

The Value of MRCP in the Evaluation of the Level and Degree of Biliary Obstruction in Obstructive Jaundice

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ABSTRACT

Objective: Obstructive jaundice, which occurs in bile duct obstructions, cannot be clinically differentiated from cholestatic jaundice caused by hepatocellular disease. An accurate diagnosis of obstructive jaundice is possible using non-invasive methods such as MRCP. The aim of this study is to evaluate the role of MRCP and determining the level and the degree of biliary obstruction in cases of obstructive jaundice.

Materials and Methods: This observational retrospective study included 38 patients who had clinical and biochemical signs of obstructive jaundice during the period from April 2016 to October 2022. MRCP findings were correlated with clinical history, examination, biochemical tests and endoscopic retrograde cholangiopancreatography (ERCP)/surgical findings, which is the gold standard, according to the diagnosis and treatment approach valid for the case using descriptive statistical methods.

Results: There were 38 patients (10 males and 28 females) in the study, whose ages ranged from 15 to 86. The study revealed that biliary obstruction was more common among males and the most common level of the obstruction was found to be the distal common bile duct (CBD). Stones were the most common cause of obstruction jaundice. The 38 patients had 49.4% CBD stones, 21.0% CBD strictures, 10.5% CBD tumors and 5.2% ampullary cancer.

Conclusion: MRCP is susceptible to biliary tract diseases such as stones, strictures and malignancies. In the postoperative period when ERCP is not possible, MRCP plays a very important role in diagnosis. In cases where ERCP is not possible or unsuccessful, MRCP plays a complementing role and the diagnostic value of MRCP can be mentioned.

Keywords: Biliary duct dilatation, biliary stricture, choledocholithiasis, ERCP, MRCP, obstructive jaundice

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INTRODUCTION

Obstructive jaundice, one of the most common and severe forms of hepatobiliary diseases, can cause problems with diagnosis and management, especially intrahepatic cholestasis.^[1] Surgical jaundice can be due to a variety of causes; cholangiocarcinoma, periampullary carcinoma, gall bladder carcinoma and pancreatic head carcinoma. Various rare causes like the Castleman disease; Caroli's syndrome and metastatic liver tumor have also been reported. Despite technical advancements, the operative methods of managing obstructive Jaundice were associated to high mortality and morbidity. However, significant progress has been made over the past decade in understanding the pathogenesis, diagno-

sis and staging of obstructive jaundice. Radiologists must be able to offer more than just a diagnosis of jaundice. It is important to identify the location, nature and extent of block before surgery. A poorly chosen helpful technique can be fatal.^[2] The diagnosis of biliary tract disease has been widely improved by recent technological imaging advances with the invasive procedures like endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangiography (PTC), endoscopic ultrasound. In addition, noninvasive techniques like ultrasonography, multidetector CT and magnetic resonance cholangiopancreatography (MRCP). Although PTC and ERCP are invasive procedures, they have the unique advantage of obtaining a tissue diag-



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nosis as well as therapeutic intervention simultaneously. On the other hand, they can not provide extra luminal data.

MRCP is considered as a superior modality owing to its multi-planar imaging capability and unique soft tissue resolution.^[3] The MRCP technologies are able to produce high-resolution images in a very short time. Since it does not require contrast agent, sedation or radiation, it has been the most popular imaging modality for evaluating various causes of obstructive jaundice in the hepato-biliary system.^[4,5] The MRCP is the gold standard in cases of suspected obstructive jaundice caused by choledocholithiasis. It is also more reliable than other imaging techniques due to its technical versatility, superior soft tissue contrast resolution, and multi-planar capabilities.^[6] Once the diagnosis is confirmed, the patient can be sent for definite therapeutic management. Stones in CBD can be managed endoscopically by ERCP or open surgical procedure/laparoscope.

