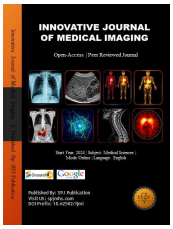
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Original Article

Significance of MRCP in Assessing Hepatobiliary Abnormalities

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ABSTRACT

Background: Magnetic Resonance Cholangiopancreatography (MRCP) has become integral in diagnosing hepatobiliary abnormalities due to its non-invasive nature and high-resolution imaging. This review highlights MRCP's effectiveness in assessing conditions such as biliary obstruction, choledocholithiasis, strictures, and congenital anomalies.
Aim & Objective: The main objective of this study was to evaluate the significance of MRCP in evaluating hepatobiliary abnormalities.
Methods & Methodology: A prospective study conducted in a Kolkata private hospital from December 2023 to March 2024 included 60 patients with suspected hepatobiliary diseases. Patients suspected with clinical, biochemical or radiological suspicion of hepatobiliary diseases were included in the study.
Result: Our study of 60 patients with suspected hepatobiliary pathologies (aged 19-82 years, mean age 49.8) revealed tenderness at the epigastric area (54%) as the most common clinical symptom, followed by upper abdominal pain (27%), recurrent vomiting (13%), and gastric problems (6%). MRCP diagnosed hepatomegaly (26.6%) as the most frequent condition, followed by gallbladder sludge (21.6%), cholecystitis (18.3%), cholelithiasis (15%), choledocholithiasis (11.6%), and dilated common bile duct (6%).
Conclusion: Our study underscores the pivotal role of MRCP in diagnosing hepatobiliary abnormalities with non-invasive, high-resolution imaging. It effectively identifies various pathologies including hepatomegaly and gallbladder disorders. MRCP emerges as a valuable tool for comprehensive assessment, guiding effective management strategies for patients with suspected hepatobiliary diseases.

Keywords: MRCP, Sequence, Breath-hold, MRI, Biliary diseases

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INTRODUCTION

Magnetic Resonance Cholangiopancreatography (MRCP) is a specialized, non-invasive Magnetic Resonance Imaging (MRI) technique designed to visualize the biliary and pancreatic ductal systems with high anatomical detail. Utilizing heavily T2-weighted pulse sequences, MRCP selectively highlights static or slow-moving fluids within the bile ducts, pancreatic duct, and gallbladder while suppressing the signal from surrounding soft tissues. This allows excellent visualization of the hepatobiliary anatomy without the need for ionizing radiation, iodinated contrast media, or invasive instrumentation, making MRCP a safe and reliable imaging modality for patients with suspected biliary and pancreatic disorders. [1,2] Hepatobiliary diseases, including choledocholithiasis, biliary strictures, obstructive jaundice, primary sclerosing cholangitis, cholangiocarcinoma, pancreaticobiliary tumors, and congenital biliary anomalies, remain major causes of morbidity worldwide. Early and accurate diagnosis is essential for appropriate therapeutic planning and

prevention of complications. Conventional diagnostic methods such as Endoscopic Retrograde Cholangiopancreatography (ERCP) provide both diagnostic and therapeutic capabilities but are invasive and associated with complications including pancreatitis, cholangitis, hemorrhage, and perforation. Consequently, MRCP has become the preferred first-line imaging modality for evaluating suspected biliary obstruction because it offers diagnostic accuracy comparable to ERCP while avoiding procedure-related risks. [3,4] The diagnostic performance of MRCP is based on heavily T2-weighted sequences such as Half-Fourier Acquisition Single-shot Turbo Spin-Echo (HASTE), Single-shot Fast Spin-Echo (SSFSE), and three-dimensional Fast-Recovery Fast Spin-Echo (FRFSE), which provide high-resolution multiplanar images of the biliary and pancreatic ducts. These sequences enable excellent visualization of ductal dilatation, strictures, calculi, inflammatory changes, and neoplastic lesions while allowing comprehensive evaluation of surrounding hepatobiliary structures. In addition, respiratory-triggered three-dimensional MRCP acquisitions improve image quality and facilitate detailed anatomical assessment for preoperative planning. [5,6]

Numerous clinical studies have demonstrated the high sensitivity and specificity of MRCP in detecting common bile duct stones, biliary obstruction, choledochal cysts, pancreatic duct abnormalities, and malignant biliary diseases. MRCP is particularly valuable in patients with obstructive jaundice, where it accurately identifies the level, cause, and severity of obstruction. Furthermore, performing MRCP before ERCP significantly reduces unnecessary invasive procedures, lowers healthcare costs, and decreases ERCP-related complications, thereby improving overall patient safety and clinical outcomes. [7,8] With continuous advancements in MRI hardware, higher field strengths, parallel imaging, respiratory motion correction, and three-dimensional reconstruction techniques, MRCP has become an indispensable tool in hepatobiliary imaging. Its ability to provide comprehensive anatomical assessment, excellent diagnostic accuracy, and non-invasive evaluation has established MRCP as the imaging modality of choice for a wide range of biliary and pancreatic disorders.

