IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 6 Ver. 2 (June. 2018), PP 56-62
www.iosrjournals.org

Comparative assessment of ultrasonography and magnetic resonance cholangio-pancreatography in pancreatico biliary diseases

Dharm raj Meena[1,] Sangeeta Saxena[2], Harshverdhan Khokhar[3], *Umesh kumar[4]

Professor[1], Professor and Head[2], Assistant Professor[3], Resident Doctor[4]
[1234]Department of Radiodiagnosis, Govt. Medical College KOTA324010
*Corresponding author:*Umesh kumar*

Abstract: *Biliary and pancreatic pathologies are common in clinical practice. Evaluation of obstructive jaundice for precise assessment of cause, level and location is necessary for management of patient. Hence aim of present study is to compare diagnostic accuracy of magnetic resonance cholangiopancreaticography and ultrasonography in biliary and pancreatic pathologies. This study was conducted among fifty patients in the Department of Radio-diagnosis, GMC Kota who were clinically suspected to be suffering from pancreaticobiliary pathologies in all age groups. All the patients in the study underwent ultrasonography and MRCP. In this study benign and malignant lesions constituted 30 (60%) and 20 (40%) cases respectively. Ductal calculi(8),stricture (5),choledochal cyst(2),gall stones(7),pancreatitis(6),postoperative bile leak(1),cholangiocarcinoma(10), infiltrative GB carcinoma (6),periampullary carcinoma (3),pancreatic head carcinoma (1). Ultrasound was found to have sensitivity 84.6%, specificity 86.4% and diagnostic accuracy of 85.7% for detecting the cause of obstruction while MRCP correctly detected cause of obstruction with sensitivity: 93.3%, specificity 95%, and the diagnostic accuracy of 94.3%. USG is considered the first choice option in the diagnostic imaging of obstructive biliary disease. However, owing to its low sensitivity in most of the benign stenosis and distal CBD disease and for a thorough staging evaluation of malignancy, MRCP is highly accurate and superior diagnostic modality in establishing diagnosis of obstructive biliary pathologies. MRCP is more sensitive and more likely to detect choledocholithiasis, CBD strictures and malignant pathologies as compared to USG.*

Keywords: *biliary obstruction, magnetic cholangiopancreaticography, ultrasonography*

Date of Submission: 23-05-2018 Date of acceptance: 05-06-2018

I. Introduction

Diagnosing patients with suspected biliary or pancreatic pathologies in their early stage is of utmost importance in patient care and management. Knowledge of the advantages and disadvantages of each technique is needed to determine the appropriate work up of patients with these pathologies. ERCP being an invasive procedure can be avoided solely for the purpose of diagnosis as MR Cholangiopancreatography has equivocal diagnostic accuracy in pancreatico biliary pathologies.

Intraductal stone visualization has limitations on US and CT, other techniques like Endoscopic Retrograde Cholangio-Pancreatography (ERCP) is invasive in nature. Magnetic Resonance Cholangio-Pancreatography (MRCP) is a non-invasive imaging modality that provides good visualization of the hepato-biliary system. Ultrasound is the initial screening tool that is used in evaluating patients presenting with pancreatico-biliary diseases. Ultrasonography has limitations especially in the evaluation of the distal CBD where bowel gas, debris 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. Neoplasms of the bile and pancreatic ducts present major challenge both for diagnosis and treatment. Before definite therapy, knowledge of the level of obstruction and its cause is essential. .MRI plays a vital role in diagnosing many conditions of the pancreatico-biliary tract. Acute pancreatitis can be distinguished from chronic pancreatitis; complications such as hemorrhage or pseudocyst formation are well examined with MRI. MRI can depict the extent of gall bladder carcinomas and can contribute to the staging of this disease. It is a non-invasive, non-ionizing imaging modality and is unaffected by bowel gas shadow as in ultrasound. With the development of high 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 examination of choice in patients with pancreatico- biliary diseases. 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.

Overall the purpose of this study will be to prospectively assess the diagnostic accuracy of USG and MRCP imaging.

