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Diagnostic Accuracy of Magnetic Resonance Cholangiopancreatography Compared to Ultrasonography and Computed Tomography in Obstructive Jaundice: A Cross-Sectional Study.

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Abstract

Background:

Obstructive jaundice is a common clinical condition requiring timely identification of the level and cause of biliary obstruction. Ultrasonography (USG) and Computed Tomography (CT) are widely used initial imaging modalities, while Magnetic Resonance Cholangiopancreatography (MRCP) provides non-invasive high-resolution visualization of the biliary tree. This study evaluates the diagnostic accuracy of MRCP compared to USG and CT.

Methodology:

A cross-sectional study was conducted at Hi-Tech Medical College & Hospital, Bhubaneswar, from July 2025 to December 2025. Sixty patients with clinical and biochemical features of obstructive jaundice were included. The mean age was 52.6 ± 14.3 years, with 60% males and 40% females. All patients underwent USG, CT, and MRCP. Final diagnosis was confirmed using ERCP, histopathology, or surgical findings.

Results:

MRCP demonstrated higher sensitivity (94.6%) compared to CT (85.1%) and USG (78.4%) ($p<0.001$). Specificity of MRCP was 92.3%. It showed superior detection of choledocholithiasis and malignant obstruction. Overall diagnostic accuracy was highest for MRCP (93.3%).

Conclusion:

MRCP is superior to USG and CT in diagnosing obstructive jaundice and accurately identifying the level and cause of obstruction. It should be considered the preferred non-invasive imaging modality following initial ultrasonography.

Key words: *MRCP, obstructive jaundice, ultrasonography, computed tomography, biliary obstruction.*
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Background of the Study

Obstructive jaundice represents a pathological interruption of bile flow due to mechanical blockage within the biliary system. The obstruction may arise from benign etiologies such as common bile duct stones and inflammatory strictures, or from malignant processes including carcinoma of the pancreas, periampullary tumors, and cholangiocarcinoma [1,2]. Delay in identifying the underlying cause can result in progressive hepatic dysfunction, ascending cholangitis, and long-term biliary cirrhosis [3].

Imaging plays a pivotal role in determining both the presence and level of obstruction. Ultrasonography (USG) is generally the first diagnostic modality employed because it is inexpensive, widely available, and capable of demonstrating biliary dilatation with reasonable accuracy [4]. However, despite its utility in detecting proximal ductal dilatation, USG may have reduced sensitivity in evaluating the distal common bile duct and periampullary region due to overlying bowel gas and operator dependency [5].

Computed Tomography (CT) provides superior cross-sectional anatomical detail and is particularly valuable in

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detecting mass lesions, assessing vascular involvement, and staging malignant obstruction [6]. Advances in multidetector CT have enhanced spatial resolution and diagnostic yield [7]. Nevertheless, CT may fail to identify small intraductal calculi or subtle benign strictures, limiting its diagnostic sensitivity in certain clinical contexts [8].

Magnetic Resonance Cholangiopancreatography (MRCP) is a non-invasive technique that exploits heavily T2-weighted sequences to visualize static or slow-moving fluid within the biliary and pancreatic ducts [9]. Since its introduction, MRCP has evolved into a highly accurate modality for delineating biliary anatomy and detecting obstruction [10]. Multiple studies have demonstrated that MRCP provides diagnostic performance comparable to invasive techniques such as ERCP for many biliary pathologies [11].

Given that ERCP is associated with procedure-related complications, including pancreatitis, bleeding, and perforation, non-invasive modalities are increasingly favored for diagnostic purposes [12]. In this context, evaluating the comparative accuracy of MRCP against USG and CT remains clinically relevant, particularly in regional populations where resource allocation and diagnostic pathways vary.

The present study was therefore undertaken to assess the diagnostic accuracy of MRCP compared with USG and CT in patients presenting with obstructive jaundice at a tertiary care center.

Methodology

Study Design

This was a **hospital-based cross-sectional analytical study**.

Study Setting

The study was conducted in the Department of Radio-Diagnosis at Hi-Tech Medical College & Hospital, Bhubaneswar, Odisha, a tertiary care teaching hospital offering radiological, surgical, and gastroenterology services. Data were collected from July 2025 to December 2025.

Participants

A total of 60 patients with clinically and biochemically suspected obstructive jaundice were included.

Inclusion Criteria:

- Age ≥18 years
- Clinical and biochemical evidence of obstructive jaundice

Exclusion Criteria:

- Hemolytic jaundice
- Severe renal impairment
- Contraindications to MRI

Sample Size Determination

The sample size of 60 patients was determined based on feasibility and the availability of eligible patients during the study period.

Sampling Method

A **consecutive sampling method** was used, where all eligible patients presenting during the study period were included until the required sample size was achieved.

