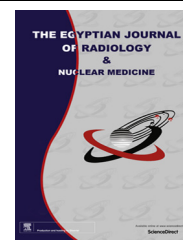




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ORIGINAL ARTICLE

Diagnostic benefit of MRCP in hepatopancreaticobiliary diseases in children



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KEYWORDS

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Abstract Objective: This study aimed at determination of the diagnostic benefit of MRCP as a noninvasive method to evaluate the hepatopancreaticobiliary disorders in children.

Materials and methods: The study retrospectively enrolled 34 patients undergoing MRCP for suspected hepatopancreaticobiliary abnormalities. MRCP findings were compared with other imaging modalities, ERCP or operative findings.

Results: MRCP had overall sensitivity, specificity, and diagnostic accuracy of 93.5%, 100% and 94.1% respectively in detecting the etiology of hepatopancreaticobiliary diseases in our patients. Positive predictive value was 100% while the negative predictive value was 62.5%.

Conclusion: MRCP is a fast, non-invasive method for diagnosing hepatopancreaticobiliary 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.

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1. Introduction

Today, Ultrasound (US) and magnetic resonance imaging (MRI) have become the preferred imaging modalities over computed tomography (CT) in imaging of the pediatric hepatobiliary and pancreatic systems (1).

Besides being noninvasive, MRI has the advantages of allowing detailed evaluation of the pancreaticobiliary tract

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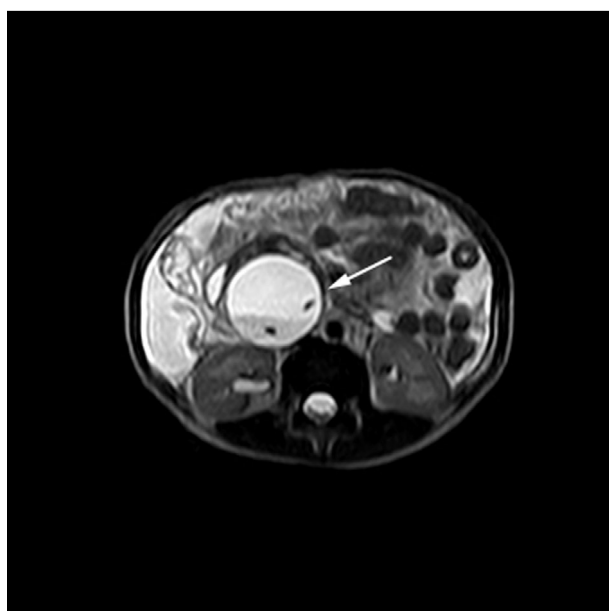
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with a large field of view (FOV) and excellent patient tolerance providing three-dimensional (3D) projection images like endoscopic retrograde cholangiopancreatography (ERCP). Thus, MRCP has virtually replaced ERCP as the primary investigative modality in all cases of obstructive jaundice not requiring early endoscopic intervention (2).

Given its success in adults, MRCP has begun to be used in children during the past decades; however, the pediatric literature to date consists mostly of case reports and a few serial studies focusing on particular clinical conditions. We therefore designed this study in a series of pediatric patients undergoing MRCP in order to assess the diagnostic benefit of MRCP in hepatopancreaticobiliary diseases in children.



(a)



(b)

Fig. 1 Four-year-old girl presented with jaundice and abdominal swelling. MRCP revealed huge cystic dilatation of the extrahepatic biliary system (choledochal cyst Todani type I) (arrow) (a). Axial T2WI shows multiple stones and mud are seen in its distal segment (arrow) (b).

2. Materials and methods

2.1. Patients

This study took place from January 2013 to June 2015 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 34 pediatric patients (16 males and 12

