



## **Role of MRCP in evaluation of hepatobiliary diseases**

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### **Abstract**

**Background:** In view of the limitations of sonography /CT scan, the invasiveness and complications of PTC (Percutaneous transhepatic cholangiography) and ERCP (Endoscopic retrograde pancreatico cholangiography), Magnetic resonance cholangiopancreatography (MRCP) is a non-invasive method of imaging the biliary tree. It provides high resolution projection images of the biliary tree and pancreatic duct. Now assuming the position of the modality of choice in evaluation of the biliary tree after initial USG.

**Methodology:** Using a standard data collection from 54 patients diagnosed or suspicious of having hepatobiliary lesions referred for MRI were studied. MRI examinations were performed by using closed type 1.5 Tesla MR Scanner.

**Result:** Of the 54 patients, 35 were male and 19 were female. Jaundice was the most common symptom present in 50 patients followed by abdominal pain and pruritus. Malignant stricture of the bile duct was the most common pathology in this study comprising 15 patients followed by benign strictures comprising 13 patients.

**Conclusion:** MRCP is a non-invasive tool for diagnosis and preoperative planning for diseases affecting biliary tree. It is useful when ERCP fails or it is incomplete. MRCP visualizes bile ducts in the normal physiological state of dilatation. MRCP has several advantages over ERCP however MRCP cannot perform biopsy, stenting and removal of CBD calculi which are possible with ERCP.

**Keywords:** Magnetic Resonance Cholangiopancreatography, Hepatobiliary System, Endoscopic Retrograde Pancreatico Cholangiography, Cholangiocarcinoma, Gallstones.

### **Introduction**

Magnetic resonance cholangiopancreatography (MRCP) was introduced in 1991, as a non-invasive method of imaging the biliary tree. Although endoscopic cholangiopancreatography (ERCP) has been the mainstay for diagnosing and treating pancreatico-biliary disease, complications such as pancreatitis, cholangitis, hemorrhage and duodenal perforation have limited its use as a routine diagnostic test. In fact, MRCP is the examination of choice in a setting where ERCP is difficult or impossible. Ultrasound is also a reliable

method for the evaluation of the hepatobiliary system and is the first method of choice when such disease is suspected. Sonography has limitations especially in the evaluation of the distal CBD which may be obscured by bowel gas and demonstration of biliary strictures.

Computed tomography (CT) can be used to image the hepatobiliary system, with perhaps the exception of the gallbladder, which is better imaged with ultrasound. CT is useful for hepatic imaging and in cases where it is not clear whether a problem is originating in the liver, gallbladder, or bile ducts.

Magnetic resonance (MR) imaging cholangiography have the advantages of allowing detailed evaluation of the biliary tract with a large field of view, excellent patient tolerance, and three-dimensional (3D) data sets that can be cholangiographically displayed. This imaging modalities is less likely to cause patient discomfort or injury than is endoscopic retrograde cholangiopancreatography (ERCP), an invasive procedure with a reported complication rate of 3%–9% and a reported mortality rate of 0.2%–0.5%.<sup>1</sup>

#### Material And Methods

The study group consisted of total 54 patients from different parts of our state and some from neighboring states. Patients diagnosed or suspicious of having hepatobiliary lesions referred for MRI were studied.

**Inclusion criteria:** patients of all age groups, presented with complaints of upper abdominal pain, symptoms of obstructive jaundice and signs of hepatobiliary pathology on initial imaging studies such as sonography or CT scan were included in the study.

**Exclusion criteria:** All those cases which had implanted medical devices containing ferro-magnetic objects were excluded. Patients in whom only pancreatic duct was

affected without involvement of biliary tree were not included in this study.

**MRI procedures:** MRI examinations were performed by using closed type 1.5 Tesla (PHILIPS ACHIEVA) MR scanner using Torso-Array surface coil, with the study subject in the supine position. The following sequences were taken (3 axial, 3 sagittal and 3 coronal). Axial T2 TSE, Axial T1 TFE, Coronal T2 FAT/SAT sense, SSh\_MRCPRad, MRCP\_3D\_HR.

