

Our endoscopic retrograde cholangiopancreatography (ERCP) experience in pediatric patients in a training and research hospital

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Abstract

Background: Endoscopic retrograde cholangiopancreatography (ERCP) was first applied in 1976 in children for diagnosing and treating pancreaticobiliary diseases based on experience with adult patients. Its application was limited initially but has become widespread in recent years with technical developments. This study evaluated the efficacy, indications, and complications of the ERCP's diagnostic and therapeutic use in pediatric patients.

Case Series: We evaluated retrospectively the files of 16 pediatric patients aged 5-18 years who underwent ERCP between January 2015 and June 2022 in the Endoscopy Unit of Prof. Dr. Cemil Taşçıoğlu City Hospital. We recorded and analyzed the demographic data, admission complaints, pre-procedure diagnostic tests, ERCP findings, and early and late post-procedure complications. Five of the 16 patients (31 %) who underwent ERCP were male, 11 (69 %) were female, and their mean age was 12.7 ± 5.44 . We utilized as a diagnostic tool the Fujifilm ED-580XT duodenoscope with a 13.4 mm outer diameter and a 4.4 mm diameter channel connected to a Fujinon Eluxeo 6000 light source, not specifically designed for children but in use for adult patients. While biochemistry and ultrasonography were conducted for all patients before the procedure, only ten patients (62 %) underwent magnetic resonance cholangiopancreatography. Indications for performing ERCP included suspected biliary pathology (8 patients, 50 %), pancreatitis attack (6 patients, 38 %), bile leakage after cholecystectomy (one patient, 6 %), and mass lesion in the ampulla (one patient, 6 %). Seven patients (44 %) underwent cholecystectomy for cholelithiasis 4-6 weeks after the ERCP (one cholecystectomy was performed in another center). In one of the patients, ERCP was performed for diagnostic-only purposes, while in fifteen patients was performed for diagnostic and therapeutic purposes (partial sphincterotomy and stent placement). While none of the patients had complications in the early post-procedure period, one experienced an acute pancreatitis episode in the late post-procedure period.

Conclusion: With the increase in endoscopists' experience and technological developments in different age groups, ERCP is a safe and effective method for diagnosing and treating pancreaticobiliary diseases in children. HIPPOKRATIA 2022, 26 (4):152-156.

Keywords: Endoscopic retrograde cholangiopancreatography, pediatric, ERCP, childhood pancreaticobiliary disease, complication

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Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is an invasive method that has become the gold standard for diagnosing and treating adult pancreaticobiliary diseases. Although pancreaticobiliary diseases are diagnosed with noninvasive radiological methods such as magnetic resonance cholangiopancreatography (MRCP), ERCP remains an important diagnostic and treatment tool. After being described by McCune in adults in 1968, ERCP was first applied to children by Waye in 1976^{1,2}.

General surgeons and adult gastroenterologists with extensive experience in adults usually perform ERCP in children. The use of ERCP is still infrequent in children due to the minimal experience and the limited publications regarding its safety³. In the endoscopy unit of our hospital, ERCP is mainly performed on adult patients by

general surgeons.

This study evaluated the effectiveness, indications, complications, and possible risk factors provoking complications, if any, of ERCP's diagnostic and therapeutic use, which we applied in pediatric patients of different age groups.

Case Series

After obtaining approval from the Clinical Research Ethics Committee of Prof Dr Cemil Taşçıoğlu City Hospital in Istanbul (decision No 294/2022, dated 10/17/2022), we evaluated retrospectively the files of pediatric patients aged 0-18 years who underwent ERCP between the 1st of January 2015 and 30th of June 2022 in the ERCP unit of our hospital. In our ERCP unit, an average of 450-550 ERCPs per year is performed on adult patients. The

ERCP in pediatric patients is performed in our hospital by a general surgeon experienced in adult patients.

We recorded and analyzed the demographic data, such as the patient's age and sex, complaints on admission, ultrasonography (USG) and MRCP results before the procedure, ERCP findings, and early and late post-procedure complications. We obtained informed consent from all patients and guardians before the procedure. ERCP was performed for diagnostic (diagnosis of pancreaticobiliary anomalies) and therapeutic (sphincterotomy, dilatation, stone extraction, stent placement) purposes.

