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# Evaluation of Magnetic ResonanceCholangio-Pancreatography(MRCP) With Clinicalcorrelation in Bile Duct and Pancreatic Duct Abnormalities -A Prospective Study

**Dr. Nishtha Parashar, MD Radiology***Ex: Senior resident (Subharti Medical College, Meerut)*[1]
**Dr. Prabhanshu Dutt Sharma, *MS General Surgery* *Associate professor (NIIMS, Noida)***[2]
**Dr. Prashant K. Gupta,MD ,DMRE***Director Professor department of Radiology ( Subharti Medical College, Meerut*[3]
**Dr. Shubhangi Sharma,MD,DNBRadilogy***Ex: Registrar JP Hospital Noida.*[4]

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CONTEXT:Pancreato-biliary system had always be an challenging region of the human body and its pathological lesions are the major cause of morbidity and mortality. A clinico-radiological accurate and cost effective diagnostic workup of a suspected case of biliary and pancreatic duct system had always be fascinating for both clinician & Clinical Radiologist.[1] MRCP isnon-invasive and highly sensitive method of assessment of biliary and pancreatic duct system.[2]

AIMS: Magnetic Resonance Cholangio-pancreatography (MRCP) evaluation of biliary and pancreatic duct abnormalities to characterize the biliary and pancreatic disease and the morphologic evaluation of biliary and pancreatic ducts on MRCP.

SETTINGS AND DESIGN:. After the approval of the SubhartiMeadicalReasearch Committee and Ethical Committee, this prospective study was conducted from 1st October 2014 to 30th July'2016 on the cases referred from OPD/IPD of the C.S.S. Hospital, to the Department of Radio-diagnosis, Imaging & Interventional Radiology, N.S.C.B. Subharti Medical College and associated hospitals, Subhartipuram, Swami Vivekanand Subharti University, Meerut. The work was completed at N.S.C.B. Subharti Medical College and associated hospitals.

METHODS AND MATERIAL: All the patient, of different age groups and of both genders, referred to the department for diagnostic evaluation were examined by the clinicians and clinical data and features were recorded. A provisional clinical diagnosis was recorded.

Patient was subjected to diagnostic modality, Magnetic Resonance Cholangio-pancrratography (MRCP), after a informed consent, for confirmation of diagnosis and additional information were obtained and recorded. The MRCP features were recorded

STATISTICAL ANALYSIS USED:Specificity, sensitivity, positive and negative predictive values were calculated and expressed as percentages.

RESULTS: Maximum number of patients were in the age group 41-60 years. The predominant chief presenting complaint was of rt hypochondrium pain followed by jaundice. The most common diagnosis was choledocholithiasis followed by cholangiocarcinoma.

CONLUSIONS: This study proved that MRCP is an excellent imaging modality for evaluating the normal anatomy, variants and pathologies of the biliary and pancreatic tract .

KEY WORDS:USG,MRCP

KEY MESSAGES: MRCP is accurate and thus increasingly accepted means of imaging pancreato-biliary diseases.

## I. INTRODUCTION:

A number of imaging modalities are available for the evaluation of biliary pancreatic duct system. Current technologies include Ultra-sonography (USG), Endoscopic retrograde cholangio-pancreatography (ERCP), Endoscopic ultrasound (EUS), Per-cutaneous transhepaticcholangio-pancreaticography (PTC), Magnetic Resonance cholangio-pancreatography (MRCP), Computed tomography (CT) and helical CT cholangiography (h CTC). [3, 4]The imaging modalities are classified into direct and indirect techniques.[5]The former are invasive, that include ERCP and PTC. Despite of more sensitive (90%) and specific (98%), their role had been limited to the evaluation of intrinsic biliary tree and couldnot define the extrinsic obstructive pathologies.The main advantage of these techniques is the ability to sample tissue and perform therapeutic maneuvers,

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such as biliary drainage, stenting or stone removal. However, they carry higher risk of complications like bleeding, perforation or bile leak.[6]Moreover the required expertise and their availability is limited. Therefore the use of direct techniques is reserved to specific clinical situations. [7] MRCP isnon-invasive and highly sensitive method of assessment of biliary and pancreatic duct system.[2]It is accurate and thus increasingly accepted means of imaging pancreato-biliary diseases.

