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The primary aim of *World Journal of Gastrointestinal Surgery* (*WJGS*, *World J Gastrointest Surg*) is to provide scholars and readers from various fields of gastrointestinal surgery with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

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ORIGINAL ARTICLE

Retrospective Study

Analysis of the efficacy and safety of endoscopic retrograde cholangiopancreatography for the treatment of pediatric pancreatobiliary diseases

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Abstract

BACKGROUND

Traditional surgical procedures are highly invasive and risky for children with pancreatic and biliary diseases. Endoscopic retrograde cholangiopancreatography (ERCP) has been used mostly in adults because it is a safe and effective surgical procedure. Its application in children will contribute to the treatment and prognosis of children with pancreatic and biliary diseases.

AIM

To analyze the efficacy and safety of ERCP for the treatment of pediatric pancreatobiliary diseases.

METHODS

A retrospective study was performed using the medical records of 101 pediatric patients who received treatment for pancreatobiliary diseases at Children's Hospital Capital Institute of Pediatrics from April 2022 to April 2024. The patients were divided into an observation group (n = 52, treated with ERCP) and a control group (n = 49, treated with traditional surgical methods). Diagnostic and therapeutic outcomes of ERCP were statistically analyzed. Treatment efficacy, time to resume eating, and hospital stay duration were compared between the two groups. Indicators of liver function were monitored preoperatively and one week postoperatively. Dynamic changes in C-reactive protein (CRP) and serum amylase levels were assessed preoperatively and at 6 and 24 hours postoperatively. Postoperative complications were also compared. Logistic multivariate regression was used to analyze the independent effect of ERCP on outcomes.

RESULTS

For the observation group, 36 and 16 patients were diagnosed with biliary and pancreatic diseases, respectively. Compared with the control group, the observa-

tion group exhibited a higher overall effective rate ($P < 0.05$), shorter times to resume eating, shorter hospital stays ($P < 0.05$), and significantly improved postoperative liver function ($P < 0.05$). CRP and serum amylase levels were significantly increased in both groups at 6 and 24 hours postoperatively ($P < 0.05$), but were significantly lower in the observation group ($P < 0.05$). The observation group also had a lower incidence of complications ($P < 0.05$). ERCP was an independent factor affecting treatment efficacy, length of hospital stay, total bilirubin, aspartate aminotransferase, and alanine aminotransferase, CRP, serum amylase, and the occurrence of complications in children with pancreaticobiliary diseases ($P < 0.05$).

CONCLUSION

ERCP effectively enhances the treatment efficacy of pediatric pancreatobiliary diseases, with a reduced inflammatory response, faster postoperative recovery, and fewer complications. ERCP is a safe and effective diagnostic and therapeutic method for pediatric pancreatobiliary diseases.

Key Words: Endoscopic retrograde cholangiopancreatography; Pediatric pancreatobiliary diseases; Efficacy; Safety

Core Tip: Pancreatic and biliary diseases are serious illnesses. Children with pancreatic and biliary diseases have traditionally received surgery; however, these procedures are traumatic and risky. Thus far, endoscopic retrograde pancreaticobiliary angiography has been used in adults as a safe and effective surgical procedure; however, there are few studies analyzing its efficacy in children. The purpose of this study was to evaluate the effect and safety of endoscopic retrograde pancreaticobiliary angiography for the treatment of pancreatic and biliary diseases in children.

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INTRODUCTION

Pediatric biliary and pancreatic diseases are predominantly congenital and encompass acute and chronic pancreatitis. Because of the dynamic nature of children's growth and development, the clinical presentations vary significantly with age[1]. Traditionally, pediatric patients with pancreatobiliary diseases are treated surgically, which is high risk and associated with considerable trauma. Therefore, identifying minimally invasive and safer treatment methods is of paramount importance for the diagnosis and treatment of pediatric pancreatobiliary diseases[2].

Since the initial use of endoscopic retrograde cholangiopancreatography (ERCP) by McCune *et al*[3] in 1968, this technique remains indispensable for diagnosing and treating biliary and pancreatic diseases. In 1976, Waye[4] introduced ERCP to pediatric patients; however, its application was limited by high operational risks and equipment constraints[5]. With the advent of pediatric-specific duodenoscopes and related devices, ERCP use has increased in pediatric cases and demonstrated significant diagnostic and therapeutic value[6,7]. Despite these advancements, however, the anatomical complexity of pediatric pancreatobiliary diseases poses greater challenges compared with that in adults. The lack of pediatric-specific endoscopic equipment necessitates the use of adult devices, which may increase the occurrence of postoperative complications[8,9]. Furthermore, there is a scarcity of studies comparing the safety and efficacy of ERCP with traditional surgical methods in the pediatric population. Thus, a comprehensive analysis of ERCP in pediatric pancreatobiliary diseases is warranted.

