"ROLE OF MAGNETIC RESONANCE CHOLANGIO-PANCREATOGRAPHY IN PATIENTS WITH PANCREATICO-BILIARY PATHOLOGY: A ONE YEAR HOSPITAL BASED CROSS - SECTIONAL STUDY"

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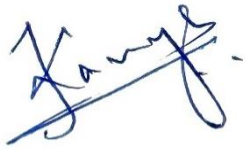

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LIST OF ABBREVIATONS

Abbreviation	Full Form
MRCP	Magnetic Resonance Cholangiopancreatography
MRI	Magnetic Resonance Imaging
ERCP	Endoscopic Retrograde Cholangiopancreatography
S-MRCP	Secretin-Stimulated Magnetic Resonance Cholangiopancreatography
CP	Chronic Pancreatitis
CT	Computed Tomography
US	Ultrasound
PSC	Primary Sclerosing Cholangitis
CBD	Common Bile Duct
PDAC	Pancreatic Ductal Adenocarcinoma
DWI	Diffusion-Weighted Imaging
FOV	Field of View
PPV	Positive Predictive Value
NPV	Negative Predictive Value
ALP	Alkaline Phosphatase
ALT	Alanine Aminotransferase
IHBR	Intrahepatic Biliary Radicle
SPIO	Superparamagnetic Iron Oxide
PTC	Percutaneous Transhepatic Cholangiography
MRCP	Magnetic Resonance Cholangiopancreatography
MRI	Magnetic Resonance Imaging
ERCP	Endoscopic Retrograde Cholangiopancreatography
S-MRCP	Secretin-Stimulated Magnetic Resonance Cholangiopancreatography
CP	Chronic Pancreatitis
CT	Computed Tomography

ABSTRACT

Background

Magnetic Resonance Cholangiopancreatography (MRCP) has emerged as a vital non-invasive imaging modality for diagnosing pancreatico-biliary disorders. This study aimed to evaluate the diagnostic accuracy of MRCP in detecting pancreatic and biliary abnormalities, comparing its findings with invasive procedures like ERCP and surgical outcomes.

Objective

The study's primary objective was to assess MRCP's role in diagnosing and characterizing pancreaticobiliary pathologies, identifying their prevalence, and determining its diagnostic accuracy in comparison to other modalities.

Materials and Methods

A hospital-based cross-sectional study was conducted over one year at KLE's Dr. Prabhakar Kore Hospital & MRC, Belgaum, Karnataka, India. A total of 72 patients with clinically suspected pancreaticobiliary pathologies underwent MRCP using a 3.0 Tesla MRI scanner. Findings were correlated with ERCP and surgical outcomes. Data on patient demographics, clinical presentation, laboratory markers, and imaging findings were analyzed statistically to determine MRCP's diagnostic performance.

Results

MRCP demonstrated a sensitivity of 88% and specificity of 92% for diagnosing pancreaticobiliary disorders. Among the 72 patients, choledocholithiasis was the most frequent diagnosis (30.6%), followed by malignant obstruction (25%), benign biliary strictures (16.7%), and chronic pancreatitis (13.9%). The correlation between MRCP and ERCP findings was 93.3% for choledocholithiasis and 100% for biliary strictures. Surgical confirmation further validated MRCP's accuracy in detecting biliary and pancreatic duct abnormalities.

Conclusion

MRCP proved to be a highly accurate, non-invasive imaging tool for diagnosing pancreaticobiliary pathologies, reducing the need for invasive procedures like ERCP except for therapeutic purposes. Its high sensitivity and specificity underscore its importance as a primary diagnostic modality. Further advancements in MRCP technology may further enhance its diagnostic precision and clinical utility.

Keywords

Magnetic Resonance Cholangiopancreatography, Pancreaticobiliary Pathology, Biliary Strictures, Choledocholithiasis, Pancreatic Cancer, MRCP Accuracy.

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INTRODUCTION

Magnetic Resonance Cholangiopancreatography (MRCP) has become an essential tool in diagnosing and managing pancreatico-biliary pathologies, including disorders of the pancreas, bile ducts, and gallbladder. These conditions, which often present with overlapping symptoms such as jaundice, abdominal pain, and digestive disturbances, require accurate and non-invasive diagnostic methods like MRCP by providing high-resolution, three-dimensional images of the biliary and pancreatic ductal systems [1,2].

One of the key advantages of MRCP is its non-invasive nature. Unlike Endoscopic Retrograde Cholangiopancreatography (ERCP), which carries risks of pancreatitis and infection, MRCP provides detailed imaging without the need for endoscopic access[9]. This makes it especially suitable for diagnostic purposes in patients with comorbidities or those at higher surgical risk [3,4].

MRCP is highly effective in identifying causes of biliary obstruction, detecting choledocholithiasis, and assessing malignancies like cholangiocarcinoma and pancreatic cancer [3-5].MRCP is also vital in managing inflammatory diseases like chronic pancreatitis and autoimmune pancreatitis.

MRCP also plays a critical role in guiding therapeutic decisions by providing detailed anatomical and pathological information, it helps determine the need for surgery, endoscopic therapy, or conservative management [8,9].

However, MRCP has few limitations. Patient motion, metallic implants, and insufficient fluid content within the ducts can affect image quality, and complementary imaging techniques may be necessary for a comprehensive assessment [7,8].

Technological modifications, such as secretin-stimulated MRCP (S-MRCP) and functional MRCP, have enhanced its diagnostic capabilities, allowing for better evaluation of ductal function and complex anatomy [6,7].

OBJECTIVE AND NEED FOR STUDY

The objective of this study was to evaluate the spectrum of findings in case of pancreatico-biliary disorders on MRCP.

The need of this study is to assess the various techniques of MRCP of 3T MRI machine for determining the accuracy in diagnosis of pancreatico-biliary pathologies, to assess the prevalence of various causes of obstructive jaundice in this population as there are no previous literature available and not enough studies have been done regarding the role of MRCP in pancreatico-biliary pathologies in this geographic area

REVIEW OF LITERATURE

The pancreatico-biliary system, encompassing the pancreas, bile ducts, gallbladder, and associated structures, plays a pivotal role in digestion and metabolism. Any pathological alteration in this system can lead to significant clinical consequences [11]. These conditions are often characterized by overlapping clinical presentations such as jaundice, abdominal pain, and changes in liver function tests, making accurate diagnosis crucial for appropriate management.[11,12]

The complex anatomy and proximity of the pancreatico-biliary structures to other abdominal organs pose diagnostic challenges. Moreover, these pathologies often coexist with or mimic other gastrointestinal disorders, further complicating their identification.

