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Research Article

Diagnostic Accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) to Diagnose Biliary Stricture as a Cause of Obstructive Jaundice, Keeping Endoscopic Retrograde Cholangiopancreatography (ERCP) as the Gold Standard

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ABSTRACT

Background: Biliary tract disease is an important clinical finding that can cause obstructive jaundice, which can be either benign or malignant. Timely diagnosis is important as biliary strictures will be misdiagnosed, causing inappropriate surgical intervention, hepatic dysfunction, progressive biliary obstruction and eventually cholangitis if the diagnosis is delayed. MRCP is a non-invasive imaging modality of the biliary system and ERCP is an important reference and therapeutic procedure.

Objective: To determine the diagnostic accuracy of magnetic resonance cholangiopancreatography for detecting biliary stricture as a cause of obstructive jaundice, using endoscopic retrograde cholangiopancreatography as the reference standard.

Methods: This cross-sectional validation study was conducted in the Hayatabad Medical Complex, Peshawar from Jan 2025 to December 2025. Include a total of 203 patients with obstructive jaundice were included. MRCP was followed by ERCP for all participants. The following parameters were noted: demographic parameters, serum bilirubin, serum alkaline phosphatase, duration of jaundice and the type and presence of biliary stricture. MRCP's diagnostic performance was assessed by calculating the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy based upon the ERCP results.

Results: The mean age of participants was 44.18 ± 10.92 years, and 116 (57.1%) were male. ERCP confirmed biliary stricture in 44 (21.7%) patients, whereas MRCP identified stricture in 70 (34.5%) patients. There were 38 true-positive, 127 true-negative, 32 false-positive, and 6 false-negative findings. MRCP demonstrated a sensitivity of 86.4%, specificity of 79.9%, PPV of **54.3%**, NPV of 95.5%, and overall diagnostic accuracy of 81.3%.

Conclusion: MRCP showed good diagnostic performance for detecting biliary strictures in patients with obstructive jaundice, particularly because of its high sensitivity and NPV. Its non-invasive nature makes it useful for initial assessment and for identifying patients in whom invasive evaluation with ERCP may be more selectively employed.

Keywords: Magnetic Resonance Cholangiopancreatography, Endoscopic Retrograde Cholangiopancreatography, Biliary Stricture, Obstructive Jaundice, Diagnostic Accuracy.

INTRODUCTION

In obstructive jaundice, there is an obstruction of the normal flow of bile from the liver to the intestine, causing the conjugated bilirubin and other biliary substances to accumulate in the blood. It can be caused by non-cancerous or cancerous disease of the intrahepatic or extrahepatic bile duct. These are usually caused

by choledocholithiasis, benign biliary strictures, cholangiocarcinoma, gallbladder carcinoma, pancreatic tumors, periampullary malignancy, or inflammatory disorders of the biliary system. The etiology can differ significantly both in populations and clinical settings and precise identification of the level and cause of obstruction is crucial for proper management (1,2).

Biliary strictures are an important subset of the causes of obstructive jaundice and can be either benign or malignant. Benign narrowing occurs following inflammation, surgical injury, chronic pancreatitis, primary sclerosing cholangitis, infection, and ischemic damage; malignant strictures may develop with cholangiocarcinoma, pancreatic carcinoma, gallbladder carcinoma, ampullary tumors or metastatic involvement. Clinically and radiologically, it can be difficult to distinguish these entities as the symptoms and imaging findings can overlap significantly (3). Instead, modern recommendations focus on systematic, or "structured," diagnostic evaluation with biochemical assays, cross-sectional imaging, endoscopy, and tissue sampling, when malignancy is suspected (4).

Liver function tests and ultrasound are typically performed as part of initial evaluation of patients with suspected obstructive jaundice. The use of ultrasonography is inexpensive, widely available, and helpful in detecting biliary dilatation; however, bowel gas, obesity, or anatomic abnormalities may interfere with the image of the distal common bile duct and pancreatic area. Magnetic resonance cholangiopancreatography addresses many of these limitations by being a high-contrast imaging technique that allows imaging of bile filled ducts without the use of routine instrumentation or the use of ionization radiation. It can represent the location, degree and probable cause of biliary obstruction and it has been shown to have excellent diagnostic accuracy in patients with suspected biliary disease (5).

