ADDIS ABABA UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCE

DEPARTMENT OF CLINICAL RADIOLOGY

Role of MRCP in Biliary Obstruction: Comparison with ERCP/Surgery in Addis Ababa, Ethiopia (2025)

By

Dr Habtamu Tilahun

DECEMBER, 2025

A RESEARCH PAPER TO BE SUBMITTED TO COLLEGE OF MEDICINE AND HEALTH SCIENCE, DEPARTMENT OF CLINICAL RADIOLOGY, ADDIS ABABA UNIVERSITY, IN PARTIAL FULFILLMENT OF A SUB-SPECIALTY IN BODY IMAGING RADIOLOGY

PRINCIPAL INVESTIGATOR;-

Dr. HABTAMU TILAHUN (BODY IMAGING FELLOW)

□: +251912272783 ✉: Htilahun25@gmail.com

ADVISORS;-

1. **DR TESFAYE KEBEDE (MD, RADIOLOGIST AND BODY IMAGING SUBSPECIALIST, PROFESSOR OF RADIOLOGY)**
2. **DR. ASSEFA GETACHEW (MD, RADIOLOGIST AND BODY IMAGING SUBSPECIALIST, ASSOCIATE PROFESSOR OF RADIOLOGY)**

DECEMBER, 2025

ADDIS ABABA,

Declaration

This is to certify that the thesis entitled "Role Of MRCP In Biliary Obstruction: Comparison With ERCP/Surgery In Addis Ababa, Ethiopia (2025)", submitted to College of Medicine and Health Science, Department of Clinical Radiology, Addis Ababa University, in partial fulfillment of a sub-specialty in body imaging radiology, is a record of original work carried out by me and has never been submitted to this or any other institution to get any other degree or certificates. The assistance and help I received during the course of this investigation have been duly acknowledged.

__________________________ ____________________ ____________________

Name of the candidate	Date	Place

ADDIS ABABA UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCE

DEPARTMENT OF CLINICAL RADIOLOGY

Approval of Dissertation/thesis for defense

We hereby certify that I have supervised, read, and evaluated this thesis/dissertation titled "Role Of MRCP In Biliary Obstruction: Comparison With ERCP/Surgery In Addis Ababa, Ethiopia (2025)" by Dr.Habtamu Tilahun, prepared under my guidance. I recommend that the thesis/dissertation be submitted for oral defense (mock-viva and viva voce).

1.Proffesor Tesfaye Kebede ______________________________ ____________

Advisor's name Signature Date

2.Dr Assefa Getachew ______________________________ ____________

Advisor's name Signature Date

ADDIS ABABA UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCE

DEPARTMENT OF CLINICAL RADIOLOGY

Approval of the Dissertation/thesis for the defense result

We hereby certify that we have examined this dissertation/thesis entitled "Role Of MRCP In Biliary Obstruction: Comparison With ERCP/Surgery In Addis Ababa, Ethiopia (2025)" by Dr.Habtamu Tilahun. We recommend and approve the dissertation/thesis a degree of "________________________________"

Board of Examiners

1.______________________	__________________	_______________
External examiner's name	Signature	Date
2.______________________	__________________	_______________
Internal examiner's name	Signature	Date
3. ______________________	__________________	_______________
Chairperson's name	Signature	Date

Acknowledgment

I'm really appreciative that Addis Ababa University(Black Lion Hospital) ,Lancet General Hospital and MCM comprehensive specialized hospital gave me the opportunity to learn more about role of MRCP in biliary obstruction: comparison with ercp/surgery My advisors, Professor Tesfaye Kebede (MD, Professor of Radiology and Body imaging subspecialty) and Dr Assefa Getachew (MD, associate professor of radiology and , Body imaging subspecialist), deserve a special word of appreciation for their unwavering support and guidance throughout the process of writing this paper.

In addition to my supervisors, I want to recognize and thank staff at the research site hospitals who took part in data gathering.

Acronyms

Acronym	Full Meaning
CT	Computed Tomography
US	Ultrasonography
MRI	Magnetic Resonance Imaging
MRCP	Magnetic Resonance Cholangiopancreatography
ERCP	Endoscopic Retrograde Cholangiopancreatography
PTC	Percutaneous Transhepatic Cholangiography
PPV	Positive Predictive Value
NPV	Negative Predictive Value
TP	True Positive
TN	True Negative
FP	False Positive
FN	False Negative
CBD	Common Bile Duct
CHD	Common Hepatic Duct
LFT	Liver Function Test
DBIL	Direct Bilirubin
TBIL	Total Bilirubin
ALP	Alkaline Phosphatase
AST	Aspartate Aminotransferase

Abstract

Background;-*A fast growing noninvasive technique for Imaging assessing the hillary tree and pancreatic ducts is magnetic resonance cholangiopancreatography (MRCP). The effectiveness of MRCP to provide maximum intensity projection(MIP) images that closely resemble those produced by endoscopic retrograde cholagiopancetigraphy (ERCP) without the need for intravenous or oral contrast agents is one of its main advantages . It uses heavily T2 weighted imaging technique or sequences which result in the generation of bright signals from slow moving or static fluids like the bile fluid or secretion from the pancreas making these structures bright and the rest of the background will appear darker.(2)*

Objectives*;-*To evaluate the diagnostic performance of MRCP in patients suspected biliary obstruction by assessing imaging features , determining etiologic causes,and comparing its diagnostic accuracy with ERCP and surgical findings

Methods;-A total of 112 patients from black lion hospital, lancet general hospital and MC comprehensive specialized hospital were included for this retrospective cross-sectional diagnostic accuracy study . There MRCP images were retrieved from PACs system and then interpreted by the body imaging subspecialist and fellow. Their surgical findings or ERCP findings were retrieved from the operational notes and their medical history were recovered from their hospital medical recording systems . Data was entered to epi info and then analysed with SPSS.

Results;-MRCP demonstrated high diagnostic performance, with an overall accuracy of approximately 91.1%, sensitivity of 94.7%, and specificity of 72.2%. The most common cause of biliary obstruction was CBD stones contributing for 43.5 % of cases followed by benign strictures and of no etiology cases .MRCP showed excellent diagnostic performance for CBD stones, with sensitivity exceeding 90% and specificity around 94%. A notable finding in this study was that 16.1% of patients demonstrated biliary dilatation without an identifiable obstructing etiology.

Conclusion and recommendation;-MRCP is a highly sensitive and accurate non-invasive imaging modality for evaluating biliary obstruction. It performs exceptionally well in detecting biliary dilatation and CBD stones and is highly reliable in excluding malignancy. However, limitations remain in detecting small stones and subtle lesions and in accurately characterizing strictures

Key Words: MRCP , ERCP , biliary obstruction , choledochlethiasis , biliary stricture , Addis Ababa University

Table of Contents Pages

List of Tables

List of figures

1. Introduction

1.1 Background-

Jaundice is defined as yellowish discoloration of the skin and eye caused by increased levels of bilirubin and usually manifested clinically when the concentrations surpass 35µmol/L. If there is blockage of bile flow anywhere along the route from the hepatic production to its drainage into the duodenum at the ampulla of vatter is known as obstructive jaundice …The blockage could take place in the intra or extrahepatic biliary ductal system .the interhepatic includes hepatocellular or canacicular dysfunction. The interhepatic , hepatic hilar , supraduodenal , retro duodenal , intrapancreatic or distal are some of the anatomical levels of obstruction where extrahepatic blockage occurs and is known as surgical jaundice. . the clinical manifestation of the obstructive jaundice includes dark urine, pruritus, pale feces, weight loss, anorexia, and jaundice, which may be painless or accompanied by stomach pain. . Elevated serum alkaline phosphatase is a common elevated biochemical result. Imaging is crucial in the evaluation of obstructive jaundice or biliary dilatation as it is accurate in the identification of the etiology, level and degree of obstruction [1]

An advanced noninvasive imaging technique called magnetic resonance cholangiopancreatography (MRCP) is used to evaluate pathologies affecting the biliary tree and pancreatic ducts . the advantage of MRCP over other techniques like ERCP is that it uses maximum intensity projection (MIP) methods to give images which are similar with those found with ERCP with out the use of intravenous contrast agents or ionizing radiation. The method makes use of strongly T2-weighted sequences, which clearly show the pancreatobiliary ducts against a low-signal backdrop. Static or slowly moving fluids, such as bile and pancreatic secretions, appear hyperintense in these sequences [2]. .

Both Percutaneous transhepatic cholangiography (PTC) and endoscopic retrograde cholangiopancreatography (ERCP) are good methods for both therapeutic and diagnostic purposes(for tissue diagnosis) at the same time . However both have limitations in assessing the extraluminal pathologies like in deception of masses causing bile ducts compression. Additionally these methods are invasive and use ionizing radiation and complications could *occur including pancreatitis, gastrointestinal perforation, bleeding, cholangitis, and sepsis, with a reported failure rate of roughly 3–10%.*

Magnetic resonance cholangiopancreatography (MRCP) has become a significant non-invasive technique for preoperative assessment of obstructive jaundice or biliary dilation in recent years. It has gradually superseded and replaced other techniques like percutaneous transhepatic cholangiography (PTC) and endoscopic retrograde cholangiopancreatography (ERCP), which were once thought to be first-line diagnostic tests in the past [3] . As there is ongoing technology advancements it has been shown that MRPC has proven to be reliable in evaluating the biliary system in cases of obstructive jaundice and gives a reliable information for preoperative planning [7]

Compared to other imaging techniques MRCP is somewhat more expensive and usually need a longer scanning time even though it is highly regarded as a highly reliable noninvasive imaging technique . There are also other drawbacks . It may have lower accessibility in certain situations as compared with multidirector CT . MRCP is associated with conditions like claustrophobia and is contraindicated in cases of patients with metallic implants and pacemakers . Additionally, motion and other artifacts can degrade image quality, and a good examination requires sufficient patient cooperation(4,5,6)

Magnetic resonance cholangiopancreatography (MRCP) uses a highly T2 weighted imaging technique to detect slowly moving or static body fluids like those found in dilated pancreatic and biliary ductal systems . After post processing the images will appear similar with those found in imaging techniques of direct cholangiographic studies, such as those obtained with endoscopic retrograde cholangiopancreatography (ERCP) or percutaneous transhepatic cholangiopancreatography (PTC) which is accomplished due to the development of ultrafast imaging techniques and sophisticated three-dimensional (3D) sequences (8).

By assessing the usefulness of magnetic resonance cholangiopancreatography (MRCP) in precisely identifying the etiology and the exact site of biliary blockage in patients with obstructive jaundice, this study seeks to close this gap. In order to better understand MRCP's role in everyday practice, increase diagnostic precision, and possibly lessen the need for more *invasive procedures, the study systematically evaluates MRCP's diagnostic performance across various clinical settings using a multicenter methodology.*

1.2. Statement of the problem

Obstructive jaundice is a common clinical condition characterized by the blockage of bile flow, leading to the accumulation of bilirubin in the bloodstream, resulting in jaundice. Accurate and timely identification of the underlying cause, level, and degree of biliary obstruction is crucial for proper diagnosis and management of patients with obstructive jaundice. Traditional diagnostic modalities, such as ultrasound and CT scans, have limitations in providing comprehensive and precise details about the biliary tree, especially in complex or subtle cases.

Magnetic Resonance Cholangiopancreatography (MRCP) has emerged as a non-invasive imaging modality that offers detailed visualization of the biliary and pancreatic ducts. MRCP allows for the assessment of biliary anatomy, obstruction levels, and the degree of obstruction with high resolution, thus providing vital information for treatment planning. The precise function of magnetic resonance cholangiopancreatography (MRCP) in determining the radiologic spectrum, diagnostic accuracy of biliary blockage in obstructive jaundice is still unclear despite its growing use, especially when multicenter studies are involved.

This study aims to assess the diagnostic value of magnetic resonance cholangiopancreatography (MRCP) in determining the radiologic spectrum, diagnostic accuracy of biliary blockage in obstructive jaundice , by analyzing data from multiple centers. Understanding its diagnostic capabilities and limitations will help optimize clinical decision-making, improve patient outcomes, and refine the role of MRCP in the diagnostic pathway of obstructive jaundice.

1.3, Justification and Significance of the study

Obstructive jaundice is a clinical burden with a challenge to evaluate the cause and hence proceed with the management. The significance of the study is to better know and understand the value of MRCP in assessing biliary obstruction so that it will guide us for accurate management. MRCP is a non-invasive imaging modality that helps to visualize the biliary tree in detail without radiation or invasiveness. So this study will try to determine the reliability in assessing the level and degree of biliary obstruction in different centers.

