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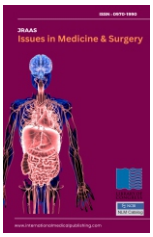

Case Report

Section: Radiodiagnosis

Unraveling Obstructive Jaundice: A Comparative Analysis of USG and MRCP

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HIGHLIGHTS

- USG aids in early jaundice detection.
- MRCP shows detailed biliary tract anatomy.
- Comparison improves diagnostic accuracy in jaundice.
- Non-invasive methods reduce patient diagnostic risks.
- Combined approach ensures better clinical outcomes.

Key Words:
Obstructive jaundice
MRCP
Ultrasonography
Biliary obstruction
Diagnostic imaging

ABSTRACT

Background: Obstructive jaundice, caused by mechanical blockage in the biliary system, presents a common diagnostic challenge in gastrointestinal and hepatobiliary medicine. Early and accurate identification of the underlying etiology and level of obstruction is vital for guiding treatment. Ultrasonography (USG) is often used as the first-line imaging modality due to its accessibility and cost-effectiveness, whereas Magnetic Resonance Cholangiopancreatography (MRCP) has emerged as a superior non-invasive technique for detailed evaluation of the biliary tract. **Objective:** To compare the diagnostic efficacy of USG and MRCP in identifying the cause and location of obstructive jaundice, and to assess their respective sensitivity, specificity, and overall diagnostic accuracy. **Methods:** A prospective observational study was conducted involving 40 patients with clinical and biochemical features of obstructive jaundice. Each participant underwent both USG and MRCP using standardized protocols. Imaging results were evaluated against clinical findings and, when available, ERCP data. Diagnostic metrics including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were computed. **Results:** Of the 40 patients, choledocholithiasis was the most common cause (52%), followed by CBD stricture (15%) and periampullary carcinoma (7%). MRCP demonstrated superior diagnostic performance with a sensitivity of 94.87%, specificity of 50%, PPV of 97.42%, NPV of 20%, and accuracy of 92.68%. In comparison, USG yielded a sensitivity of 67.75%, specificity of 33.3%, PPV of 86.6%, NPV of 10%, and accuracy of 65%. MRCP was particularly effective in detecting distal CBD lesions and rare entities like Lemmel syndrome. **Conclusion:** MRCP is significantly more accurate than USG in diagnosing both benign and malignant causes of obstructive jaundice. While USG remains a valuable initial screening tool, MRCP should be considered essential for comprehensive diagnostic assessment and treatment planning.

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Obstructive jaundice, a subtype of jaundice characterized by mechanical blockage in the biliary drainage system, remains a frequent clinical challenge encountered in hepatobiliary and gastrointestinal medicine. The obstruction impedes the normal flow of bile from the liver to the duodenum, resulting in the accumulation of conjugated bilirubin in the bloodstream. Clinically, this condition manifests with a characteristic triad of jaundice, pruritus, and pale stools, often accompanied by abdominal pain and dark urine. The etiologies of obstructive jaundice are diverse, ranging from benign causes such as choledocholithiasis and strictures, to malignant pathologies including cholangiocarcinoma, pancreatic carcinoma, and periampullary tumors. Prompt and accurate identification of the underlying cause and level of obstruction is crucial for guiding therapeutic decisions and improving patient outcomes [1,2].

Over the years, imaging has emerged as the cornerstone for the diagnosis and characterization of biliary obstruction. Among the various imaging modalities available, ultrasonography (USG) is often the initial investigation of choice. It is widely available, non-invasive, cost-effective, and does not involve ionizing radiation. USG can detect biliary ductal dilation and gallstones with fair sensitivity and specificity, particularly when performed by experienced operators. However, its diagnostic yield may be limited by patient body habitus, presence of bowel gas, and difficulty in visualizing distal common bile duct (CBD) obstructions. These limitations necessitate the need for advanced imaging techniques to supplement initial findings [3,4].

