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Original Research Article

Role of magnetic resonance cholangio pancreatography in diagnosing pancreatico biliary diseases

[1]Dr. Revansiddappa Kalyani, [2]Dr. Veeresh S Aland, [3]Dr. Santosh P Patil, [4]Dr. Sunil Kumar

[1,2] Associate Professor, Department of Radiodiagnosis, Faculty of Medical Sciences, Khaja BandaNawaz University, Kalaburagi, Karnataka, India.
[3]Junior Resident, Department of Radiodiagnosis, Faculty of Medical Sciences, Khaja BandaNawaz University, Kalaburagi, Karnataka, India.
[4]Associate Professor, Department of General Surgery, ESIC Medical College, Kalaburagi, Karnataka, India

Corresponding Author:
Dr. Sunil Kumar

Abstract

Background: Many imaging modalities, such as USG, CT, and Invasive Cholangiography, have limitations and poor visualization of intraductal stones and leads to the requirement for intrusive procedures like ERCP and PTC. MRCP is a non-invasive imaging modality, which provides good visualization of the hepatobiliary system.
Aim and Objectives: To study the role of MRCP in screening and diagnosing pancreatico - biliary diseases and to study the imaging appearance of pancreatico-biliary diseases on Magnetic Resonance Cholangio-Pancreatography.
Materials and Methods: A correctional study of 50 patients of pancreatico-Biliary diseases were evaluated with MRCP using 1.5 T MRI attending KBNTGH attached to KBNUFMS, kalaburagi, over a period of one and half year
Results: Out Of the 50 patients, 31 were male and remaining 19 were female patients. The patients of > 40 years had the highest number of instances. Out of 50 patients who underwent MRCP, 14 has cholangiocarcinoma (Males-9 & Females-5), 11 patients had Pancreatits (Males-8 & Females-3), 07 had Choledocholithiasis (Males-2 & Females-5), 06 had Periampullary carcinoma, 05 patients had Carcinoma pancreas, 03 patients had Carcinoma Gall bladder, and other had post-operative stricture, choledochal cyst. Biliary strictures were seen in 12 patients, out of which 5 had benign strictures and 7 were malignant.
Conclusion: MRI and MRCP have been proven to be sensitive, non-invasive imaging modalities that aid in the early detection and diagnosis of disease as well as in providing crucial details of therapeutic and prognostic implications.

Keywords: Magnetic Resonance Cholangio-Pancreatography (MRCP), Ultrasonography (US), Computed Tomography (CT), Endoscopic Retrograde Cholangio-Pancreatography (ERCP)

Introduction

Many imaging modalities, such as Ultrasonography (USG), Computed Tomography (CT), and Invasive Cholangiography (IVC), have previously been used to evaluate suspected biliary

ISSN 2515-8260 Volume 10, Issue 01, 2023

obstruction. Because of the poor visualization of intraductal stones on USG and CT, these procedures have limitations and the requirement for intrusive procedures like Endoscopic retrograde cholangio-pancreatography (ERCP) and Percutaneous Transhepatic Cholangiography (PTC). Magnetic Resonance Cholangio-Pancreatography (MRCP) is a non-invasive imaging modality, which provides good visualization of the hepatobiliary system [1].
Currently, USG and CT are the primary non-invasive diagnostic methods for bile duct obstruction, however the low sensitivity of these methods limits their accuracy in detection of stones in common bile duct when compared with that of ERCP. However The ERCP procedure is an invasive technic, operator-dependent, and linked to 1-7% morbidity and 0.2%-1% mortality [2].
Many pancreatico-biliary tract pathologies can be accurately diagnosed with magnetic resonance imaging (MRI). Several characteristic features of primary sclerosing cholangitis can be seen on MRI including the bile duct abnormalities, increased enhancement of liver parenchyma, wall thickening and enhancement of extra hepatic bile duct are also common findings in primary sclerosing cholangitis [3]. Acute pancreatitis can be distinguished from chronic pancreatitis; complications such as hemorrhage or pseudocyst formation are well exhibited in MRI. MRI is frequently able to distinguish focal enlargement due to chronic pancreatitis from that due to pancreatic carcinoma [4]. Additionally, It can also depict the extent of gall bladder carcinomas and can contribute to the staging of the disease [5]. It is a non-invasive, non-ionizing imaging modality that is unaffected by intestinal gas shadow, unlike USG.
This imaging technique has the ability to provide projectional-type of images those are comparable to the direct cholangiography in terms of detail and appearance. It is relatively operator independent and it does not contain intravenous (I.V.) contrast or ionising radiation. Recent studies have shown that MRCP is capable of accurately identifying common bile duct stones with sensitivity of 81-100%. Biliary strictures can also be visualized with sufficient anatomic detail to determine the level of obstruction and in some instances it differentiates benign from malignant causes. When it comes to neoplastic pancreatico-biliary obstruction, MRCP has potentially two major advantages. 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].
With this background the purpose of this study will be to prospectively assess the accuracy of Magnetic Resonance imaging

Background and Objectives

1 To study the role of MRCP in screening and diagnosing pancreatico -biliary diseases.
2 To study the imaging appearance of pancreatico -biliary diseases on Magnetic Resonance Cholangio-Pancreatography.