We utilized as a diagnostic tool the Fujifilm ED-580XT model video duodenoscope with a 13.4 mm outer diameter and a 4.4 mm diameter working channel connected to a Fujinon Eluxeo 6000 light source (Fujifilm Corporation, Tokyo/Japan) not specifically designed for children but in use for adult patients (Figure 1). All patients had fasted for at least eight hours before the procedure. The ERCP procedure was performed by the same general surgeon (EG) with the patient under deep sedation provided by the anesthesia department. The patient's heart rate, blood pressure, and oxygen saturation were continuously monitored while face masks delivered oxygen during the procedure. The Pediatric Gastroenterology or Pediatric Surgery team monitored all ERCP procedures, including pre-procedure preparation and post-procedure follow-up of all patients for at least 24 hours. After the procedure, we monitored intravenous fluid administration and hematological and biochemical parameters [hemogram, C-reactive protein, gamma-glutamyl transferase (GGT), alkaline phosphatase (ALP), amylase, and lipase]. Cefazolin 50 mg/kg was administered intravenously one hour before the procedure for antibiotic

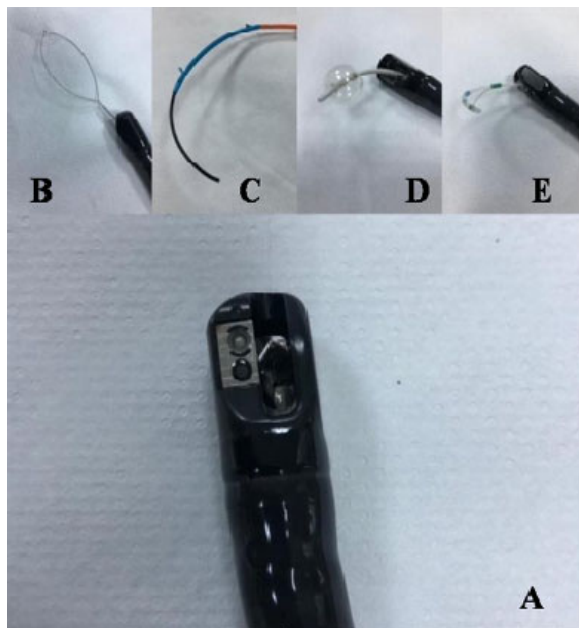


Figure 1: Choledochoscope and its components for the endoscopic retrograde cholangiopancreatography equipment, A) duodenoscope, B) endoscopic snare, C) endoscopic biliary stent, D) endoscopic balloon and endoscopic sphincterotome.

prophylaxis, and paracetamol 10 mg/kg was routinely administered intravenously for post-procedure analgesia. We did not use non-steroidal anti-inflammatory drugs for pancreatitis prophylaxis.

We performed statistical analysis using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Data were calculated with frequency tables. Categorical variables are expressed as numbers and percentages, and continuous variables as means \pm standard deviation.

Sixteen pediatric patients who underwent ERCP were included in the study. While biochemistry and ultrasonography were conducted for all patients before the procedure, only ten patients (62 %) underwent MRCP. ERCP was performed in five (31 %) boys and 11 (69 %) girls with a mean age of 12.7 ± 5.44 (range: 5-18) years. Indications for performing ERCP included suspected biliary pathology (8 patients, 50 %), pancreatitis attack (6 patients, 38 %), bile leakage after cholecystectomy (one patient, 6 %), and mass lesion in the ampulla (one patient, 6 %). The majority of the pediatric patients underwent partial sphincterotomy with stone extraction, mucus and particle extirpation, papilla biopsy, papillotomy, and stent placement (15 patients, 94 %), while in one of the patients (6 %), ERCP was performed for diagnostic-only purposes. Seven patients (44 %) underwent cholecystectomy for cholelithiasis 4-6 weeks after the ERCP (one ERCP was performed in another center). Five (83 %) of the six patients who underwent ERCP for pancreatitis did not experience further pancreatitis episodes, while one experienced an acute pancreatitis episode in the late post-procedure period. The pancreatic mass regressed in two patients who underwent sphincterotomy and stent placement due to bile leakage, and no pathology was found in the patient who underwent ERCP for obstruction of the bile ducts (Table 1). ERCP images of the patients are given in Figure 2 and Figure 3. Laparoscopic cholecystectomy was performed in seven patients with cholelithiasis, and no postoperative complications were observed.

