Original Research Article

Role of Magnetic Resonance Cholangiopancreatography (MRCP) as a diagnostic aid in various Pancreaticobiliary tract pathologies

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Abstract

Introduction: MRCP (Magnetic Resonance Cholangiopancreatography) has rapidly gained ground and has now firmly established its role in the evaluation of the biliary and pancreatic ducts. It often aids in the assessment of causes of biliary obstruction and can be helpful in the evaluation of the pancreatic duct without the inherent invasiveness of an endoscopic procedure.**Material and Methods:** This is a prospective, observational and descriptive study conducted in the Department of Radiodiagnosis, Subbaiah Institute of Medical Sciences and a tertiary care hospital over a period of 1 year. The patients presented with one or more of the following signs and symptoms: jaundice, acute or intermittent biliary colic with or without fever and postoperative or post-traumatic complaints. Few patients were assessed preoperatively as being living donors for hepatic transplantation. **Result:** In the present study, a total of 65 patients were included out of which 41 (63.0%) were males and 24 (36.9%) were females. In our study, most of the patients were 51-70 years i.e., 36 out of 65 (55.4%), followed by 31-50 years, i.e., 19 out of 65 (29.2%). In our 65 cases, Cholelithiasis was the most common cause with 21 (32.3%) cases, choledocholithiasis was the second most common cause with 10 (15.4%) cases, followed by stricture with 9 (13.8%) cases, cholecystitis with 5 (7.7%) cases, periampullary carcinoma with 2 (3.1%) cases, cholangiocarcinoma with 4 (6.2%) cases, choledochal cyst and cholangitic abscess with 4 (6.2%) cases and 1 (1.5%) case respectively. **Conclusion:** Our study confirms that MRCP, a non-invasive, non-ionizing procedure and well tolerated imaging technique is of immense value in aiding the diagnosis of various Pancreaticobiliary tract pathologies.

Key words: Magnetic Resonance Cholangiopancreatography, Pancreaticobiliary tract, Cholecystitis.

Introduction

It has been two decades since Magnetic Resonance Cholangiopancreatography (MRCP) was first described. [1] Over this time, the technique has evolved considerably, aided by improvements in spatial resolution and speed of acquisition. It has now established a role in the investigation of many biliary disorders, serving as a non-invasive alternative to Endoscopic Retrograde Cholangiopa ncreatography (ERCP). It makes use of heavily T2-weighted pulse sequences, thus exploiting the inherent differences in the T2-weighted contrast between stationary fluid-filled structures in the abdomen (which have a long T2 relaxation time) and adjacent soft tissue (which has a much shorter T2 relaxation time), hence static or slow-moving fluids within the biliary tree and pancreatic duct show high signal intensity on MRCP, whilst surrounding tissue show low signal intensity. [2]

MRCP is an application of Magnetic Resonance Imaging (MRI) that can provide both high quality cross -sectional images of ductal structures and projectional (coronal) images of the biliary tree and pancreatic duct. Unlike ERCP, MRCP is non-invasive and the images are obtained without administration of oral or intravenous contrast agents. A first approach towards projection cholangiography in biliary tract dilatation by Magnetic Resonance Imaging was published by Wallaner et al. in 1991. [3] It was then followed by Morimoto et al. and Hall-Craggs et al. using the Three-Dimensional (3D) Contrast Enchanced Fourier Acquired Steady State Technique (CE-FAST). [4] The 3D CE-FAST is a fast T2-weighted imaging method of acquiring Maximum Intensity Projection (MIP) post processing algorithm to obtain cholangiograms. In a recent publication Takehara et al. showed 3D reconstruction images of the pancreatic ducts acquired with a modified Fast Spin-Echo (FSE) technique requiring an acquisition time of 20-40 seconds. [5] Since the introduction of Rapid Acquisition with Relaxation Enhancement (RARE) technique by Henning et al. a large variety of applications have been described using modifications of RARE such as Turbo Spin-Echo (TSE or FSE) imaging and Half Fourier Acquired Single-shot Turbo spin-Echo (HASTE) imaging. Using RARE and HASTE sequences, image acquisition is possible in few seconds with single breath hold thus greatly reducing motion artifacts and improving image quality of MRCP. [6]

