

## MRI and MRCP in the Evaluation of Pediatric Pancreatico-Biliary Diseases

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### Abstract

**Background:** This study aimed to determine of the diagnostic benefit of MRCP as a noninvasive method to evaluate the pancreatico-biliary disorders in pediatric age group.

**Aim of Study:** Is to evaluate the role of MRCP in the diagnosis of pancreatico-biliary disease in pediatric age group.

**Patients and Methods:** The study retrospectively enrolled 25 patients undergoing MRCP for suspected pancreatico-biliary abnormalities. MRCP findings were compared with other imaging modalities, ERCP or operative findings.

**Results:** MRCP had overall sensitivity, specificity, and diagnostic accuracy of 100%, 100% and 88% respectively in detecting the etiology of pancreatico-biliary diseases in our patients.

Positive predictive value was 88% while the negative predictive value was 100%.

**Conclusion:** In conclusion, based on own experience, MRCP is a fast, non-invasive method for diagnosing pancreatico-biliary disorders in children with high diagnostic accuracy, sensitivity and specificity. MRCP doesn't involve the use of ionizing radiation which is suitable for children. Thus, MRCP ought to be the standard diagnostic procedure in the future.

**Key Words:** MRCP – Pancreatico-biliary diseases – Pediatric – Jaundice – ERCP.

### Introduction

**PANCREATICO-BILIARY** diseases are common in pediatric age group and can result in high morbidity and mortality if not accurately and promptly diagnosed [1]. These diseases include choledochal cyst, primary sclerosing cholangitis, cholelithiasis, choledocholithiasis, biliary atresia, pancreas divisum, Caroli's disease, disorders of the pancreatobiliary junction, and pancreatic duct abnormalities related to chronic pancreatitis [2].

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The commonly used non-invasive imaging, such as computed tomography (CT) and ultrasonography (US), are the initial imaging methods of choice for evaluating the pediatric age group pancreatico-biliary ductal system. But, when they fail to provide an accurate diagnosis, endoscopic retrograde cholangiopancreatography (ERCP) has been frequently required since nearly five decades and generally was considered the diagnostic reference standard for the evaluation of a wide range of abnormalities involving the pancreatico-biliary tree [3,4,5]. Unfortunately some drawbacks due to ERCP have been reported as pancreatitis, duodenal perforation, duodenal hemorrhage, infections and stent migration [6].

In addition to being invasive, ERCP requires significant radiation exposure and is expensive [7]. Hence, a non-invasive, lower-risk, and widely available technique is needed.

Magnetic resonance cholangiopancreatography (MRCP) is a non-invasive technique that rapidly popularized in clinical use in the 1990s [8,9]. MRCP refers to MR imaging optimized for visualization of the pancreatico-biliary system. This includes a variety of heavily T2-weighted imaging sequences which increase the conspicuity of fluid, including thin-section single-shot fast spin-echo (SSFSE), thick-section SSFSE, and very thin-section 3D fast spin-echo imaging that allows both 2D reformats and 3D reconstructions [4,10].

**Aim of the study:**

The purpose of this study is to evaluate the role of MRCP in the diagnosis of pancreatico-biliary disease in pediatric age group.

## Patients and Methods

### 1- Patients:

This study took place from Augusts 2020 to march 2021 in Ain Shams University Hospitals, Radiodiagnosis department. The study was approved by the local ethics committee in Ain Shams University hospitals, and we retrospectively reviewed the MRCP studies of 25 pediatric patients (12 males and 13 females) who were part of diagnostic workup for clinically suspected pancreatico-biliary disease. Patients' data extracted from our database records included gender and age; medical history (including prenatal history if relevant, abdominal US, CT, isotope scan or ERCP findings, and any surgery before MRCP or histopathological results); and clinical manifestations which included jaundice, fever, abdominal pain, and abdominal swelling.

Seventeen patients had additional imaging studies; US was done for 10 cases and CT for 7 cases. Therapeutic ERCP was carried out for 3 cases. Upon MRCP findings, Eight patients out of 25 were candidates for surgical intervention. In our study, we compared the MRCP results with those of other imaging modalities; US in 10 cases and CT in 7 cases, ERCP in 3 cases or intraoperative findings in 8 cases. We reviewed the MRCP examinations of all patients in an attempt to display the benefit of MRCP in differentiating the different causes of pancreatico-biliary pathologies in paediatrics age group and to find out its diagnostic accuracy.