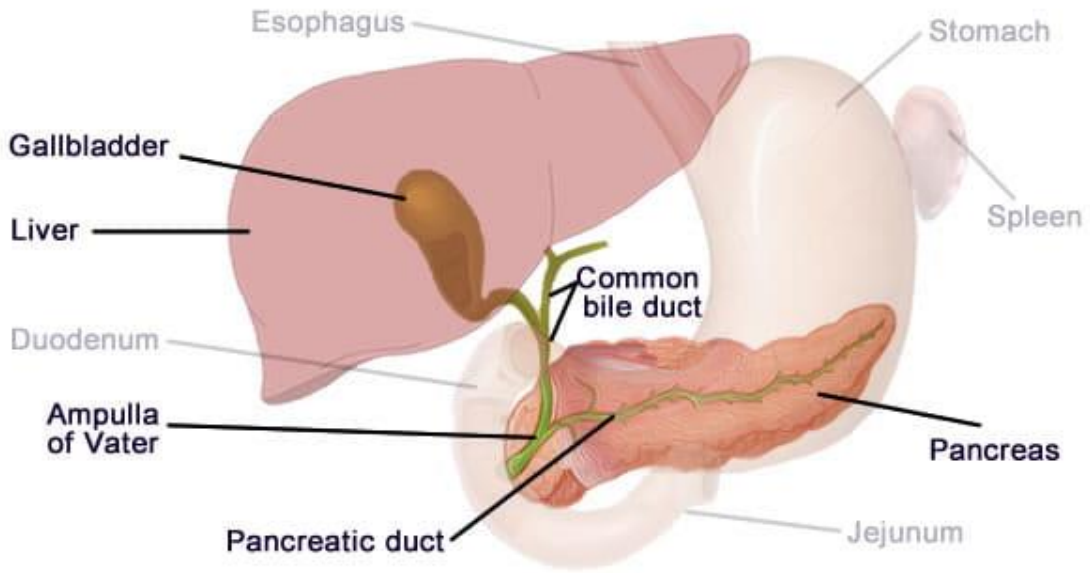

Figure: Pancreaticobiliary System

Common Conditions Affecting the Pancreas and Biliary Tract

Bile Duct Obstruction: Bile duct obstruction occurs when the normal flow of bile from the liver to the small intestine is interrupted. It can arise from benign or malignant causes, leading to cholestasis, jaundice, and potential complications such as infection or liver damage.[27,28]

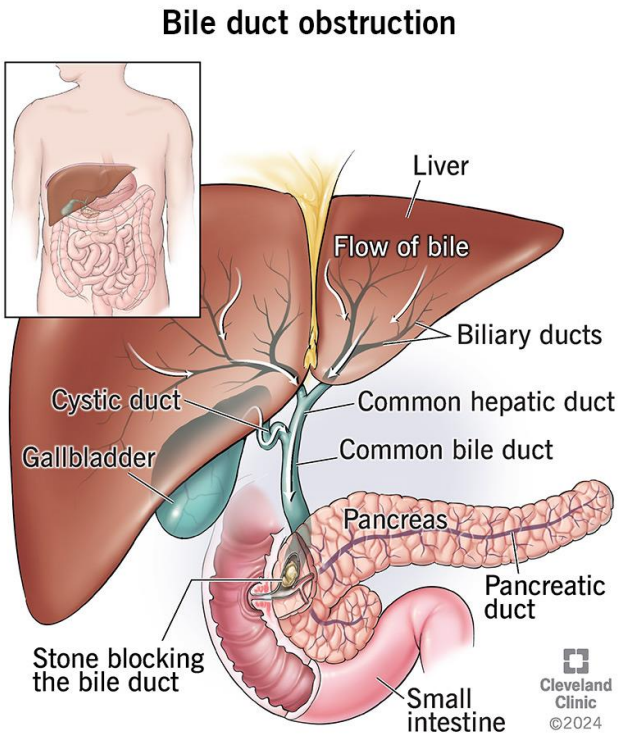

Figure: Bile Duct Obstruction

- **Benign Causes**:
    - **Gallstones (Cholelithiasis):** Gallstones are the most common cause of bile duct obstruction. Stones formed in the gallbladder can migrate into the common bile duct, causing pain, jaundice, and potentially life-threatening infections like cholangitis.
    - **Benign Biliary Strictures:** These can result from previous surgeries, inflammation, or trauma. Strictures impede bile flow, often mimicking malignant obstruction.
    - **Primary Sclerosing Cholangitis (PSC):** PSC is a chronic inflammatory condition associated with bile duct scarring and strictures. It is strongly linked to inflammatory bowel disease and poses a risk for cholangiocarcinoma.
    - **Chronic Pancreatitis (CP):** Chronic pancreatitis is characterized by progressive and irreversible damage to the pancreas, often secondary to long-term alcohol use or genetic predispositions. CP presents with chronic abdominal pain, malabsorption, and diabetes mellitus due to exocrine and endocrine insufficiency.

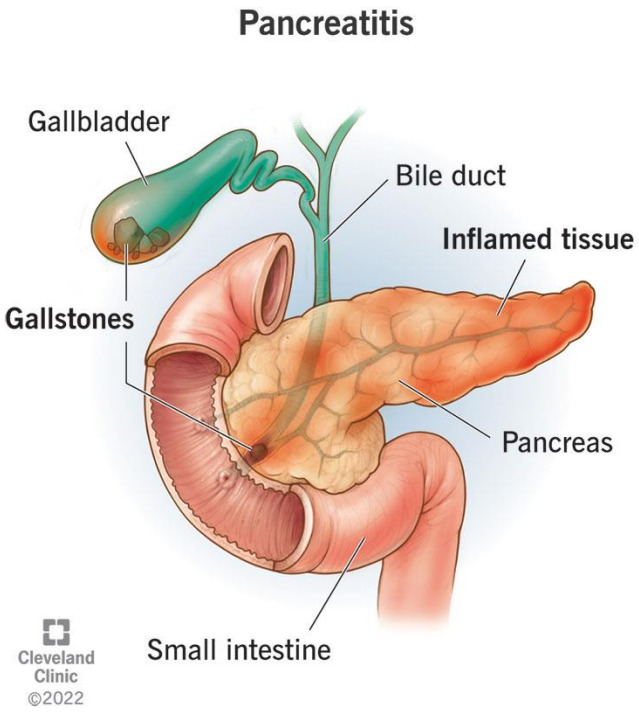

Figure: Pancreatitis

- **Malignant Causes**: [28,29]
    - **Cholangiocarcinoma:** Cholangiocarcinoma is a rare but highly aggressive malignancy of the bile ducts, classified based on its location into intrahepatic, perihilar, or distal types.[30,31]

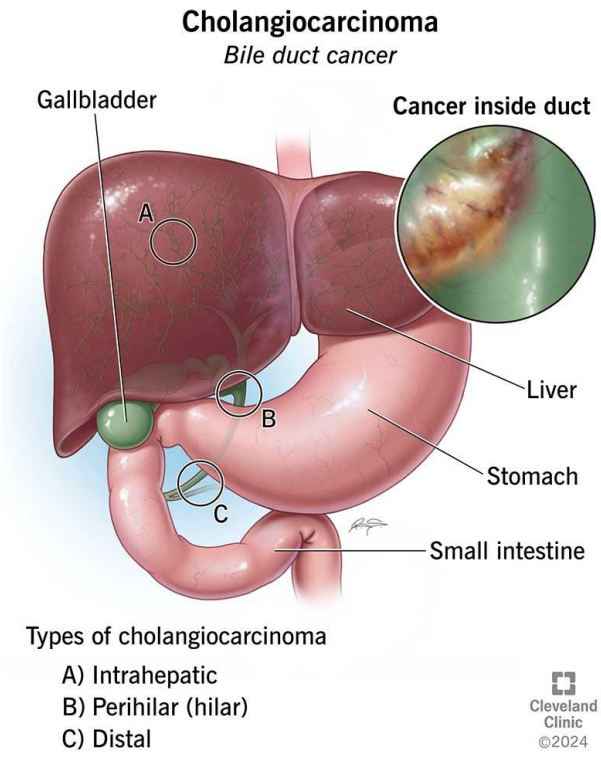

Figure: Cholangiocarcinoma

- **Pancreatic Cancer:** Pancreatic ductal adenocarcinoma (PDAC) is the most common malignancy of the pancreas, often presenting at an advanced stage.[31,32]