Aim of the Study: The present study aims to evaluate the clinical significance and diagnostic utility of Magnetic Resonance Cholangiopancreatography (MRCP) in the assessment of hepatobiliary abnormalities, with emphasis on its role in detecting biliary obstruction, choledocholithiasis, hepatopancreatobiliary malignancies, while highlighting its advantages over conventional diagnostic techniques.

MATERIALS AND METHODS

Study Design and Setting: A prospective observational study was conducted in a private hospital in Kolkata, West Bengal, India, over a four-month period from December 2023 to March 2024.

Study Population: A total of 60 patients with clinical, biochemical, or radiological suspicion of hepatobiliary disease were enrolled in the study after obtaining written informed consent.

Inclusion Criteria: Patients with suspected hepatobiliary abnormalities based on clinical presentation, laboratory findings, or previous radiological investigations were included.

Exclusion Criteria: Patients with claustrophobia, non-cooperative behavior, MRI-incompatible implants or devices, and other contraindications to MRI were excluded from the study.

Ethical Considerations: The study protocol was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to imaging.

MRCP Imaging Protocol: Before the examination, all patients were instructed to consume 50 mL of an iron-rich oral solution to suppress gastrointestinal fluid signals and improve visualization of the pancreatobiliary system. Patients were positioned supine, and imaging was performed using a 3.0 Tesla Siemens MRI scanner equipped with a phased-array body coil. No intravenous contrast agent was administered. The MRI protocol included three-plane localizer images, axial T1-weighted images, axial T2-weighted HASTE fat-suppressed sequences, coronal T2-weighted HASTE fat-suppressed sequences, T1-weighted FLASH breath-hold images, three-dimensional (3D) MRCP, and thick- and thin-slab HASTE sequences. Images were acquired with a 5-mm slice thickness extending from the right hemidiaphragm to the inferior margin of the liver.

Image Reconstruction and Analysis: Three-dimensional Maximum Intensity Projection (MIP) post-processing was performed to reconstruct the biliary and pancreatic ductal systems. MIP images and thick angled coronal reformatted images were analyzed to evaluate the biliary tree, pancreatic duct, and associated hepatobiliary abnormalities.

RESULTS

A total of 60 patients with clinical, biochemical, or radiological suspicion of hepatobiliary disease

underwent Magnetic Resonance Cholangiopancreatography (MRCP). The study population ranged in age from 19 to 82 years, with an overall mean age of 49.8 years. Male participants had a mean age of 44.4 years, whereas female participants had a higher mean age of 54.6 years, as summarized in Table 1.

Table 1. Age distribution of the study participants (n = 60)

Gender	Minimum Age (years)	Mean Age (years)	Maximum Age (years)
Male (n = 36)	20	44.4	77
Female (n = 24)	19	54.6	82
Overall	19	49.8	82

Of the 60 participants, 36 (60%) were male and 24 (40%) were female, indicating a male predominance among patients presenting with hepatobiliary disorders. The most common presenting complaint was epigastric tenderness, reported in 54% of patients, followed by upper abdominal pain (27%), recurrent vomiting (13%), and gastric discomfort (6%). These findings indicate that upper gastrointestinal symptoms were the predominant clinical manifestations prompting MRCP evaluation (Table 2).

Table 2. Clinical presentation of patients undergoing MRCP

Clinical Presentation	Number of Patients	Percentage (%)
Epigastric tenderness	32	54.0
Upper abdominal pain	16	27.0
Recurrent vomiting	8	13.0
Gastric discomfort	4	6.0
Total	60	100

MRCP successfully identified a broad spectrum of hepatobiliary abnormalities (Table 3). The most frequently observed abnormality was hepatomegaly, detected in 16 patients (26.6%), followed by gallbladder sludge in 13 patients (21.7%), cholecystitis in 11 patients (18.3%), cholelithiasis in 9 patients (15.0%), choledocholithiasis in 7 patients (11.7%), and dilatation of the common bile duct (CBD) in 4 patients (6.7%).

