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

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**Original Research Article**

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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

Since the first clinical application of magnetic resonance cholangiopancreatography (MRCP) in the early 1990s, MRCP has evolved from a technique with questionable potential for imaging of the biliary tract and pancreatic duct to one that is now recognized as a pivotal tool for diagnosis of pancreaticobiliary disease. In fact, the evolution of MRCP has been such that at many centers, MRCP has replaced diagnostic endoscopic retrograde cholangiopancreatography (ERCP) in a number of clinical scenarios [1].

A prospective survey revealed that MRCP findings enhance the diagnostic confidence of gastroenterologists and decrease the need for invasive procedures.1 For many years, ERCP has been considered the standard of reference for imaging of the biliary tract and pancreatic duct because of its ability to render high-quality images of the ducts. However, ERCP is an invasive examination associated with complications that occur in up to 5% of all attempts and that range from subclinical to life-threatening [2].

Those complications include pancreatitis, hemorrhage, cholangitis, and gastrointestinal tract perforation. The relatively rapid acceptance of MRCP is related, in large part, to its ability to provide images of the ducts similar to those of ERCP. These images can be obtained without the associated complications of ERCP while offering comparable sensitivity, specificity, and accuracy. In addition, MRCP is readily performed in the outpatient setting and does not expose patients to ionizing radiation. In most instances, performance of MRCP does not require administration of sedation [3]. In contrast to ERCP, MRCP readily depicts ducts proximal to a high-grade obstruction as well as ducts in patients with surgical alterations of the biliary tract and gastrointestinal tract, such as biliaryenteric anastomoses. Although ERCP yields exquisite images of the ductal systems, it provides no direct information about the solid organs and vessels of the abdomen [4].

However,when MRCP is performed in conjunction with conventional magnetic resonance imaging (MRI) and, when necessary, magnetic resonance angiography (MRA), a comprehensive examination is achieved. This information assists in determining resectability of neoplasms, such as pancreatic carcinoma, and in detecting complications of primary sclerosing cholangitis, such as cirrhosis and cholangiocarcinoma. Technique Before acquisition of the MRCP image, many advocate the use of heavily T2-weighted, non–fat-suppressed sequences, such as the half-Fourier acquisition single-shot turbo spin-echo (HASTE) sequence, to provide an overview of the entire abdomen [5]. These comprehensive images allow visualization of the solid organs as well as of the pancreaticobiliary tract and gallbladder. The MRCP image is then acquired. This can be achieved by use of a two-dimensional (2D), heavily T2-weighted, fat-suppressed, breath-hold sequence. This sequence can provide single thick-slab images with slice thicknesses ranging from 10 to 70 mm and multiple thin-slab images with slice thicknesses ranging from 2 to 5 mm [6].

The images depict the biliary tract, pancreatic duct, and gallbladder as high signal intensity structures. Multiple acquisitions are conducted in the coronal and coronal oblique planes to optimally image the ducts. In addition, the axial plane is useful in distinguishing stones, which layer in the dependent portion of the duct, from pneumobilia, which is nondependent. In general, the thin-slab images allow improved delineation of the finer details of the ductal systems,whereas the thick-slab images provide comprehensive views of the ducts that assist in the depiction of diffuse ductal diseases, such as primary sclerosing cholangitis [7-9].

## MATERIAL AND METHODS

This is a prospective, observational and descriptive study conducted in the Department of Radiodiagnosis, Dr. VRK Women's Medical College, Teaching Hospital and Research Center, Hyderabad 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 90 patients were included out of which 61 (67.7%) were males and 29 (32.2%) were females (table-1).

**Table 1: Distribution of gender**

| Gender | No. of patients | Percentage |
|---|---|---|
| Male | 61 | 67.77 |
| Female | 29 | 32.22 |
| Total | 90 | 100 |

**Table 2: Distribution of different age groups of patients**

| Age | No. of patients | Percentage |
|---|---|---|
| <30 years | 2 | 2.22 |
| 31-50 years | 33 | 36.66 |
| 51-70 years | 46 | 51.11 |
| >71 years | 9 | 10 |
| Total | 90 | 100 |

In our study, most of the patients were 51-70 years i.e., 33 out of 90 (51.11%), followed by 31-50 years, i.e., 33 out of 90 (36.6%).