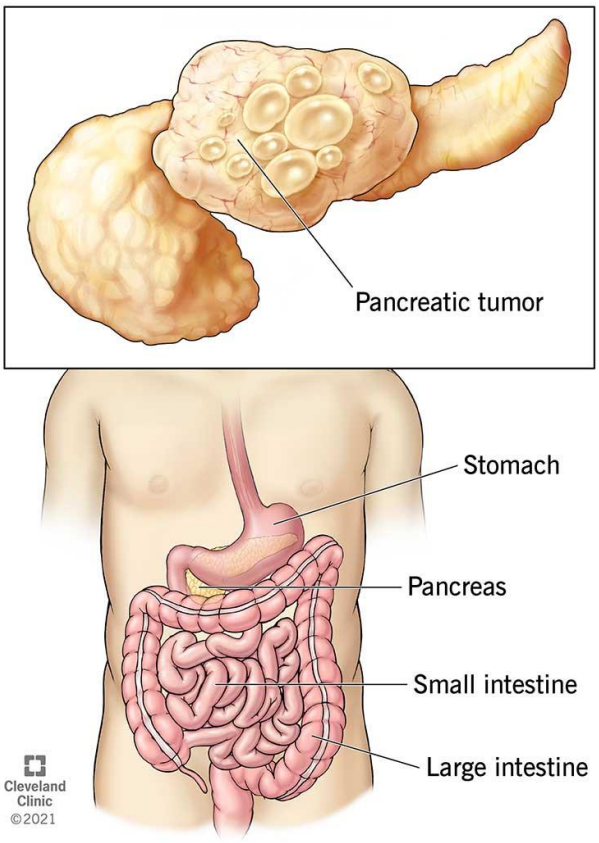

Figure: Pancreatic Cancer

- **Congenital Anomalies and Structural Disorders**
    - **Choledochal Cysts:** These cystic dilations of the bile duct predispose patients to biliary obstruction, infection, and malignancy. Surgical excision is typically recommended to prevent complications.
    - **Pancreatic Divisum:** A congenital anomaly where the pancreas fails to fuse during embryogenesis. While often asymptomatic, it can predispose individuals to recurrent pancreatitis.

Diagnostic Imaging in Managing Pancreatico-Biliary Pathologies

Accurate and timely diagnosis of pancreatico-biliary diseases is paramount for effective management and improved outcomes. Diagnostic imaging plays a cornerstone role in achieving these objectives, enabling visualization of the anatomy and pathology of the

pancreas and biliary system. Imaging is indispensable not only for diagnosis but also for staging, treatment planning, and monitoring response to therapy.[15,16]

Different Imaging Modalities:

The most commonly employed imaging modalities are ultrasound (US), computed tomography (CT), endoscopic retrograde cholangiopancreatography (ERCP), and magnetic resonance cholangiopancreatography (MRCP). Each modality offers unique advantages and limitations, making their selection dependent on the clinical scenario.[40,41]

Ultrasound (US): Ultrasound is often the first-line imaging modality for evaluating pancreatico-biliary pathologies due to its wide availability, cost-effectiveness, and non-invasiveness.[40,41]

Applications [41,42]

- **Gallstones:** Ultrasound is the gold standard for detecting gallstones and sludge in the gallbladder
- **Bile Duct Dilatation:** It effectively identifies bile duct dilatation, which may indicate obstruction.
- **Pancreatitis:** Acute pancreatitis can be evaluated with ultrasound, particularly for detecting associated gallstones or fluid collections.
- **Cystic Lesions:** Pancreatic cysts and pseudocysts can often be visualized, although detailed characterization may require further imaging.

Advantages: Widely available and inexpensive, No radiation exposure and Real-time imaging allows dynamic assessments.

Limitations: Operator-dependent technique, Limited in patients with obesity or excessive bowel gas and Poor visualization of deep structures like the pancreas tail or distal bile duct.

Computed Tomography (CT): It provides cross-sectional imaging using X-rays, offering detailed anatomical visualization and the ability to assess disease extent. [43]

Applications [43,44]

- **Acute and Chronic Pancreatitis:** CT is highly sensitive for detecting complications such as necrosis, pseudocysts, or abscesses.

- **Pancreatic Cancer:** It is the preferred initial imaging modality for staging pancreatic cancer, assessing tumor size, local invasion, and metastases.
- **Biliary Obstruction:** CT effectively identifies mass lesions causing biliary obstruction, such as cholangiocarcinoma or pancreatic head tumors.
- **Trauma and Vascular Involvement:** In pancreatico-biliary trauma, CT provides crucial details on organ injury and vascular involvement.

Advantages: High spatial resolution allows excellent visualization of the pancreas and biliary tree, provides detailed anatomical and pathological information in a single scan and Useful for guiding biopsy procedures.

Limitations: Involves ionizing radiation, Contrast administration may not be suitable for patients with renal impairment or allergies and Less sensitive than MRCP for detecting small biliary abnormalities.

Endoscopic Retrograde Cholangiopancreatography (ERCP)

ERCP combines endoscopy and fluoroscopy to visualize and treat diseases of the pancreatico-biliary system. Initially used for diagnostic purposes, its role has shifted primarily to therapeutic applications with the advent of non-invasive alternatives like MRCP.[45,46]

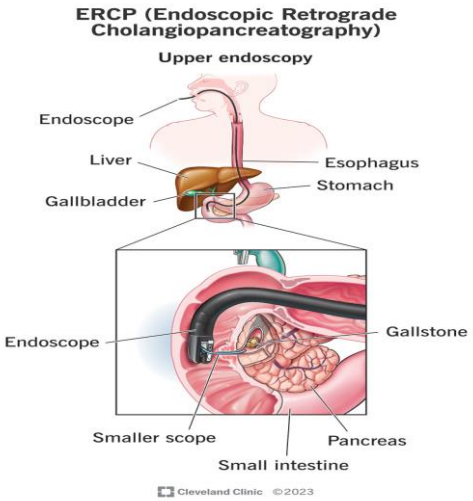

Figure: Endoscopic Retrograde Cholangiopancreatography (ERCP)

Applications [46,47]

- **Therapeutic Interventions:** ERCP is invaluable for stone removal, stent placement, and dilation of strictures.
- **Tissue Diagnosis:** Brush cytology or biopsy can be performed during the procedure to obtain samples for histopathological analysis.
- **Biliary Obstruction:** Direct visualization allows precise identification of the cause of obstruction, such as stones, strictures, or tumors.

Advantages: Combines diagnostic and therapeutic capabilities in a single procedure, High sensitivity for detecting small ductal abnormalities and Allows direct tissue sampling.

Limitations: Invasive, with risks of complications such as pancreatitis, infection, bleeding, and perforation, requires specialized expertise and equipment and Limited use in patients unfit for sedation or general anesthesia.

While ultrasound and CT remain essential first-line tools and ERCP continues to play a pivotal role in therapeutic interventions, the need for a non-invasive, accurate, and safe diagnostic tool has become increasingly apparent, paving the way for magnetic resonance cholangiopancreatography (MRCP).