Following ERCP, ALP increased in five patients, and GGT increased in one patient. Amylase and lipase levels increased after ERCP in two patients without relevant clinical findings (Figure 4). Only one pediatric ERCP was performed between 2015 and 2018, whereas the annual number of pediatric ERCP procedures increased after 2020. While none of the patients had complications in the early post-procedure period, one patient who underwent ERCP due to pancreatitis experienced an acute pancreatitis episode in the late post-procedure period. ERCP has been performed on relatively younger patients over the years (Table 1).

Discussion

Pancreatobiliary diseases such as pancreaticobiliary malunion (pancreatic divisum 4-10 %), congenital bile duct cysts (choledochal cyst 1/100,000), and biliary tract stone disease (choledocholithiasis 0.13-0.22 %) are rarely seen in children (Table 2). Diagnosis and treatment of these diseases can be either endoscopic or surgical. For the first

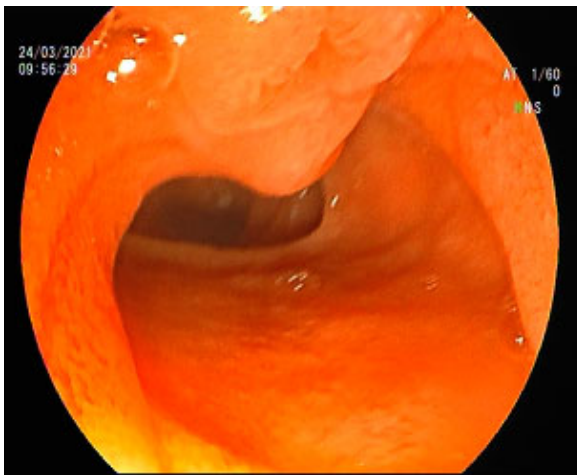


Figure 2: Image of endoscopic retrograde cholangiopancreatography (ERCP) showing a suspected mass lesion on the ampulla Vateri (our youngest pediatric patient who underwent ERCP: aged five years, weighing 11 kg with a diagnosis of mental retardation and cerebral palsy). ERCP revealed a mass larger than its normal size on ampulla Vateri. We obtained a biopsy and performed a papillotomy and stenting.

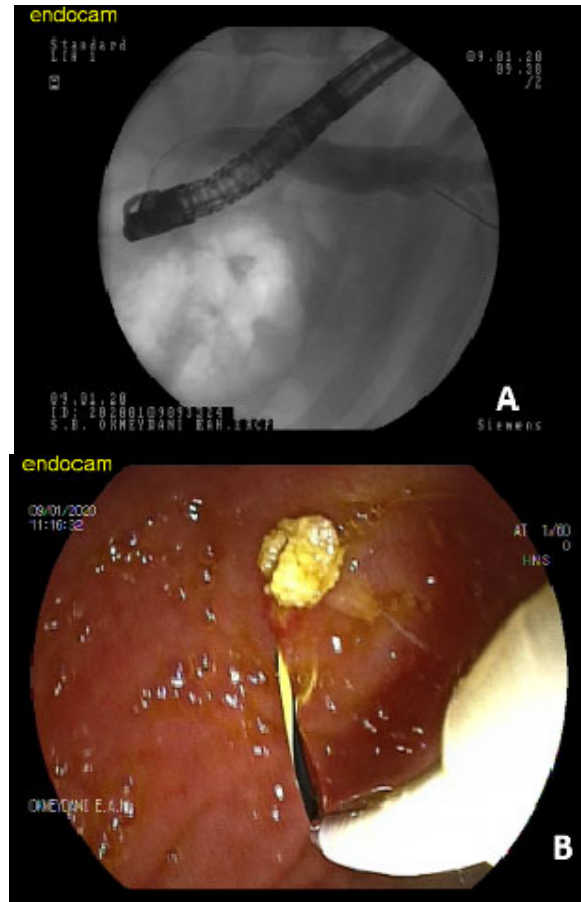


Figure 3: A) Cholangiography image and B) endoscopic image during duodenoscopy in a 12-year female patient who underwent endoscopic retrograde cholangiopancreatography with the indication of cholangitis.