II. Materials and Method

STUDY DESIGN - A prospective study.
SOURCE OF DATA- All patients referred to radiology department with clinically suspected pancreaticobiliary disease attending Government Medical College and Attached Group of Hospitals, Kota.
STUDY GROUP- Patients of all age groups and both sexes, suspected of biliary pathology, during duration from July 2016 to October 2017 are included in this study.
SAMPLE SIZE--The study comprised a total of fifty patients of pancreatico-biliary disease.
INCLUSION CRITERIA-All cases referred to radiology department with clinically suspected pancreaticobiliary disease attending Government medical college and attached group of hospitals, Kota.
EXCLUSION CRITERIA- Patients having Cardiac pacemakers, prosthetic heart valves, cochlear implants or any metallic orthopedic implants.
STATISTICAL ANALYSIS -- Data analysis was done using Graph pad software using rates, ratios and Percentages of different diagnosis and outcome made by USG & MRCP.
EQUIPMENTS-The patient was scanned using available Ultrasound machines (Siemens Sonoline G50, Siemens Sonoline G60, GE CISPR11/EN, Philips HD11XE, ALPINION ECUBE 15EX, Micromax Sonosite) and a MRI using abdominal surface coils on 1.5T Philips ACHIEVA machine.
METHOD OF STUDY
All patients were instructed to fast for 6 hours prior to examination. Examination was carried out in supine position with breath holding in inspiration. In a few critically ill and uncooperative patients, respiratory triggering was used. MRCP examinations were performed with a 1.5T Philips ACHIEVA machine .Evaluation was done both in the axial and coronal planes using a combination of following pulse sequences: T2W-TSE sequences, T2 SSH FSE sequences, T2-SPAIR sequences, 3D FSE sequences, T1 dual FFE. Follow-up:- The radiological diagnosis was correlated with ERCP, surgical findings and histopathology correlation.

III. Results:

Of the 50 patients included in this study benign and malignant lesions constituted 30 (60%) and 20 (40%) cases respectively .Ductal calculi(8),stricture (5),choledochal cyst(2),gall stones(7),pancreatitis(6),postoperative bile leak(1),cholangiocarcinoma(10), infiltrative GB carcinoma (6),periampullary carcinoma (3),pancreatic head carcinoma (1). ultrasound was found to have sensitivity 84.6%, specificity 86.4% and diagnostic accuracy of 85.7% for detecting the cause of obstruction while MRCP correctly detected cause of obstruction with sensitivity: 93.3%, specificity 95%, and the diagnostic accuracy of 94.3%. The mean age of the study sample was 52.4 years with a range of 18-81 years .Maximum number of cases were in 50-60 years age group. Majority of patients were females. Jaundice was predominant feature followed by pain abdomen. Weight loss, Steatorrhea and vomiting were other presenting complaints. Cholangiocarcinoma was the most common finding followed by choledocholithiasis. Malignant strictures found more common than the benign strictures. Both benign and malignant strictures are more common in the proximal common bile duct.

IV. Discussion

Obstructive jaundice is common amongst females and choledocholithiasis is the commonest benign cause. In our study, there was a declining trend observed in the ability of sonography to visualize the biliary tree as we moved distally. Visualization of the proximal ducts was possible in 91.6% cases and dropped to 63.3% for distal CBD, decreasing the diagnostic performance of sonography because of difficulty in visualizing the distal CBD and the pancreatic region mainly due to interference by bowel gases. Similar observations were also made by Vicary et al[1] who opined that limitation in the sonographic evaluation of the distal biliary tree and pancreas was due to bowel gases besides the operator's experience. MRCP was better in showing the distal biliary tree. The distal CBD was visualized in 30/35 patients (84%) as against 18/35 (51%) patients by sonography. In five cases, non-visualization of the distal CBD on MRCP was caused by complete cut-off at the level of hilum due to malignant masses. Both ultrasound and MRCP seem to have sensitivity and specificity of nearly 100% for detecting the presence of a biliary obstruction. Regan et al[2] in their prospective study on MRCP demonstrated biliary dilatation in 100% cases. A meta-analysis of 67 published controlled trials by Romagnuolo et al.[3] have shown both sensitivity of 95% and specificity of 95% for detecting the presence of a biliary obstruction. According to our study most common site of obstruction was hilar and intra-hepatic (50%).Our study was

comparable to Kumar et al[4] who found a variable range of accuracy ranging from 27% to 95% for detecting the level of obstruction by ultrasound. The extent of the lesion could be determined in 100% of patients by MRCP as compared to only 66% by sonography. When considering only mass lesions, an extent of biliary involvement could be completely assessed in only 8 cases by sonography while it was detected in all 20 cases by MRCP.
The study conducted by Manfredi[5] quoted that MRCP had good accuracy and optimal capability for tumour extent evaluation, he analyzed only hilar malignant stenosis of the biliary structures, reported an accuracy of 89% in the assessment of their extent. Our finding is also in concurrence with the study conducted by Soto et al[6] who suggested that in case of mass lesions, when MRCP is combined with MRI, a complete staging information can be obtained about the tumor size, bile duct involvement, and vascular invasion.

