Original Article
MVP Journal of Medical Sciences, *Vol 7(2), 216-224, July-December 2020*
ISSN (Print) : 2348–263X
ISSN (Online) : 2348-2648
DOI: 10.18311/mvpjms/2020/v7i2/22909

Magnetic Resonance Cholangiopancreatography (MRCP) Evaluation of Pancreatico-Biliary Diseases

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Abstract

Introduction: Magnetic Resonance Cholangiopancreatography (MRCP) is a non-invasive and important imaging modality useful for study of pancreas and biliary system using advanced rapid imaging and invention of new sequences for pancreatic and biliary ductal system. **Aims and Objectives:** To study role of Magnetic Resonance Cholangiopancreatography (MRCP) finding in various pancreatico-biliary pathologies. **Results:** Total 60 cases were studied with various pancreatico-biliary conditions. Variety of study showed that 37(62%) out of 60 cases were encountered with biliary pathologies followed by pancreatic lesion in 17(29%) cases and pancreatic-biliary lesions were present in 6 (9%) cases. Among the lesions, most common cases were of obstructive etiology in 24(40%) followed by inflammatory condition in 21(36%), congenital lesions in 7(11%), neoplastic lesions seen in 6(10%) and strictures in the 2 (3%) cases. **Conclusion:** According to our study, MRCP is an advanced and noninvasive diagnostic imaging of choice for the pancreatico-biliary lesions.

Keywords: Choledocholithiasis, Magnetic Resonance Cholangiopancreatography (MRCP), Pancreatitis

1. Introduction

Ultrasonography (USG) and Computed Tomography (CT) have limited ability with poor visualization of intraductal pathologies with requirement of invasive procedures like Endoscopic Retrograde Cholangio-Pancreatography and Percutaneous Trans hepatic Cholangiography (PTC). Magnetic resonance Cholangio-pancreatography (MRCP) is a non-invasive imaging diagnostic technique which provides good visualization of hepatobiliary system[1].

Magnetic resonance cholangiopancreatography is considered for direct visualization of biliary tree and pancreatic duct, and provides images similar to those obtained with invasive cholangiography viz. PTC and ERCP. MRCP does not require use of contrast medium or any biliary intervention, with combination of advanced projectional and cross-sectional imaging, so MRCP considered as diagnostic technique that can replace endoscopic retrograde cholangiopancreatography (ERCP) in most clinical scenario. MRCP technique is based on heavily T2W images which result in remarkable increase in contrast between stationary fluid (bile) and background like abdominal fat, hepatic and pancreatic parenchyma[2–5].

This method was first introduced by Wallner BK *et al.*, in 1991. He first used breath hold 2D T2W Steady State Free Precession (SSFP). With the period of time, advancement and rapid Magnetic Resonance (MR) imaging technology has upgraded overall resolution that have led to better understanding of diseases of the hepatobiliary and pancreatic ducts at MR cholangiopancreatography. Comparatively higher water contents and greater stability or less fluidity of bile as compared to flowing blood in

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adjacent vessels in portal tracts aid in better visualization of bile containing structures. This modality can potentially replace endoscopic retrograde cholangiopancreatography and percutaneous transhepatic cholangiography as for diagnostic purposes[6].

2. Aims and Objectives

To study the MRI findings among pancreatico-biliary diseases.

3. Materials and Methods

- **Type of Study**: This is a Descriptive study
- **Study Period**: JAN 2017 – OCT 2018 (22 months)
- **Study Setting**: The study was conducted in MRI section of Department Radio-diagnosis of Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Nashik, Maharashtra.
- **Study Participants: Sample size:** 60 cases

Obtained by the formula - where, Proportion (p)

n =**5.4%** $n = \frac{z^2 - p(1-p)}{d^2}$

z = **1.96** (at 95% confidence interval)
Margin of error (d) = **3.5%**

Inclusion Criteria

- All patients who presented with sign or symptoms of Biliary or pancreatic pathology after initial clinical evaluation by senior surgeon or physician and referred for evaluation of Biliary or pancreatic pathologies or to detect the anomaly preoperatively, were included in this study.
- All age groups and both the sexes, including children, adult and old age patients were included in study.

