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BRIEF ARTICLE

Role of magnetic resonance cholangiopancreatography in diagnosing choledochal cysts: Case series and review

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Abstract

AIM: To determine the merits of magnetic resonance cholangiopancreatography (MRCP) as the primary diagnostic test for choledochal cysts (CC's).

METHODS: Between 2009 and 2012, patients who underwent MRCP for perioperative diagnosis were identified. Demographic information, clinical characteristics, and radiographic findings were recorded. MRCP results were compared with intraoperative findings. A PubMed search identified studies published between 1996-2012, employing MRCP as the primary preoperative imaging and comparing results with either endoscopic retrograde cholangiopancreatography (ERCP) or operative findings. Detection rates for CC's and abnormal pancreaticobiliary junction (APBJ) were calculated. In addition detection rates for clinically related biliary pathology like choledocholithiasis and cholangiocarcinomas in patients diagnosed with CC's were also evaluated.

RESULTS: Eight patients were identified with CC's. Six patients out of them had type Ⅳ CC's, 1 had type I and 1 had a new variant of choledochal cyst with confluent dilatation of the common bile duct (CBD) and cystic duct. Seven patients had an APBJ and 3 of those had a long common-channel. Gallstones were found in 2 patients, 1 had a CBD stone, and 1 pancreatic-duct stone was also detected. In all cases, MRCP successfully identified the type of CC's, as well as APBJ with ductal stones. From analyzing the literature, we found that MRCP has 96%-100% detection rate for CC's. Additionally, we found that the range for sensitivity, specificity, and diagnostic accuracy was 53%-100%, 90%-100% and 56%-100% in diagnosing APBJ. MRCP's detection rate was 100% for choledocholithiasis and 87% for cholangiocarcinomas with concurrent CC's.

CONCLUSION: After initial ultrasound and computed tomography scan, MRCP should be the next diagnostic test in both adult and pediatric patients. ERCP should be reserved for patients where therapeutic intervention is needed.

Key words: Magnetic resonance cholangiopancreatography; Choledochal cyst; Abnormal pancreaticobiliary junction; Diagnostic test; Choledocholithiasis; Cholangiocarcinomas

Core tip: Magnetic resonance cholangiopancreatography (MRCP) is used as primary diagnostic approach in various biliary pathologies. This is the first literature review of published studies discussing MRCP as a diagnostic modality for choledochal cysts. This review further outlines how recent imaging techniques have improved diagnostic accuracy of MRCP in diagnosing choledochal cysts and their associated anatomic variants. Advantages, disadvantages and contraindication for MRCP with respect to endoscopic retrograde cholangiopancreatography are also discussed.

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INTRODUCTION

Choledochal cysts (CC's) are congenital cystic, fusiform dilatations of extrahepatic or intrahepatic bile ducts. The anatomy of choledochal cyst disease was first described by Vater[1], and Alonso-Lej *et al*[2] categorized three types of choledochal cysts. This was later modified by Todani to the five cyst categories that are in use today. Choledochal cysts estimated prevalence in Western countries varies between 1:100000-150000, although it is higher in Asia[3,4]. Choledochal cysts occur preferentially in females (75%-80%) and younger patients, with 80% of cases are diagnosed before the age of 10[4].

Choledochal cysts carry a long-term burden of morbidity and potential mortality. Choledocholithiasis, recurrent cholangitis, pancreatitis, biliary cirrhosis, biliary strictures, liver abscess, portal hypertension, pancreatic stones, cyst rupture, and portal aneurysm, are all well-recognized complications[4-10]. A ductal anomaly with an unresected choledochal cyst remnant is believed to have a considerable risk for developing cholangiocarcinoma[11-14]. Therefore, the optimal treatment is total surgical excision and possible biliary diversion[15-17].

Operative intervention requires careful attention to anatomic detail. Choledochal cysts are frequently associated with anatomic variants, which have pathologic and surgical implications. Patients with an anomalous pancreaticobiliary junction (APBJ) are at increased risk for cholangiocarcinoma or gall bladder carcinoma[18-21]. Attendant stones within the biliary tree may further complicate resection and repair. Delineating precise anatomic detail enables surgeons to carefully plan their procedure while preventing complications.