In this study, we analyzed the efficacy and safety of ERCP for the treatment of pediatric pancreatobiliary diseases and provided data for selecting the appropriate treatment for these conditions.

MATERIALS AND METHODS

Clinical data

A retrospective analysis was performed on 101 pediatric patients with pancreatobiliary diseases treated at Children's Hospital Capital Institute of Pediatrics from April 2022 to April 2024. Based on the treatment method, patients were categorized into an observation group ($n = 52$) that underwent ERCP, and a control group ($n = 49$) receiving traditional surgical intervention. The inclusion criteria were as follows: (1) Children who met the diagnostic criteria for pancreatobiliary diseases; (2) Children aged below 12 years; and (3) Patients with complete medical records. The exclusion criteria were as follows: (1) Patients with other malignant tumors; (2) Patients with severe hepatic or renal dysfunction; (3) Patients with contraindications to surgery; and (4) Patients with immunodeficiency disorders.

Preoperative preparation

All patients underwent complete blood count, liver and kidney function tests, coagulation profiles, abdominal ultrasound, chest X-rays, and electrocardiograms to assess cardiopulmonary function. Additional tests, such as computed tomography, magnetic resonance cholangiopancreatography (MRCP), blood calcium, blood lipids, IgG4, and autoantibodies, were done as needed to confirm a diagnosis. Preoperative discussions were held with the guardians to inform them of the necessity of the treatment, expected outcomes, intraoperative risks, and potential postoperative complications. Informed consent was also obtained. Preoperative preparations included fasting, gastric decompression through a nasogastric tube, and prophylactic antibiotic administration.

Treatment protocols

Patients with control group underwent conventional surgical treatment specific to their condition. Two pediatric surgeons with over 10 years of experience in pancreatobiliary diseases performed the surgeries, which included laparoscopic and classic open surgeries. Postoperative care included intensive monitoring, oxygen therapy, fasting, gastric decompression, prophylactic antibiotics, and regular checks of blood counts and biochemical indices. Healing of the surgical incision was monitored and the diet was gradually transitioned from liquid to regular food.

Observation group patients were treated with ERCP. The procedure was performed using Olympus JF240 and TJF240 endoscopes with distal end outer diameters of 12.6 mm and 13.5 mm, respectively. They were equipped with specialized ERCP accessories from cook medical, which included various guidewires, duodenal papillotomy knives, dilators, and pancreatobiliary stents. Because of the difficulty in patient cooperation, poor tolerance, and the delicate nature of the pediatric gastrointestinal tract, all procedures were done under general anesthesia with endotracheal intubation by a dedicated anesthesiologist. Experienced endoscopists conducted the procedures.

During ERCP, the pancreatic or bile ducts were cannulated, and X-rays were taken to confirm the pancreatobiliary pathology. Appropriate ERCP techniques were selected based on the specific condition. The most common procedures for chronic pancreatitis, pancreatic duct stenosis, and pancreatic divisum included ERCP with endoscopic retrograde pancreatic drainage (ERPD) and ERCP with endoscopic sphincterotomy (EST) plus ERPD. For bile duct stones, the procedures included ERCP with EST and balloon stone extraction, ERPD with endoscopic retrograde biliary drainage, and ERCP with balloon stone extraction plus endoscopic nasobiliary drainage.

Post-ERCP, the patients were kept fasting and provided with symptomatic supportive treatments, such as inhibition of digestive secretion and broad-spectrum antibiotics, based on intraoperative findings. Regular monitoring of blood counts and serum amylase levels was done along with periodic monitoring of blood biochemistry and electrolyte levels. The clinical manifestations of the patients were closely observed.

Observation indicators

Diagnostic and therapeutic outcomes of ERCP: The results of the diagnostic and therapeutic procedures performed by ERCP were statistically analyzed.

Comparison of treatment efficacy: The treatment efficacy between the two groups was compared and classified as follows: Markedly effective: Laboratory indices returned to normal and symptoms completely disappeared. Effective: Significant improvement in laboratory indices and symptoms. Ineffective: No significant relief of symptoms postoperatively.

Time to resume eating and hospital stay duration: The time required for the patient to resume eating and the duration of hospital stay were compared between the two groups.

Liver function indicators: Using a biochemical analyzer (BECKMANAU680), liver function indicators, including total bilirubin (TBil), aspartate aminotransferase (AST), and alanine aminotransferase (ALT), were monitored preoperatively and one week postoperatively in both groups.

Dynamic monitoring of inflammatory markers: Preoperative and postoperative (6 and 24 hours) C-reactive protein (CRP) and serum amylase levels were dynamically monitored in both groups.

Postoperative complications: The incidence of postoperative complications, including hyperamylasemia, stress-induced hyperglycemia, transient acute pancreatitis, and bleeding, was compared between the two groups.