### MRCP Technique:

Coronal 3D FSE HR MRCP sequence (TR/TE: 1100-1300/650) slice thickness 1.2mm and 320 x 256 matrix size, with MIP post-processing.

- i- Additional axial and coronal T2-weighted fast spin-echo and fat-suppressed sequence images were acquired with the following parameters: SSFSE repetition time/echo time of 300-550, 80-100ms; slice thickness, 4mm. The whole examination lasted for 20-25min.
- ii- In children the MRCP examination was performed with respiratory triggering. The acquisition time for each sequence varied according to the patient's body volume and breathing rate.
- iii- Patients fasted at least 6h before the examination.
- iv- Sedation was administered by an anesthesiologist following the American Academy of Pediatrics guidelines. Vital signs were monitored

during the sedation, and all the patients completed the examination smoothly, without any complications.

### MRCP analysis:

MRCP images were analyzed and reviewed blindly and independently by two pediatric radiology consultants. They were blinded to any other radiological or non-radiological examination results.

### Statistical analysis:

The overall sensitivity, specificity, positive and negative predictive and diagnostic accuracy of MRCP in differentiating the different pancreatico-biliary pathologies were calculated relative to the final diagnosis using SPSS 20.0 (SPSS Inc., Chicago, IL) software.

## Results

The twenty-five patients (13 females and 12 males) in our study series ranged in age from 9 month to 18 years (mean age: 12 years). The clinical manifestations varied but abdominal pain was the predominant presentation (Table 1). MRCP findings regarding the children pancreaticobiliary pathologies revealed that 7 cases (28%) had gall bladder stone, 5 cases (20%) had IHBRD and pancreatitis, 3 cases (12%) had choledocal cyst, 2 cases (8%) had pancreatic tear or injury and dilated common bile duct respectively and one patient showed pancreatic divisum and duodenal cyst.

Table (1): Clinical presentation in the studied patients.

	Studied patients n=25	
	n	%
Clinical presentation	Abdominal pain	19 76.0
	Jaundice	12 48.0
	Vomiting	4 16.0
	Fever	1 4.0

Based on ERCP, operation finding or other modalities as a reference standard, MRCP identified the etiology of pancreaticobiliary pathology in 22 patients (true positive cases) that also found by ERCP, operation findings or other modalities. Three cases with different pathology (pancreatic divisum, dorsal agenesis with non-visualized tail of pancreas and pancreatic injury/tear) were detected by MRCP and not diagnosed by ultrasound modality (Table 2).

Table (2): MRCP diagnosis accuracy (based on ERCP, operation finding or other modalities) in the studied patients.

	Studied patients n=25	
	Number of cases detected by MRCP	MRCP diagnosis accuracy (based on ERCP, operation finding or other modalities)
Chronic calcular cholecystitis	7	100%
Choledocal cyst	3	100%
IHBRD	5	100%
Parenchymatous liver changes	1	100%
Biliary atresia	1	100%
Pancreatic cyst	1	100%
Pancreatic injury/ tear	2	50%
Pancreatitis	5	80%
Dilated Common bile duct	2	100%
Duodenal cyst	1	100%

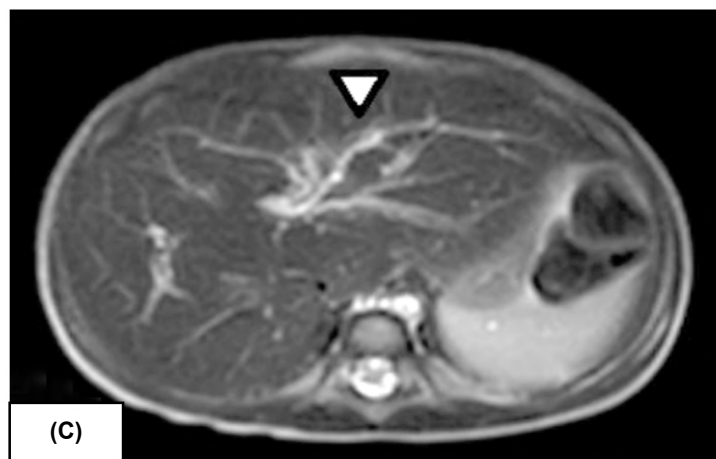
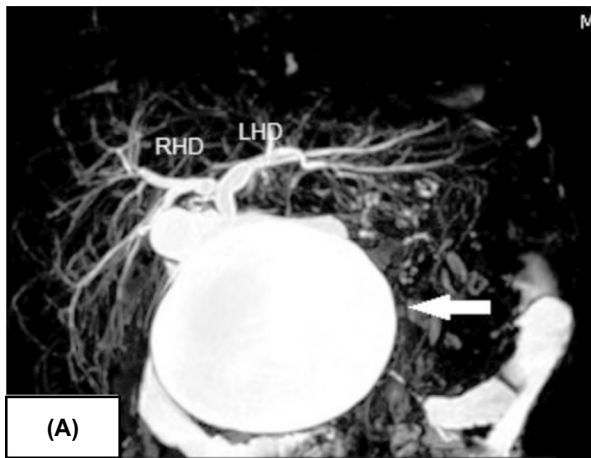


