

Role of Magnetic Resonance Cholangiopancreatography in Patients with Pancreatic Biliary Disease

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Abstract

Background: Magnetic resonance imaging is helpful in evaluating pancreaticobiliary disease after preliminary screening by ultrasonography, instead of undergoing repeated ionizing radiation exposure or invasive procedures such as endoscopic retrograde cholangiopancreatography (ERCP) or transhepatic biliary procedures. Magnetic resonance Cholangiopancreatography (MRCP) is more sensitive in identifying lesions of cystadenomas and cystadenocarcinomas of the biliary tree. The present study was designed to evaluate the role of MRCP in Pancreaticobiliary diseases. **Subjects and Methods:** A hospital based Prospective Cross-sectional study was conducted in 50 patients with Pancreaticobiliary diseases using 3T whole-body MR system. Pancreatic, biliary diseases were evaluated on all the sequences. **Results:** Of the 50 patients, males and female ratio is 2.1:1, and the mean age was 45 years. Biliary anatomical variants are seen in 10 cases. Biliary congenital anomalies (Choledochal cysts) are seen in 3 cases. Biliary stone diseases are seen in 26(52%) cases. Out of 26 cases, 19(38%) patients showed cholelithiasis, and 7(14%) patients showed choledocholithiasis. Among the patients with biliary strictures (9), the most common are benign strictures observed in 7 patients, and the two are malignant. Distal CBD is most commonly involved than proximal CBD. Three pancreaticobiliary malignancies were identified, which were proved on histopathological examination. One case is hilar cholangiocarcinoma, one case is distal CBD cholangiocarcinoma and another case is carcinoma head of the pancreas. **Conclusion:** Most common cause identified in evaluating idiopathic acute pancreatitis is distal CBD stones suggesting acute gall stone pancreatitis. MRCP is a sensitive, very reliable non-invasive imaging that helps diagnose hepatobiliary disorders, predominantly in patients undergoing biliary enteric anastomosis, for knowing the level and extent of strictures. The diffusion-weighted sequence was helpful in characterizing the pancreatic neoplasms.

Keywords: Hepatobiliary Disorders, Cholangiocarcinoma, Magnetic Resonance Cholangiopancreatography.

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Introduction

Neoplasms of the bile and pancreatic ducts put major challenge both for diagnosis and treatment. These tumors may arise primarily from the ducts or may involve the pancreaticobiliary tree secondarily by extension from metastatic tumors of the liver, gall bladder, pancreas or adjacent lymph nodes. Before definite therapy, knowledge of the level of obstruction and its cause is essential. Evaluation of suspected biliary obstruction has involved various imaging modalities, including Ultrasonography, Computed Tomography, and invasive cholangiography. These techniques have limitations, such as less sensitivity for intraductal stones on ultrasound and CT, and there is a need for invasive procedures like ERCP and Percutaneous Transhepatic Cholangiography. Magnetic Resonance

Cholangiopancreatography (MRCP) is a non-invasive imaging modality that provides good visualization of the hepatobiliary system.^[1,2]

CT scan also has its own limitations, especially in demonstrating two important pathologies, biliary stones and biliary strictures.^[3-5] As there are limitations for US and CT and invasiveness of PTC, IVC, and ERCP, there is necessity for an imaging modality that is non-invasive and provides high resolution projection images of the biliary pancreatic duct. MRI primary sclerosing cholangitis shows several characteristic features, including bile duct abnormalities and increased liver parenchyma enhancement. Acute pancreatitis can be distinguished from chronic pancreatitis; complications such as hemorrhage or pseudocyst formation are well examined with MRI.^[6] MRI is frequently able to distinguish focal enlarge-

ment due to chronic pancreatitis from that due to pancreatic carcinoma. MRI can depict the extent of gall bladder carcinomas and contribute to this disease's staging.^[7]

With the development of newer pulse sequences and higher magnetic field strength, MRCP with its inherent high contrast resolution, multiplanar capability rapidly, and virtually artifact-free display of pathology and anatomy in this region makes it the examination of choice in patients with pancreaticobiliary diseases.^[8]