Impact of ERCP on outcomes: Logistic multivariate regression was used to analyze the independent impact of ERCP on outcomes.

Statistical analysis

Data analysis was performed using SPSS 23.0 software and graphical representations were created using GraphPad Prism 8.0. The sample size of this study was calculated using the formula: $n = Z \times [P \times (1\text{-}P)]/E$, where n is the sample size; Z is the statistic, $Z = 1.96$ when the confidence level is 95%; $Z = 1.64$ when the confidence level is 90%; E is the error value. The "statistics power calculator" was used for power analysis to determine whether the sample size was sufficient. All continuous variables in this study were normal. The categorical data are expressed as n (%) and the χ^2 test was used for comparison. Continuous data are expressed as the mean ± SD. Between-group comparisons were conducted using the independent samples t-test, whereas within-group comparisons before and after intervention were conducted using the paired samples t-test. A P value less than 0.05 was considered statistically significant.

RESULTS

Comparison of general data

The results of a power analysis revealed that the power threshold of the sample size could reach 0.9. No significant differences were observed between the two groups in terms of gender, age, and preoperative body mass index ($P > 0.05$; Table 1)[10].

Diagnosis and treatment results of ERCP in the observation group

Thirty-six cases were diagnosed with biliary diseases, including 20 cases of simple common bile duct stones, 8 cases of bile duct stricture/dilatation, 2 cases of bile duct dilatation and gallbladder stones, 2 cases of bile duct stones and abnormal bile-pancreatic junction, 2 cases of bile duct stones combined with bile duct stricture, and 2 cases of suspected bile duct stones. Sixteen cases were diagnosed with pancreatic diseases, including 6 cases of chronic pancreatitis, 3 cases of pancreatic pseudocysts, 2 cases after pancreatic duct stenting, 3 cases of pancreatic divisum, and 2 cases of pancreatic duct stricture (Table 2 and Table 3).

Comparison of treatment efficacy between the two groups of children

The number of children showing a marked effect, effective, and ineffective in the observation group was 30, 20, and 2, respectively, whereas the number of children with a marked effect, effective, and ineffective in the control group was 20, 18, and 11, respectively. The total treatment efficacy of the observation group was markedly higher compared with that of the control group (96.15% *vs* 77.55%, $P < 0.05$; Table 4).

Comparison of the time to resume eating and hospitalization time between the two groups

The time to resume eating and hospitalization time of the children in the observation group were shorter compared with those in the control group ($P < 0.05$; Table 5).

Comparison of liver function indicators between the two groups before and one week after surgery

Before surgery, two groups were observed with insignificant differences in liver function indicators (TBil, ALT, AST; $P > 0.05$). After treatment, TBil, ALT, and AST for both groups were improved; however, such improvement of the observation group was more apparent compared with the control group ($P < 0.05$; Figure 1).

Comparison of changes in CRP and serum amylase before and after surgery in the two groups of children

No significant difference was observed in the levels of CRP and serum amylase between the two groups before surgery ($P > 0.05$). The CRP and serum amylase levels in both groups of children at 6 and 24 hours after surgery were significantly higher compared with those before surgery ($P < 0.05$); however, the levels of CRP and serum amylase in the observation group were markedly lower compared with those in the control group ($P < 0.05$; Figure 2).

Comparison of complication rates between the two groups

For the observation group, the number of children with hyperamylasemia, stress hyperglycemia, transient acute pancreatitis, and bleeding was 12, 2, 2 and 0, respectively, whereas the complication rate was 30.77%. For the control group, the number of children with hyperamylasemia, stress hyperglycemia, transient acute pancreatitis, and bleeding was 17, 4, 3, and 1, respectively, whereas the complication rate was 51.07%. The complication rate was notably lower in the observation group compared with the control group ($P < 0.05$; Table 6).

Multivariate analysis

Logistic regression was used to analyze the independent effect of ERCP on the results. The results indicated that there were differences between the two groups in terms of time to resume eating, length of hospital stay, postoperative liver function indicators (TBil, ALT, AST), CRP, serum amylase, and complication rate. The e variables with statistically significant differences were assigned values (Table 7) and included in the multivariate logistic regression analysis. The results indicated that TBil, ALT, AST, CRP, serum amylase are independent factors affecting treatment effectiveness (Table 8).

DISCUSSION

ERCP is a routine technique for the diagnosis and treatment of pancreaticobiliary diseases in adults. With advancements in non-invasive cross-sectional imaging technologies, including MRCP, MRCP has largely replaced ERCP for the diagnosis of pancreaticobiliary diseases. Nonetheless, ERCP remains the preferred therapeutic method for these cases. A systematic analysis of the pediatric ERCP literature in China revealed that ERCP is increasingly recognized as a therapeutic technique for pediatric patients, with therapeutic ERCP accounting for 77% of the total procedures with the proportion continuing to rise annually[11]. Currently, ERCP is not only a diagnostic technique, but also a therapeutic tool.