MRCP is primarily performed using heavily T2-weighted magnetic resonance sequences in which fluid motion (or slow motion) in the bile and pancreatic duct results in a high signal intensity. This provides detailed visualization of ductal anatomy, narrowing, dilatation, calculi and surrounding abnormalities. The advent of new acquisition technologies has propelled its status as a non-invasive tool for the diagnosis of the biliopancreatic system. Comparisons of MRCP to invasive methods have shown good sensitivity and specificity of MRCP in the diagnosis of common bile duct pathology such as ducts dilations and biliary strictures (6,7).

ERCP, on the other hand, is a combination of both the endoscopic and fluoroscopic methods and allows for direct cholangiographic visualization of the biliary tract. It also offers vital therapeutic procedures such as sphincterotomy, stone removal, dilatation of strictures, biliary drainage, stenting, brush cytology and tissue sampling. Therefore, ERCP continues to be a useful standard procedure in patients with clinically important biliary obstruction. But it has been found that due to its invasive nature it causes well recognized complications such as post-ERCP pancreatitis, bleeding, infection, perforation, and anesthesia complications (8).

Accurate non-invasive imaging prior to ERCP has therefore led to a greater interest in the possibility of avoiding unnecessary invasive procedures. Selective application of so called advanced non invasive or minimally invasive diagnostic methods can be useful to prevent unnecessary ERCP for common bile duct disease (9). In a similar way, recent evidence is growing to support the use of MRCP as a valuable diagnostic tool before therapeutic endoscopy, when diagnosis is still unclear.

There have been a few recent studies which have investigated how accurate MRCP is in the diagnosis of obstructive jaundice, but results have been variable depending on the underlying condition. Patel et al. showed that MRCP could be helpful in establishing the site and cause of biliary obstruction, while Kumar et al. reported high sensitivity (83.33%), high specificity (97.92%), and overall accuracy (95%) when compared to ERCP in such cases (6,7).

But the variability is more apparent when benign and malignant stricturing are separated. While the MRCP was able to show excellent MRCP performance for a variety of obstructive jaundices, excellent sensitivity was reported for only benign and malignant distal common bile duct (dCD) strictures with relatively low specificity (10). These discrepancies may be due to patient selection, anatomic location, underlying disease, imaging techniques, reader experience, and reference standard for confirmation.

Consequently, additional local diagnostic-accuracy studies remain important, particularly in settings where ERCP carries greater procedural burden and where MRCP may help guide selection of patients for invasive

intervention. Establishing the predictive value of a negative MRCP is especially relevant because reliable exclusion of biliary stricture could potentially reduce avoidable invasive procedures while maintaining diagnostic safety. Therefore, the present study was conducted to determine the diagnostic accuracy of magnetic resonance cholangiopancreatography in detecting biliary stricture as a cause of obstructive jaundice, using endoscopic retrograde cholangiopancreatography as the reference standard**.**

METHODOLOGY

This cross-sectional validation study was conducted in the Hayatabad Medical Complex, Peshawar from Jan 2025 to December 2025. The number of patients enrolled was 203 and sampling was done consecutively. The sampling was non-probability consecutive sampling with a total number of patients 203. A sample-size approach for a diagnostic sensitivity and specificity was used with a 95% confidence level, 10% precision, and the following expected values: sensitivity 87%, specificity 80%, and a prevalence of biliary stricture of 21.43%. These assumptions resulted in a (required) sample size of n = 203. Obstructive jaundiced patients (aged 18–60 years), referred to the radiology department for MRCP evaluation prior to ERCP were included.

Patients who were not suitable for anesthesia, who had contraindications for magnetic resonance imaging (MRI) (pacemakers, metallic implants, bleeding disorders, and a previously diagnosed malignancy involving the liver or biliary tract) were excluded. Patients with serum aspartate aminotransferase (AST) or alanine aminotransferase (ALT) levels greater than four times the upper limit of normal (ULN) were excluded. For the purpose of this study, obstructive jaundice was defined as a serum total bilirubin level greater than 1.5 mg/dL, accompanied by a predominantly cholestatic biochemical pattern characterized by elevated serum alkaline phosphatase (ALP).

Demographic and clinical data such as age, gender, serum bilirubin concentration, serum alkaline phosphatase level and duration of obstructive jaundice was collected on a structured data collection proforma after enrollment. All participants then had a magnetic resonance cholangiopancreatography (MRCP) performed, which was then reviewed by a consultant radiologist blind to the subsequent ERCP results. MRCP was used to define biliary stricture as a common bile duct lumen < 5 mm. Smooth, tapered margins were classified as benign while margins that were irregular or showed a "shoulder" with duct-wall thickening of more than 1.5 mm were classified as suspicious for malignancy.