This imaging technique can create projectional type images similar in detail and appearance to direct cholangiography. It avoids the use of Intravenous (I.V) contrast and ionizing radiation and is relatively operator-independent. Several latest studies have demonstrated that MRCP can identify CBD stones with sensitivity of 81-100%. Biliary strictures can also be visualized with adequate anatomic detail to determine the obstruction level and differentiate benign from malignant causes. MRCP has potentially two major advantages in neoplastic pancreaticobiliary obstruction. Firstly, MRCP can clearly reveal extraductal tumor, whereas ERCP is confined to the duct lumen. Second, MRCP is not having a major complication rate of approximately 3%, which is associated with ERCP like sepsis, bile leak, bleeding, and death. The aim of the study is to evaluate the spectrum of findings in pancreatic and biliary disorders on MRCP.

Subjects and Methods

The study protocol was approved by Intuitional Ethics Committee of our medical institution. A Hospital-based Prospective Cross-sectional study was conducted on a total of fifty patients of pancreaticobiliary disease. This sample size was calculated by taking into account 80% of the average of similar cases in the previous three years hospitalized in our tertiary care centre. All patients referred for MRCP with clinically suspected pancreaticobiliary disease attending to clinical department of our hospital.

Inclusion Criteria

All cases referred for MRCP in clinically suspected cases of pancreaticobiliary disease attending Narayana Medical College and Hospital, Nellore over a period of one year.

Exclusion criteria

Patients having Cardiac pacemakers, prosthetic heart valves, cochlear implants, or any metallic orthopedic implants, and Patients with claustrophobia.

Equipment

The MRCP examinations performed on all patients who met inclusion criteria at a 3T whole-body MR system (DISCOVERY 750W 3T MRI GE Healthcare, Chicago, Illinois) using a 32-channel phased-array torso coil.

A complete clinical history of patients was taken, which included name, age, sex, occupation, presenting complaints. This is followed by general physical examination and detailed abdominal examination with examination of other significant systems. All the required biochemical parameters like Liver function tests (bilirubin, SGOT, SGPT, ALP), Sr.Amylase, Sr.Lipase, Complete Blood Picture are obtained for correlation.

Preparation of the Patient

All patients were instructed to fast for 6 hours prior to examination. MR imaging is carried out in a supine position with respiratory triggering.

Follow-Up

Cases were followed up clinically, biochemically, and radiologically as indicated. The Radiological diagnosis was correlated with ERCP, surgical findings and histopathology correlation.

Statistics

After taking consent from the patient, information is obtained as per the proforma. After confirming the findings, the MRCP sequences were taken. Data analysis was done using Rates, ratios, and Percentages of different diagnoses, and the outcome made by MRCP will be computed and compiled.

Results

Using 3T MRI, along with 3D MRCP, SSFSE, and T2 FS sequences were performed in 50 clinically suspected cases of pancreaticobiliary diseases in our study. All the images were studied independently by two different Radiologists with good experience in evaluating MRCP.

Fifty cases were referred for MRI with suspicion of pancreaticobiliary disorders were subjected to MRCP and included in the study. Male preponderance was noted with 68% (34), and females were 32 % (16). There were 22 patients in 41-60 years, 18 patients in 21-40 years, 8 patients in >60 years, and two patients in <20 years age groups were noted, respectively.

The maximum cases diagnosed on MRCP were Cholelithiasis (38%) followed by chronic pancreatitis (22%), Biliary Duct Anomalies(20%), choledocholithiasis (14%), Choledochal Cysts(6%), Malignancies(6%), and Bile duct Injury(4%).

Anatomical variants of biliary tree

In our study, out of 50 patients, anatomical variants of the biliary tree are detected in 10(20%) patients. Rest 40 (80%) patients have the typical Type I configuration of RHD, with RPD joining RAD to form RHD.