Materials and Methods

A Cross sectional study of 50 patients of pancreatico-Biliary diseases were evaluated with MRCP attending Khaja Banda Nawaz Teaching and General Hospital attached to Faculty of Medical Sciences-Khaja BandaNawaz University, Karnataka, over a period of one and half year using Siemens Magnetom Symphony 1.5 T. PancreaticoBiliary diseases were evaluated on all the sequences and images of MRCP appropriate sequences such as T2 HASTE, FLASH; FS, FLASH, FISP, T1 TSE, T2 TSE. The findings were confirmed by follow up surgery, ERCP, Biopsy and histopathology.

ISSN 2515-8260 Volume 10, Issue 01, 2023

Technique of MRCP

Body fluids have high signal intensity on heavily T2W MRI, which is used as an advantage for MRCP. The pancreatic and bile ducts, which are static or slowly moving fluid-filled structures, appear as hyperintense areas, whereas the background tissues generate some signal. MRCP can be performed without a contrast agent due to the inherent difference in signal intensity [7, 8]. MRCP is usually performed with heavily T2W sequences by using fast spin echo or SSFSE (Single Shot Fast Spin Echo) technique and both a thick collimation (single section) and thin collimation multisection technique with a torso phased array coil. The coronal plane is used to provide a cholangiographic display and the axial plane is used to evaluate the pancreatic duct and CBD [9].

All patients were instructed to fast for 6 hours prior to examination. Examination was carried out in supine position with breath holding in inspiration. It reduces the amount of fluid in the stomach, slows down duodenal peristalsis, and encourages gall bladder filling.

MRCP is done by using 2 sequences of Fast spin echo those are breath hold or non-breath hold. The non-breath hold essentially being used for uncooperative patients or who are unable to hold their breath for a long period of time. The image qualities of non-breath hold were inferior to the breath hold sequences [10]. In a few critically ill and unco-operative patients and children, respiratory triggering was used. The breath-hold sequence acquires a single slab of data, between 40 and 80mm thick, in 1 or 2 seconds. Thin slabs (4mm thick) can also be acquired using breath-hold T2-weighted half Fourier acquisition single-shot turbo spin echo (HASTE) sequences. These are obtained in coronal or oblique coronal views. In addition, the MRCP involves acquiring multiple thin collimation slices, a non-breath hold, respiratory-triggered 3D turbo spin-echo (TSE) T2- weighted sequence, (1.5mm) that can be post-processed on an imaging workstation. The source images from a thin collimation multislice acquisition are reviewed in addition to the reconstructed images, in order to demonstrate small stones or other intraductal pathology that may be obscured by reconstruction effects [11].

Inclusion criteria

1. The study incorporates all referred cases for MRCP suspected / proven cases of pancreatico-biliary diseases.
2. Patients detected with biliary tract pathology on ultrasonography.
3. Patients of all age group.

Exclusion criteria

1. Cardiac pacemaker implantation.
2. Prosthetic valves.
3. Cochlear implants.
4. Metal coils in blood vessels.
5. Any metallic orthopaedic implants.
6. Severe claustrophobia.
7. Pregnant and lactating women’s.
8. New born.

Result

This study has total 50 patients out of which 31 (62%) were male and 19 (38%) were female. Male preponderance is seen and male:female ratio being 1.6:1. This study shows the peak incidence of pancreatico-biliary diseases is in the age group of >40 years (82%) and least in age group of 0-18 Years i.e. (18%) (Table 1).

ISSN 2515-8260 Volume 10, Issue 01, 2023

Our study showed maximum cases diagnosed on MRCP were cholangiocarcinoma (28%) followed by chronic pancreatitis (22%) and choledocholithiasis (14%) and a significant difference in cases of cholangiocarcinoma being affecting male and chronic pancreatitis also being common in males but in contrast we found increased incidence of choledocholithiasis in females (Table 2). In our study malignant strictures were more common than the benign strictures (Table 3), benign strictures were common in the distal common bile duct and malignant strictures were common at the confluence of right and left main hepatic ducts (Table 3 & Fig 1, 2).