All patients were then treated with an endoscopic retrograde cholangiopancreatography (ERCP) as the reference standard. Biliary stricture defined by ERCP was any narrowing of the common bile duct (CBD) to ≤5 mm. Brush biopsy or tissue sampling was obtained when there was a suspicion of stricture and was used where appropriate along with the histopathology to help classify the stricture as benign or malignant. The presence, or absence, of biliary stricture on both investigations was noted and also considered as true positive, true negative, false positive or false negative.

All the data were analyzed with SPSS version 20.0. Continuous variables such as age, serum bilirubin, serum alkaline phosphatase and duration of obstructive jaundice were presented as mean ± SD, and categorical variables as frequencies and percentages. A contingency table was created with MRCP being the reference test to determine the sensitivity, specificity, PPV, NPV, and overall diagnostic accuracy of MRCP. The data were also analyzed by age, sex, and duration of jaundice for possible interaction effects. The comparisons of post-stratification were made using the chi-square test or Fisher's exact test, as appropriate, and a p value <0.05 was deemed statistically significant.

RESULTS

The total number of patients included in the study was 203 patients with obstructive jaundice. Participants' age was 44.18 ± 10.92 years, the highest rate being for 51-60 years. There were 116 (57.1%) males and 87 (42.9%) females. The mean serum bilirubin concentration was 6.84 ± 3.12 mg/dL and the mean serum alkaline phosphatase level was 428.7 ± 176.5 IU/L. The mean time of obstructive jaundice prior investigation was 4.36 ± 2.21 weeks.

Table 1. Baseline and Clinical Characteristics of Study Participants (N = 203)

Variable	n (%) / Mean ± SD
Age, years	44.18 ± 10.92
18–30 years	28 (13.8)
31–40 years	48 (23.6)
41–50 years	59 (29.1)
51–60 years	68 (33.5)
Male	116 (57.1)
Female	87 (42.9)
Serum bilirubin, mg/dL	6.84 ± 3.12
Serum ALP, IU/L	428.7 ± 176.5
Duration of obstructive jaundice, weeks	4.36 ± 2.21
Duration ≤4 weeks	118 (58.1)
Duration >4 weeks	85 (41.9)

Baseline variables are those stated in the study protocol, such as age, gender, bilirubin, ALP, and length of time of obstructive jaundice.

Table 2. Detection of Biliary Stricture by MRCP and ERCP (N = 203)

Finding	MRCP n (%)	ERCP n (%)
Biliary stricture present	70 (34.5)	44 (21.7)
No biliary stricture	133 (65.5)	159 (78.3)
Total	203 (100)	203 (100)

MRCP identified a biliary stricture in 70 (34.5%) patients, while ERCP identified a biliary stricture in 44 (21.7%) patients. With this, MRCP detected more suspected strictures than were confirmed by the reference investigation.

Table 3. Nature of Biliary Stricture among Positive Cases

Nature of stricture	MRCP n (%)	ERCP/Histopathology n (%)
Benign	42 (60.0)	27 (61.4)
Malignant	28 (40.0)	17 (38.6)
Total strictures	70 (100)	44 (100)

Of the 70 strictures suspected on MRCP 42 were benign (60.0%) and 28 were malignant (40.0%). Of the 44 strictures that were confirmed by ERCP and pathological evaluation (where available), 27 (61.4%) were benign, and 17 (38.6%) were malignant. The protocol indicated that smooth tapered margins were suggestive of benign disease whereas irregular shouldered margins with duct-wall thickening suggested malignant stricture.

Table 4. Diagnostic Comparison of MRCP with ERCP for Biliary Stricture

MRCP result	ERCP positive	ERCP negative	Total
MRCP positive	38 (TP)	32 (FP)	70
MRCP negative	6 (FN)	127 (TN)	133
Total	44	159	203

A total of 203 patients were involved, with 38 true-positive, 127 true-negative, 32 false-positive, and 6 false-negative patients. The relatively low number of false negative results may suggest that MRCP was able to identify most of the strictures that were later identified during ERCP, but some patients were over-classed as having a stricture during MRCP.