Out of 10 patients, 8 cases have different RHD variants, 1 case had a variant of the cystic duct and 1 with gall bladder anomaly. In RHD variants; 5 patients showed trifurcation

Table 1: Distribution of Cholelithiasis and Choledocholithiasis as observed on MRCP in our study

| S No | Observations | Cholelithiasis | Choledocholithiasis | Cholelithiasis & Choledocholithiasis |
|------|--|----------------|---------------------|--------------------------------------|
| 1 | Total No of Patients | 14 | 7 | 5 |
| 2 | Males Females | 8 6 | 3 4 | 3 2 |
| 3 | Associated with Cholecystitis | 3 | - | 2 |
| 4 | Associated with Cholangitis | 1 | - | 1 |
| 5 | Associated with Acute Pancreatitis | - | 2 | 1 |
| 6 | Associated with Biliary strictures | 1 | - | 1 |
| 7 | Associated with other congenital abnormalities | - | 1 | 1 |

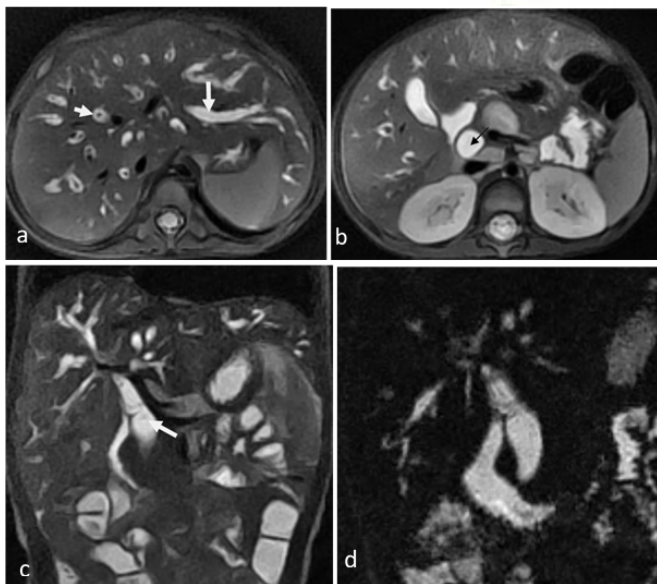


Figure 1: A 2year old female child presented with features of obstructive jaundice. USG showed IHBRD and dilated CBD. MRCP revealed Type IVa Choledochal cyst fusiform-fusiform type a) Axial T2 FS sequence showing fusiform dilatation of bilobar intrahepatic biliary radicles (white arrows), b) dilated extrahepatic CBD(black arrow),c) Coronal SSFSE sequence showing fusiform dilatation of extra hepatic CBD and intrahepatic biliary radicles, d) 3D MRCP image showing fusiform dilatation of both intra and extra hepatic biliary duct.

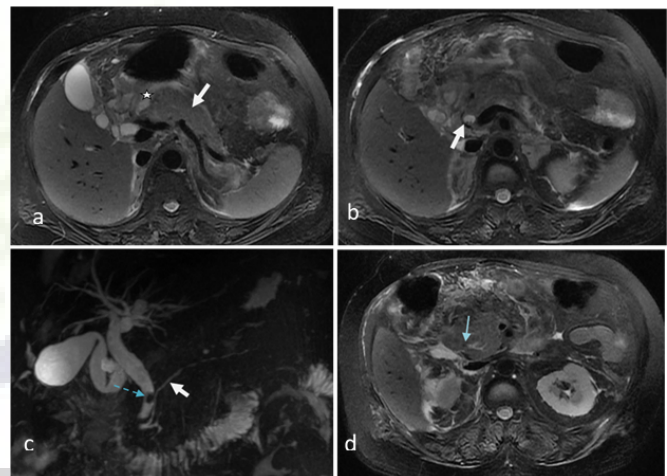


Figure 2: A 45year old male patient presented with acute pain abdomen with no alcoholic history and elevated Sr Amylase and Lipase levels. USG showed features of acute pancreatitis. MRCP revealed (a) Axial T2 FS sequence showing bulky pancreas (white arrow) with mild peripancreatic T2 hyperintense fluid (*), (b) Axial T2 FS sequence showing few tiny filling defects (calculi)in intrapancreatic part of CBD, (c) Reformatted 3D MRCP image showing filling defect(calculi) (dotted blue arrow) in distal CBD with resultant upstream dilation of CBD & IHBRD and dilated MPD (white arrow)also can be seen, (d) Axial T2 FS sequence showing tiny calculus in ampulla of Vater (blue arrow) and bulky uncinete process with peripancreatic fluid tracking along the anterior pararenal space.