Table 1: Age wise distribution of Pancreaticobiliary diseases

Age	No. of Cases	Percentage
≤20 yrs	3	6%
21-40yrs	6	12%
41-60yrs	29	58%
>60yrs	12	24%
Total	50	100%

Table 2: Sex wise distribution of diagnosis on MRCP

Diagnosis	No. of cases	Percentage	No. of cases (Male)	Percentage	No. of Cases (Female)	Percentage
Cholangio Carcinoma	14	28%	09	29.03%	05	26.31%
Cronic Pancreatitis	11	22%	08	25.80%	03	15.78%
Periampullary Carcinoma	6	12%	04	12.90%	02	10.52%
Carcinoma Pancreas	5	10%	03	9.67%	02	10.52%
Carcinoma Gall Bladder	3	6%	02	6.45%	01	5.26%
Choledocholithiasis	7	14%	02	6.45%	05	26.31%
Post-Operative Stricture	3	6%	02	6.45%	01	5.26%
Choledochal CYST	1	2%	01	3.22%	00	00%
Total	50	100%	31	100%	19	100%

Table 3: Pancreaticobiliary diseases based on stricture (including preoperative and postoperative strictures)

Type of Stricture	No. of Cases	Percentage
Benign	5	41.6%
Malignant	7	58.4%
Total	12	100%

ISSN 2515-8260 Volume 10, Issue 01, 2023

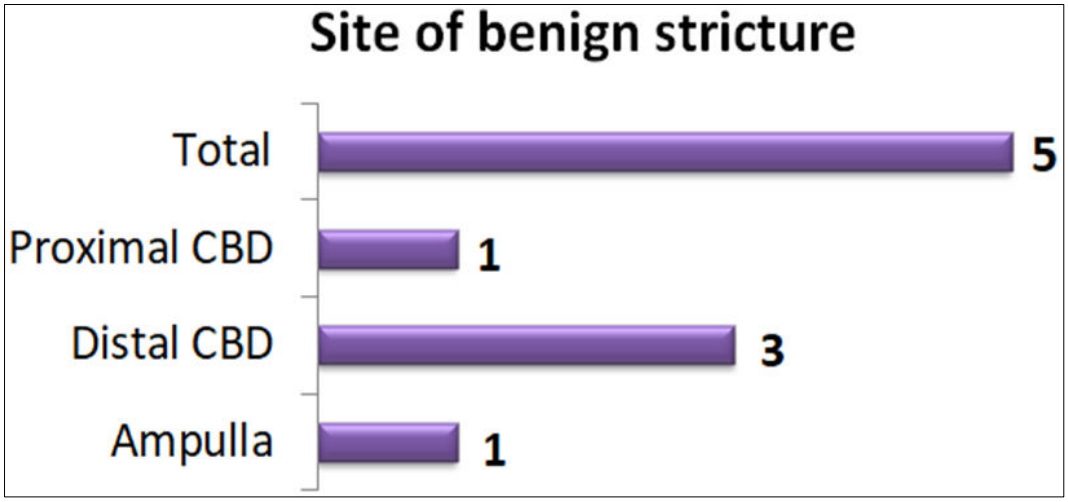

Fig 1: Benign Pancreaticobiliary diseases based on site of stricture

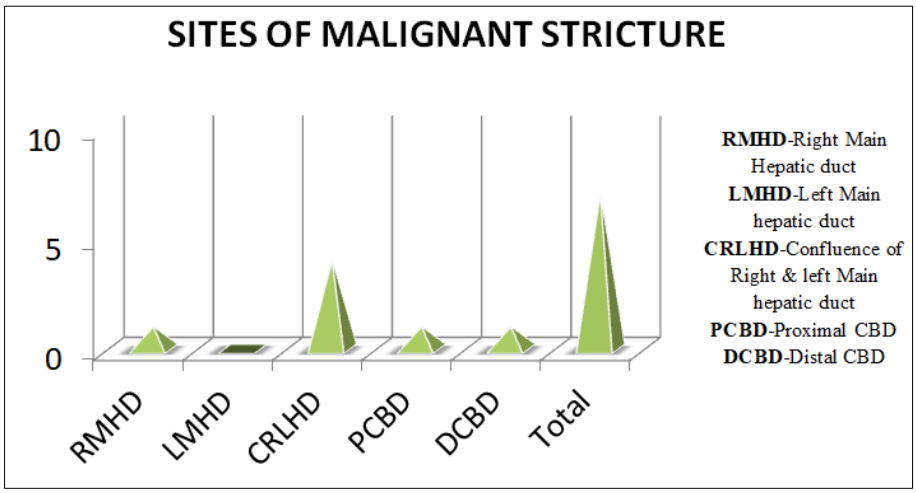

Fig 2: Malignant Pancreaticobiliary diseases based on site of stricture

Statistical data analysis

Data was analyzed by IBM SPSS 25.0 version software. Collected data were spread on excel sheet and prepared master chart. Through the master chart tables and graphs were constructed. For quantitative data analysis of descriptive statistics were done mean, standard deviation initially; independent samples "t" test was used to compare the mean values between two variables for statistical significant and for qualitative data analysis chi-square test was applied for statistical significant. $P \leq 0.05$ was considered statistically significant for all comparisons.