Precise identification of the level, degree, and etiology of biliary obstruction helps to improve decision-making regarding the choice of management, like surgery, percutaneous intervention, ERCP, or another method of management

ERCP and percutaneous approaches are relatively invasive, so being familiar with and knowing the diagnostic accuracy and utilization of MRCP helps to avoid a more invasive diagnostic approach

The study also helps to improve patient treatment outcomes, as it helps for early detection of etiology and guiding treatment decisions

The results could inform future research directions and technological advancements in imaging modalities for biliary disorders.

In conclusion, the significance of the study is that it will broaden our knowledge of the potential role of MRCP in the evaluation of MRCP, especially in our setup, to determine the etiology, guide management, and improve patient outcome, including its role in future research due to a technological advancement in imaging modalities specifically for obstructive jaundice.

2, LITERATURE REVIEW

Obstructive jaundice, a disease frequently seen in both surgical and medical gastroenterology, has numerous causes [9]. A major one is bile duct obstruction which can be due to gall stones[10], strictures or cancers like pancreatic head carcinoma, cholangiocarcinoma, periampullary carcinoma and gallbladder carcinoma [11, 12]. Less commonly reported causes are Caroli's syndrome, Castleman disease and liver metastases.

As can be understood from the name, jaundice or yellowish discoloration of the sclera and skin, is a major symptom seen in these patients, which may or may not be accompanied by abdominal pain. Other frequently seen symptoms are loss of appetite, weight loss, pruritus, dark urine and pale feces. Obstructive jaundice is one of the more serious hepatobiliary disorders often needing immediate surgical intervention. Serious complications from this problem are ascending cholangitis, malabsorption and hepatorenal syndrome. To effectively treat these patients, one needs to have early diagnosis and an accurate assessment of degree and underlying cause of biliary blockade.

Diagnostic accuracy for obstructive jaundice using an MRCP shows different results across different studies. Specificity of 100% and sensitivity of 94% was recorded in a study by Shaik Farid et al. CBD stones were the most frequent cause accounting for 24% in this study. Ultrasonography and CT scan show low specificity (69%) but high sensitivity. Benign and malignant causes account for 40 and 60% of all cases, respectively [13].

Farman Ali and colleagues reported that, among 64 cases involving bile duct dilatation, magnetic resonance cholangiopancreatography accurately identified 59 cases (92.2%). Additionally, out of 28 patients without the condition, the technique correctly ruled it out in 27 cases (96.4%) [14]

A study done by Viral and colleagues revealed that in the diagnosis of bile duct stones ERCP gave a specificity and sensitivity of 87.5% while MRCP showed 100% specificity and sensitivity. In the diagnosis of CBD strictures ERCP achieved 100% in both sensitivity and specificity while MRCP obtained sensitivity of 93% and a specificity of 95%. Both MRCP and

ERCP achieved sensitivity and specificity of 100% for diagnosing CBD tumors. Likewise, MRCP showed 100% sensitivity and specificity in diagnosing biliary duct dilatation and ampullary carcinoma [15].

Serdar and colleagues did a study at Yenibosna Safa private hospital in Istanbul, Turkey which showed that MRCP was able to correctly identify degree of obstruction in all 38 cases of biliary obstruction, both intrahepatic and extrahepatic. Moreover, in 97% of the cases i.e. 37 out of 38 cases, cause of the obstruction was found with great accuracy [16].

A study done at Era's Lucknow Medical College in India by Umesh et al revealed 100% sensitivity of Mrcp in identifying degree of biliary blockage in comparison to the final diagnosis. For the identification of level of obstruction, diagnostic accuracy of MRCP in comparison with final diagnosis was 96.29% giving a robust Pearson's correlation coefficient of 0.958 (P = 0.032). When it comes to finding the underlying cause of blockage, MRCP showed sensitivity of 92.30% and specificity of 88%(17).

Conceptual frame work

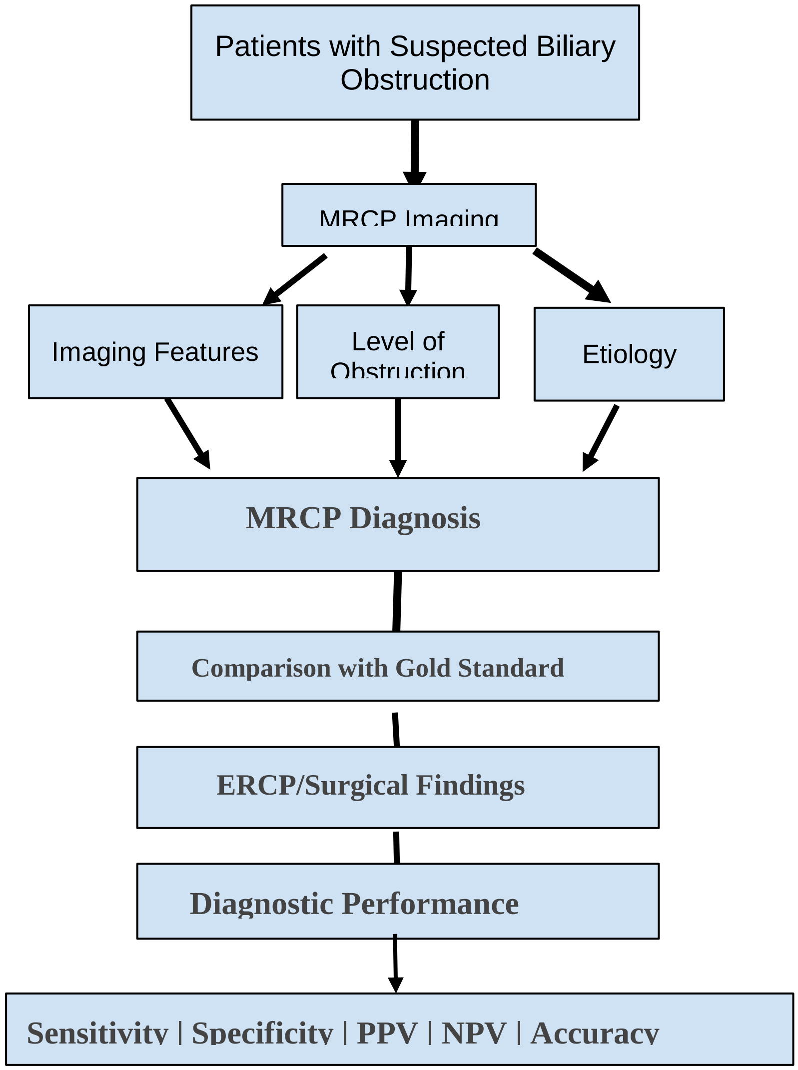


Figure 1 :conceptual frame work that shows the relationship between the dependent variable and other primary independent variable.

3. Objectives

3.1. General objectives

To evaluate the diagnostic performance of MRCP in patients suspected biliary obstruction by assessing imaging features , determining etiologic causes,and comparing its diagnostic accuracy with ERCP and surgical findings

3.2 Specific objectives

1. To establish the imaging features of biliary obstruction using MRCP in clinically suspected biliary obstructions
2. To identify the level of biliary obstruction
3. To identify the causes of biliary obstruction
4. To make a comparison of findings from MRCP with ERCP or surgical findings
5. To evaluate the sensitivity , specificity , positive and negative predictive values and overall diagnostic accuracy of MRCP

4. METHODS

4.1 Study area and study period

This was a multicenter study conducted at three healthcare institutions providing advanced diagnostic imaging and hepatobiliary services. The study was carried out at Black Lion Hospital , Lancet General Hospital and MCM Comprehensive specialized hospital, where MRCP examinations are routinely performed in the two institutions for patients with suspected biliary obstruction. These centers serve as major referral facilities for hepatobiliary diseases. and the two institutions(LANCET General Hospital and MCM Comprehensive Specialized Hospital) are equipped with MRI systems capable of performing MRCP, as well as facilities for surgical management. MCM Comprehensive Specialized Hospital has facilities for surgical and ERCP management

The study was conducted over a period of September/2024 to December /2025, during which eligible patients who underwent MRCP for suspected biliary obstruction and had subsequent ERCP and/or surgical confirmation were included.

4.2. Study Design

A retrospective cross-sectional diagnostic accuracy study was conducted by reviewing their medical records and imaging data from PACS for patients who underwent MRCP and subsequently had ERCP or surgery, as it is the gold standard

4.3. Population

4.3.1. Source Population

All patients who underwent MRCP in the centers for suspected biliary obstruction in the study period

4.3.2. Study population

All patients who underwent MRCP and had available ERCP or surgical findings as a gold standard.

4.4. Sample size

We used a formula for sensitivity of

$$n = \frac{Z2 \, x Se \, x(1-Se)}{D2 \, x \; p}$$

Where:

- n = required sample size
- Z= 1.96 (95% confidence interval)
- Se = expected sensitivity of MRCP
- D = acceptable margin of error (precision)
- P = prevalence of biliary obstruction

With an assumption of sensitivity of MRCP of 90 %; prevalence of biliary obstruction of 65% ; desired precision of +_ 8% and confidence level of 95%

Adjustment for specificity and overall accuracy

When specificity is also considered, and to allow for:

- Patients without obstruction,
- Incomplete reference standard confirmation,
- Imaging exclusions,

An inflation of 25–30% is recommended: so n will be 110

4.5. Inclusion and Exclusion criteria

4.5.1. Inclusion criteria

All adult patients aged>18 years with a suspicion of biliary obstruction based on clinical features and evidence of biliary obstruction based on previous imaging, laboratory data, or any other modality of imaging, like ultrasound

The above-mentioned patients must have MRCP with an available reference stranded (like ERCP, surgery, or histopathology for validation of the MRCP result

4.5.2. Exclusion criteria

Lack of reference standard, such as absence of surgical, ERCP, or definitive clinical follow-up confirmation

Incomplete or missing data

Poor-quality MRCP studies

Patients with contraindications for MRI

4.6. Study variables

4.6.1. Dependent variables

- Final diagnosis of biliary obstruction -yes/no

-Presence and type of biliary pathology as confirmed by the reference standard (surgery, ERPC, and clinical follow-up)

4.6.2. Independent Variables

Primary independent variables (MRCP findings)
MRCP result: presence or absence of obstruction, CBD dilation, level of obstruction, degree of obstruction, and etiology suggested by the MRCP. Secondary independent variables: Age, Gender, Clinical history, liver function tests

4.7. Operational Definitions and Definitions of terms

Biliary obstruction : Biliary duct dilatation (intrahepatic ducts >2 mm or >40% of portal vein diameter; CBD >6 mm, >8 mm post-cholecystectomy), abrupt ductal cut-off, stricture, or intraluminal filling defect are indicators of impaired bile flow on MRCP.

MRCP: A non-invasive MRI technique using heavily T2-weighted sequences to visualize the biliary and pancreatic ductal systems without contrast.

MRCP imaging features of obstruction: Extrinsic compression, mass lesion, smooth or irregular strictures, ductal dilatation, abrupt cut-off, and intraductal filling defects.

Level of Biliary obstruction : Classified as distal/intrapancreatic , suprapancreatic extrahepatic, hilar and intrahepatic CBD which are exact anatomical sites of obstruction on MRCP

Etiology of Biliary obstruction : This includes the causes of biliary obstruction determined by the MRCP which can be benign causes (like cbd stones , benign stricture) or malignant causes like cholangiocarcinoma , pancreatic head carcinoma or perimapullary tumors

Choledocholithiasis or bile duct stone : the presence of intraductal signal void in all sequences associated with proximal biliary ducts dilation

Benign biliary stricture : it is a short segment tapered and smooth narrowing of the bile duct which may be associated with a mass lesion on MRCP

Biliary Stricture with Malignancy: On MRCP, there is an irregular, long-segment narrowing with shouldering or a related mass lesion.

ERCP : A reference standard, this invasive endoscopic procedure is used to directly visualize and treat biliary obstruction.

Surgical Results: The degree and cause of biliary obstruction are confirmed by intraoperative findings and/or histopathological diagnosis.

Standard of Reference: MRCP results are compared with ERCP and/or surgical findings (including histopathology when available).

True Positive (TP): Biliary obstruction was accurately detected on MRCP and verified by ERCP or surgery.

True Negative (TN): stands for True Negative: The absence of biliary obstruction was accurately detected on MRCP and verified by ERCP or surgery.

False Positive (FP): ERCP or surgery did not confirm the MRCP's suggestion of biliary obstruction or incorrect aetiology.

