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Comparison of Diagnostic Reliability of Ultrasound and Magnetic Resonance Cholangiopancreatography in Patients with Obstructive jaundice

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ABSTRACT

Introduction: Accurate identification of the underlying cause of obstructive jaundice is essential for selecting the most appropriate management strategy. Imaging plays a crucial role in the diagnosis, with ultrasound often used as an initial investigation and magnetic resonance cholangiopancreatography as a non-invasive alternative to invasive cholangiography.

Objectives: To compare the diagnostic performance of Ultrasound and Magnetic Resonance Cholangiopancreatography (MRCP) in determining the etiology of obstructive jaundice, using the final clinical, surgical, or endoscopic diagnosis as the reference standard.

Methodology: This prospective cross-sectional study included 52 patients presenting with clinical and biochemical evidence of obstructive jaundice. All patients underwent both Ultrasound and MRCP. Imaging findings were correlated with the final diagnosis obtained from surgical, endoscopic, or clinical follow-up data. Sensitivity, specificity, accuracy, positive predictive value (PPV), negative predictive value (NPV), and kappa (κ) agreement were calculated for each modality.

Results: The patients ranged in age from 20 to 80 years (mean = 53.7 ± 14.7 years), with a male-to-female ratio of 1.9:1. The most common cause of obstruction was choledocholithiasis (48.1%), followed by common bile duct stricture (13.5%) and cholangiocarcinoma (17.3%). Ultrasound demonstrated sensitivity of 66.7%, specificity of 94.6%, and accuracy of 86.5%, with a κ-value of 0.65 (substantial agreement). MRCP showed higher sensitivity (93.3%), specificity (97.3%), and accuracy (96.2%), with a κ-value of 0.91 (almost perfect agreement) when compared with the final diagnosis.

Conclusion: MRCP provides superior diagnostic performance compared to Ultrasound in evaluating the cause of obstructive jaundice, particularly in identifying choledocholithiasis and malignant lesions. While Ultrasound remains a valuable initial screening modality, MRCP should be preferred for definitive diagnosis and treatment planning.

Introduction

Obstructive jaundice is one of the commonly encountered and worst form of hepatobiliary disease. In cases of intrahepatic cholestasis, it can create problems in diagnosis and management.[1] High morbidity and mortality are associated with the management of the obstructive jaundice despite advances in operative techniques. Significant advances have led us to understand the pathogenesis,

diagnosis, staging and the effective management of the obstructive jaundice in the last decade.[2] With the increase in treatment options for patients of obstructive jaundice, it has become necessary for the radiologists to do further than simply differencing between obstructive and non-obstructive jaundice. Specific evaluation of etiology, location, level and extent of disease results in correct choices among therapeutic options.[3]

Obstructive jaundice is commonly diagnosed in routine clinical practice. In patients with signs and symptoms in conjunction with laboratory parameters are suggestive of obstructive jaundice, the main objective is to find out its cause and, if so, to determine its cause, location and severity. Among the various diagnostic tools available, ultrasonography (USG) and magnetic resonance cholangiopancreatography (MRCP) are commonly used to assess disorders of the biliary system.

USG is typically the first imaging modality used in assessment of obstructive jaundice due to its affordability and non-invasiveness, as it does not involve radiation exposure. Nevertheless, its diagnostic utility is limited in some cases particularly in evaluating the distal common bile duct (CBD) and pancreatic region because bowel gas can obscure the view in up to one-third of patients.[4,5]

MRCP offers more detailed visualization of the anatomy of biliary system and is unaffected by bowel gas interference.[6] It has clear advantages over USG in the assessment of obstructive jaundice, including high contrast resolution, multiplanar imaging capabilities, and the ability to comprehensively display the biliary tree without the use of contrast agents. Moreover, MRCP produces high-quality, artifact-free images that enhance diagnostic accuracy in biliary obstruction cases.[7]

The objective of this study is to compare the diagnostic performance of Ultrasound and Magnetic Resonance Cholangiopancreatography (MRCP) in determining the etiology of obstructive jaundice, using the final clinical, surgical, or endoscopic diagnosis as the reference standard.

This study was undertaken to compare the diagnostic performance of USG and MRCP in patients with obstructive jaundice, with the aim of defining the diagnostic value and limitations of USG and establishing the complementary role of MRCP. The results may help in optimizing imaging protocols, improving diagnostic confidence, and ensuring cost-effective patient care.

