

Role of magnetic resonance cholangio-pancreatography in the evaluation of pancreatico-biliary diseases

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Abstract

Background: MRCP was first described in 1986. First clinical application study of MRCP was done by Wallner B K et al in 1991 using breath hold 2D T2W Gradient echo sequence using Steady State Free Precision (SSFP). Magnetic Resonance Cholangio Pancreaticography (MRCP) is a relatively new MR technique that is used for non invasive workup of patient with pancreaticobiliary disease serving as a alternative to Endoscopic Retrograde Cholangio Pancreaticography (ERCP).

Aims & Objectives

- To describe features of pancreaticobiliary diseases on MRCP.
- To prove that Magnetic Resonance Cholangio Pancreaticography (MRCP) is one of the best imaging modality for evaluation of pancreatico-biliary diseases.

Methodology: The study included 30 patients referred to Department of Radiodiagnosis with signs and

symptoms of pancreatico-biliary diseases, over a period of 10 months. All patients were subjected to MRCP using 1.5T Philips Achieva MRI machine.

Results: Of the 30 study subjects, most common cause for pancreatico-biliary disease is benign in nature [21 patients (70%)]. Among the benign causes, cholelithiasis/choledocholithiasis was the most common [8 patients (38%)]. And among malignant causes, cholangiocarcinoma was the most common [4 patients (44%)].

Conclusion: MRI serves as an accurate, non-invasive and non-ionizing imaging method for evaluation of pancreatico-biliary anatomy and pathology. The efficacy of MRI and MRCP is at par with that of ERCP and can be considered as the gold standard for evaluation of the pancreatico-biliary system.

Keywords: Magnetic resonance cholangio-pancreatography (MRCP), Pancreatico-biliary diseases.

Introduction

Evaluation of suspected pancreatobiliary diseases has traditionally involved a variety of imaging modalities including Ultrasonography (US), Computed tomography (CT) and invasive cholangiography. These techniques have limitations because of poor visualization on US and CT and the need for invasive procedures like Endoscopic Retrograde Cholangio-Pancreatography (ERCP) and Percutaneous Transhepatic Cholangiography (PTC). Magnetic Resonance Cholangio-Pancreatography (MRCP) is a non-invasive imaging modality that provides good visualization of the hepato-biliary system. In view of limitation of US & CT and invasiveness of Percutaneous transhepatic cholangiography, Intravenous cholangiography & Endoscopic retrograde cholangio-pancreatography, there is a need for an imaging modality which is non-invasive & provides high resolution projection images of the biliary & pancreatic duct. Magnetic Resonance Cholangiopancreatography (MRCP) is a noninvasive diagnostic technique that was developed for the visualization of the biliary & pancreatic ducts. Its use was first reported in 1991, & since then the method has evolved along with the advances in MRI hardware & imaging sequences¹. MRCP is an alternative to diagnostic ERCP for imaging the biliary tree & investigating biliary obstruction. MRCP does not expose the patient to the risks associated with ERCP or PTC². In addition, there is no use of ionizing radiation or iodinated contrast agents. It has, therefore, become the investigation of choice for many conditions when evaluating pancreatobiliary ductal disease. MRI plays a vital role in diagnosing many conditions of the pancreatobiliary

tract. On MRI, Primary Sclerosing Cholangitis (PSC) shows several characteristic features including bile duct abnormalities & increased enhancement of liver parenchyma. Wall thickening & enhancement of extrahepatic bile ducts are also common MRI findings in patients with PSC³. Acute pancreatitis can be distinguished from chronic pancreatitis from that due to pancreatic carcinoma⁴. MRI can depict the extent of gall bladder carcinomas & can contribute to the staging of this disease⁵. It is unaffected by bowel gas shadow as in US. With the development of higher magnetic field strength & newer pulse sequences, MRCP with its inherent high contrast resolution, rapidity, multiplanar capability & virtually artifact free display of anatomy & pathology in this region is proving to be examination of choice in patients with pancreatobiliary diseases⁶. This imaging technique is able to create projectional type images similar in detail & appearance to direct cholangiography. It avoids the use of intravenous (IV) contrast & is relatively operator independent. Several recent studies have demonstrated that MRCP is able to accurately identify CBD stones with sensitivity of 81 – 100%. Biliary strictures can also be visualized with sufficient anatomic detail to determine the level of obstruction & in some instances differentiate benign from malignant causes. MRCP has potentially two major advantages in neoplastic pancreatobiliary obstruction. Firstly, MRCP can directly reveal extraductal tumor whereas ERCP depicts only the duct lumen. Second, MRCP lacks