Fig. (1): A 15 month old female child with a history of abdominal pain and increase abdominal circumference, (A) 3D MRCP shows duodenal duplicated cyst, It seen markedly compressing the related 2 nd part of the duodenum and CBD, (B,C) Axial T2WI shows Dilated Intrahepatic biliary radicals. LHD=Left hepatic duct, RHD=Right hepatic duct.

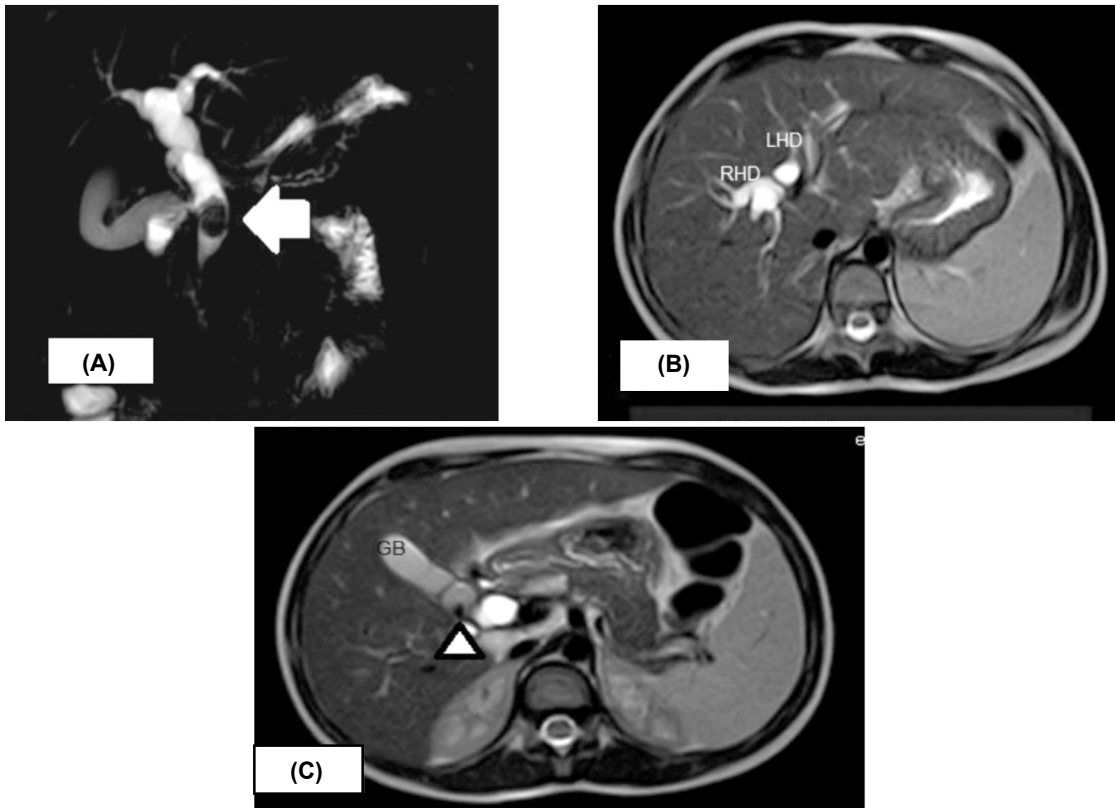


Fig. (2): A 10 years old female child with a history of abdominal pain and jaundice. (A) 3D MRCP shows intraluminal filling defect inside CBD just before the most distal attenuated segment (arrow). (B) Axial T2WI shows Dilated intra hepatic biliary system. (C) Axial T2WI shows with intraluminal filling defect (arrowhead).