MRCP offers a number of advantages compared with ERCP/PTC.MRCP being non invasive is devoid of ERCP related complication like pancreatitis, gastrointestinal tract perforation and haemorrhage that occur in up to 5% of all ERCP examinations.[8] The present study has been undertaken to study the role of MRCP in evaluation of biliopancreatic disorders and to delineate anatomical variations and congenital anomalies in pancreatobiliary tract (if present) and to compare and analyze the findings of ultrasonography and MRCP in biliopancreatic disorders and correlate them with intraoperative findings, histopathological examination or image guided FNAC or biopsy, ERCP +/- sphincterotomy, laboratory investigations or clinical follow up.

The present study was a prospective study in suspected cases of bilary or pancreatic duct system with MRCP and to evaluate the radiological features of specific diseases with this modalities and to recognize the specific morphologic features in an accurate method especially to differentiate a benign from malignant pathologies of the pancreatic and biliary ductal system which may substantially reduce the cytological evaluation. The clinical, ERCP and histo-pathological correlation shall also be done wherever possible.

## II. SUBJECT AND METHODS:

**TYPE OF STUDY:**A prospective study

**SETTING:**Department of Radio-diagnosis, Imaging & Interventional Radiology, C.S.S.Hospital associated hospital of N.S.C.B. Subharti Medical College, Meerut.

**SUBJECTS:**A total of Sixty (60) Patients of both sexes and different age group, meeting the inclusion criterion, were the part of present prospective study. The cases referred to the Department of Radio-diagnosis and imaging from OPD/IPD of C.S.S. Hospital, under the aegis of N.S.C.B. Subharti Medical College, Swami Vivekanand Subharti University for a period from October'2014 to July'2016. A informed consent was taken from all the patients subjected for evaluation.

**INCLUSION CRITERIA:**All the cases presented and referred on clinical grounds for suspicion of Biliary and/or Pancreaticdiseases.

**EXCLUSION CRITERIA:**Patient who have been diagnosed, treated or operated earlier for any Biliary or pancreatic duct disease.

The study will include the cases referred to the Department of Radiodiagnosis and imaging from OPD/IPD of C.S.S.Hospital, under the aegis of N.S.C.B. Subharti Medical College, Swami Vivekanand Subharti University for a period from October'2014 to July'2016

## III. RESULTS:

After meeting inclusion criteria, a total sixty (60) patients of both sexes and different age group, were included in the present prospective study done from 1$^{st}$October'2014 to 31$^{st}$July'2016 These patients clinical and relevant blood investigations data was recorded and MRCP was done for evaluation of Biliary & Pancreatic duct system. The clinical data, MRCP findings were recorded, compared and analyzed to achieve the aims and objectives. The data collected was subjected to statistical analysis and results derived. The observations are presented as follows:

Table 1: CLINICAL DIAGNOSIS OF THE PATIENTS

| CLINICAL DIAGNOSIS | NO OF PATIENTS |
|---|---|
| Jaundice | 22 |
| Lump abdomen | 10 |
| Pancreatitis | 6 |
| Cholecystitis | 10 |
| Cholelithiasis | 6 |
| Others | 6 |

In this study, jaundice (36%) was the most common clinical diagnosis,followed by lump abdomen and cholecystitis.

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Table 2: NUMBER OF PATINETS SHOWING VARIOUS DISEASES AS OBSERVED ON MRCP.

| DIAGNOSIS | NUMBER OF PATIENTS | PERCENTAGE (%) |
|---|---|---|
| Mass lesions | 13 | 21 |
| Cholelithiasis | 5 | 8.3 |
| Cholecystitis | 1 | 1.6 |
| Choledocholithiasis | 6 | 10 |
| Cholelithiasis with cholecystitis | 3 | 5 |
| Cholelithiasis with choledocholithiasis | 11 | 18.3 |
| Choledochal cyst | 4 | 6.6 |
| Pancreatitis | 6 | 10 |
| Others | 11 | 13.4 |
| Total | 60 | 100% |

Table 3:Comparision of the level of stenosis on USG and MRCP

| LEVEL OF STENOSIS | FINAL | NO OF PT ON USG | NO OF PT ON MRCP |
|---|---|---|---|
| Intrahepatic /hilar | 10(31.2%) | 10(31.2%) | 10(31.2%) |
| Suprapancreatic | 12(37.5%) | 10(31.2%) | 12(37.5%) |
| Ampullary CBD | 10(31.2%) | 8(25%) | 9(28.1%) |
| | 32 | 28* | 31 |

*The level of stenosis could not be determined in four patients due to difficulty in sonographic evaluation.

