LIBYAN INTERNATIONAL JOURNAL OF ONCOLOGY

Libyan International Journal of Oncology. 2025;4(2):26-32
e-ISSN: *2957-6717*

Original article

Diagnostic Accuracy of MRCP with T2-Weighted Imaging in the Evaluation of Benign and Malignant Biliary Strictures

Amna Mezughi[1,2], Khalid Gashoot[1,2]

[1] Diagnostic Radiology Department, Tripoli Central Hospital, Tripoli, Libya
[2] Radiology Department, Tripoli University, Tripoli, Libya
Corresponding email. *kgashut@gmail.com*

Abstract

Distinguishing malignant from benign biliary strictures is important for treatment planning and prognosis. This retrospective study evaluated the diagnostic performance of magnetic resonance cholangiopancreatography (MRCP) with T2-weighted imaging in determining the level, cause, and imaging characteristics of benign and malignant biliary strictures. Fifty patients with obstructive jaundice who underwent MRI/MRCP at Tripoli Central Hospital between January 2018 and January 2019 were included. MRCP findings, including ductal dilatation, stricture level, stricture length, wall thickness, suspected cause, and T2 signal intensity, were compared with a composite reference standard based on endoscopic retrograde cholangiopancreatography, operative findings, and biopsy/histopathology results. MRCP detected ductal dilatation in all patients and correctly identified the level of obstruction in all cases. MRI/MRCP correctly determined the cause of obstruction in 48 of 50 patients, giving an overall diagnostic accuracy of 96%. The distal common bile duct was the most frequent obstruction site (56%). The sensitivity and specificity of MRCP for malignant strictures were 94.7% and 96.7%, respectively. Malignant strictures were generally longer (>11 mm) and had thicker walls (>3 mm) than benign strictures. T2 hyperintensity was strongly associated with malignant disease, whereas T2 isointensity was more commonly associated with benign strictures. MRCP with T2-weighted imaging is a reliable non-invasive modality for localizing and characterizing biliary strictures and may help differentiate benign from malignant causes of biliary obstruction.

Keywords. MRCP; Biliary Obstruction; Benign Stricture; Malignant Stricture.

Received*: 25/08/25*
Accepted*: 27/10/25*
Published*: 30/12/25*

Introduction

A biliary stricture is a narrowing of a segment of the bile duct that may impair bile drainage and result in obstructive jaundice. Biliary strictures may arise from several hepatobiliary and pancreatic diseases, and accurate localization and characterization are essential for diagnosis and management.[1]

Benign biliary strictures most commonly result from previous hepatobiliary surgery and are particularly associated with cholecystectomy. Extrahepatic bile duct strictures may also occur after open or laparoscopic cholecystectomy, commonly near the cystic duct insertion or hepatic duct confluence.[2-4]

Malignant biliary strictures are usually caused by malignancies such as cholangiocarcinoma, pancreatic adenocarcinoma, gallbladder carcinoma, periampullary neoplasm, or metastatic disease.[5]

Biliary strictures represent a complex clinical challenge in gastroenterology and hepatobiliary practice. Wallner et al. introduced magnetic resonance cholangiography for evaluation of biliary tract dilatation, and MRCP has since become an important technique for depicting biliary anatomy and identifying strictures.[6,7]

MRCP is valuable because it is non-invasive, provides high soft-tissue contrast, and avoids ionizing radiation. Several studies have demonstrated high diagnostic accuracy of MRCP in differentiating malignant from benign biliary strictures.[8] Recent developments, including diffusion-weighted imaging and magnetic resonance elastography, have also been investigated for improving the assessment of biliary strictures.[9-11]

Despite its diagnostic value, MRCP has limitations. Benign strictures, including inflammatory or postoperative strictures, may mimic malignant disease, and small ductal lesions or early malignancies may be difficult to detect.[12,13] This study aimed to evaluate the ability of MRCP with T2-weighted imaging to determine the cause and level of biliary tract obstruction and to identify MRCP features that may help differentiate benign from malignant pancreaticobiliary strictures.

