

MRCP – A Problem Solving Diagnostic Tool in Pancreaticobiliary Pathologies

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A B S T R A C T

Introduction: Magnetic Resonance Cholangiopancreatography (MRCP) is based on heavily T2W pulse sequences wherein only biliary tree is visualized without need for contrast medium administration in a noninvasive way. Study aims and objectives were to detect various pancreaticobiliary pathologies, to characterize various pancreaticobiliary pathologies and to evaluate role of MRCP in various pancreaticobiliary pathologies.

Material and Methods: The study was carried out with patients who presented with symptoms suggestive of involvement of pancreato-biliary system. Patients were kept fasting for at least 6 hrs prior to examination. Total 40 patients were imaged on GE Signa HDxT Twinspeed 1.5 T MRI (USA). A clinical, radiological correlation and confirmation of radiological diagnosis was done by Surgery / Biopsy / Endoscopic Retrograde Cholangiopancreatography (ERCP) findings.

Result: We encountered various benign as well as malignant pathologies during the study. Highest percentage of imaging features were of common bile duct (CBD) stricture (30%), acute pancreatitis (17.5%), followed by chronic pancreatitis (15%).

Conclusion: MRCP is noninvasive, non-ionizing imaging modality for evaluation of the pancreaticobiliary anatomy and pathology. It is much superior in the diagnosis and evaluation of various pathologies as compared to the ultrasound and Computed Tomography.

MRCP has highest resolution of the pancreaticobiliary tree. MRCP is capable of multiplanar imaging and 3D reconstruction.

Keywords: MRCP, Pancreatobiliary, Stricture, Periampullary Ca, Pancreas Divisum, Pseudocyst

INTRODUCTION

MRCP was first described in clinical practice in 1991 by **Walner et al.**¹ The technique is based on heavily T2W pulse sequences, which result in dramatic increase in contrast between biliary fluid and background pancreatic hepatic tissue. The background tissue T2 relaxation time is shorter hence does not give much signal as compared to the high water containing bile. Hence it is sufficiently suppressed to result in a cholangiographic or pancreaticographic effect. Only biliary tree is visualized without need for contrast medium administration. In other invasive cholangiographies which also results in a very high signal intensity bile and background at low. So the appearance of imaging is similar but MRCP has benefit of being noninvasive.

MRCP is useful in diagnosis of commonly occurring disorders of pancreato-biliary systems such as Cholelithiasis, Choledocholithiasis, Acute cholecystitis, chronic cholecystitis, CBD strictures, Acute Pancreatitis, Chronic Pancreatitis, and Pseudocyst of Pancreas. MRCP is also useful in diagnosis of less commonly occurring diseases like Gall Bladder carcinoma, Cholangitis, Cholangiocarcinoma, Ca pancreas, Perimpullary Ca and Congenital anomalies of ductal system.

Study aims and objectives were to detect various

pancreaticobiliary pathologies, to characterize various pancreaticobiliary pathologies and to evaluate role of MRCP in various pancreaticobiliary pathologies.

MATERIAL AND METHODS

The study was carried out in Department of Radiodiagnosis, BJGMC, Pune, with patients who presented with symptoms suggestive of involvement of pancreato-biliary system like pain in abdomen, jaundice, fever, vomiting. Detailed history of patients including name, age, sex, habits, chief complaints, with detail clinical examination was taken and findings were recorded. All patients referred for MRCP are kept fasting for at least 6 hrs prior to examination. The study was taken after clearance of institutional ethical committee.

Inclusion Criteria

Patients who presented with symptoms suggestive of involvement of pancreato-biliary system like pain in abdomen, jaundice, fever, vomiting etc who were referred to department of radiology in our institute were included in study. Almost all of these patients had undergone sonography prior to MRCP.

Exclusion Criteria

1. Patients with metallic implants, cardiac pacemaker, cochlear implant

2. Patients who are claustrophobic.

Machine: GE Signa HDxT Twinspeed 1.5 T MRI (USA).

Coil: Body coil.

FOV: 20x30 cm.

Matrix: 256 x 256, 352x352.