Methodology

This is a prospective cross-sectional study done at Birat Medical College, Teaching hospital over a period of 1 year from 17th October 2024 to 16th October 2025. Sample size calculations was done on the basis of reported sensitivities of ultrasound (USG) and magnetic resonance cholangiopancreatography (MRCP) in benign and malignant causes of obstructive jaundice.[8] For benign cases, USG sensitivity was 65.57% and MRCP 95.2%, requiring approximately 27 patients to detect this difference with 80% power at 5% significance. For malignant cases, USG sensitivity was 56% and MRCP 95.75%, requiring about 15 patients. Considering these and aiming to ensure adequate power for subgroup analyses, the study targeted a minimum of 50 patients overall, to capture both benign and malignant cases sufficiently. The study included 52 patients, which provided adequate statistical power (≥80%) at a 95% confidence level to evaluate and compare the diagnostic performance of ultrasonography (USG) and magnetic resonance cholangiopancreatography (MRCP) in patients with obstructive jaundice.

Ethical clearance was obtained from the institutional review committee (IRC- PA-416/2024) of Birat Medical College. Patients with the clinical suspicion of obstructive jaundice with elevated serum bilirubin levels were included in the study. Known case of malignancy, patients with previous surgical history and medical cause of jaundice were excluded from the study. Patients with surgical history such as cholecystectomy, biliary bypass, or pancreatic surgery can lead to postoperative anatomical distortion, scarring, altered ductal caliber, or the presence of surgical clips and anastomoses.

Patients were advised NPO for 4-6 hours before Ultrasound examination, Ultrasound was done in GE Versana and the liver, gallbladder, intrahepatic ducts, CBD, pancreas and the periampullary region were scanned. Ultrasound findings and diagnosis was made for each of the patients with obstructive jaundice. Following dependent variables were evaluated, presence or absence of dilated IHBR and CBD, level of obstruction, cause of obstruction(benign or malignant) and outcome variables were calculated.

The patients were advised for MRCP by the surgeons and the oncologists. The usual contraindications for MRI were noted before MRCP. All patients were advised overnight fasting to avoid fluid collection in the stomach and duodenum and to distend the gallbladder. Patients were examined in standard MRCP sequences. The findings were noted by another radiologist.

MRCP is routinely done in cases of obstructive jaundice as most of the patients are planned for surgery and ERCP.

After Ultrasound and MRCP, their respective diagnosis was compared with ERCP, surgery and/or histopathology, whichever is feasible as the gold standard for final diagnosis. After completion, Data were entered and analyzed using standard statistical software SPSS(Version 26.0). Categorical variables were expressed as frequencies and percentages.

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were calculated for USG and MRCP.

To assess the agreement between USG and MRCP, kappa (κ) statistic was used. Associations between categorical variables were evaluated using the Chi-square test or Fisher's exact test, depending on expected cell counts.

Results

A total of 52 patients with clinical and biochemical evidence of obstructive jaundice were included in the study. The age of patients ranged from 20 to 80 years, with a mean age of 53.7 ± 14.7 years. The majority of patients (30.8%) were in the 51–60 year age group. There was a male predominance, with 34 (65.4%)

males and 18 (34.6%) females, yielding a male-to-female ratio of approximately 1.9:1.

Findings on Ultrasonography (USG)

On USG evaluation, benign causes of obstruction were more common (40; 76.9%) than malignant causes (12; 23.1%) (Table 1). The most frequent benign etiology was biliary stricture (28.8%), followed by choledocholithiasis (23.1%) and choledochal cyst (7.7%). Among malignant lesions, carcinoma of the head of pancreas (5.8%), distal cholangiocarcinoma (5.8%), and gallbladder carcinoma infiltrating the hilum (5.8%) were the predominant findings.

Findings on Magnetic Resonance Cholangiopancreatography (MRCP)

MRCP revealed benign causes in 37 (71.2%) cases and malignant causes in 15 (28.8%) (Table 2). The most common lesion detected was choledocholithiasis (46.2%), followed by biliary stricture (19.2%) and choledochal cyst (11.5%). Among malignant lesions, carcinoma of the head of pancreas (7.7%), distal cholangiocarcinoma (5.8%), hilar cholangiocarcinoma (5.8%), and gallbladder carcinoma infiltrating the hilum (3.8%) were observed. Compared with USG, MRCP detected a greater number of cases of choledocholithiasis and choledochal cyst, demonstrating superior capability in delineating biliary anatomy and identifying small calculi or cystic dilatations.

