 75.23%. There was no significant difference between the groups in terms of sex according to success situation ($P = .965$).

Table 4. Complications Demographic Features in Endoscopic Retrograde Cholangiopancreatography Procedures

Complications	*Present*	*Absent*	*Total*	P
Sex male/ female	5/11	34/55	39/66	.267
Age	11.76 ± 5.16	10.22 ± 4.47	10.45 ± 4.57	.623

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Table 5. Endoscopic Retrograde Cholangiopancreatography Some Large Case Series in Pediatric Patients Since 2010

Author (year)	*Male-female %*	*Mean age-year (range)*	*Patients and procedures (N)*	*Therapeutic-diagnostic (%)*	*The first three indications, respectively*	*Therapeutic procedures respectively*	*Success rate (%)*	*Adverse events (%)*
Keil et al.[1] (2019)	47–53	4.9 (0–18)	626/856	59–41	Biliary obstruction, chronic pancreatitis, pancreatic duct disruption	Stent insertion, sphincterotomy, stones extraction	96	9.35
Kieling et al.[2] (2015)	22–78	13.9 (1–18)	60–75	68–32	Biliary obstruction, sclerosing cholangitis, postsurgery	Sphincterotomy, stone extraction, removal/ replacement stent	94.7	9.3
Rosen et al.[3] (2017)	33–67	8 (0–18)	184–215	78–22	Choledocholithiasis, pancreatitis, sclerosing cholangitis	Sphincterotomy, stone extraction, stent placement	97	10
Yıldırım et al.[8] (2016)	58–42	13 (2–17)	48–65	49–51	Choledocholithiasis, post-liver transplantation, bile duct injury	Sphincterotomy, balloon sweep, stent insertion	93.8	12.3
Felux et al.[10] (2017)	48–52	11 (0–17)	31–54	67–33	Choledocholithiasis, post-liver transplantation, malignant stenosis	Sphincterotomy	90.7	9.3
Otto et al. [11] (2011)	41–59	11.4 (0–21)	167–231	69–31	Chronic pancreatitis, acute pancreatitis, choledocholithiasis	Sphincterotomy, stone extraction, stent insertion	unknown	4.76
Jang et al.[12] (2010)	43–57	8 (0–16)	122–245	78–22	Choledochal cyst, choledocholithiasis, chronic pancreatitis	Sphincterotomy, stone extraction, stent insertion	98.4	11.8
Åvitsland et al.[13] (2021)	unknown	8.8 (0–18)	158–244	51–49	Biliary stricture, sclerosing cholangitis, biliary atresia	Sphincterotomy, stent insertion, stricture dilation	92.2	10.8

Although mean age is higher in the unsuccessful group, there was no statically significant difference between the groups ($P = .285$) (Table 3). The overall complication rate was 15.23%. Postprocedure pancreatitis occurred in 11.42%, hemorrhage occurred in 2.85%, and aggravation of cholangitis in 0.95%. All complications were managed conservatively (analgesia, fasting, and antimicrobial therapy). No mortality occurred during this study period. Complications are summarized in Table 4.

Discussion

Experience with ERCP in pediatric patients is limited due to the low number of diseases requiring ERCP procedure, due to the impression that the procedure is technically difficult in children, and because ERCP has not been well defined in the pediatric population.[8,9] In this study, we summarized some large case series of ERCPs performed in children in recent years and their features (Table 5).

The most common indication for ERCP in children and adults is choledocholithiasis.[7,10] However, pancreatic and biliary system diseases differ between regions in the world.[14] For example, some congenital choledochal cysts are the most common indication for ERCP in eastern countries.[11,12] Again, it is among the most common indications for ERCP after liver transplantation.[8]

In our previous study, which includes adult patients in our clinic, choledochal stones and liver cysts are the first ones for ERCP indication.[15] Since our region is an endemic region for liver hydatid disease, unlike the literature, the ERCP procedure for hydatid cyst comes first. In our study, the most common ERCP indications for pediatric patients, in descending order, were choledocholithiasis, cyst hydatic disease, choledochal cysts, biliary atresia or anomaly, liver transplantation-related disorders, and pancreatic disorders.

The use of ERCP in pediatric patients is increasing. While the rate of diagnostic ERCP usage is decreasing over time, the rate of use of therapeutic ERCP is rising.[6] In the past studies, diagnostic ERCPs of 22%–51% and therapeutic ERCP rate of 49%–78% were recorded.[1,3,8,10,12] In our study, diagnostic ERCP was 20%, whereas the therapeutic ERCP rate was 80%. The therapeutic ERCP rate is above the literature data. This is due to the increasing rate of therapeutic ERCP and the fact that our patients are mostly sent from surgical departments for therapeutic purposes.

We defined success as the success of deep papillary cannulation, delivering adequate diagnosis or therapy in response to the clinical situation. Some factors may impair the success of the cannulation of the ampulla of Vater with pancreaticobiliary duct imaging, such as previous surgeries, anatomical abnormalities, and inadequate sedation.[2] Again, failure was correlated with low body weight and younger age. Failure is more common, especially in infants.[10,16] The success rate for ERCP in studies has been reported as 82%–96%.[1,2,6] In our previous study performed in our clinic, the success rate of cannulation was 94.5%.[15] The success rate in our current study is 75.2%, and the cannulation rate is 83%. Our low success rate in our previous study may result from the fact that the patients are in the pediatric age group.

Again, our success rate is partially lower than the success rate of ERCP performed in pediatric patients in the literature. Since the procedures are performed under sedation, the inability to comply with the general anesthesia procedure can be explained by the procedures performed with an adult duodenoscope. Moreover, we did not define success as only papillary cannulation, but making an adequate diagnosis and performing adequate therapy according to the clinical situation were considered successful. In our study, the rate of the infant age group was low (2.85%), and no relationship was found between age and gender and the success rate (Table 3).

The most common complication after ERCP in pediatric patients is pancreatitis, and the most dangerous complication is duodenal perforation. In the literature, the complication rate after ERCP is 4.8%–12.3%.[7,8,10,11,17] Rectal nonsteroidal anti-inflammatory drugs (NSAIDs) and prophylactic pancreatic duct stenting have been shown to prevent PEP.[18] Although studies show that pancreatic stenting increases the development of PEP,[6] it has generally been shown to decrease the development of PEP. Also, a multicenter randomized trial has shown that rectal indomethacin administered at the time of ERCP significantly decreased rates of PEP.[19] In our clinical practice, the follow-up period of patients is 24 hours. All complications were treated medically, and no severe complication was observed.

The complication development rate is 15.23%, which is partially above the literature data. This high rate can be explained by situations such as not using rectal NSAIDs in our patients, using the adult endoscope, and not using prophylactic pancreatic duct stenting. Again, in parallel with the literature, the most common complication is pancreatitis (11.42%). Bleeding, perforation, and infection are other rare complications that can be seen after ERCP.[6,7] In our study, hemorrhage and cholangitis complications decreased, respectively.

Conclusion

ERCP in pediatric patients is a safe procedure that adult endoscopists with high success rates can perform. The complication development rate is at an acceptable level, and the most common complication is pancreatitis. Despite the morbidity risk, ERCP is a method that can be used in the diagnosis and treatment of hepatobiliary and pancreatic diseases. Since hydatid disease is endemic in eastern Turkey, the most common indication for ERCP after choledocholithiasis is procedures related to the hydatid cyst of the liver.

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No competing financial interests exist.

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Address correspondence to:
Rıfat Peksöz, MD
Department of General Surgery
Atatürk University Research Hospital
Erzurum 25240
Turkey

E-mail: rifat-peksoz@hotmail.com

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