Exclusion Criteria

- Children's, especially very young children's who cannot obey commands of breath holding were excluded.
- Hemodynamically unstable, unconscious and the patient on ventilator or other life support were excluded.
- Patient having contraindication for MRI, as patient with cardiac pacemaker, recent history of non MRI compatible metallic implants, cochlear implants were excluded.
- Severe claustrophobia

Patient Preparation

In order to promote gastric emptying and gall bladder filling, patient is advised to fast for 4 hours[7,8].

Methodology

The study was conducted in MRI section of Department Radio-diagnosis of Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Nashik, Maharashtra. 60 patients were included after satisfying the eligibility criteria. Written informed consent was taken from all study participants.

- About 60 patients who were referred for MRCP will be included in the study were subjected to MRCP with the SIEMENS MAGNETOM ESSENZAA 1.5 TESLA MACHINE.
- Initial evaluation was done using T2W axial and coronal FSE and HASTE sequence.
- Fat suppression technique was used for suppression of background fat.
- 2D and 3D imaging of biliary tree was performed with T2 HASTE sequences.

4. Results

Total 60 patients (29 males and 31 females) distribution as shown in (Chart 1) were studied with various conditions.

It was found that 37(62%) out of 60 patients were encountered with biliary pathologies followed by

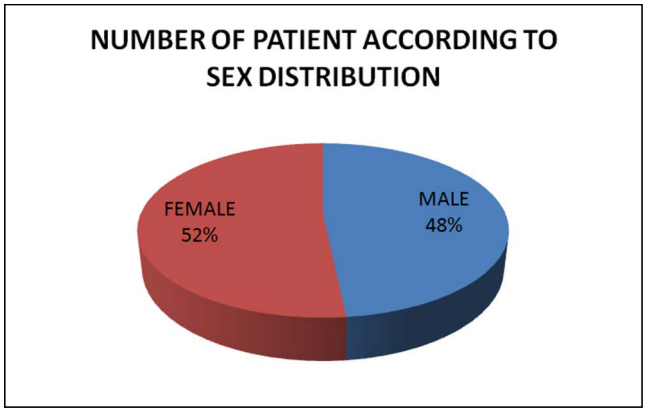

Chart 1: Genderwise distribution of study participants.

pancreatic lesion in 17(29%) patients and both were present in 6 (9%) patients. Among the lesions most common were obstructive condition seen in 24(40%) patients, inflammatory condition 21 (36%) patients with congenital lesions 7(11%), neoplastic lesions were seen in 6(10%) and patients with strictures seen in the 2 (3%) patient (Table 1).

Table 1. Distribution of study participants according to pancreatico-biliary pathologies.

Pathologies	No of Cases	Diagnosis
Obstructive	24 (40%)	Cholelithiasis:15 Choledocolithiasis: 9
Inflammatory	21(36%)	Acute Cholecystitis: 9 Chronic Cholecystitis: 2 Acute Pacreatitis: 7 Chronic Pancreatitis: 3
Congenital	7 (11%)	Choledochal Cyst: 4 Duodenal Diverticulum: 2 Pancreatic Divisum: 1
Neoplastic	6 (10%)	Cholangiocarcinoma: 3 Pancreatic Carcinoma: 3
Strictures	2 (3%)	Benign Stricture: 2

5. Discussion

Different Types of Pathologies Encountered

5.1 Obstructive

In respected study out of the 24 cases of obstructive etiology, out of which patient had 15 Cholelithiasis**,** patients were diagnosed with 9 choledocholithiasis.

a. Cholelithiasis

In our study out of the 15 patients 8 were female and 7 were male, preponderance with male to female ratio 1:1.1, similar results were observed in Chang *et al.*[9]. In our study Gallstones are best appreciated at T2-weighted MR imaging and MR Cholangiopancreatography and appear as hypo intense on T2-weighted MR imaging (Figure 1).