configuration (Type 2) (10%), one patient showed RPD joining CBD (IV) (2%), one patient showed RAD joining CHD (Type V), and one patient showed aberrant segment six duct draining into CHD (Type V) (4%). Out of 10 patients, 1(2%) patient showed cystic duct variant, which is seen joining into

the duodenum directly, and 1(2%) patient showed dual gall bladder, a rare variant [Table 1, Figure 6].

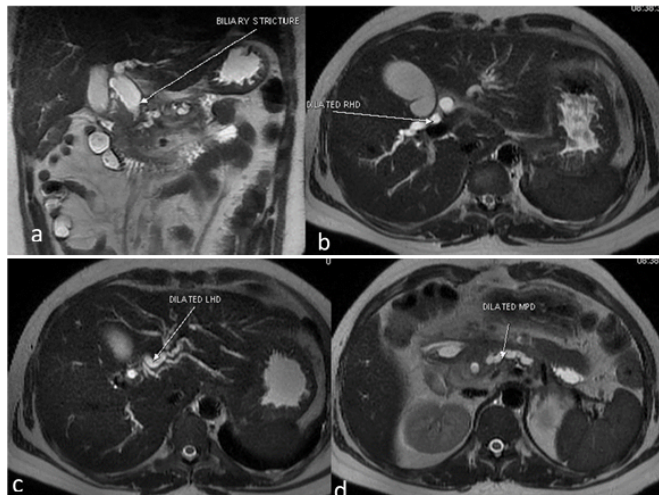


Figure 3: A 28-year-old male patient with chronic pancreatitis and symptoms of obstructive jaundice. MRCP revealed (a) Coronal FFSE image showing smooth tapering of the distal part of the CBD with resultant upstream dilatation of the CBD. Sludge was noted within the narrowed part of the CBD. Axial FFSE images (b) dilated RHD and (c) dilated LHD. (d) Axial FFSE image showing atrophic pancreas with dilated MPD.

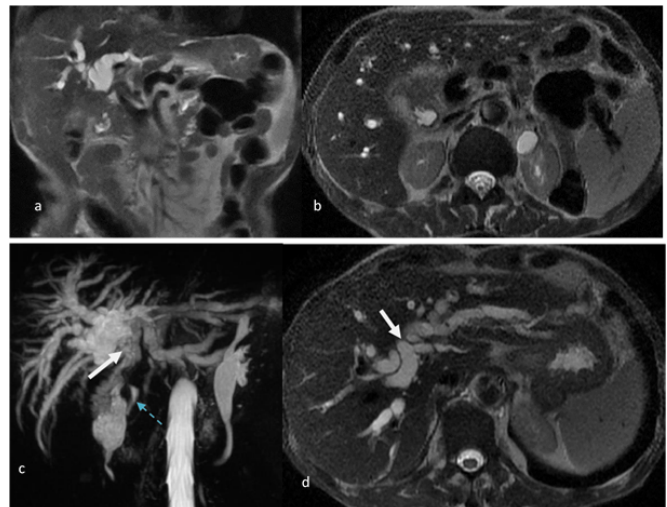


Figure 4: A 73-year-old male patient presented with features of obstructive jaundice. MRCP showed Hilar Cholangiocarcinoma (Type I Bismuth Corlette classification). (a) Coronal (b) Axial SSFSE image showing T2 hypointense irregular wall thickening involving the common hepatic duct, however, the primary confluence is maintained. There is near-total occlusion of the lumen with resultant upstream bilobar IHBRD; (c) 3D MRCP image showing extensive IHBRD with an abrupt cut-off just beneath the confluence and the distal intrapancreatic part of the CBD is visualized normally; (d) T2 FS axial image showing IHBRD.