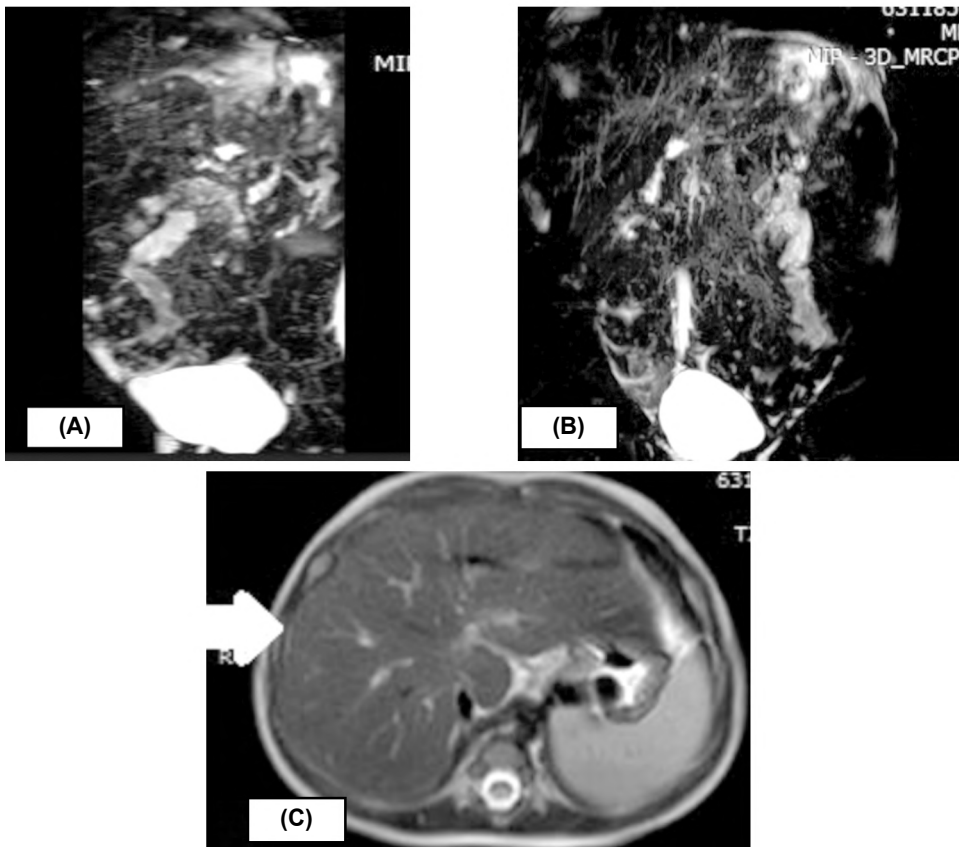


Fig. (3): A 9 month male child diagnosed with biliary atresia subjected to KASAI operation (A,B) 3D MRCP non visualized GB, non recognized intra and extra biliary system. (C) Axial T2WI shows Parenchymatous liver with early cirrhotic features.