Table 4**:**Comparision of the level of stenosis on USG & MRCP

| EXTENT OF STENOSIS | USG | MRCP |
|---|---|---|
| Could not be assessed | 4(12%) | 1(3.1%) |
| Partially assessed | 8(24%) | 1(3.1%) |
| Completely assessed | 20(62.5%) | 30(93,7%) |

Table 5:Cause of stenosis

| CAUSE OF STENOSIS | NO. OF PATIENTS | % |
|---|---|---|
| Benign | 22 | 68.7% |
| Malignant | 10 | 31.2% |

Table 6:Comparison of USG with MRCP in 20 patients with Choledocholithiasis

| SIZE | FINAL | USG | MRCP |
|---|---|---|---|
| >10 mm | 2(10%) | 2(10%) | 2(10%) |
| 5-10 mm | 14(70%) | 12(60%) | 13(65%) |
| <5 mm | 4(20%) | 1(10%) | 3(30%) |
| TOTAL | 100% | 15(75%) | 18(90%) |

Table 7:Association of Cholelithiasis in twenty two patients and its evaluation on USG & MRCP

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| ASSOCIATION OF CHOLELITHIASIS | NO OF PTS | DETECTED ON USG | DETECTED ON MRCP |
|---|---|---|---|
| Choledocholithiasis | 12 | 12 | 12 |
| Masses | 2 | 2 | 2 |
| Choledochal cyst | 2 | 2 | 2 |
| Pancreatitis | 1 | 1 | 1 |
| Others | 5 | 5 | 5 |
| Total | 22 | 22 | 22 |

Table 8: Diagnostic performance of MRCP for evaluation of various diseases

| | SENSITIVITY | SPECIFICITY | POSITIVE PREDICTIVE VALUE | NEGATIVE PREDICTIVE VALUE | DIAGNOSTIC ACCURACY |
|---|---|---|---|---|---|
| Choledocholithiasis | 90% | 97.5% | 94.7% | 95.1% | 95% |
| Biliary duct stenosis | 96.9% | 96.2% | 96.9% | 96.2% | 96.6% |
| Benign cause of biliary duct stenosis | 90.9% | 90.9% | 90.9% | 94.7% | 93.3% |
| Malignant cause of biliary duct stenosis | 90.9% | 90.9% | 90.9% | 97.9% | 96.9% |
| Level of biliary duct stenosis | 96.9% | 92.5% | 94.1% | 96.1% | 95% |

## IV. DISCUSION

The present prospective study comprising sixty patients with clinical symptoms (abdominal pain and obstructive jaundice) or biochemical evidence or Ultrasound features consistent with either bile duct and/or pancreatic pathologies.

Out of sixty patients, thirty nine patients were females (65%) and twenty one were males (35%), females were affected more common than males and Maximum number of patients were in the age-group of 40-60 years, the range was 8-94 years, mean age was 48.43 years, these findings were in corroboration with the study of **Nandalur KR et al.**[9]The commonest presentation in this study was pain in the abdomen and Jaundice.

In our study group, choledocholithiasis comprised the largest group n=18 (30%) and followed by mass lesions n=13 (21%)

Presence Of Stenosis

The diagnostic value of MRCP was evaluated to detect bile duct stenosis and in this study 31 cases . MRCP was seen to have sensitivity and specificity of nearly 96% for detecting the presence of biliary stenosis .

**Regan et al**[8]in a prospective study on MRCP demonstrated biliary dilatation in 100% cases. A recent meta-analysis of 67 published controlled trials by **Romagnuoloetal**[10]have shown both sensitivity of 95% and specificity of 95% for detecting the presence of biliary obstruction.