Magnetic Resonance Cholangiopancreatography (MRCP) has revolutionized the evaluation of biliary and pancreatic ductal systems. MRCP is a specialized non-invasive MRI technique that offers high-resolution, multiplanar visualization of the biliary tree without the need for contrast media or invasive instrumentation. It employs heavily T2-weighted sequences that exploit the high fluid content of bile, producing detailed images of the intrahepatic and extrahepatic ducts. Unlike USG, MRCP is not affected by bowel gas and provides a comprehensive assessment of both intraductal and extraductal abnormalities. Moreover, MRCP avoids the potential complications associated with endoscopic retrograde cholangiopancreatography (ERCP), such as pancreatitis, perforation, and bleeding, making it a safer alternative for diagnostic purposes [5,6].

The increasing use of MRCP in clinical practice necessitates a comparative evaluation with traditional imaging methods such as USG, particularly in resource-limited settings where cost and accessibility remain key determinants. Numerous studies have demonstrated the superior diagnostic performance of MRCP in delineating the level and cause of biliary obstruction, especially in complex cases and in visualizing distal CBD and periampullary lesions. Nonetheless, USG continues to hold value as a frontline modality due to its ease of use and utility in initial triage and follow-up. Therefore, a head-to-head analysis of these two techniques is essential for delineating their respective roles and establishing a rational diagnostic algorithm [7,8].

This research study aims to compare the diagnostic performance of USG and MRCP in patients with clinically and biochemically suspected obstructive jaundice. The study includes a cohort of 40 patients evaluated prospectively over six months using standardized imaging protocols. Patients underwent USG using a curvilinear probe (2.5–5 MHz) to obtain sagittal, transverse, and subcostal views of the biliary tree. Subsequently, MRCP was performed using a 1.5 Tesla MRI system with sequences tailored to optimize biliary tract visualization. The diagnostic findings from both modalities were compared and analyzed with respect to sensitivity, specificity, and diagnostic accuracy in detecting benign and malignant causes of obstruction [9].

In an era where accurate, timely, and cost-effective diagnosis is imperative, the findings from this comparative analysis will contribute valuable insights into the utility and limitations of USG and MRCP in gastrointestinal imaging. This study not only highlights the technological advances in imaging but also addresses practical concerns related to diagnostic decision-making in clinical gastroenterology. Ultimately, establishing a robust imaging strategy is pivotal for optimizing the management of patients with obstructive jaundice and ensuring better prognostic outcomes [10].

MATERIAL AND METHODS

This prospective observational study was conducted at the Department of Radiology, Kempegowda institute of medical sciences, Bangalore for 6 months. Ethical approval has been obtained from the Ethical Approval Committee of Kempegowda institute of medical sciences, Bangalore.

Study Population

A total of 40 patients clinically and biochemically diagnosed with obstructive jaundice were included. The study population consisted of 24 females (60%) and 16 males (40%), ranging in age from 22 to 82 years. All patients presented with symptoms of jaundice, abdominal pain, and pruritus. Individuals with follow-up scans or MR images compromised by artifacts were excluded to ensure data integrity and imaging accuracy in both modalities under investigation.

Data Analysis

Data were collected and tabulated based on the findings from USG and MRCP. Diagnostic accuracy, sensitivity, and specificity were calculated for both modalities by correlating imaging results with clinical, laboratory, and, when available, ERCP findings. Statistical comparisons were made to determine the ability of each modality to identify benign and malignant causes. Emphasis was placed on evaluating the precision of

lesion localization, particularly in the distal CBD, across all imaging techniques.