Cholangiocarcinoma comprised maximum number of cases, (n = 10) in our study with hilar and proximal CBD (n =07) and distal CBD cholangiocarcinoma (n = 03) forming a majority of these masses. In our study cholangiocarcinoma comprised most common cause of obstruction (28%), choledocholithiasis comprised second common cause (n=8 [23%]) of obstruction .The third most common cause of obstruction was infiltrative G.B mass 6/35 (17 %) cases. MRI helped in defining the level, extent and staging of the disease in the pre surgical evaluation. Guibaud et al, Barish and Soto and Pavone et al[7] 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.

In 3 cases of periampullary carcinoma, MRI was able to delineate the extent, level and local infiltration and helped in staging of the lesion. MRCP detected causative lesion in all 3 cases. One case of periampullary carcinoma was missed by USG in our study. The assessment of the periampullary lesions was difficult on ultrasound in obese patients and bowel gas shadows was also a limiting factor. Sugita et al[8] in her study of 25 cases of periampullary tumors reported a sensitivity 88%, specificity 100% and diagnostic accuracy of 96%.

One case of carcinoma of pancreas was studied. Ultrasound is unable to detect the loco regional spread accurately. Eric Tam et al[9] who reported sensitivity of 80%and specificity of 95 % and Enrique Lopez Hanninen et al who in a study of 66 pts of suspected pancreatic cancers reported a diagnostic accuracy, sensitivity and specificity of 91%, 95%and 96%.

In our study of 6 cases of carcinoma of gall bladder, MRI can be used for investigative tool and the staging will be very accurate. MRI detected all 6 cases and detecting subtle lesions in liver and local spread and helped in pre-surgical staging. Ultrasound also detected all the cases of gall bladder carcinoma but it can be used as a primary investigative tool and cannot be used for staging purpose of carcinoma gall bladder. The diagnostic accuracy for staging was very low.

In our study, ultrasound was found to have sensitivity 84.6%, specificity 86.4% and diagnostic accuracy of 85.7% for detecting the cause of obstruction while MRCP correctly detected cause of obstruction with sensitivity: 93.3%, specificity 95%, and the diagnostic accuracy of 94.3%. Upadhyaya et al[10] in a prospective study of comparative assessment of imaging modalities in biliary diseases found that MRCP had the accuracy of 87.5% for assessing the cause which is similar to our study. Vaishali et al[11] found the overall diagnostic accuracy of 89.65% for detection of the cause of obstruction by MRCP which is comparable to our study. Aube et al.[12] found sensitivity of 90.5% and specificity of 87.5% of MRCP in etiological diagnosis which is also comparable to our study.

In our study choledocholithiasis comprised second common cause (n=8 [23%]) of obstruction, ultrasound missed CBD calculi in 2 cases as distal CBD was not visualized due to overlying bowel gases. Other cases missed on Ultrasound were 2 CBD stricture and small lesions such as mass in periampullary region. These were probably due to inadequate visualization of the entire CBD due to bowel gas and obesity. Ultrasound was found to have sensitivity: 75%, specificity: 100%, PPV: 100% and diagnostic accuracy of 95% for choledocholithiasis while MRCP clearly shows 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 showed calculus region as an area of signal void. MRCP correctly detected 7/8 cases of choledocholithiasis with sensitivity: 87.5%, specificity: 100%, PPV: 100% and the diagnostic accuracy of 98%, one case missed due to small calculus size. Ferrari et al. in their study showed the diagnostic accuracy of 80.15%, with a sensitivity of 71.08% and a specificity of 95.83% which is in concordance with our study. Ferrari et al.[13] have found that MRCP has a diagnostic accuracy of 93.89%, sensitivity of 93.97% and specificity of 93.75% in the diagnosis of choledocholithiasis. Two false negative cases on USG were due to hindering of distal CBD evaluation by bowel gas shadow and obese body habitus. Pasanen et al.[14] found that the sensitivity of ultrasound for choledocholithiasis varies widely from 20% to 80% with a high specificity of approximately 98%. The present study reported similar results as study by Soto et al who reported sensitivity of 94% and specificity of 100% for detecting biliary calculi in MRCP. Varghese et al who reported 91% sensitivity, specificity of 98% and diagnostic accuracy of 97% on MRCP. Sugiyama et al reported 91% sensitivity, specificity of 100% and diagnostic accuracy of 97% on 66 patients. Caroline Reinhold et al[15] showed a sensitivity of 90%, specificity of

100% and accuracy of 97 % on MRCP. Pavone et al found sensitivity of diagnosing CBD calculus on MRCP was 88.9% and specificity in 100%.