False Negative (FN): MRCP did not detect biliary obstruction or its cause, but ERCP and surgery did.

Sensitivity: MRCP's capacity to accurately detect biliary obstruction: TP / (TP + FN).

Particularity MRCP's ability to accurately rule out biliary obstruction: TN / (TN + FP).

Accuracy of Diagnosis: MRCP's overall accuracy: (TP + TN) / (TP + TN + FP + FN).

4.8. Data collection methods and procedures

This study was designed to assess diagnostic performance of MRCP in patients suspected biliary obstruction by assessing imaging features , determining etiologic causes,and comparing its diagnostic accuracy with ERCP and surgical findings

Materials and Methods

A retrospective study was conducted including 112 patients evaluated between September 2022 and September 2025. Eligible participants presented with clinical and biochemical features suggestive of obstructive jaundice or had evidence of biliary dilatation on prior imaging modalities, including ultrasound or computed tomography (CT). Obstructive jaundice was clinically defined by persistent yellow discoloration of the skin and sclera for at least two weeks, accompanied by elevated serum bilirubin levels (≥2–2.5 mg/dL).

Biliary dilatation was defined radiologically as an intrahepatic bile duct diameter of ≥2 mm and an extrahepatic bile duct diameter of ≥6 mm on MRCP. Demographic and clinical data, including age, sex, residence, and imaging findings, were recorded using a structured data collection form.

All patients underwent MRCP using a 1.5 Tesla MRI system (GE Healthcare). Imaging was performed with the patient in the supine position using an eight-channel phased-array body coil. The MRCP protocol included axial T2-weighted sequences with respiratory triggering and fat suppression, axial T2 single-shot fast spin echo (SS-FSE), coronal SS-FSE with respiratory triggering, thin-section coronal T2 SS-FSE, 3–5 mm thick T2-weighted SS-FSE sequences, and three-dimensional acquisitions. Intravenous contrast (gadolinium-DTPA, 0.01 mmol/kg) was administered when clinically indicated.

Post-processing of images was performed using multiplanar reconstruction (MPR) and maximum intensity projection (MIP) techniques to optimize visualization of the biliary system. Patients were instructed to fast for 4–6 hours prior to the examination. Written informed consent was obtained from all participants before imaging.

MRCP findings were correlated with clinical history, physical examination findings, and laboratory results. Where available, ERCP findings and/or surgical outcomes were used as reference standards. Data were analyzed using descriptive statistical methods.

Ethical approval was obtained from the Department of Radiology Training and Research Ethics Committee of Addis Ababa University (September 2025).

4.9, Data analysis and interpretation

4.10. Quality control measures

The images were reviewed with a body imaging subspecialist and body imaging fellow . The questioners were checked for completeness

4.11. Ethical consideration

Prior to the commencement of data gathering the institutional review board of addis ababa university medical college and health science and the involved institutions granted ethical approval.. We also got verbal informed permission. The examination's findings were kept private and accountable, and only the investigator and the medical professionals who imaged and managed the patient were informed . The IRB waived the need for informed consent because the study involved reviewing patients' pre-existing medical records and imaging data (MRCP) of suspected biliary obstruction. Throughout the study, patient confidentiality was strictly upheld by anonymizing all identifiable information.

4.12. Dissemination plan

The study's conclusions were written up and sent to the radiology department. Additionally, the findings will be published in a peer-reviewed journal.

5. RESULTS

5.1-Demographics

This study included 112 patients of which 66 were female and 44 female. Their age ranged from 21 to 89 years with mean age of 48+/- 16 years and median of 49 years.

The commonest presenting symptoms were right upper quadrant pain (n=83) and yellowish discoloration of the eyes (n=62). Among the least common are fever and weight loss. History of cholecystectomy is seen in a noteworthy number of patients (n=42).

Results of the biochemical analysis showed elevated levels of liver enzymes in the patients suggesting significant hepatobiliary involvement. The mean total bilirubin (TBIL) level was 5.69 mg/dL (median: 2.94 mg/dL; range: 0.30–24.92 mg/dL), while direct bilirubin (DBIL) had a mean of 2.91 mg/dL (median: 1.77 mg/dL; range: 0.10–13.10 mg/dL). Alkaline phosphatase (ALP) levels were notably elevated, with a mean of 431.01 U/L and a wide range from 24 to 2784 U/L. Alanine aminotransferase (ALT) had a mean value of 194.92 U/L (range: 15.3–817.0 U/L), and aspartate aminotransferase (AST) had a mean of 142.92 U/L (range: 18.7–499.0 U/L).

High prevalence of biochemical abnormalities was seen in the patients in this cohort. Alkaline phosphatase (ALP), alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were elevated in 81% (73/90), 74% (66/89) and 81% (70/87) of patients respectively. Total bilirubin (TBIL) was elevated in 78% (69/89), and direct bilirubin (DBIL) in 87% (77/89) of patients. As can be seen from these numbers, the majority of the patients exhibited a mixed pattern of liver injury, with both hepatocellular (ALT, AST) and cholestatic (ALP, bilirubin) markers frequently elevated.

Category	Details
Total Patients	112
Gender Distribution	Female: 66 Male: 45
Age	Mean age :48 years Range: 21 up to 89 years
Symptoms	Right upper quadrant pain: 83 Yellowish discoloration of eyes: 62
History of Cholecystectomy	42
Biochemical Markers	
Total Bilirubin (TBIL)	Mean: 5.69 mg/dL Median: 2.94 mg/dL Range: 0.30–24.92 mg/dL
Direct Bilirubin (DBIL)	Mean: 2.91 mg/dL Median: 1.77 mg/dL Range: 0.10–13.10 mg/dL
Alkaline Phosphatase (ALP)	Mean: 431.01 U/L Range: 24–2784 U/L
Alanine Aminotransferase (ALT)	Mean: 194.92 U/L Range: 15.3–817.0 U/L
Aspartate Aminotransferase (AST)	Mean: 142.92 U/L Range: 18.7–499.0 U/L

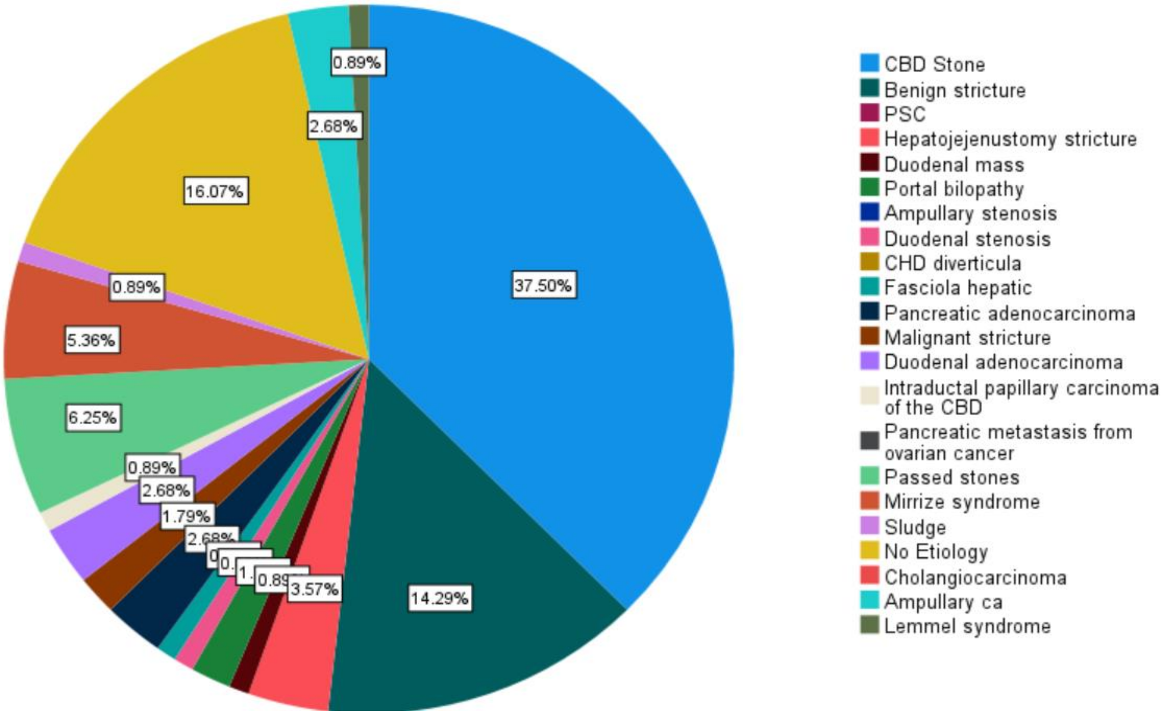
Table 1: The demographics of the study population including the age, gender , presenting symptoms and values of the biochemical markers serum level.

5.2-Biliary obstruction -all causes

Table 2: table showing frequency of etiologies of biliary obstructions

Etiology of biliary obstruction		Frequency	Percentage
Benign causes	Bile duct stones	42	37.5%
	Benign strictures	16	14.29%
	PSC	1	0.89%
	Hepatojejunostomy Stricture	4	3.57%
	Duodenal mass	1	0.89%
	Ampullary stenosis	1	0.89%
	Duodenal stenosis	2	1.79%
	Portal bilopathy	2	1.79%
	Fasciola hepatica	1	0.89%
	Mirizzi Syndrome	6	5.36 %
Malignant causes	Pancreatic Adenocarcinoma	3	2.25%
	Cholangiocarcinoma	5	4.9%
	Duodenal Adenocarcinoma	2	1.79%
	Intraductal papillary carcinoma of the CBD	1	0.89%
	Pancreatic metastasis from ovarian cancer	1	0.89%
	Ampullary cancer	1	0.89%

Figure 1 : ***Pie chart Showing the etiology of biliary obstructions, which were confirmed by the gold standard (***



ERCP/surgery)

. In this study, final diagnosis of biliary obstruction was made based on ERCP findings, surgical exploration and clinical follow up in 43, 60 and 9 patients respectively. Of the 112 patients in the study, 98 had evidence of biliary obstruction. choledocholithiasis (CBD stones) was identified as the most common cause of biliary obstruction, which was seen in 42 patients. Other benign causes together accounted for a large share, with benign biliary strictures being the most common among them (16 cases), followed by hepatojejunostomy stricture (4 cases), portal biliopathy (2 cases), and isolated cases of primary sclerosing cholangitis (PSC), duodenal mass, ampullary stenosis, duodenal stenosis, CHD diverticulum, and parasitic infestation with Fasciola hepatica.. In twelve patients we were able to identify malignant etiologies, including malignant stricture due to cholangiocarcinoma (5 cases), pancreatic adenocarcinoma (3 cases), duodenal adenocarcinoma (2 cases), intraductal papillary carcinoma of the common bile duct (1 case), and a case of biliary obstruction secondary to pancreatic metastasis from ovarian cancer. In 7 patients, passed stones were inferred as the cause. Six patients were diagnosed with Mirizzi syndrome, of which 4 were due to impacted cystic duct stones and 2 due to cystic duct adenocarcinoma. Biliary sludge was identified as the cause in one patient. Interestingly, in 15 patients, no definitive etiology could be determined despite comprehensive evaluation. Presence of biliary dilation was rightly detected with MRCP in all cases showing 100% sensitivity.

5.3-Level of obstruction

Level of obstruction	Frequency	Percentage
CHD	11	10.2
Hilar	6	5.5
Supraduodenal Segment of CBD (proximal)	17	15.7
Retroduodenal Segment of CBD (mid)	5	4.6
Distal or intrapancreatic segment of CBD	69	63

Table 3: showing the level of biliary obstruction

In this study, the commonest site of obstruction identified is the distal CBD, with 69 cases. The runner up is supraduodenal segment with 17 cases, with less frequent but notable obstructions. Less common sites are CHD, hilar and retroduodenal segment obstructions with 11, 6 and 5 cases respectively. Overall, distal CBD obstructions are the most significant, with other sites being less involved.

5.4-Degree of obstruction

The MRCP findings of the 112 cases showed that the majority of patients had mild obstruction (50 cases, 44.6%), followed by severe obstruction (25 cases, 22.3%) and moderate obstruction (36 cases, 32.1%). Three-quarters of all cases are due to mild and severe obstructions, which indicates that both early and advanced stages of obstruction are commonly presented in clinical settings

Severity of obstruction	Frequency	Percentage
mild	50	44.6
Moderate	25	22.3
Severe	36	32.1

Table 4 : showing the severity of biliary obstruction

5.5-Common bile duct stones

Intraoperative findings or ERCP have shown that 42 patients had biliary obstruction secondary to CBD stones.. Out of the 42, 12 had gall bladder stones as well and none of them had undergone cholecystectomyAccording to their location distal CBD was the most common with 30 cases, followed by retroduodenal CBD (n=6) , supraduodenal CBD (n=3), and one was at the hilar segment.