Magnetic Resonance Cholangiopancreatography (MRCP)

Magnetic Resonance Cholangiopancreatography (MRCP) is a specialized imaging technique designed to visualize the biliary and pancreatic ducts in a non-invasive manner[47,48]. Below, the principles, technical considerations, applications, advantages, limitations , management challenges and advancements of MRCP are explored in detail.

Figure: MRCP (MR Cholangiopancreatography)

Basics/ Principle of MRCP [50-54]

MRCP is an application of magnetic resonance imaging (MRI), which exploits the fluid present in the biliary and pancreatic ducts as an intrinsic contrast medium by acquiring the images using heavily T2-weighted sequences. These structures appear hyperintense against the adjacent non-fluid-containing tissues on a heavily T2-weighted sequence and can easily be delineated.

Technical Considerations and Protocols [58-60]:

Patient Preparation

- **Fasting:** Patients are typically required to fast for 4–6 hours before the scan. to minimize gastrointestinal motility enhancing image clarity.
- **Breath Holding:** Instruct the patient to hold their breath for the breath hold scans and breathe gently for the gated scans essential to minimize motion artifacts

Positioning for MRCP:

- Position the patient in supine position with head pointing towards the magnet (head first supine)
- Position the patient over the spine coil and place the body coil over the upper abdomen (nipple down to iliac crest)
- Centre the laser beam localizer over xiphoid process of sternum

MRI Scanner Requirements

- **Magnetic Field Strength:** MRCP is commonly performed using high-field (1.5 Tesla or 3 Tesla) MRI scanners. Higher magnetic field strength provides improved spatial resolution.
- **Coils:** Dedicated body coils are used to enhance the signal-to-noise ratio for abdominal imaging.

Imaging Protocols: All protocols obtain heavily T2-weighted sequences. Most commonly obtained sequences are:

- RARE: Rapid acquisition and relaxation enhancement
- FRFSE: Fast-recovery fast spin-echo coronal oblique 3D respiratory triggered. (even though prone to motion artefact , this sequence is capable of multiplanar reconstructions.)
- HASTE: Half-Fourier acquisition single shot turbo spin echo-axial 2D breath hold sequence which provides superior images and can be performed in single breath hold (<20 s) and a fat-suppressed sequence
- An additional sequence that can be acquired to evaluate the duct wall is a fat suppressed T1 GRE sequence
- The incorporation of diffusion-weighted imaging (DWI) evaluates the movement of water molecules within tissues, helping differentiating benign from malignant lesions.[67,68]

For optimal visualization of ducts, acquired images are reformatted in different planes using multiplanar reconstruction (MPR) and maximum intensity projection (MIP).

Applications: **[22-26]**

- Evaluation of obstructive jaundice to distinguish between benign and malignant causes.
- Preoperative mapping of bile duct anatomy in patients undergoing liver or pancreatic surgery.
- Assessment of recurrent pancreatitis to identify underlying causes such as ductal anomalies or strictures.
- Monitoring response to treatment or disease progression in chronic pancreatico-biliary conditions.
- In cases of incomplete or failed ERCP
- In cases of post-surgical alteration of the biliary duct , MRCP helps in clearly delineating the pathologies

Advantages of MRCP:[20-23]

- **Non-Invasive and Safe**: Unlike ERCP and PTC, MRCP does not require instrumentation of the bile ducts, eliminating risks such as infection, pancreatitis, or perforation.
- **High Sensitivity and Specificity**: MRCP demonstrates exceptional accuracy in detecting biliary strictures, stones, and other ductal abnormalities, making it a preferred choice in many clinical scenarios.
- **Comprehensive Evaluation**: MRCP can visualize both the pancreatic and biliary systems in a single session. When combined with conventional MRI sequences, it also assesses adjacent soft tissues and vascular structures, aiding in the diagnosis and staging of malignancies.
- **No Radiation Exposure**: This makes MRCP particularly suitable for repeated imaging in younger patients, pregnant women, and those requiring long-term follow-up.
- **Contrast-Free Imaging**: For patients with renal impairment or allergies to iodinated contrast, MRCP provides a safer alternative to CT or contrast-enhanced MRI.

Limitations of MRCP:[59-63]

- **Lower Spatial Resolution Compared to ERCP:** While MRCP is excellent for non-invasive imaging, its spatial resolution is slightly inferior to that of ERCP, particularly for small lesions or stones.
- **Limited Therapeutic Application:** MRCP is purely diagnostic, whereas ERCP combines diagnostic and therapeutic capabilities.
- Time-consuming compared to other modalities.
- **Motion Artifacts:** Respiratory or bowel motion can degrade image quality. Techniques such as respiratory gating or breath-holding sequences mitigate this issue.
- **Metallic Implants:** Patients with metallic implants may not be suitable for MRCP due to potential image distortion and safety concerns.
- **Claustrophobia:** Enclosed MRI scanners can be challenging for claustrophobic patients. Open MRI scanners or sedation may be required.

- High cost and limited availability in some regions.

Management Challenges: Managing pancreatico-biliary pathologies is equally challenging, requiring a multidisciplinary approach involving gastroenterologists, radiologists, surgeons, and oncologists. The key management challenges include:[35-37]

- **Balancing Non-Invasive and Invasive Techniques:** Non-invasive modalities like MRCP are preferred for diagnosis, but invasive techniques such as ERCP or PTC are often necessary for therapeutic interventions like stone removal or stent placement.
- **High Surgical Risk:** Curative treatment for malignancies, such as the Whipple procedure for pancreatic cancer, is associated with significant morbidity and mortality. Patient selection and perioperative care are critical.
- **Limited Therapeutic Options for Advanced Disease:** Advanced-stage cancers, such as cholangiocarcinoma and pancreatic cancer, have limited treatment options, with systemic chemotherapy providing modest survival benefits.
- **Management of Comorbidities:** Patients with pancreatico-biliary pathologies often have comorbid conditions such as diabetes, cardiovascular disease, or liver dysfunction, complicating treatment planning and prognosis.
- **Recurrence and Long-Term Outcomes:** Chronic conditions like recurrent pancreatitis or PSC require ongoing monitoring and management to prevent complications such as fibrosis, cirrhosis, or malignancy.

Advancements in MRCP:

These developments aim to improve image quality, reduce scan time, and enhance diagnostic precision. [24,25, 64]

Secretin-stimulated MRCP is a new advancement as secretin, a hormone secreted by the pancreas resulting in main pancreatic duct dilatation is administered intravenously resulting in better visualization of subtle abnormalities, dysfunction of any sphincters and

demonstrating any duct communication with the mass lesion as it changes the diagnosis and management.

Three-dimensional (3D) MRCP has further refined the modality's capabilities by capturing volumetric images that provide comprehensive ductal visualization. Its applications are particularly valuable in evaluating conditions such as pancreatic divisum and planning surgical or therapeutic interventions. Despite these benefits, the need for advanced software and prolonged acquisition times has limited its widespread adoption. [65,66]. Compressed Sensing Techniques reduce scan times while maintaining image quality, improving patient comfort and efficiency.