Although the indications for pediatric ERCP are similar to those in adults, there are differences. Compared with adults, congenital anomalies of the pancreaticobiliary anatomy are more common in children[12]. Research data from the United States indicate that recurrent pancreatitis, pancreatic duct stones, and congenital anatomical anomalies, such as pancreaticobiliary maljunction, pancreatic divisum, and annular pancreas, are common indications for ERCP in pediatric

Table 1 General data comparison, *n* (%)

Factor	Observation group (*n* = 52)	Control group (*n* = 49)	χ^2	*P* value
Gender			0.013	0.909
Male	27 (51.92)	26 (53.06)		
Female	25 (48.08)	23 (46.94)		
Age (years)			0.058	0.809
≤ 7	32 (61.54)	29 (59.18)		
> 7	20 (38.46)	20 (40.82)		
BMI (kg/m^2)			0.016	0.899
≤ 16	28 (53.85)	27 (55.10)		
> 16	24 (46.15)	22 (44.90)		
JSGPM-PBM[10]			0.050	0.997
A	16 (30.77)	15 (30.61)		
B	15 (28.85)	15 (30.61)		
C	13 (25.00)	12 (24.49)		
D	8 (15.38)	7 (14.29)		

BMI: Body mass index.

Table 2 Pre- and post- endoscopic retrograde cholangiopancreatography diagnosis of 36 children with biliary tract diseases in the observation group

Preoperative imaging diagnosis	Postoperative ERCP diagnosis					
	Simple common bile duct stones	Bile duct stricture/dilatation	Bile duct dilatation and gallstones	Choledocholithiasis and abnormal biliopancreatic junction	Bile duct stones combined with bile duct stricture	Suspected bile duct stones
Bile duct stones	17	1	1	0	1	0
Abnormal bile duct signs	0	0	0	0	0	1
Bile duct stricture/dilatation	0	5	0	1	0	0
Bile duct dilatation and gallstones	3	2	1	0	1	1
Biliary pancreatitis	0	0	0	1	0	0

ERCP: Endoscopic retrograde cholangiopancreatography.

patients, which differs from those in adults[13]. In addition, the incidence and detection rate of common bile duct stones and choledochal cysts are higher in children compared with that in adults. In the present study, the most common condition treated with ERCP was bile duct stones, followed by chronic pancreatitis, pancreatic divisum, and pancreatic duct strictures. Other studies have indicated that common bile duct stones are the most common indication for ERCP in pediatric patients with biliary diseases, whereas chronic pancreatitis is a frequent indication among children with pancreatic diseases[14]. Pancreatic divisum and pancreatic duct strictures are common congenital anatomical anomalies of the pancreas in children. With the development of ERCP in pediatric patients, they may now be effectively treated. Further analysis of the therapeutic efficacy of ERCP in pediatric pancreaticobiliary diseases in the present study revealed that the overall treatment efficacy in the observation group was significantly higher compared with that in the control group. In addition, the time to resume eating in the observation group was significantly shorter compared with that in the control group. This suggests that ERCP for pediatric pancreaticobiliary diseases not only improves treatment efficacy, but also contributes to postoperative recovery[15]. The likely reason for these outcomes is that the pancreaticobiliary diseases involved in this study were primarily common bile duct stones. As a diagnostic and therapeutic method that does not require incision of the common bile duct, ERCP can display the morphology of the bile duct and stones when combined

Table 3 Preoperative and postoperative diagnosis of endoscopic retrograde cholangiopancreatography in 16 children with pancreatic diseases in the observation group

Preoperative imaging diagnosis	Postoperative ERCP diagnosis				
	Chronic pancreatitis	Pancreatic pseudocyst	Pancreatic schizophrenia	Pancreatic duct stent placement	Pancreatic duct stenosis
Chronic recurrent pancreatitis	5	0	0	0	2
Pancreatic cyst	1	3	0	0	0
Acute pancreatitis	0	0	3	0	0
After pancreatic duct stent placement	0	0	0	2	0

ERCP: Endoscopic retrograde cholangiopancreatography.