MRCP has correctly identified CBD stones 32 cases out of 40 with a sensitivity of 80%
MRCP incorrectly identified a CBD stone in 4 patients. 4 cases were incorrectly diagnosed as CBD stones by MRCP. One was dense fibrous tissue due to a hepatojejunenostomy stricture, the second was sludge, and the third was an air bubble seen on the CT, and nothing was found intraoperatively. The 4th one was found to be Fasciola hepatica(Image 1). MRCP failed to detect stones in three cases where no etiology was identified; however, surgery revealed microlithiasis in all cases (Images 1 and 2)

Forty one patients (97.6%) had CBD dilatation with the mean CBD diameter of 13mm and size of the stone ranged from 3 mm to 20 mm, with a mean stone size of approximately 8.8 mm.
This variability in stone size highlights the diverse presentations of biliary obstruction encountered and underscores the importance of accurate imaging modalities like MRCP in detecting stones of varying dimensions. Out of 38 CBD stones, 38 all of the 38 CBD stones appeared hypointense on T2-weighted images and showed low to intermediate intensity on T1-weighted images, while 15 stones demonstrated a central dot of hyperintensity on T2.

The levels of obstructions of all 40 CBD stones were correctly identified by MRCP.

Out of the 112 patients in this study, presence of CBD stone was surgically confirmed in 42 patients. 39 of them were also correctly identified by MRCP, resulting in a sensitivity of 92.9%. Among the 70 patients without surgically confirmed stones, MRCP falsely suggested stones in 4 cases, yielding a specificity of 94.3%. The PPV and NPP values were found to be 90.5% and 95.6%, respectively. The overall diagnostic accuracy of MRCP was 93.8%, supporting its role as a reliable non-invasive imaging modality for the evaluation of suspected CBD stones and potentially reducing the need for invasive procedures such as ERCP.

5.6-Benign biliary obstruction

Etiology of biliary obstruction

	Frequency	Percentage
Benign causes	42	37.5%
Benign strictures	16	14.29%
PSC	1	0.89%
Hepatojejunostomy Stricture	4	3.57%
Duodenal mass	1	0.89%
Ampullary stenosis	2	1.79%
Fascioɾla hepata	1	0.89%

Table 5 : showing Benign causes of biliary obstruction

After CBD stones 27 out of 112 cases(24.1%) were secondary to other benign causes. benign stricture including PSC (n=1) accounted 15 cases out of 27, the rest were hepatojejeunsuoymy stricture(n=4), portal biolpathy (n=2), benign duodenal mass(n=1), ampullary stenosis (n=1), duodenal stenosis(n=1), CHD diverticula (n=1) ,fasciola hepatica (n=1) and lemmel syndrome(n=1) .

The most common cause of biliary stricture was bile duct injury. Previous cholecystectomy was recorded in 22 out of 27 patients with benign biliary obstruction.

The anatomical locations involved are distributed as follows: the common hepatic duct (CHD) was the most frequently affected site, observed in 8 cases. This was followed by the distal common bile duct (CBD) and the paraduodenal CBD, each identified in 5 cases. The paraduodenal CBD was noted in 3 cases, as was the hilar region. Less commonly, the retroduodenal CBD and the supraduodenal segment were involved, each accounting for a single case. 4 out of 15 cases have gall bladder stone associated, and 4 have biliary tree stones and the rest 7 showed no stone at all at the time of imaging . The mean CBD diameter is 11.6mm

The stricture pattern was categorized based on the morphology of biliary narrowing shown on the MRCP. The majority of the cases (~10) exhibited a smooth and gradual tapering of the bile duct. In contrast, three cases demonstrated an abrupt and irregular pattern and two cases showed a smooth but abrupt narrowing.

. Twenty-two MRCP-detected biliary strictures length were evaluated The stricture lengths varied from 3 to 30 mm, with a median of 10.35 mm and a mean of roughly 12.0 mm (the typical stricture length is less than 20 mm). Five cases had the shortest strictures (≤ 5 mm), 9 had moderately long strictures (6–15 mm), and 8 had long strictures (>15 mm).. Given that longer and more irregular strictures are frequently linked to malignant strictures, this distribution of stricture lengths may help correlate stricture morphology with underlying etiology.

The wall thickness was also assessed among 22 strictures. The median was 3mm and the SD was 0.99mm , the mean thickness was 2.85mm . 23 % or five cases categorized as thin that is <2mm whereas 68% showed moderate wall thickness (2-4mm) . Thickened walls (>4mm) were present only in 2 cases which may indicate underlying inflammatory or malignant processes . When correlated with stricture length, morphology, and clinical findings, these thickness measurements can offer more contexts for a more precise differential diagnosis

MRCP has correctly diagnosed 10 cases of benign strictures out of 15. 10 cases which were assumed to be benign stricture with MRCP were found to be in most cases with no etiology (idiopathic) as their final diagnosis on surgical exploration.

15 cases of benign biliary strictures were confirmed by surgical exploration in this study of 112 patients assessed for biliary obstruction. Ten of these cases were correctly identified by MRCP, yielding a sensitivity of 66.7%. Ten of the 20 cases that MRCP identified as benign strictures were false positives based on surgical findings. With a specificity of 89.7%, MRCP correctly ruled out benign strictures in 87 of the patients. In general, MRCP had an 86.6% diagnostic accuracy rate in identifying benign biliary strictures. These results show that although MRCP has a high specificity and is a useful non-invasive tool, its sensitivity is moderate and false positives can happen.

The ERCP revealed a proximally retracted biliary orifice, no major papilla, and duodenal stenosis, which was the other cause of benign obstruction discovered. A benign pattern of distal CBD obstruction was detected by MRCP. The image's retrospective analysis revealed wall thickening and narrowing at the duodenum's second segment.

The other rare cause of biliary obstruction detected with ERCP was facial hepatica but the MRCP labeled it as filling defect due to stone or sludge as it is hypointense

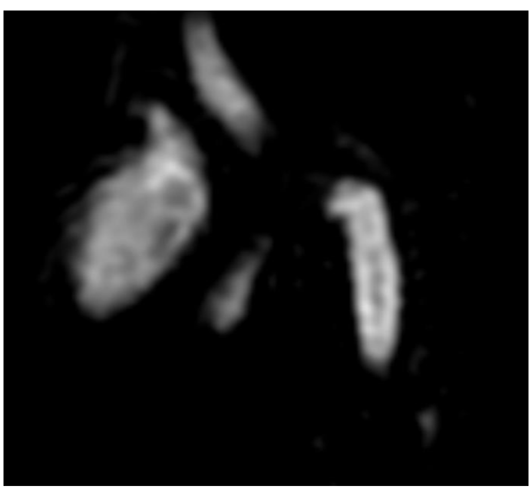


Figure 1 : an MRCP image showing a linear filling defect at the distal CBD representing fasciosis

Lemmel syndrome was another rare cause of biliary obstruction detected with MRCP and confirmed with ERCP. A 5x4cm diverticula from the anterior aspect of the second part of the duodenum which is air filled with mild dilatation of both the CBD and pancreatic duct is seen on the MRCP.

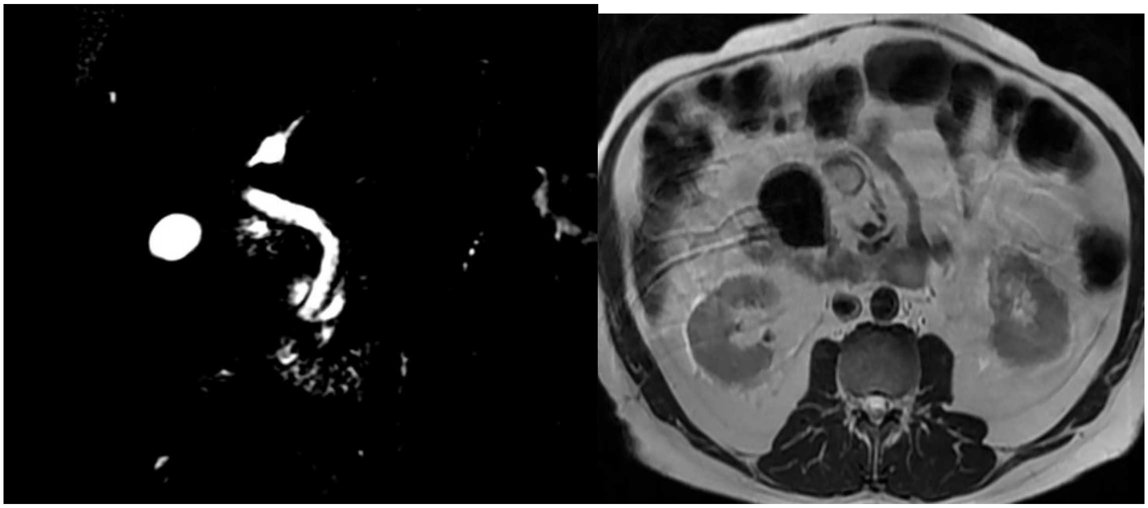


Figure 2 : MRCP image showing a diverticulum at the duodenum resulting in CBD dilatation

5.7-Malignant causes of biliary obstruction

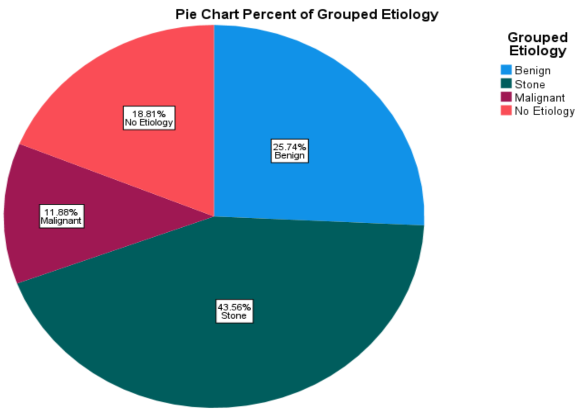


Figure 2 : ***Pie chart Showing the etiology of biliary obstructions, which were confirmed by the gold standard (ERCP/surgery) ; malingat etiologies make 11 % of the cases***

In this study, biliary obstruction due to malignant causes were identified with MRCP, but the gold standard for confirmation being surgical exploration or ERCP. . Cholangiocarcinoma was the most frequent etiology, found in 5patients (4.5%) followed by pancreatic adenocarcinoma found in 3 patients (2.7%) and duodenal adenocarcinoma in 2patients (1.8%). Intraductal papillary carcinoma of the common bile duct (CBD) and pancreatic metastasis from ovarian cancer were each identified in 1 patient (0.9%)

. MRCP identified 12 malignant causes of biliary obstruction which were also confirmed surgically, yielding a sensitivity of 100%. However, MRCP also falsely identified malignancy in 4 cases: 2 of which were later found to be benign obstructions and 2 with no definitive etiology on surgical/ERCP follow-up. This resulted in a specificity of 96%, a positive predictive value (PPV) of 75%, and a negative predictive value (NPV) of 100%. The overall diagnostic accuracy of MRCP for detecting malignant biliary obstructions in this study was approximately 96.4%. These findings support the high reliability of MRCP in ruling out malignancy, though false positives may still occur.

MRCP performs well in detecting presence of malignancy but has limitations in identifying the exact etiology. As an example, there was one case the MRCP interpreted as an ampullary carcinoma but surgical findings diagnosed as duodenal adenocarcinoma. Additionally, two cases diagnosed as cholangiocarcinoma by MRCP were later found to be pancreatic adenocarcinoma and intraductal papillary carcinoma of the CBD, respectively. These findings demonstrate the high sensitivity of the MRCP in diagnosing malignant obstruction, but underscore the need for histopathological confirmation to define the specific diagnosis.

The most common level of obstruction was at the distal CBD(N=9) followed by paradudenna segment and hilar segment .

Three out of twelve surgically confirmed malignant cases of biliary obstructions, showed pancreatic duct dilatation was identified on MRCP. Of these, 2 cases were due to pancreatic adenocarcinoma, and 1 case was associated with duodenal adenocarcinoma. This shows that although pancreatic duct dilatation may be used as a supportive imaging feature in cases of pancreatic malignancy, it was absent in the majority (75%) of malignant cases, including those involving other periampullary and biliary tract tumors. Therefore, pancreatic duct dilatation, though suggestive when present, should not be considered a consistent or standalone indicator of malignant biliary obstruction on MRCP.