There are 5 cases of Interstitial Edematous Pancreatitis and Necrotizing Pancreatitis in 4 cases are seen.

Etiology of Acute Pancreatitis: Alcoholic, acute gall stone pancreatitis, and Idiopathic etiology seen in 4, 3, and 2 cases, respectively.

Etiology for Biliary Strictures: Chronic Pancreatitis, Post Infectious, Post Procedure, and Malignant etiology recorded in 4, 1, 2, and 2 cases, respectively.

Site of Stricture of Biliary System as observed on MRCP: Proximal CBD in 3 cases and Distal CBD in 6 cases were noted as Biliary Strictures site.

Three pancreaticobiliary malignancies were identified, which were proved on histopathological examination. One case is hilar cholangiocarcinoma, one case is distal CBD cholangiocarcinoma and another case is carcinoma head of the pancreas. One case was reported with pancreatic head adenocarcinoma.

Discussion

In our study, out of 50 patients, anatomical variants of the biliary tree are detected in 10 (20%) patients. Rest 40 (80%) patients have the typical Type I configuration of RHD, with RPD joining RAD to form RHD. Among ten patients with the biliary duct anatomical variants, six were male, and 4 were

females.

In our study, the hourglass gall bladder with cholelithiasis is identified in the US and turned out to be a Y-shaped double gall bladder with upper and lower moieties with two separate cystic ducts opening into the CBD on 3D MRCP.

Liu QY et al. reported that malignancy is most commonly seen with types I and IVA choledochal cysts and Caroli disease and Caroli's disease and the commonest being cholangiocarcinoma.^[9,10]

In our study, choledochal cysts are detected in 3 cases out of 50 patients. Among these 3, two cases are Type I choledochal cysts with no obvious proximal dilatation of biliary radicles on MRCP and seen in adults of age range 20 to 30 years. Among these three patients, 2 are females, and one is male. Out of two cases, one showed choledocholithiasis. They presented with abdominal pain; however, they do not have significant biliary obstruction features and underwent surgical management as there is a risk of development of cholangiocarcinoma in choledochal cysts. One patient of age 2 years is classified under Type IVA choledochal cyst with extensive intrahepatic and extrahepatic biliary cysts. The child is managed symptomatically in our hospital and referred to

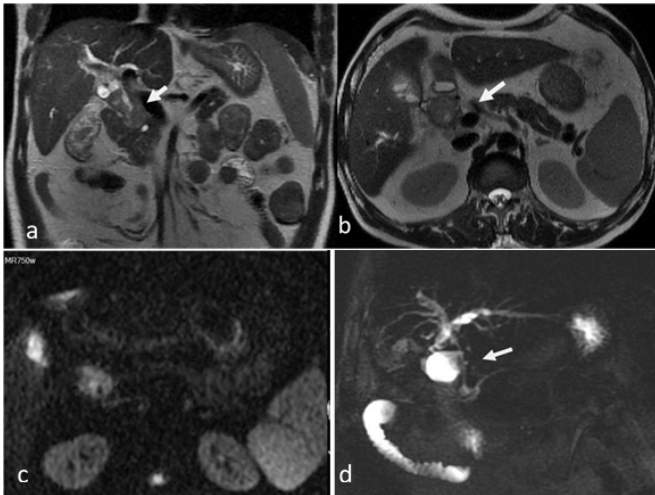


Figure 5: A 60 year old male patient presented with features of obstructive jaundice. USG showed dilated CBD with IHBRD. MRCP showed distal CBD Cholangio carcinoma. a) Coronal b) Axial SSFSE image showing irregular T2 hypointense wall thickening with maintained fat planes involving the distal CBD, however confluence is maintained. There is mild resultant upstream dilatation of proximal CBD and IHBRD, c) The irregular thickening area of distal CBD is showing diffusion restriction, d) MRCP showing irregular filling defect.

