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DIAGNOSTIC ACCURACY OF MRCP FOR DETECTING CHOLEDOCOLITHIASIS IN PATIENTS PRESENTED WITH OBSTRUCTIVE JAUDICE KEEPING ERCP FINDING AS GOLD STANDARD

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Abstract

Objective:
To evaluate the diagnostic accuracy of magnetic resonance cholangiopancreatography (MRCP) in detecting choledocholithiasis (common bile duct stones) in patients with obstructive jaundice, using endoscopic retrograde cholangiopancreatography (ERCP) as the reference standard.

Design:
A cross-sectional validation study.

Place & Duration of Study:
Department of Radiology, Bacha Khan Medical College/Mardan Medical Complex, Mardan, from December 2024 to April 2025.

Methodology:
A total of 115 patients aged 16–65 years presenting with features of obstructive jaundice and cholestatic liver function tests were enrolled. All patients underwent MRCP followed by ERCP. MRCP scans were interpreted by a consultant radiologist blinded to ERCP results. The presence of choledocholithiasis on MRCP was defined as a signal void or filling defect within the common bile duct, while ERCP findings were considered the gold standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of MRCP were calculated with ERCP as the reference.

Results:
The mean age of patients was 48 ± 13 years, and 56% were female. ERCP confirmed choledocholithiasis in 50 patients (43.5%). MRCP correctly identified 45 of these (true positives) and missed 5 (false negatives), yielding a sensitivity of 90.0%. Among 65 ERCP-negative patients, MRCP correctly ruled out stones in 55 (true negatives) and showed false-positive findings in 10, giving a specificity of 84.6%. The positive predictive value was 81.8%, negative predictive value 91.7%, and overall diagnostic accuracy 87.0%. No statistically significant differences in diagnostic performance were observed across subgroups stratified by age, sex, or duration of symptoms ($p>0.05$).

Conclusion:
MRCP demonstrated high diagnostic accuracy in detecting choledocholithiasis in patients with obstructive jaundice. Given its excellent sensitivity and negative predictive value, MRCP serves as a reliable, non-invasive tool for screening and triaging patients for therapeutic ERCP, potentially reducing unnecessary invasive procedures. However, positive MRCP findings should be confirmed with ERCP for definitive diagnosis and treatment.

INTRODUCTION

Obstructive jaundice is clinically evident jaundice caused by mechanical blockage of bile flow through the biliary tract[1,2]. This condition can lead to significant morbidity, including hepatic and renal dysfunction if not relieved. Identifying the cause of obstruction is critical for effective management. Endoscopic retrograde cholangiopancreatography (ERCP) is considered the diagnostic gold standard for locating and managing the cause of biliary obstruction[1,3]. ERCP not only allows visualization of the biliary tree but also enables therapeutic interventions (stone extraction or stenting) during the same procedure. Studies have reported that ERCP has a high diagnostic success rate in determining the cause of obstructive jaundice[4]. However, ERCP is an invasive procedure that requires technical expertise and carries a risk of complications such as pancreatitis, bleeding, infection, and even a small but significant risk of mortality[5]. These risks are exacerbated in certain populations (for example, the elderly or those with comorbid conditions), where more frequent difficulty in cannulation and higher adverse event rates are observed[6]. Given these challenges, non-invasive imaging techniques are increasingly favored for initial diagnosis[7].

Ultrasound (US) is often the first-line imaging modality for patients with obstructive jaundice, but transabdominal US has limitations in detecting distal or small common bile duct (CBD) stones[8]. In contrast, magnetic resonance cholangiopancreatography (MRCP) can provide high-resolution images of the biliary tree non-invasively. MRCP has shown superior diagnostic performance compared to ultrasound; for example, one study found that US had a sensitivity of only 33.3% for identifying the cause of biliary obstruction, whereas MRCP's sensitivity was 94.1% in the same patients[9]. MRCP is essentially an MRI sequence optimized to visualize static or slow-moving fluids in the biliary and pancreatic ducts, thereby highlighting biliary stones as filling defects without the need for contrast injection or ionizing radiation. Notably, MRCP can also delineate strictures or masses causing obstruction, aiding comprehensive assessment[10].

Choledocholithiasis (CBD stones) is the single most common cause of extrahepatic biliary obstruction in most series of obstructive jaundice[11]. Epidemiologically, benign causes (like stones or biliary strictures) account for the majority of obstructive jaundice cases, whereas malignant causes (such as cholangiocarcinoma, pancreatic head carcinoma, or periampullary tumors) are less frequent in comparison[1]. Thus, accurately detecting or excluding a CBD stone is often the pivotal step in management. MRCP offers a promising non-invasive alternative to ERCP for this purpose. Prior studies have reported varying diagnostic performance of MRCP in detecting choledocholithiasis. For instance, Isram et al. reported that MRCP could detect CBD stones with a sensitivity of 96.2% and specificity of 91.8% when compared to ERCP[12]. In another study, however, MRCP yielded a sensitivity of 87% and specificity of 80%, indicating more modest accuracy[13]. Similarly, a Pakistani study using intra-operative findings as the reference standard found MRCP sensitivity of about 83% (with higher specificity ~94%)[2]. These discrepancies in MRCP performance may stem from differences in patient populations, imaging technology, prevalence of small stone sizes, or operator expertise in image interpretation. As a result, it remains uncertain whether clinicians can rely on MRCP alone to definitively diagnose choledocholithiasis in all cases.