MRCP is becoming more important because it can be used in patients to identify those who need a therapeutic intervention. Its diagnostic capabilities are comparable to ERCP. Therefore, it can be used in high-risk patients to reduce significant morbidity.^[7]

In cases of obstructive jaundice, we want to establish the value of MRCP in determining etiology, degree and level of bile duct obstruction. We also want to compare and correlate MRCP findings with ERCP findings in all possible circumstances.

MATERIALS and METHODS

In this retrospective study, 38 patients were included from April 2016 to October 2022 who had clinical and biochemical signs of obstructive jaundice. Patients with clinical features of obstructed jaundice are yellowing of the skin and sclera for about 2 weeks or more accompanied by high bilirubin levels (2–2.5 mg/dL). In case of measurement, the bile duct dilatation is 2 mm or more in intrahepatic, 6 mm or more in extrahepatic bile ducts on MRCP.

Each case was recorded with a protocol form that collected data about the patient's age, gender, address, and specific imaging findings. All the patients were evaluated by MRCP which was performed using a 1.5T MRI unit (Signa H De, GE Healthcare, Waukesha, WI, USA). Imaging was carried out in the supine position with an eight-channel phased-array body coil. The MRCP scans were performed with 5 mm thick axial T2 Respiratory Triggering (Rtr) FatSat, Axial T2 Single-shot fast spin echo (SS-FSE), coronal SS-FSE Rtr, Thin coronal T2 SS-FSE, 3–5 mm thick T2 weighted SS-FSE and 3D sequence.

I.V. Contrast medium was administered if necessary (Gadolinium DTPA in a dose of 0.01 mmol/Kg). Acquired images were reformatted in different planes using multiplanar reconstruction and maximum intensity projection for optimal ductal visualization (Fig 1-4).

Before MRCP imaging, patients were instructed to keep their stomach empty for at least 4–6 h. Before the study, all patients gave written consent. MRCP findings were correlated with the clinical history, examination, biochemical tests and as the gold standard ERCP/surgical findings (if any) in accordance with the applicable diagnostic and therapeutic approach for the case by using descriptive statistical methods to analyze. Patients younger than 15 and older than 90 years of age, patients with contraindications to MRI and patients with clinical-laboratory evidence of perihepatic/hepatic jaundice were excluded. The study was approved by University of Health Sciences İstanbul Bakırköy Dr. Sadi Konuk Training and Research Ethics Committee (2022/401; December 05, 2022).

RESULTS

There were 38 patients (10 males and 28 females) in the study, whose ages ranged from 15 to 86. The study revealed that biliary obstruction was more common among males and the most common level of the obstruction was found to be the distal common bile duct (CBD). Stones were the most common cause of obstruction jaundice.

The 38 patients had 49.4% CBD stones, 21.0% CBD strictures, 10.5% CBD tumors and 5.2% ampullary cancer.

MRCP was sensitive and specific at detecting bile duct stone, while ERCP had 100% sensitivity.

82% of patients were found to have biliary duct dilatation on both ERCP or MRCP. Thus, MRCP and ERCP were 100% sensitive and specific in detecting biliary duct dilatation.

From 38 patients, 42% of them had gall bladder stones. MRCP sensitivity/specificity was 86.2% and 100% respectively. This was comparable to ERCP.

Two patients had pancreatic dilatation. Specificity was 100%, which was comparable to ERCP (Table 1).

MRCP was able to diagnose the obstruction of biliary system (intra- or extrahepatic) in 38/38 (100%) cases as well as the level of obstruction. Cause of obstruction were also identified in higher accuracy rates such as 37/38 (97%) (Table 2).

In terms of benign structures, MRCP decreased its sensitivity as it detected false-negative in one case (Table 3).

In terms of CBD stones, MRCP decreased its specificity as it detected false positive-detection in one case (Table 4).