b. Choledocholithiasis

In our study out of 9 patients, males and females were 5 and 4 respectively, similar results were obtained in Chhoda *et al.*[10]. MRCP has comparable results with ERCP in detection of choledocholithiasis and far better than CT and US[10,11]. Biliary calculi imaged as a low signal intensity round shaped "filling defect" within the common bile duct (CBD) encircled by the hyper intense bile independently of calcium content on MR images. Higher contrast resolution of MRCP allows 2 to 3 mm stones to be easily detected (Figure 2).

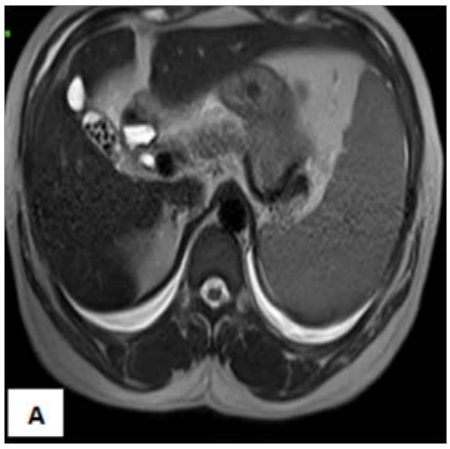

Figure 1. MRCP HASTE axial images showing gall bladder calculi (cholelithiasis) as T2W hypo intense filling defect.

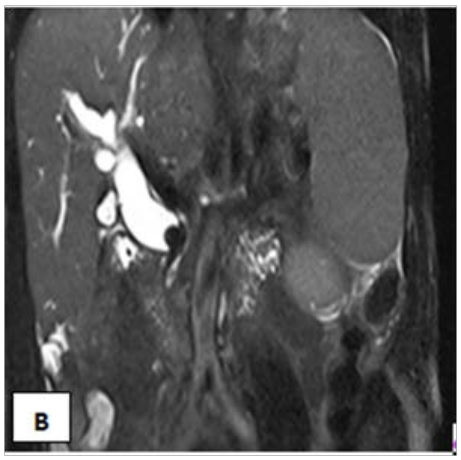

Figure 2. MRCP HASTE coronal images showing distal common bile duct calculus (choledocholithiasis) as T2W hypo intense filling defect.

5.2 Benign Biliary Strictures

In this study benign strictures were found in 2 patients, Benign biliary strictures are the result of iatrogenic trauma in 90%-95% of cases while other less common causes are penetrating injury, blunt trauma, inflammation associated with lithiasis, chronic pancreatitis, or primary infection such as in primary sclerosing cholangitis[12]. MRCP has been equivalent or even excellent to ERCP in demonstration of the level of strictures of the extrahepatic bile duct as well as location[13].

5.3 Neoplastic Lesions

Among the neoplastic lesions, Cholangiocarcinoma was reported in 3 patients and 3 patients had pancreatic carcinoma. Cholangiocarcinoma can have presentation like stricture of the CBD (30%–36%), the common hepatic duct (15%–30%), the biliary bifurcation, with the typical location of Klatskin tumor (10%–26%), and the intrahepatic ducts (8%–13%) with no evidence of mass lesion or as a nodular process with intrahepatic solid mass. The MRCP can visualize these bile duct strictures closely reflecting gross pathological changes along biliary tree. Cholangiocarcinoma MRCP and dynamic MRCP can depict biliary tree extension and also liver parenchymal and vascular involvement[7].

5.4 Sclerosing Cholangitis

In sclerosing cholangitis, there is sclerosis and fibrosis of the bile ducts leading to stenosis of the extra hepatic bile ducts[1,10]. Multifocal and alternate strictures with mild dilatation or normal-caliber bile ducts, producing a beaded or "pruned tree" appearance. MRCP is primarily used for diagnosis of complications or follow up of more advanced cases. Primary sclerosing cholangitis is chronic idiopathic inflammation of the bile ducts seen mostly in association with ulcerative colitis[7] (Figure 3).