Findings on Final Diagnosis

Based on surgical, endoscopic, and clinical findings, choledocholithiasis was the most frequent cause of obstruction (48.1%), followed by common bile duct (CBD) stricture (13.5%), distal cholangiocarcinoma (11.5%), choledochal cyst (11.5%), and Carcinoma head of pancreas (7.7%) (Table 3). Malignant causes collectively accounted for 14 (26.9%) of all cases.

Comparison of Diagnostic Performance of USG and MRCP

When compared with the final diagnosis, MRCP demonstrated markedly superior diagnostic performance (Table 4). The sensitivity, specificity, and overall accuracy of MRCP were 93.3%, 97.3%, and 96.2%, respectively, compared with 66.7%, 94.6%, and 86.5% for USG. The positive predictive value (PPV) and negative predictive value (NPV) of MRCP were 93.3% and 97.3%, respectively, while those for USG were 83.3% and 87.5%. The kappa (κ) coefficient for agreement with the final diagnosis was 0.65 for USG (substantial agreement) and 0.91 for MRCP (almost perfect agreement). Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated using standard 2×2 contingency tables, with the final diagnosis (based on surgical, ERCP findings) as the reference standard. These findings confirm that MRCP is more accurate and reliable than USG in identifying the etiology of obstructive jaundice.

Level of obstruction

Hilar obstruction was mostly seen in malignant cases (Hilar cholangiocarcinoma) and CBD obstruction was seen in mostly benign cases (choledocholithiasis, cysts). Distal obstruction (ampulla/periampullary) was seen in mix of benign and malignant cases, but malignancy dominates (distal cholangiocarcinoma, carcinoma head of pancreas). (Figure 1)

Table 1: Causes of Obstructive Jaundice on USG (n = 52)

Etiology	USG (n, %)
Choledocholithiasis	12 (23.1%)
Choledochal cyst	4 (7.7%)
Carcinoma of head of pancreas	3 (5.8 %)
Hilar mass	2 (3.8%)
Distal Cholangiocarcinoma	3 (5.8%)
Gallbladder carcinoma infiltrating hilum	3 (5.8 %)
Biliary Stricture	15 (28.8%)
Total benign causes	40 (76.9%)
Total malignant causes	12 (23.1%)

Table 2: Causes of Obstructive Jaundice on MRCP (n = 52)

Etiology	MRCP (n, %)
Choledocholithiasis	24 (46.2%)
Biliary stricture	10 (19.2%)
Carcinoma of head of pancreas	4 (7.7%)
Distal cholangiocarcinoma	3 (5.8%)
Hilar Cholangiocarcinoma	3 (5.8%)
Gallbladder carcinoma infiltrating hilum	2 (3.8%)
Choledochal cyst	6 (11.5%)
Total benign causes	37 (71.2%)
Total malignant causes	15 (28.8%)

Table 3: Final diagnosis(n=52)

Final diagnosis	(n, %)
Choledocholithiasis	25(48.1%)
GB carcinoma infiltrating hilum	1(1.9%)
Hilar cholangiocarcinoma	3(5.8%)
CBD stricture	7(13.5%)
Distal cholangiocarcinoma	6(11.5%)
Carcinoma head of pancreas	4(7.7%)
Choledochal cyst	6(11.5%)
Total	52(100%)

Table 4: Comparison of USG and MRCP with Final Diagnosis (n = 52)

Parameter	USG (%)	MRCP (%)
Sensitivity	66.7	93.3
Specificity	94.6	97.3
Accuracy	86.5	96.2
Positive Predictive Value (PPV)	83.3	93.3
Negative Predictive Value (NPV)	87.5	97.3
Kappa (κ) agreement with final diagnosis	0.65 (substantial)	0.91 (almost perfect)

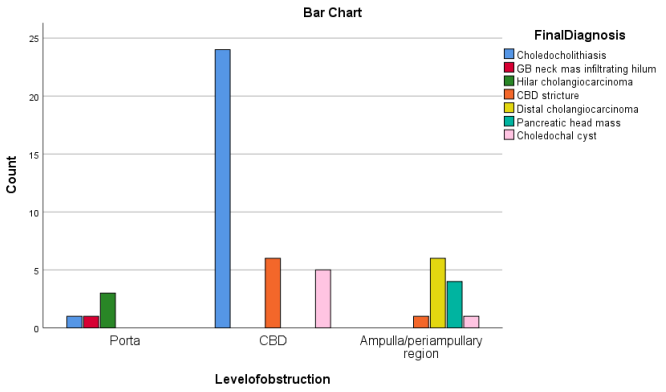

Figure 1: Level of obstruction and final diagnosis

Figure 2: Ultrasound image showing fusiform dilatation of proximal CBD representing choledochal cyst

