Original Research

The study of role of magnetic resonance cholangio-pancreatography (MRCP) in pancreato-biliary disorders

Nehal Diwanji[1], Rajeev B Dibbad[2], Mona Sastri[1], Ekta Desai[1]

[1]Department of Radiology, Surat Municipal Institute of Medical Education and Research, Surat, Gujarat, India.
[2]Department of Radiology, S.D.M College of Medical Science and Hospital, Dharwad, Karnataka, India.
Correspondence to: Nehal Diwanji, E-mail: nehaldiwanji@yahoo.co.in

Received July 14, 2016. Accepted August 10, 2016

Abstract

Background: Evaluation of suspected biliary obstruction 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 of intra-ductal stones 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.

Objective: To describe the MRCP appearance of pancreatico-biliary diseases and differentiating benign from malignant strictures, and also to determine sensitivity, specificity, and accuracy of MRCP in the detection of pancreatico-biliary diseases.

Materials and Methods: A prospective study carried out over a period of 2 years. If on ultrasonography patient having pancretico–biliary disease then s/he would be selected for the study. Once the patient agrees to participate in the study, information is obtained as per the performa. MRCP was done in all participants.

Result: The peak incidence of pancreatico-biliary diseases is seen in the age group of 61–70 years with 9 (22.5%) participants. Common presenting complaint were right upper quadrant pain seen in 37 (92.5%) patients followed by yellowish discoloration of skin and sclera, present in 29 (32.5%) of patients. The cases of cholangiocarcinoma predominated and was seen in 08 (20 %) patients followed by choledochal cyst in 06 (15 %) and cholelithiasis-choledocholithiasis in 6 (15%). Benign diseases were seen in 21 (52.5%) participants while malignant diseases in 19 (47.5%). Sensitivity and specificity of MR pancreatico-cholengiography scan for pancreatico-biliary diseases was nearly 95%. Also accuracy of diagnosis was also 95%.

Conclusion: MRCP is providing useful criteria in differentiating benign from malignant strictures. MRI in combination with MRCP has the advantage of multiplanar capability, high tissue contrast, combining projectional, and cross sectional images in the evaluation of the biliary system. After the initial USG examination in these patients, the next investigation should be MRI with MRCP.

KEYWORDS: Pancreatico-biliary diseases, magnetic resonance cholangio-pancreatography (MRCP)

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2016.14072016578	

Introduction

Evaluation of suspected biliary obstruction 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 of intra-ductal stones 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.[1]

Ultrasonography 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.[3,4] ERCP is operator dependent and invasive procedure and it is associated with 1–7% morbidity and 0.2%–1% mortality.[2] MRI plays a vital role in diagnosing many conditions of the pancreatico-biliary tract. On MRI various pancreato-biliary diseases like primary sclerosing cholangitis, acute and chronic pancreatitis, pancreatic, and gall bladder carcinoma can accurately diagnosed. It is a non-invasive, non-ionizing imaging modality and is unaffected by bowel gas shadow.[3]

However, with the development of higher magnetic field strength and newer pulse sequences, MRCP with its inherent high contrast resolution, rapidity, multiplanar capability, and virtually artifact free display of anatomy and pathology in this region is proving to be an examination of choice in patients with pancreatico-biliary diseases.[4] This imaging technique is able to create projectional type images similar in detail and appearance to direct cholangiography. It avoids the use of tntravenous (IV) contrast and ionizing radiation and is relatively operator independent. Several recent studies have demonstrated that MRCP is able to accurately identify common bile duct stones with sensitivity of 81–100%.[5] Biliary strictures can also be visualized with sufficient anatomic detail to determine the level of obstruction and in some instances, differentiate benign from malignant causes. MRCP has potentially two major advantages in neoplastic pancreatico-biliary 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, and death.[6]

The objective of the study was to describe the MRCP appearance of pancreatico-biliary diseases and differentiating benign from malignant strictures, and also to determine sensitivity, specificity, and accuracy of MRCP in the detection of pancreatico-biliary diseases.