5.5 Biliary Injuries

MRCP is helpful in detection of iatrogenic biliary injuries as bile leaks result in accumulation of fluid, usually in the sub-hepatic space, which is readily detected at MRCP. But normal MRCP cannot determine if a leak is active. Hepatocytes metabolizes and excreted Mangafodipir in bile. So excretion of Mangafodipir non-invasively detects active bile leaks[14].

5.6 Inflammatory

In total 21 patients were reported with inflammatory etiology, 9 patients were with acute cholecystitis in which 7 patients were with calculus cholecystitis and 2 were with Acalculous cholecystitis. Chronic cholecystitis was encountered in 2 patients. Among pancreatic pathologies acute pancreatitis was encountered in patients and chronic pancreatitis in patients. Similar results were obtained in study conducted by Venkatachalam *et al.*[15] (Figure 4).

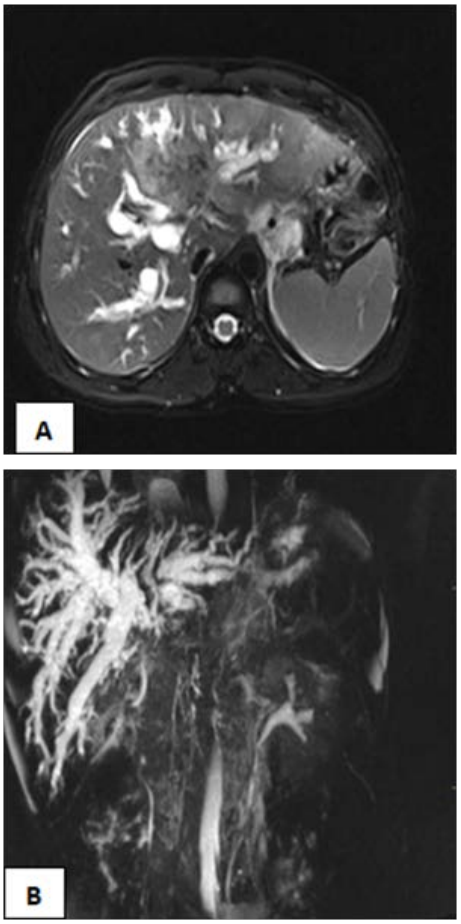

Figure 3. A. T2 W image shows hyper intense lesion at hilum. B. MIP coronal image shows dilated intrahepatic biliary radicles with sudden non-visualization of Common bile duct s/o mass at hilum (Klatskin tumor).

5.7 Acute and Chronic Pancreatitis

In our study 2 patients were diagnosed with chronic pancreatitis, out of which 1 were male and one were female, our results are comparable with study conducted by Barish *et al.*[16] Diagnostic criteria of chronic pancreatitis in MRCP are either dilatation or narrowing, stricture or irregularity of pancreatic duct[7] Pancreatic outline abnormality, pseudocysts, and filling defects in the ducts due to stones, debris or mucinous plugs. In chronic pancreatitis intraductal calculi may present as hypo intense filling defects in pancreatic parenchyma and pancreatic duct surrounded by hyper intense pancreatic fluid (meniscus sign). "Chain of lake" appearance of side branches seen in severe pancreatitis[16] (Figure 5).