Proper imaging plays an essential role in preoperative planning. Ultrasonography, computed tomography (CT) and radionuclide scintigraphy may be used initially for diagnosis. However, these techniques are inadequate for delineating the exact pathologic anatomy, APBJ and, duct stones, or concomitant carcinoma. Surgeons have traditionally turned to endoscopic retrograde cholangiopancreatography (ERCP) to visualize biliary anatomy in sufficient detail[16-17,22]. However, ERCP is not without risk, and known complications include cholangitis, duodenal perforation, hemorrhage, contrast allergy, biliary sepsis, and pancreatitis. In the past few years, magnetic resonance cholangiopancreatography (MRCP) has received increasing attention as a less invasive option.

This study presents our institution's experience with choledochal cysts where MRCP was used as the major preoperative diagnostic approach. In addition, a literature review was performed on existing published studies. The purpose of this study is to determine whether MRCP may be used as the primary pre-operative imaging modality in patients with choledochal cysts.

MATERIALS AND METHODS

Patients

From January 2009 to July 2012, all patients at our institution in whom MRCP was used to diagnose and classify the choledochal cysts were identified. Demographic information, clinical characteristics, and imaging details, and operative reports were collected for each patient. MRCP results were compared with intraoperative findings. ERCP's if done, were also included and compared to the MRCP results.

Imaging techniques

Four commercially available MR imagers were used [Siemens 1.5-T Magnetom (Avanto), Siemens Magnetom 1.5 T (Symphony), Siemens Magnetom 1.5 T (Sonata), and Siemens 3-T Magnetom (Trio)]. MRCP imaging was performed using T2 weighted half-fourier acquisition single-shot turbo spin-echo (HASTE) sequences. Abnormal pancreaticobiliary ductal junction was diagnosed when the union between the common bile duct and pancreatic duct was located far from the duodenum and the length of common channel exceeded 15 mm in adults and more than 5 mm in pediatric patients.

All images were obtained using breath holding techniques except in one patient where non-breath-holding method (with respiratory triggering) was used. We obtained both sequential multislice imaging followed by maximum-intensity projection (MIP) reconstruction and single slice projection images.

Image review

The MRCP images were reviewed by a trained radiologist, with substantial experience reading MRCPs. The radiologist had no knowledge of the patients' presentation or clinical data. Relevant findings included pancreaticobiliary junction, common channel, and pancreatic duct location, choledochal cyst type and characterization, and additional gallbladder pathology. All MRCP findings were compared with intraoperative and ERCP findings. However, secretin stimulation test was not performed at our center.

Literature review criteria

The English language literature was searched to identify relevant studies. PubMed, Google Scholar and Scopus, were searched using the keywords "MRCP" and "choledochal cyst". Reference lists of all retrieved articles were further reviewed, and inclusion/exclusion criteria were applied to identify the potentially relevant studies. Studies were included that had a minimum of 5 patients in whom MRCP was used as a diagnostic tool and findings were compared to ERCP or surgery. Smaller case series were excluded, as is consistent with previously published

Table 1 Demographics, physical exam, abdominal ultrasound, computed tomography scan, magnetic resonance cholangiopancreatography, endoscopic retrograde cholangiopancreatography and intraoperative findings for each subject

Patient/age (yr)/sex	Abdominal pain RUQ/epigastric	Ultrasound	CT abdomen	MRCP	Intraoperative/ERCP results
1/16/F	Yes	Intrahepatic biliary dilatation, cystic mass from porta hepatis to pancreatic head	Cyst extending from pancreatichead to anterior hepatic area	Type Ⅳ CC Positive APBJ	Type Ⅳ CC Positive APBJ
2/6/F	Yes	Saccular dilatation of CBD	Not done	Type Ⅳ CC Positive APBJ	Type Ⅳ CC Positive APBJ
3/74/F	Yes	Dilated cystic structure in CBD, choledocholithiasis	Dilated cystic structure in CBD, choledocholithiasis	Type Ⅳ CC Long common channel, CBD stones	Type Ⅳ CC Long common channel, CBD stones
4/47/M	Yes	Dilated CBD	Not done	Type Ⅳ CC, positive APBJ, cholelithiasis	Type Ⅳ CC, positive APBJ, cholelithiasis
5/30/F	Yes	Not done	Not done	Type Ⅳ CC Long common channel	Type Ⅳ CC Long common channel
6/69/F	Yes	Dilated CBD	Not done	Type Ⅳ CC	Type Ⅳ CC
7/58/M	Yes	Dilated CBD, distended gall bladder wall	Dilated CBD, distended gall bladder wall	New variant (dilated CBD and dilated cystic duct), long common channel	New variant (dilated CBD and dilated cystic duct), long common channel
8/49/M	Yes	Not done	Not done	Type Ⅰ CC, positive APBJ, pancreatic duct stone,cholelithiasis	Type Ⅰ CC, positive APBJ, pancreatic duct stone, cholelithiasis