Contrast-enhanced MRCP is done by using hepatobiliary-specific agents and enhances visualization of small lesions and improves the characterization of the lesions. These innovations collectively elevate MRCP's effectiveness in diagnosing and managing pancreatico-biliary diseases. [69]

Functional imaging methods, including MR elastography and dynamic contrast-enhanced imaging, are expanding MRCP's diagnostic range by assessing tissue stiffness and vascular characteristics. [68,69]

Comparative Summary of Imaging Modalities

Modality	Key Applications	Strengths	Weaknesses
Ultrasound	Gallstones, bile duct dilatation	Inexpensive, no radiation	Operator-dependent, limited in obese patients
CT	Pancreatic cancer, complications of pancreatitis	High-resolution, widely available	Radiation exposure, contrast risks
ERCP	Therapeutic interventions	Combines diagnosis and treatment	Invasive, risk of complications
MRCP	Biliary obstruction, post-surgical anatomy	Non-invasive, no radiation	Expensive, limited availability

MRCP is a pivotal imaging modality in the evaluation of pancreatico-biliary pathologies. Its non-invasive nature, lack of ionizing radiation, and ability to provide high-resolution images make it an indispensable tool in modern diagnostic imaging. Coupled with ongoing innovations, MRCP continues to redefine the standards of care for patients with pancreatico-biliary disorders.[62-63]

REVIEW OF PREVIOUS STUDIES:

The study done by Halefoglu (2008) discusses the utility of magnetic resonance cholangiopancreatography (MRCP) as a non-invasive imaging modality for evaluating pancreatico-biliary disorders. The study emphasizes the use of T2-weighted magnetic resonance imaging (MRI) sequences, which enable the visualization of fluid-filled biliary and pancreatic ducts as high-intensity signals. MRCP offers significant advantages, including improved spatial resolution and the ability to capture images of the entire pancreatico-biliary tract in a single breath-hold. The author notes that MRCP is increasingly replacing endoscopic retrograde cholangiopancreatography (ERCP) for diagnostic purposes, reserving ERCP for therapeutic interventions. Additionally, the study highlights that MRCP avoids the complications associated with ERCP, such as pancreatitis and perforation, making it a safer alternative. MRCP's non-reliance on anesthesia or contrast agents further enhances its appeal as a diagnostic tool. Despite its benefits, the author identifies limitations, such as difficulty in differentiating between benign and malignant strictures and the inability to provide therapeutic interventions. Halefoglu concludes that MRCP is particularly valuable in patients for whom ERCP is contraindicated or has failed and provides a comprehensive evaluation of biliary anatomy.[71]

The study done by Sahni and Mortelé (2008) explore the evolving applications and clinical importance of MRCP as a robust diagnostic tool for biliary and pancreatic disorders. The study highlights MRCP's ability to produce high-resolution images of the biliary tree and pancreatic duct without the need for ionizing radiation or contrast agents. According to the authors, MRCP provides diagnostic accuracy comparable to ERCP, while eliminating the associated risks of invasive procedures. The review discusses technical advancements, such as secretin-stimulated MRCP, which improves ductal visualization by stimulating pancreatic secretions. The authors also address common pitfalls in MRCP, including motion artifacts and overlapping anatomy, which may hinder accurate diagnosis. Emerging applications include the integration of MRCP with other functional imaging techniques to assess bile flow

dynamics. The study concludes by emphasizing the role of MRCP in situations where ERCP is difficult or dangerous, such as in patients with severe biliary obstructions or those with a history of unsuccessful ERCP attempts. [72]

The study done by Al-Dhuhli (2009) evaluates the role of MRCP in diagnosing biliary and pancreatic pathologies, particularly in cases where invasive procedures are not feasible. The author highlights MRCP's non-invasive nature, absence of radiation exposure, and high diagnostic accuracy. The study underscores the clinical significance of MRCP in detecting bile duct strictures, choledocholithiasis, and congenital abnormalities like choledochal cysts. Al-Dhuhli discusses its utility in patients with severe biliary obstruction, allowing visualization of ducts proximal to the obstruction. MRCP's ability to combine T1- and T2-weighted imaging enables the assessment of both intra- and extra-ductal pathologies. Additionally, the study notes that MRCP is cost-effective and less operator-dependent compared to ERCP, making it a practical diagnostic choice in resource-limited settings. However, the author points out limitations, such as challenges in differentiating between certain benign and malignant lesions. Overall, MRCP is described as an invaluable tool for evaluating complex biliary cases.[73]

The study done by Prabhakar and colleagues (2010) provide a detailed analysis of MRCP's application in benign biliary disorders, focusing on its role in non-invasive imaging of the biliary system. The study emphasizes recent technological advancements, such as three-dimensional imaging and enhanced T2-weighted sequences, which facilitate a detailed assessment of biliary anatomy. According to the authors, MRCP effectively identifies congenital anomalies, such as biliary atresia and choledochal cysts, as well as acquired conditions like strictures and stones. The integration of MRCP with contrast-enhanced MRI enables concurrent evaluation of the liver and pancreas, offering a comprehensive diagnostic approach. The study highlights MRCP's ability to replace diagnostic ERCP in most cases, thus avoiding ERCP-associated complications. However, the authors caution that MRCP may occasionally miss small stones or subtle abnormalities in patients with significant ductal disease. They conclude that MRCP is a reliable, first-line diagnostic modality for benign biliary conditions.[74]

The study done by Huang and colleagues (2011) examine the utility of MRCP in pediatric patients with suspected biliary abnormalities. The retrospective study includes 60 pediatric patients, with conditions such as choledochal cysts and biliary atresia being the primary

focus. The authors report that MRCP achieved a diagnostic sensitivity and specificity of 100% for choledochal cysts and 86.7% and 100%, respectively, for biliary atresia. MRCP findings were corroborated with surgical and clinical outcomes, demonstrating its reliability. The study underscores MRCP's non-invasive nature, which is particularly advantageous in children, as it avoids radiation exposure and anesthesia. The authors note that MRCP's ability to visualize both intrahepatic and extrahepatic biliary structures makes it superior to ultrasound for complex cases. However, limitations include challenges in imaging younger children due to motion artifacts. Huang et al. conclude that MRCP is a valuable tool for pediatric biliary imaging and should be integrated into routine diagnostic protocols for biliary pathologies.[75]

The study done by Griffin and colleagues (2011) provide an overview of MRCP's technical aspects, clinical applications, and evolving role in the diagnosis of pancreatico-biliary disorders. The review highlights the advantages of MRCP over invasive techniques, such as its non-reliance on ionizing radiation, absence of contrast agents, and minimal patient discomfort. The authors discuss the incorporation of functional imaging techniques, such as secretin-stimulated MRCP, to enhance diagnostic accuracy in ductal pathologies. They also address potential pitfalls, such as motion artifacts and signal loss, which may affect image quality. Griffin et al. emphasize MRCP's role in evaluating conditions like biliary strictures, stones, and pancreatic abnormalities. The authors advocate for its use as a first-line imaging modality in non-invasive diagnostics while acknowledging the complementary role of ERCP for therapeutic interventions.[76]

The study done by Büyük and Gökharman (2012) investigate the contribution of MRCP to diagnosing biliary obstruction in patients with clinical and laboratory findings suggestive of obstructive pathologies. The study analyzes 198 cases where MRCP was performed following inconclusive ultrasound or computed tomography (CT) results. MRCP effectively identified conditions such as choledocholithiasis, bile duct strictures, and intraluminal filling defects, with a high diagnostic accuracy. The authors highlight the importance of MRCP in detecting gallstones, particularly in cases where ultrasound findings are ambiguous. The study also notes MRCP's role in visualizing structural abnormalities, such as contracted gallbladder lumens and biliary stents. Despite its diagnostic strengths, the authors acknowledge limitations in evaluating certain air-filled structures or small calculi. Büyük and Gökharman conclude that MRCP is a robust diagnostic tool, capable of replacing ERCP in

most diagnostic scenarios, thereby minimizing the risks associated with invasive procedures.[77]