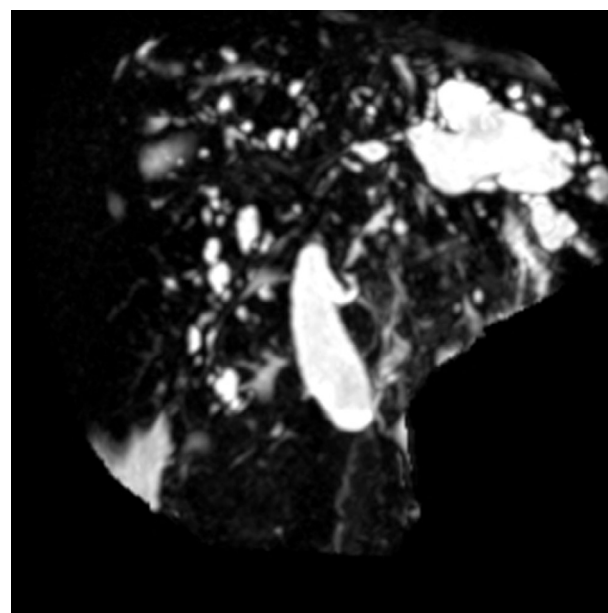


Fig. 2 Five-year-old girl presented with jaundice. MRCP shows innumerable scattered, peripheral and intrahepatic liver cystic lesions with high signal intensity. A case of Caroli disease.

females) who were part of diagnostic workup for clinically suspected hepatopancreaticobiliary 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, clay-colored stool, abdominal pain, and abdominal swelling (Table 1).

All patients were subjected to abdominal US as a primary imaging investigation. Eight patients had additional imaging studies; CT was done for 5 cases and HIDA isotope scan for 3 cases. Therapeutic ERCP was carried out for 3 cases. Upon MRCP findings, fourteen patients out of 34 were candidates for surgical intervention.

In our study, we compared the MRCP results with those of other imaging modalities; US in 9 cases, CT in 5 and isotope scan in 3 cases, ERCP in 3 cases or intraoperative findings in 14 cases. We reviewed the MRCP examinations of all patients in an attempt to display the benefit of MRCP in differentiating the different causes of hepatopancreaticobiliary pathologies in pediatrics and to find out its diagnostic accuracy.

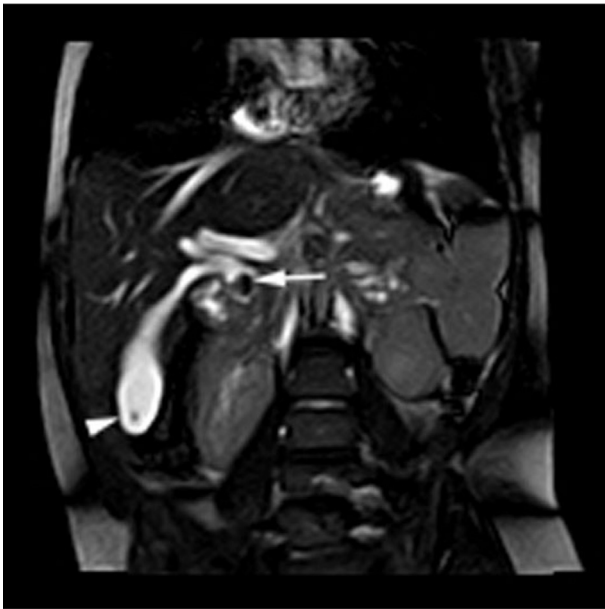
2.2. MRCP examination

2.2.1. MRCP technique

MRCP examinations were all performed with a 1.5 T Achieva; Philips Medical Systems, Eindhoven, The Netherlands, by using sense cardiac or sense body coil, depending on the body size of patients. MRCP was performed as follows: coronal 3D FSE HR MRCP sequence (TR/TE:1100-1300/650) slice thickness 1.2 mm and 320×256 matrix size, with MIP post-processing. 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, 80–100 ms; slice thickness, 4 mm. The whole



(a)



(b)

Fig. 3 Seven-year-old girl presented with jaundice and colicky abdominal pain. MRCP revealed dilatation of the intrahepatic and the proximal extrahepatic biliary radicles with abrupt obstruction (a). Coronal T2WI shows a stone within the proximal CBD (arrow), and another stone is seen in the GB (arrowhead).

examination lasted for 20–25 min. All images were acquired by use of breath-hold technique in the older children if possible. In children who could not hold their breath, 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. Patients fasted at least 6 h before the examination. Sedation with oral chloral hydrate at a dose of 40 mg/kg of body weight (maximum, 1 g) was used if the child was younger than 6 years or not able to cooperate

