



ISSN 2278 – 0211 (Online)

## MRCP in the Evaluation of Hepatobiliary Pathologies

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### **Abstract:**

#### *Aims and objectives*

1. To evaluate and correlate accuracy of MRCP in diagnosing suspected cases of hepato-biliary obstruction.
2. To know the level and grade of obstruction in clinically suspected biliary obstruction.
3. To know the anatomy of hepatobiliary tree.

#### *Materials And Methods*

Clinical records of 70 patient with suspected Hepatobiliary pathologies, of all age group who presented to the department of Radio diagnosis BMCRI for MRCP during June 2013 to September 2014 where analyzed prospectively.

Various sequences in coronal, sagittal and axial planes were obtained.

#### *Results*

Out of 70 patients who presented to us abnormal findings were there in 53 patients (aprox. 76%). In our study stricture and mass lesions in lower part of Common Bile Duct were better evaluated by MRCP. Post operative stricture also better evaluated by MRCP.

In all cases of chronic pancreatitis, calcification was better seen by USG. But pancreatic duct dilatation, irregularity and pancreatic duct calculi were well demonstrated by MRCP.

Available ERCP/Histo pathological examination and per/postoperative records were compared and MRCP was ~98% accurate in diagnosis.

#### *Conclusion*

MRCP is an accurate, one of the non invasive modality with significant role in evaluation of hepatobiliary duct pathologies. In patients with hepatobiliary pathologies though USG is the primary modality of choice, it has very less diagnostic accuracy in benign and malignant strictures in lower end of CBD, post operative biliary tree anatomy and pathology. So all patients having biliary and pancreatic pathology not diagnosed by USG must be evaluated by MRCP.

**Key words:** MRI, MRCP, Ultrasound, ERCP.

### **1. Introduction**

Blockage of any duct that carries bile from liver to gallbladder or from gallbladder to small intestine can cause obstructive jaundice. It can be due to intra-hepatic or extra-hepatic causes. Extra hepatic can be intra-ductal and extra-ductal. Neoplasm, choledo-cholithiasis, biliary stricture, parasites and primary sclerosing cholangitis lead to intra-ductal obstruction. External compression of biliary channels by neoplasm, pancreatitis or cystic duct stones with subsequent gallbladder distention lead to extra-ductal obstruction.

MRCP has emerged as an accurate, noninvasive means of evaluating the biliary and pancreatic ducts. It uses heavily T2-weighted sequences that depict the fluid-containing ducts as a high-signal-intensity structure. MRCP can be acquired as two- or three-dimensional breathing-averaged or breath-hold FSE sequences and represents a viable alternative to diagnostic ERCP.

## 2. Materials and Methods

This is a prospective hospital based study conducted in the department of radiodiagnosis, BMCRI. 70 patients presented to the department of radio diagnosis with a history suggestive of hepatobiliary pathologies were subjected for MRCP evaluation taking informed consent.

## 3. Protocol

MRCP was performed for all patients on a 1.5-Tesla Magneto Avanto system (Siemens) the patients fasted for 6 hours before MRCP. All patients were imaged with a body phased-array receive coil. 5 mm thick sections were taken from right dome of diaphragm to lower edge of liver. Following are the sequences which were used after the localiser: T2 HASTE AXIAL free breath, T2 HASTE FS AXIAL free breath, T1 FLASH AXIAL breath hold, T2 HASTE CORONAL free breath, 3D MRCP free breath (PACE), Single shot HASTE MRCP and single shot HASTE different angle. A 3D reconstruction was performed by MIP post processing. MIP image and thick angled coronal sections provided views of pancreatico - biliary tree.

## 4. Patient Preparation

No patient preparation is required for MRCP but fasting 2-4 hours prior to the examination can be beneficial because it reduces the fluid in the gastric antrum and the duodenum, which may overlie the ducts. The MRCP examination takes 30-40 minutes. If a complete MRI of the liver and pancreas is necessary, the entire procedure takes about one hour and may include the administration of a contrast agent.

## 5. Inclusion and Exclusion Criteria

We included patients between the age groups 21-60 years and those presented with history of history abdominal pain and dyspepsia and those patients in which the preliminary investigations (clinical and biochemical) suggested pathologies involving the hepatobiliary tree.