Table 3. MRCP findings among the study participants (n = 60)

S. No.	MRCP Finding	Number of Patients	Percentage (%)
1	Hepatomegaly	16	26.6
2	Gallbladder sludge	13	21.7
3	Cholecystitis	11	18.3
4	Cholelithiasis	9	15.0
5	Choledocholithiasis	7	11.7
6	Dilated common bile duct (CBD)	4	6.7
	Total	60	100

Overall, MRCP demonstrated excellent capability in detecting both obstructive and non-obstructive hepatobiliary diseases. The technique provided clear visualization of the biliary and pancreatic ductal systems, enabling accurate identification of hepatobiliary abnormalities without the use of ionizing radiation or intravenous contrast agents.

DISCUSSION

Magnetic Resonance Cholangiopancreatography (MRCP) has become an established non-invasive imaging modality for evaluating hepatobiliary and pancreatic disorders owing to its excellent soft-tissue contrast and superior visualization of the biliary tree without the use of ionizing radiation or intravenous contrast media. The present study assessed the diagnostic findings of MRCP in 60 patients with suspected hepatobiliary disease and demonstrated its significant clinical value in identifying a wide range of biliary abnormalities. The majority of patients in the present study were middle-aged adults, with a mean age of 49.8 years, and a male predominance (60%). Similar demographic patterns have been reported in previous studies evaluating hepatobiliary disorders, where gallstone disease and biliary obstruction are more frequently observed among adults. The most common presenting symptoms were epigastric tenderness and upper abdominal pain, reflecting the typical clinical manifestations of hepatobiliary pathology and emphasizing the need for accurate imaging to establish the underlying diagnosis.

MRCP detected hepatomegaly as the most frequent abnormality (26.6%), followed by gallbladder sludge, cholecystitis, cholelithiasis, choledocholithiasis, and common bile duct dilatation. These findings highlight the ability of MRCP to comprehensively evaluate both hepatic parenchymal changes and biliary tract abnormalities within a single examination. The

excellent depiction of the biliary anatomy enables accurate localization of obstruction, identification of biliary calculi, inflammatory changes, and congenital anomalies, thereby facilitating appropriate clinical management. Compared with invasive techniques such as Endoscopic Retrograde Cholangiopancreatography (ERCP), MRCP offers several advantages, including the absence of procedure-related complications such as pancreatitis, hemorrhage, infection, and perforation. Furthermore, its multiplanar imaging capability and three-dimensional reconstruction provide detailed anatomical information that is valuable for preoperative planning and therapeutic decision-making. Consequently, MRCP has become the preferred first-line investigation for patients with suspected biliary obstruction and other hepatopancreatobiliary disorders.

Although the present study demonstrates the diagnostic usefulness of MRCP, certain limitations should be acknowledged. The relatively small sample size and single-center design may limit the generalizability of the findings. Larger multicenter studies comparing MRCP with ERCP, computed tomography, and endoscopic ultrasound would further validate its diagnostic performance across different hepatobiliary diseases.

CONCLUSION

The present study demonstrates that Magnetic Resonance Cholangiopancreatography is a highly effective, safe, and non-invasive imaging modality for the evaluation of hepatobiliary abnormalities. MRCP accurately identified a broad spectrum of biliary disorders, including hepatomegaly, gallbladder sludge, cholecystitis, cholelithiasis, choledocholithiasis, and common bile duct dilatation, while providing excellent visualization of the pancreatobiliary system without radiation exposure or contrast administration. Its high diagnostic accuracy, multiplanar capability, and ability to reduce unnecessary invasive procedures make MRCP an invaluable first-line investigation for patients with suspected hepatobiliary disease. Further large-scale studies are warranted to strengthen the evidence supporting its routine clinical application and to optimize its role in the diagnosis and management of hepatopancreatobiliary disorders.

DECLARATIONS

Ethical Approval and Consent to Participate: The study was approved by the Institutional Ethics Committee of the participating institution. Written informed consent was obtained from all participants prior to inclusion in the study. All study procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki.

Consent for Publication: Not applicable.

Availability of Data and Materials: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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Conflict of Interest: The authors declare that they have no competing interests or conflicts of interest.

Authors' Contributions: All authors contributed substantially to the study conception and design, data acquisition, analysis and interpretation, manuscript preparation, critical revision, and approval of the final version of the manuscript.

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