the major complication rate of approximately 3% associated with ERCP such as sepsis, bleeding, bile leak & death⁶. MRCP is being used with increasing frequency as it is noninvasive procedure. It has high accuracy, and involves no ionizing radiation. Major limitation of MRCP is that it is not easily available and it is costly. Overall the purpose of this study will be to prospectively assess the accuracy of MR imaging.

Methodology

This study on “Role of magnetic resonance cholangiopancreatography in the evaluation of pancreatoco-biliary diseases” has been carried out in the Department of Radio-diagnosis, Mahadevappa Rampure Medical College, Kalaburagi. A total number of 30 patients with clinical and laboratory features suggestive of pancreatoco-biliary disease of all age groups and either sex referred to the Department of Radiodiagnosis over a period of 10 months i.e. between 1st March 2022 to 31st December 2022 were included in this study. The study protocol was approved by the ethical committee. All the patients gave informed consent to participate in the study. Patients were excluded if considered unsuitable for MRI. For study purpose we tend to refrain patients from ERCP or biliary drainage prior to MR procedure to avoid artifacts in this examination.

MRI-MRCP was performed by using Philips Achieva 1.5 Tesla MRI machine. MRCP was performed with heavily T2W sequences by using FSE (fast spin echo) or SSFSE (Single Shot Fast Spin Echo) technique and both a thick collimation (single section) and thin collimation multisection technique with a torso phased array coil.

Modified FSE sequences including Rapid Acquisition with Rapid Enhancement (RARE), Half-fourier acquisition single-shot turbo spin-echo (HASTE) and fast-recovery fast spin-echo (FRFSE) sequences were

used. Both breath-hold (using a single shot approach) and non-breath-hold techniques (with respiratory triggering) were used, with images obtained either as a two-dimensional (2D) or three-dimensional (3D) acquisition.

INCLUSION CRITERIA:

- a) Pain abdomen
- b) Deranged bilirubin level
- c) Dilated IHBR and detection of mass in pancreatoco-biliary region on USG

EXCLUSION CRITERIA:

- a) Claustrophobia
- b) Patients with cardiac pacemaker/aneurysmal clips
- c) Elderly, children and debilitated patients in whom breath holding is not possible.

Results

Of the 30 patients who underwent MRCP during the study,

- **9** patients had **carcinoma** (with avg age ranging from 45-65 years) with 4 patients diagnosed as cholangiocarcinoma, 3 patients having gall bladder carcinoma which includes one patient with associated cholangitic abscesses in both lobes of liver, one patient had periampullary ca and one had metastasis in GB fossa,
- **3** patients had **choledochal cysts** of which one had pancreatitis due to rupture of choledochal cyst,
- **4** patients presented with **strictures**, of which 2 were benign, one with malignant and one with post-operative strictures,
- **8** patients had **calculi** either in GB or CBD.
- **2** patients had **chronic pancreatitis** and **2** had **acute pancreatitis**,
- **1** patient had **emphysematous cholecystitis** and

- 1 patient had **IHBR dilatation** due to obstruction by portal lymph node.