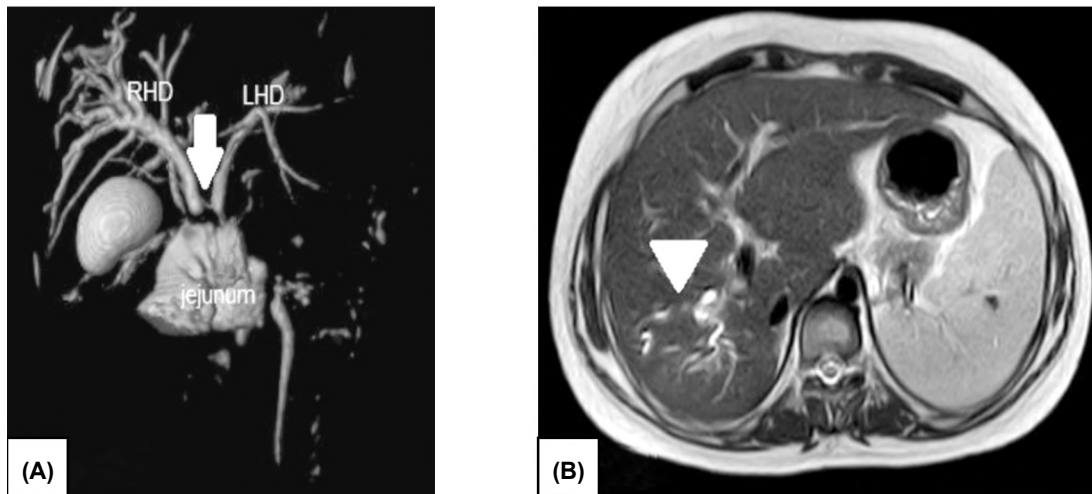


Fig. (4): A 17 years old female child with a history of autoimmune cholangitis, hepaticojejunostomy, cholecystectomy operations and multiple ERCP with biliary stents, which last one remove from one year ago. (A) 3D MRCP shows separate ultrashort stenotic segment connecting the right anterior, posterior and left main hepatic ducts with jejunum (white arrow). (B) Axial T2WI shows mild intrahepatic biliary radicals dilatation mainly involving right hepatic lobe with mild beading (arrow head).

### Discussion

Pancreaticobiliary disorders are being diagnosed with increasing frequency in children. This is probably as a result of a rise in predisposing risk factors for HPB (hepatopancreatic biliary) disease as well as improvements in the sensitivity and availability of diagnostic tools to detect these conditions. However, ERCP (endoscopic retrograde cholangiopancreatography) in this population continue to be performed relatively rarely, which may be due to a lack of awareness of the indications or limited local availability of advanced endoscopists who are able to perform these procedures in this population [11].

Magnetic resonance cholangiopancreatography (MRCP) is an extremely useful tool for evaluating a wide variety of disorders of the pancreaticobiliary system in pediatric patients of all ages, including neonates/infants, children, and adolescents [12].

The main aim of this study was to evaluate the role of MRCP in the diagnosis of pancreaticobiliary disease in pediatric age group.

This retrospective study was conducted at Ain-Shams University hospitals. The study involved 25 Children with clinically suspected pancreaticobiliary disease. The duration of the study ranged from 12 months.

Patients' age ranged between 9 months to 18 years with mean  $\pm$  SD=10.56 $\pm$ 5.01. The majority of them, 11 patients (44%), were between 6-10 years. In this study, 12 patients (48%), were males

and 13 (52%), were females with male to female ratio of 1:1.08.

However, in the study of Osman et al., [10] the thirty-four patients (20 females and 14 males) in their study series ranged in age from 1 month to 14 years (mean age: 6.2 years). In the study of Demirbaş et al., [13] out of 41 patients, 25 (61.0%) were female, and 16 (39.0%) were male. The mean age of the patients at the time of EUS application was 12.2 $\pm$ 4.2 years (range, 3.7-17.6 years), and these patients had a mean follow-up period of 21.3 months (range, 3-89 months).

The present study showed that the clinical manifestations varied but abdominal pain was the predominant presentation in 76% cases, followed by jaundice in 48% of cases then vomiting and fever in 16% and 4% respectively.

Our results were supported by the study performed by Demirbas et al., [13] as they reported that the most common clinical manifestations among their studied group was abdominal pain followed by jaundice.

However, in the study of Osman et al., [10] the clinical manifestations varied but jaundice was the predominant presentation.

The current study MRCP findings regarding the children pancreaticobiliary pathologies revealed that 7 cases (28%) had gall bladder stone, 5 cases (20%) had IHBRD and pancreatitis, 3 cases (12%) had choledochal cyst, 2 cases (8%) had pancreatic tear or injury and dilated common bile duct respec-

tively and one patient showed pancreatic divisum and duodenal cyst.

Our results were supported by the study of Osman et al., [10] as they reported that the majority of findings among their studied group was CBD stones with/without GB followed by Choledochal cysts and Calcular cholecystitis/GB stones. Arce-ment et al., [14] revealed that MRCP depicted abnormalities including stones, stricture, intraductal tumor, and extrinsic compression, all of which were confirmed at ERCP, PTC (two unsuccessful in patients with non-dilated ducts by MRCP), surgery, liver biopsy, and autopsy. In study of the Suzuki et al., [15] they reviewed MRCP findings in 33 children (ages 1 month to 18 years) diagnosed with choledochal cysts by CT or ultrasonography. MRCP findings were compared with intraoperative cholangiograms in 27 patients and ERCP in six. MRCP detected the choledochal cysts in all children. Detection rates of other associated anatomic anomalies (abnormal pancreatobiliary junction, stones, dilated pancreatic duct) were lower in children aged younger than 2 years compared with older children and in children with cystic versus fusiform common bile duct abnormalities.