Materials and methods

Study design and setting

This retrospective observational study was conducted at Tripoli Central Hospital, Tripoli, Libya. The study included patients who presented with obstructive jaundice and underwent MRI/MRCP between January 2018 and January 2019.

Eligibility criteria and clinical data

Patients were eligible for inclusion if they presented with clinical and/or laboratory evidence of obstructive jaundice and were referred for MRCP after initial ultrasonography and laboratory assessment. Patients with incomplete medical records or missing laboratory or ultrasound data were excluded. The collected data included age, sex, clinical presentation, serum bilirubin, and liver function tests.

MRCP protocol

All MRI/MRCP examinations were performed using a 1.5-T Philips MRI scanner with a body coil. Patients fasted for approximately 4–6 hours before the examination to allow gallbladder distension and reduce gastric and upper gastrointestinal fluid artifacts. The imaging protocol included routine upper abdominal MRI sequences, including T1-weighted and T2-weighted images with and without fat suppression when available. Heavily T2-weighted MRCP sequences were obtained to evaluate the intrahepatic and extrahepatic bile ducts, gallbladder, cystic duct, common hepatic duct, common bile duct, and pancreatic duct. Source images and reconstructed MRCP images were reviewed when available. Intravenous gadolinium-based contrast was administered when clinically indicated at a dose of 0.1 mmol/kg to assess suspected mass lesions, duct wall thickening, enhancement pattern, and possible malignant obstruction. Because this was a retrospective study, minor variations in imaging parameters and sequence availability were accepted according to the clinical protocol used at the time of examination.

Image evaluation and composite reference standard

MRCP findings were reviewed for ductal dilatation, level of obstruction, suspected cause, stricture length, wall thickness, T2 signal intensity of the stricture, and condition of the proximal bile ducts. The final diagnosis was established using a composite reference standard limited to endoscopic retrograde cholangiopancreatography (ERCP) findings, operative findings, and biopsy/histopathology results.

Statistical analysis

Data were analyzed using SPSS version 24. The Shapiro-Wilk test was used to assess normality. Continuous variables were summarized using mean and standard deviation when appropriate, while categorical variables were summarized as frequencies and percentages. Diagnostic performance was expressed using sensitivity, specificity, and accuracy. Receiver operating characteristic analysis was used to evaluate stricture length and wall thickness as predictors of malignancy.

Ethical considerations

Ethical approval and administrative permission for this retrospective study were obtained from the Research Ethics Committee and relevant administrative authorities at Tripoli Central Hospital. The study was based on a retrospective review of available clinical and imaging records. All data were anonymized before analysis, and no identifying patient information is presented in this record review.

Results

Patient characteristics

Fifty patients with obstructive jaundice were included. Age ranged from 16 to 90 years, with a mean age of 53 years. There were 27 women (54%) and 23 men (46%), giving a female-to-male ratio of 1.2:1. Most patients were in the middle-age groups, and 52% were between 31 and 60 years of age. The age and sex distribution is summarized in Table 1.

Table 1. Age and sex distribution of patients with obstructive jaundice.

Age group (years)	Male	Female	Total, n (%)
15-30	1	5	6 (12%)
31-45	4	6	10 (20%)
46-60	10	6	16 (32%)
61-75	7	5	12 (24%)
76-90	1	5	6 (12%)
Total	23	27	50 (100%)

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Clinical presentation
Twenty-two patients had multiple symptoms. Yellow discoloration of the sclera and skin was the most common presentation (40%). Abdominal pain with nausea and vomiting was the second most common presentation (32%), followed by weight loss and fever. The distribution of the main clinical symptoms is shown in Figure 1.