time in 1976, Waye et al used an adult duodenoscope to diagnose and treat pancreaticobiliary disease in children. They initially utilized successfully an adult duodenoscope for a 3.5-month-old infant weighing six kg who had cholelithiasis, and then small-caliber (7.5-9.0 mm) duodenoscopes were developed². Hence, ERCP, which had limited use in children, has become a widespread examination with technical developments in recent years.

The European Society for Pediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) recommends

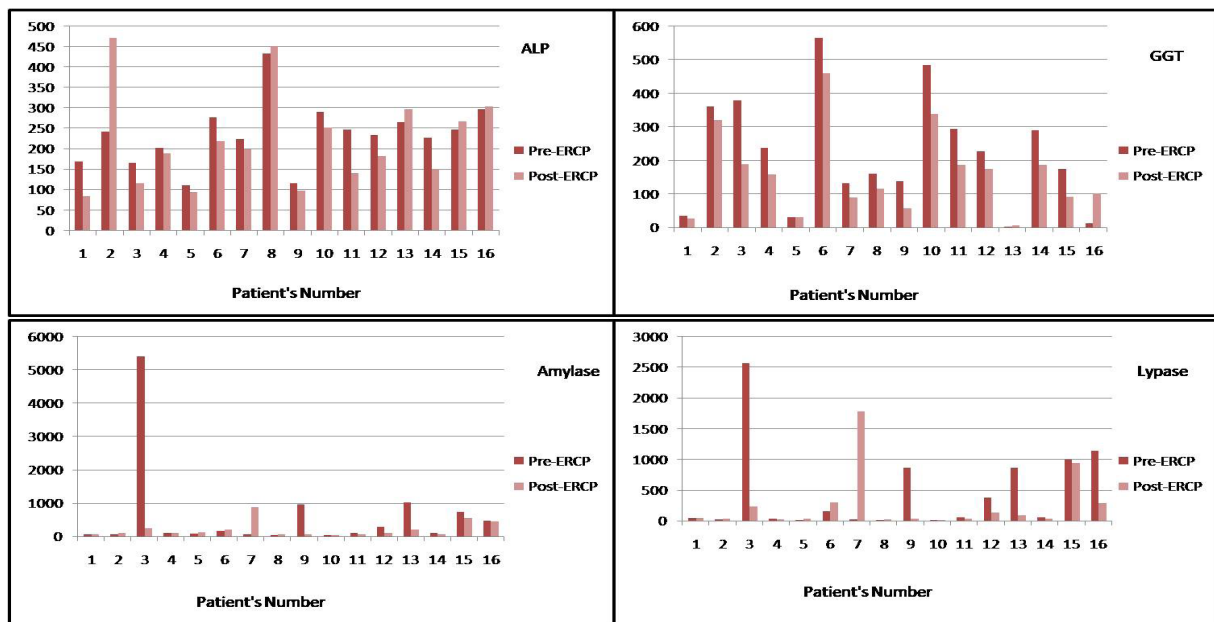


Figure 4: Histograms showing the levels of A) Alkaline phosphatase, B) gamma-glutamyl transferase, C) amylase, and D) lipase in the 16 pediatric patients who underwent endoscopic retrograde cholangiopancreatography between 2015 and 2022.

ALP: Alkaline phosphatase, GGT: Gamma-Glutamyl Transferase.

Table 1: Demographic, imaging, endoscopic retrograde cholangiopancreatography (ERCP), and follow-up information of the 16 pediatric patients aged 5-18 years who underwent ERCP between January 2015 and June 2022.