In our study for stricture ultrasound detected 3 out of 5 cases of stricture with sensitivity: 60% specificity 89% and diagnostic accuracy: 96% while MRCP detected 4/5 cases of biliary strictures with sensitivity, specificity and diagnostic accuracy of 80%, 95.6%, and 94%, respectively. In contrast to our study, Pandit et al[16] in their study found accuracy of ultrasound in detection of benign stricture was 31% but results are comparable to a study done by Lomas et al[17] who compared MRCP and ERCP in 78 patients with obstruction and reported a sensitivity and specificity of 86.4% and 82.4% respectively for benign stenosis. The low sensitivity figures are to be related to intrinsic limitations of the methodology, which despite showing the indirect signs of stenosis, did not allow optimal visualization of the distal CBD and the ampullary region.

Both USG and MRCP detected all the two cases of the choledochal cyst and gave information of involvement confidently; similar findings were discussed by Kim et al.[18] in their study.

A total of 6 cases of pancreatitis were evaluated. Two cases were of acute and four cases were of chronic pancreatitis. MRI showed diffuse homogeneous enhancement of the entire gland in case of acute pancreatitis in early stages where ultrasound features were normal. In cases of chronic pancreatitis, calcifications were better visualized on ultrasonography, whereas pancreatic duct dilatation, pancreatic duct irregularity, tortuosity were well demonstrated by MRCP and the conclusion on the accuracy of the findings were similar to that mentioned in the study conducted by Bhatt C et al.[19] Main pancreatic duct was better seen on MRI in cases of chronic pancreatitis.

Ultrasound will not show much significant changes in cases of acute pancreatitis. Necrotic changes were detected rarely. Exact extent was not appreciated due to bowel gas and probe tenderness. In cases of chronic pancreatitis the altered morphology of the gland can be seen but the caliber of main pancreatic duct was difficult to visualize..

Endoscopic retrograde cholangiopancreatography (ERCP) was considered the gold standard for imaging of the biliary tract but is associated with complications. Less invasive imaging techniques, such as magnetic resonance cholangiopancreatography (MRCP), have a much lower complication rate. The accuracy of MRCP is comparable to that of ERCP. MRCP may be more effective and cost-effective, particularly in cases for which further intervention can be avoided.

Over the course of time different techniques have been developed for imaging of the intra- and extrahepatic bile ducts. Noninvasive modalities such as an ultrasound, CT, and MRI progressively take over from diagnostic ERCP. They allow a comprehensive and noninvasive evaluation of the liver parenchyma, periductal tissue, and bile ducts. Invasive ERCP still is the standard of reference and is given the priority in the case of simultaneous intervention.

Ultrasound is an easily available, non-invasive and low cost investigation without exposure to ionizing radiation. However, it is highly operator dependent, as it is subject to interference from bowel gas.