The study done by Sacher and Davis (2013) evaluated the efficacy of MRCP as the primary diagnostic modality for choledochal cysts (CCs) in a case series of patients, comparing its findings with intraoperative observations and ERCP results. The study included eight patients, six of whom presented with type IV CCs, one with type I, and one with a rare variant involving confluent dilatation of the common bile duct (CBD) and cystic duct. MRCP successfully identified the type of CCs in all cases and detected associated abnormalities such as pancreaticobiliary junction anomalies and ductal stones. The sensitivity of MRCP in diagnosing CCs was reported at 96%-100%, with similarly high specificity. Furthermore, MRCP identified associated biliary pathologies like choledocholithiasis and cholangiocarcinomas in patients with CCs. The study highlights the superiority of MRCP over ultrasound in delineating complex biliary anatomy and its non-invasive nature, making it ideal for both adult and pediatric patients. The authors concluded that MRCP should follow initial imaging with ultrasound or CT and that ERCP should be reserved for cases requiring therapeutic intervention.[78]

The study done by Aydelotte et al. (2015) conducted a retrospective analysis to compare the diagnostic accuracy of MRCP with ERCP, the gold standard for biliary and pancreatic imaging. Over a six-year period, MRCP findings in 81 patients were correlated with follow-on ERCP results. Of these, 36 patients were diagnosed with choledocholithiasis, 14 with malignant strictures, and 3 with pancreatic duct abnormalities. While MRCP demonstrated high specificity (94%) and positive predictive value (98%), it was less sensitive (80%), with a negative predictive value of only 54%. This discrepancy was attributed to MRCP's limitations in detecting subtle or small lesions that were later identified by ERCP. The authors concluded that MRCP has limited utility in the diagnostic algorithm for stone or non-stone disease of the biliary tree and pancreas. They suggested reserving MRCP for cases where ERCP is not feasible, cautioning against over-reliance on MRCP findings.[79]

The study done by El-Latif and Borg (2016) assessed the diagnostic accuracy of MRCP in identifying benign and malignant biliary obstructions. The prospective study involved 40 patients with suspected biliary obstructive disease, using MRCP findings validated against ERCP, percutaneous transhepatic cholangiography (PTC), or histopathological results. MRCP accurately detected biliary dilatation and the level of obstruction in 100% of cases,

with 95% accuracy in determining the underlying cause. The sensitivity and specificity for diagnosing benign obstructions were 100%, while for malignant etiologies, MRCP had 90.5% sensitivity and accuracy. This study highlighted MRCP's non-invasive nature and ability to differentiate between benign and malignant conditions, particularly in patients for whom invasive procedures pose risks. The authors concluded that MRCP is indispensable for initial diagnostic evaluation, reducing the reliance on invasive methods like ERCP.[80]

The study done by Polakova and Mocikova (2016) investigated the utility of MRCP in patients with liver cirrhosis and ascites, focusing on the use of a novel superparamagnetic iron oxide (SPIO) nanoparticle-based negative oral contrast agent. The study included 40 patients divided into two groups, with 20 receiving SPIO contrast before MRCP and 20 undergoing standard MRCP without bowel preparation. Ascites, present in more than half the patients, complicated the imaging of biliary ducts in the non-SPIO group. SPIO contrast significantly improved extrahepatic duct visualization in patients with ascites, allowing for clearer delineation of the biliary tree and the detection of pathologies. The authors concluded that SPIO-enhanced MRCP offers superior diagnostic accuracy in complex cases, particularly for preoperative planning in liver transplant candidates.[81]

The study done by Rao and Routhu (2018) conducted a cross-sectional study on 30 patients with suspected pancreatico-biliary pathologies. The study correlated MRCP findings with those of ultrasound, computed tomography, ERCP, and surgical outcomes. The authors reported that pancreatitis was the most common pathology (33.4%), followed by cholangiocarcinoma. MRCP demonstrated equal efficacy to ERCP in detecting biliary strictures, with proximal strictures (83.3%) more frequently identified than distal ones (16.7%). The study emphasized MRCP's ability to delineate the exact location and nature of both benign and malignant strictures. The authors concluded that MRCP's diagnostic capabilities rival those of ERCP, positioning it as the gold standard for non-invasive evaluation of the pancreatico-biliary system.[82]

The study done by Singh and Mohanty (2020) explored advancements in MRCP technology, focusing on its improved imaging of pancreatico-biliary diseases. In this prospective study, 50 patients underwent MRCP followed by ERCP or surgery. The study reported MRCP's sensitivity and specificity at 97.96% and 100%, respectively, with a 100% positive predictive value. MRCP proved particularly effective in diagnosing intrahepatic and extrahepatic biliary duct abnormalities, including strictures and stones. The authors

emphasized that MRCP eliminates the risks of complications associated with ERCP, such as pancreatitis and perforation. They concluded that MRCP should serve as the primary diagnostic tool, reserving ERCP for therapeutic purposes or cases requiring biopsy.[83]

The study done by Garse and Kakade (2021) reviewed 60 cases of pancreatico-biliary conditions, analyzing MRCP findings to determine its diagnostic efficacy. The study revealed that 62% of cases involved biliary pathologies, followed by pancreatic lesions (29%) and combined pancreaticobiliary conditions (9%). Obstructive etiologies, such as choledocholithiasis and biliary strictures, were the most common findings. MRCP was highly effective in identifying inflammatory, congenital, neoplastic, and obstructive lesions, with a sensitivity and specificity comparable to ERCP. The study concluded that MRCP's non-invasive nature, coupled with its ability to provide detailed imaging without radiation or contrast agents, establishes it as the preferred diagnostic modality for pancreatico-biliary disorders. The authors recommended MRCP as a first-line investigation, particularly for patients unsuitable for invasive procedures.[84]

The study done by Narra RK, Badisa S, Yatam T, Pasupaleti B (2021): conducted an in-depth evaluation of MRCP in diagnosing biliary, gallbladder, and pancreatic pathologies. The study included 60 patients presenting with symptoms of obstructive jaundice or suspected pancreaticobiliary disease. MRCP successfully identified a wide spectrum of pathologies, including cholelithiasis, choledocholithiasis, cholangiocarcinoma, periampullary carcinoma, and gallbladder carcinoma. Most patients in the study were between 30 and 70 years of age, with males accounting for 58% of cases. Among benign conditions, MRCP demonstrated high sensitivity in detecting cholelithiasis and choledocholithiasis, even identifying sub-centimetric stones that might be challenging for CT. Malignant conditions, such as cholangiocarcinoma and periampullary carcinoma, were also effectively visualized, with precise delineation of tumor extent and involvement of surrounding structures. The authors emphasized MRCP's advantages over CT and ultrasound, particularly in cases of small stones and soft tissue lesions. MRCP's non-invasive nature, combined with its high spatial resolution and multiplanar imaging capabilities, was highlighted as a significant benefit. The study concluded by endorsing MRCP as the gold standard imaging modality for pancreaticobiliary disorders, particularly in complex or ambiguous cases.[85]