In light of the need for a safe and accurate diagnostic approach, we aimed to determine the diagnostic accuracy of MRCP for detecting choledocholithiasis in patients with obstructive jaundice, using ERCP findings as the gold standard. We hypothesized that MRCP would show high sensitivity and NPV (to reliably rule out CBD stones) and high, though perhaps slightly lower, specificity and PPV (recognizing that some false positives might occur). By establishing the reliability of MRCP in this context, the study seeks to inform clinical decision-making — specifically, whether MRCP can be used as a triage test to avoid unnecessary ERCP in patients without stones, and to confirm the need for therapeutic ERCP in those with stones. The results may strengthen confidence in MRCP as an effective non-invasive diagnostic modality for choledocholithiasis, thus improving patient care by minimizing invasive procedures.

Methodology

This cross-sectional validation study was conducted at the Department of Radiology, Bacha Khan Medical College/Mardan Medical Complex, from December 2024 to April 2025. A total of 115 patients, aged 16–65 years, who presented with obstructive jaundice were enrolled through non-probability consecutive sampling. Obstructive jaundice was defined clinically and biochemically by a cholestatic liver profile with elevated serum bilirubin and alkaline phosphatase levels.

All participants underwent magnetic resonance cholangiopancreatography (MRCP) followed by endoscopic retrograde cholangiopancreatography (ERCP) for diagnostic confirmation. MRCP was performed and interpreted by a consultant radiologist blinded to ERCP findings. A filling defect within the common bile duct (CBD) on MRCP was considered positive for choledocholithiasis. ERCP, performed by an experienced gastroenterologist, served as the reference (gold) standard, confirming the presence or absence of CBD stones.

Patients with contraindications to MRI (such as metallic implants, pacemakers, or severe claustrophobia), renal impairment, pregnancy, or hypersensitivity to contrast agents were excluded. Data were collected using a structured proforma, including demographic details, imaging results, and ERCP findings.

Data were analyzed using IBM SPSS Statistics version 26. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Diagnostic accuracy parameters—sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy—were calculated using a 2×2 contingency table with ERCP as the reference standard.

Ethical approval for this study was obtained from the Institutional Ethical Review Board of Bacha Khan Medical College, Mardan (Approval No. 425/BKMC). Written informed consent was obtained from all participants prior to inclusion.

Results

A total of 115 patients with obstructive jaundice were included. The mean age was 48.1 ± 12.7 years (range: 17–65 years), and 64 patients (55.7%) were female. The median duration of jaundice prior to imaging was 4 weeks (IQR 3–6). The mean serum bilirubin was 8.2 ± 3.5 mg/dL, and the mean alkaline phosphatase level was 410 ± 150 IU/L. Most patients (70%) were from rural areas, and 30% from urban settings. No significant association was found between demographic or clinical variables and the presence of choledocholithiasis ($p>0.05$).

ERCP confirmed choledocholithiasis in 50 patients (43.5%), while 65 patients (56.5%) had no CBD stones. MRCP identified stones in 55 cases and reported no stone in 60 cases. Comparison of MRCP with ERCP findings is shown in Table 1. MRCP correctly identified 45 of 50 true positives and 55 of 65 true negatives, while 10 false-positive and 5 false-negative results were recorded.

Table 1: 2×2 Contingency Table of MRCP Results vs ERCP (Gold Standard) for CBD Stone Detection

MRCP finding \ ERCP finding	ERCP: Stone present (n)	ERCP: No stone (n)	Total MRCP cases (n)
MRCP: Stone present	45 (True Positive)	10 (False Positive)	55
MRCP: No stone present	5 (False Negative)	55 (True Negative)	60
Total cases	50	65	115

The sensitivity of MRCP for detecting CBD stones was 90.0%, specificity 84.6%, positive predictive value (PPV) 81.8%, negative predictive value (NPV) 91.7%, and overall diagnostic accuracy 87.0%. The 95% confidence intervals were: sensitivity 79.9–95.3%, specificity 73.0–92.1%, PPV 69.1–90.9%, NPV 81.6–97.2%, and accuracy 79.7–92.2%.

MRCP performance did not significantly differ across subgroups stratified by age, sex, or duration of jaundice (all $p>0.05$). No adverse events occurred from MRCP, while ERCP-related minor complications were observed in 3 patients (2.6%), all of whom developed mild pancreatitis that resolved with conservative management.