CBD is markedly dilated in the malignant obstructions with a median of 28mm.

5.8- Biliary dilatation without any obstructing etiology

MRCP overcalled an etiology in five cases, reporting four cases as benign biliary strictures and one case as tiny calculi; however, all five cases were ultimately confirmed to have no obstructing etiology on gold standard evaluation.

From the 112 cases in this study, 18 had no identifiable etiology on all of the final gold standard assessment methods i.e. surgery, ERCP and follow up.

On the contrary, MRCP missed the etiology in 5 cases, which were settled as two passed stones, two CBD stones and a tiny ampullary carcinoma.

Patients with benign or malignant obstructive causes showed significantly more biliary dilatation compared with those with no identifiable etiology. Patients with malignant obstruction showed a mean CBD diameter of 28mm which is much higher than 12mm CBD diameter in patients with benign obstruction and 8.6mm CBD diameter in patients with no detected cause.

The intrahepatic bile duct diameters ranged from 1.8 mm to 3.2 mm and showed none to mild dilatation, with a non-dilated ductal system in 13 of 18 cases. Pancreatic duct dilatation was uncommon, present in only 2 cases. History of previous cholecystectomy was noted in 4 patients.

In the no-etiology group, the mean serum levels were: ALP 265 IU/L, ALT 134 IU/L, AST 93 IU/L, total bilirubin 3.9 mg/dL, and direct bilirubin 2.2 mg/dL. In contrast, patients with malignant obstruction demonstrated substantially higher values, with mean levels of ALP 824 IU/L, ALT 199 IU/L, AST 150 IU/L, total bilirubin 5.9 mg/dL, and direct bilirubin 2.9 mg/dL.

Compared to other causes of biliary obstruction, including CBD stones, benign strictures, and malignant strictures, serum biochemical markers showed milder elevations

5.9- DIagnostic accuracy of MRCP with surgery/ERCP as gold standard

Overall diagnostic accuracy of MRCP for detecting the correct etiology as surgeryERCP as a gold standard

5.9.1- CBD stones

	Surgery: Stone +		Surgery: Stone –	Total=112
MRCP Stone +	42 (TP)		5 (FP)	
MRCP Stone –	5 (FN)		60 (TN)	
Sensitivity:	Specificity:		PPV:	NPV:
93.3%	94.0%		91.3%	95.5%

Table 6 : the sensitivity , specificity ,PPV and NPV of MRCP in detecting biliary stones as comapred to the gold standard

5.9.2 ; Malignant versus Benign

	Surgery Malignant (+)	Surgery Benign (–)		
MRCP malignant (+)	9 (TP)	7 (FP)		
MRCP benign (–)	4 (FN)	88 (TN)		
Sensitivity	Specificity	PPV	NPV	Accuracy
69.2%	92.6%	56.3%	95.7%	89.8%

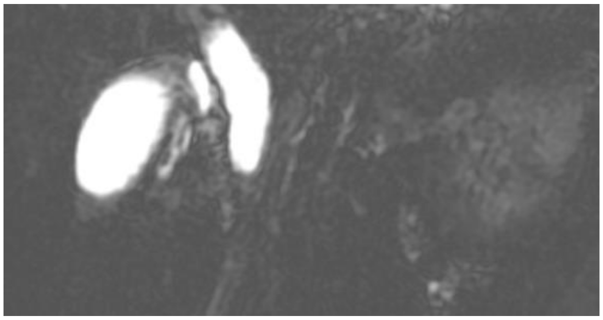
Table 7 ; the sensitivity , specificity , negative and positive predictive value and accuracy of MRCP in differentiating malignant versus benign causes of biliary obstruction

5.9.3–Diagnostic accuracy of MRCP for detecting biliary obstructions with a surgical/ERCP gold standard

	Gold standard :Yes	Gold standard: No
MRCP: Yes	86	8
MRCP: No	6	12

Table 8: showing a cross tabulation for diagnostic accuracy study of MRCP in detecting obstruction as compared with the gold standard

Compared with the gold standard ,MRCP demonstrated a sensitivity of 93.5 % and specificity of 60% for the detection of biliary obstruction . the positive predictive value and the negative predictive value were 91.5% and 66.7% respectively . Finally the overall diagnostic accuracy of MRCP was 87.5%



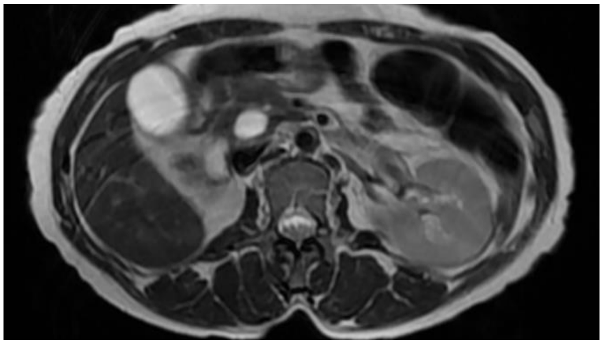


Figure 3 : MRCP images of a 33-year-old female patient demonstrate gallbladder stones with marked dilatation of the intrahepatic and extrahepatic biliary ducts. There is abrupt distal common bile duct (CBD) narrowing, initially suggestive of malignant obstruction. Surgical exploration revealed no obstructing lesion, and the imaging findings were consistent with a passed stone. Liver enzymes and serum bilirubin were within normal limits (total bilirubin 0.72 mg/dL; direct bilirubin 0.123 mg/dL).

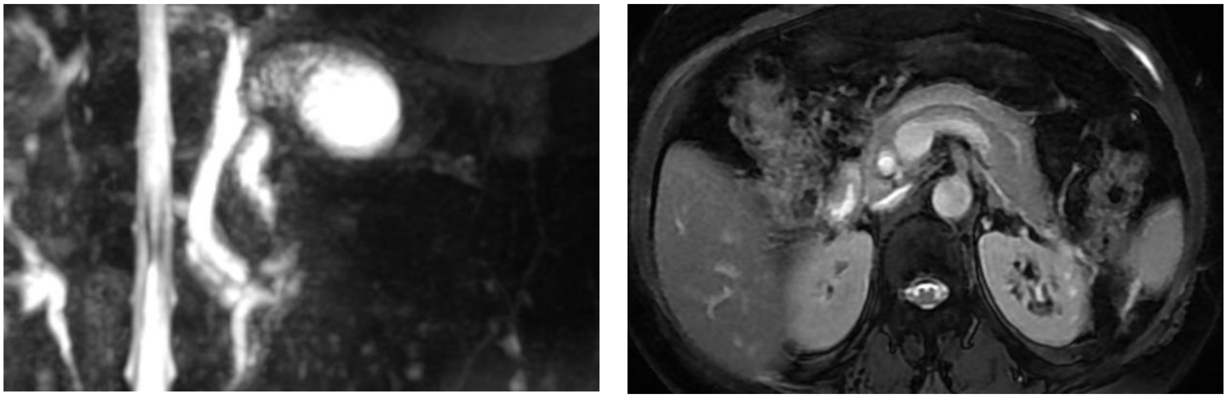


Figure 4 : A 55-year-old female patient showing gallbladder stones with dilatation of the intra- and extrahepatic biliary tree. No definite obstructing lesion was identified on imaging. However, surgical exploration revealed multiple gallbladder stones and tiny distal common bile duct stones, which were responsible for the biliary obstruction. The patient presented with features of obstructive jaundice, including deranged liver function tests and elevated serum bilirubin levels.

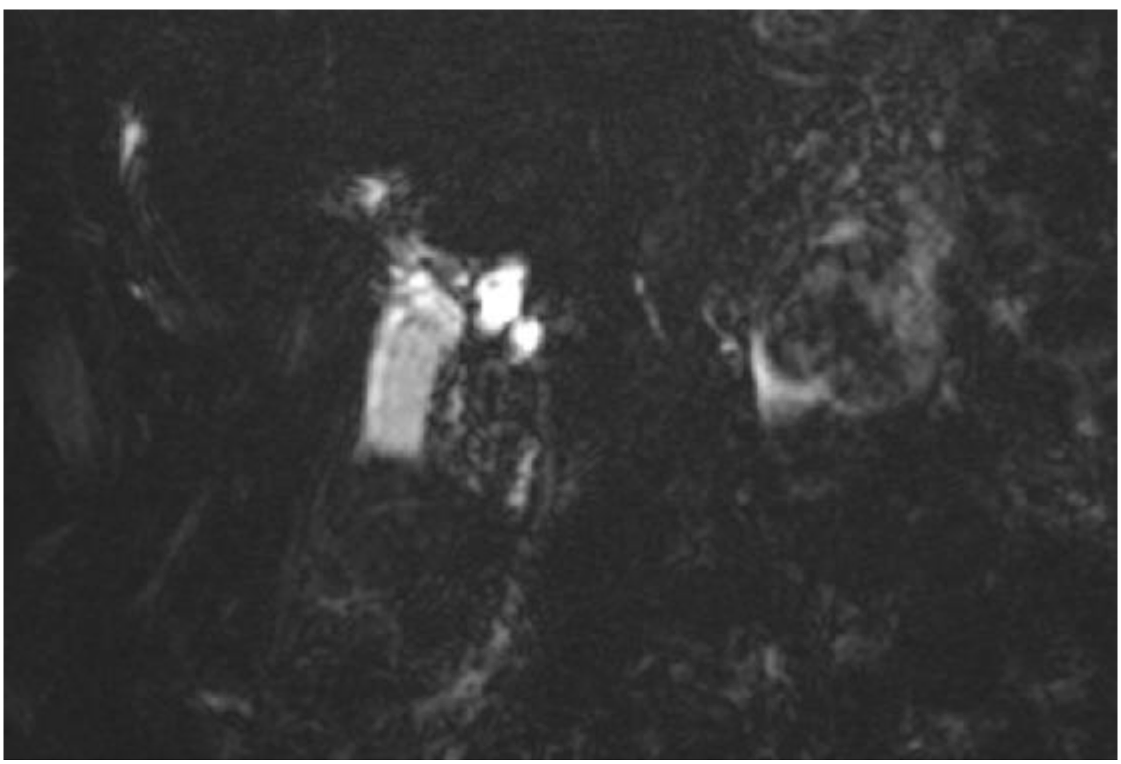


Figure 5 . MRCP findings in a 69-year-old female patient demonstrating dilatation of the common bile duct and pancreatic duct without any identifiable obstructing lesion. Intraoperative

exploration confirmed the absence of obstruction. Liver enzymes and serum bilirubin were not deranged.

