# A Comparative Evaluation of USG and MRCP Findings in Biliary and Pancreatic Pathologies

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## ABSTRACT

**Introduction:** Obstructive jaundice is one of the most frequent and grave form of hepatobiliary disease. It can pose problems in diagnosis and management, particularly intrahepatic cholestasis. Hence, aim of the present study was to compare the diagnostic accuracy between Magnetic Resonance Cholangiopancreatography (MRCP) and Ultrasonography (USG) in detection and characterisation in patients suspected with pancreatic and biliary system pathologies.

**Material and methods:** This study was conducted among forty six patients suffering from obstructive jaundice of all age groups All the patients in the study underwent ultrasonography and MRCP. The results so obtained was expressed as percentages and variables as required.

**Results:** The overall sensitivity and specificity of ultrasonography in detecting lesions were 91.90% and 69.20% with a positive predictive value of 89.40% and negative predictive value of 75%. The overall sensitivity and specificity of MRCP in detecting lesions were 97.14% and 81.80% with a positive predictive value of 94.40% and a negative value of 90%. It was inferred that MRCP has the higher accuracy for detecting lesions. The sensitivity of MRCP was 97.14% and the specificity is as high as 81.8%.

**Conclusion:** MRCP can be considered as the new gold standard for the investigation of CBD and pancreatic ductal pathologies and permits reservation of ERCP to patients with a high probability of therapeutic intervention.


**Keywords:** Magnetic Resonance Cholangiopancreatography (MRCP), Obstructive Jaundice, Pancreatic Pathologies, Ultrasonograpy (USG)

## INTRODUCTION

Obstructive jaundice is one of the most frequent and grave form of hepatobiliary disease. It can pose problems in diagnosis and management, particularly intrahepatic cholestasis. So, it is mandatory to determine pre-operatively the existence, the nature and site of obstruction because an ill chosen therapeutic approach can be dangerous. Ultrasound is used as an initial modality to confirm or exclude duct obstruction, which it does with at least 90% accuracy.[1]

However, USG is operator dependent and has a limitation in patients with obesity and those with large amount of bowel gas. Computed tomography (CT) is a reliable modality and provides good definition of lesions and facilitates visualization of the entire extent of pancreatic pathology.[2]

The range of application of CT has been partially restricted by MRCP.[3] MRCP techniques have greatly evolved, providing high resolution images of the biliary tree with short exam duration, while remaining non invasive without contrast medium injection.[1]

MR Cholangiography was introduced by Wallner et al in 1991. Authors used the rapid sequence gradient echo acquisition with three- dimensional post processing technique to evaluate the biliary system in five healthy volunteers and 13 patients of obstructive jaundice. The results were compared with other imaging modalities (US, CT scan and conventional radiographs obtained during PTC or ERCP) and concluded that MR cholangiopancreatography has the capability for noninvasive imaging of the biliary tree in patients with obstructive jaundice but improvement in technique is needed to overcome limited spatial resolution and low signal to noise ratio.[4]

Hence, aim of the present study was to compare the diagnostic accuracy between Magnetic Resonance Cholangiopancreatography (MRCP) and Ultrasonography (USG) in detection and characterisation in patients suspected with pancreatic and biliary system pathologies.

## MATERIAL AND METHODS

This study was conducted in the Department of Radio Diagnosis, A. J. Institute of Medical Sciences, Mangalore. A total number of forty six patients suffering from obstructive jaundice of all age groups and either sex were included in this study. The study protocol was approved by the ethical committee at RGUHS University and all the patients gave informed consent to participate. Patients clinically diagnosed as suffering from obstructive jaundice, patients with deranged liver function tests or amylase and/or history of jaundice in case of ultrasound-proven cholelithiasis, evaluation of the bile ducts in patients with symptoms compatible with bile duct stones, but with lack of evidence of stones at ultrasound, patients following surgical reconstruction for benign disease, there is a significant incidence of those patients with recurrent biliary stricture and recurrent stones. Patients who does not gave consent to undergo MRCP studies, patients who were medically unfit for surgery / endoscopy due to other diseases, cases diagnosed clinically and ultrasonographically but not willing for admission for further management, patients with implants such as cardiac pacemakers, implantable cardiac defibrillators, cerebral aneurysm clips, implantable drug infusion pumps, cochlear implants, ocular prosthesis, dental implants, tissue expanders, dorsal column neurostimulators and bone growth stimulators, pregnancy (1st trimester) is a relative contraindication although there was no convincing evidence of foetal risk, motion disorder