Figure 1. Coronal thin slab MRCP image of a 67 year-old male showing an ampullary cancer (Arrows). Also multiple calculi seen in gall bladder lumina (Arrowhead)

MRCP: Magnetic resonance cholangiopancreatography

DISCUSSION

We classified etiology based upon benign and malignant characteristics on imaging MRCP. In descending order, the most common findings were choledocholithiasis (49.4%) followed by stricture (21%), and tumors (16%). This is contrary to O'Connor et al.^[6] study which the choledocholithiasis, stricture and malignancy were in an ascending order. Nineteen patients with CBD stones were evaluated. MRCP was able to detect bile duct stones at 100% sensitivity and specificity, whereas ERCP had a sensitivity of 94.7%. MRCP is therefore a superior imaging method than ERCP for detecting choledocholithiasis. Verma et al.^[9] also made similar observations like sensitivities of MRCP to detect choledocholithiasis were 92.3%, 86% and respectively. We also observed the location and number of stones on MRCP, which was well correlated with ERCP.

CBD strictures consisted of 8 cases with the sensitivity was 89% and the specificity was 91%. This was in line with Griffin et al.^[10] who showed as sensitivity ranged from 91 to 100%.

We observed 4 CBD tumor patients, 2 of them were benign (adenom, polyp) and 2 of them were malign (cholangiocarcinoma). It is observed that MRCP has 100% of sensitivity

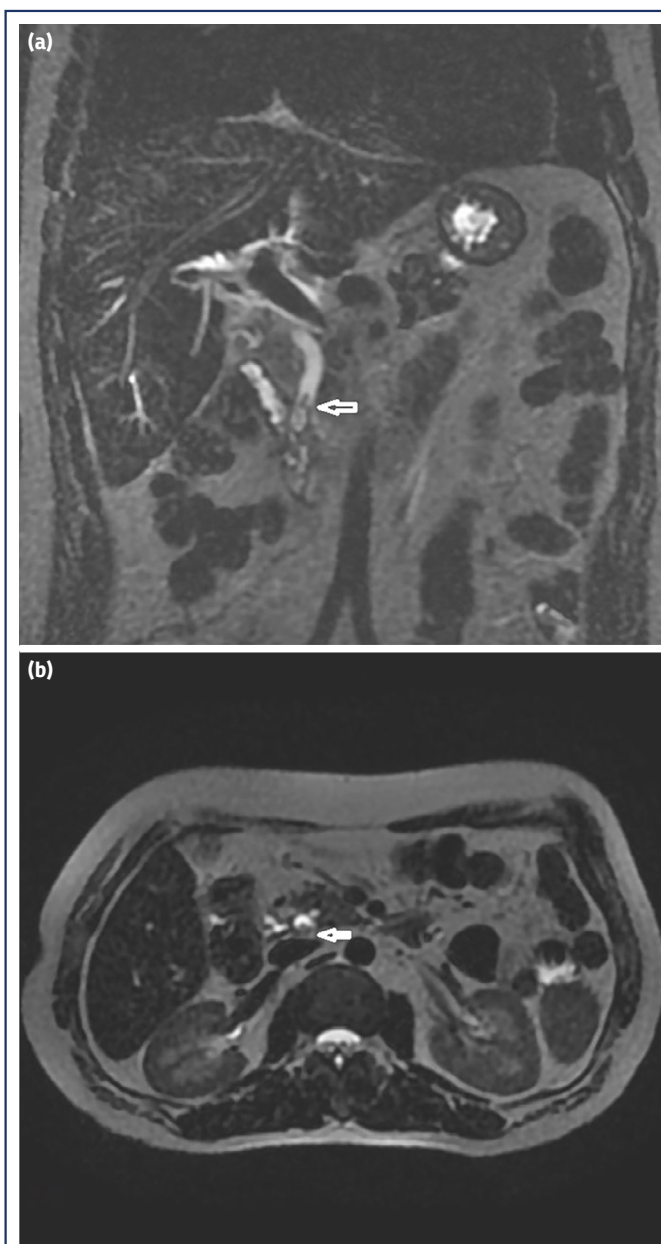


Figure 2. Coronal and axial thin slab MRCP images (a, b) of a 44 year-old male, signal void calculi seen in distal choledochus

MRCP: Magnetic resonance cholangiopancreatography

and specificity which was in concordance with Andersson et al.^[11] concluded sensitivity and specificity at 100%. MRCP was better at determining the extent and location of the tumor. Cross-sectional sequences are also useful for planning for resectability and evaluating nodal status.