Level and Extent of Stenosis

The stenoses were localized at the intrahepatic or hilar level in 10 patients (31.2%), the suprapancreatic portion of the common bile duct in 12 patients (37.5%), and the intrapancreatic or ampullay level in 10 patients (31.2%).

The ability of MRCP for detecting the level of stenosis was good and had a sensitivity of 96.9%.The level of obstruction was picked up more accurately by MRCP than by ultrasound.

**Romognuolu et al**[10] found an accuracy of 95% for MRCP for detecting the level of stenosis .Other authors like **Reinhold C et al**[11]found that MRCP could predict the level of stenosis in 85-100%.

**Vaishali et al** [12]reported a diagnostic accuracy of 96.3% for detecting the level of stenosis on MRCP.

For MRCP extent of the lesion could be determined in a majority of patients 30/32 (93.7%). One patient missed by MRCP was a case of cholangiocarcinoma causing complete cut-off at the hilum and therefore leading to non-visualization of the ducts distal to the mass. Surgery confirmed the MRCP finding by showing complete obliteration of the biliary lumen and longer extent of involvement by the mass . This finding is in corroboration with the study conducted by **Soto JA et al**[13]who suggested that in case of mass lesions, when MRCP is combined with MRI ,a complete staging information can be obtained as to the tumour size, bile duct involvement and vascular invasion.

Cause Of Stenosis

On the basis of the final diagnoses, 32 patients had stenoses; causes of stenoses were benign in 22 patients (68.7%) and malignant in 10 patients(31.2%).

Choledocholithiasis comprised the maximum number of cases, with mass lesions(n=10).

Previous studies[4] have also shown choledocholithiasis and pancreaticobiliary malignancies to be the most common cause of obstructive jaundice. Out of 22 patients having benign stenosis cholangitis(associated with choledocholithiasis) was found to be the most common cause of benign stenosis constituting 20% of the total population and Gb mass with periampullary carcinoma (18.3%) found to be the most common cause of malignant stenosis (total=10)in the current study.

MRCP was found to have a sensitivity of 90.9%, specificity of 94.9% and a PPV of 90% for detecting the benign cause of stenosis in our study. The diagnostic performance of MRCP in diagnosing malignant stenosis was found to be better (sensitivity=90.9%, specificity=97.9%, PPV=90.9%) and was improved after adding MRI.

**Hekimoglu K et al**[15]compared MRCP and ERCP in the evaluation of biliary pathologies and found MRCP had 100% sensitivity and a 100% specificity for 20 patients in malignancies. It also had 100% PPV, 100% NPV, and 100% total accuracy rates in this group.

**Romognuolo et al** [10]**,** has found MRCP to be less reliable (88%) for the differentiation between benign and malignant obstruction. **Vaishali et al**[12]found sensitivity of 94.44% for differentiating benign and malignant cause of obstruction which is comparable to our result of 100%.

Choledocholithiasis

On the basis of the final diagnosis, 20 patients had choledocholithiasis and 40 patients did not. Four patients had calculi less than 5 mm, and 14 patients had 5-10-mm calculi.

The diagnostic value of MRCP for detecting choledocholithiasis is observed in this study and in 57 cases, the presence or absence of calculi was correctly diagnosed. Calculi were associated with mild or distinct bile duct dilatation in 15 cases and with non-dilated bile ducts in five cases. MRCP detected eighteen calculi whereas USG was informative in fifteen patients.

In patients with multiple calculi the exact number and the size of the calculi could be delineated more clearly on MRCP as compared with USG. .

**Pasanen P et al**[14]found that the sensitivity of ultrasound for choledocholithiasis varies widely from 20% to 80% with a high specificity of approximately 98%.

**Hekimoglu K et al**[15]found that MRCP had a 88.9% sensitivity and a 100% specificity for diagnosing biliary stone disease. Its positive predictive value (PPV), negative predictive value (NPV) and accuracy rates were 100%, 99.2% and 99.2%, respectively. Other authors like **Mendler MH et al**[16]have also found decreasing sensitivity in detecting stones according to the stone size: 67-100% for stones > 10mm size, 89-94% for stones measuring 6-10mm, and 33-71% for bile duct stones < 6mm in size.