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and claustrophobia were excluded from the study. Very large patients may not fit inside the bore of certain magnets and also present other technical problems, such as inadequate fit of the surface coil. All the patients were instructed to fast overnight prior to examination. All the metallic belongings removed prior to the examination. All the patients in the study underwent MRCP. MRCP was performed on forty six patients at 1.5 Tesla MRI Scanner. All images were obtained with breath holding and parameters were individualized. Detailed parameters of each sequence are summarized below. The various related parameters were studied on the MRCP. The classification of imaging findings as benign or malignant cause of obstructive jaundice. MRCP was analyzed separately in a blinded fashion without knowledge of the results of other examinations, or of clinical findings. Final diagnosis was established with per operative or histopathological correlation. Probably benign lesions were considered as benign and similarly probably malignant lesions were considered as malignant.

## STATISTICAL ANALYSIS

The results so obtained was expressed as percentages and variables as required. Microsoft office 2007 was used for the data analysis.

## RESULTS

Table 1 shows Accuracy of Diagnosis of USG versus MRCP findings in biliary and pancreatic pathologies in the study population. Ultrasound was able to identify choledochal cyst. Identification of calculi in the mid part of CBD was 66% and distal part was 25% probably due to the obscuration due to bowel gas. CBD Stricture was identified in 25% of cases. Among carcinomas, 53% of the periampullary carcinomas and 83% of cholangiocarcinoma were identified on USG. MRCP could detect most of the levels of obstruction better in comparison to that seen on USG. Choledochal cyst was also well seen on MRCP. Ductal calculi were seen in the CHD, mid and distal portions of CBD, strictures were better visualised and demonstration as benign and malignant on MRCP. Post Op cases such as leak were better demonstrated on MRCP. Periampullary carcinomas were seen in 50% cases. Cholangiocarcinomas and gall bladder mass were also well seen on MRCP. Pancreatic duct calculi were better depicted on MRCP than ultrasound.

The overall sensitivity and specificity of ultrasonography in detecting lesions were 91.90% and 69.20% with a positive predictive value of 89.40% and negative predictive value of 75%. The overall sensitivity and specificity of MRCP in detecting lesions were 97.14% and 81.80% with a positive predictive value of 94.40% and a negative value of 90%. From the above tables, it is inferred that MRCP has the higher accuracy for detecting lesions. The sensitivity of MRCP is 97.14% and the specificity is as high as 81.8%.

Table 3 shows sensitivity and specificity of ultrasound and MRCP in detecting Benign Lesions (biliary and pancreatic pathologies). The sensitivity and specificity of ultrasonography in detecting benign lesions were 94.40% and 50% with a positive predictive value of 94.40% and negative predictive value of 50%. The sensitivity and specificity of MRCP in detecting benign lesions were 92.30% and 76.92% with a positive predictive value of 92.30% and negative predictive value of 76.92%. Cases such as biliary leak is better visualized on MRCP than on USG.