V. Tables and figures

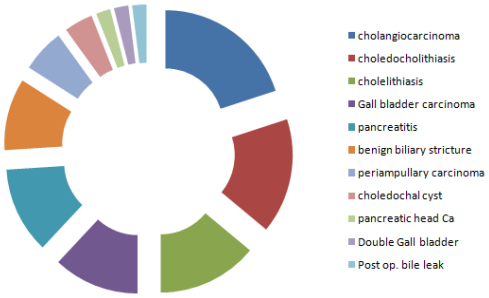


fig 1 distribution of cases

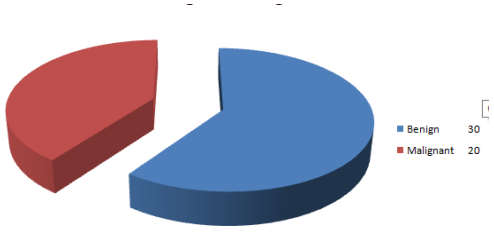


Fig 2 benign vs malignant cases

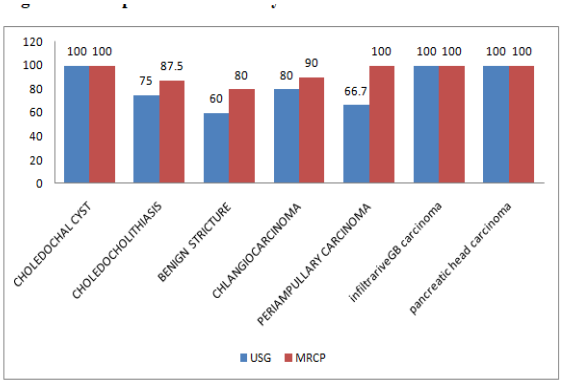


Fig 3 comparison of sensitivity of usg and mrcp

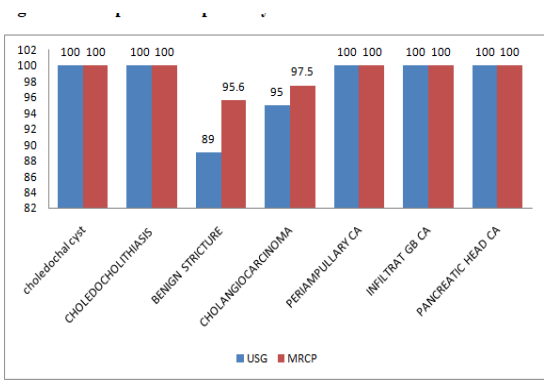


Fig 4 comparison of specificity of usg and mrcp

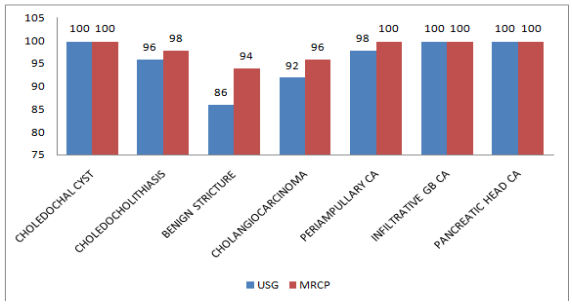


Fig 5 comparison of diagnostic accuracy

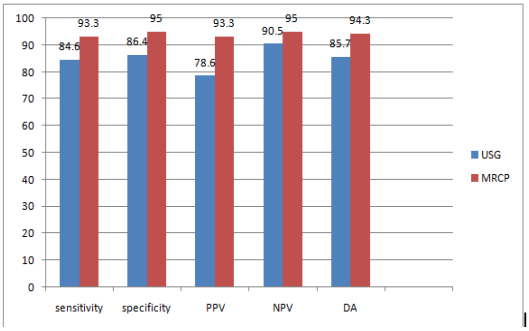


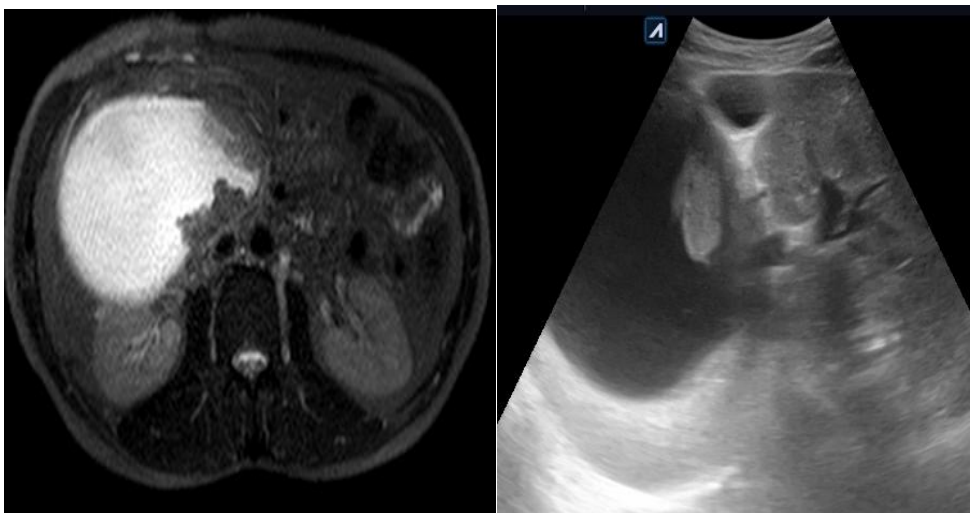
Fig 6 comparison of diagnostic variable for etiological diagnosis