F: Female; M: Male; RUQ: Right upper quadrant; CBD: Common bile duct; CT: Computerized tomography; MRCP: Magnetic resonance cholangiopancreatography; ERCP: Endoscopic retrograde cholangiopancreatography; CC: Choledochal cyst; APBJ: Abnormal pancreaticobiliary junction.

peer-reviewed data[23,24].

This study was approved by the local institutional review board.

RESULTS

Eight patients from our institution were included in the initial part of the study. The patients ranged in age from 6 years to 74 years old, and 5 were females. Table 1 summarizes demographics, symptoms, initial imaging results, MRCP and subsequent surgical findings.

Types of choledochal cyst

Subsequently, the patients underwent MRCP as their primary preoperative diagnostic study. Six patients had type Ⅳ and 1 patient had type Ⅰ according to the Todani classification scheme[25]. One patient had a new variant of choledochal cyst with confluent dilatation of the CBD and cystic duct. In every case except for one, ultrasound (US) and CT findings were the same as those seen on MRCP. Patient 3 was found to have type Ⅰ cyst on US, but was shown to have type Ⅳ on MRCP. All MRCP reads were confirmed intraoperatively.

APBJ

Seven of the patients had APBJ. Three patients had long common channel, while four were classified based on their acute angle of union. MRCP also detected gallbladder stones in 2 patients, a CBD stone in 1 patient and a pancreatic duct stone in one patient. All findings were later confirmed surgically except in a patient with choledocholithiasis where ERCP was also done (Figures 1-4).

Surgical techniques

Surgical resection of choledochal cysts was performed in all the patients. The types of resection were choledochal cyst excision with roux-en-y hepaticojejunostomy, cyst excision with Hutson-Russell loop, and hepatic segmentectomy and cholecystectomy with roux-en-y hepaticojejunostomy.

DISCUSSION

MRCP is a relatively recent addition to the surgeon's diagnostic armamentarium. Initially, MRCP images were reported with gradient-echo balanced steady-state free precision technique to study biliary obstruction[26-28]. Subsequently, various sequences including fast spin-echo (FSE) pulse, rapid acquisition with rapid enhancement, HASTE and fast-recovery fast spin echo have been used to improve spatial resolution and hasten acquisition times[29-32]. Breath-hold and non-breath-hold techniques were employed, as were two-dimensional (2D) and three-dimensional (3D) acquisition[33,34].

MRCP vs ERCP

Over the past decade, MRCP has started to replace ERCP as the diagnostic study of choice for a variety of biliary and pancreatic conditions[35-41]. Specifically, MRCP has been reported to have similar diagnostic accuracy for extrahepatic biliary diseases such as choledocholithiasis and biliary malignancies[40,42]. A similar trend is notable with respect to choledochal cysts. 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