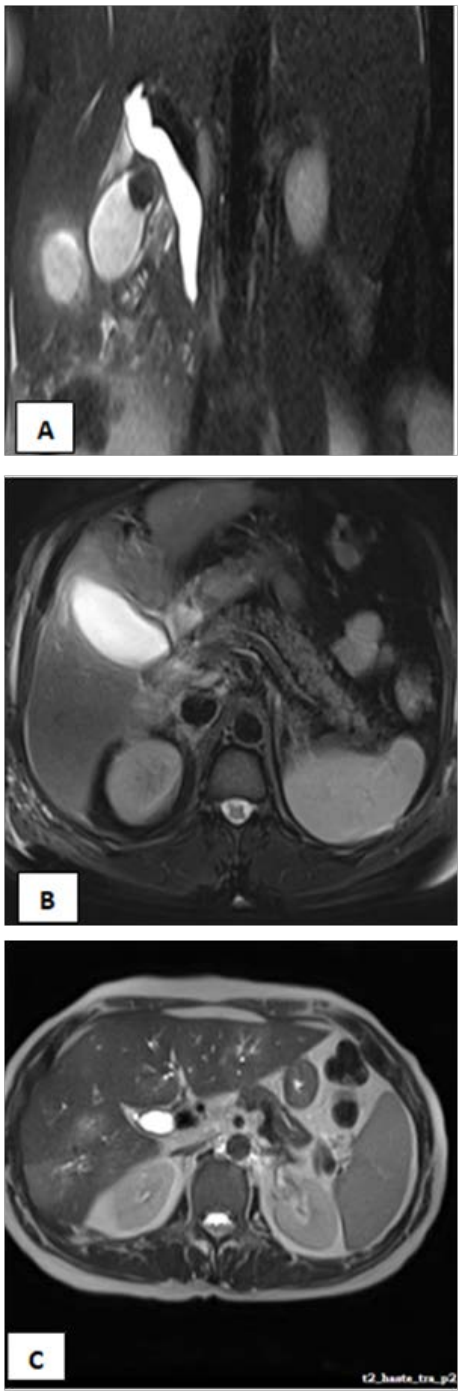

Figure 4. MRCP HASTE images A, B and C showing calculus cholecystitis, Acalculous cholecystitis and chronic cholecystitis respectively.

5.8 Pancreatic Pseudo Cyst

Pancreatic pseudocysts are most common cystic lesion of pancreas with fluid collections as sequelae of acute or chronic pancreatitis. MRCP is more sensitive than

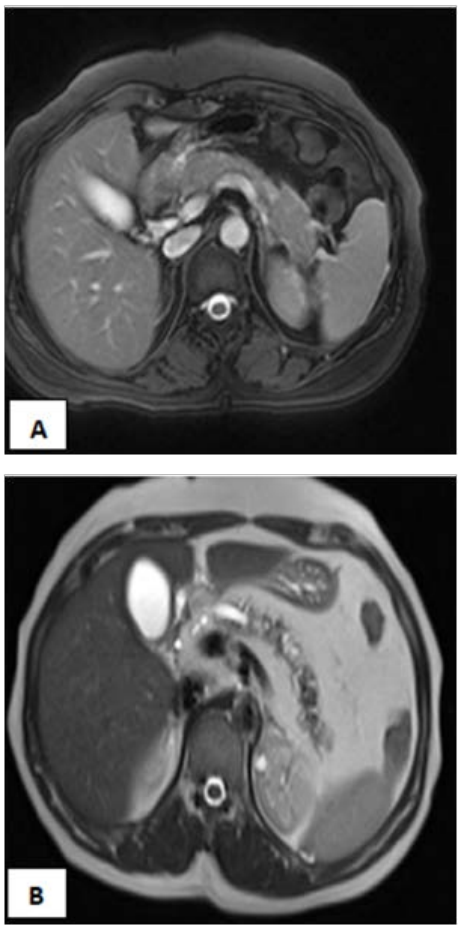

Figure 5. MRCP HASTE images showing acute and chronic pancreatitis respectively.

ERCP in detection of pseudocysts. MRI demonstrates pseudocysts and presence of associated complications like hemorrhage devoid of any risk of infection which may occur during ERCP[7] (Figure 6).

5.9 Annular Pancreas

This is aberrant pancreatic tissue in continuity with the head of pancreas this Pancreatic tissue surrounds the second part of duodenum in annular pancreas[16].