Table 4 Comparison of treatment efficacy, *n* (%)

Efficacy	Observation group (*n* = 52)	Control group (*n* = 49)	χ^2	*P* value
Marked effect	30 (57.69)	20 (40.86)	-	-
Effective	20 (38.46)	18 (36.73)	-	-
Ineffective	2 (3.85)	11 (22.45)	-	-
The total treatment efficacy	50 (96.15)	38 (77.55)	7.785	0.005

Table 5 Comparison of the time to resume eating and hospitalization time between the two groups

Project	Observation group (*n* = 52)	Control group (*n* = 49)	*t* value	*P* value
Time to resume eating (day)	2.12 ± 0.38	4.86 ± 0.61	27.26	< 0.001
Hospitalization time (day)	8.19 ± 1.09	15.29 ± 1.1	32.57	< 0.001

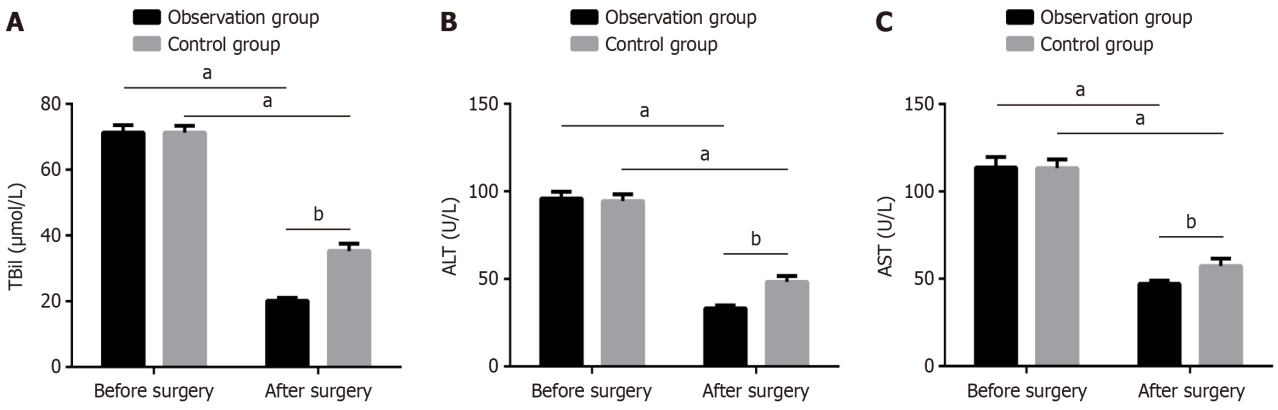

Figure 1 Comparison of liver function indicators before and after surgery between the observation and control groups. A: Comparison of total bilirubin before and after surgery between the two groups; B: Comparison of alanine aminotransferase before and after surgery between the two groups; C: Comparison of aspartate aminotransferase before and after surgery between the two groups. [a]*P* < 0.05 for comparison before and after surgery within the group; [b]*P* < 0.05 for comparison between groups. ALT: Alanine Aminotransferase; TBil: Total Bilirubin; AST: Aspartate aminotransferase.

with contrast agents, accurately identifying their location, number, and size. This ensures the complete removal of stones, reduces stone residue, minimizes physiological impairment, and enhances postoperative recovery[16,17].

To further assess postoperative recovery, we compared liver function indicators in both groups before and after surgery. TBil is an important clinical indicator for diagnosing liver and biliary abnormalities, whereas ALT is used for assessing liver damage. Increased levels indicate possible liver injury[18,19]. Following ERCP treatment, both indicators were significantly decreased, indicating effective improvement in liver function. This was likely the result of the

Table 6 Comparison of the incidence of complications between the two groups, *n* (%)

Complication	Observation group (*n* = 52)	Control group (*n* = 49)	χ^2	*P* value
Hyperamylasemia	12 (23.07)	17 (34.69)	-	-
Stress-induced hyperglycemia	2 (3.85)	4 (8.16)	-	-
Transient acute pancreatitis	2 (3.85)	3 (6.12)	-	-
Bleeding	0	1 (2.04)	-	-
Overall incidence	16 (30.77)	25 (51.01)	4.290	0.038

Table 7 Assignment table

Factor	Assignment
Recovery feeding time	Continuous variables
Length of hospital stay	Continuous variables
TBil	Continuous variables
ALT	Continuous variables
AST	Continuous variables
C-reactive protein	Continuous variables
Serum amylase	Continuous variables
Complication	Complications occurred = 1, no complications occurred = 0

ALT: Alanine aminotransferase; TBil: Total bilirubin; AST: Aspartate aminotransferase.