Normal billiary anatomy

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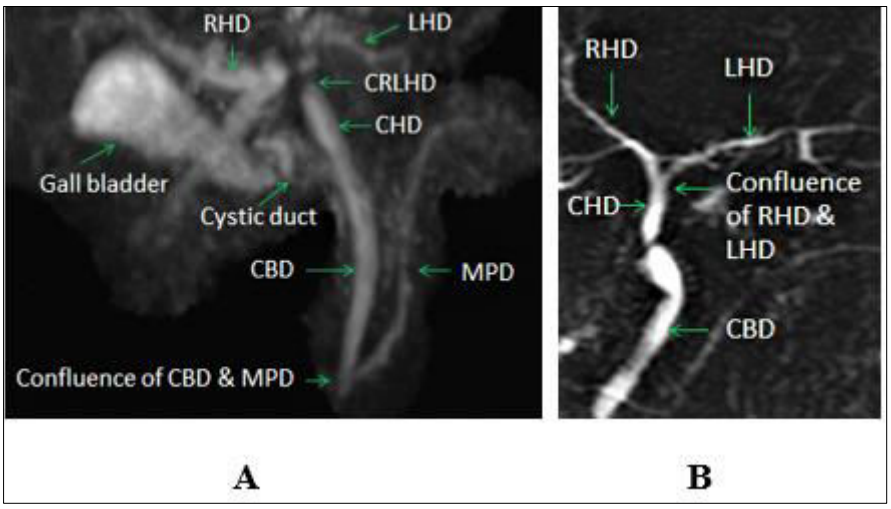
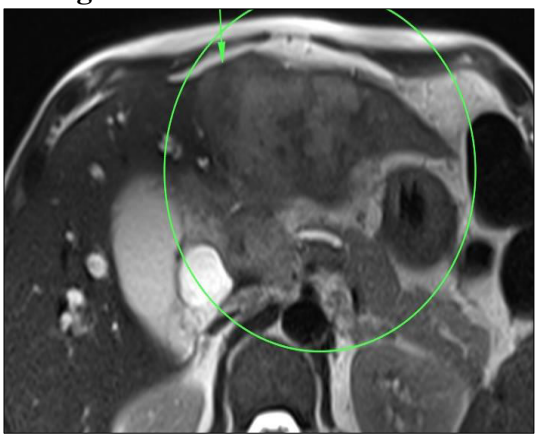


Fig 3 A & B: MRCP-2D Thick slab: RHD- Right hepatic duct, LHD- Left hepatic duct, CRLHD- Confluence of right and left hepatic duct, CHD- Common hepatic duct, Cystic duct, CBD- Common bile duct, MPD- Main pancreatic duct, Confluence of Common bile duct and Main pancreatic duct

Cholangio carcinoma extending to left lobe



A

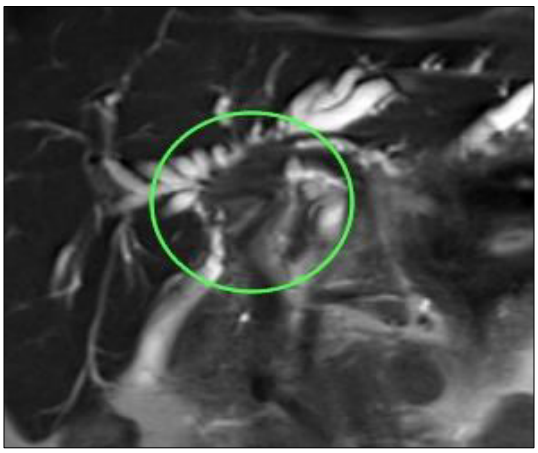
Fig 4 A: T2HASTE: T2 hyper intense mass lesion involving CBD and extending to left lobe of liver

B

Fig 4 B: MRCP-2D Thick slab obstruction at mid and distal CBD with dilated proximal CBD and PD, as well malignant stricture in left hepatic ductal system (arrows)