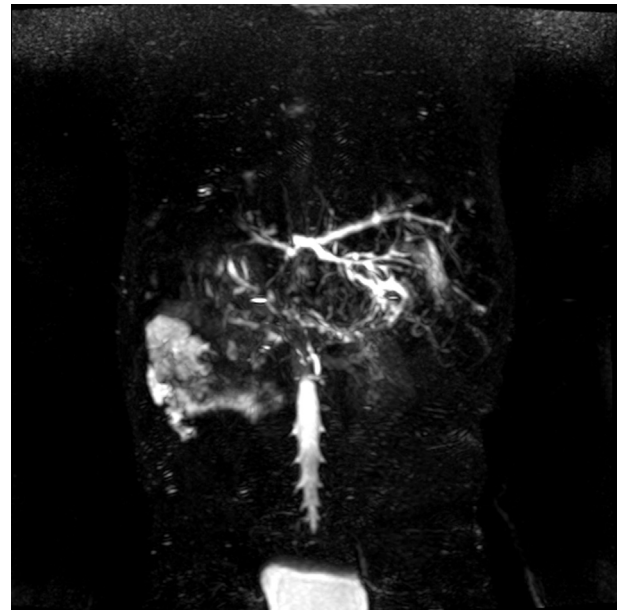


Fig. 4 Two-month male presented with jaundice. MRCP revealed non-visualization of the extrahepatic central biliary ducts and common bile duct. HIDA scan was positive for biliary atresia.

during the examination. In children older than 6 years pentobarbital (2–6 mg/kg, maximum 100 mg) was administered intravenously. Sedation was administered by an Anesthesiologist following the American Academy of Pediatrics guidelines (3). Vital signs were monitored during the sedation, and all the patients completed the examination smoothly, without any complications.

2.2.2. MRCP interpretation

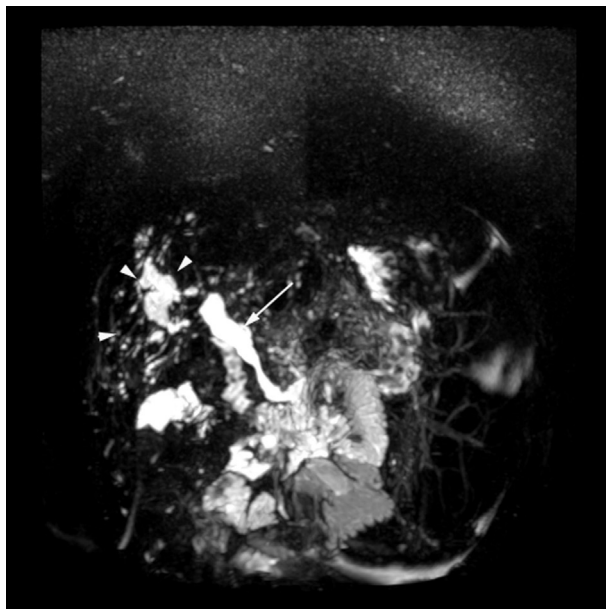
MRCP images were analyzed and reviewed blindly and independently by two pediatric radiology consultants of 10 years experience. They were blinded to any other radiological or non-radiological examination results.

2.3. Statistical analysis

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

3. Results

The thirty-four patients (20 females and 14 males) in our study series ranged in age from 1 month to 14 years (mean age: 6.2 years). The clinical manifestations varied but jaundice was the predominant presentation (Table 1). MRCP identified the etiology of hepatopancreaticobiliary pathology in 29 patients, all of whom were true positives (see Figs. 1–6). MRCP did not detect hepatopancreaticobiliary pathology in 5 patients of which only 3 were true negatives (Table 2). Patients with false negative MRCP results (2 cases) were found to have CBD stones by ERCP.