Table 4 shows sensitivity and specificity of ultrasound and MRCP in detecting malignant lesions (biliary and pancreatic pathologies). The sensitivity and specificity of ultrasonography in detecting malignant lesions were 83.33% and 94.4% with a positive predictive value of 83.33% and negative predictive

| Pathologies | No. of Cases | USG Dx Accuracy | MRCP Dx Accuracy |
|---|---|---|---|
| Congenital | 1 | | |
| Choledochal cyst | 1 | 100% | 100% |
| Ductal Calculi | 6 | | |
| In CHD | 1 | 100% | 100% |
| In mid part of CBD | 1 | 66% | 100% |
| in distal CBD | 4 | 25% | 100% |
| Stricture | 9 | | |
| Benign | 5 | 0% | 100% |
| Malignant | 4 | 25% | 100% |
| Post OP cases | 2 | 0% | 100% |
| Mass lesion | 12 | | |
| Periampullary | 2 | 50% | 50% |
| Carcinoma | | | |
| Cholangiocarcinoma | 9 | 83% | 100% |
| GB Mass | 1 | 100% | 100% |
| Pancreatic duct calculi | 10 | 75% | 100% |
| Miscellaneous | 8 | | |
| Total | 46 | | |

**Table-1:** Shows Accuracy of Diagnosis of USG versus MRCP findings in biliary and pancreatic pathologies in the study population

| Modality | Sensitivity (%) | Specificity (%) | Positive predictive value (%) | Negative predictive value (%) |
|---|---|---|---|---|
| USG | 91.90% | 69.20% | 89.40% | 75% |
| MRCP | 97.14% | 81.80% | 94.40% | 90% |

**Table-2:** Shows overall Sensitivity and Specificity of Ultrasound (USG) and MRCP findings in biliary and pancreatic pathologies

| Modality | Sensitivity (%) | Specificity (%) | Positive predictive value (%) | Negative predictive value (%) |
|---|---|---|---|---|
| Ultrasound | 94.40 | 50 | 94.40 | 50 |
| MRCP | 92.3 | 76.92 | 92.3 | 76.92 |

**Table-3:** Sensitivity and Specificity of ultrasound and MRCP in detecting Benign Lesions (biliary and pancreatic pathologies)

| Modality | Sensitivity(%) | Specificity (%) | Positive predictive value (%) | Negative predictive value (%) |
|---|---|---|---|---|
| **Ultrasound** | 83.33 | 94.4 | 83.33 | 94.4 |
| MRCP | 81.25 | 91.66 | 81.25 | 91.66 |

**Table-4:** Sensitivity and Specificity of ultrasound and MRCP in detecting Malignant Lesions (biliary and pancreatic pathologies)

value of 94.4%. The sensitivity and specificity of MRCP in detecting malignant lesions were 81.25% and 91.66% with a positive predictive value of 81.25% and negative predictive value of 91.66%.

## DISCUSSION

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. With the introduction of MR Cholangiopancreatography for the diagnosis of biliary and pancreatic ductal pathologies, invasive procedures like ERCP can be avoided solely for the purpose of diagnosis. In the present study, 48 patients suffering from obstructive jaundice were studied. Most of the patients presented with jaundice and abdominal pain. Icterus was the most common sign followed by passing of white stools and itching. The European Association for Endoscopic Surgery (EAES) consensus development conference committee recommends common bile duct investigation to rule out choledocholithiasis in all patients with symptomatic cholelithiasis.[5]

Various clinical, biochemical and investigative procedures can be used to identify the ductal calculi. However, biochemical tests have poor sensitivity and specificity.[6] Ultrasound is an easily available, non-invasive and low cost investigation with no requirement for ionizing radiation. However, it is highly operator dependent, as it is subject to interference from bowel gas.[7] In the present study, ultrasound missed CBD calculi in 3 of the cases as CBD ducts were not dilated which made the detection difficult. Other cases missed on Ultrasound were CBD stricture and small lesions such as periampullary region. These were probably due to inadequate visualization of the entire CBD due to bowel gas and obesity.