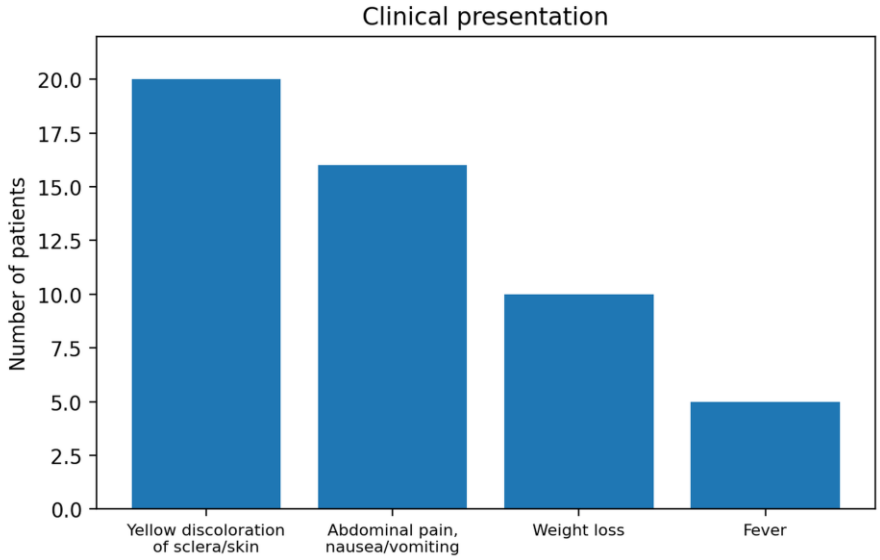

Figure 1. Distribution of the main clinical symptoms related to biliary obstruction.

Level and cause of biliary obstruction
All 50 patients showed ductal dilatation on MRI/MRCP. The distal common bile duct (CBD) was the most common site of obstruction (28/50, 56%). MRCP identified the level of obstruction in all patients (Table 2).

Table 2. MRCP detection of the level of obstruction.

Level of obstruction	No. of cases	MRCP no. of cases	Percentage
Porta hepatis	6	6	12%
Middle and distal CHD	9	9	18%
Proximal CBD	7	7	14%
Distal CBD	28	28	56%
Total	50	50	100%

Choledocholithiasis was the most common cause of obstructive jaundice, accounting for 44% of cases. Tumors were the second most common cause (34%), followed by benign CBD strictures (16%) and lymph node masses (2%). Compared with the composite reference standard, MRI/MRCP correctly identified the cause of obstruction in 48 patients, representing an overall diagnostic accuracy of 96%. Benign etiologies accounted for 31 cases (62%), while malignant etiologies accounted for 19 cases (38%) (Tables 3 and 4).

Table 3. Distribution of benign causes of obstruction.

Benign pathology	Number of patients	Percentage
Inflammatory strictures	5	10%
Post-surgical stricture	2	4%
Choledocholithiasis	17	34%
Mirizzi syndrome	3	6%
Chronic pancreatitis	2	4%
Periampullary lesion (sphincter of Oddi dysfunction)	1	2%
Hydatid cyst	1	2%
Total	31	62%

Table 4. Distribution of malignant causes of obstruction.

Malignant diagnosis	Number of patients	Percentage
Cancer of the pancreatic head	5	10%
Gallbladder adenocarcinoma	3	6%
Cholangiocarcinoma	4	8%
Periampullary neoplasm	5	10%

Liver metastasis	1	2%
Lymphoma	1	2%
Total	19	38%

Imaging features of benign and malignant strictures

Malignant strictures were generally longer and had thicker walls than benign strictures. Stricture length ranged from 2.5 to 13 mm in benign lesions and from 10 to 32 mm in malignant lesions. Wall thickness ranged from 1 to 3 mm in benign strictures and from 3 to 11 mm in malignant strictures. A stricture length greater than 11 mm predicted malignancy with 87% sensitivity and 75% specificity, while wall thickness greater than 3 mm predicted malignancy with 95% sensitivity and 93% specificity.

The signal intensity of the strictures on T2-weighted images was categorized as hyperintense, isointense, or hypointense relative to hepatic parenchyma. T2 hyperintensity was strongly associated with malignant lesions, whereas T2 isointensity was more commonly associated with benign lesions (Table 5). Representative MRI/MRCP findings are shown in Figures 2 and 3.

Table 5. Distribution of T2 signal intensity according to final diagnosis.