The study done by Kaushal L, Goyal S, Suresh A (2022): examined MRCP's diagnostic performance compared to ultrasound in the evaluation of pancreaticobiliary diseases. This

observational study was conducted over 20 months and included patients with suspected pathologies based on clinical presentation and ultrasound findings. MRCP findings were correlated with surgical, histopathological, or ERCP outcomes. The authors found that MRCP had a higher sensitivity and diagnostic accuracy than ultrasound, particularly in detecting CBD dilatation and intrahepatic biliary radicle (IHBR) abnormalities. While ultrasound was effective for initial screening, its limitations in obese patients or those with obscured visualization due to bowel gas were highlighted. MRCP provided superior characterization of both benign and malignant lesions, enabling more accurate preoperative planning. Additionally, MRCP allowed detailed imaging of biliary anatomy in cases of obstructive jaundice, distinguishing between surgical and non-surgical causes. The authors emphasized that MRCP is indispensable in situations where ultrasound results are equivocal or incomplete and concluded that it should be integrated as an essential adjunct to other diagnostic tools for comprehensive evaluation.[86]

The study done by Tan CK, Wong MK, Ng SK, Stevenson C, Khan KS (2023): conducted a retrospective cohort study to evaluate the prevalence of extra-biliary findings in MRCP imaging and their diagnostic implications. This study analyzed 1,016 MRCPs performed at a single center, with a focus on identifying incidental findings beyond the biliary tree. The study population had a median age of 64 years, and 58.3% of MRCPs revealed extra-biliary abnormalities. Common findings included renal cysts (21%), hepatic cysts (11.6%), pancreatic cysts (6.8%), and pleural effusions (7.8%). Notably, 9.5% of cases required urgent follow-up due to significant findings, including newly diagnosed malignancies in 2.6% of patients. The study demonstrated that MRCP is highly sensitive not only for biliary pathologies but also for detecting incidental extra-biliary abnormalities that could alter patient management. The authors recommended using a structured reporting template to ensure all clinically relevant findings are captured. They concluded that MRCP has diagnostic value extending beyond the biliary system, warranting its broader application in clinical practice.[87]

The study done by Tan CK, Wong MK, Ng SK, Stevenson C, Khan KS (2024): further analyzed the role of MRCP in detecting extra-biliary pathologies, with an emphasis on its integration into clinical workflows. This retrospective analysis expanded upon previous findings by highlighting the utility of MRCP in identifying pathologies that required urgent or long-term interventions, such as pancreatic cysts, cirrhosis-related complications, and malignancies. Among 1,016 MRCPs, 26 patients (2.6%) were diagnosed with malignancies,

emphasizing MRCP's critical role in early detection. The study also underscored the importance of correlating MRCP findings with patient history and clinical symptoms to prioritize follow-up care. Tan et al. advocated for standardized reporting protocols to improve diagnostic consistency and enhance communication between radiologists and clinicians. They concluded that MRCP's ability to detect both biliary and extra-biliary abnormalities makes it a vital tool in comprehensive patient evaluation and management, particularly in complex cases.[88]

MATERIALS AND METHODS

Present study was carried out from January 1st to December 31st of 2024 at the KLES Dr. Prabhakar Kore Hospital and Medical Research Centre in Belgaum in the Department of Radio-diagnosis.

Study design: Hospital based cross sectional study

Source of data: Patients with suspected pancreatico-biliary pathologies detected on MRCP

Sample Size: The study sample size was determined using statistical power analysis to ensure sufficient power to detect clinically significant differences between MRCP findings and the reference standards (ERCP and surgical outcomes). Based on preliminary data and existing literature, the sample size was calculated to achieve a power of 80% with a significance level (alpha) of 0.05. A total of 72 patients were enrolled during the study period.

Study period and duration: The investigation was carried out from 1st January to 31st December, 2024 (1 year).

Study Sampling: Convenience sampling method

Inclusion and Exclusion Criteria

Inclusion criteria:

• Patients aged between 18 and 80 years of any sex suspected of common bile duct and pancreatic pathologies and are referred for MRCP in KLE Dr Prabhakar Kore Hospital & MRC , Belagavi .

Exclusion criteria :

• Patients with contraindications to MRI, such as the presence of metallic implants or pacemakers.

• Patients with a known history of claustrophobia that precluded them from completing an MRI examination.

• Patients who had undergone prior biliary surgery that significantly altered the biliary anatomy.

• Patients with unstable vitals or critical illness where imaging could not be safely performed.

Ethical clearance: Prior to the study's start, the Institutional Ethics Committee of Jawaharlal Nehru Medical College in Belgaum granted ethical clearance.

Informed Consent: Patients who met the eligibility requirements were notified of the study's goals and design, and they were only enrolled with their signed informed consent (Annexure I).

Sampling data: The study population's demographic details, including age and sex, were gathered, comprehensive clinical examination and complete history was taken. 3.0 Tesla MRI (MAGNETOM® Spectra), made by SIEMENS (Erlangen, Germany), was used for each scan.

Position the patient in supine position with head pointing towards the magnet (head first supine). The following sequences were used: T2 HASTE coronal, axial, T2 HASTE coronal fat sat (thick and thin slices), T2 TRUFI axial, T1 in phase and out phase axial, T1 DIXON axial, Diffusion weighted sequences and T2 coronal PD sequences were taken. The variables were used to conduct the evaluations. Thickness of slice: 5.5 mm Field of view (FOV): 38.0 cm Size of the matrix: 256 x 256. These results were documented using pre-made proforma (Annexure-Il).

Methods of data analysis

Data analysis was conducted using statistical software, and analyses were performed. Descriptive statistics were calculated for all variables, including mean values, standard deviations, and ranges for continuous variables, and frequencies and percentages for categorical variables. The diagnostic performance of MRCP was evaluated by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy. These performance metrics were derived by comparing MRCP findings to ERCP and surgical findings .

RESULT AND ANALYSIS

1.Age Group Distribution

The age group distribution of the study population was stratified into four groups. Among the 72 patients, 10 (13.9%) were between 18 and 30 years, 12 (16.7%) between 31 and 45 years, 30 (41.7%) between 46 and 60 years, and 20 (27.8%) between 61 and 80 years highlighting that the largest segment of patients falls in the 46–60 years' range

Table 1: Age Group Distribution

Age Group (years)	Frequency	Percentage
18–30	10	13.9%
31–45	12	16.7%
46–60	30	41.7%
61–80	20	27.8%