In all the 4 cases of choledochal cysts, the entire extent of biliary involvement was seen on MRCP but not on USG. USG was able to give a confident diagnosis of choledochal cyst in only two of 4 patients whereas MRCP detected all 4 cases.

In patients with pancreatitis, USG gave limited information and the exact nature of the biliary obstruction could not be delineated. MRCP could demonstrate the presence of a benign stricture but it also gave limited information on the status of the pancreas as a whole wherein MRI abdomen gave the complete diagnostic information.

Ultrasound was not able to assess the cystic duct in 18/31 patients whereas MRCP was non-informative with regard to cystic duct in only one patient. Also, it was found that MRCP could visualize the cystic duct more easily and pick up abnormality in 22(66%) cases as compared with ultrasound in only 6 cases (18%).

**Miyazaki T et al** [17]reported visualization of the cystic duct in 88% using HASTE MRCP sequences.

Congenital Anomalies and Variations of The Pancreatico Biliary Tract MRCP demonstrated normal bile and pancreatic ducts in 91.7% (n=55)

of patients. In the remaining 8.7% (n=5), it documented anatomical variants and congenital anomalies. Variants of the intrahepatic bile duct were seen in 1.6% (n=1) of cases . Variants of the extrahepatic bile ducts were present in 3.2%(n=2) of patients.

Pancreatic divisum was found in 1.6%(n=1) of cases,annular pancreas present in1.6%(n=1)of cases. Type I choledochal cyst accounted for 75% of all bile duct cyst and was found to be the most common choledochal cyst.

**Thungsuppawattanakit P et al**[18]found atypical branching pattern of intrahepatic bile duct in 35% cases. The highest incidence of variation was trifurcation in 17.2%, anomalous drainage of RP into CHD in 5.5% and drainage of RP into LHD in 9.2%,Other variations in 3.1% included the presence of an accessory duct and drainage of RP into common bile duct.

**Choiet JW et al**[19]and **Onder H et al** [20]also showed similar results.

## V. CONCLUSION

MRCP is an non invasive diagnostic Imaging Modality for the diagnosis of bilio-pancreatic diseases and can be considered part of a comprehensive MR study of the upper abdomen In our study we sought the role of MRCP in evaluation of biliopancreatic disorders and anatomical variations in pancreatobiliary tract and compared and analyzed the findings of USG and MRCP in biliopancreatic disorders and correlated them with intra-operative findings, histo-pathological examination or image guided FNAC or biopsy, ERCP +/- sphincterotomy, laboratory investigations or clinical follow up. USG is the first modality of choice in the diagnostic evaluation of the patient with suspected bile duct or pancreatic duct pathologies however the MRCP is superior to USG and could be comparablewith ERCP indetectionofextrahepaticbileductand pancreatic duct abnormalities.

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LEGENDS

FIGURE 1:3D MRCP image showing abrupt cut off of CHD at hilum in case of cholangiocarcinoma at biliary confluence

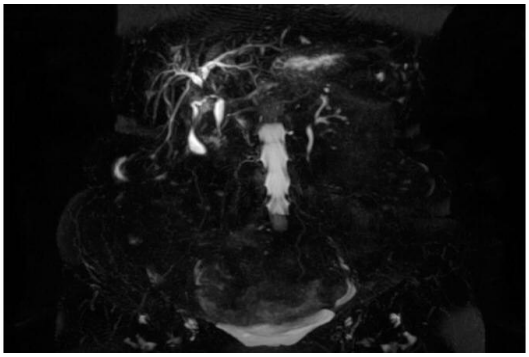

FIGURE2: 3D MRCP image showing gross dilatation of IHBR &EHBR with abrupt cut off of at distal CBD in a case of cholangiocarcinoma at distal CBD

FIGURE3: 3D MRCP image showing gross dilatation of biliarypancreatic ducts with abrupt narrowing at ampulla in acase of periampullary carcinoma

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FIGURE4: 3D MRCP image showing signal void at distal end of CBD with proximal dilatation of biliary tree in case of choledocholithiasis