Table 1: Sex wise distribution of pancreatico-biliary diseases

Sex	No. of Cases	Percentage
Males	17	56.7
Females	13	43.3
Total	30	100%

Chart 1: Sex-wise distribution of pancreatico-Biliary diseases

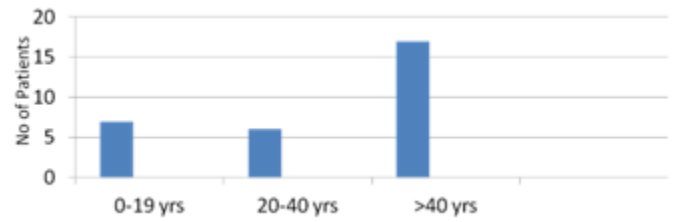


Out of the 30 subjects studied, 17 (56.7%) were males and 13 (43.3%) were females. In the Present study there is male preponderance, with male : female ratio being 1.3:1.

Table 2: Age wise distribution of pancreatico-biliary diseases

Age	No. of Patients	Percentage
0-19	07	23.3%
20-40	06	20%
>40	17	56.7%
TOTAL	30	100%

Chart 2: Bar graph showing age wise distribution of pancreatico-biliary diseases



Out of the total 30 patients included in the study, maximum 17(56.7%) were in the age group of > 40 years.

Table 3: Clinical symptoms presented by patients with various pancreatico-biliary diseases

Symptomatology	No. of patients	Percentage
Abdominal Pain	26	88 %
Nausea	14	46 %
Vomiting	11	38 %
Jaundice	14	46 %
Weight loss	5	16 %
Steatorrhoea	9	30 %
Constipation	4	14 %

Out of the total 30 patients included in the study, most common clinical presentation was Pain in abdomen seen in 26(88%) patients followed by nausea and jaundice seen in 14(46%) patients, while least common presentation was Constipation seen in 4 (14%) patients. Most of patients presented with combination of symptoms.

Chart 3: Clinical symptoms presented by patients with various pancreatico-biliary diseases

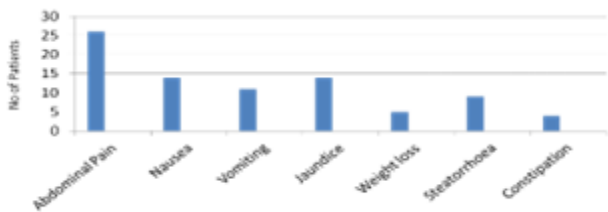
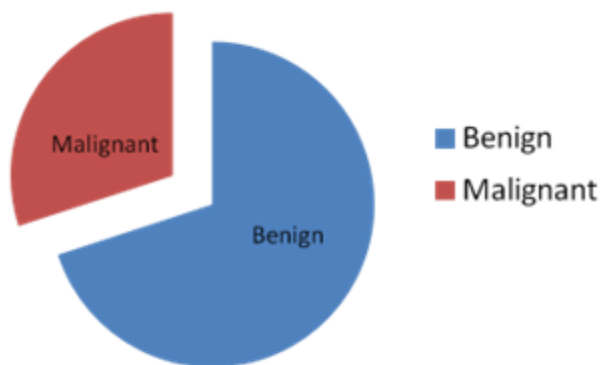


Table 4: Distribution of pancreatico-biliary conditions observed on MRCP

Type	No. of Patients
Benign	21
Malignant	9
Total	30

Chart 4: Distribution of pancreatico-biliary conditions observed on MRCP



Out of the total 30 cases included in the study, 21 (70%) patients had benign disorders, while 9 (30%) patients had malignant disorders.