USG was done in majority of patients. CT Abdomen was done in 3 patients. ERCP was done in 7 patients. Histopathological findings were available in 5 patients.

#### Result and Discussion

In this study most of the patients were between 0-10 years of age group comprising 10 patients (18.5%) followed by 41-50 years of age group which included 9 patients (16.6%). out of 54 patients, 35 were male and 19 were female. Jaundice was the most common symptom present in 50 patients followed by abdominal pain and pruritus which was present in the 34 patients. Malignant stricture of the bile duct was the most common pathology in this study comprising 15 patients followed by benign strictures comprising 13 patients. This was in accordance with the study conducted by Adamek H et al<sup>2</sup>.

This study included total 8 patients of Choledochal cyst, 4 patients with type1 Choledochal cyst, 2 patients with type 4A Choledochal cyst, 1 patient with type 3 and type 5 Choledochal cyst (Caroli's disease). Associated complications were present in 3 patients, which include common bile duct calculi in 2 patients, and common bile duct stricture in 1 patient. In Irie H et al<sup>3</sup> study common bile duct calculi were present in 8 patients out of total 16 patients. Continuity of the cyst with bile duct was demonstrated in every patient which is helpful to differentiate Choledochal cyst from the other differentials

like enteric duplication cyst of duodenum, pseudocyst of pancreas.

There were total 9 patients of choledocholithiasis in this study. 6 of 9 patients were male and 3 were female. Out of the 9 patients choledocholithiasis was secondary to choledochal cyst in 2 patients. Associated Cholelithiasis was present in 3 patients. History of cholecystectomy was present in 2 Patients. One patient had associated carcinoma of gall bladder. 1 patient had findings of cholecystitis on T2W images. 2 patients had single calculus within bile duct, rest all patients had multiple. Size of the calculi ranges from the 4 mm to 19 mm in this study. Smallest sized calculus detected in this study was 4 mm in distal CBD which was not visualized on USG. Common bile duct was dilated in 8 patients. Most of the patients had calculi situated within distal CBD. Small calculi were best displayed on axial T2W images because they were perpendicular to the axis of the bile duct. Calculi were obscured on MIP images because of volume averaging with surrounding hyperintense bile in two patients in this study. One patient in this study had distal CBD stricture and had undergone ERCP. Patient had multiple hypointensities in the CBD and CHD on MRCP examination which can be confused with CBD calculi; however, the diagnosis of the pneumobilia was made on the basis of the non-dependent position of the hypointensities.

This study includes total 13 patients of benign stricture. Iatrogenic injury was the most common cause of the bile duct stricture in patients of benign biliary Stricture (6 patients). Smooth, symmetrical and long segment tapered narrowing is the pattern seen most commonly in the patients of the benign stricture. Distal CBD was the most common site of involvement present in 6 patients followed by CHD involvement present in 3 cases.

Among iatrogenic strictures cholecystectomy was the most important cause comprising of 4 cases. Strictures were classified using Bismuth classification. Bismuth type 3 was the most common type in iatrogenic bile duct injury comprising 3 patients. In study done by Alfonso R et al<sup>4</sup>, cholecystectomy was the most common cause of the bile duct injury. Bile duct injury was more common after laparoscopic cholecystectomy than after open cholecystectomy. Chronic pancreatitis was the cause of benign bile duct stricture in 2 patients. All the 2 patients had smooth tapered narrowing of distal common bile duct with dilated main pancreatic duct and pancreatic parenchymal atrophy suggesting chronic pancreatitis as the etiology of the stricture in these 2 patients. One patient in this study had stone impacted in cystic duct with resultant compression over common bile duct with proximal dilatation of biliary radicals suggestive of Mirizzi syndrome<sup>5</sup>. Stone was better visualized on T2W imaging with status of the biliary apparatus was better demonstrated on MRCP. Choi W et al in his study concluded that T2 weighted images can detect all diagnostic components of the Mirizzi syndrome, while MRCP can delineate the extent and shape of the stricture and detect fistula.<sup>6</sup>