On MRCP, two cases of ampullary carcinoma have been identified in our study which were consistent with the pathology

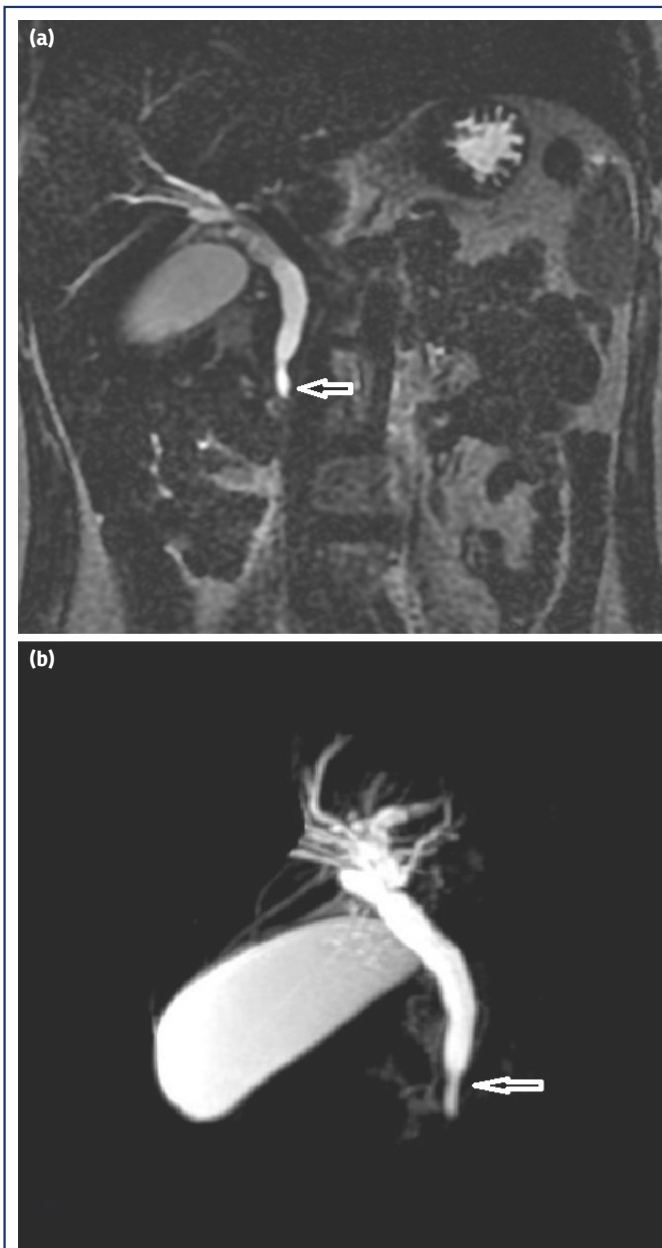


Figure 3. Coronal thick slab **(a)** and MIP **(b)** MRCP images; narrowing distal choledochus and dilatation above segments indicating biliary duct stricture. (Arrows)

MIP: Maximum intensity projection; MRCP: Magnetic resonance cholangiopancreatography

results. We found MRCP to be 100% sensitive and specific. This is contrary to Chen et al.^[12] previous study, the sensitivity and specificity for detection of ampullary carcinoma was 26.83% on MRCP. The small sample size led to significant differences in MRCP and ERCP. Larger data sets would have provided more convincing results. MRCP should be preferred