FOV and Matrix changes were done according to patients size and pathology.

Abdomen was assessed in axial, sagittal and coronal planes. Sedation was given if required for pediatric and irritable patients.

Recommended sequences

T2 SSFSE-Axial/Coronal, T2FRFSE-Axial, 2D IESTA-Axial / Coronal. Coronal 3D FSE (Resp. triggered), Axial thin slices T2 weighted, Coronal Oblique thick slab, T1-Axial / Coronal FAT SAT pre and post-contrast GRE (whenever indicated), Post contrast dynamic LAVA sequence (whenever indicated). Breath hold imaging acquisitions were used to reduce respiratory related artifacts.

A clinical, radiological correlation and confirmation of radiological diagnosis was done by Surgery / Biopsy / ERCP findings.

Statistical Methodology

Tabulation of data was done to study the benign and malignant characteristics of lesions which helped in diagnosis. Various bar charts were constructed to determine the occurrence of different lesions and their predilection according to age and gender. Data was analyzed descriptively.

RESULTS

Out of 40 patients 22(55%) were male and 18(45%) were females. Mean age of the subjects was 40.93 + 14.812. Various clinical symptoms of the patients were studied which revealed pain in abdomen in 95% of the patients followed by jaundice in 47.5%. Most patients were presented with overlapping of clinical symptoms. So many patients were having pain in abdomen and jaundice. Least found clinical

feature was fever (5%). Detailed evaluation of Pancreatic duct (PD) was done which showed its dilatation and tortuousness was most common feature; it is because of presence of chronic pancreatitis patients and gross dilatation in patients with periampullary carcinoma. Highest percentage of imaging

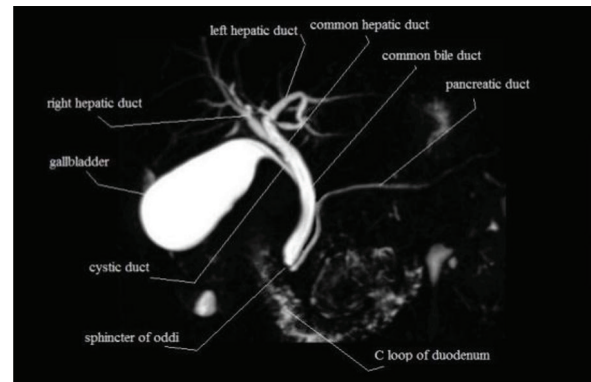


Figure-1: AXIAL T2W images of upper abdomen and 3D MRCP image showing normal radiological (MRI) anatomy of adult pancreaticobiliary system with visualization of hepatic ducts, CBD, gall bladder and pancreatic duct.

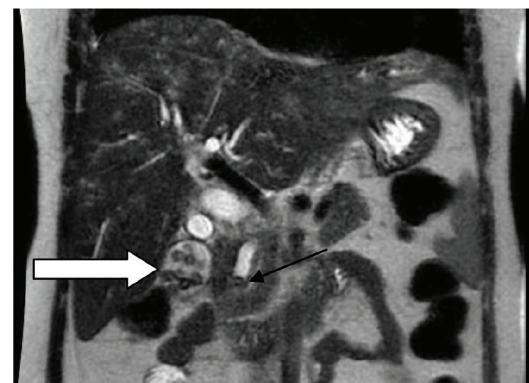


Figure-2: Coronal image showing hypointense calculi in gall bladder and single obstructive distal CBD calculus causing moderate IHBR dilatation. Hypointense sludge is also noted in the gall bladder.