Table 5: Showing number of patients with various diseases as observed on MRCP

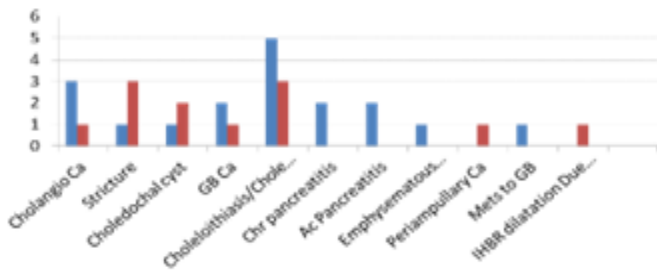
Disease	No. of patients	Percentage
Cholangiocarcinoma	04	13.3
Strictures	04	13.3
Choledochal cyst	03	10
Gallbladder carcinoma	03	10
Cholelithiasis	02	6.7
Choledocholithiasis	02	6.7
Cholelithiasis with choledocholithiasis	04	13.3
Chronic pancreatitis	02	6.7
Acute pancreatitis	02	6.7
Emphysematous cholecystitis	01	3.3
Periampullary carcinoma	01	3.3
Metastasis to gb	01	3.3
Ihbr dilatation due to portal node compression	01	3.3
Total	30	100

Table 6: Sex wise distribution of various diseases as observed on MRCP

Disease	Males %	Females %
Cholangiocarcinoma	03 10 %	01 3.3 %
Strictures	01 3.3 %	03 10 %
Choledochal Cyst	01 3.3 %	02 6.67 %

Gallbladder Carcinoma	02 6.67%	01 3.3 %
Cholelithiasis	01 3.3%	01 3.3 %
Choledocholithiasis	01 3.3 %	01 3.3 %
Cholelithiasis With Choledocholithiasis	03 10 %	01 3.3 %
Chronic Pancreatitis	02 6.67 %	00 --
Acute Pancreatitis	02 6.67 %	00 --
Emphysematous Cholecystitis	01 3.3 %	00 --
Periampullary Carcinoma	00 --	01 3.3 %
Metastasis To Gb	01 3.3 %	00 --
Ihbr Dilatation Due To Portal Node Compression	00 --	01 3.3 %
Total	17 60 %	13 40 %

Chart 5: Bar graph showing sex wise distribution of various diseases as observed on MRCP



Out of the total 30 cases included in the study, most commonly observed was Calculus etiology in either GB or CBD 8 (23.6%) patients with Male preponderance. Second most common benign disorder was Strictures seen in 4 (13.3%) patients with female preponderance.

Table 7: Characterisation of stricture in this study

Types	No. of patients	Percentage
Benign	2	50%
Malignant	1	25%
Post operative	1	25%
Total	4	100%

Out of 4 patients with strictures detected in our study, 2 (50%) were benign, 1 was malignant and 1 case was postoperative stricture of CBD.

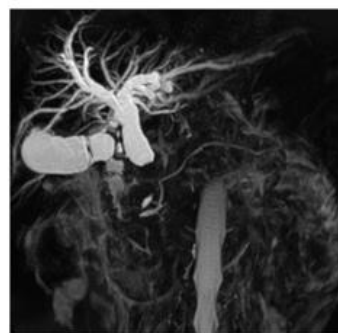
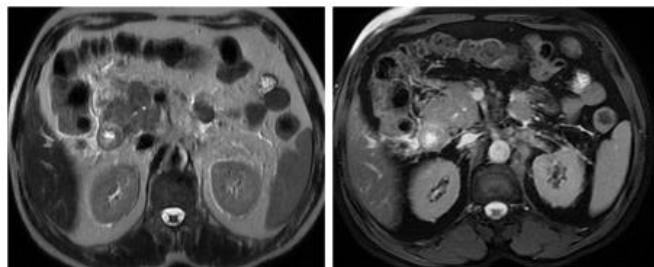


Figure 1: A 69 year old male patients axial T2W and T1+C images (above) , coronal 3D MRCP image (below) showing ill defined mass lesion between 2nd part of duodenum and head of pancreas with loss of fat planes showing moderate enhancement. Dilatation of CBD

m/s 16 mm with abrupt cut off noted at the mass.