MRCP was done for all patients. Of the six patients diagnosed with CBD calculi, MRCP had accurately diagnosed all the six cases. MRCP showed calculus region as an area of signal void. The present study was in concordance with Soto et al who reported sensitivity of 94% and specificity of 100% for detecting biliary calculi in MRCP.[21] Pavone et al found sensitivity of diagnosing CBD calculus on MRCP was 88.9% and specificity in 100%.[8]

The study conducted by Bhatt C et al[9] revealed that biliary duct stricture and mass lesions in the lower part of CBD can be better evaluated by MRCP which was also true in the present case. In cases of chronic pancreatitis, calcifications were better visualized on ultrasonography, whereas pancreatic duct dilatation, pancreatic duct irregularity, tortuosity and calculi within the pancreatic duct 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.[9] Upadhyaya V et al[10] conducted another study on MR cholangiopancreatography and revealed better results in detecting the cause of obstruction and was second only to ERCP in detecting the level of biliary obstruction on 100 patients. They concluded that with its excellent diagnostic capabilities, MR cholangiopancreatography has certainly carved a niche for itself in the non-invasive evaluation of the patient with obstructive jaundice. Dave M et al[11] conducted a study and concluded that MRCP has high sensitivity and very high specificity for diagnosis of PSC. In many cases of suspected PSC, MRCP is sufficient for diagnosis, and, thus, the risks associated with ERCP can be avoided. A study was conducted by Hazem ZA et al[6] on acute biliary pancreatitis and found that 81 to 100% sensitivity for detecting common bile duct stones, 94% negative predictive value and 94% positive predictive value for bile duct stones and found MR cholangiopancreatography to be as accurate as contrast enhanced CT in predicting the severity of pancreatitis and identifying pancreatic necrosis. MRCP can be recommended for the final diagnosis of pancreatic duct stones in patients with gastrointestinal symptoms, intermittent abdominal pain, DM / IGT and positive B-ultrasonography result.[12] Al-Obaidi S et al[13] found sensitivity (100%), specificity (98.5%), accuracy (98.7%) of MRI/MRCP for cases with benign stricture as compared to sensitivity of USG (44.4%). Andersson M et al[14] concluded in their study that MRI with MRCP was more accurate than CT in differentiating between malignant and benign lesions in patients with suspected periampullary tumors. Munir K et al[15] evaluated the diagnostic value of MRCP and confirmed it as a noninvasive and well tolerated imaging technique in the diagnosis of obstructive jaundice as the study revealed sensitivity and specificity of MRCP in detecting benign main bile duct stricture was 83.3% and 97.6% respectively, and 92% and 100% for malignant stricture.

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, and MRCP may be more effective and cost-effective, particularly in cases for which the suspected prevalence of disease is low and further intervention can be avoided.[16]

Post-operative case of cholestectomy where CBD were evaluated for leak, the origin of bile leak were better evaluated on MRCP. Like all investigations, MRCP also has a few limitations. It cannot be used for patients with metallic implants or pacemakers or patients having claustrophobia. It cannot provide therapeutic options like ERCP.

With the introduction of MRI guided interventions it may soon be possible in the near future to use MRCP for diagnostic and therapeutic applications in biliary tract and pancreatic pathologies. 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. In a study conducted by Onishi H et a1[17] concluded that MR cholangiopancreatography at 3.0 T revealed equivalent or superior image quality compared with that at 1.5 T. More recently developed hepatocyte-specific contrast agents such as Gd-EOB-DTPA are still in the process of evaluation for contrast-enhanced MR cholangiography. Added value of these agents is anticipated in the assessment of postoperative complications such as bile leakage and stenosis, as well as in the evaluation of PSC and small bile duct disease.

The study also has a few limitations. MRCP performance in primary sclerosing cholangitis, pediatric biliary disease, sphincter of Oddi dysfunction and post-liver transplant cholestasis, wherein biliary dilatation is less common and a falsely normal ultrasonogram is more common. Failures of MRCP were due to claustrophobia, or excessive body mass. The accuracy of the study would have improved had the sample size been larger.

## CONCLUSION

MRCP can be considered as the new gold standard for the investigation of CBD and pancreatic ductal pathologies and permits reservation of ERCP to patients with a high probability of therapeutic intervention. The only drawback of MRCP is the cost involved and the availability.

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