RESULTS

In a study involving 40 patients diagnosed with obstructive jaundice, the majority of participants were female, accounting for 60%, while males constituted 40%, indicating a clear gender disparity in prevalence. The most frequently observed cause of obstructive jaundice was choledocholithiasis, identified in 21 patients (52%). This was followed by common bile duct (CBD) stricture and periampullary carcinoma. Less frequent etiologies included cholangiocarcinoma, gallbladder mass with infiltration, intraductal papillary mucinous neoplasm (IPMN), choledochal cyst, hypertrophied ampulla, and Mirizzi syndrome. Notably, choledochal cyst was the only congenital cause, and one case of Lemmel's syndrome-a rare cause of obstruction-was not detected on ultrasonography but identified on MRCP. These findings highlight the diversity of etiologies contributing to obstructive jaundice and underscore the importance of advanced imaging modalities like MRCP for accurate diagnosis.

Table 1: Causes of Obstructive Jaundice

Cause	Number of Cases	Percentage (%)
Choledocholithiasis	21	52%
CBD Stricture	6	15%
Periampullary Carcinoma	3	7%
Cholangiocarcinoma	2	5%
Gallbladder Mass with Infiltration	2	5%
IPMN (Intraductal Papillary Mucinous Neoplasm)	2	5%
Choledochal Cyst	1	2%
Hypertrophied Ampulla	1	2%
Mirizzi Syndrome	1	2%
Lemmel Syndrome	1	2%

Choledocholithiasis was the most common cause of obstructive jaundice (52%), followed by CBD stricture (15%), periampullary carcinoma (7%), and other less frequent causes like cholangiocarcinoma, gallbladder mass, IPMN, choledochal cyst, hypertrophied ampulla, Mirizzi, and Lemmel syndromes.

Out of 40 patients evaluated, the cause of obstructive jaundice was identified in 39 individuals. Among these, 32 were diagnosed with benign etiologies and 7 with malignant ones. Magnetic Resonance Cholangiopancreatography (MRCP) demonstrated a higher diagnostic performance, correctly identifying 31 benign cases and all 7 malignant cases. In comparison, Ultrasonography (USG) detected 22 of the 32 benign cases and only 3 of the 7 malignant ones. These findings are supported by the comparative diagnostic metrics: MRCP exhibited a sensitivity of 94.87%, specificity of 50%, positive predictive value (PPV) of 97.42%, negative predictive value (NPV) of 20%, and overall diagnostic accuracy of 92.68%. In contrast, USG showed a sensitivity of 67.75%, specificity of 33.3%, PPV of 86.6%, NPV of 10%, and diagnostic accuracy of 65%. These results clearly establish MRCP as a more accurate and reliable imaging modality for evaluating the etiology of obstructive jaundice than USG.

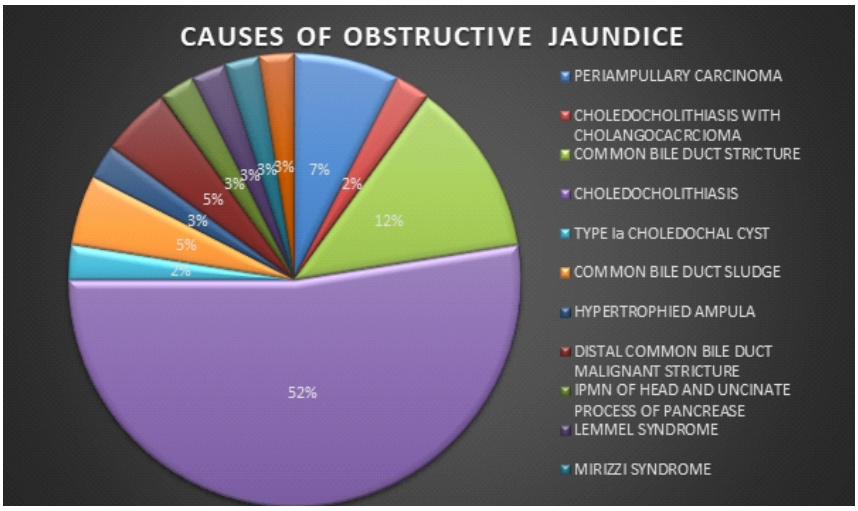

Figure 1: Causes of obstructive Jaundice

Table 2: Comparison of Diagnostic Values of USG and MRCP

Diagnostic Metric	USG (%)	MRCP (%)
Sensitivity	67.75	94.87
Specificity	33.3	50.00
Positive Predictive Value (PPV)	86.6	97.42
Negative Predictive Value (NPV)	10.0	20.00
Diagnostic Accuracy	65.00	92.68