Variables

- **Independent variables:** Imaging modality (USG, CT, MRCP)
- **Dependent variables:** Sensitivity, specificity, PPV, NPV, diagnostic accuracy
- **Outcome variable:** Final diagnosis confirmed by ERCP, histopathology, or surgery

Data Collection Methods and Tools

Data were collected using a structured data collection form. All patients underwent USG, CT, and MRCP using standard imaging protocols. Imaging findings were recorded and compared with the final diagnosis obtained through ERCP, histopathology, or surgical findings.

Bias

To minimize bias:

- Standard imaging protocols were followed
- Radiologists were blinded to other imaging findings where feasible
- Objective diagnostic criteria were used

Ethical Approval

Ethical approval was obtained from the Institutional Ethics Committee of Hi-Tech Medical College & Hospital, Bhubaneswar. Written informed consent was obtained from all participants.

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Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Comparisons between imaging modalities were carried out using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 60 patients with clinically and biochemically suspected obstructive jaundice were included in the study.

Demographic Characteristics

The mean age of the study population was **52.6 ± 14.3 years** (range: 21–78 years). The majority of patients were males (60%). Detailed demographic distribution is shown in **Table 1**.

Table 1. Demographic Distribution (n = 60)

Variable	Value
Mean age (years)	52.6 ± 14.3
Age range	21–78
Male	36 (60%)
Female	24 (40%)

Etiology of Obstructive Jaundice

The most common cause of obstruction was **choledocholithiasis (43.3%)**, followed by periampullary carcinoma (23.3%), pancreatic carcinoma (16.7%), benign strictures (10%), and cholangiocarcinoma (6.7%). The distribution of etiological factors is summarized in **Table 2**.

Table 2. Etiology of Biliary Obstruction

Etiology	Number (n=60)	Percentage (%)
Choledocholithiasis	26	43.3
Periampullary carcinoma	14	23.3
Pancreatic carcinoma	10	16.7
Benign stricture	6	10.0
Cholangiocarcinoma	4	6.7

Diagnostic Performance of Imaging Modalities

MRCP demonstrated the highest diagnostic performance among the three imaging modalities. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy are presented in **Table 3**.

Table 3. Diagnostic Performance Comparison

Modality	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
USG	78.4	75.0	80.2	72.5	75.0
CT	85.1	83.3	87.4	80.0	83.3
MRCP	94.6	92.3	95.8	90.0	93.3

Comparison using the Chi-square test showed a statistically significant difference between MRCP and USG ($\chi^2 = 11.4$, **$p < 0.001$**) and between MRCP and CT ($\chi^2 = 6.2$, **$p = 0.01$**).

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Detection of Choledocholithiasis

MRCP demonstrated superior sensitivity (96.1%) for detecting choledocholithiasis compared to CT (80.7%) and USG (73.0%). This difference was statistically significant ($\chi^2 = 9.8$, **p = 0.002**). Details are shown in **Table 4**.

Table 4. Sensitivity for Detection of Choledocholithiasis (n = 26)

Modality	True Positive	False Negative	Sensitivity (%)
USG	19	7	73.0
CT	21	5	80.7
MRCP	25	1	96.1

Detection of Malignant Obstruction

MRCP showed higher sensitivity (93.8%) for malignant obstruction compared to CT (87.5%) and USG (70.8%). The difference between MRCP and USG was statistically significant (**p < 0.01**).

Overall Diagnostic Accuracy Comparison

The overall diagnostic accuracy of each imaging modality is illustrated in **Figure 1**.

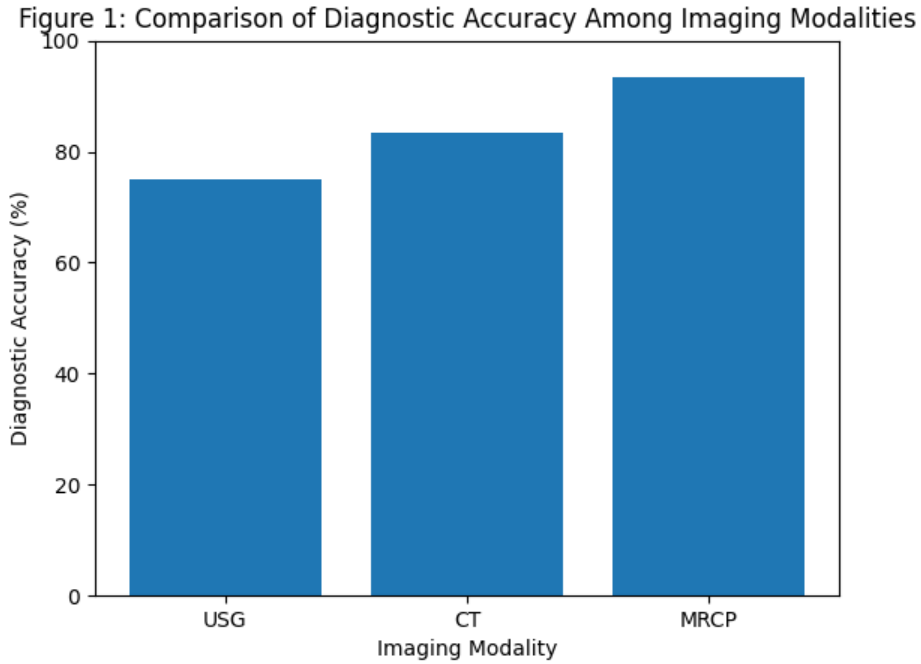

Figure 1. Comparison of Diagnostic Accuracy Among Imaging Modalities

MRCP demonstrated significantly higher diagnostic accuracy compared to USG and CT (**p < 0.001**).