We didn't include in our study those patients who are not co-operative to undergo the procedure, those with MRI incompatible prosthesis, and those using pacemakers.

## 6. Observations and Results

NO	DIAGNOSIS	NO OF CASES	% OF CASES
1	Calculi(cholelithiasis, choledo-cholithiasis, hepatic duct calculi)	30	42.80%
2	Congenital cysts	6	8.50%
3	Strictures (benign and malignant)	9	12.80%
4	Neoplasm	5	7.10%
5	Cholecystitis	8	11.40%
6	Pancreatitis	7	7%
7	Normal	5	7.10%
8	Others (post operative bile leak, pancreatico-duodenal fistula)	2	2.80%

Table 1

Our study was a hospital based prospective study of 70 patients with clinical, biochemical or radiological suspicions of suspicion of hepatobiliary pathologies. Patients were of the age group between 21-70 years with a mean age of 50 years. Out of 70 patients, 39 (55.57%) were females.

### 6.1. Calculi(Figure 2)

Out of a 70 patients, 9(12.8%) had choledocholithiasis. Out of 60, 21(30%) had cholelithiasis.

Cholelithiasis will be seen as focus of signal void inside gallbladder.

Detection of choledocholithiasis is one of the common aims of MRCP.MRCP has largely replaced ERCP as the gold standard for diagnosis of choledocholithiasis with comparable sensitivity and specificity (~100%)without ionizing radiation ,iv contrast or complications associated with ERCP. Defects are seen within the biliary tree on thin cross sectional T2 weighted imaging. Thick slabs should not be used for diagnosis as volume averaging may obscure stones.<sup>(1)</sup>

### 6.2. Choledochal cysts (Figure 1)

Out of a 70 patients, 6(8.5%) had Choledochal cysts.

Choledochal cysts are congenital cystic dilatations of any portion of the bile ducts, but most often occur in the main portion of the common bile duct (CBD). The diagnosis of a choledochal cyst is made on the basis of disproportional dilatation of the extrahepatic bile ducts (EHDs) after excluding the possibility of a tumor, stone, or inflammation as the cause of the dilatation. Out of 70 patients, 6(8.5%) had Choledochal cysts.

#### Classification

Commonly accepted classification currently is one devised by *Todani et al.* There are 5 main types, with several sub types some of which can be pathologically unrelated. Briefly:

- **Type I:** most common, accounting for 80-90%<sup>1</sup> (this type can present in utero)
  - **Ia:** dilatation of extrahepatic bile duct (entire)
  - **Ib:** dilatation of extrahepatic bile duct (focal segment)
  - **Ic:** dilatation of the common bile duct portion of extrahepatic bile duct
- **Type II:** true diverticulum from extra hepatic bile duct
- **Type III:** dilatation of extra-hepatic bile duct within duodenal wall (choledochocoele)
- **Type IV:** next most common
  - **Iva:** cysts involving both intra and extrahepatic ducts
  - **Ivb:** multiple dilatations/cysts of extra hepatic ducts only
- **Type V:** multiple dilatations/cysts of intra hepatic ducts only (Caroli disease)

### 6.3. Strictures (Benign And Malignant)<sup>5,7</sup>

Out of a 70 patients, 5(7.1%) had Features suggestive of benign strictures. Out of 70, 4(5%) had malignant strictures.

The distinction between malignant and benign structures relies on two aspects: Morphology and associated findings.

#### Benign features include

- Long segment
- Smooth
- Tapered margins

#### Malignant features include:

- Short segment
- Irregular
- Shouldered margins

### 6.4. Neoplasm<sup>(9,10)</sup> (Figure 3)

Out of a 70 patients, 5(7.1%) had Features suggestive of malignant neoplasm. Out of 70, 3(30%) had periampullary lesion and out of 70, 2(2.8%) had cholangiocarcinoma.

MRCP plays an important role in the assessment of Perihilar cholangiocarcinoma for the preoperative staging of the tumor. MRCP can non-invasively evaluate the biliary tree proximal and distal to an obstruction, adding accuracy to the preoperative staging. The main advantage of MRCP over ERCP, when assessing perihilar tumors, is its ability to evaluate suprahilar tumor extension which is difficult to assess by ERCP, because of insufficient contrast filling of ducts distal to a constricting tumor. The main drawback of MRCP when compared to ERCP is that it is solely diagnostic.