| Diagnosis | No.of positive cases out of 40 patients | Percentage In total 40 patients | Confirmed on |
|--|---|---------------------------------|---|
| Cholelithiasis | 6 | 15% | Surgery/ERCP |
| Acute Pancreatitis with/without Pseudocyst | 7 | 17.5% | CT Abdomen/Lab findings (Sr.lipase & amylase) |
| Benign Stricture | 6 | 15% | Surgery/ERCP |
| Malignant stricture | 6 | 15% | Surgery/ERCP |
| Gall bladder carcinoma | 1 | 2.5% | Histopath |
| Periampullary Carcinoma | 3 | 7.5% | ERCP & Histopath |
| Choledocholithiasis | 4 | 10% | ERCP |
| Chronic Pancreatitis | 6 | 15% | ERCP |
| Normal study | 1 | 2.5% | ERCP |
| Pancreatic laceration | 1 | 2.5% | Surgery |
| Cholecystitis | 1 | 2.5% | Surgery |
| HIV Cholangiopathy | 2 | 5% | Surgery/ERCP |
| Choledochal cysts | 3 | 7.5% | ERCP |
| Pancreatic carcinoma | 1 | 2.5% | ERCP |

Table-1: Different benign and malignant pathologies in the study

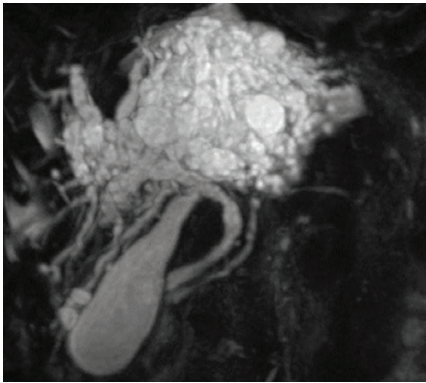


Figure-3: Coronal T2 SSFSE images showing grossly dilated intrahepatic bile ducts with no dilatation of extrahepatic bile duct suggestive of caroli's disease or Type IV choledochal cyst.

features were of CBD stricture (30%), acute pancreatitis (17.5%), followed by chronic pancreatitis (15%) (Table-1).

DISCUSSION

Evolution of suspected hepatobiliary and pancreatic pathologies has traditionally involved the investigations such as Ultrasound, CT and endoscopic retrograde pancreaticography. These investigations have certain limitations and less specificity to detect and characterize the stricture, stones. Previously invasive procedures were used prior to operative treatment. Therefore, MRCP an application of MR imaging is now used for noninvasive cholangiopancreatography. It provides good visualization of biliary tree.

Most common clinical symptom in our study was pain in abdomen seen in 38 patients, followed by jaundice seen in 19 patients. Least common presentation was fever, seen in 2 patients. Jaundice was predominantly the first presentation symptom in patients with malignancy.

In our study total Cholelithiasis was found in 6 (15%) patients, total choledocholithiasis was found in 4 (10%) patients. Isolated Cholelithiasis was found in 2(5%) patients and combination with choledocholithiasis was found in 2(5%) patients and isolated choledocholithiasis seen in 1 (2.5%) patient. This is because most of the patients with Cholelithiasis diagnosed on ultrasound without any CBD/IHBR dilatation are not further investigated and directly operated. Only few patients were investigated further with MRCP. Out of these biliary stones patients, majority were female patients suggesting female prediction for Cholelithiasis. Shadan et al² reported total choledocholithiasis (isolated + combined) in 20% patients. Maculay et al³ reported total choledocholithiasis in 14.2% patients. Our study matches with that of the Maculay et al in the choledocholithiasis percentage.

Most common location for CBD calculus is distal most CBD. MRCP clearly demonstrated IHBR dilatation, caliber of the CBD and exact location, size of the calculus, which is difficult to visualize on ultrasound. Advantage of MRCP is that stones as small as 3mm can be seen.

In our study, the strictures were detected in 30% of the patients who underwent MRCP for suspected pancreaticobiliary