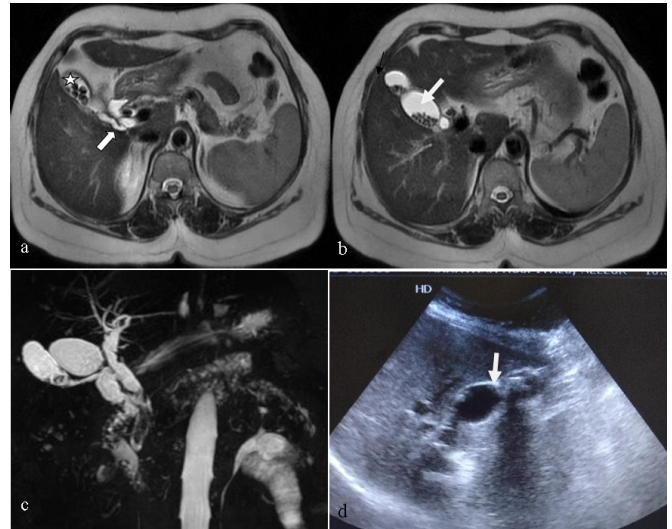


Figure 6: Dual gallbladder. A 54 year female patient presented with pain abdomen USG (d) revealed hour glass gall bladder with calculi. MRCP revealed Y shaped dual Gall bladder, (a) Axial SSFSE image showing inferior moiety GB (*) with cystic duct draining into the CBD (depicted by white arrow). Few filling defects noted in lumen of gall bladder suggestive of calculi. (b) Axial SSFSE image showing both moieties of GB, upper moiety is depicted by white arrow and lower moiety denoted by black arrow. (c) Reformatted 3D MRCP image depicting dual gall bladder with superior and inferior moieties and cholelithiasis and choledocholithiasis

higher centers for further management.

In our study, biliary stone diseases are seen in 26 (52%) cases. Out of 26 cases, 19 (38%) patients showed cholelithiasis, and 7 (14%) patients showed choledocholithiasis. Out of 19 cases, five patients had associated choledocholithiasis, five patients had calculous cholecystitis, three patients had acute pancreatitis, one patient had distal CBD stricture, and 1 had focal cholangitis. Prior US detected cholelithiasis in 18 cases and associated choledocholithiasis in 2 patients only as distal CBD could not be adequately evaluated. However, MRCP detected choledocholithiasis in 5 patients, which were confirmed and managed by ERCP. One patient in the US showed an isoechoic GB lesion, but MRCP showed sludge with tiny calculi diagnosed as cholelithiasis per operatively. Another patient showed the distal CBD stricture and Focal cholangitis, which was not detected in the US, which later identified on preop MRCP, and were managed medically followed by surgery.

In our study, seven patients out of 25 patients with the biliary stone disease showed choledocholithiasis—all these patients presented with symptoms of biliary obstruction and elevated liver function tests.

Bhat et al. report the results of a randomized controlled trial comparing an MRCP-first strategy with an ERCP-first strategy in patients with suspected benign biliary obstruction. The authors found that while an MRCP-first strategy reduced the number of ERCPs required by 50%. A cause of biliary obstruction was found in 39.7% vs. 49.6% of patients ($P = 0.11$) ERCP vs. MRCP, respectively.^[11]

In our study, nine patients showed features of acute pancreatitis. MRCP was done out of which five were of interstitial edematous pancreatitis type, and 4 were necrotizing pancreatitis. Five cases were of unknown etiology, and MRCP was indicated to know the cause. Among these 5 patients, three patients showed gall stones in distal CBD and ampulla of Vater (Acute gall stone pancreatitis). In a study done by Barlow AD et al. on 173 suspected gall stone pancreatitis patients, 52 (30%) showed choledocholithiasis.^[12]

Four among the nine patients showed necrotizing pancreatitis, and the etiological factor is chronic alcohol consumption. Two of them showed pseudocysts, and there were no MPD ductal anomalies, disruptions, and pancreatic fistulas identified in our

representative study population. Recently there is an increased role of DWI and ADC values in evaluating the early AP.