Perihilar cholangiocarcinoma appears on MRCP as irregular narrowing of the bile duct involved by tumor, with asymmetric upstream dilation of the intrahepatic bile ducts.

The reported sensitivity and specificity of MRCP compared to ERCP for the detection of bile duct malignancy are 81 and 100% compared to 93 and 94%, respectively. *Manfredi et al.* found that the level and extent of bile duct involvement with cholangiocarcinoma using the Bismuth–Corlette classification was accurately depicted on MRCP in 84% (10 of 12) of their patients.

MRCP can accurately depict the presence and level of obstruction, and has been shown to be more effective than ERCP in delineating the anatomic extent of the cancerous infiltration.

MRCP is also useful in the evaluation of periampullary carcinoma. Masses usually will appear iso intense or hypo intense on MRCP. If mass is not seen, bulging duodenal papilla may be the only indication of periampullary lesion. This bulge is caused to dilated pancreatic and bile ducts.

### 6.5. Cholecystitis And Pancreatitis<sup>(6,8)</sup> (Figure.5)

Out of a 70 patients, 8(11.4%) had cholecystitis. Out of 70, 7(7%) had pancreatitis.

MRCP in cholecystitis may show an impacted stone in the gallbladder neck or cystic duct.

MRCP is emerging as potentially valuable tests in the evaluation of pancreatitis. It is helpful in detecting stones in the common bile duct and in directly assessing the pancreatic parenchyma. Magnetic resonance imaging is similar or superior to contrast CT in its ability to stage acute pancreatitis and detect necrosis and complications, and it does not require intravenous contrast.

#### 6.6. Pancreaticopleural Fistula<sup>4</sup>(Figure 4)

It is rare type of internal pancreatic fistula. Although the precise incidence is unknown, these fistulas are most commonly associated with alcoholic chronic pancreatitis.

The pancreaticopleural fistula results from a disruption of a major pancreatic duct usually due to an underlying pancreatic disease. A ductal disruption on the anterior surface of the pancreas usually leads to pancreatic ascites, whereas the posterior ductal leakage might result in thoracic fluid collections. <sup>(4)</sup>

### 7. Discussion

Different modalities for evaluation of hepato biliary ductal systems are ultrasound, MRCP and ERCP.

Two noninvasive, non-radiating modalities for evaluation of biliary & pancreatic pathology are USG & MRCP, whereas ERCP is invasive, need expert personals, IV sedation and contrast administration.

MRCP produces images of the pancreatico biliary tree that are similar in appearance to those obtained by ERCP for a broad spectrum of benign and malignant pancreatic & biliary diseases.

The basic principle underlying MRCP stationary fluids, such as bile and pancreatic secretions serve as intrinsic contrast medium and have high signal intensity on heavily T2-weighted magnetic resonance sequences whereas surrounding tissues appear hypo intense.

With new RARE(Rapid Acquisition with Rapid Enhancement sequence) and HASTE (half fourier acquisition single shot turbo spin echo sequences).sequences will allow improved image quality ,in addition to shortening image acquisition time and reducing image artifacts.

Ultrasonography is the initial imaging test which is used in the evaluation of patients with suspected bile duct stones Even though Ultrasonography is a noninvasive modality and is patient complaint; it is highly operator dependent also influenced by patient factors such as the number, size and site of stones, patient's body habitus and presence of overlying bowel gas especially evaluation of stricture, mass lesion, calculi over distal CBD. The sensitivity of trans-abdominal ultrasound in the detection of choledocholithiasis is operator dependent and it varies between 20 and 80%.

Even with current imaging techniques, the accuracy of MRCP in diagnosing CBD stones varies widely. Most of the large series have reported sensitivities which ranged from 81-100%, specificities which ranged from 85-100% and diagnostic accuracies which ranged from 89-100% in the MRCP diagnosis of choledocholithiasis~98% specific for pancreatitis.

In our study, MRCP had a sensitivity of 95% (19 of 20 patients) in the demonstration of common duct stones and a specificity of 90% (9 of 10 patients). The positive predictive value of MRCP was 95% (19 of 20), whereas the negative predictive value was 90% (9 of 10 patients). There was one false positive and one false negative in the MRCP diagnosis of choledocholithiasis. The cause of the false positive finding on MRCP was mistaking a prominent ampullary sphincter for a lower bile duct stone. The false negative diagnosis had occurred, as multiple, small intrahepatic duct stones were missed out on MRCP. Stones were probably missed because of the lack of contrast between the stones and surrounding liver, with no high signal bile outlining the stones.