diseases. This percentage is larger as compared to the other studies. Isolated strictures without any other abnormality were less common and seen in 6 patients. Other strictures were associated with other pancreaticobiliary pathologies, such as Ca Gall Bladder with spread to CBD causing stricture or pancreatic carcinoma causing distal CBD stricture. Out of 6 Isolated strictures in our study 3 were benign and 3 were malignant. Two patients were reported as stricture on endoscopy were associated with choledocholithiasis and cholelithiasis. Judy et al⁴ in study of 46 patients observed that CBD Stricture was identified in 25% of cases. Bhatt et al⁵ reported benign strictures in 4% cases and malignant strictures in 9% cases. Study conducted by Hurter et al⁶ reported benign strictures in 9.6% and malignant strictures in 5.7% cases. So our study is more related to Bhatt et al in malignant strictures and to Hurter et al in benign strictures comparison. Andrew C et al⁷ studied the MRCP in patients referred to the ERCP, which showed biliary strictures in 12 (9.3%) patients out of 129 MRCP done. More percentage for strictures in our study could be because of inclusion of the pathologies, which were involving the CBD and causing stricturous CBD narrowing. In our study distal CBD stricture were most common. One patient was given the diagnosis of benign distal CBD stricture on ultrasound so the patient was advised MRCP, which revealed isolated CBD calculus causing the dilatation of CBD and IHBR. Patient was undergone ERCP and successfully treated with Sphincterotomy.

It was observed that 3 (7.5%) cases of choledochal cyst were there in our study. Two patients were having Type I choledochal cyst and one patient was having Type V choledochal cyst (Caroli's disease). Type I choledochal cyst was associated with presence of choledocholithiasis and gall bladder calculi. One patient with type I choledochocoele was associated with anomalous pancreaticobiliary junction. The length of the common channel was 18.6mm. This resulted in the obstruction of the pancreaticobiliary secretion with formation of choledochal cyst in mid CBD. Both the choledochal cyst were involving the mid CBD. One case was Caroli's disease was included in our study. In our case, there was gross dilatation of the intrahepatic biliary dilatation with normal CBD and PD. It was giving as tuft of bile ducts appearance with few showing central dot sign. Cholangitis, Cholelithiasis, Choledocholithiasis, biliary abscesses, liver cirrhosis are all potential complications of choledochal cysts. Guy et al⁸ had three patient of Caroli's disease in their study in which they studied the imaging features of Caroli's disease about location and dilatations. They showed that MR imaging findings were sufficient to diagnose the Caroli's disease.

In our study, pancreatitis was seen in 13(32.5%) patients. Out of which acute pancreatitis was involving 17.5% and chronic pancreatitis patients constituted for 15% patients. Out of 13 patients of pancreatitis 3 patients were females rest 10 patients were males, suggesting male preponderance of pancreatitis. It could be because of more prevalence of alcohol consumption in males as a causative factor.

Detailed evaluation of pancreas is possible with the MRCP imaging as compared to all other imaging modalities such

size, texture, pancreatic duct dilatation, any fluid collections, any calculi in the pancreatic duct, anatomical variations.

Smooth dilated pancreatic duct was associated with 30.7% of patients. Most of these patients were of acute pancreatitis. Most common appearance of pancreatic duct was dilated and tortuous appearance for 46.15% patients, which was seen in all the patients of chronic pancreatitis. One case of pancreatic laceration was also included in our study. Patient was young age with history of blunt abdominal trauma presented with pain in abdomen. Pancreas was disrupted into two halves in the pancreatic body region with discontinuation of the pancreatic duct. Large traumatic fluid collection/pseudocyst was formed in peripancreatic region. All chronic pancreatitis patients were associated with presence of intraductal calculi. Few were having intraparenchymal calcifications as well. Two chronic pancreatitis patients were having multiple intercommunicating pseudocyst that were directly communicating with the pancreatic duct also. One (2.5%) patient of chronic pancreatitis was associated with pancreas divisum. Pancreas divisum is most common anatomical variant constituting for 4-14% at autopsy and 9% at MRCP. There is drainage of the pancreas through the dorsal pancreatic duct, many times ventral pancreatic duct may be absent. Shadan et al reported 10% cases of chronic pancreatitis.

Yagmarulu et al⁹ demonstrated a 11 patients with age ranging from 23 to 71 years (mean: 55.8 +/- 4.2) were diagnosed as having the variation "pancreas divisum" (4.4%). These peoples were associated with pancreaticobiliary diseases. Bret et al¹⁰ observed pancreas divisum in 9% of the patients.