T2 signal	Total, n (%)	Benign, n (%)	Malignant, n (%)
Hyperintensity	19 (38%)	2/31 (6.4%)	15/19 (79.0%)
Isointensity	30 (60%)	28/31 (90.3%)	4/19 (21.0%)
Hypointensity	1 (2%)	1/31 (3.3%)	0/19 (0.0%)

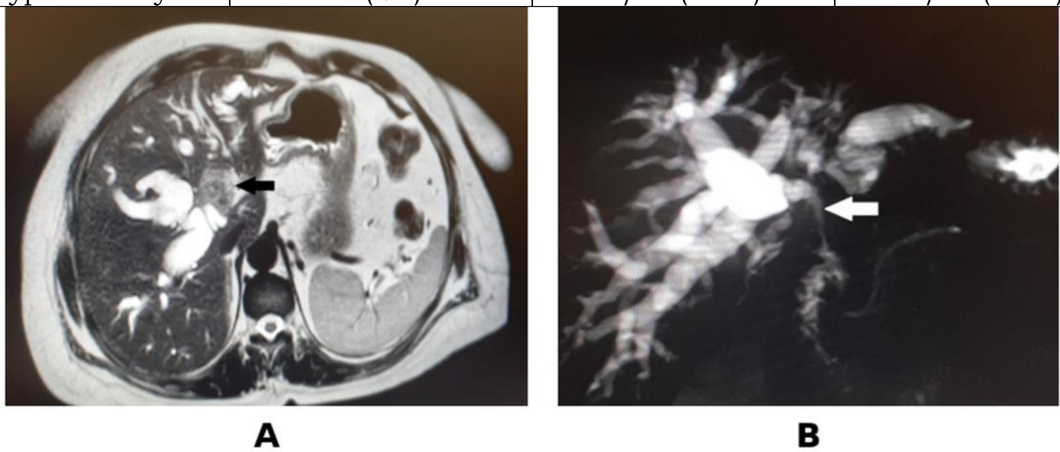

Figure 2. Representative MRI/MRCP findings of a suspected hilar malignant stricture. (A) Axial T2-weighted image shows a hilar soft-tissue lesion near the confluence of the hepatic ducts. (B) MRCP image shows proximal bilobar intrahepatic biliary radical dilatation with preserved distal duct caliber, suspicious for a Klatskin tumor.

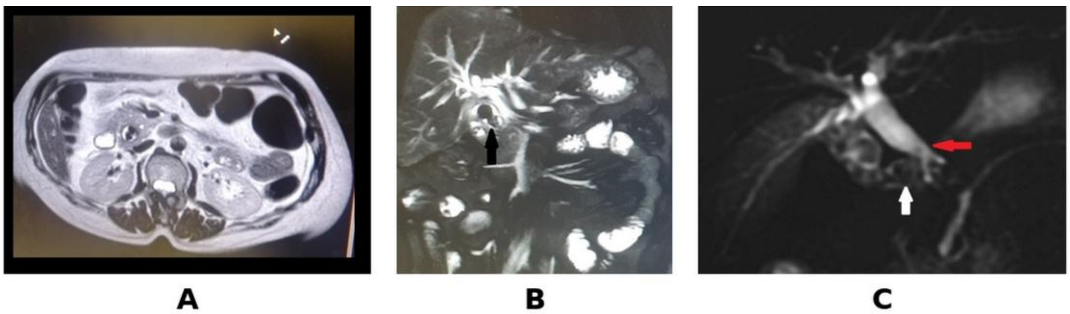

Figure 3. Representative imaging findings of Mirizzi syndrome. (A) Axial T2-weighted image, (B) coronal T2-weighted image, and (C) thick-slab MRCP image show calculi in the gallbladder neck/cystic duct with extrinsic compression and narrowing of the common bile duct, resulting in upstream biliary dilatation.

Discussion

This study supports the role of MRCP as a reliable non-invasive method for evaluating obstructive jaundice and differentiating benign from malignant biliary strictures. In this cohort, MRCP detected ductal dilatation in all patients, identified the level of obstruction in all cases, and correctly determined the cause of obstruction in 48 of 50 patients.