In the studies in which an MR cholangiography was performed with a two-dimensional fast or turbo spin-echo sequence and a standard body coil, the sensitivity of MR cholangiography in the detection of CBD stones was reported to range from 57% to 92%. A previous study in which patients with small stones comprised more than half of the study population, produced the lowest sensitivity (57.7%) in the detection of CBD stones [6]. However, motion artifacts and blurring which are associated with the long acquisition times in the non-breath hold technique which is used would make the detection of small stones difficult and small stones may also move during MRCP when long acquisition times are required.

### 7. Drawbacks and Limitations

The small sample size was one of the limitations of our study. There are several other limitations which are associated with MRCP. Smaller CBD stones can be missed on MRCP . However, usually, stones of sizes of up to 2–3 mm are visible. Papilla can only be seen in about 40% of patients who have MRCP . There may also be a difficulty in depicting minor narrowing of the cystic and pancreatic ducts . Another problem which is associated with MRCP is that maximum intensity projection (MIP) reconstructed images may completely obscure small filling defects and that they may demonstrate respiratory motion artefacts. Another issue is T2 weighting, which may vary with different MRI sequences and influence the findings. It should be noted that MRCP is only a diagnostic procedure. The impact of this is that if an ERCP was necessary afterwards as a therapeutic intervention, an MRCP could have been avoided and patients would have been able to proceed immediately for treatment.

### 8. Conclusion

USG is the primary imaging modality of choice in suspected biliary and pancreatic pathology, but it has very less diagnostic accuracy in evaluation of benign, malignant strictures and calculi in lower end of CBD, and provides inconclusive results in post-operative biliary tree anatomy and pathology.

Since MRCP has almost 100% diagnostic accuracy, those cases not clearly diagnosed by USG must be evaluated by MRCP. Use of MRCP could therefore spare these patients from invasive preoperative endoscopic procedures and it can also most likely reduce overall surgical costs. However, the potential application of MRCP in detection of CBD stones is limited by the expense and availability of technology, due to its high cost and lack of available expertise in operating the machine.

From the study we propose MRCP as the method of choice for the diagnostic imaging of bile duct calculi. Ultrasonography should be used as the initial imaging test in the screening of patients with suspected bile duct stones.

MRCP is an excellent primary tool for detecting or excluding CBD stones before cholecystectomy. In the present study, use of MRCP permitted a purely non-invasive negative diagnosis for 9 (90%) of 10 patients in whom probability of CBD stones was high.

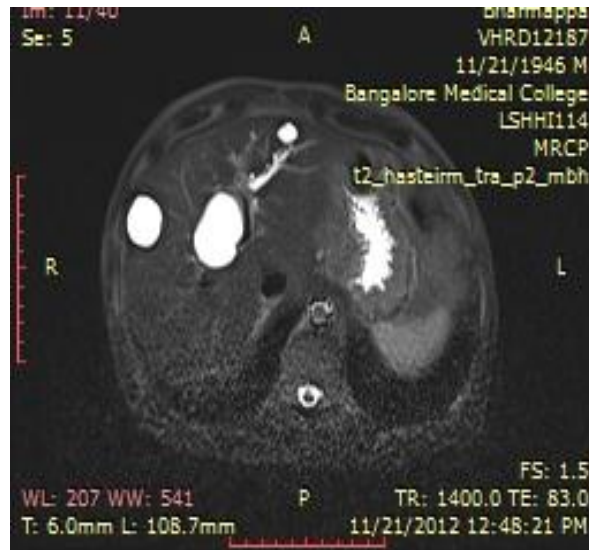


Figure 1: Fusiform dilatation of intrahepatic Choledochal cyst



Figure 2: Filling defects are seen within the common bile duct with dilatation of extra hepatic and intrahepatic biliary radicles with bulky pancreas



Figure 3: Hyper intense lesion causing extra hepatic biliary radicles obstruction



Figure 4: Hyper intense fistulous communication between main pancreatic duct and left pleural cavity



Figure 5: Filling defects are seen within gall bladder with thick hyper intense gall bladder wall

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