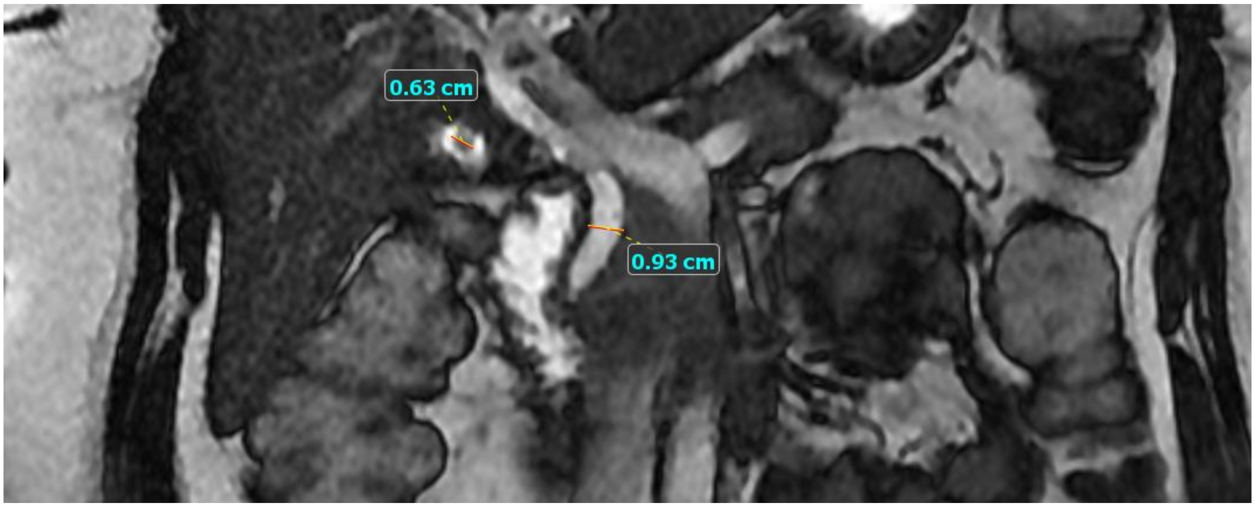


Figure 6 : MRCP demonstrating cholelithiasis with mild common bile duct (CBD) dilatation in a 60-year-old female patient, without any identifiable obstructing lesion. Subsequent surgical exploration confirmed the absence of biliary obstruction. Liver function tests, including serum bilirubin, were within normal limits

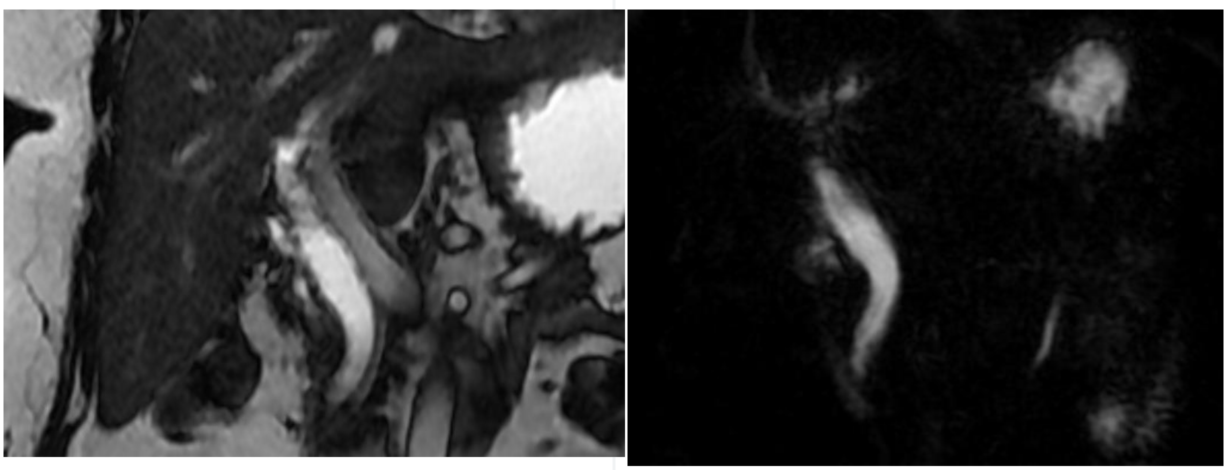


Figure 7 : MRCP of a 47-year-old male patient, status post cholecystectomy, demonstrating dilatation of the common bile duct (CBD) with smooth tapering at its distal segment, initially suggestive of a benign stricture. Biochemical markers were elevated; however, subsequent surgical exploration revealed no obstructing etiology**.**

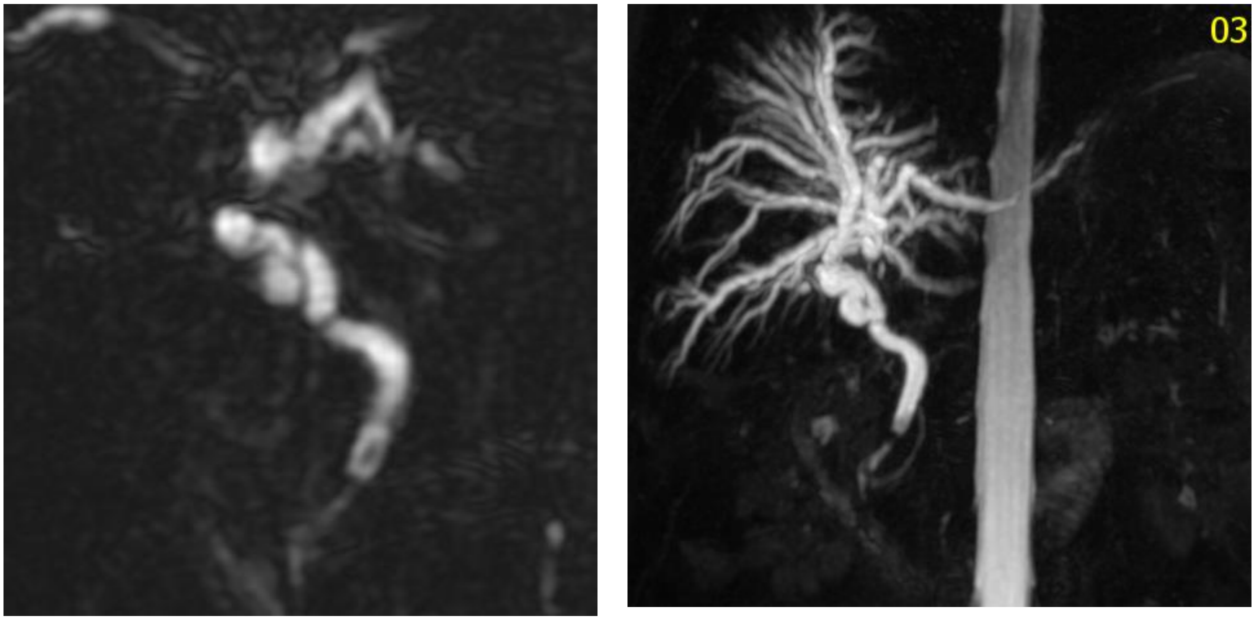


Figure 8 : MRCP of a 40-year-old male patient status post cholecystectomy demonstrating a questionable signal void in the distal common bile duct, suspicious for a distal CBD stone, along with subtle distal tapering. However, surgical exploration revealed no obstructive etiology. Biochemical markers, including liver enzymes and serum bilirubin, were within normal limits.

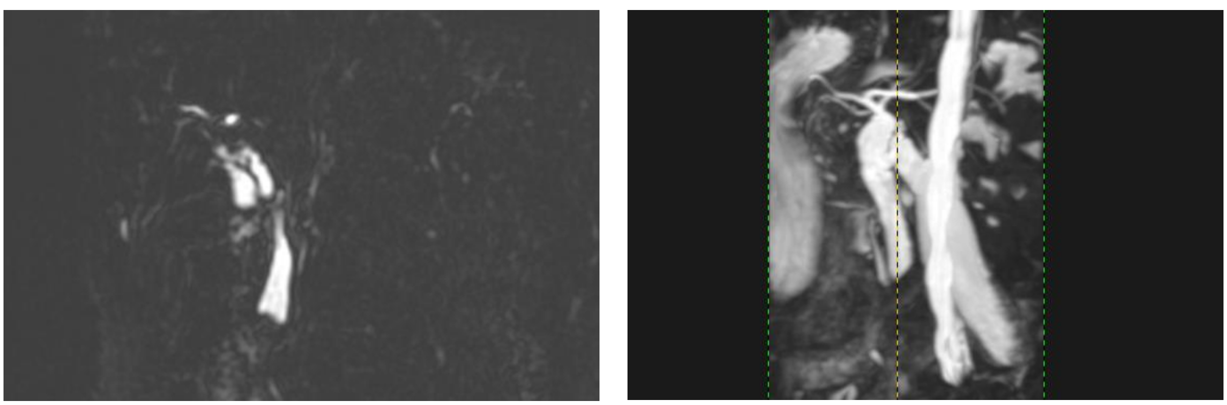


Figure: MRCP image of a 78-year-old male with cholelithiasis showing a dilated common bile duct with smooth tapering at its distal segment and mild prominence of the pancreatic duct. Surgical exploration revealed no obstructive etiology, and biochemical markers were within normal ranges.

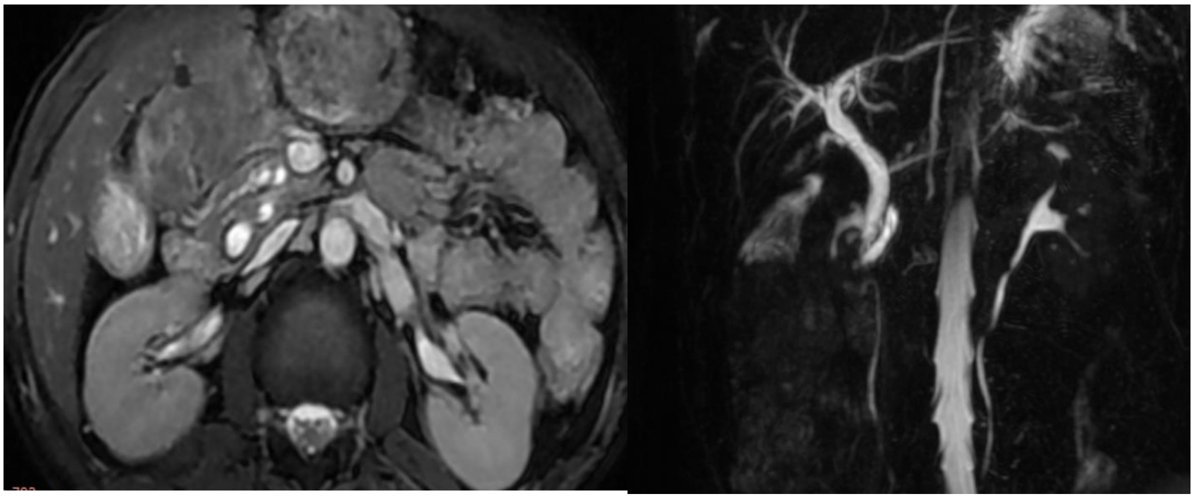


Figure: MRCP of a 48-year-old male patient who presented with intermittent jaundice, demonstrating a dilated common bile duct with no identifiable obstructive etiology on imaging. However, surgical exploration revealed an impacted small stone at the ampulla.

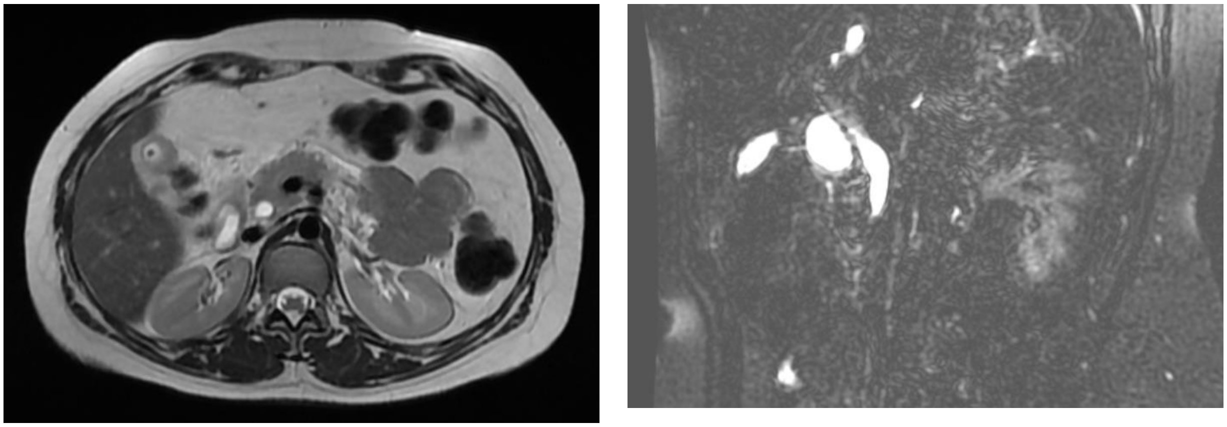


Figure: MRCP of a 27-year-old female patient demonstrating dilatation of the common bile duct with no identifiable obstructing lesion on imaging. Surgical exploration revealed evidence of cholangitis and acute pancreatitis. Biochemical markers were significantly elevated

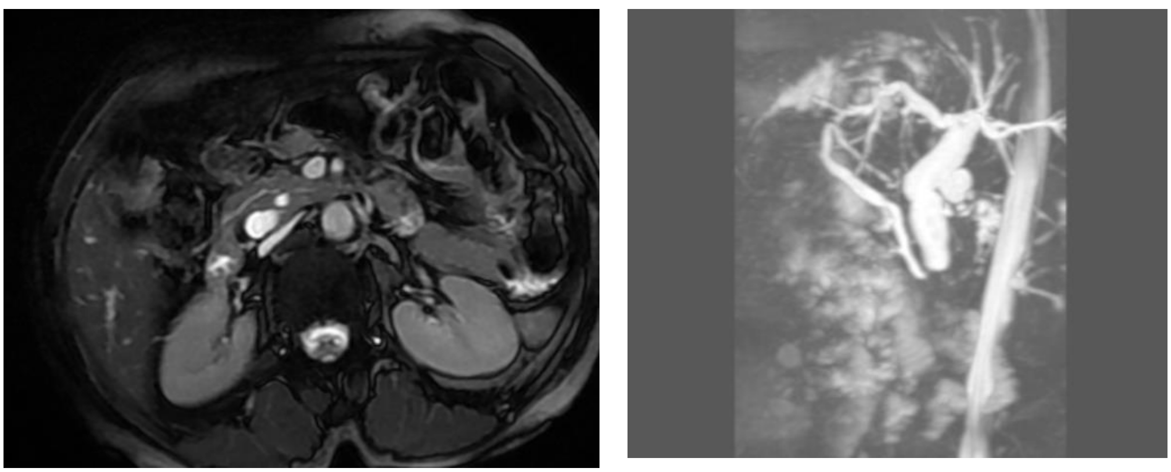


Figure: MRCP of a 60-year-old female patient, post-cholecystectomy, showing mild dilatation of the common bile duct and intrahepatic bile ducts. The distal CBD demonstrates smooth tapering, suggestive of a benign stricture. However, surgical exploration revealed no identifiable cause of obstruction. Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels were moderately elevated, while the remaining biochemical parameters, including bilirubin, were within normal limits.