Furthermore, our findings were in concordance with Nandan & Abhinay [12] that revealed in their 65 case study, Cholelithiasis was the most common cause with 21 cases (32.3%), choledocholithiasis was the second most common cause with 10 cases (15.4%), followed by stricture with 9 cases (13.8%), cholecystitis with 5 cases (7.7%), periampullary carcinoma with 2 cases (3.1 %), cholangiocarcinoma with 4 cases (6.2%), choledochal cyst and cholangitic abscess with 4 cases (6.2%) and 1 case (1.5%) respectively.

In our study, based on ERCP, operation finding and other modalities as a reference standard MRCP diagnosis accuracy was 100% in detecting chronic calcular cholecystitis, choledochal cyst, IHBRD, pancreatic cyst, dilated CBD and duodenal cyst. MRCP identified the etiology of pancreaticobiliary pathology in 22 patients (true positive cases) that were confirmed by ERCP, operation findings and other modalities. Three cases of different pathological entities (pancreatic divisum, dorsal agenesis with non-visualized tail of pancreas and pancreatic injury/tear) were detected by MRCP and not diagnosed by ultrasound modality. We found that MRCP had overall sensitivity, specificity, and diagnostic accuracy of 100%, 100% and 88% respectively in detecting the etiology of pancreaticobiliary diseases in our patients. Positive predictive value was 88% while the negative predictive value was 100%.

Our results were supported by the study of Osman et al., [10] as they reported that MRCP had overall diagnostic accuracy, sensitivity and specificity of 94.1%, 93.5% and 100% respectively in detecting the etiology of hepatopancreatic biliary disease in their patient series. Positive predictive value was 100% while the negative predictive value was 60%.

In the previous study, their false negative patients were found to have CBD stones at ERCP. The CBDs were dilated 5 and 6mm in those cases. Current literature states that the sensitivity of MRCP in detecting CBD stones decreases with bile duct dilatation [16]. Their result agrees with those of Hurter et al., [17] who studied the accuracy of MRCP compared with ERCP in the diagnosis of bile duct disorders and concluded that MRCP had sensitivity of 87% in detecting bile duct calculi.

Our findings supported by Tipnis and Werlin [2] cumulatively reviewed the literature for evaluating the role of MRCP in wide variety of hepatobiliary disorders in pediatric patients; they stated that in 10 studies, MRCP produced 134 true positive, 6 false positive, 63 true negative, and 18 false negative cases. Thus, the overall diagnostic accuracy, sensitivity and specificity of MRCP for hepatobiliary disease were 89%, 88% and 91% respectively. Positive predictive value was 96% and negative predictive value was 78%. Uhm et al., [18] studied the role of MRCP in differentiating hepatobiliary pathologies in 70 children. They declared that the overall diagnostic accuracy of MRCP was 97.1 %.

Over the past decade, MRCP has started to replace ERCP as the diagnostic study of choice for a variety of biliary and pancreatic conditions. Initially, MRCP was extremely limited in its diagnostic accuracy and used sparingly in extremely cooperative patients. The advent of respiratory trigger and non-breath holding techniques gradually enabled MRCP use in less cooperative patients, especially children. Concurrently, rapid imaging techniques including HASTE/single-shot FSE/single-shot turbo spin echo (TSE) decreased image acquisition time to 2-5s. Today, MRCP is utilized to study the biliary system in almost all populations [19].

According to Dillman et al., [4], they demonstrated that MRCP is moderately sensitive compared to ERCP in pediatric patients in a "real-life" clinical practice. Sensitivities were similar whether comparing our entire study population, patients undergoing MRCP for a biliary indication, or

patients undergoing MRCP for a pancreatic indication (73.5-76.8%). Positive predictive values also were similar despite the MRCP indication (78.3-84.9%). Unfortunately, their study cannot determine the specificity of MRCP, as MRCP is typically used as a screening test and many children with a normal (or negative) MRCP examination never undergo subsequent ERCP evaluation.

A small retrospective study by Tipnis et al., [20] in 32 children documented a higher sensitivity for MRCP than our study, with only one false-positive finding and no false-negative findings. However, in their study, only 15 individuals (less than half the study population) had correlative ERCP or other reference study. Another study by Delaney et al., [21] included 16 children that underwent both MRCP and ERCP, demonstrating MRCP-ERCP concordance in 13 of 16 (81%) individuals.