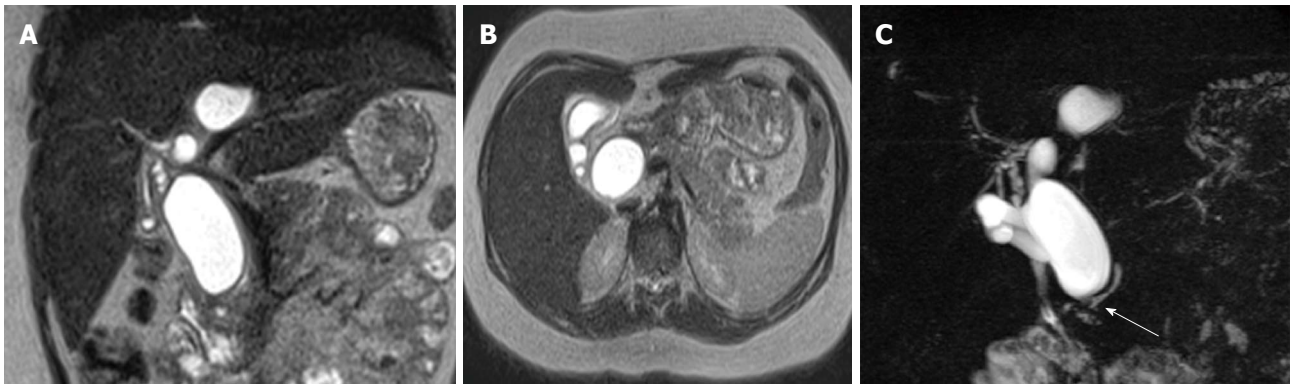

Figure 1 Sixty-year-old female. A, B: Coronal and axial T2 weighted half-fourier acquisition single-shot turbo spin-echo images show a type IV Choledochal cyst; C: Thin-slice magnetic resonance cholangiopancreatography sequence demonstrates the anomalous union of pancreaticobiliary duct (arrow).

Table 2 Contrasts, relative disadvantages, and contraindications for magnetic resonance cholangiopancreatography, endoscopic retrograde cholangiopancreatography

MRCP	ERCP
Highlight any structure with static fluid	Requires opacification with injected contrast media
Noninvasive so safe esp. in children and pregnant patients	Invasive
Lower cost, faster	20% more expensive than MRCP
No sedation except in few patients	Sedation required
Delineate structures proximal to obstruction.	May fail in patients because of possible tight stricture
No therapeutic intervention	Therapeutic intervention possible
Doesnot use iodine-based com pounds	Requires iodine-based compound usage
Disadvantages	
Duct images obscured by other fluid structures	Risk of pancreatitis
(renal cysts, ascites, pseudocyst)	Intraluminal bleeding
Image artifacts from stents, clips, *etc.*	Duodenal perforation
	Bile leaks
	Stent migration
Contraindications	
Claustrophobic patient	Patient with previous biliary or gastric surgery
Patients with ferromagnetic implants	Patients with high risk profile for general anesthesia

MRCP: Magnetic resonance cholangiopancreatography; ERCP: Endoscopic retrograde cholangiopancreatography.

gradually enabled MRCP use in less cooperative patients, especially children[43-46]. 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[47,48].

ERCP is the definitive diagnostic method for evaluating choledochal cysts and ABPJ, but the procedure comes with inherent risks (Table 2). ERCP is invasive and requires sedation in all patients. For pediatric patients and those with low respiratory reserve, general anesthesia is required. Morbidity from ERCP ranges from 2%-8% in children and 1%-2% in adults, which rises to

Figure 2 Forty nine-year-old male. Maximum intensity projection reconstruction of thin-slice magnetic resonance cholangiopancreatography half-fourier acquisition single-shot turbo spin-echo images demonstrates a choledochal cyst type IV. Note the anomalous union of the pancreaticobiliary duct (black arrow) and the presence of a small stones in the pancreatic duct (arrows).

10% when combined with sphincterotomy, and mortality estimates is estimated between 0.05%-0.90%[42,49-53]. Cholangitis, duodenal perforation, hemorrhage, contrast allergy, biliary sepsis, and pancreatitis are all recognized complications. Even without untoward complications, complete pancreatico-biliary opacification fails in 5%-30% of patients[54]. Incompletely visualizing the pancreaticobiliary duct union, or potentially missing a small CBD stone or cancer can impact operative intervention and results. Hence, the interest in the MRCP as a less invasive, less morbid diagnostic and preoperative modality has increased.

Literature review

A total of 19 published studies including our case-series on adult and pediatric patients met criteria for inclusion in the review. The study populations and methodologies did vary somewhat. While ten studies were devoted to children exclusively, nine case-series evaluated MRCP in all ages. Fourteen studies were retrospective, and five were prospectively designed. Since the studies spanned a 17-year period, the MRCP technology has evolved, and a range of image acquisition techniques were employed. However, all studies compared and rated MRCP findings

Table 3 Ability of magnetic resonance cholangiopancreatography to determine the presence of choledochal cysts in previous studies