Discussion:

This study evaluated the diagnostic accuracy of MRCP in detecting choledocholithiasis using ERCP as the reference standard in patients with obstructive jaundice. The results demonstrated that MRCP had a high sensitivity (90%) and specificity (84.6%), with an overall accuracy of 87%. These findings indicate that MRCP can correctly identify most true stone cases while excluding the majority of non-stone cases. The high negative predictive value (91.7%) in particular suggests that a negative MRCP reliably rules out choledocholithiasis, supporting its use as a non-invasive triage tool before ERCP.

Our findings align with previously published literature. Isram et al. (2023) reported MRCP sensitivity and specificity of 96.2% and 91.8%, respectively, for detecting CBD stones, while Nayab et al. observed slightly lower values of 87% and 80%[12,13]. Naseem et al. found MRCP sensitivity of 83.3% and specificity of 93.9% when compared with surgical findings[14]. These results collectively reinforce MRCP's strong diagnostic performance, with minor inter-study variations likely due to differences in disease prevalence, imaging technique, and operator expertise. In our study, disease prevalence was 43.5%, comparable to prior reports. Variations in MRCP accuracy may also depend on stone size—smaller calculi (<6 mm) are more easily missed, leading to occasional false negatives. Operator interpretation and MRI equipment resolution can also affect diagnostic yield, emphasizing the importance of experienced radiologists and optimized imaging protocols.

The high NPV of MRCP across studies (ranging from 84% to 96%) is clinically meaningful, as it allows clinicians to confidently exclude choledocholithiasis in patients with negative MRCP findings. This could significantly reduce the number of unnecessary ERCP procedures. ERCP, though valuable therapeutically, carries inherent risks including pancreatitis, bleeding, cholangitis, and perforation, with an estimated 1% mortality rate. In our cohort, minor post-ERCP complications were noted in 5% of patients, consistent with literature reports. An MRCP-first strategy could therefore improve patient safety, reduce procedural risks, and lower healthcare costs by reserving ERCP for therapeutic interventions.

However, the positive predictive value (81.8%) suggests that not all positive MRCP findings represent true stones. False positives may result from small stones that pass spontaneously, biliary sludge, air bubbles, or artifacts mimicking filling defects. A few false negatives in our study likely represented small or transient stones not visualized on MRCP. Hence, while a negative MRCP may obviate the need for ERCP, a positive MRCP should still be followed by confirmatory and therapeutic ERCP. In equivocal cases, endoscopic ultrasound (EUS) may serve as a complementary modality due to its excellent

resolution for detecting small CBD stones, though it was not available in our center.

In addition to stone detection, MRCP provided valuable information on alternative causes of biliary obstruction, such as strictures and masses, highlighting its utility in comprehensive evaluation of obstructive jaundice. Prior studies have shown that MRCP demonstrates high specificity for these lesions but relatively lower sensitivity compared to stones[12]. Nonetheless, its ability to delineate the biliary anatomy non-invasively makes it indispensable for diagnostic and preoperative planning.

Overall, our study confirms that MRCP is a reliable, safe, and accurate diagnostic tool for evaluating patients with suspected choledocholithiasis. While ERCP remains essential for therapy, MRCP can effectively guide clinical decision-making by identifying patients who truly require intervention and sparing others from unnecessary invasive procedures.

This study was conducted at a single center with a modest sample size, which may limit the generalizability of the results. Stone size stratification and correlation with MRCP detectability were not analyzed, which could provide additional insights. Clinically, our findings reinforce the value of MRCP as a non-invasive triage tool for suspected choledocholithiasis, potentially reducing unnecessary diagnostic ERCPs and their related risks. Future multicenter studies incorporating endoscopic ultrasound (EUS) could further refine diagnostic pathways and validate these findings across broader patient populations.

Conclusion

This study demonstrates that magnetic resonance cholangiopancreatography (MRCP) has high diagnostic accuracy for detecting choledocholithiasis in patients with obstructive jaundice, showing excellent sensitivity and negative predictive value when compared with ERCP. These findings support the role of MRCP as a reliable, non-invasive first-line imaging modality for evaluating suspected common bile duct stones. By accurately identifying patients who require therapeutic ERCP, MRCP can help minimize unnecessary invasive procedures, reducing both patient risk and healthcare burden. However, given its moderate positive predictive value, a positive MRCP result should be confirmed by ERCP for definitive diagnosis and management.

Declarations

Ethical Approval:

The study was approved by the Ethical Review Board of Bacha Khan Medical College, Mardan (Approval No. 425/BKMC). Written informed consent was obtained from all participants prior to inclusion in the study.

Conflict of Interest:

The authors declare that there is no conflict of interest related to this study or its publication.

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Authors' Contribution:

- **Dr. Muhammad Farah Adeed Khan:** Conceptualization, study design, supervision, and critical revision of the manuscript.
- **Dr. Ihtesham Noor:** Data collection, imaging interpretation, and drafting of the initial manuscript.
- **Dr. Zubair Janan Aurakzai:** Methodological guidance, statistical analysis, and manuscript review for important intellectual content.
- **Dr. Hamayoon:** Data acquisition, patient coordination, and literature review.

All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work in ensuring its accuracy and integrity.

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