The diagnostic performance observed in this study is consistent with previous reports. The sensitivity and specificity of MRCP for malignant strictures were 94.7% and 96.7%, respectively. Suthar et al. reported a specificity of 96.3% and a sensitivity of 85.7% for malignant strictures, while Saxena et al. reported sensitivity and specificity of 94% and 94%, respectively.[13,14] These findings are also consistent with published descriptions of the role of MR imaging and MRCP in adult bile duct strictures.[15]

Several MRCP features helped distinguish malignant from benign strictures. Malignant strictures were generally longer and had thicker walls than benign strictures. In this study, a stricture length greater than 11 mm and wall thickness greater than 3 mm were useful predictors of malignancy. This is consistent with previous evidence showing that increasing stricture length and wall thickness are associated with malignant obstruction.[16]

Magnetic resonance cholangiography can detect bile duct dilatation, strictures, and choledocholithiasis. It also provides information about the precise location of the stenosis, the extent of proximal dilatation, the presence and size of biliary stones, and associated findings such as intraductal tumor growth. Conventional MRI, together with MR cholangiography, can help assess tumor dimensions and boundaries in patients with malignant obstruction, which is important when evaluating resectability.[17]

In this study, benign lesions predominated in patients younger than 55 years, whereas benign and malignant lesions were equally distributed in older patients. The average age of patients with malignant lesions was approximately 60 years, which is broadly consistent with previous reports.[17] The most common presenting complaints were yellow discoloration of the sclera and skin and abdominal discomfort with vomiting, similar to findings reported by Verma et al.[18]

The distal CBD was the most frequent level of obstruction in the present study. This finding is consistent with Upadhyaya et al., who reported the intrapancreatic CBD as a common site of obstruction, followed by suprapancreatic CBD and common hepatic duct obstruction.[19] However, reported etiological patterns vary among studies according to referral patterns and study populations.

Benign disease, mainly choledocholithiasis, accounted for most cases in this study, while malignant causes represented 38% of cases. Siddique et al. reported a higher proportion of malignant causes, whereas benign lesions were less frequent in their cohort.[20] Attri et al. also reported different etiological patterns and observed that CA 19-9 levels were significantly higher in cases with malignant strictures.[21]

The ability of MRCP to determine the level and cause of obstruction has been shown in several studies. Magnuson et al. demonstrated the utility of magnetic resonance cholangiography in evaluating biliary obstruction, and other reports have also shown high accuracy in identifying malignant and benign obstructive causes.[22,23]

The practical benefits of MRCP are related to its ability to depict ducts above and below the obstruction and to show intrahepatic biliary branches. It is particularly useful when ERCP is incomplete or when cannulation of the bile duct is technically difficult. MRCP can therefore guide the selection of patients who are most likely to require therapeutic ERCP or tissue diagnosis.[24]

Limitations

This study has several limitations. First, it was retrospective and included a relatively small number of patients from a single center. Second, dynamic contrast-enhanced MRI and diffusion-weighted imaging were not routinely performed in all cases, which limited assessment of their additional diagnostic value. Third, histopathological confirmation was not available for every case; therefore, the final diagnosis was established using a composite reference standard limited to ERCP findings, operative findings, and biopsy/histopathology results. This may have introduced verification bias. Finally, the sample size may limit the generalizability of the findings.

Conclusions

MRCP with T2-weighted imaging is a reliable non-invasive modality for evaluating biliary obstruction. It can accurately identify the level and likely cause of obstruction and provides useful imaging features for differentiating benign from malignant biliary strictures. Stricture length, wall thickness, and T2 signal intensity are valuable predictors of malignancy. MRCP may help reserve ERCP for patients with a high likelihood of requiring therapeutic intervention or tissue diagnosis.

Authors' contributions

Amna H. M. Mezughi contributed to study conception and design, data collection, data analysis, and drafting of the manuscript. Khalid Gashoot contributed to study design, image interpretation, data interpretation, supervision, and critical revision of the manuscript.

Acknowledgments
None declared.

Conflict of interest
Amna H. M. Mezughi declares no conflict of interest. Khalid Gashoot declares no conflict of interest.

Funding
No external funding was received for this study.

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