5.10 Cystic Duct Variations

The most common cystic duct variations include Medial insertion of the cystic duct. The cystic duct is inserted into the left side of the common hepatic duct. It is also seen in approx. 10% of population. Luschka's duct –These are small ductules and they pass from the right lobe of liver up to the gall bladder fossa. It mostly joins either the common hepatic duct or right hepatic duct. It is mostly

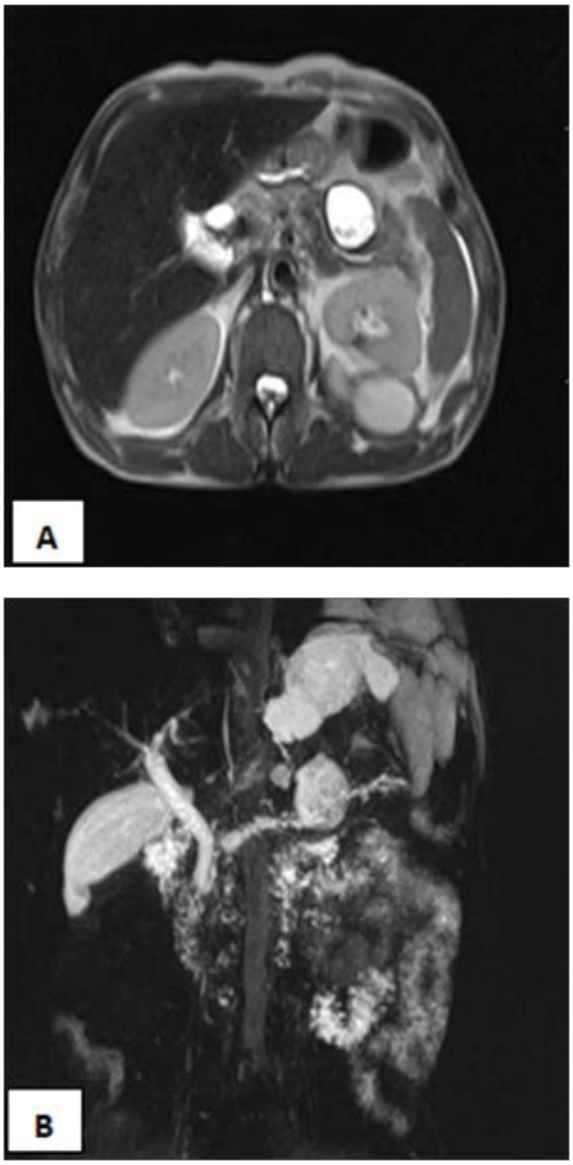

Figure 6. MRCP HASTE and T2 coronal images show pseudocyst arising from the pancreatic tail region.