The clinical applications of MRCP include: [7]

- Obstructive jaundice
- Incomplete or failed ERCP
- Post-surgical alteration of the biliary tract
- Intrahepatic bile duct pathology, e.g., sclerosing cholangitis and AIDS(Acquired Immuno Deficiency Syndrome) cholangiopathy.
- Chronic Pancreatitis
- Congenital anomalies of the biliary tract and pancreatic duct
- Gallbladder pathologies

Material and Methods

This is a prospective, observational and descriptive study conducted in the Department of Radiodiagnosis, Subbaiah Institute of Medical

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Sciences and a tertiary care hospital over a period of 1 year. The patients presented with one or more of the following signs and symptoms: jaundice, acute or intermittent biliary colic with or without fever and postoperative or post-traumatic complaints. Few patients were assessed preoperatively as being living donors for hepatic transplantation. 65 consecutive patients suspected of obstructive jaundice on the basis of clinical signs, laboratory workup and ultrasound scan were prospectively included.All patients were subjected to full history taking, review of previous laboratory investigations such as liver and renal function tests (LFTs and RFTs), or radiological investigations such as MRCP and hepatobiliary ultrasound (US) examination.

Inclusion Criteria

Patients having suspected biliary obstruction with clinical and laboratory findings suggestive of obstructive jaundice who were referred for USG and MRCP.

Exclusion Criteria

If suspected or known to have pancreatic disease, rapid or irregular respiratory pattern due to liver failure with tense ascites or absolute contraindications for MRI such as (Permanent metallic implants, cardiac pace makers), pregnancy and renal insufficiency.

Patient Preparation

Fasting was requested for at least 6 hours before the MRI examination to promote gall bladder filling, gastric emptying and to reduce unwanted fluid signal from the intestine. Sedation with oral chloral hydrate was given to children less than 6 years of age, or those who were not able to cooperate during the examination. Patients were instructed to control their breath according to the MRI technician instructions.

MRCP Technique

MRCP images were acquired using 1.5 tesla MRI machine with appropriate commercially available software. A (2D) Two-Dimensional multi-slice T2 weighted single breath hold RARE and HASTE sequence with a quadrature (QD) spine coil in the axial plane was used to facilitate anatomical pinpointing, with the patient lying prone position. Imaging parameters for axial (TE) Time of Echo in phase are: average echo time 5 millisecond, repetition time 137 millisecond, field of view 9x27.5mm, a 128x256 matrix, 50.5-mm thick slabs and approximately 2-minute duration with breath hold of 20 seconds. MR cholangiogram was acquired by a Two-Dimensional Fast Spin Echo (2D FASE) sequence, which is a non-breath hold one shot sequence using a QD spine coil especially in paediatric and non-compliant patients. MRI parameters for coronal T2-FASE are: average echo time of 250 millisecond, repetition time of 4000 millisecond, field of view of 30mm, a 384x384 matrix, 50mm thick slabs with fat-suppression for coronal sequences. Coronal slabs in the hilar plane were post processed using a Maximum Intensity Projection (MIP) algorithm. Projectional images of biliary tree were obtained at different angles so as to eliminate overlapping.

Assessment

Assessment comprises analysis of MRCP regarding ductal conspicuity of normal and pathologic ducts, assessment of ductal morphology and to differentiate benign and malignant findings by Contrast Enhanced MRCP (CE-MRCP) study. In all the examined cases, MRCP images were evaluated for the presence and degree of intrahepatic and/or extrahepatic biliary dilatation, the cause of biliary obstruction, and any additional information provided by the axial T1WI and T2WI. The criteria used to determine biliary distension in cases of biliary obstruction were either the presence of a stone or a stricture whether benign or malignant with consequent proximal biliary dilatation, while in cases of no obstruction, there was diffuse dilatation like Caroli's disease, choledochal cyst, primary sclerosing cholangitis, and recurrent pyogenic cholangitis.

Statistical Analysis

The data collected were tabulated. The tabulated data were analysed using descriptive statistics, i.e by using percentages.

Result

In our present study, a total of 65 patients were included out of which 41 (63.1%) were males and 24 (36.9%) were females (table-1).