MRCP showed superior diagnostic performance over USG with higher sensitivity (94.87% vs. 67.75%), PPV (97.42% vs. 86.6%), and overall accuracy (92.68% vs. 65%), while USG had notably lower specificity and NPV.

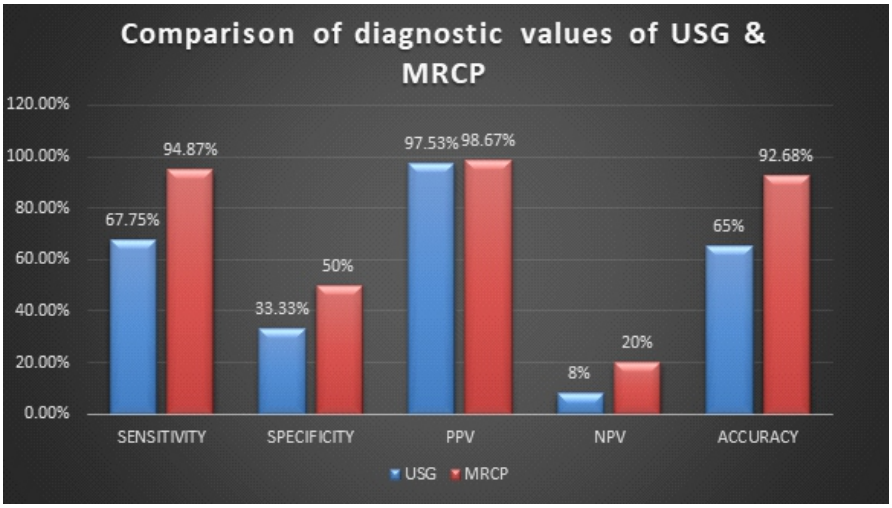

Figure 2: Comparison of Diagnostic Values of USG and MRCP

The above graph infer that MRCP has better diagnostic accuracy (92.68 %) than the USG (65 %). The sensitivity of MRCP is greater than that of USG.

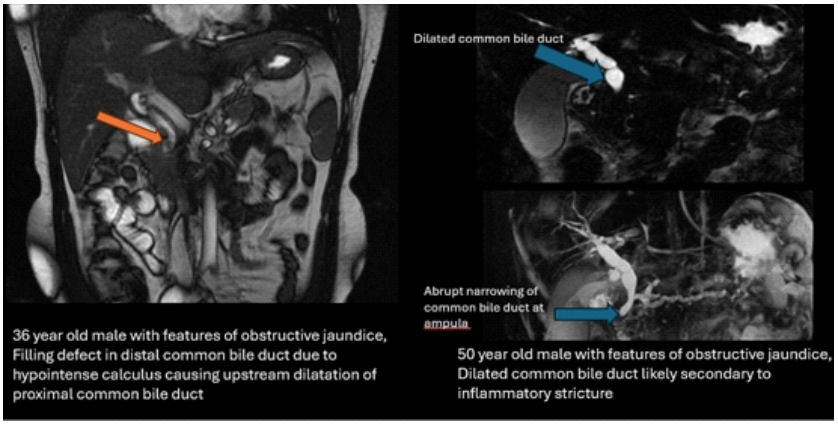

Figure 3: Representive Cases

Figure 4: Representive Cases

DISCUSSION

The study aimed to evaluate the comparative diagnostic utility of USG and MRCP in patients presenting with obstructive jaundice, a condition requiring accurate imaging for effective treatment. Among 40 participants, MRCP demonstrated a substantially higher diagnostic accuracy (92.68%) than USG (65%), especially in detecting pathologies located in the distal common bile duct (CBD) [11].