Materials and Methods

It was a prospective study carried out in the Department of Radiodiagnosis, Medical College and S.S.G. Hospital, Vadodara, over a period of 2 years. Permission from Institutional Ethics Committee and hospital superintendent was taken before starting the study.

The study was conducted in coordination with department of Surgery. Patients were selected from the outpatient as well of inpatient department of surgery. Patients with suspected pancreatico–biliary abnormality (right abdominal lump and/or yellowish discoloration of urine or skin) are screened for ultrasonography. If on ultrasonography patient having pancretico–biliary disease then s/he would be selected for the study. However, s/he could be included in the study only if s/he gave informed written consent. Patients having cardiac pacemakers, prosthetic heart valves, cochlear implants or any metallic orthopedic implants were excluded from the study. Once the patient agrees to participate in the study, information is obtained as per the performa. Detailed demographic data, clinical history like detailed history jaundice, abdominal pain, fever, anorexia, and abdominal lump was taken. Past history, family history, and drug history were elaborated. General and systemic examination specifically abdominal examination was done. Various laboratory investigation related to pancreatico-biliary function were done in each participant. The magnetic resonance imaging scan (MRI scan) was done in all participants using 1.0 Tesla PHILIPS MRI MACHINE and various parameter were noted and the final diagnosis was confirm by senior radiologist. The data analysis was done using rates, ratios, and percentages of different diagnosis and outcome made by MRCP will be computed and compiled.

All participants were followed up and examined clinically, biochemically, and radiologically as indicated. The radiological diagnosis was correlated with ERCP, surgical findings, and histopathology correlation was done whenever possible.

Result

A total of 54 patients having suspected pancreatico-biliary diseases were screened for the study. Out of which 40 patients, who were clinically diagnosed as having pancreatico-biliary diseases, were sent for MRCP and are included in the present study.

In the present study the peak incidence of pancreatico-biliary diseases is seen in the age group of 61–70 years with 9 (22.5%) participants falling in this age group. The age ranges from 3 to 77 years (Table 1). Gender wise distribution shows slight preponderance towards female with male:female ratio is 1:1.2. Common presenting complaint was right upper quadrant pain, which was present in 37 (92.5%). This was followed by yellowish discoloration of skin and sclera, present in 29 (32.5%) of patients. The others were vomiting, loss of appetite, fever, and lump in the abdomen as seen in Figure 1.

In the present study, the cases of cholangiocarcinoma predominated and was seen in 08 (20%) patients followed by choledochal cyst in 06 (15%) and cholelithiasis-choledocholithiasis in 6 (15%). There are 4 cases, where there were more than one positive findings related to pancretico–biliary tract on MRCP. One participant had chronic pancreatitis with inflammatory stricture of distal CBD that was included in group of chronic pancreatitis. One had chronic choleclystitis with ampullary stenosis that was included in cholecystitis group. One another had cholelithiasis with distal CBD stricture, that was included in cholelithiasis group and one had inflammatory stricture of CBD with cholelithiasis that was included in

Table 1: Agewise distribution in pancreatico-biliary diseases

Age (Years)	No. of patients	Percentage (%)
< 20	4	10
21–30	5	12.5
31–40	5	12.5
41–50	7	17.5
51–60	4	10
61–70	9	22.5
>70	6	15
TOTAL	40	100

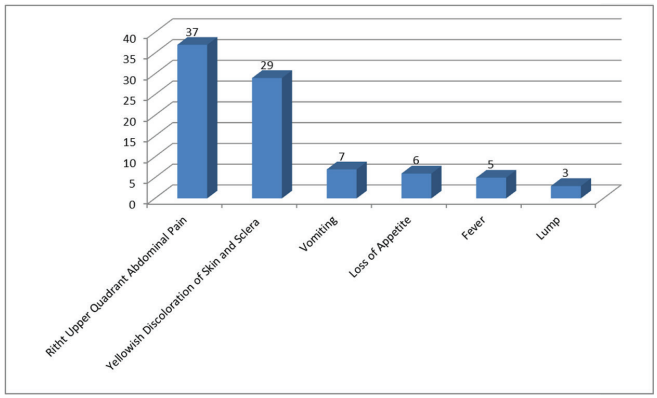

Figure 1: Presenting complaints

group of benign CBD stricture. So, benign diseases were slightly more 21 (52.5%) as compared to malignant diseases 19 (47.5%).