Table 5. Diagnostic Performance of MRCP for Detection of Biliary Stricture

Diagnostic parameter	Value (%)
Sensitivity	86.4
Specificity	79.9
Positive predictive value	54.3

Negative predictive value	95.5
Overall diagnostic accuracy	81.3

When compared with the ERCP, MRCP had a sensitivity of 86.4%, specificity of 79.9%, positive predictive value of 54.3%, negative predictive value of 95.5%, and an overall diagnostic accuracy of 81.3%. The high negative predictive value indicates that a negative MRCP result was highly associated with the absence of a biliary stricture on ERCP. A lower PPV is the result of the presence of false positive MRCP findings. These measures follow the diagnostic calculations prespecified in the protocol.

Table 6. Agreement between MRCP and ERCP/Histopathology for Characterization of Biliary Stricture

MRCP classification	Benign on ERCP/histopathology	Malignant on ERCP/histopathology	Total
Benign	24	3	27
Malignant	3	14	17
Total	27	17	44

The MRCP correctly identified 24 of 27 strictures as being benign and 14 of 17 as malignant. There was, therefore, an overall concordance of 86.4% (38/44) for characterization of stricture type. There was misclassification in six patients, three of whom had benign strictures that were diagnosed as malignant on MRCP and three who had malignant strictures that were diagnosed as benign on MRCP.

Table 7. Diagnostic Performance of MRCP after Stratification by Age, Gender, and Duration of Jaundice

Variable	Category	Sensitivity (%)	Specificity (%)	Accuracy (%)
Age	18–30 years	83.3	81.8	82.1
	31–40 years	85.7	80.5	81.3
	41–50 years	87.5	79.1	81.4
	51–60 years	86.7	78.0	80.9
Gender	Male	87.0	80.6	81.9
	Female	85.7	78.9	80.5
Duration of jaundice	≤4 weeks	85.0	81.6	82.2
	>4 weeks	87.5	77.4	80.0

Diagnostic performance was the same across all age, gender and extent of obstructive jaundice categories. Across the subgroups studied, the sensitivities ranged from 83.3% to 87.5% and the specificities ranged from 77.4% to 81.8%. These demographic or clinical factors did not show any significant difference in the level of diagnostic accuracy. These factors were specified in the original analysis plan and were stratified.

Overall, ERCP confirmed biliary stricture in 44 of 203 patients (21.7%). MRCP correctly identified 38 of these 44 cases, while six strictures were missed. Among patients without biliary stricture on ERCP, 127 were correctly classified as negative by MRCP, whereas 32 yielded false-positive findings. Consequently, MRCP achieved 86.4% sensitivity, 79.9% specificity, 54.3% PPV, 95.5% NPV, and 81.3% overall diagnostic accuracy. These findings suggest that MRCP may provide particularly useful information for excluding biliary stricture because of its high negative predictive value, while positive MRCP findings may still require confirmation with ERCP and appropriate tissue assessment.

The bar chart shows the sensitivity (86.4%), specificity (79.9%), positive predictive value (54.3%), negative predictive value (95.5%), and overall diagnostic accuracy (81.3%) of MRCP in identifying biliary stricture among patients with obstructive jaundice.

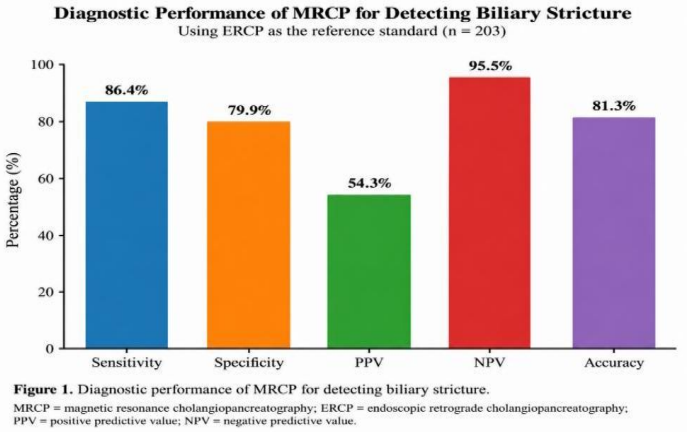


Figure 1. Diagnostic Performance Of MRCP For Detecting Biliary Stricture Using ERCP As The Reference Standard (N = 203).

DISCUSSION

The present study evaluated the diagnostic performance of magnetic resonance cholangiopancreatography (MRCP) for detecting biliary stricture in patients with obstructive jaundice, using endoscopic retrograde cholangiopancreatography (ERCP) as the reference standard. Among 203 patients, ERCP confirmed biliary stricture in 44 (21.7%), while MRCP identified stricture in 70 (34.5%). MRCP demonstrated a sensitivity of 86.4%**,** specificity of 79.9%**,** positive predictive value (PPV) of 54.3%**,** negative predictive value (NPV) of 95.5%**,** and overall diagnostic accuracy of 81.3%**.** These findings indicate that MRCP was particularly effective in excluding biliary stricture when the examination was negative. This is clinically important because biliary strictures remain diagnostically challenging, with benign and malignant lesions often showing overlapping clinical and radiological characteristics (11,12).