	Age	Gender	Year	Initial Diagnosis	USG	MRCP	ERCP	After the procedure
1	18	M	2017	Biliary fistula	N/A	N/A	Spincterotomy-stenting	Follow-up
2	18	F	2018	Obstruction	Normal	N/A	Normal	EC
3	16	F	2020	Choledochal stone	Biliary dilata- tion	Right and left hepatic duct dilatation	Spincterotomy- particle extirpation	EC
4	16	F	2020	Choledochal stone	Cholelithiasis- Biliary dilata- tion	N/A	Spincterotomy- calcu- lus extirpation	Follow-up
5	16	F	2021	Choledochal stone	Cholelithiasis (microcalculi)	Intact intrahepatic bile ducts	Spincterotomy- calcu- lus extirpation	EC
6	7	F	2021	Pancreatitis	Chronic pan- creatitis	Stone in the gallbladder lu- men	Spincterotomy- particle extirpation	Follow-up
7	6	F	2021	Ampullary mass	Biliary dilata- tion	Pancreaticobiliary duct dila- tation, diffuse thickening of the wall of the ampulla	PT-Dilatation-Biopsy- Stenting	Follow-up
8	5	M	2021	Choledochal stone	Choledochal stone	Multiple stones in the chole- duct	Spincterotomy- particle extirpation	Medical treatment
9	13	M	2021	Choledochal stone	Cholelithiasis	A 3.5 mm stone in the chole- duct	Spincterotomy- calcu- lus extirpation	Acute pancreatitis epi- sode - EC
10	13	F	2021	Pancreatitis	N/A	N/A	Spincterotomy- particle extirpation	Follow-up
11	12	M	2021	Pancreatitis	Pancreatitis	Pancreatitis	Papillotomy- particle extirpation	Follow-up
12	14	F	2022	Pancreatitis	Biliary dilata- tion	Acute cholecystolithiasis	Spincterotomy- particle extirpation	EC
13	5	F	2022	Choledochal stone	Sludge in the gallbladder	N/A	Spincterotomy- particle extirpation	EC
14	15	F	2022	Pancreatitis	Cholelithiasis- Biliary dilata- tion	N/A	Papillotomy- particle extirpation	Follow-up
15	15	F	2022	Choledochal stone	Cholelithiasis- Biliary dilata- tion	Stone in the distal part of the choleduct	Spincterotomy- particle extirpation	Follow-up
16	17	M	2022	Pancreatitis	Biliary dilata- tion	Particles in the bile ducts	Spincterotomy- calcu- lus extirpation	EC

EC: early cholecystectomy, MRCP: magnetic resonance cholangiopancreatography, N/A: not available, USG: ultrasonography.

Table 2: Indications for endoscopic retrograde cholangiopancreatography (ERCP) in pediatric patients.

Biliary		Pancreatic	
Diagnostic	Therapeutic	Diagnostic	Therapeutic
Cholestasis in neonates and infants	Common bile duct stones	Evaluation of anomalous biliopancreatic junction	Chronic pancreatitis
Choledochal cyst	Bile leak (post-surgical, post-traumatic)		Recurrent acute pancreatitis
Primary sclerosing cholangitis (brush cytology)	Benign biliary strictures		Pancreas divisum
	Primary sclerosing cholangitis		Pancreatic duct leak (post-surgical, post-traumatic)
	Malignant biliary strictures		Pancreatic pseudocyst
	Parasitosis (ascariasis, fascioliasis)		

the diagnostic use of ERCP in children in cases where noninvasive techniques such as MRCP are insufficient and also recommends its therapeutic use in patients with suspected pancreaticobiliary disease after the application of MRCP. In our study, all patients were evaluated with ultrasonography before the procedure, while ten patients (62 %) were assessed with MRCP. ESPGHAN recommends that ERCP is performed under general anesthesia by experienced endoscopists in tertiary hospitals where ERCP is frequently performed⁴. Studies have reported

that the diagnostic use of ERCP is safe, while its therapeutic use is limited in newborns and infants⁵.