Ref.	Total No. of Pts.	Enrollment	Blinding	Total with CC[1]	CC detected	Not detected
Hirohashi *et al*[47]	10	Retrospective	Not stated	5	5	0
Sugiyama *et al*[22]	11	Prospective	Unblinded	7	7	0
Chan *et al*[44]	11	Retrospective	Not stated	6	6	0
Irie *et al*[56]	16	Retrospective	Blinded	16	16	0
Matos *et al*[57]	8	Prospective	Blinded	8	8	0
Govil *et al*[58]	9	Retrospective	Not stated	9	9	0
Miyazaki *et al*[43]	6	Prospective	Blinded	6	6	0
Frampas *et al*[54]	5	Retrospective	Not stated	5	5	0
Shimuzu *et al*[59]	16	Prospective	Blinded	7	7	0
Tang *et al*[77]	10	Prospective	Not stated	10	10	0
Kim *et al*[60]	20	Retrospective	Blinded	20	20	0
Park *et al*[55]	72	Retrospective	Blinded	72	69	3
Suzuki *et al*[61]	33	Retrospective	Blinded	32	32	0
Fitoz *et al*[62]	23	Retrospective	Blinded	5	5	0
Huang *et al*[63]	60	Retrospective	Unblinded	22	22	0
Saito *et al*[64]	16	Retrospective	Blinded	16	16	0
Michaelides *et al*[65]	6	Retrospective	Not stated	6	6	0
De Angelis *et al*[66]	28	Retrospective	Not stated	15	15	0
Sacher *et al*	8	Retrospective	Blinded	8	8	0

[1]As determined by intraoperative/endoscopic retrograde cholangiopancreatography findings. CC detected: Choledochal cyst detected by magnetic resonance cholangiopancreatography.

Table 4 Ability of magnetic resonance cholangiopancreatography to determine the presence of an abnormal pancreaticobiliary junction in previous studies and various magnetic resonance cholangiopancreatography sequences stated in the previous studies

Ref.	Patients with CC	True positives	True negatives	False positives	False negatives	MRI sequences
Hirohashi *et al*[47]	5	4	0	0	1	HASTE
Sugiyama *et al*[22]	7	5	0	0	2	HASTE
Chan *et al*[44]	6	0	4	0	2	2D TSE
Irie *et al*[56]	16	10	1	0	5	HASTE
Matos *et al*[57]	8	6	2	0	0	SSTSE
Miyazaki *et al*[43]	6	2	3	0	1	HASTE
Frampas *et al*[54]	5	1	4	0	0	HASTE
Shimuzu *et al*[59]	7	6	0	0	1	HASTE
Tang *et al*[77]	10	6	2	0	2	HASTE
Kim *et al*[60]	20	12	3	0	5	SSFSE
Park *et al*[55]	72	34	28	3	7	HASTE
Suzuki *et al*[61]	32	16	2	0	14	HASTE
Fitoz *et al*[62]	5	1	4	0	0	SSFSE
Saito *et al*[64]	16	9	2	0	5	3D SSTSE
Sacher *et al*	8	7	1	0	0	HASTE

CC: Choledochal cyst; MRI: Magnetic resonance imaging; HASTE: Half-fourier acquisition single-shot turbo spin-echo (Siemens); SSFSE: Single-shot fast spin echo (GE Medical systems); SSTSE: Single-shot turbo spin echo (Philips); 2D TSE: 2 dimensional turbo spin echo; 3D SSTSE: 3 dimensional single shot turbo spin echo.

with at least one more established diagnostic modality.

Detection rate for choledochal cyst

MRCP demonstrated excellent overall detection rate for choledochal cysts, albeit with some specific limitations. Out of 368 patients (age range 6 d-78 years old), the range for choledochal cyst detection rate was 96%-100% (Table 3). Of note, all 3 false negatives were reported in a single study[55] with all 3 undetected cases being exclusively type Ⅲ, choledochocele. Only 10 of the 19 studies specified the choledochal cysts' Todani classification[25]. Range for detection rates was 81%-100% for type Ⅰ, 100% for type Ⅱ, 84%-100% for type Ⅳ, and 100% for type Ⅴ. Type Ⅲ' slower detection rate was reported only in one study (73%)[55] is likely due to its location near the ampulla, and perhaps because a small choledochocele may become evident only when contrast medium is injected under pressure[67]. Kamisawa *et al*[68] also suggested the use of 3 dimensional MRCP and dynamic MRCP with secretin stimulation for congenital pancreaticobiliary malformations especially choledochocele.