Klatskin tumor and cholangio carcinoma of CBD

ISSN 2515-8260 Volume 10, Issue 01, 2023



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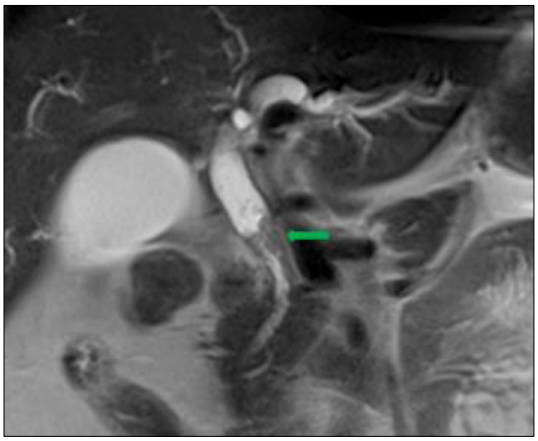
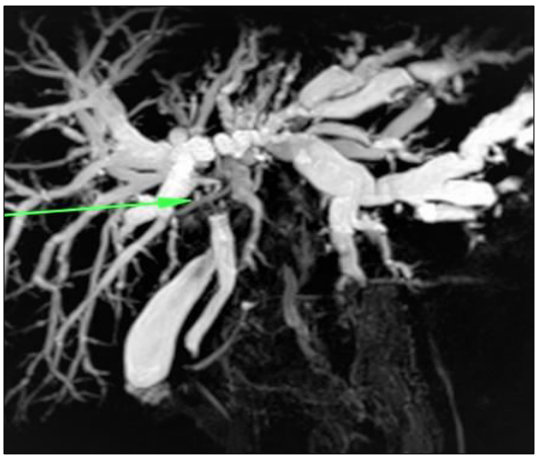


B

Fig 5: Klatskin tumor-fig A & B soft tissue lesion at the hilum and proximal CHD showing low ADC value**s**



C

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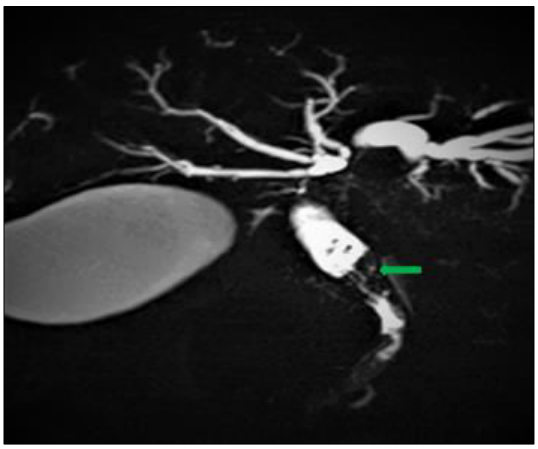
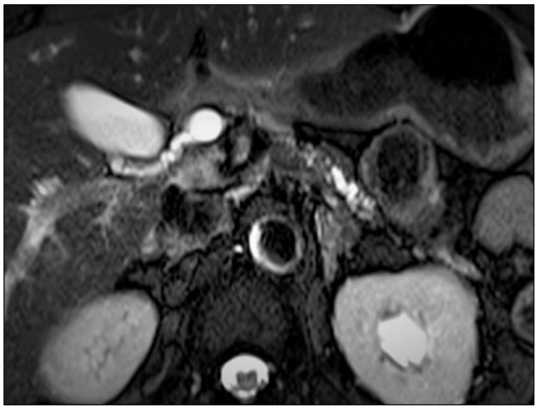


D

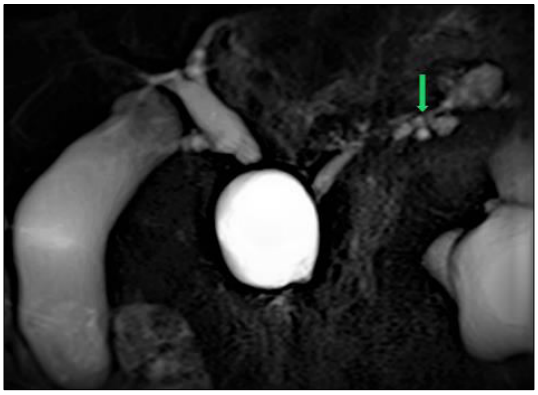
Fig 5: C & D: IHBRD in both lobes with malignant obstruction at hilum and at mid CBD by irregular mass lesion with shouldering.

Chronic pancreatitis



A

Fig 6 A: Chronic pancreatitis with irregularly dilated PD and pancreatic atrophy.



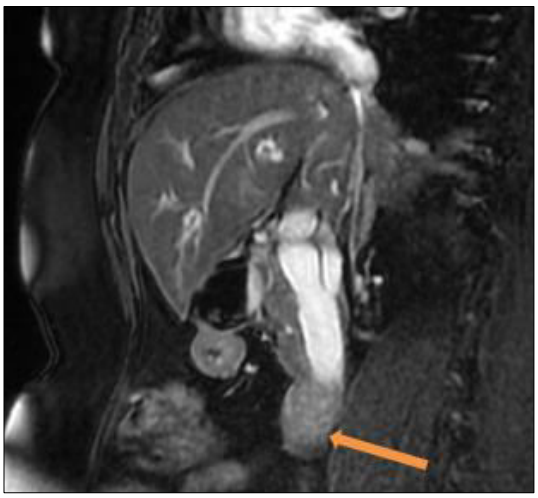
B

Fig 6B: Same patient as in A with cystic lesion in the region of pancreatic head representing pseudocyst with irregular dilatation of distal pancreatic duct.