The sensitivity and specificity in the current study is comparable to that seen in previous studies that have shown MRCP to be a valuable non-invasive modality in evaluation of patients with a suspected biliary obstruction. In patients with jaundice who were being evaluated for possible common bile duct disease, O'Neill et al reported that the sensitivity of MRCP was 91%, specificity 80%, PPV 66%, and NPV 96% (13). The figures are comparable with the sensitivity of 86.4%, specificity of 79.9% and NPV of 95.5% found in the present study. The high NPV is similar for both groups, consistent with the use of MRCP as a useful test to rule out clinically significant biliary obstruction prior to invasive procedure. However, in some patients a moderate specificity can lead to unnecessary further ERCP (13).

Another important clinical dilemma is the differentiation of benign and malignant biliary strictures. In the present study, 27 strictures were considered as benign, and 17 were malignant, with MRCP correctly characterizing 38 of the 44 known strictures, achieving an overall agreement rate of 86.4% with the ERCP and histopathological classification. Although radiological differentiation of benign from malignant strictures is important, it is not always reliable, and definitive diagnosis often requires a combination of imaging, endoscopic evaluation and tissue procurement, Dorrell et al. noted (14). Huynh et al. also emphasized the need for neither the omission of malignancy nor the unnecessary operation for a benign disease (15). In diagnostic pathway, Rodriguez and Boike outlined a wide spectrum of benign and malignant causes for biliary narrowing and suggested that the process should involve the use of clinical history, laboratory findings, imaging data and endoscopy (16).

The PPV of 54.3% in this study indicates that a positive MRCP result is not necessarily a definitive sign of a true biliary stricture. MRCP has the ability to show narrowing of the duct(s), from inflammatory change, edema, technical artifact or other non-specific causes that can be mistaken for a fixed stricture. Ney et al. pointed out that differentiation of cholangiocarcinoma from benign biliary narrowing is frequently a combined radiological, biochemical, endoscopic and histological process, and not a single investigation (17). Del Vecchio Blanco et al. further noted that MRCP is a crucial element of the diagnostic process, but that ERCP remains of benefit if tissue sampling is needed or if therapeutic intervention is desired (18). In indeterminate strictures, other modalities like EUS and cholangioscopy can help with the diagnostic characterization. There have also been some consensus recommendations that cholangioscopy-guided visualization and biopsy should be utilized in targeted patients in whom conventional imaging and ERCP-based sampling are not conclusive (19).

The findings of the present study therefore support a complementary rather than competitive role for MRCP and ERCP. MRCP is useful for delineating the biliary anatomy and help select those patients who are unlikely to require an invasive procedure for diagnosis, while ERCP is useful for drainage, stenting, direct acquisition of tissue, and further evaluation of an indeterminate stricture. Nabi and Reddy also pointed out that difficult biliary strictures may necessitate a multi-disciplinary evaluation, as cross-sectional imaging and traditional ERCP sampling may leave a certain percentage of patients unhelpful (20). Currently, there is also a preference for further tissue acquisition techniques under endoscopic guidance if malignancy is not certain after the initial evaluation. The present study was limited by its single-center design, the consecutive non-probability sampling and the relatively small number of ERCP-proven strictures compared to the total sample. The diagnostic accuracy could also depend on the site of the stricture, underlying disease, experience of the radiologist, and image quality. Multicenter, prospective studies with larger groups of benign and malignant strictures, detailed MRCP interpretation and longer clinical/histopathological follow-up are recommended for future studies.

CONCLUSION

MRCP demonstrated good diagnostic performance for the detection of biliary stricture in patients with obstructive jaundice, with a sensitivity of 86.4%**,** specificity of 79.9%**,** NPV of 95.5%, and overall accuracy of 81.3%**.** Its high negative predictive value suggests an important role in excluding biliary stricture and assisting in the selection of patients who may require invasive evaluation. However, the lower PPV indicates that positive MRCP findings should be interpreted alongside clinical, biochemical, endoscopic, and histopathological information. ERCP therefore remains important when therapeutic intervention or tissue confirmation is required, particularly in suspected malignant or indeterminate strictures.

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