In the present study, 6 patients were showing dilatation of only intrahepatic biliary radicals (IHBR). 5 of these were due to clatskin tumor cusing hilar obstruction and one was due to carcinoma GB with hilar invasion. Only 1 patient was showing dilatation of solely extrahepatic biliary radicals (EHBR), due to type 1 C choledochal cyst. 15 patients were showing dilatation of both IHBR and EHBR, out which 4 cases were due to malignant causes and 11 were due to benign causes. Malignant causes include periampullary carcinoma (2 cases) and carcinoma GB (2 cases). In the benign etiology, 5 patients had choledochal cyst, 4 patients had choledocholithiasis and 6 patients had benign stricture as a cause. Five patients had dilatation IHBR, EHBR as well as CD, out of which one patient had cholangiocarcinoma at junction of CHD and cystic duct, another one had choledochal cyst and rest 3 had choledocholithisis. Three patients had dilatation of only pancreatic duct and all these patients had chronic pancreatitis. Ten patients had dilatation of IHBR, EHBR, and PD and double duct sign was positive in these patients. Eight of these had malignant disease and only 2 patients had benign disease. Malignant causes include pancreatic head carcinoma (3 cases), cholangiocarcinoma (2 cases) and periampullary carcinoma (3 cases). Among benign causes there were one case of scerosing cholangitis and one case of chronic pancreatitis with benign CBD stricture.

In present study, out of 40, 6 patients had abnormal gall bladder (GB) lumen and 8 had GB wall thickening. Among abnormal GB lumen, 5 had grossly distended lumen and one had GB carcinoma replacing its lumen. Grossly distended GB was due to cholangiocarcinoma (1 case), pancreatic head carcinoma (1 case), periampullary carcinoma (2 cases) and benign distal CBD stricture (1 case). GB wall thickening was seen in 8 patients. Among them one patient had focal wall thickening due to carcinoma GB, 4 patients had diffuse wall thickening and 3 patients had both focal and diffuse wall thickening. Among patients with diffuse wall thickening 3 cases were of cholecystitis and among patient with both focal and diffuse wall thickening, 2 cases were of carcinoma GB. One patient with diffuse thickening and one patient with focal and diffuse thickening had Klatskin tumor, in which GB wall thickening was associated findings.

As seen in Table 3, sensitivity, and specificity of MRI scan for pancreatico-biliary diseases was nearly 95%. Also accuracy of diagnosis was also 95%.

Table 2: Number of patients with biliary duct, cystic duct and pancreatic duct dilatation

Dilated ducts	No. of patients	Percentage (%)
IHBR only	6	15
EHBR only	1	2.5
IHBR + EHBR	15	37.5
IHBR + EHBR +CD	5	12.5
PD only	3	7.5
IHBR + EHBR + PD	10	25
Total	40	100

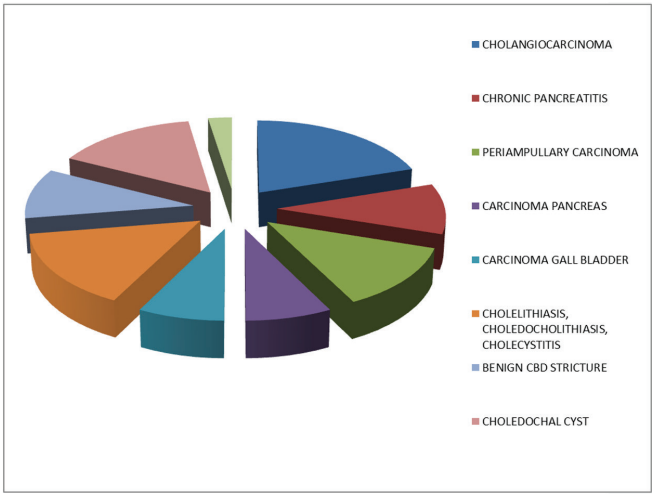

Figure 2: Number of patients showing various pancreatico-biliary diseases

Table 3: Overall sensitivity, specificity, PPV and NPV of MRCP for pancreatico-billiary diseases