Chronic pancreatic with pseudo cyst

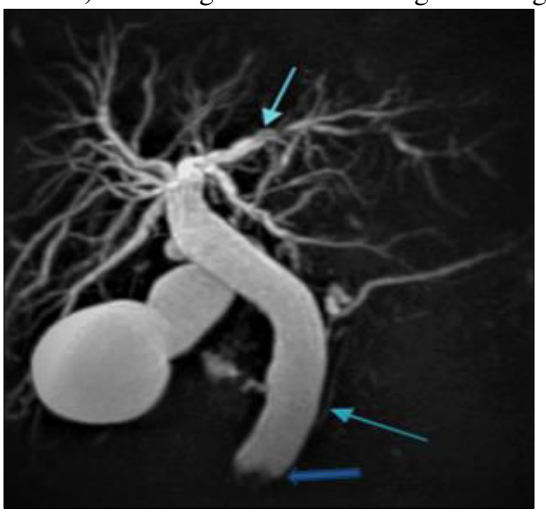
Periampullary carcinoma

ISSN 2515-8260 Volume 10, Issue 01, 2023



A

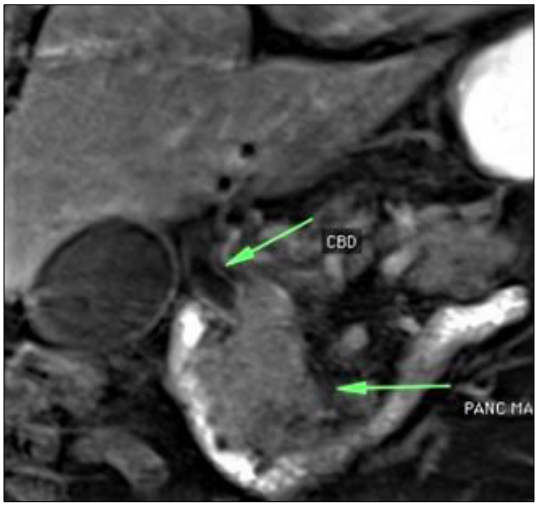
Fig 7 A: SAG T2 Fat-Sat images shows abrupt cut off of terminal CBD with intraluminal iso to hyperintense mass (orange arrow) involving intraduodenal segment bulging into duodenal lumen.



B

Fig 7 B: 3D-MRCP MIP image showing IHBRD and dilated CBD (blue arrows) with abrupt cut off of CBD due to intraluminal mass (thick blue arrow). Pancreatic duct is normal in calibre.

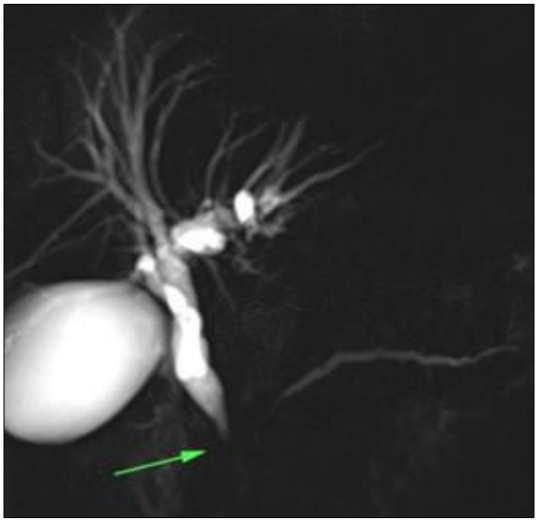
Carcinoma head of pancreas



A

Fig 8 A: Homogenous soft tissue mass lesion in the region of head of pancreas, showing mild heterogenous enhancement and involving medial wall of duodenum.

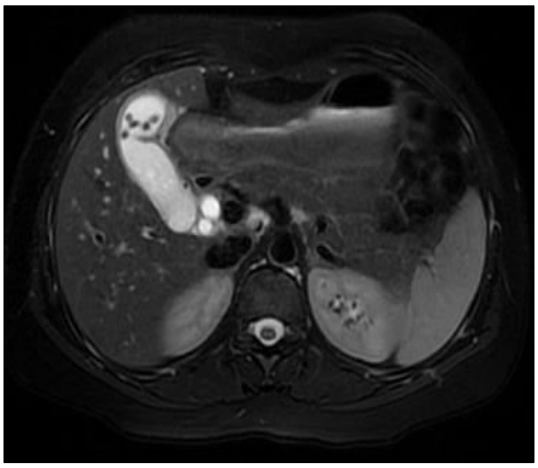
ISSN 2515-8260 Volume 10, Issue 01, 2023



B

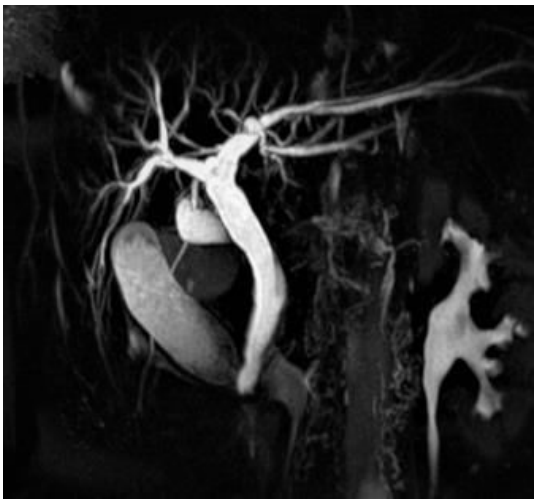
Fig 8 B: MRCP image showing double duct sign with obstruction at the level of pancreatic head.