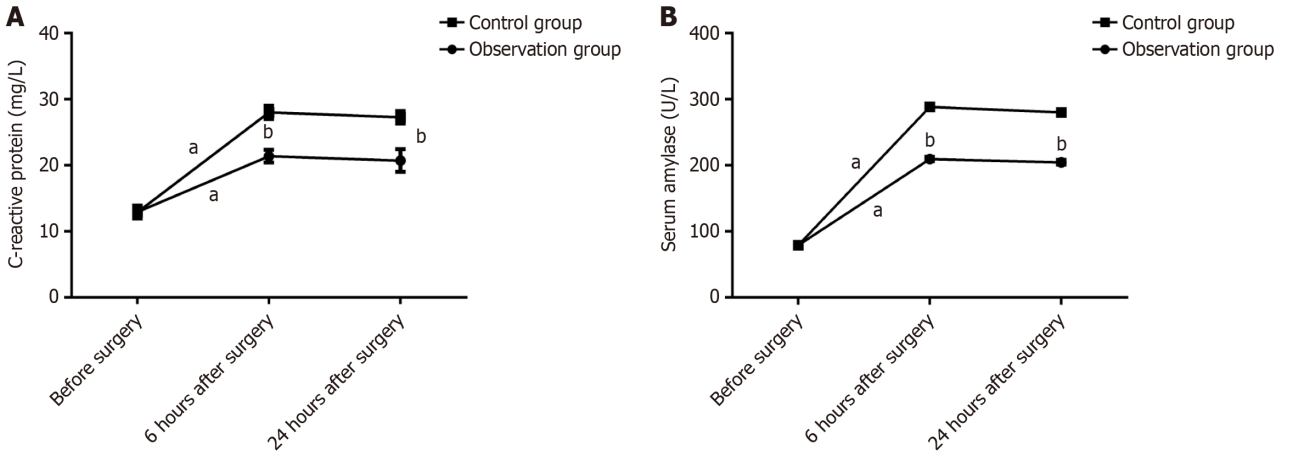

Figure 2 Comparison of changes in C-reactive protein and serum amylase in the pediatric observational and control groups following surgery. A: Comparison of C-reactive protein in the two groups of children before and after surgery; B: Comparison of serum amylase in the two groups of children before and after surgery. $^{a}P < 0.05$ for comparison before and after surgery within the group; $^{b}P < 0.05$ for comparison between groups.

noninvasive nature of ERCP, which avoids incising the common bile duct and maximizes its integrity[20]. However, ERCP is an invasive procedure that induces an inflammatory response and elevates serum amylase levels[21]. Therefore, we compared the changes in CRP and serum amylase levels postoperatively between the two groups. The results indicated that both CRP and serum amylase levels significantly increased postoperatively in both groups; however, the increases were more pronounced in the control group, suggesting that although ERCP induces some inflammatory response, it is less than that caused by traditional surgery.

ERCP is an invasive diagnostic and therapeutic technique. It may also result in complications, such as hyperamylasemia, postoperative pancreatitis, gastrointestinal bleeding, and perforation. Post-ERCP pancreatitis is the most common adverse event, with a reported incidence ranging from 3% to 15%, and approximately 5% of the cases progressing to severe disease[22]. The pathophysiology of post-ERCP pancreatitis is not well understood, although physical, chemical, and microbial factors may contribute to early enzyme activation and pancreatic injury. In most cases, post-ERCP pancre-

Table 8 Multivariate analysis

Factor	B	SE	Wals	*P* value	OR	95%CI	
						Lower limit	Upper limit
Recovery feeding time	-0.145	0.888	0.027	0.870	0.865	0.152	1.927
Length of hospital stay	-0.706	0.711	0.985	0.321	0.494	0.123	1.989
TBil	-2.496	1.066	5.487	0.019	0.082	0.010	0.665
ALT	-0.679	0.325	4.349	0.037	0.507	0.268	0.960
AST	-0.616	0.296	4.314	0.038	0.540	0.302	0.966
C-reactive protein	-1.248	0.586	4.532	0.033	0.287	0.091	0.906
Serum amylase	0.837	0.361	5.380	0.020	2.308	1.138	4.680
Complication	-2.648	1.855	2.037	0.153	0.071	0.002	2.686

ALT: Alanine aminotransferase; TBil: Total bilirubin; AST: Aspartate aminotransferase.

atitis is mild and has a good prognosis; however, some patients may develop organ failure or local complications resulting in severe acute pancreatitis that worsens rapidly with a poor prognosis[23]. In the present study, the most common complication in the observation group was hyperamylasemia, which typically resolved within 48 to 72 hours postoperatively, and a 5.5% incidence of post-ERCP pancreatitis. A retrospective study in Turkey analyzing pediatric ERCP data over ten years reported a complication rate of 15.23%, with post-ERCP pancreatitis incidence at 11.42%. This indicates that ERCP is safe and reliable for pediatric patients[24]. Nevertheless, strict adherence to ERCP indications is essential to minimize unnecessary procedures.

CONCLUSION

ERCP is an effective and safe method for the diagnosis and treatment of pediatric pancreaticobiliary diseases. Studies suggest that ERCP will be the preferred method for certain types of pediatric pancreaticobiliary diseases in the future; however, careful consideration of indications and contraindications is necessary for the management of these conditions. With advancements in operator skills, improved equipment, and appropriate anesthesia methods, ERCP will increasingly play an important role in the diagnosis and treatment of pediatric pancreaticobiliary diseases because of its minimally invasive nature, efficacy, safety, repeatability, and good prognosis. Nonetheless, this study has certain limitations. First, it is a retrospective analysis and there may be certain biases in the data collection. Second, because of the relatively small sample size and the lack of related studies, large-sample, multicenter randomized controlled trials are needed to corroborate our findings.