MRCP findings	Final diagnosis		
	True positive (malignant)	True negative (benign)	Total
Test positive (maliganant)	18	1	19
Test negative (benign)	1	20	21
Total	19	21	40
MRCP	**Percentage**		
Sensitivity	94.73		
Specificity	95.23		
Accuracy	95		
PPV	94.73		
NPV	95.23		

Discussion

Evaluation of pancreatico-biliary diseases is a common radiological problem. Advances in ultrasonography, computed tomography and magnetic resonance imaging technology over the past decade have greatly improved the ability to evaluate the biliary tract. The main aim of this study was to describe the MRCP appearance in pancreatico-biliary diseases and determine sensitivity, specificity, and accuracy of MRCP in the detection of pancreatico-biliary diseases.

In present study, 36 patients had some form of biliary obstruction, 3 patients had chronic pancreatitis and one patient had chronic pancreatitis with biliary obstruction. The aim in patient with biliary obstruction is to determine the presence or absence of obstruction, level of obstruction, and the cause of obstruction. Both benign and malignant can cause biliary obstruction. MRCP with its excellent diagnostic capabilities, it has certainly carved a niche for itself in the non invasive evaluation of the patient with biliary obstruction. In present study, MRCP correctly diagnosed presence of obstruction in all 37 patients with some form of obstruction, with overall accuracy of 100%. According to Macaulay et al.,[7] MRCP depicted 100% cases of biliary obstruction. This is in correlation with the findings of present study. In the study series of Reinhold et al.,[2] MRCP diagnosed the presence of bile duct obstruction in 91–100% of the cases.

For detection of level of obstruction in pancreatico-biliary disease, Pavone et al.[8] described all-in-one approach, with acquisition of T1- and T2-weighted images. The all-in-one approach can provide the identification, characterization, and staging of the lesion, giving the clinician all the information necessary for the planning of adequate treatment. With all-in-one approach in present study, MRCP had correctly diagnosed level of obstruction in all 37 patients with overall accuracy of 100%. The accuracy for detecting the level of obstruction has been described between 90% and 100%.[9,10] The higher sensitivity in the present study was due to the all-in-one approach which gives additional multiplanar conventional MR sequences in addition to the MRCP to assess the level of obstruction.

The sensitivity, specificity, and diagnostic accuracy for detection of cause of biliary obstruction in present study were 94.73%, 94.44% and 94.59%, respectively. In the study of Guibaud et al.,[10] the sensitivity, specificity, and overall accuracy for detection of biliary obstruction was 91%, 100%, and 94%, respectively. In the study of Becker et al.,[11] the specificity for detection of biliary obstruction was 91–98% and comparable to the present study. The higher sensitivity in detecting the cause of biliary obstruction in the present study by MR imaging was due to the all-in-one approach and smaller study group (n=37).

In diagnosing the carcinoma gall bladder the sensitivity and specificity were 100% and was superior to USG with detection of level of obstruction, loco regional spread and preoperative staging in all the cases. This result was comparable with the results of Reinhold et al.[2] There were 4 patients who had choledocholithiasis and 3 patients had cholecysitits with more than one finding in 5 of 6 patients. In all cases of cholelithiasis and choledocholithiasis, MRCP clearly showed the IHBR dilatation, caliber of CBD and the site of the calculus, especially in the distal CBD which is difficult to visualize on ultrasound. MRCP accurately detected changes of acute or chronic cholecystitis in all 3 cases. The sensitivity, specificity, and accuracy of MRCP for calculus diseases are 100% in present study. Similar 100% results had also been reported by Soto.[12] Calculi which are missed by MRCP (MIP images) are most of the times picked up by the source images and conventional cross sectional imaging as small filling defects within the bile filled dilated common duct. There were 6 cases of choledochal cysts in present study, which included 2 cases of type I and 4 cases of type IV choledochal cyst. All the 6 cases of choledochal cysts were correctly diagnosed and classified by MRI with MRCP similar to the study of Upadhyaya et al.[13]