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

| Cause of Obstruction | No. of patients | Percentage |
|---|---|---|
| Cholelithiasis | 21 | 23.33 |
| Choledocholithiasis | 11 | 12.22 |
| Cholecystitis | 9 | 10 |
| Stricture | 7 | 7.77 |
| Choledochal cyst | 11 | 12.22 |
| Cholangiocarcinoma | 9 | 10 |
| Acute pancreatitis | 7 | 7.77 |
| Chronic pancreatitis | 6 | 6.66 |
| Pancreatic Mass | 4 | 4.44 |
| Periampullary neoplasm | 3 | 3.33 |
| Cholangitic Abscess | 1 | 1.11 |
| Hepatojejunal | 1 | 1.11 |
| Total | 90 | 100 |

In our 90 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 | 3 |
| Pancreatic Divisum | 2 |
| Right Hepatic Duct (RHD) inserting into ductal confluence | 1 |
| Total | 6 |

**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 | 4 | 33.3 |
| Cystic Duct | 2 | 16.6 |
| Proximal CBD (Common Bile Duct) | 2 | 16.6 |
| Mid CBD | 1 | 8.3 |
| Distal CBD | 3 | 25 |
| Total | 12 | 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 |

## DISCUSSION

Today MRCP, a non-invasive technique with no morbidity, has gained a role in the evaluation of bile duct disease. Preliminary results show high sensitivity in detecting benign or malignant lesions the biliary tree and related organs as well as intrahepatic and common bile duct lithiasis [10]. Recently, ERCP has been challenged not only by MRCP but also by endoscopic ultrasonography (EUS), which has proved to have an equal or superior sensitivity in diagnosing choledocholithiasis [11].

Our prospective controlled study is the first to confirm that MRCP, compared with ERCP and with a follow up of at least one year, can distinguish clearly between benign and malig- nant diseases. In contrast to former investigations, we reviewed MR cholangiograms and pancreatograms. Introducing a technique based on the RARE pulse sequence, we were able to visualise even the normal pancreatic duct as a high signal structure against a black low signal background [12].

We found MRCP to be highly sensitive in the visualisation of normal common bile duct. This corresponds to other studies that were able to visualise the normal extrahepatic bile ducts in 90–100% of patients [13]. Bile duct dilatation is constantly visible during MRCP [14 15]. Although only three cases of choledocholithiasis were found, our results confirm former trials, finding a sensitivity approaching 100% for detection of biliary ductal dilatation and choledocholithiasis [16]. Smaller calculi are some-times missed on single shot sequences and are better visualised on source images [17]. In choledocholithiasis, MRCP competes with EUS, which had a sensitivity of 97% in a recent investigation [18].

Until now, there has been little information about the value of MRCP in diagnosing choledochal cysts [19, 20]. In our trial, we were able to depict one case of choledochal cyst in a child presenting with jaundice, fever, and abdominal pain. MRCP was able to display the anomaly, as well as the common bile duct stricture associated with the cyst. Thus, MRCP is able to present a detailed visualisation of the anatomy of the choledochal cyst and surrounding bile ducts, which is required for planning surgery and postoperative control.

Although the diagnosis of malignant bile duct obstruction can be established by ultra- sonography, the evaluation of tumour site and disease extent requires direct cholangiopan- creatography. ERCP often only shows the ducts below the site of obstruction (double duct sign); visualisation of an obstructed part of the biliary tree is often not possible. In addition, opacification of undrained bile ducts places the patient at risk of cholangitis. Our results confirm the findings of former studies, [21] where MRCP sometimes failed to depict the cause of bile duct obstruction. Sensitivity of MRCP (81%) is less than that of ERCP (93%). Nevertheless, the differential diagnostic considerations can be improved with evaluation of the MR images always obtained before MRCP images [22].

In the future, MRT will provide a sophisticated non-invasive technique for suspected biliary or pancreatic malignancies. In a single study, it has the potential of producing excellent cross sectional images of the liver and pancreas together with MRCP as well as MR angiography, thus extending the diagnostic information from simple biliopancreatic duct morphology to the surrounding structures, such as parenchymal and vascular tissues. It will therefore decrease the total cost of diagnostic work up in patients with suspected pancreatic carcinoma, providing similar or better results than ERCP, EUS, angiography, and CT in a single examination. This trend will probably improve the current lack of MR equipment in Europe, which is overloaded by neuroradiological and osteoarticular routines.

## 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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