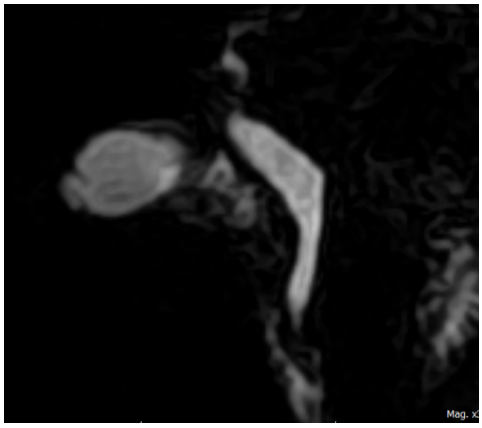

Figure 3: MRCP 3D MIP image showing distal CBD stricture

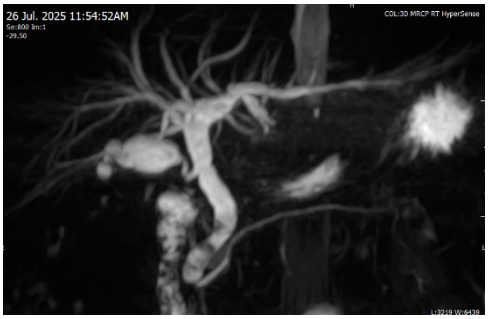

Figure 4: MRCP 3D MIP image showing multiple choledocholithiasis.

Discussion

In our study of 52 patients with obstructive jaundice, MRCP demonstrated higher diagnostic accuracy (96.2%) than USG (86.5%) when compared with the final diagnosis. The sensitivity, specificity, and kappa agreement of MRCP (93.3%, 97.3%, κ = 0.91) were superior to those of USG (66.7%, 94.6%, κ = 0.65). These findings establish MRCP as a more reliable imaging modality for evaluating the etiology and level of biliary obstruction.

Similar results were obtained by Amardeep et al, where they concluded MRCP as an important non invasive imaging investigation in the pre operative evaluation of patients with obstructive jaundice.[9]

We found out common cause of obstructive jaundice in this study was benign lesion. Similar results were noted in the study done by Sharma et al.[10] where they found 53% of their patients had benign lesion for obstructive jaundice and malignant lesions in 47%. Ranjan et al.[11] in their study also found similar results, where they noted 90% of lesions were benign and 10% of lesions were malignant in 40 patients.

In our study, hilar obstruction was mostly seen in malignant cases and CBD obstruction was seen in mostly benign cases. Similar result was found in the study done by Ghimire R et al, where hilar level of obstruction was seen.[12]

Choledocholithiasis was found to be the most common cause of obstructive jaundice in our study. Similar results were seen in the study conducted by Karki s et al, where choledocholithiasis followed by CBD stricture were most common causes.[13]

Ikram s et al observed diagnosed accuracy of ultrasound 80%, which is lower than our study.[14]

In our study, Ultrasound correctly diagnosed choledocholithiasis in only 12 out of total 25 patients of choledocholithiasis. This is quite low and probably because of bowel gas obstructing the proper visualization of distal CBD especially in obese patients. Similar results were seen in a study done by Andrea Piña and colleagues where they observed ultrasonography to be less sensitive in detecting choledocholithiasis with sensitivity of 25% and biliary tract expansion with sensitivity of 66.5%.[15] Similarly previous studies showed a sensitivity range of 20 to 80% in detecting CBD stones using ultrasound.[16]

Conclusion

MRCP demonstrated significantly higher sensitivity, specificity, and overall diagnostic accuracy than ultrasonography in evaluating the underlying causes of obstructive jaundice. While USG remains a valuable, initial, and widely available screening tool for detecting biliary dilatation, it is limited in characterizing the level and etiology of obstruction. MRCP, being non-invasive and highly reliable, serves as a superior problem-solving modality and should be preferred when detailed anatomical assessment is required. Combining both modalities in a stepwise approach can optimize early diagnosis and guide appropriate clinical management.

Recommendations

Standardized imaging protocols combining initial ultrasound with selective MRCP may improve diagnostic efficiency in patients with suspected obstructive jaundice.

Limitations of the study

The study was limited by its relatively small sample size and single-center design, which may affect the generalizability of the findings.

Operator dependency of USG could have influenced the diagnostic accuracy.

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