In all the malignant pathologies (20%) evaluated, 7.5% were males and 12.5% were females so there was female predominance in present study. Most common malignant etiology in present study was malignant CBD stricture (15%) followed by periampullary carcinoma (7.5%). Out of three cases of periampullary carcinoma, one patient's ERCP report turned out to be Periampullary adenoma. The patient was having a nodular swelling the duodenal ampulla. Diagnosis given on MRCP was malignant neoplastic etiology- Periampullary malignancy. Periampullary carcinomas are associated with dilatation of both CBD and pancreatic duct called as double duct sign. One patient of CBD cholangiocarcinoma and hilar Klatskin tumor is included in present study. The Cholangiocarcinoma patient was showing polypoidal intraluminal mass lesion with gross dilatation of CBD and IHBR. Klatskin Tumor was seen at the confluence causing stricturous narrowing of both hepatic duct- Bismuth type IV stricture. One case of pancreatic head carcinoma was included in this study. One case of Carcinoma gall bladder was seen. Gall bladder wall was thickened and irregular with heterogeneous contrast enhancement. It was seen involving the adjacent liver parenchyma with hyperintense signal on T2W images and showing contrast enhancement. The tumor was seen extending along the cystic duct causing stricture of CBD with IHBR dilatation.

Advantage of MRCP over Ultrasound

- Provides high-resolution images of biliary tree. Diagnostic images both above and below obstruction are possible.

- 3D images of biliary tree can be obtained which can help in diagnosis and treatment planning
- Can be used in obese patients, children and those patients who are poor sonographic candidates due to technical factors and limited field of view as in postoperative patients.

Advantages of MRCP in evaluation of pancreaticobiliary pathologies

- There is no use of ionizing radiation.
- It provides all preoperative information required by surgeon about
- GB calculi and cholecystitis, Size of the calculus, Gall bladder mass lesion, GB wall thickness, GB wall surface, Diameter and presence of the calculus in CBD,
- Benign or malignant stricture.
- Main role of MRCP in modern era is to reduce or eliminate need for diagnostic ERCP which is a invasive procedure.
- MRCP is able to produce highly accurate cholangiographic images similar to that of direct cholangiography.

Limitations of MRCP

- Respiratory motion artifacts are common. Less occurrences with the newer fast spin Echo sequences.
- Requires breath hold for breath hold sequences, which is not possible if the patient is very sick.
- Susceptibility artifacts were common in sequences with steady state free precession techniques.
- MIP 3D images may completely obscure a very small filling defect due to the partial volume effect; therefore, evaluation should be based on the multiple source images.
- Limited spatial resolutions compared to ERCP in which there is direct opacification of ducts with contrast.

CONCLUSION

- Based on the imaging finding following conclusions can be made:
 1. MRCP is noninvasive, non-ionizing imaging modality for evaluation of the pancreaticobiliary anatomy and pathology. It is much superior in the diagnosis and evaluation of various pathologies as compared to the ultrasound and Computed Tomography.
 2. MRCP has highest resolution of the pancreaticobiliary tree. MRCP is capable of multiplanar imaging and 3D reconstruction.
 3. All the pancreaticobiliary pathologies can be evaluated with MRCP and additional gadolinium contrast T1W imaging can be done.
 4. Highest sensitivity of MRCP is for the any fluid collections in the pancreatic region as compared to other imaging modalities. The parameters that are best evaluated are the communication with the pancreatic duct, wall thickness, size and number.
 5. It is highly useful in postoperative patients of bilioenteric anastomosis which are difficult to evaluate on CT/ultrasound.

- As MRCP is noninvasive, it has similar sensitivity and specificity as compared to the ERCP in Choledocholithiasis and CBD stricture and chronic pancreatitis. So it is a safe presurgical imaging modality.
- If cost of MRCP is compared with that of Abdominal triphasic CT, it is little higher for MRCP but at the cost of high dose of ionizing radiation, decreased image resolution and decreased sensitivity.
- After preliminary ultrasound evaluation of abdomen in suspected cases of pancreaticobiliary pathologies, the next modality of choice should be MRCP. If the patient is not able to hold the breath or debilitated or there is contraindication for MR then one can go for quicker CT abdomen imaging.

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