FOOTNOTES

Author contributions: Wang XQ designed the study; Wang XQ and Kong CH collected and analyzed the data; Wang XQ wrote the manuscript; Wang XQ and Ye M revised the manuscript; Wang XQ and Diao M participated in collection of the data; all authors approved the final version of the manuscript.

Institutional review board statement: This study was approved by the Ethic Committee of Children's Hospital Capital Institute of Pediatrics.

Informed consent statement: Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent.

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REFERENCES

1 **Keil R**, Drábek J, Lochmannová J, Šťovíček J, Koptová P, Wasserbauer M, Frýbová B, Šnajdauf J, Matouš J, Kotalová R, Rygl M, Hlava Š. ERCP in infants, children, and adolescents-Different roles of the methods in different age groups. *PLoS One* 2019; **14**: e0210805 [PMID: 30653580 DOI: 10.1371/journal.pone.0210805]

2 **Felux J**, Sturm E, Busch A, Zerabruck E, Graepler F, Stüker D, Manger A, Kirschner HJ, Blumenstock G, Malek NP, Goetz M. ERCP in infants, children and adolescents is feasible and safe: results from a tertiary care center. *United European Gastroenterol J* 2017; **5**: 1024-1029 [PMID: 29163969 DOI: 10.1177/2050640616687868]

3 **McCune WS**, Shorb PE, Moscovitz H. Endoscopic cannulation of the ampulla of vater: a preliminary report. *Ann Surg* 1968; **167**: 752-756 [PMID: 5646296 DOI: 10.1097/00000658-196805000-00013]

4 **Waye JD**. Endoscopic retrograde cholangiopancreatography in the infant. *Am J Gastroenterol* 1976; **65**: 461-463 [PMID: 949055]

5 **Lou Q**, Sun J, Zhang X, Shen H. Successful Therapeutic ERCP in a 99-Day-Old Child With Common Bile Duct Stones: A Case Report and Discussions on the Particularities of the ERCP in Children. *Front Pediatr* 2020; **8**: 435 [PMID: 32850548 DOI: 10.3389/fped.2020.00435]

6 **Abu-El-Haija M**, Kumar S, Quiros JA, Balakrishnan K, Barth B, Bitton S, Eisses JF, Foglio EJ, Fox V, Francis D, Freeman AJ, Gonska T, Grover AS, Husain SZ, Kumar R, Lapsia S, Lin T, Liu QY, Maqbool A, Sellers ZM, Szabo F, Uc A, Werlin SL, Morinville VD. Management of Acute Pancreatitis in the Pediatric Population: A Clinical Report From the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition Pancreas Committee. *J Pediatr Gastroenterol Nutr* 2018; **66**: 159-176 [PMID: 29280782 DOI: 10.1097/MPG.0000000000001715]

7 **Asenov Y**, Akın M, Cantez S, Gün Soysal F, Tekant Y. Endoscopic retrograde cholangiopancreatography in children: Retrospective series with a long-term follow-up and literature review. *Turk J Gastroenterol* 2019; **30**: 192-197 [PMID: 30459128 DOI: 10.5152/tjg.2018.18165]

8 **Trocchia C**, Khalaf R, Amankwah E, Ruan W, Fishman DS, Barth BA, Liu QY, Giefer M, Kim KM, Martinez M, Dall'oglio L, Torroni F, De Angelis P, Faraci S, Bitton S, Werlin SL, Dua K, Gugig R, Huang C, Mamula P, Quiros JA, Zheng Y, Piester T, Grover A, Fox VL, Wilsey M, Troendle DM. Pediatric ERCP in the Setting of Acute Pancreatitis: A Secondary Analysis of an International Multicenter Cohort Study. *J Pediatr Gastroenterol Nutr* 2023; **76**: 817-821 [PMID: 36913706 DOI: 10.1097/MPG.0000000000003762]

9 **Åvitsland TL**, Aabakken L. Endoscopic retrograde cholangiopancreatography in infants and children. *Endosc Int Open* 2021; **9**: E292-E296 [PMID: 33655024 DOI: 10.1055/a-1337-2212]

10 **Zhu L**, Xiong J, Lv Z, Liu J, Huang X, Xu W. Type C Pancreaticobiliary Maljunction Is Associated With Perforated Choledochal Cyst in Children. *Front Pediatr* 2020; **8**: 168 [PMID: 32363172 DOI: 10.3389/fped.2020.00168]

11 **Zhang J**, Gao LC, Guo S, Mei TL, Zhou J, Wang GL, Yu FH, Fang YL, Xu BP. Endoscopic retrograde cholangiopancreatography in the treatment of pancreaticopleural fistula in children. *World J Gastroenterol* 2020; **26**: 5718-5730 [PMID: 33088164 DOI: 10.3748/wjg.v26.i37.5718]