Benign stricture in one patient was due to AIDS cholangiopathy. Cello J P et al<sup>7</sup> studied cholangiographic patterns in 26 patients suspected of having AIDS cholangitis and the results were similar in our study also. There was benign smooth tapering of distal CBD with papillary stenosis. The main differential diagnosis of CAS is represented by sclerosing cholangitis<sup>8</sup>. Benign stricture in one patient was due to primary sclerosing cholangitis. Patient was having stricture of left hepatic duct and distal common bile duct, with multifocal areas of the narrowing, intermittent dilatation and tortuosity

involving the common hepatic duct, proximal and mid part of common bile duct. Ebru et al<sup>9</sup> concluded in his study of 23 patients that irregularities, multifocal strictures and dilatations in different levels of the biliary channels were seen in all patients.

There was total 15 patients of malignant stricture in this study. Among them, most common cause of malignant stricture was cholangiocarcinoma which accounted for total 10 patients. 2 patients of the malignant stricture were due to periampullary mass, 1 was due to pancreatic mass infiltrating common bile duct, 1 was due to gall bladder mass infiltrating common bile duct, and one was due to liver mass infiltrating common hepatic duct. Among 10 cases of the cholangiocarcinoma, hilar cholangiocarcinoma was the most common type. Abrupt narrowing was the most common pattern seen in 9 Patients of malignant bile duct stricture on MRCP. Other patterns seen were irregularity and asymmetric narrowing of the bile duct seen in 4 patients. Intraluminal mass was visualized in 2 patients. Among the total 6 cases of hilar cholangiocarcinoma 4 were of Bismuth type 2 which involves only primary confluence. MRCP was able to identify proximal and distal extent of the disease in all patients. T2W images also identified liver metastasis in one patient. Fulcher A et al<sup>10</sup> studied 6 patients of hilar cholangiocarcinoma with MR cholangiography. MRCP allowed for determination of the proximal extent of disease and assessment of resectability and delineated the duct both proximal and distal to the stricture and isolated ductal obstructions in his study. Manfredi R et al<sup>11</sup> studied 12 patients of hilar cholangiocarcinoma. The results of his study, were same as our study. There were 2 patients of periampullary carcinoma in this study. Both of them had 'double duct sign'. All 2 patients had abrupt cut off the distal CBD. Dilatation of side branches of MPD

was not seen in any of the 2 patients. Kim MJ et al<sup>12</sup> noted 'double-duct sign' in 15 patients among total 29 patients while only the bile duct was dilated in the remaining 14 patients, with dilatation of the pancreatic side branches was rarely seen. Similar results were seen in study conducted by Park M et al<sup>13</sup>.

This study included single case of the bile leak from the cystic duct following cholecystectomy. On MRCP sub hepatic collection below the right lobe of the liver was visualized with cystic duct remnant was seen communicating with the above-mentioned collection. Khalid et al<sup>14</sup> mentioned in his study of that presence of free fluid on the right side of the abdomen, with or without fluid collection adjacent to the injured bile duct, should suggest the diagnosis of bile leak.

Advantages of the MRCP over ERCP in this study:

There was one patient of hepatico-jejunostomy with operative site stricture in this study. MRCP examination in this patient shows stricture at the site of anastomoses. In this patient ERCP was not possible due to unfavorable anatomy. Extraductal pathologies like renal cysts (2 patients), hydronephrosis (2 patients) and liver cysts (1 patient) were visualized on MRCP images. T2W and T1W images also identified additional liver pathologies like hemangioma (1 patient), metastases in patient of cholangiocarcinoma (1 patient), hydatid cyst (1 patient), liver atrophy (2 patients) and liver abscess (2 patients). In addition, other extraductal pathologies like ascites (2 patients), pleural effusion (1 patient), hepatomegaly (3 patients), splenomegaly (3 patients), pancreatic mass (2 patients), pseudo cyst of pancreas (1 patient). All these extraductal pathologies were not possible to be seen in ERCP. In 2 patients of hilar cholangiocarcinoma MRCP shows ductal dilatation proximal to stricture which was not possible on ERCP in these two patients due to tight

stricture. MRCP does not involve ionizing radiation, contrast media and is totally non-invasive.