Cholelithiasis and choledocholithiasis



A

Fig 9 A: Axial T2 Fat sat: Image showing multiple calculi in the lumen of GB (arrow), mild thickening of the wall of GB seen with minimal pericholecystic fluid (orange arrow).

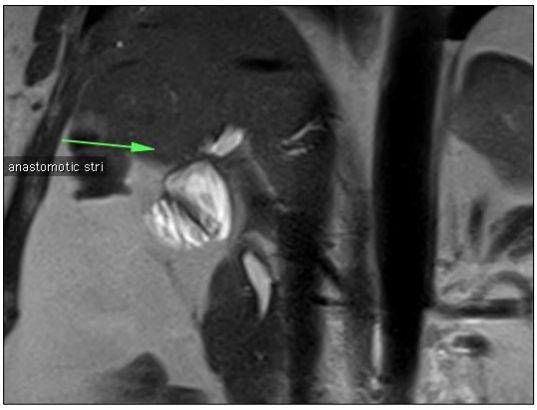


B

Fig 9 B: 3D-MRCP: Image showing IHBRD and dilated CBD with abrupt cut off of CBD (arrow) due

to calculus.

Benign strictures



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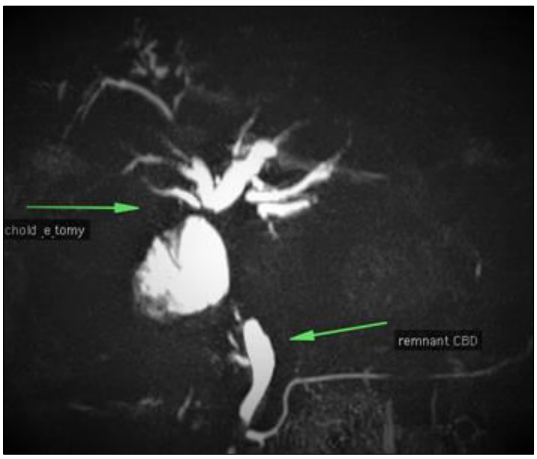
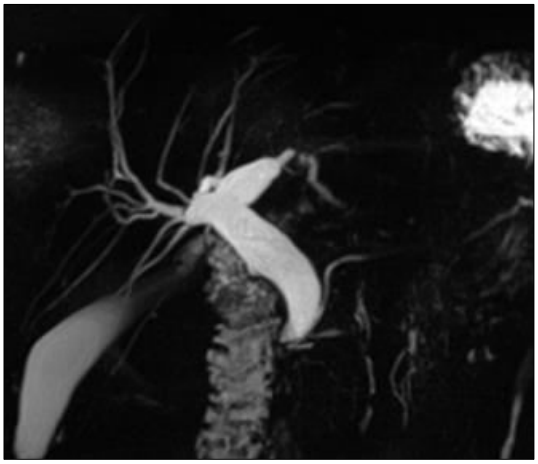


B

Fig 10 A & B: Following choledochojejunostomy, Arrows showing stricture site and remnant distal CBD

Choledochal CYST



A

ISSN 2515-8260 Volume 10, Issue 01, 2023

B

Fig 11 A and B: Dilatation of common bile duct and left hepatic duct and normal right hepatic duct representing type IV-b choledochal cyst.

Discussion

Anatomy of biliary system

Biliary tract includes right and left hepatic ducts which joins to form common hepatic duct. Cystic duct from gall bladder joins with common hepatic duct to form common bile duct. Common bile ducts have supraduodenal, retroduodenal, pancreatic and intraduodenal segments. Sphincter of oddi typically encircles the terminal portions of biliary and pancreatic ducts and their common channel [11]. (Fig. 3)

Venkata S. Katabathina, *et al*. concluded that patients with biliary obstruction caused by malignant lesions, MRCP shows the site of the obstruction and the severity of bile duct dilatation, additional cross sections of MRI imaging obtained by conventional sequences are beneficial and necessary to locate the organ of tumor origin and to define the margins of the malignant lesion [12]. T Hyodo, *et al*. reported that MRCP is most widely used as a non-invasive means of evaluating biliary diseases, particularly in patients with dilated bile ducts [13].