(Periampullary carcinoma)

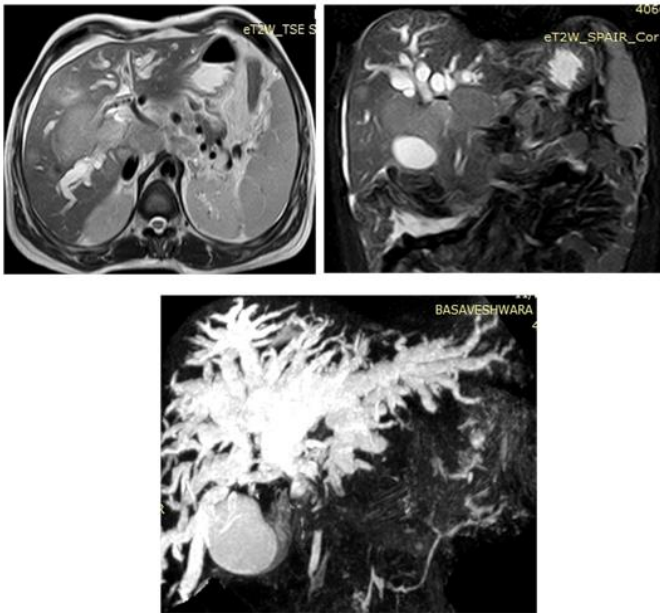


Figure 2: A 56 year old female patients T2W axial, SPAIR coronal images (above) and coronal 3D MRCP image (below) showing well-defined hyperintense GB fossa lesion with hepatic invasion and multiple focal hepatic hyperintense lesions adjacent to GB fossa. Similar lesion is noted in CHD and proximal CBD causing moderate to gross dilation of biliary radicles in both lobes of liver (Gallbladder carcinoma)

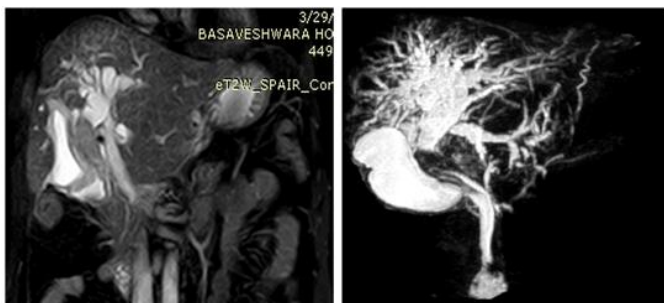


Figure 3: A 54 year old female patients coronal SPAIR and 3D MRCP images showing hypointense lesion noted at the level of porta amputating biliary confluence and is epicentered on CBD causing dilated biliary radicles in both lobes of liver. (Cholangiocarcinoma)

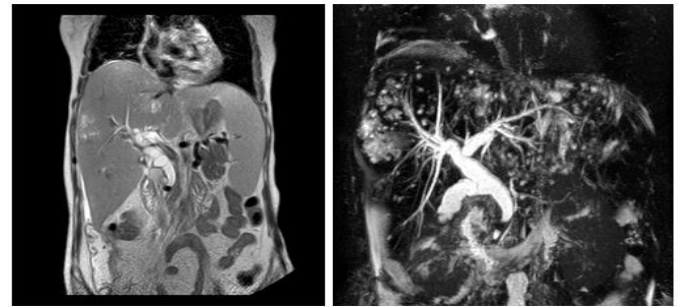


Figure 4 : A 27 year old male patients coronal T2W and 3D MRCP images showing filling defect in distal CBD with dilated proximal biliary radicles. (Cholelithiasis)

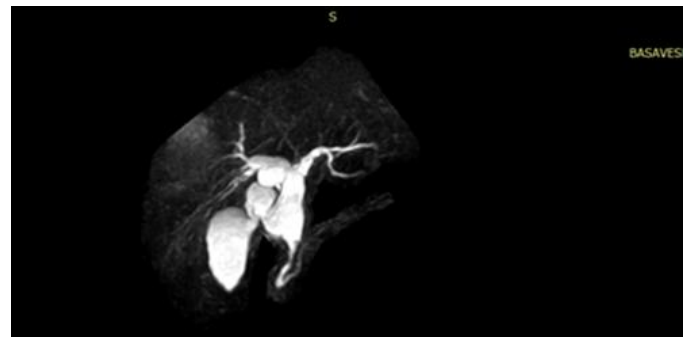


Figure 5: A 45 year old male patients coronal 3D MRCP image showing abrupt termination of dilated CBD at the region of the head of the pancreas secondary to a malignant stricture