Agreement with Final Diagnosis

Kappa agreement analysis showed:

- MRCP: $\kappa = 0.88$ (excellent agreement)
- CT: $\kappa = 0.72$ (substantial agreement)
- USG: $\kappa = 0.61$ (moderate agreement)

The agreement of MRCP with the gold standard diagnosis was statistically significant (**p < 0.001**).

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Summary of Key Findings in Results

MRCP demonstrated superior sensitivity (94.6%), specificity (92.3%), and diagnostic accuracy (93.3%) compared to CT and USG. It showed statistically significant superiority in detecting choledocholithiasis and malignant obstruction. Kappa analysis confirmed excellent agreement between MRCP and final diagnosis.

Discussion

The present study demonstrates that MRCP has superior diagnostic performance compared to USG and CT in evaluating obstructive jaundice. With an overall diagnostic accuracy of 93.3%, MRCP showed higher sensitivity and specificity for identifying both benign and malignant causes of obstruction.

A comprehensive meta-analysis by Romagnuolo et al. reported pooled sensitivity and specificity of MRCP exceeding 90% for detecting choledocholithiasis, reinforcing its reliability as a diagnostic modality [13]. Similarly, Verma et al. concluded that MRCP provides excellent accuracy in identifying bile duct stones and can effectively reduce the need for diagnostic ERCP [14]. The high sensitivity observed in our study for choledocholithiasis aligns with these findings.

MRCP has also demonstrated strong performance in evaluating malignant obstruction. Boraschi et al. highlighted its ability to differentiate benign from malignant strictures with high diagnostic confidence [15]. Kim et al. further emphasized the utility of MRCP in defining stricture morphology and tumor extension [16]. Our findings of improved detection of malignant causes compared with USG support these earlier observations.

In cases of pancreatic and periampullary carcinoma, MRCP provides detailed ductal mapping without exposure to ionizing radiation. Manfredi et al. reported that MRCP offers a reliable assessment of pancreaticobiliary malignancies and assists in preoperative planning [17]. Although CT remains valuable for staging and vascular assessment, its sensitivity in detecting small intraductal stones is comparatively lower [18].

Park et al. noted that MRCP offers superior ductal visualization compared with CT, particularly in complex biliary strictures [19]. Additionally, Adamek et al. demonstrated that MRCP could replace diagnostic ERCP in many patients with suspected biliary obstruction, thereby minimizing invasive procedures [20].

The clinical relevance of avoiding unnecessary ERCP is well established. Freeman et al. documented significant rates of post-ERCP pancreatitis and other complications [21]. Andriulli et al., in a systematic review, reported similar complication rates, underscoring the need for careful patient selection [22]. Cotton et al. further emphasized structured risk stratification before therapeutic ERCP [23].

Guibaud et al. demonstrated that MRCP reliably identifies both the level and cause of biliary obstruction with high accuracy [24]. Varghese et al. similarly confirmed strong concordance between MRCP findings and final diagnosis in obstructive jaundice [25]. Our kappa agreement value (κ = 0.88) indicates excellent agreement, supporting the consistency of MRCP findings with definitive diagnosis.

Overall, MRCP provides a comprehensive evaluation of the biliary tree, avoids radiation exposure, and reduces reliance on invasive diagnostic procedures. These advantages, combined with the high diagnostic accuracy demonstrated in the present study, reinforce its role as the preferred non-invasive imaging modality in obstructive jaundice.

Conclusion

MRCP demonstrates superior diagnostic accuracy compared to USG and CT in obstructive jaundice. It should be the preferred imaging modality after initial ultrasonography.

Limitations

This study had a relatively small sample size and was conducted at a single center, which may limit generalizability. Selection bias may be present due to hospital-based sampling. Additionally, not all patients underwent uniform gold standard testing, which may affect diagnostic comparisons.

Recommendation

MRCP should be routinely used for definitive evaluation of obstructive jaundice before therapeutic intervention.

Acknowledgement

We thank the Department of Radio-diagnosis and Surgery, Hi-Tech Medical College & Hospital.

List of Abbreviations

MRCP – Magnetic Resonance Cholangiopancreatography
USG – Ultrasonography
CT – Computed Tomography
ERCP – Endoscopic Retrograde Cholangiopancreatography

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Author Contributions
All authors contributed equally to the concept, data collection, analysis, and manuscript preparation.

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