Table 1: Distribution of gender

Gender	No. of patients	Percentage
Male	41	63.1
Female	24	36.9
Total	65	100

Table 2: Distribution of different age groups of patients

Age	No. of patients	Percentage
<30 years	3	4.6
31-50 years	19	29.2
51-70 years	36	55.4
>71 years	7	10.8
Total	65	100

In our study, most of the patients were 51-70 years i.e., 36 out of 65 (55.4%), followed by 31-50 years, i.e., 19 out of 65 (29.2%).

Table 3: Number of patients showing various Pancreaticobiliary pathologies as observed on MRCP

Cause of Obstruction	No. of patients	Percentage
Cholelithiasis	21	32.3
Choledocholithiasis	10	15.4
Cholecystitis	5	7.7
Stricture	9	13.8
Choledochal cyst	4	6.2
Cholangiocarcinoma	4	6.2
Acute pancreatitis	3	4.6
Chronic pancreatitis	3	4.6
Pancreatic Mass	2	3.1
Periampullary neoplasm	2	3.1
Cholangitic Abscess	1	1.5
Hepatojejunal	1	1.5
Total	65	100

In our 65 cases, Cholelithiasis was the most common cause with 21 (32.3%) cases, choledocholithiasis was the second most common cause with 10 (15.4%) cases, followed by stricture with 9 (13.8%) cases, cholecystitis with 5 (7.7%) cases, periampullary carcinoma with 2 (3.1%) cases, cholangiocarcinoma with 4 (6.2%) cases, choledochal cyst and cholangitic abscess with 4 cases (6.2%) and 1 (1.5%) case respectively.

Table 4: Anatomical Variations

Anatomical Variations	No. of patients
Choledochal Cyst	2
Pancreatic Divisum	1
Right Hepatic Duct (RHD) inserting into ductal confluence	1
Total	4

Table 5: Distribution of site of stricture involving Pancreatico-biliary system as observed on MRCP

Site of stricture	No. of patients	Percentage
Common hepatic duct	3	33.3
Cystic Duct	1	11.1
Proximal CBD (Common Bile Duct)	1	11.1
Mid CBD	1	11.1
Distal CBD	3	33.3
Total	9	100

Table 6: Pancreatic pathologies on MRCP

Pancreatic pathologies	No. of patients	Percentage
Acute Pancreatitis	3	37.5
Chronic Pancreatitis	3	37.5
Pancreatic Mass	2	25
Total	8	100

Table 7: Distribution of site of Cholangiocarcinoma on MRCP

Site of Cholangiocarcinoma	No. of patients	Percentage
Ductal confluence + Part of CBD	1	25
Proximal	1	25
Mid	1	25
Distal	1	25
Total	4	100