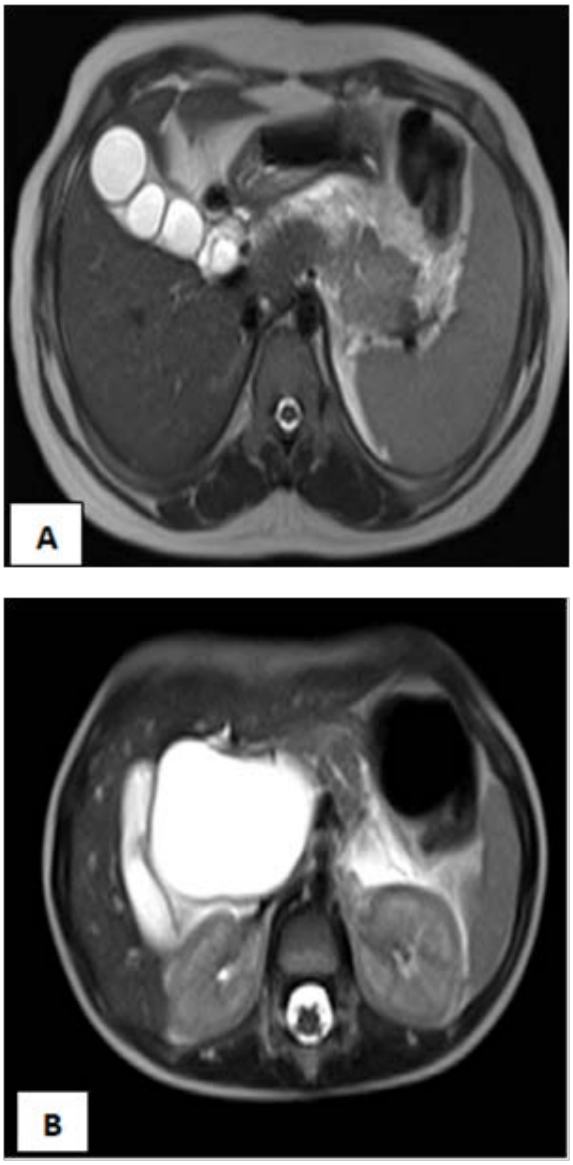

Figure 7. MRCP images A and B showing Choledochal cyst Type I and Type IV respectively.

injured during laparoscopic cholecystectomy[17]. Low cystic duct insertion. In this, there is fusion of the cystic duct with distal third of the extra-hepatic bile duct. It is seen in around 10% of population[18] (Figures 7 and 8).

5.11 MRCP in Neoplastic Biliary or Pancreatic Duct Obstruction

Around 90% of malignant pancreatic neoplasms are ductal in origin with most common being adenocarcinoma. 95% cases of Pancreatic carcinoma are a focal mass and extensive engrossment of the gland occurs in the remaining 5%[19]. Locations for focal carcinoma are as in descending order 1. head 62%, 2. body (26%) and 3. tail (12%) of the pancreas[19]. The MRCP findings of pancreatic carcinoma include encasement and obstruction of the pancreatic duct or bile duct. The "double duct sign", is highly suggestive for malignancy[20]. In cases of periampullary carcinoma abrupt termination of duct and mild dilatation of the pancreatic duct is usually present[21] (Figure 9).

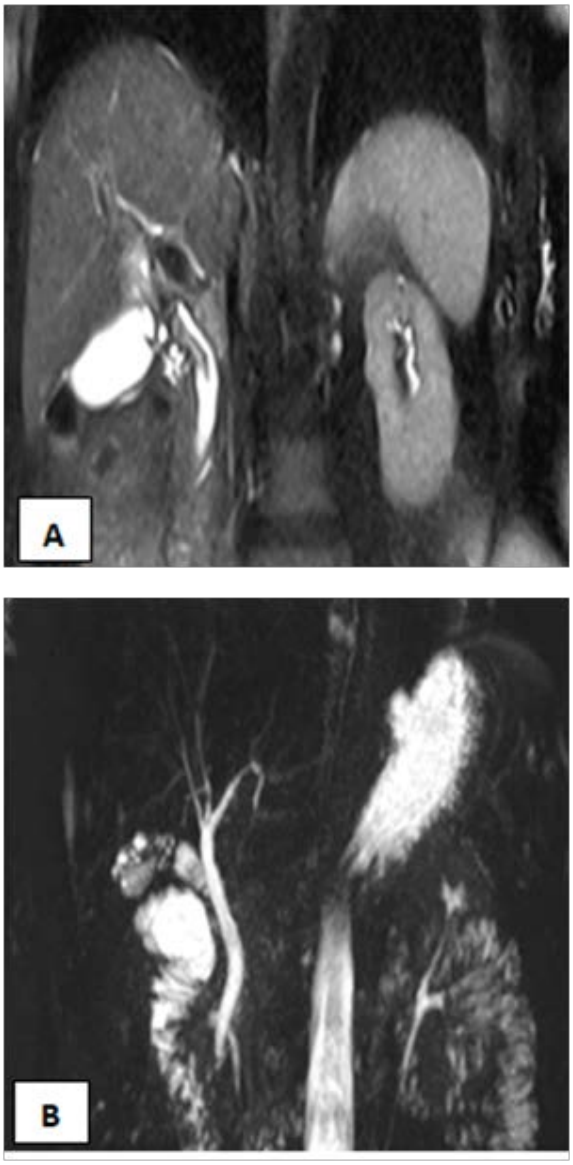

Figure 8. MRCP T2 HASTE (A) image shows low medial insertion of cystic duct variation and MIP coronal (B) image shows trifurcation variation of hepatic duct.