Cholangiocarcinomas are generally classified as:

1. Intrahepatic (peripheral) tumors
2. Hilar lesions occurring just past the confluence of right and left hepatic ducts, commonly referred to as “Klatskin ” tumors; and
3. Distal ductal tumors [14].

Out of 14 cases of cholangiocarcinoma were evaluated with MRI, in one case of cholangiocarcinoma diagnosed by MRI there was infiltration into the gallbladder and minimal local spread. Pre-operative findings were those of carcinoma of gallbladder. When the bile duct and gall bladder are both affected, imaging is known to be limited. MRI assisted in determining the level, extent and staging of the disease in the pre surgical evaluation. Barish M A and Soto [15] who concluded their studies with sensitivities ranging from 80-86% and specificities of 96-98% and diagnostic accuracies of 91-100% for level of obstruction. (Fig. 4, 5)

Six cases of periampullary carcinoma were evaluated. MRI was able to delineate the extent, level and local infiltration and helped in staging of the lesion. On ultrasound, assessment of the periampullary lesions was difficult in obese patients and bowel gas shadows was also a

ISSN 2515-8260 Volume 10, Issue 01, 2023

limiting factor. Sugita *et al.* [16] in his study of 25 cases of periampullary tumors reported a sensitivity 88%, specificity 100% and diagnostic accuracy of 96%. (Fig. 7)

Out of five cases of carcinoma of pancreas, 3 cases were involving the head and body region, 2 case involving the distal part of body and tail. MRI was able to differentiate clearly between pancreatic cancer and pancreatitis in all the cases except, in one case there was difficulty in differentiating neoplasm from chronic pancreatitis. The accurate detection of the loco-regional spread by ultrasound is difficult. Eric Tam *et al.* [17] who reported sensitivity of 80%and specificity of 95% and that concluded by Enrique Lopez Haminem *et al.* [18] in a study of 66 cases of suspected pancreatic cancers reported a diagnostic accuracy, sensitivity and specificity of 91%, 95% and 96%. (Fig. 8)

In our three cases of carcinoma of gall bladder, MRI was used as investigative tool. The staging was very accurate. MRI detected all 3 cases and detecting subtle lesions in liver and local spread. Also it helped in pre-surgical staging. While staging of cancer of the gallbladder cannot be done using ultrasound, it can be used as a primary investigative tool. The diagnostic accuracy of ultrasound for staging will be very low.

In our study, a total of 11 cases of pancreatitis were evaluated with MRI. MRI showed diffuse homogeneous enhancement of the entire gland in cases of acute pancreatitis in early stages where ultrasound features were normal. Main pancreatic duct was better delineated on MRI in cases of chronic pancreatitis where surgical intervention was required. In one case, it was challenging to distinguish between chronic pancreatitis and neoplastic alteration on MRI, which is a known limitation of MR imaging. (Fig. 6)

In our study seven cases of choledocholithiasis were evaluated with MRI. The IHBR dilatation, CBD calibre, and calculus location are all clearly evident on MRCP, especially in the distal CBD which is difficult to visualize on ultrasound. Caroline Reinhold *et al.* [19] showed a sensitivity of 90%, specificity of 100% and accuracy of 97% on MRCP. Mandelia, A. *et al*. concluded that MRCP is an excellent primary tool for detecting or excluding CBD stones before cholecystectomy [20]. (Fig. 9)

In one cases of choledochal cysts, MRCP offered precise diagnostic information by providing exact anatomic map in pre surgical evaluation. Kim *et al.*[21] in his study of 20 patients concluded the same. Vikas Y Sache, *et al.* [22] reported that Magneticresonance cholangiopancreatography (MRCP) is used as primary diagnostic approach in various biliary pathologies. The recent imaging techniques have improved diagnostic accuracy of MRCP in diagnosing choledochal cysts and their associated anatomic variants. (Fig.11)

Conclusion

With the advent of MRCP, it is now quite simple to investigate the anatomy and pathologies of the biliary tree, including the pancreatic duct.

The following conclusions can be drawn based on the results of our:

- For the assessment of pancreatico-biliary anatomy and disease, MRI is an accurate, non-invasive, and non-ionizing imaging technique.
- The primary investigational method of choice is still ultrasound.
- Safe surgical management decisions are made possible by the combination of MRI and MRCP.
- Potentially useful to determine the severity and location of strictures in patients undergoing biliary enteric anastomosis.
- Useful tool in case of the obese patients and children.

There is now sufficient data to demonstrate that MRI and MRCP are equally effective as ERCP and should be used as the gold standard for assessing the pancreatico-biliary system.

Drawbacks and Limitations

- Claustrophobia
- There can be no therapeutic or interventional procedures.
- In elderly, children, and individuals with debilitating conditions breath holding is not possible.
- Time consuming.

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ISSN 2515-8260 Volume 10, Issue 01, 2023

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