#### Conclusion:

In conclusion, based on own experience, MRCP is a fast, non-invasive method for diagnosing pancreatico-biliary disorders in children with high diagnostic accuracy, sensitivity and specificity. MRCP doesn't involve the use of ionizing radiation which is suitable for children. Thus, MRCP ought to be the standard diagnostic procedure in the future.

#### References

- 1- GOLDMAN M. and PRANIKOFF T.: Biliary disease in children. *Current gastroenterology reports*, 13 (2): 193-201, 2011.
- 2- TIPNIS N.A. and WERLIN S.L.: The use of magnetic resonance cholangiopancreatography in children. *Current gastroenterology reports*, 9 (3): 225-229, 2007.
- 3- CHENG C.-L., FOGEL E.L., SHERMAN S., MCHENRY L., WATKINS J.L., CROFFIE J.M. and SCHMIDT S.: Diagnostic and therapeutic endoscopic retrograde cholangiopancreatography in children: A large series report. *Journal of pediatric gastroenterology and nutrition*, 41 (4): 445-453, 2005.
- 4- DILLMAN J.R., PATEL R.M., LIN T.K., TOWBIN A.J. and TROUT A.T.: Diagnostic performance of magnetic resonance cholangiopancreatography (MRCP) versus endoscopic retrograde cholangiopancreatography (ERCP) in the pediatric population: A clinical effectiveness study. *Abdominal Radiology*, 44 (7): 2377-2383, 2019.
- 5- FITOZ S., ERDEN A. and BORUBAN S.: Magnetic resonance cholangiopancreatography of biliary system abnormalities in children. *Clinical Imaging*, 31 (2): 93-101, 2007.
- 6- SZARY N.M. and AL-KAWAS F.H.: Complications of endoscopic retrograde cholangiopancreatography: How to avoid and manage them. *Gastroenterology & hepatology*, 9 (8): 496-504, 2013.
- 7- PFAU P.R., CHELIMSKY G.G., KINNARD M.F., SIVAK Jr. M.V., WONG R.C., ISENBERG G.A. and CHAK A.: Endoscopic retrograde cholangiopancreatography in children and adolescents. *Journal of pediatric gastroenterology and nutrition*, 35 (5): 619-623, 2002.
- 8- SAITO T., TERUI K., MITSUNAGA T., NAKATA M. and YOSHIDA H.: Significance of imaging modalities for preoperative evaluation of the pancreaticobiliary system in surgery for pediatric choledochal cyst. *Journal of Hepato-Biliary-Pancreatic Sciences*, 23 (6): 347-352, 2016.
- 9- WANG C.L., DING H.Y., DAI Y., XIE T.T., LI Y.B., CHENG L. and NIE W.X.: Magnetic resonance cholangiopancreatography study of pancreaticobiliary maljunction and pancreaticobiliary diseases. *World J. Gastroenterol.*, 20 (22): 7005-7010, 2014.
- 10- OSMAN N.M., MOHAMMAD S.A. and KHALIL R.M.: Diagnostic benefit of MRCP in hepatopancreaticobiliary diseases in children. *The Egyptian Journal of Radiology and Nuclear Medicine*, 47 (1): 291-295, 2016.
- 11- SCHEERS I., ERGUN M., AOUATTAH T., PIESSEVAUX H., BORBATH I., STEPHENNE X. and DEPPEZ P.H.: Diagnostic and therapeutic roles of endoscopic ultrasound in pediatric pancreaticobiliary disorders. *Journal of pediatric gastroenterology and nutrition*, 61 (2): 238-247, 2015.
- 12- NANDAN KUMAR L.D. and ABHINAY A.C.: Role of Magnetic Resonance Cholangiopancreatography (MRCP) as a diagnostic aid in various Pancreaticobiliary tract pathologies. *International Journal of Health and Clinical Research*, 4 (5): 268-271, 2021.
- 13- DEMIRBAS F., KAYMAZLI M., ÇALTEPE G., ABBASGULIYEV H., KALAYCI A.G. and BEKTAS A.: Endoscopic Ultrasonography in Pediatric Patients with Pancreatobiliary Disease: Single-Center Trial. *Pediatric Gastroenterology, Hepatology & Nutrition*, 24 (2): 164-172, 2021.
- 14- ARCEMENT C.M., MEZA M.P., ARUMANLA S. and TOWBIN R.B.: MRCP in the evaluation of pancreaticobiliary disease in children. *Pediatric Radiology*, 31 (2): 92-97, 2001.
- 15- SUZUKI M., SHIMIZU T., KUDO T., SUZUKI R., OHTSUKA Y., YAMASHIRO Y. and YAMATAKA A.: Usefulness of Nonbreath-hold 1-Shot Magnetic Resonance Cholangiopancreatography for the Evaluation of Choledochal Cyst in Children. *Journal of Pediatric Gastroenterology and Nutrition*, 42 (5): 539-544, 2006.
- 16- JONG MOON J.H., CHO Y.D., CHA S.W., CHEON Y.K., AHN H.C., KIM Y.S. and KIM B.S.: The detection of bile duct stones in suspected biliary pancreatitis: Comparison of MRCP, ERCP, and intraductal US. *American Journal of Gastroenterology*, 100 (5): 1051-1057, 2005.
- 17- HURTER D., De VRIES C., POTGIETER P., BARRY R., BOTHA F. and JOUBERT G.: Accuracy of MRCP compared to ERCP in the diagnosis of bile duct disorders. *SA Journal of Radiology*, 12 (1): 14-22, 2008.
- 18- UHM J.H., LEE S.Y. and CHUNG K.S.: The usefulness of MRCP in the evaluation of pancreaticobiliary diseases in children *Korean J. Pediatr.*, 45 (11): pp. 1381-1388, 2002.