In present study there were 12 cases of CBD stricture, which include 7 cases of benign CBD stricture, and 5 cases of malignant CBD stricture. One case of distal CBD fibrosis was misinterpreted as a malignant stricture and one case of periampullry adenocarcinoma (malignant stricture) was wrongly diagnosed as a distal CBD benign stricture. The sensitivity, specificity, and accuracy of MRCP in differentiating benign from malignant strictures were 80%, 87.5%, and 84.61%, respectively. Park et al.[14] retrospectively studied MRCP criteria for differentiating benign from malignant stricture and found sensitivity, specificity, and accuracy of 81%, 70%, and 76%, respectively. They found that irregular margins and asymmetric narrowing were more common in cholangiocarcinomas than in benign strictures. There were 5 case of periampullary carcinoma, which include 3 cases of ampullary mass, one case of periampullary adenocarcinoma and one case of duodenal malignancy. MRI was able to delineate the extent, level and local infiltration and helped in staging of the lesion, with sensitivity, specificity, and diagnostic accuracy of 100%. The assessment of the periampullary lesions was difficult on ultrasound in obese patients and bowel gas shadows is also a limiting factor. Sugita et al.[15] in his study of 25 cases of periampullary tumors reported a sensitivity 88%, specificity 100%, and diagnostic accuracy of 96%. Eight cases of cholangiocarcinoma were evaluated which include 5 cases of Klatskin tumor and 3 cases of extrahepatic duct cholangiocarcinoma. In one patient with Klatskin tumor MRCP also diagnosed vascular invasion. In extrahepatic cholangiocarcinoma MRCP has accurately assessed level of obstruction and its extent. In 2 patients it had also showed extension of mass into ampullary region with help of axial images. Three cases of carcinoma head of the pancreas was correctly diagnosed by MRCP (100%). Hanninen et al.[16] in a study of 66 patients of suspected pancreatic cancers reported a diagnostic accuracy, sensitivity, and specificity of 91%, 95%, and 96% with MRCP. In present study double duct sign was seen in 10 patients, out of whom 8 had malignant disease and only 2 had benign disease.

In a study by Fulcher et al.,[17] MR cholangiography was found to be accurate in detecting primary sclerosing cholangitis (PSC) and in defining the extent of disease. In the detection of PSC, the sensitivity, specificity, PPV, and NPV were 88%, 97%, 94%, and 94%, respectively. In present study, only one case of sclerosing cholangitis which was accurately diagnosed by MRCP, however ERCP findings were not available. In that patient MRCP accurately showed multiple strictures, irregularities of bile ducts and also showed bile duct wall thickening. In present study, there were 4 cases of chronic pancreatitis, which was accurately diagnosed by MRCP, with overall accuracy of 100%. Tamura and Ishibashi[18] retrospectively studied 24 patients with chronic pancreatitis and determined the accuracy of MRCP for depiction of pathologic changes and found the overall sensitivity, specificity, and accuracy for depiction of pathologic changes with MRCP were 88%, 98%, and 91%, respectively.

In present study, 40 patients with pancreatico-biliary diseases underwent MRCP evaluation, out of which 38 patients were correctly diagnosed and properly evaluated by MRCP with sensitivity, specificity, PPV, and NPV of 94.73, 95.23, 94.73, and 95.23 respectively. Study by Shanmugam et al.[19] showed sensitivity, specificity, PPV, and NPV was 97.98%, 84.43%, 83.62%, and 98.10%, respectively. Thus in present study it was found that MRCP was highly sensitive, specific, and accurate imaging modality for various pancreatico–biliary pathologies.