APBJ detection

Our review also assessed MRCP's ability to detect APBJ in the setting of a choledochal cyst (Table 4). Fifteen studies provided information about APBJ detection, providing a total of 223 cases. MRCP diagnosis of APBJ yielded a sensitivity of 53%-100%, specificity of 90%-100%, and

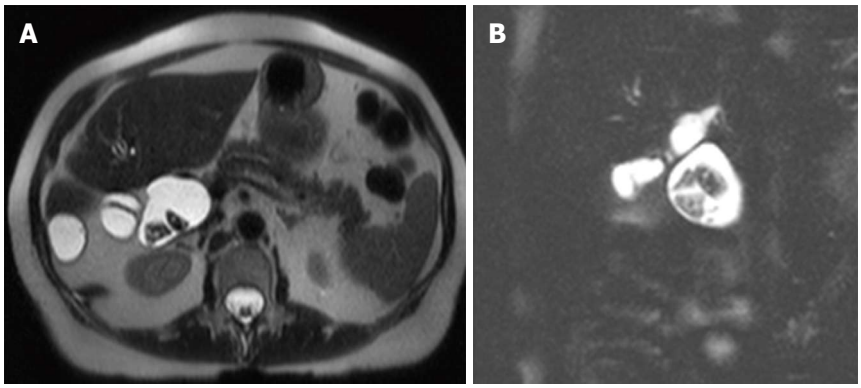

Figure 3 Seventy four-year-old female. Axial and coronal T2 weighted half-fourier acquisition single-shot turbo spin-echo images showing type IV choledochal cyst with multiple stones in the lumen.

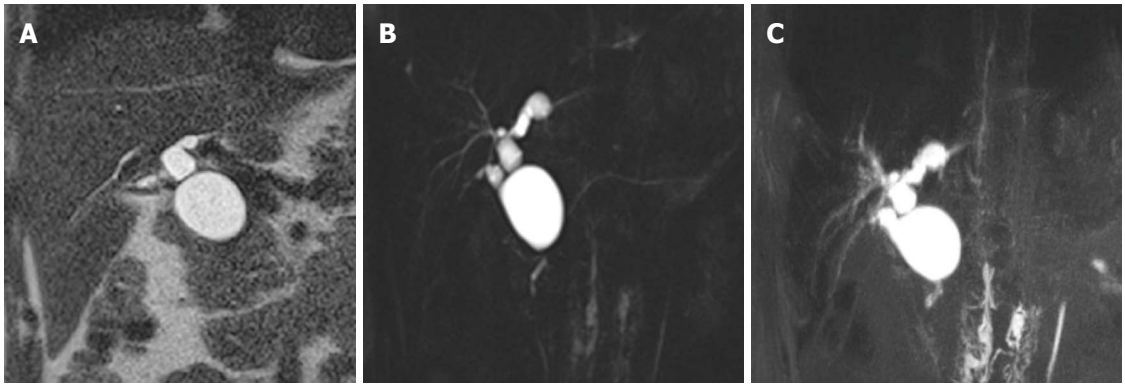

Figure 4 Forty seven-year-old male. A, B: Coronal T2 weighted half-fourier acquisition single-shot turbo spin-echo image and thick-slice magnetic resonance cholangiopancreatography sequence; C: Maximum intensity projection reconstruction demonstrate a choledochal cyst type IV.

Table 5 Ability of magnetic resonance cholangiopancreatography to detect choledocholithiasis in previous studies

Ref.	Choledocholithiasis detected by MRCP	Choledocholithiasis detected by all means
Hirohashi *et al*[47]	4	4
Sugiyama *et al*[22]	1	2
Irie *et al*[56]	0	2
Matos *et al*[57]	2	2
Govil *et al*[58]	3	3
Frampas *et al*[54]	3	3
Kim *et al*[60]	8	8
Park *et al*[55]	8	8
Suzuki *et al*[61]	10	13
Sacher *et al*	1	1

MRCP: Magnetic resonance cholangiopancreatography.

overall diagnostic accuracy of 56%-100%. In contrast, ERCP has been reported with sensitivity and specificity > 90% for diagnosing APBJ[11]. Possible explanations for these differences variation include the broad range of patient ages and heterogeneous imaging techniques used across studies. Choledochal cyst size and concurrent impacted stones may limit MRCP's sensitivity[48,56]. Furthermore, MRCP does not distend the bile ducts, leading to a suboptimal representation of the pancreaticobiliary junction[69]. Newer imaging sequences, such as secretin-enhanced MRCP[56,70], 3D SSFSE[39], HASTE sequence single-slice, and MIP images[31,71], all have increased diagnostic accuracy in adults and pediatric patients.