Discussion

Magnetic resonance cholangiopancreatography (MRCP) is a relatively new MRI technique which is used for non-invasive work-up of patients with pancreaticobiliary pathologies. [8] By using heavily T2-weighted imaging sequences, the signal of static or slow-moving fluid-filled structures such as the bile duct and pancreatic duct is greatly increased, resulting in increased duct-to-background contrast. [9] Recent studies have shown that MRCP is comparable with invasive endoscopic retrograde cholangiopancreatography (ERCP) for the diagnosis of extrahepatic bile duct and pancreatic duct abnormalities such as choledocholithiasis, malignant obstruction of the bile and pancreatic ducts, congenital anomalies, and chronic pancreatitis. In some institutions, MRCP is becoming the primary imaging tool for the evaluation of biliary tree and pancreatic duct pathologies, with ERCP being reserved for therapeutic indications. [10]Few data have been published about how MRCP changes the clinical practice. In a 2019 prospective study that included 40 patients, Mahaboob khan A et al. evaluated the efficacy of MRCP in supplimenting ERCP. [11] The patients had diagnosis of jaundice, abnormal liver enzymes, abdominal pain, recurrent acute pancreatitis and suspected complications of chronic pancreatitis. The investigators concluded that MRCP findings did not significantly affect clinicians decision making and that adding results of MRCP to other clinical information would have prevented less than 3% of diagnostic and therapeutic ERCP procedures. [12]The results of the study by Pramod K et al. differ from our study for a number of reasons. The patient selection process differed substantially. We entered only patients referred for MRCP, whereas they selected patients scheduled for ERCP. [13] This is a crucial methodological difference, resulting in different patient populations. The technology underlying MRCP has improved substantially in the 15 years between these studies. Modern MRI systems can generate 3D high-resolution MRCP images that can show tiny ductal stones, abnormal side branches and ductal strictures. In addition, visualization of the pancreatic duct can be significantly enhanced with intravenous (IV) secretin. [14]In a 2015 study, Vinay R et al. collected data suggesting that in a suitably selected subgroup of patients, MRCP could obviate ERCP, a result similar to ours. [15] In a retrospective study including 1148 patients, Arrive L et al. concluded, "initial MRCP in patients referred with abdominal pain would potentially have avoided ERCP in 44% of cases, and significantly reduced patient morbidity and mortality." [16] These studies approached the problem from different vantage points, yet both concluded that MRCP was useful in reducing the need for ERCP. However, they did not test the clinical value of MRCP in defining the cause of symptoms. Moreover, the MRCP protocols were mainly heavily T2 weighted imaging, in other words, they could be classified as Magnetic Resonance Ductography. At our institution, we generally incorporate MRCP in a complete MRI study, which includes anatomic soft-tissue imaging and the use of IV gadolinium contrast medium in addition to MRCP with IV secretin.Contrast enhancement yields valuable information about parenchymal organs, including the pancreas. In some cases, high-grade pancreatic ductal strictures can be caused by an obstructive mass, and thus contrast media may be useful for excluding malignancy. IV Secretin enhancement provides information about pancreatic exocrine function and improves visualization of the main duct, its side branches, pancreatic cystic lesions and their relation to the main duct in differentiation of side-branch intrapapillary mucinous neoplasms. Use of IV secretin also facilitates delineation of complete versus incomplete pancreatic divisum and pseudostrictures. [17]Our results show that in a patient population representative of that seen for evaluation of suspected pancreaticobiliary pathologies at a tertiary care hospital and medical institute, MRCP had a significant effect on clinical decision making. According to the study done by Parashari et al, they observed that, gastroenterologists would have recommended endoscopic procedures

for 76% of patients (ERCP, 49.1%; endoscopic ultrasound, 26.9%) without MRCP findings compared with 48.6% (ERCP, 35.1%; endoscopic ultrasound, 13.5%) when MRCP results were available. Although unproven, preprocedure MRCP may also help in planning for subsequent ERCP in patients in whom it is necessary, as for confirming the presence of complete pancreatic divisum and thereby eliminating efforts to cannulate the ventral pancreatic duct. [18]

The decreased need for invasive procedures like ERCP resulted largely from confirmation of suspected chronic pancreatitis and exclusion of structural abnormalities that might have required intervention. This alone may justify the value of diagnostic MRCP in the evaluation of many abdominal disorders. Another important result is the increased level of confidence in gastroenterologists after MRCP examination. [18]

Chronic abdominal pain related to pancreaticobiliary pathologies is most commonly due to pancreatitis (acute or chronic), sphincter of Oddi dysfunction, pancreatic cysts, pseudocysts and mass effect from pancreatic neoplasms, including intraductal pancreatic mucinous neoplasms. In our tertiary care hospital and medical institute, we currently perform a good number of MRCP examinations each year to evaluate pancreaticobiliary pathologies. Although ERCP and endoscopic ultrasound are still common procedures, MRCP has reduced the need for purely diagnostic ERCP at our tertiary care hospital and medical institute. MRCP can be performed in both inpatient and outpatient settings, does not require sedation or extra nursing staff other than MRI technologists and can be performed relatively quickly, often within 1 hour in case of good patient compliance. The only major limitation of MRI and MRCP is that some patients cannot undergo MRI because of pre-existing conditions such as claustrophobia and the presence of devices such as metallic implants, cardiac pacemakers, aneurysm clips, certain types of aortic grafts, pregnancy, renal insufficiency and economic constraints.

Conclusion

The combination of conventional and functional MRCP offers a good technique for the comprehensive evaluation of a wide range of biliary and pancreatic pathologies and their effect on morphology and function. Our study confirms that understanding the clinical perspectives and then optimizing the MRCP imaging protocols are the key determinants that influence the development and support of a successful MRCP practice, which aids in the diagnosis of various pacreaticobiliary pathologies.

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