(a)



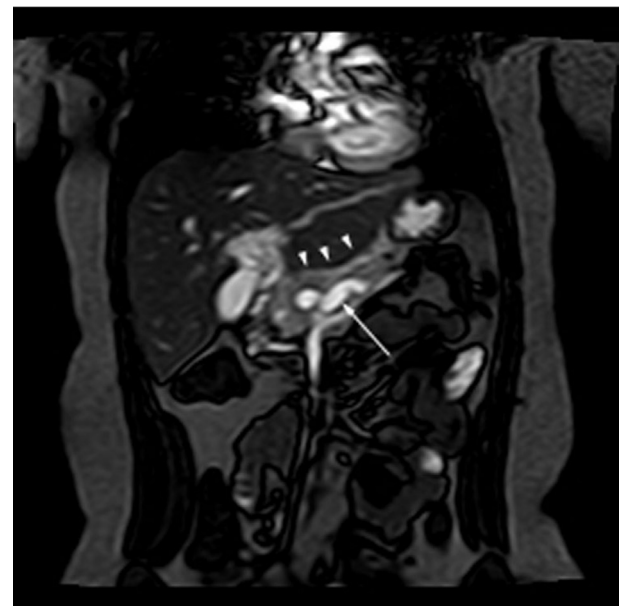
(b)

Fig. 5 Five-year-old boy with history of Kasai operation (portoenterostomy) (arrow) for biliary atresia, presented with acute abdominal pain. MRCP and coronal T2WI revealed segmental intrahepatic biliary radicles dilatations in hepatic segment VII with areas of cystic dilatation (arrowheads), and marked splenomegaly is also noted. Similar imaging findings were reported by CT. The case was regarded as ascending cholangitis.

In comparison with other imaging modalities, ERCP, or operative results, we found that MRCP had overall sensitivity, specificity, and diagnostic accuracy of 93.5%, 100% and 94.1% respectively in detecting the etiology of hepatopancreaticobiliary diseases in our patients. Positive predictive value was 100% while the negative predictive value was 60%.



(a)



(b)

Fig. 6 Eight-year-old boy presented with chronic abdominal pain and intermittent jaundice. MRCP shows dilated tortuous main pancreatic duct and abnormal side branches (arrow) (a). Coronal T2WI showing bulky pancreas with altered signals (arrowheads) and dilated tortuous pancreatic duct (arrow) (b). A case of chronic pancreatitis.

4. Discussion

Relatively few studies of good quality have evaluated MRCP in children, in part because of the relative rarity of such disorders in children. Most of publications studied MRCP exams in specific entities commonly the diagnosis of choledochal cysts and biliary atresia.

Table 1 Clinical manifestations of our patients' series (34 children).

Symptoms/signs	No. (%)
Jaundice	28(82.3%)
Clay colored stools	11(32.3%)
Abdominal pain/tenderness	7(20.6%)
Abdominal swelling	3(8.8%)

Table 2 Final diagnosis of 34 children undergoing MRCP.

Final diagnosis	No.
Choledochal cysts (Figs. 1 and 2)	4
CBD with/without GB stones (Fig. 3)	7
Biliary atresia (Fig. 4)	3
Calcular cholecystitis/GB stones	4
Acalculous cholecystitis	1
GB mucocele	1
Hepatic hydatid cysts	1
Postoperative biliary stricture	2
Postoperative ascending cholangitis (Fig. 5)	1
Pancreatic trauma	2
Pancreatitis (Fig. 6)	2
Negative pathology	3

Tipnis and Werlin (4) 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 positives, six false positives, 63 true negatives, and 18 false negatives. 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. (5) studied the role of MRCP in differentiating hepatobiliary pathologies in 70 children. They declared that the overall diagnostic accuracy of MRCP was 97.1%.

Our study concluded that MRCP had overall diagnostic accuracy, sensitivity and specificity of 94.1%, 93.5% and 100% respectively in detecting the etiology of hepatopancreaticobiliary disease in our patient series. Positive predictive value was 100% while the negative predictive value was 60%.

Our false negative patients were found to have CBD stones at ERCP. The CBDs were dilated 5 and 6 mm in those cases. Current literature states that the sensitivity of MRCP in detecting CBD stones decreases with bile duct dilatation (6). Our result agrees with those of Hurter et al. (7) 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.

Over the past decade, MRCP has started to replace ERCP as the diagnostic study of choice for a variety of biliary and pancreatic conditions (8,9). 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 (10). Concurrently, rapid imaging techniques including HASTE/single-shot FSE/single-shot turbo spin echo (TSE) decreased image acquisition time to 2–5 s. Today, MRCP is utilized to study the biliary system in almost all populations (8).

In conclusion, based on own experience, MRCP is a fast, non-invasive method for diagnosing hepatopancreaticobiliary 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.

Conflicts of interest and source of funding

None declared.

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