- 19- SCHAEFER J.F., KIRSCHNER H.-J., LICHY M., SCHLEMMER H.P., SCHICK F., CLAUSSEN C.D. and FUCHS J.: Highly resolved free-breathing magnetic resonance cholangiopancreatography in the diagnostic workup of pancreaticobiliary diseases in infants and young children-initial experiences. *Pediatric Surgery*, 41 (10): 1645-1651, 2006.
- 20- TIPNIS N.A., DUA K.S. and WERLIN S.L.: A retrospective assessment of magnetic resonance cholangiopancreatography in children. *Journal of pediatric gastroenterology and nutrition*, 46: 59-64, 2008.
- 21- DELANEY L., APPLGATE K.E., KARMAZYN B., AKISIK M.F. and JENNINGS S.G.: MR cholangiopancreatography in children: Feasibility, safety, and initial experience. *Pediatric Radiology*, 38 (1): 64-75, 2008.

## التصوير بالرنين المغناطيسي والرنين المغناطيسي على البنكرياس والقنوات المرارية في تقييم أمراض البنكرياس والقنوات المرارية لدى الأطفال

إن تصوير البنكرياس والقنوات الصفراوية بالرنين المغناطيسي حساس للغاية في الممارسة السريرية الواقعية للكشف عن تشوهات القنوات الصفراوية والبنكرياس لدى الأطفال. تظهر نتائجنا أن تصوير البنكرياس والقنوات الصفراوية بالرنين المغناطيسي يمكن أن يؤكد وجود العديد من أمراض البنكرياس الصفراوية. ومع ذلك، تظهر دراستنا أيضاً أن حالات تصوير البنكرياس والقنوات الصفراوية بالرنين المغناطيسي الإيجابية الكاذبة والسلبية الكاذبة شائعة في الممارسة السريرية، وأن هناك مجالاً لتحسين خصائص الأداء التشخيصي لهذا الفحص لدى الأطفال. تشمل الطرق المحتملة لتحسين التفسير الأداء التشخيصي لتصوير البنكرياس والقنوات الصفراوية بالرنين المغناطيسي للأطفال تعليماً إضافياً لأخصائي الأشعة وتقييم توافق تصوير البنكرياس والقنوات الصفراوية بالرنين المغناطيسي وتصوير البنكرياس والقنوات الصفراوية بالمنظار على مستوى القسم كمقياس جودة يسمح لأخصائي الأشعة بتحديد الأخطاء والتعلم منها.

في الختام، بناءً على التجربة الخاصة، يعد تصوير البنكرياس والقنوات الصفراوية بالرنين المغناطيسي طريقة سريعة وغير جراحية لتشخيص اضطرابات البنكرياس الصفراوية لدى الأطفال بدقة تشخيصية وحساسية وخصوصية عالية. لا يتضمن تصوير البنكرياس والقنوات الصفراوية بالرنين المغناطيسي استخدام الإشعاع المؤين المناسب للأطفال. وبالتالي، يجب أن يكون تصوير البنكرياس والقنوات الصفراوية بالرنين المغناطيسي هو الإجراء التشخيصي القياسي في المستقبل.