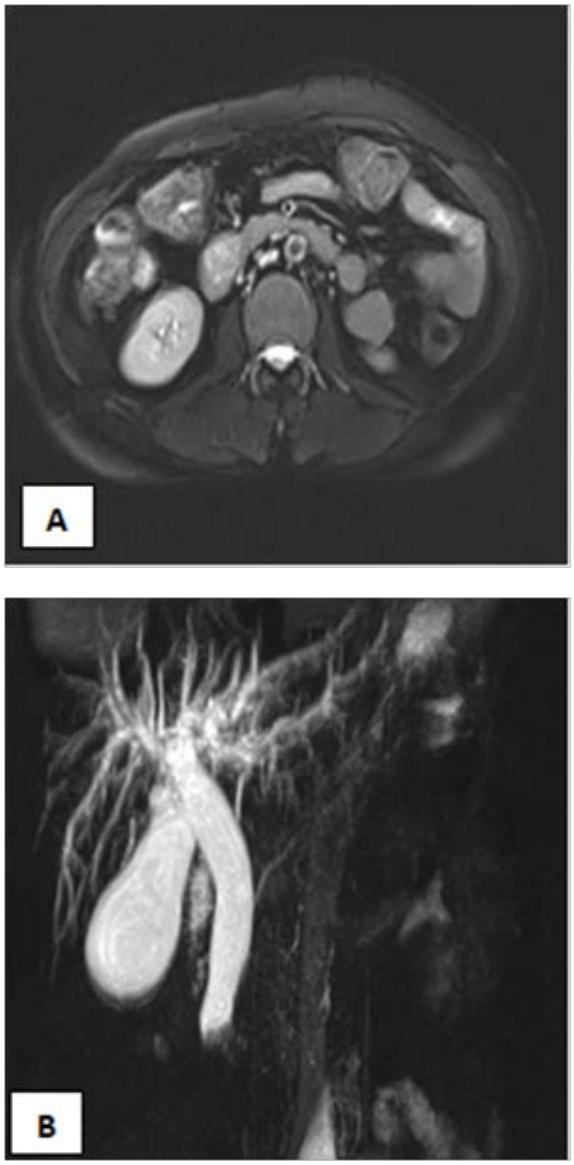

Figure 9. MRCP A. T2 HASTE image shows hyper intense lesion at ampulla of vater.

5.12 Post-surgical Biliary Tract Alterations

MRCP has a sensitivity of 100% in diagnosing anastomotic strictures[22].

6.1 Advantages of MRCP

- It is non-invasive and non-operator dependent.
- It does not require contrast.
- It has no radiation exposure.

6.2 Disadvantages of MRCP

- It has relatively low spatial resolution.
- Secretin administration can cause pancreatitis.
- Non visualization of small filling defects because of volume averaging associated with thick slab MRCP images.
- Extra-ductal vascular compression may mimic a stricture.

7. Conclusion

In summary, MRCP is an excellent non-invasive extremely precise diagnostic imaging technique for pancreaticobiliary diseases. In spite of relatively low spatial resolution early assessments suggest that MRCP can accurately diagnose the cause and site of obstruction, even avoids complication associated with ERCP as well as unfailingly demonstrate normal and abnormal pancreatic and biliary ducts. When ERCP is not possible or unsuccessful MRCP is considered it is considered to be of diagnostic value. MRCP plays crucial role in post-operative period when ERCP is not feasible.

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How to cite this article: Garse P, Kakade A, Bavisar S, Yadav M and Saxena S. Magnetic Resonance Cholangiopancreatography (MRCP) Evaluation of Pancreatico-Biliary Diseases. MVP J. Med. Sci. 2020; 7(2): 216-224.