12 **Pan G**, Yang K, Gong B, Deng Z. Analysis of the Efficacy and Safety of Endoscopic Retrograde Cholangiopancreatography in Children With Symptomatic Pancreas Divisum. *Front Pediatr* 2021; **9**: 761331 [PMID: 34796156 DOI: 10.3389/fped.2021.761331]

13 **Rashid R**, Arfin MS, Karim ASMB, Alam MB, Mahmud S. Endoscopic Retrograde Cholangiopancreatography in Bangladeshi Children: Experiences and Challenges in a Developing Country. *Pediatr Gastroenterol Hepatol Nutr* 2022; **25**: 332-339 [PMID: 35903495 DOI: 10.5223/pghn.2022.25.4.332]

14 **Gómez SR**, Trujillo Ceballos AA, Montaño Rozo GA Sr, Solano Mariño J, Carias Domínguez AM, Vera Chamorro JF. Endoscopic Retrograde Cholangiopancreatography in Children: Nine Years' Experience at Santa Fe Foundation in Bogota, Colombia. *Cureus* 2023; **15**: e41835 [PMID: 37575826 DOI: 10.7759/cureus.41835]

15 **Gong SC**, An S, Shin IS, Jung PY. Usefulness of Endoscopic Retrograde Cholangiopancreatography in the Diagnosis and Treatment of Traumatic Pancreatic Injury in Children. *Diagnostics (Basel)* 2023; **13** [PMID: 37370939 DOI: 10.3390/diagnostics13122044]

16 **Kandırıcı A**, Gürbüz E. Our endoscopic retrograde cholangiopancreatography (ERCP) experience in pediatric patients in a training and research hospital. *Hippokratia* 2022; **26**: 152-156 [PMID: 37497530]

17 **Perera KDR**, Nawarathne NMM, Samarawickrama VT, Deraniyagala MP, Luxman WGE, Fernandopulle ANR. Endoscopic Retrograde Cholangiopancreatography in Children: Feasibility, Success, and Safety with Standard Adult Endoscopes and Accessories. *Pediatr Gastroenterol Hepatol Nutr* 2022; **25**: 406-412 [PMID: 36148288 DOI: 10.5223/pghn.2022.25.5.406]

18 **Liu W**, Liu Q, Wang W, Wang P, Chen J, Hong T, Zhang N, Li B, Qu Q, He X. Differential diagnostic roles of the serum CA19-9, total bilirubin (TBIL) and the ratio of CA19-9 to TBIL for benign and malignant. *J Cancer* 2018; **9**: 1804-1812 [PMID: 29805707 DOI: 10.7150/jca.25093]

19 **Sehatpour F**, Salehi A, Molavi Vardanjani H, Poustchi H, Gandomkar A, Malekzadeh R. Upper Normal Limit of Serum Alanine Aminotransferase and Its Association with Metabolic Risk Factors in Pars Cohort Study. *Middle East J Dig Dis* 2020; **12**: 19-26 [PMID: 32082517 DOI: 10.15171/mejdd.2020.159]

20 **Zhang XL**, Sun JH, Wu Y, Xie M, Li CC, Lv D, Yu W, Cui PL. Therapeutic outcomes of early and delayed endoscopic retrograde cholangiopancreatography and percutaneous transhepatic cholangial drainage in patients with obstructive severe acute biliary pancreatitis. *J Clin Transl Res* 2023; **9**: 160-167 [PMID: 37457545]

21 **Lv ZH**, Kou DQ, Guo SB. Three-hour post-ERCP amylase level: a useful indicator for early prediction of post-ERCP pancreatitis. *BMC Gastroenterol* 2020; **20**: 118 [PMID: 32306904 DOI: 10.1186/s12876-020-01254-7]

22 **Morales SJ**, Sampath K, Gardner TB. A Review of Prevention of Post-ERCP Pancreatitis. *Gastroenterol Hepatol (N Y)* 2018; **14**: 286-292 [PMID: 29991936]

23 **Shih HY**, Hsu WH, Kuo CH. Postendoscopic retrograde cholangiopancreatography pancreatitis. *Kaohsiung J Med Sci* 2019; **35**: 195-201

[PMID: 30887733 DOI: 10.1002/kjm2.12040]

24 **Dişçi E**, Peksöz R, Yıldız M, Yıldırgan Mİ, Albayrak Y, Fakirullahoğlu M, Fırıncı B, Atamanalp SS. Endoscopic Retrograde Cholangiopancreatography in Pediatric Patients. *J Laparoendosc Adv Surg Tech A* 2022; **32**: 320-324 [PMID: 35041496 DOI: 10.1089/lap.2021.0517]

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