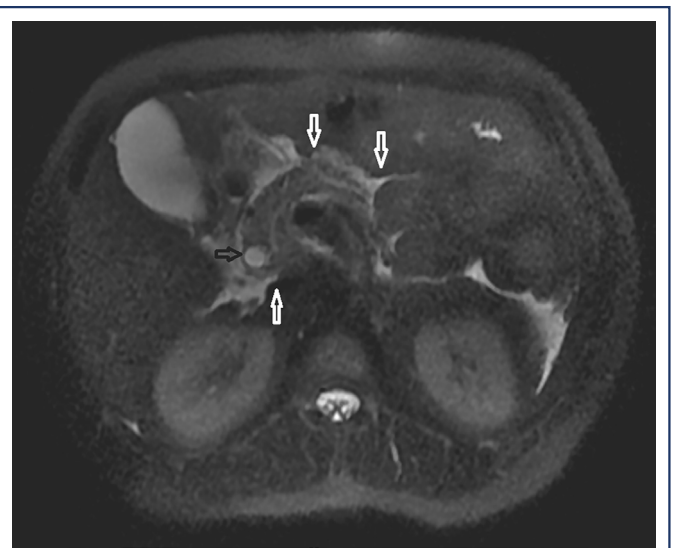


Figure 4. Axial thick slab MRCP image showing peripancreatic fluid (white arrows) and biliary duct dilatation indicating Acute Pancreatitis. (Black arrow)

MRCP: Magnetic resonance cholangiopancreatography

to ERCP as it offers simultaneous cross-sectional imaging. This allows for a roadmap of proximal obstruction sites in the biliary tract, which aids surgical planning.

82% cases of biliary duct dilatation were detected on MRCP which was also confirmed by ERCP. MRCP had 100% sensitivity to detect biliary duct dilatation in compare with ERCP. Angulo et al.^[13] found that MRCP had a diagnostic accuracy greater than 90% in diagnosing biliary duct dilatation which was consistent with our results.

From 38 cases, 42% had gall bladder stones. MRCP demonstrated a sensitivity and specificity of 86.76% in these cases. Calvo et al.^[14] also observed a similar result of cholelithiasis at 97.7% sensitivity detected by MRCP.

Two cases showed pancreatic duct dilatation and the sensitivity and the specificity of MRCP in diagnosing pancreatic duct dilatation was 100% in our study. Meng et al.^[15] discovered that MRCP had a 72.7% sensitivity to detect pancreatic duct dilatation and reported the superiority between MRI and MRCP in evaluating dilated ducts for determining whether there is chronic pancreatic disease or pancreatic carcinoma.

1 case of choledochal cyst which was confirmed by pathology were identified by MRCP. The sensitivity and specificity for MRCP were 100%, according to our study. Park et al.^[16] reported that the study sensitivity of MRCP in choledochal cyst was 96%, which is consistent with our study.

Table 1. Distribution of cases as per ERCP and MRCP diagnosis

Causes	MRCP n=38		ERCP n=38	
	n	%	n	%
Malignant				
Periampullary cancer	2	5.2	2	5.2
Cholangiocarcinoma	2	5.2	2	5.2
Pancreas cancer	1	2.6	1	2.6
Benign				
Benign stricture	7	18.2	8	21.0
Choledocholithiasis	19	49.4	18	46.8
Choledochal cyst	1	2.6	1	2.6
Benign mass	2	5.2	2	5.2
Pancreatitis	1	2.6	0	0.0
Others	2	5.2	3	7.8
Inconclusive	1	2.6	1	2.6
Total	38	100.0	38	100.0

ERCP: Endoscopic retrograde cholangiopancreatography; MRCP: Magnetic resonance cholangiopancreatography