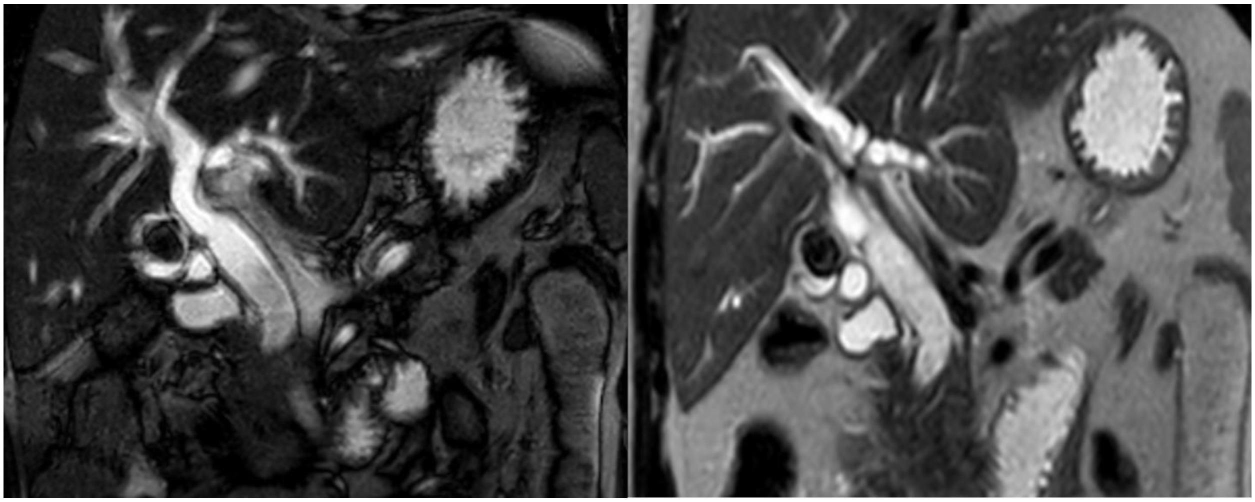


Figure: MRCP of a 40-year-old patient with a history of prior ERCP for distal common bile duct stone removal, showing no residual stones. There is moderate dilatation of the biliary tree with smooth tapering of the distal CBD. Repeat ERCP demonstrated no apparent obstructing lesion. Biochemical markers were significantly elevated

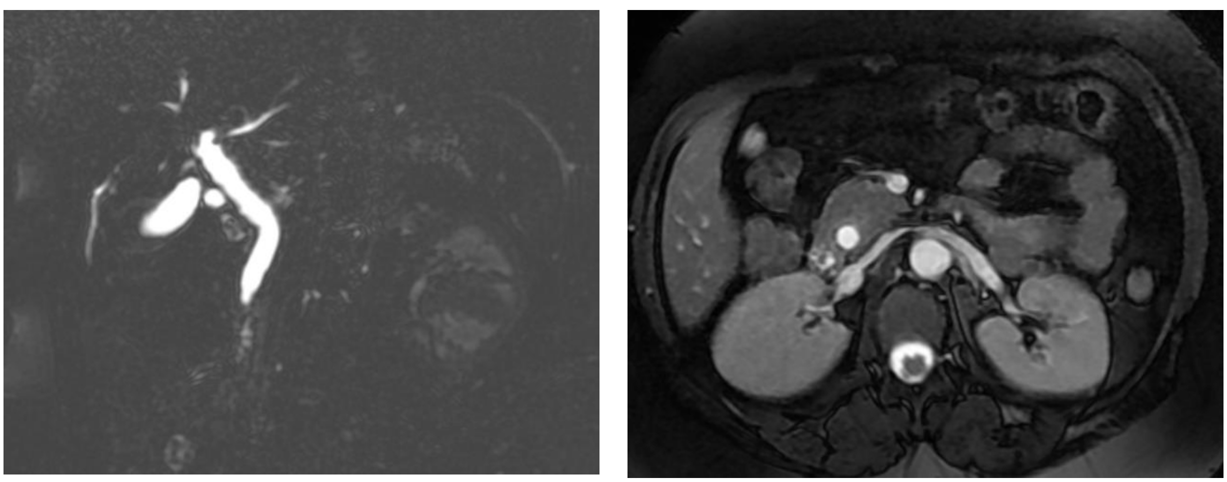


Figure: MRCP of a 43-year-old female patient showing mild dilatation of the common bile duct with no identifiable obstructive lesion, including on diffusion-weighted imaging. Surgical exploration revealed a very small ampullary carcinoma.

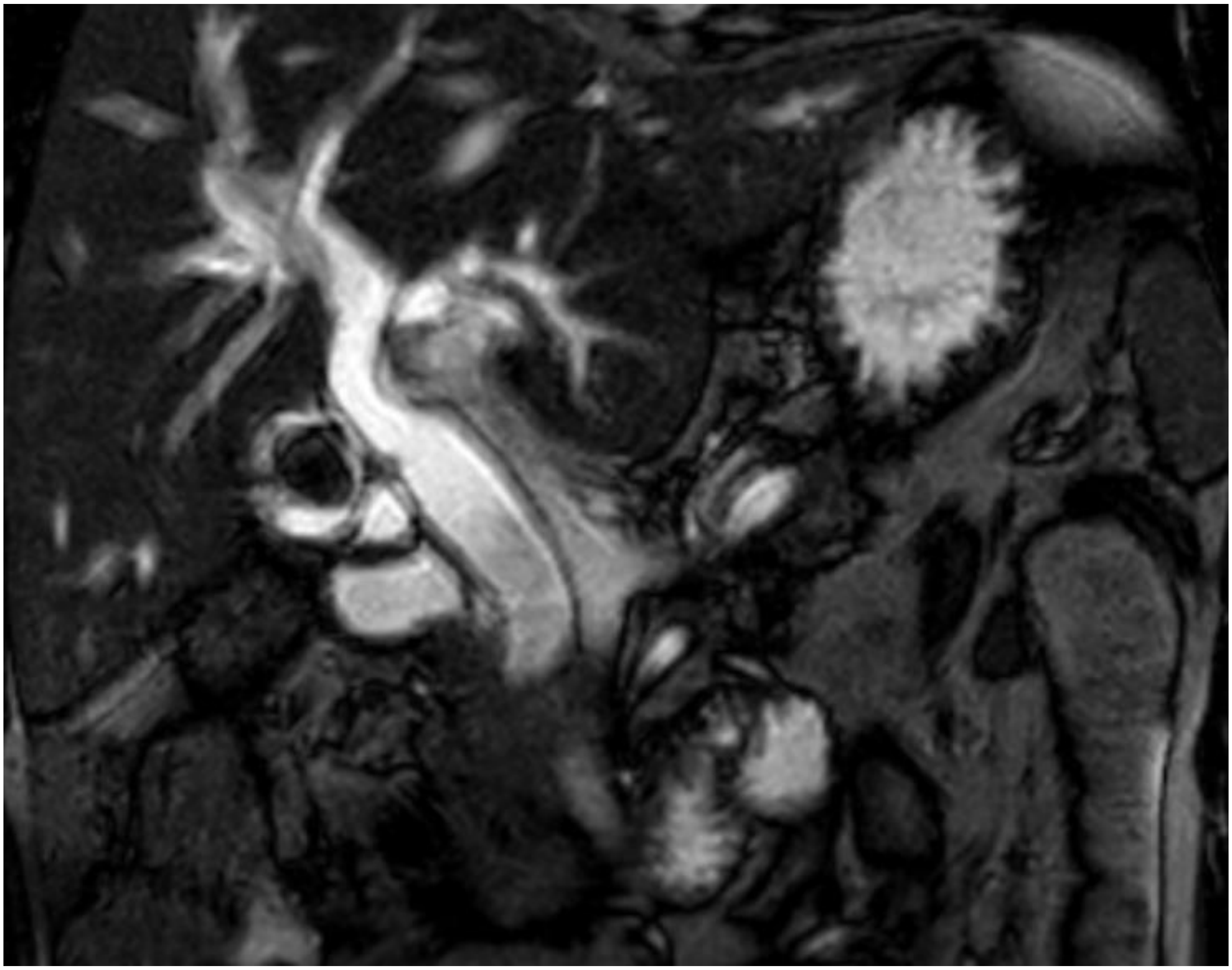


Figure: Pulsation artifcat micicmicking a distal cbd sludge

6-DISCUSSION

This study looked at how MRCP works to diagnose problems in patients who might have a blockage in their bile ducts. The study used ERCP and surgery results as a comparison. The results show that MRCP is really good at finding problems without being invasive. It is very good at detecting when the bile ducts are dilated and when there are stones in the bile duct. However MRCP is not as good at finding problems or telling the difference between non-cancerous and cancerous narrowings of the bile ducts. MRCP is a tool for diagnosing problems with the bile ducts especially when it comes to detecting bile duct stones and dilated bile ducts. The study found that MRCP has some limitations. It is still a very useful test for patients, with suspected biliary obstruction(21,27,29).

6.1-Patient Characteristics and Clinical Presentation

The age of the patients in this study was 48 years. Some patients were a lot older or younger than that with SD of 16 years . 48 Years is the average age. This is similar to what other studies have found(33,34). There were more women in the study than men; about 61 percent were women. This is what other studies have also found (35) . the reason is said to be women are also more likely to get gallstones

The patients in the study mostly had pain in the upper part quadrant and jaundice. These are symptoms when there is blockage of the bile ducts. Other studies have also found that these are the most common symptoms(25). There is a relatively lower frequency of symptoms, like fever or weight loss, which're symptoms of more serious problems. This suggests that the patients present before complicated like before developing cholangitis or advanced malignancy)

6.2-Etiology of Biliary Obstruction

Choledocholithiasis was the most common reason for biliary obstruction in this study making up 37.5% of cases. Benign strictures (which accounts for 14.79% of cases)and malignant causes wre the next most common causes of obstruction .This pattern is similar to prior studies, which showed that CBD stones caused the most obstructions.(26,33).

Benign strictures made up a significant part of cases. Postoperative strictures after gallbladder removal surgery were common.This shows the clinical relevance of iatrogenic bile duct injury

Malignant causes were not as common in our study , but still important.Cholangiocarcinoma was the common cancer, followed by pancreatic cancer. This matches what we know about these cancers from around the world. These findings are consistent with global trends(24,26).

6.3-Level and Degree of Obstruction

(The most common location of biliary obstruction was the distal CBD making up 63 % of the cases , with the supraduodenal segment coming in second. Due to its anatomical connection to the pancreas and ampulla, distal CBD is the most vulnerable segment, according to earlier imaging-based studies (24).

The most common presentation in terms of severity was mild obstruction, which was followed by severe and moderate obstruction. This distribution supports the use of MRCP as a first-line imaging modality and suggests early clinical detection.)

6.4-Diagnostic Performance of MRCP

6.4.1-Overall Performance

With an overall accuracy of roughly 91.1%, sensitivity of 94.7%, and specificity of 72.2%, MRCP showed excellent diagnostic performance. These results are consistent with previously published meta-analyses and prospective studies that show MRCP's high sensitivity and moderate-to-high specificity (36).

False-positive interpretations, especially in cases of benign strictures and subtle ampullary abnormalities, are the main cause of this study's comparatively lower specificity.