Advantages of MRCP over USG in this study:

2 Patients in this study had calculi in distal common bile duct which was not visualized on USG due to

obscuration by gas. One patient of type 1 choledochal cyst had also undergone USG. USG examination failed to identify communication of the cyst with bile duct due to the large size of the cyst. However, the communication was readily visualized on MRCP.

**Observations**

The present study included 54 MRCP patients having lesions affecting hepatobiliary system.

Table 1: Symptoms distribution

Symptoms	Number of patients	Percentage
Jaundice	50	92.5
Abdominal pain	34	62.96
Nausea/vomiting	29	53.70
Pruritus	34	62.96
Abdominal lump	8	14.8

Table 2: Spectrum of hepatobiliary diseases

Hepatobiliary diseases	Number of patients	Percentage
Choledochal cyst	8	
Choledocholithiasis	9	17.33
Benign bile duct stricture	13	25.33
Malignant bile duct stricture	15	33.33
Cystic leak	1	1.33
Agenesis of Gallbladder	1	1.33
Cholelithiasis	10	
Total	57	

Table 3: Etiology in patients with benign stricture

Etiology	Number of patients	Percentage
Iatrogenic bile duct injury	6	46.15
Chronic pancreatitis	2	15.38
Mirrizi syndrome	1	7.69
AIDS cholangiopathy	1	7.69
Primary sclerosing cholangitis	1	7.69
Secondary to choledochal cyst	1	7.69
Indeterminate cause	1	7.69
Total	13	

Table 4: Etiology in patients with malignant stricture

Bismuth classification of iatrogenic bile duct stricture	Number of patients	Percentage
Cholangiocarcinoma	10	66.66
Gall bladder mass infiltrating bile duct	1	6.66
Pancreatic mass infiltrating CBD	1	6.66
Liver mass infiltrating CHD	1	6.66
Periampullary mass	2	13.33
Total	15	

**Summary and Conclusion**

54 patients with hepatobiliary diseases were studied by Magnetic Resonance Cholangiopancreatography on 1.5 T units. Malignant stricture Comprises commonest disease, followed by benign stricture of bile duct and choledochal cysts. Choledochal cyst is most common in the age group of 0-10 years. Type 1 Choledochal cyst is the most common type followed by type 4A. MRCP is a non-invasive technique that can diagnose Caroli's disease without invasive procedure like ERCP. MRCP is of advantage when distal CBD calculi are obscured by gas on USG. Iatrogenic injury is the most common cause of the benign bile duct stricture. Cholecystectomy is the most common cause of the iatrogenic bile duct stricture. Bismuth staging by MRCP can provide important clue to the surgeon on type of the intervention being needed. Hilar cholangiocarcinoma is the most common type of the cholangiocarcinoma. At MRCP typical malignant common bile duct strictures manifest as irregular, asymmetric strictures with a shouldered margin whereas benign strictures tend to have smooth and symmetric borders with tapered margins. However, MRCP is not 100% accurate in differentiating stricture in to benign and malignant based on above findings. In pancreatitis, MRCP is useful to evaluate complication. T2WI may show intraluminal mass in distal CBD cholangiocarcinoma which may be missed on the MIP

images. MRCP is less; time consuming than ERCP. MRCP can visualize the status of the biliary apparatus proximal to the complete stricture, which is not feasible on ERCP. MRCP visualizes bile ducts in the normal physiological state of dilatation. MRCP is useful when ERCP fails or it is incomplete. MRCP cannot perform biopsy, stenting and removal of CBD calculi which are possible with ERCP. MRCP is a non-invasive tool for diagnosis and preoperative planning for diseases affecting biliary tree.