Choledocholithiasis was the most frequently observed etiology, present in 21 of the 40 patients (52%). MRCP showed a perfect detection rate for these cases, correctly identifying all distal and proximal calculi. This aligns with findings from Swaraj et al., who reported 100% sensitivity for MRCP in detecting CBD calculi. USG performed relatively well in identifying proximal CBD stones but failed in several distal cases, highlighting one of its key limitations. The acoustic window provided by USG often struggles with deep or gas-obstructed abdominal areas, affecting its performance in distal duct visualization [12].

In terms of malignant causes, MRCP detected all seven cases accurately, including periampullary carcinoma and cases suggestive of intraductal papillary mucinous neoplasm. USG identified only three of these malignancies, which raises concern about its utility as a standalone modality in evaluating suspected cancerous obstructions. Notably, one case involving a distal CBD stricture confirmed by ERCP was missed by both USG and MRCP, suggesting limitations still exist for all imaging methods, particularly in subtle or early-stage lesions [13].

The study also documented a rare case of Lemmel syndrome that was diagnosed solely by MRCP. USG failed to identify this duodenal diverticulum-related obstruction due to its subtle presentation and complex anatomic positioning. The MRCP's ability to detect such unusual cases further supports its value in comprehensive biliary assessment. In contrast, congenital anomalies such as choledochal cysts were detected by both modalities, suggesting that large or prominent anomalies can still be picked up by USG [14].

When sensitivity, specificity, and diagnostic accuracy were compared quantitatively, MRCP showed significantly better performance: 94.87% sensitivity, 50% specificity, and 92.68% diagnostic accuracy. For USG, the values were lower: 67.75% sensitivity, 33.3% specificity, and 65% diagnostic accuracy. Compared to studies like that of **Gupta AK, et. al; 2017,** USG's sensitivity in this study was slightly higher but still showed marked inferiority to MRCP. This consistent disparity across studies supports the position that MRCP is better suited for diagnostic confirmation and preoperative planning [15].

The superiority of MRCP stems from its high spatial resolution, ability to provide multiplanar views, and resistance to common confounders such as bowel gas and operator dependence. Unlike Endoscopic Retrograde Cholangiopancreatography (ERCP),

MRCP is non-invasive and free of procedural risks. While ERCP remains the gold standard for therapeutic intervention, MRCP is the preferred method for initial comprehensive evaluation. Moreover, MRCP's integration with T1 and T2 MRI sequences allows detection of both intra-ductal and extra-ductal abnormalities [16,17].

Despite its advantages, MRCP has limitations such as longer scanning time, higher cost, and lower availability in resource-limited settings. Therefore, while USG remains useful for initial screening, especially in rural or peripheral healthcare centers, MRCP should be utilized in ambiguous or complex cases to confirm diagnosis and guide management strategies [18,19].

This study reinforces the importance of a tiered imaging approach: beginning with USG for basic evaluation and proceeding to MRCP for definitive diagnosis. The combined use enhances diagnostic confidence and facilitates accurate clinical decision-making in obstructive jaundice cases.

CONCLUSION

This study confirms that Magnetic Resonance Cholangiopancreatography (MRCP) is a superior imaging modality compared to Ultrasonography (USG) in diagnosing obstructive jaundice. MRCP offers higher diagnostic accuracy, particularly for distal CBD lesions, and precisely detects both benign and malignant causes. While USG remains useful as a preliminary tool due to its affordability and accessibility, its diagnostic limitations warrant further imaging with MRCP for confirmation. MRCP's non-invasive nature, superior sensitivity, and comprehensive visualization of the biliary system make it essential for accurate diagnosis and effective management in patients presenting with obstructive jaundice.

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