Table 2. Evaluating obstruction in compare with MRCP and ERCP

n=38	MRCP (#cases)		ERCP (#cases)	
	n	%	n	%
Existence of obstruction	38/38	100	38/38	100
Determining level of obstruction	38/38	100	38/38	100
Degree of obstruction	35/38	92	35/38	92
Determining etiology of obstruction	37/38	97	37/38	97

MRCP: Magnetic resonance cholangiopancreatography; ERCP: Endoscopic retrograde cholangiopancreatography

We also found two cases of CBD compression externally at the suprapancreatic region of MRCP. One was a case of breast and the other was a gastric cancer. Also in one case the compression of common hepatic duct was due to a malignant lesion of liver.

MRCP is comparable in its sensitivity to malignancies. It also offers cross-sectional imaging which can make it more competitive than ERCP. MRCP is comparable to ERCP in terms of sensitivity for ancillary findings such as gall stones or intrahepatic biliary dilatation. ERCP might be preferable for lower biliary abnormalities such as ampullary stricture or

Table 3. ERCP and MRCP specificity and sensitivity for benign structures

Benign structure n=38	ERCP (n=38)	
	Presence (n=8)	Absence (n=30)
MRCP (n=38)		
Presence (n=7)	7/38	0/38
Absence (n=31)	1/38	30/38

Sensitivity: TP/TP+FN=8/8+1=88,8%; Specificity: TN/TN+FP=30/30+0=100%.
ERCP: Endoscopic retrograde cholangiopancreatography; MRCP: Magnetic resonance cholangiopancreatography; TP: True positive; FN: False negative; TN: True negative; FP: False positive

Table 4. ERCP and MRCP specificity and sensitivity for choledochal stones

Choledocholithiasis n=38	ERCP (n=38)	
	Presence (n=18)	Absence (n=20)
MRCP (n=38)		
Presence (n=19)	18/38	1/38
Absence (n=19)	0/38	19/38

Sensitivity: TP/TP+FN=18/18+0=100%; Specificity: TN/TN+FP=18/18+1=94.74%.
ERCP: Endoscopic retrograde cholangiopancreatography; MRCP: Magnetic resonance cholangiopancreatography; TP: True positive; FN: False negative; TN: True negative; FP: False positive

pancreatic duct abnormalities. Other studies have shown a significantly higher sensitivity to ERCP than MRCP for detection of ampullary cancer.

Study Limitations

The study was limited by its retrospective design, and the relatively small size. It was not possible to assess the time-saving benefits of the abbreviated MRCP Protocol in real life exams because the study was retrospective. The results of other biliary tests were inconsistent due to the small size of the study population. To get the same result, a future study will need to be done with more patients in a new hospital setting. Some patients could not hold their breath for long enough. This affected the quality of MRCP sequences.

CONCLUSION

MRCP plays a complementing role and is sensitive to biliary tract diseases like stones, strictures and malignancies. In spite of relatively low spatial resolution, early assessments suggest that MRCP help in diagnosing and treating obstruction

by identifying the cause and level of obstruction. Accurately. Unlike ERCP, MRCP is a noncomplicated and noninvasive imaging method that's extremely effective. In cases where ERCP is not possible or unsuccessful, the diagnostic value of MRCP can be mentioned. In the postoperative period when ERCP is not possible, MRCP plays a very important role in diagnosis.

We think that MRCP can also be used as a gold standard because the specificity and sensitivity percentages are close to ERCP and it will reduce the number of ERCPs. As a result, we think that the use of MRCP as a diagnostic procedure and ERCP as a therapeutic invasive procedure will prevent unnecessary and serious complications of ERCP.

Disclosures

Ethics Committee Approval: The study was approved by the University of Health Sciences İstanbul Bakırköy Dr. Sadi Konuk Training and Research Ethics Committee (No: 2022/401, Date: 05/12/2022).

Informed Consent: Written informed consent was obtained from all patients.

Peer-review: Externally peer reviewed.

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