6.4.2-Detection of CBD Stones

In our study MRCP showed a good diagnostic performance for detection of CBD stones with a sensitivity of 90 % and specificity of about 94% . These findings are comparable to prior studies reported including Taylor et al and Soto et al as they have demonstrated similar findings (37,38)

The limitations found in our study were like false-negatives due to microlithiasis and very small stones which is acutely a known limitation of MRCP(5). False negatives were also found in our study which were attributed to mimickers of CBD stones including air bubble ,sludge ,and parasitic infestations like fasciola hepaticus . despite these limitations MRCP showed a high diagnostic overall accuracy for detection of biliary stones

6.4.3-Benign Biliary Strictures

The overall diagnostic ability of MRCP in detecting biliary tree strictures was found to be moderate . The sensitivity was 66.7% and the specificity was 89.7% . these findings are in line with previous literatures reported (37)

The relative;y lower sensitivity of MRCP in detecting biliary strictures may be explained by difficulty in distinguishing true strictures from transient narrowings particular with case of previous interventions like ERCP or surgery including case of cholecystectomy

Additionally a number of cases of biliary stricture which were diagnosed with MRCP were not confirmed on surgical explorations contributing for false positive results

Most benign structures found in our study showed a smooth tapering and short segment involvement morphology on MRCP . These were consistent established imaging criteria for benign strictures (28)

6.4.4-Malignant Biliary Obstruction

MRCP showed a high overall diagnostic accuracy of about 96.4 % and excellent sensitivity of nearly 100 % which is consistent with previous other research (28). However the positive predictive value in this study was lower which could be due to the false-positive cases

It showed limitations in accurately telling the exact type of tumor even though it was highly effective in detecting malignant causes of obstruction . difficulty of classifying tumor types like cholangiocarcinoma , pancreatic adenocarcinoma and periampullary tumors was observed , emphasizing the need for histopathologic confirmation.

The morphologic imaging findings for malignant obstruction in this study were mostly asymmetric , irregular ,long segment strictures which are in an agreement with other prior radiologic studies (28).

6.4.5-Biliary Dilatation Without Obstruction

A notable finding in this study was that 16.1% of patients demonstrated biliary dilatation without an identifiable obstructing etiology. This observation highlights a recognized diagnostic challenge, as biliary dilatation does not always imply persistent mechanical obstruction (28).

Possible explanations include spontaneous passage of stones, post-cholecystectomy changes, transient obstruction, and functional biliary dilatation. Subtle pathologies such as microlithiasis or early ampullary lesions may also be missed (19).

Importantly, the mean CBD diameter in this group (8.6 mm) was significantly lower than in benign and malignant obstruction groups. This finding is supported by studies suggesting that CBD diameter correlates with age, surgical history, and degree of obstruction (19).

7-Clinical Implications

This study showed that MRCP has a reliable imaging modality in suspected biliary obstruction . its high sensitivity and no invasiveness makes it valuable in reducing unnecessary ERCP procedures , which are associated with more complications (4,10)

However caution should be taken in evaluation of microlithiasis , small ampullary tumors and differentiating between the different types of malignant strictures and in such cases correlation with clinical , biochemical and histopathological findings should be done

8-Limitations

There are a number of limitations to this study. Because some diagnoses were based on clinical follow-up, not all patients received the same gold standard evaluation. Furthermore, observer variability may affect MRCP interpretation. Sensitivity in certain subgroups may be impacted by the failure to detect small lesions like microlithiasis and early ampullary tumors (5).

9-Conclusion

MRCP is a highly sensitive and accurate non-invasive imaging modality for evaluating biliary obstruction. It performs exceptionally well in detecting biliary dilatation and CBD stones and is highly reliable in excluding malignancy. However, limitations remain in detecting small stones and subtle lesions and in accurately characterizing strictures. Despite these challenges, MRCP plays a crucial role as an initial diagnostic tool and can significantly reduce the need for invasive procedures such as ERCP.

11. Recommendations

A study with more sample size will be beneficial in accurately studying the diagnostic effectiveness of MRCP in local studies. More advanced MRCP techniques shall be applied to detect subtle stricture, tumors or stones. The results of research studies comparing the technique may improve diagnosis algorithms.

References

[1] Bheemashanker. MRCP and ERCP in diagnosis of obstructive jaundice. J. Evid. Based Med. Healthc. 2017; 4(70), 4170-4174. DOI: 10.18410/jebmh/2017/830

[2].Vrachliotis TG, Shirkhoda A, Bis KG, Shetty AN, Konez O, Ference JJ, Madrazo BL. MR cholangiopancreatography (MRCP). Crit Rev Diagn Imaging. 1997 Aug;38(4):295-323. PMID: 9376087.

[3].Raza M, Shams A, Munir S, Shah Z. Diagnostic accuracy of magnetic resonance cholangiopancreatography for detection of choledocholithiasis in obstructive jaundice patients taking surgical findings as gold standard. PJR. 2017;27:189–94. [Google Scholar]

4.GriffinN,Charles-Edwards G, Grant LA. Magnetic resonance cholangiopancreatography:The ABC of MRCP. Insights Imaging. 2012;3:11–21. doi: 10.1007/s13244-011-0129-9. [DOI] [PMC free article] [PubMed] [Google Scholar]

5..Joshi A, Rajpal K, Kakadiya K, Bansal A. Role of CT and MRCP in evaluation of biliary tract obstruction. Curr Radiol Rep. 2014;2:72. [Google Scholar]

6.Mathew RP, Moorkath A, Basti RS, Suresh HB. Value and accuracy of multidetector computed tomography in obstructive jaundice. Pol J Radiol. 2016;81:303–9. doi: 10.12659/PJR.896680. [DOI] [PMC free article] [PubMed] [Google Scholar]

7.Hanif H, Khan SA, Muneer S, Adil SO. Diagnostic accuracy of ultrasound in evaluation of obstructive jaundice with MRCP as gold standard. Pak J Med Sci. 2020;36:652–6. doi: 10.12669/pjms.36.4.1665. [DOI] [PMC free article] [PubMed] [Google Scholar]

8.Expert Panel on Gastrointestinal Imaging. Hindman NM, Hindman NM, Arif-Tiwari H, Kamel IR, Al-Refaie WB, et al. ACR appropriateness criteria ® jaundice. Am Coll Radiol. 2019;16:S126–40. doi: 10.1016/j.jacr.2019.02.012. [DOI] [PubMed] [Google Scholar]

9.Whitehead MW, Hains Worth I, Kingham JG. The causes of obvious jaundice in southwest Wales:Perceptions vs reality. Gut. 2001;48:409–13. doi: 10.1136/gut.48.3.409. [DOI] [PMC free article] [PubMed] [Google Scholar]

10.Bekele Z, Yifru A. Obstructive jaundice in adult Ethiopians in a referral hospital. Ethiop Med J. 2000;38:267–75. [PubMed] [Google Scholar]

11.Aziz M, Ahmad N, Faizullah Incidence of malignant obstructive jaundice-A study of hundred patients at Nishtar Hospital Multan. Ann KE Med Coll. 2004;10:71–3. [Google Scholar]

12.Ahmed F, Khan AF, Ahmed A, Cheema KM. Extra hepatic biliary obstruction:A study of etiological factors in a teaching hospital. Ann KE Med Coll. 1997;2:6–8. [Google Scholar]

13. Shaik Farid, R. Sundara Raja Perumal. Role of magnetic resonance cholangiopancreatography (MRCP) in the evaluation of patients with obstructive jaundice. International Journal of Contemporary Medical Research 2019;6(5):E1-E5.

14. Ali F, Aamir N, Hassan MK; Fakhar-E-Alam; Khan HU, Khan D. Comparison of MRCP and ERCP findings: A retrospective secondary data analysis. J Pak Med Assoc. 2022 Feb;72(2):284-286. doi: 10.47391/JPMA.20-721. PMID: 35320178.

15. Patel VB, Musa RK, Patel N, Patel SD. Role of MRCP to determine the etiological spectrum, level and degree of biliary obstruction in obstructive jaundice. J Family Med Prim Care. 2022 Jul;11(7):3436-3441. doi: 10.4103/jfmpc.jfmpc_2362_21. Epub 2022 Jul 22. PMID: 36387625; PMCID: PMC9648261.

16.Serinsöz S, Aktürk R. The Value of MRCP in the Evaluation of the Level and Degree of Biliary Obstruction in Obstructive Jaundice. CM 2023;15(3):199-204

17. Parashari UC, Khanduri S, Bhadury S, Upadhyay D, Kishore K. Diagnostic role of magnetic resonance cholangiopancreatography in evaluation of obstructive biliopathies and correlating it with final diagnosis and clinical profile of patients. J Nat Sci Biol Med. 2015 Jan-Jun;6(1):131-8. doi: 10.4103/0976-9668.149110. PMID: 25810650; PMCID: PMC4367024.

18. Fulcher AS, Turner MA. MR cholangiopancreatography: technical advances and clinical applications. Radiographics. 1999;19(1):25–41.

19 Soto JA, Barish MA, Yucel EK, Ferrucci JT. MR cholangiopancreatography: findings on

MR imaging. AJR Am J Roentgenol. 1995;165(6):1395–1401.

20. Verma D, Kapadia A, Eisen GM, Adler DG. EUS vs MRCP for detection of choledocholithiasis: systematic review. Gastrointest Endosc. 2006;64(2):248–254.

21 .Baron RL, Stanley RJ, Lee JK, Koehler RE, Levitt RG. Evaluation of biliary obstruction. Radiology. 1982;145(1):91–98.

22. Boraschi P, Neri E, Braccini G, Gigoni R, Caramella D, Perri G. MRCP in choledocholithiasis. Eur Radiol. 1999;9(5):865–872.

23. Kim HJ, Kim MH, Lee SK, Seo DW, Kim YT, Lee DK, et al. Pancreaticobiliary duct variations. Radiographics. 2002;22(6):1575–1590.

24. Yeh BM, Liu PS, Soto JA, Corvera CA, Hussain HK. MR imaging of the biliary tract. Radiology. 2009;253(3):678–697.

25. Williams EJ, Green J, Beckingham I, Parks R, Martin D, Lombard M. Management of CBD stones. Gut. 2008;57(7):1004–1021.

26. Park MS, Kim TK, Kim KW, Lee JK, Kim AY, Kim PN, et al. Cholangiocarcinoma imaging. Radiology. 2004;233(1):234–240.

27. Mortelé KJ, Ros PR. Biliary tract variants and pitfalls. AJR Am J Roentgenol. 2001;177(2):389–394.

28. Baron RL. Common bile duct strictures: imaging features. Radiology. 1987;162(2):343–347.

29. Perret RS, Sloop GD, Borne JA. Common bile duct size correlation. Radiology. 2000;214(2):475–479.

30. Bachar GN, Cohen M, Belenky A, Atar E, Gideon S. Effect of aging on CBD diameter. J Clin Ultrasound. 2003;31(2):67–70.

31. Parulekar SG. Ultrasound evaluation of CBD size. Radiology. 1979;133(3):703–707

33. Shaik F, Perumal RSR. Role of magnetic resonance cholangiopancreatography (MRCP) in the evaluation of patients with obstructive jaundice. International Journal of Contemporary Medical Research. 2019;6(5):E1–E5.

34. Rabiu NM, Muhammad AR, Umar AB, Donzomga SD, Garzali IU, Abba SM, et al. Evaluation of hepatobiliary disorders using magnetic resonance cholangiopancreatography *in a low-resource setting in Kano, Nigeria: a retrospective study. BMC Gastroenterol. 2025;25(1):254.*

35 Kartal I, Yilmaz N. Comparison of ultrasonography and magnetic resonance cholangiopancreatography findings with endoscopic retrograde cholangiopancreatography in patients with cholestasis. Research Square [Preprint]. 2025 Jul 22. doi:10.21203/rs.3.rs-7115400/v1.

36. Romagnuolo J, Bardou M, Rahme E, Joseph L, Reinhold C, Barkun AN. Magnetic resonance cholangiopancreatography: a meta-analysis of test performance in suspected biliary disease. Ann Intern Med. 2003;139(7):547–557.

37. Serinsöz S, Aktürk R. The value of MRCP in the evaluation of the level and degree of biliary obstruction in obstructive jaundice. Comprehensive Medicine. 2023;15(3):199–204. doi:10.14744/cm.2023.74317.

38. Kumar A, Mohanty NR, Mohanty M, Dash S. Comparison of MRCP and ERCP in the evaluation of common bile duct and pancreatic duct pathologies. Front Med Technol. 2023;5:946555. doi:10.3389/fmedt.2023.946555.