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#### Legend Figures

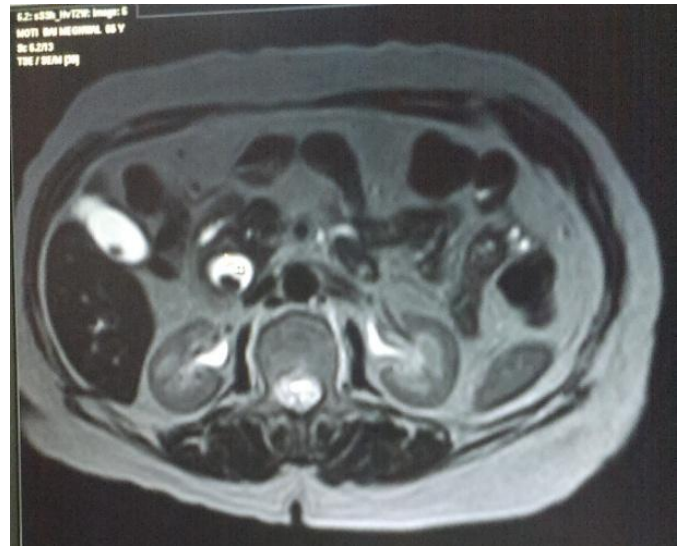


Figure 1: Cholelithiasis and Choledocholithiasis



Figure 2: Type I Choledochal Cyst



Figure 3: Benign Stricture in Terminal CBD

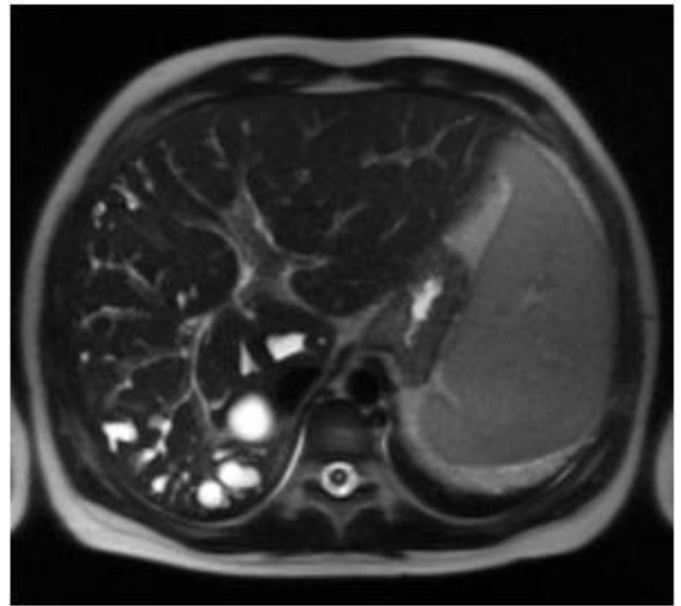


Figure 5: Caroli's Disease

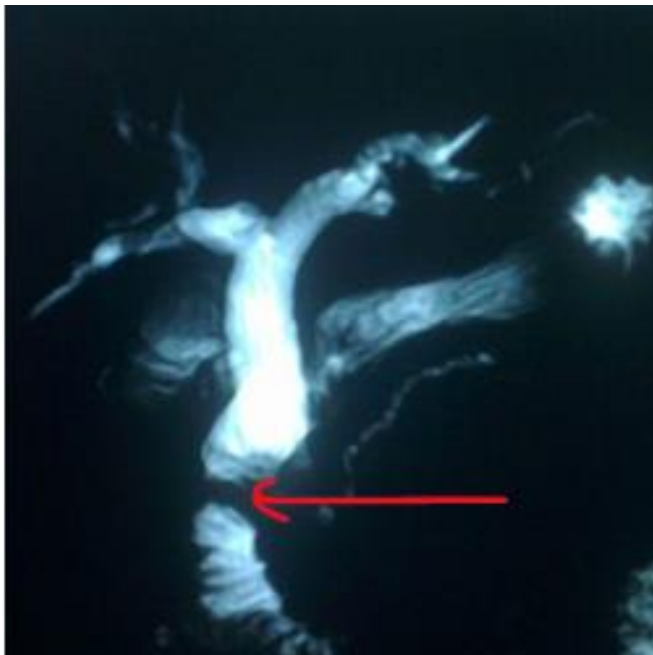


Figure 4: Malignant Stricture in Distal CBD