FIGURE5: 3D MRCP image showing signal void at fudus of gallbladder and at distal end of CBD in a case of cholelithiasis with choledocholithiasis

FIGURE6: Thick slab coronal image showing multiple signal void in the lumen of gallbladder in a case of cholelithiasis

FIGURE7: 3 D MRCP image showing multiple fluid collections in & around the region of pancreas in a case of acute pancreatitis with forming pseudocysts

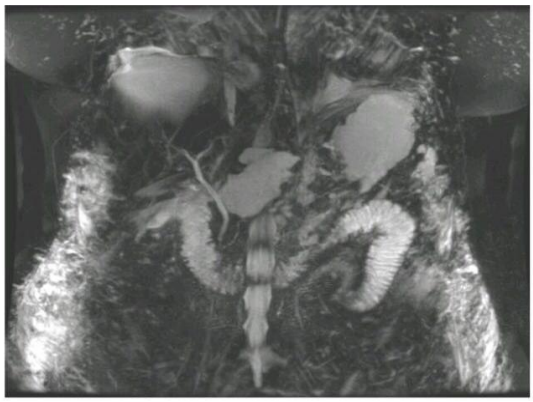

FIGURE8: 3D MRCP image showing multiple small fluid collections in the region of pancreas in a case of chronic pancreatitis

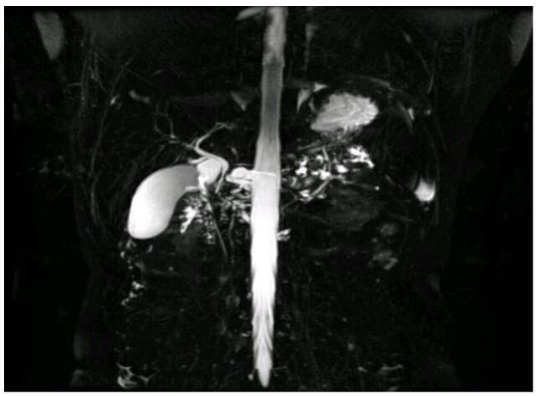

FIGURE9: 3D MRCP image showing pancreatic duct encircling second part of duodenum in a case of annular pancreas

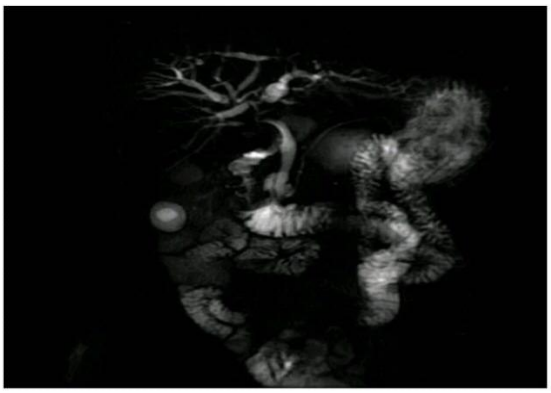

FIGURE10: 3D MRCP image showing focal dilatation of CBD in a case of Type I choledochal cyst

FIGURE 11: 3D MRCP image showing focal dilatation of CBD with multiple signal voids in gallbladder lumen in a case of choledochal cystwith cholelithiasis

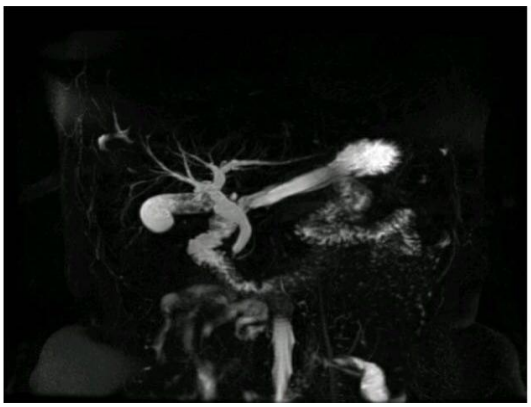

FIGURE 12: 3D MRCP image showing multiple segmental dilatations of intra and extra hepatic biliary channels in acase of Type IV choledochal cyst