Conclusion

In conclusion the MRI serves as a sensitive, specific, accurate and non invasive, non ionizing imaging method for evaluation of pancreatico-biliary anatomy and pathology. MRCP is providing useful criteria in differentiating benign from malignant strictures. MRI in combination with MRCP has the advantage of multiplanar capability, high tissue contrast, combining projectional and cross sectional images in the evaluation of the biliary system. After the initial USG examination in these patients, the next investigation should be MRI with MRCP.

References

1. Magnuson TH, Bender JS, Duncan MD. Utility of magnetic resonance cholangiography in the evaluation of biliary obstruction. J Am Coll Surg 1999; 189: 63–72.
2. Reinhold C, Taorel P, Bret P et al. Choledocholithiasis: evaluation of MR cholangiography for diagnosis. Radiology 1998; 209:435–42.
3. Katsuoyshi, Donald MG, Outwater. Primary sclerosing cholangitis: MR imaging features. AJR 1999; 172:1527–33.
4. David, Reinhold C, Wang L, Kaplan R et al. Pitfalls in the interpretation of MR Cholangiopancreatography. AJR 1998; 170:1055–9.
5. Morimoto, Shimoi M, Shirakawa T et al. Biliary obstruction evaluation with 3 dimensional MRCP. Radiology 1992; 183:578–80.
6. Wallner BK, Schumacher KA, Weidenmaier W et al. Dilated biliary tract – evaluation with MR cholangiography with a T2 weighted contrast-enhanced Fast sequence. Radiology 1991; 181: 805–8.
7. Macaulay SE, Schulte SJ, Sekijima JH et al. Evaluation of a non-breath-hold MR cholangiography technique. Radiology 1995; 196: 227–32.
8. Pavone P, Laghi A and Passariello R. MR Cholangiopancreatography in malignant biliary obstruction. Seminars in Ultrasound, CT and MRI 1999; 20(5): 317–323.
9. Ishizaki Y, Wakayama T, Okada Y et al. Magnetic resonance cholangiography for evaluation of obstructive jaundice. The Am J Gastroenterol 1993; 88(12): 2072–7.
10. Guibaud L, Bret PM, Reinhold C et al. Diagnosis of choledocholithiasis – value of MR cholangiography. AJR 1994; 163: 847–50.

11. Becker CD, Grossholz M, Becker M et al. Choledocholithiasis and bile duct stenosis – diagnostic accuracy of MR Cholangiopancreatography. Radiology 1997; 205: 523–30.
12. Soto JA. Bile duct stones: diagnosis with MRCP and helical CT. Seminar US, CT, MR. 1999; 20 (5): 304–16.
13. Upadhyay V et al. comparative assessment of imaging modalities in biliary obstruction. IJRI 2005, 16:577–82.
14. Mi-Suk Park, Tae Kyoung Kim, Kyoung Won Kim et al. Differentiation of extrahepatic bile duct cholangiocarcinoma from benign stricture: findings at MRCP versus ERCP. Radiology 2004; 233:234–40.
15. Sugita R, Furuta A, Ito K, Fujita N, Ichinohasama R, Takahashi S. Periampullary tumors: high spatial MR imaging and histopathologic findings in ampullary region specimens. Radiology 2004;231:767–74.
16. Enrique Lopez Hänninen, Holger Amthauer, Norbert Hosten et al. Prospective evaluation of pancreatic tumors: accuracy of MR imaging with MRCP and MR angiography. Radiology 2002; 224:34–41.
17. Ann S Fulcher, Mary A Turner. Primary sclerosing cholangitis: evaluation with MR cholangiography-a case-control study1. Radiology 2000;215:71–80.
18. Ryo Tamura, Tadashi Ishibashi. MRCP versus ERCP for quantitative caliber measurement and qualitative evaluation.
19. Shanmugam V, Beattie GC et al. Is magnetic resonance cholangiopancreatography the new gold standard in biliary imaging? British J Radiol2005;78:888–93.

How to cite this article: Diwanji N, Dibbad RB, Mona Sastri M, Desai E. The study of role of magnetic resonance cholangiopancreatography (MRCP) in pancreato-biliary disorders. Int J Med Sci Public Health 2016;5:2635-2640

Source of Support: Nil, **Conflict of Interest:** None declared.