Table1. Diagnostic performance of USG for different causes of obstructive jaundice

Cause of obstruction	True +ve	False +VE	False -ve	True -ve	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Choledochal cyst	2	0	0	48	100	100	100	100	100
CBD stone	6	0	2	42	75	100	100	95	96
Benign biliary stricture	3	5	2	40	60	89	37	95	86
Cholangiocarcinoma	8	2	2	38	80	95	80	95	92
Periampullary carcinoma	2	0	1	47	66.7	100	100	97	98
GB ca infiltrative	6	0	0	44	100	100	100	100	100
Pancreatic head Ca	1	0	0	49	100	100	100	100	100

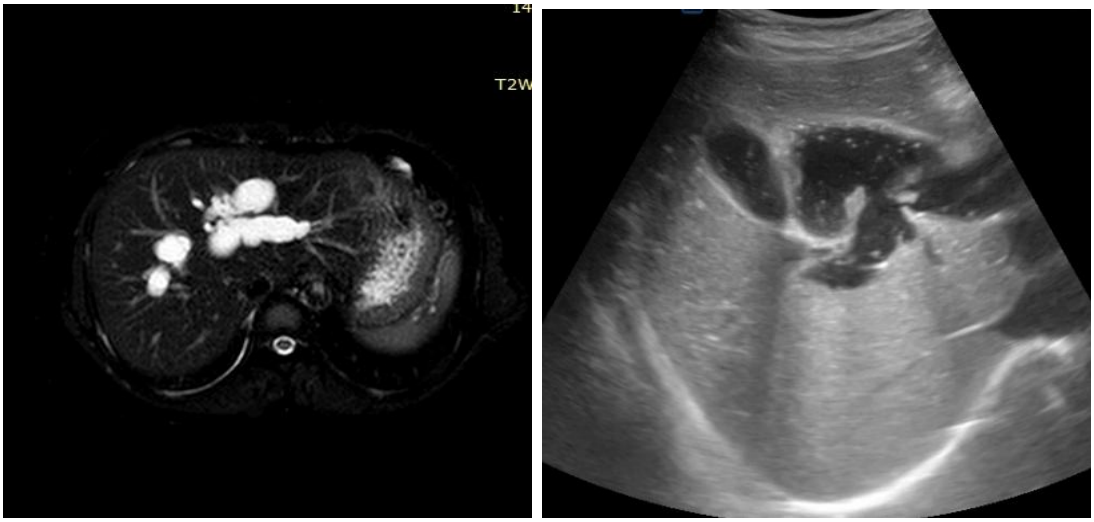
Table 2 Diagnostic performance of MRCP for different causes of obstructive jaundice

Cause of obstruction	True +ve	False +VE	False -ve	True -ve	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Choledochal cyst	2	0	0	48	100	100	100	100	100
CBD stone	7	0	1	42	87.5	100	100	95	96
Benign biliary stricture	5	2	0	43	100	95	71	95	100
Cholangiocarcinoma	9	0	1	40	90	100	100	97	98
Periampullary carcinoma	3	0	0	47	100	100	100	100	100
GB ca infiltrative	6	0	0	44	100	100	100	100	100
Pancreatic head Ca	1	0	0	49	100	100	100	100	100



A **B**

Fig 1A T2 axial MRCP images large choledochal cyst with hypointense growth within it .1**B** USG papillary growth within choledochal cyst.



A **B**

Figure 2A: T2 SPAIR axial, images showing multiple dilated biliary channels . **2B** USG showing multiple dilated biliary channels

VI. Conclusion

MRCP readily permits the study of anatomy and pathology of the biliary tree including pancreatic duct very easily.MRCP serves as an accurate and non invasive, non ionizing imaging method for evaluation of pancreatico-biliary anatomy and pathology .Ultrasound still remains the primary investigative modality of choice. However, owing to its low sensitivity in most of the benign stenosis and distal CBD disease, where the clinical and laboratory suspicion is strong and unsupported by ultrasound, and for a thorough staging evaluation of malignancy, MRCP is highly accurate and superior diagnostic modality in establishing diagnosis of obstructive biliary pathologies. Although U\S provides good information about the presence and level of biliary obstruction, it does not suggest the possible cause in many cases. So U\S is regarded as the initial examination, which provides a guide to choose patients for MRI examination.

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