Choledocholithiasis and cholangiocarcinoma detection

Choledochal cysts and ABPJ aside, we also evaluated MRCP's ability to visualize clinically related biliary pathology in patients diagnosed with CC's. MRCP detected choledocholithiasis in nearly all studies (Table 5), and 87% (13/15) of reported cholangiocarcinomas in this cohort[55]. MRCP images are helpful when detecting cholangiocarcinomas because they display periductal anatomy, a critical element in surgical decision-making[55,72]. Previous studies support using MRCP for this purpose[40,56,73]. Irie *et al*[56] recommended MRCP axial plane images in detecting concurrent choledocholithiasis, especially in the common channel. Following cyst excision, MRCP may also play a role in surveillance for the subsequent development of cholangiocarcinoma[74-77].

This study is subject to certain limitations. First, the cases presented represent a small number of patients from our local institution, and they were treated according to our own practices and protocols. They may not represent other patients in other institution. Moreover, some caution is necessary in interpreting findings from our literature review. The studies that were included span

15 years, employing different designs, techniques, and gold standards as imaging and detection protocols have evolved. Due to those improvements, contemporary detection rates are possibly higher than what our cumulative data indicates.

In conclusion, our retrospective study and review of relevant literature suggest that MRCP is as effective as an initial pre-operative diagnostic study for choledochal cysts in adult and pediatric populations. In addition, MRCP is equivalent to ERCP in determining choledochal cyst type, and helpful in diagnosing related pancreaticobiliary anomalies, such as ABPJ, cholangiocarcinoma, and choledocholithiasis. Given its relatively moderate risk profile and lower cost, MRCP should be the diagnostic test of choice when pre-operatively evaluating choledochal cysts and their associated anomalies. But more evaluation needs to be done to assess the MRCP ability to detect APBJ and choledochocele. ERCP should be used when MRCP inadequately visualizes the terminal CBD or the pancreaticobiliary duct junction, or when a therapeutic procedure is anticipated.

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COMMENTS

Background

Choledochal cysts carry a long term morbidity and mortality. Choledochal cysts are frequently associated with various anatomic variants that carry considerable risk of complications such as cholangiocarcinoma. Therefore outlining these anatomic details are critical in order to help surgeons plan their operations and prevent complications.

Research frontiers

Various techniques like ultrasound, computed tomography, radionuclide scintigraphy and endoscopic retrograde cholangiopancreatography (ERCP) are used to visualize choledochal cyst and their anatomic variants. However magnetic resonance cholangiopancreatography (MRCP) has received increasing attention as the primary diagnostic study. This study presents our institution's experience using MRCP to diagnose choledochal cysts. A literature review on the topic accompanies the results.

Innovations and breakthroughs

This is the first study which review the literature from past 16 years explaining MRCP as primary diagnostic approach in adult and pediatric patients for choledochal cysts. Authors report the advancement of MRCP with time. It shows how newer imaging techniques have improved diagnostic accuracy of MRCP.

Applications

MRCP being lower cost and noninvasive should be diagnostic test of choice used pre-operatively for choledochal cysts and their associated anomalies. ERCP should be used when MRCP inadequately visualizes the terminal common bile duct or the pancreaticobiliary junction or when a therapeutic procedure is needed.

Terminology

Half-fourier acquisition single-shot turbo spin-echo (HASTE) refers to a rapid magnetic resonance imaging protocol with an image acquisition time of 2-5 s. HASTE has increased the diagnostic accuracy of MRCP in both adult and pediatric patients.

Peer review

This article deals with new diagnostic approach for choledochal cysts. The results are interesting and suggest that after initial ultrasound and computed tomography scan, MRCP should be the next diagnostic test in both adult and pediatric patients. ERCP should be reserved for patients where therapeutic intervention is needed.

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