De-Freitas Tertulino et al. found that the ADC value can distinguish mild inflammation from necrosis of the pancreas, which is significant for evaluating the severity of acute pancreatitis. In our study, 11 patients showed features of chronic pancreatitis. MPD is dilated in 9 cases, and intraductal filling defects (calculi) are noted in 5 cases. Four patients had biliary strictures in an intrapancreatic portion of the CBD. Two cases had pseudocysts, there is no obvious communication between the pseudocyst, and the MPD noted.^[13]

In the present study, three pancreaticobiliary malignancies were identified, which were proved on histopathological examination. Another patient with postcholecystectomy status with CBD stent showed irregular T2 hypointense wall thickening involving the distal CBD with proximal dilatation of CBD and IHBRD. On DWI, the lesion showed diffusion restriction, and on MRCP irregular filling defect was noted. The patient underwent follow-up ERCP and surgical management and histopathologically proved to be cholangiocarcinoma.

ERCP is having a crucial role in the workup of a patient with suspected biliary stricture yielding high-spatial-resolution images, allowing tissue biopsy, thereby aiding in establishing the diagnosis, and has therapeutic applications. However, ERCP is an invasive procedure that requires an intravenously administered sedative and ionizing radiation, and it is relatively time-consuming.

Visualization of biliary ductal morphology with MR imaging—MR cholangiopancreatography is comparable to that with ERCP.

Venkata S et al. reported that multidetector CT and MR imaging are equally effective in tumor detection with a sensitivity of 91% and 84%, and assessment of tumor resectability (sensitivity of 82% and 81%, respectively). MR imaging is routinely used as a “problem-solving” tool in suspected cases of non-contour-deforming pancreatic masses at multidetector CT, small masses (<2 cm), and patients with inconclusive CT findings. In the present study, one case was reported with pancreatic head adenocarcinoma. On MRCP, ill-defined lesion with slight T2 hyperintensity on the background of chronic pancreatitis.

In the present study, nine patients showed biliary strictures, out of which seven are benign, and two are of malignant etiology. Among these nine patients, proximal CBD is involved in 3 patients, and distal CBD is involved in 6 patients. The etiology for the benign strictures in decreasing order is Chronic pancreatitis (4/7), post-procedure (2/7), and post-infectious (1/7) [Figure 3].

Katabathina et al. showed chronic pancreatitis accounts for about 10% of all benign biliary strictures, and the prevalence of strictures in patients with chronic pancreatitis varies from

3% to 46%.^[12]

Shanbhogue AK et al. reported that recurrent pyogenic cholangitis is mainly due to recurrent bacterial cholangitis, intrahepatic pigment stones, and biliary obstruction. Epidemiologically the disease is more prevalent in Southeast Asia.^[14]

In our study, two patients showed malignant strictures due to hilar cholangiocarcinoma and another due to distal CBD cholangiocarcinoma [Figure 5]. Contrast-enhanced MR imaging with MR cholangiopancreatography is very useful in evaluating the bile ducts in patients with obstructive jaundice [Figure 1]. Although biopsy is necessary for distinguishing malignant from benign strictures, certain MR imaging findings of the narrowed segment may favor a malignant cause. Thus, MRCP helps the surgeon plan the patient’s surgical management with fewer complications and better patient outcomes.

The limitation of this study was MIP 3D images might 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; Secretin MRCP protocol is presently not available in our institution, thus limiting the evaluation of early pancreatic duct pathologies.

Conclusion

Evaluation of pancreaticobiliary system with a combination of MRI and MRCP helps manage and better patient outcomes. MRCP provides the complete anatomy and normal variants of the biliary and pancreatic ductal system, enabling the surgeon to perform surgeries efficiently. Potentially useful in patients undergoing biliary enteric anastomosis for knowing the level and extent of strictures. Respiratory triggering MRCP allows the easy and accurate diagnosis of pancreaticobiliary diseases in children and morbid patients who are unable to hold breath. 3D MRCP is becoming the choice of investigation in renal failure patients in evaluating pancreatitis as contrast CT studies are Contraindicated due to elevated renal parameters. The efficacy of MRI and MRCP is at par with that of ERCP and can be considered the gold standard for evaluating the pancreaticobiliary system.

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