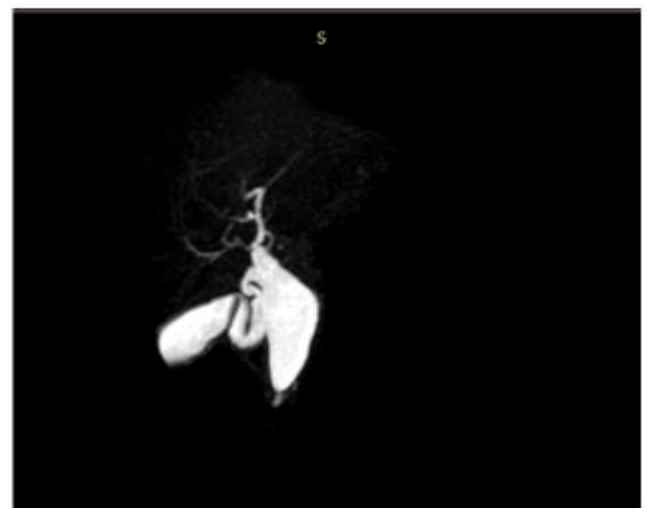


Figure 6: A 6 months old male patients 3D MRCP image showing fusiform dilatation of the CBD, suggestive of type I Choledochal cyst

Discussion

Evaluation of suspected biliary obstruction has traditionally involved a variety of imaging modalities including Ultrasonography (US), Computed Tomography (CT) and invasive cholangiography.

Ultrasound is the initial screening tool and has limitations especially in the evaluation of the distal CBD where bowel gas, debris, fluid in the duodenum and obesity can degrade the image quality.

CT scan also has its share of limitations, especially in demonstrating two important pathologies, biliary stones and biliary strictures. CT has a sensitivity of only 90% for detecting biliary stones.

For these reasons cholangiographic modalities like Intravenous Cholangiography (IVC), Percutaneous transhepatic cholangiography (PTC) and ERCP are required.

IVC has limitations, in 30-40% of cases there is incomplete opacification of the biliary system.

PTC has the same diagnostic and therapeutic role as ERCP but is more invasive and risky. Incidence of sepsis is around 1-4%.

ERCP is a very operator dependent and invasive procedure and it is associated with **1-7%** related morbidity and **0.2%-1%** mortality.

In view of limitation of US and CT and invasiveness of PTC, IVC and ERCP there is need for an imaging modality which is non invasive and provides high resolution projection images of the biliary and pancreatic duct.

Magnetic Resonance Cholangio Pancreatography (MRCP) is a non-invasive imaging modality that provides good visualization of the hepato- biliary system.

Limitations of MRCP

- Respiratory motion artifacts
- Requires breath hold for breath hold sequences which is not possible if patient is very sick, asthmatic.
- Susceptibility artifact.
- MIP 3D reconstructed images may completely obscure a very small filling defect due to the partial volume effect.
- Limited spatial resolutions compared to ERCP in which there is direct opacification of ducts with contrast.

Conclusion

Based on the results of our study the following conclusions can be made:

- MRI serves as an accurate and non invasive, non ionizing imaging method for evaluation of pancreatico-biliary anatomy and pathology.
- Combination of MRI and MRCP allows safe surgical management decisions.
- Potentially useful in patients undergoing biliary enteric anastomosis for knowing the level and extent of strictures.
- Very useful tool in case of obese patients and children.

There is now enough evidence to suggest that the efficacy of MRI and MRCP is at par with that of ERCP and can be considered as the gold standard for evaluation of the pancreatico-biliary system.

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