Acute pancreatitis has been documented as the most common ERCP indication^{3,6,7}. In our study, the most common indications for ERCP were choledocholithiasis in seven (43 %) and pancreatitis in six (37 %) patients. ERCP was performed in one patient due to a biliary fistula and a mass in the ampulla, which are rare indications in children. According to our experience and patient diversity, ERCP was performed in the adolescent age group of patients

mostly due to biliary tract stones in the first years of our learning curve. However, it has also been performed in the younger age group to diagnose recurrent pancreatitis and biliopancreatic duct anomalies in recent years.

The success of ERCP depends on the appropriate equipment and, most importantly, on the endoscopist's experience. ERCP in the pediatric age group is performed by specialists in adult gastroenterology and general surgeons, and based on the guidelines, these specialists are required to have performed 200 ERCPs in the pediatric age group to be competent⁸. In our study, diagnostic-only ERCP was successfully performed in one patient, and diagnostic and therapeutic ERCP was performed in 15 patients. During the study period, our endoscopist performed a total of 2,700 ERCPs. Since we do not perform pediatric endoscopy, performing ERCP in the newborn and infant age groups is not feasible.

The rate of complications and the success rate of the procedure depends on the endoscopist's experience. It has been reported that the complication rates of endoscopists performing more than 100 ERCPs per year are lower than those who perform less than 40 ERCPs per year⁹. An average of 450 ERCPs per year is performed by a single general surgeon (EG) in the ERCP unit of our hospital.

The most common complication following ERCP is pancreatitis, reported to occur at a rate ranging between 3-10 %³. Prophylactic pancreatic stenting in adult patients is neither effective nor safe compared to its use in pediatric patients⁹. The ESPGHAN 2017 guidelines recommend using non-steroidal anti-inflammatory drugs for children over 14 years of age for prophylaxis of pancreatitis secondary to ERCP⁴. Only moderate elevation in pancreatic enzymes was recorded in our patients, not accompanied by abdominal pain, which regressed in the follow-up after ERCP. Another potential complication after sphincterotomy is bleeding. Since we performed only partial sphincterotomy, we did not observe bleeding in any of our patients.

Published studies in adult patients recommend cholecystectomy for patients with cholelithiasis who underwent sphincterotomy to prevent recurrence and gallstone-related pancreatitis^{10,11}. In our study, cholecystectomy was performed in six patients who had undergone partial sphincterotomy for choledocholithiasis with associated cholelithiasis before our intervention. In one patient, the stones in the gallbladder disappeared with ursodeoxycholic acid treatment. Cholecystectomy was performed in an external center on one patient who underwent ERCP for diagnostic purposes, and no pathology was detected. No acute pancreatitis episodes recurred in the follow-up of five patients who underwent sphincterotomy due to pancreatitis not associated with cholelithiasis. The patient's symptoms with a biliary fistula regressed after sphincterotomy and cholecystectomy with stent placement. One patient with no pancreaticobiliary pathology detected in ERCP had no complaints during follow-up.

Limitations of this study include i) the inability to perform ERCP in younger age groups due to the lack of pediatric duodenoscopes, ii) the low number and limited diversity of patients, and iii) the fact that there were patients

who did not attend post-procedure follow-up visits (unknown whether they underwent cholecystectomy or not).

Conclusion

ERCP is a method that can be used in diagnosing and treating pancreaticobiliary diseases in pediatric patients and adults, and its use will increase gradually. Performing ERCP using standard adult-oriented equipment in adolescent or even younger patient groups is difficult. While mainly general surgeons and gastroenterologists perform ERCP in adults, it is also performed in children by pediatric gastroenterologists in a limited number of centers. The endoscopist's experience performing ERCP procedures is critical in reducing complications and increasing success rates, especially in the pediatric age group. Despite the limited technical equipment in the ERCP unit of our hospital, the ERCP procedures can be performed safely and effectively in selected pediatric patients.

Conflict of interest

The authors declared no competing interest. No company or institution has financially contributed to the study.

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