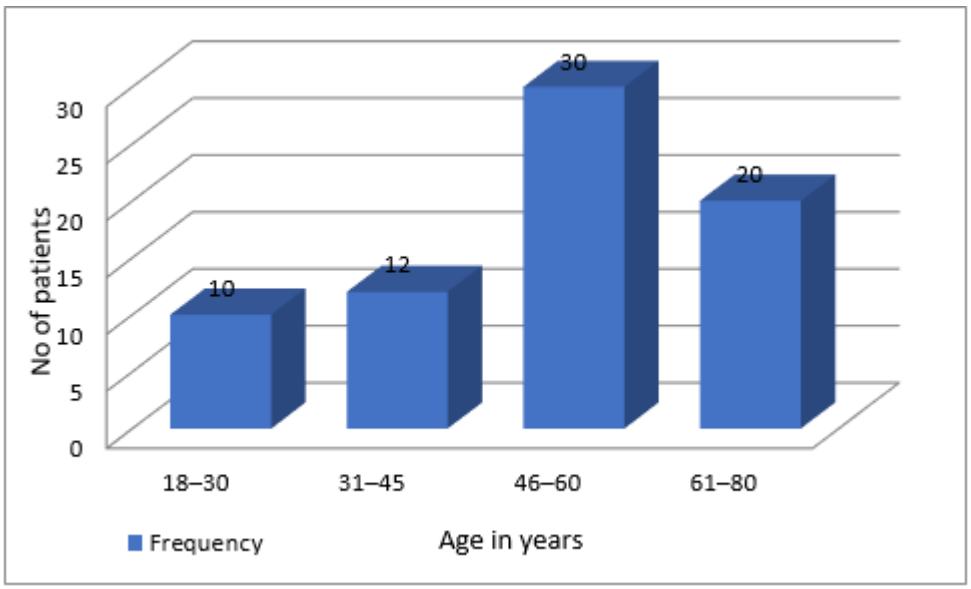

Figure 1 demonstrates that pancreatico-biliary disorders were most common in the 46 to 60 years of age group (41.7 % of patients)

2.Gender Distribution

The study cohort consisted of 72 patients, out of the which, 40 patients (55.6%) were male, while 32 patients (44.4%) were female.

Table 2: Gender Distribution

Gender	Frequency	Percentage
Male	40	55.6%
Female	32	44.4%

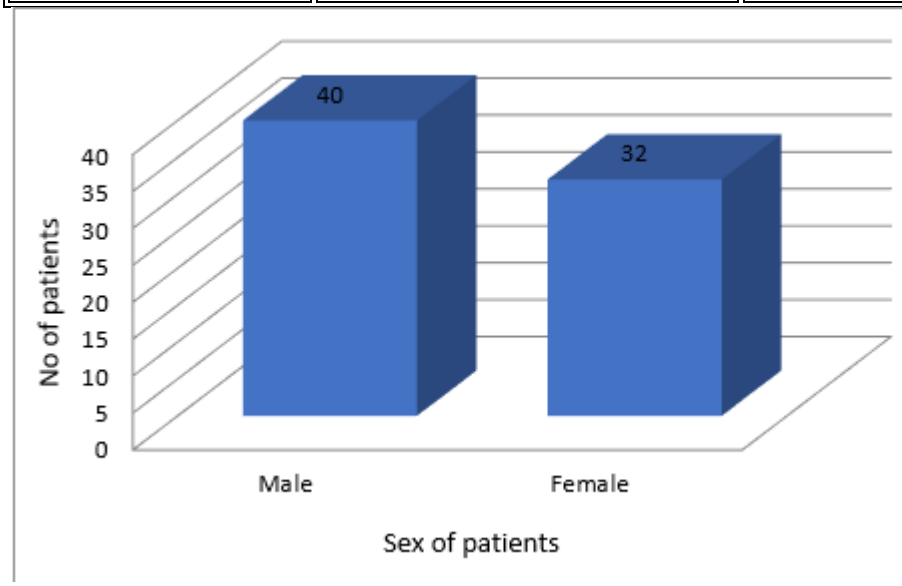

Figure 2 shows incidence of pancreatico-biliary disorders to be more common in males (55.6 %) than in females (44.4 %)

3.Clinical Presenting Symptoms

Among 72 patients, jaundice was reported in 50 (69.4%), abdominal pain in 40 (55.6%), weight loss in 25 (34.7%), pruritus in 15 (20.8%), fever in 10 (13.9%), and other symptoms in 5 (6.9%).

Table 3: Clinical Presenting Symptoms

Symptom	Frequency	Percentage
Jaundice	50	69.4%
Abdominal pain	40	55.6%
Weight loss	25	34.7%
Pruritus	15	20.8%
Fever	10	13.9%
Others (altered bowel habits , dyspepsia , vomiting)	5	6.9%

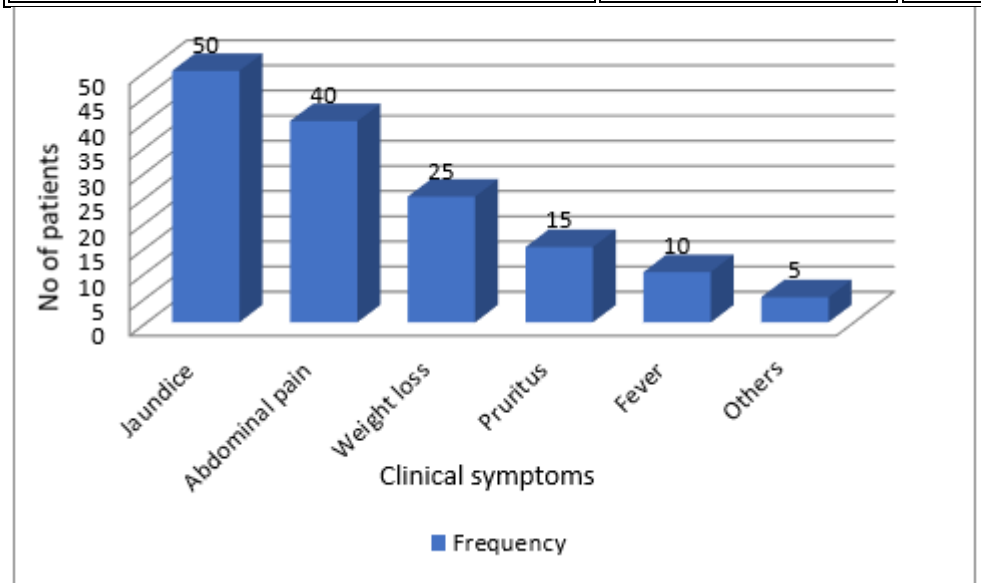

Figure 3 shows the frequency of clinically presenting symptoms in patients with suspected pancreatico-biliary pathologies where jaundice (69.4%) and abdominal pain (55.6 %) were the most common symptom

4. Laboratory Parameters

The mean total bilirubin level was 5.2 ± 3.0 mg/dL, ranging from 1.0 to 12.0 mg/dL, while alkaline phosphatase (ALP) had a mean value of 280 ± 150 IU/L, with a range between 80 and 600 IU/L. Alanine aminotransferase (ALT) levels averaged 60 ± 30 IU/L, ranging from 20 to 120 IU/L.

Table 4: Laboratory Parameters

Parameter	Mean ± SD	Range
Total Bilirubin (mg/dL)	5.2 ± 3.0	1.0 – 12.0
ALP (IU/L)	280 ± 150	80 – 600
ALT (IU/L)	60 ± 30	20 – 120

5. Indications for MRCP

The indications for MRCP among the 72 patients varied out of which suspected choledocholithiasis was the most frequent indication, accounting for 30 cases (41.7%). Suspected malignant obstruction was the reason in 20 patients (27.8%), followed by chronic pancreatitis in 10 cases (13.9%), biliary strictures in 8 patients (11.1%), and other indications in 4 cases (5.6%).

Table 5: Indications for MRCP

Indication	Frequency	Percentage
Suspected choledocholithiasis	30	41.7%
Suspected malignant obstruction	20	27.8%
Chronic pancreatitis	10	13.9%
Biliary strictures	8	11.1%
Others (cholangitis ,hepatoliths, acute/recurrent pancreatitis)	4	5.6%

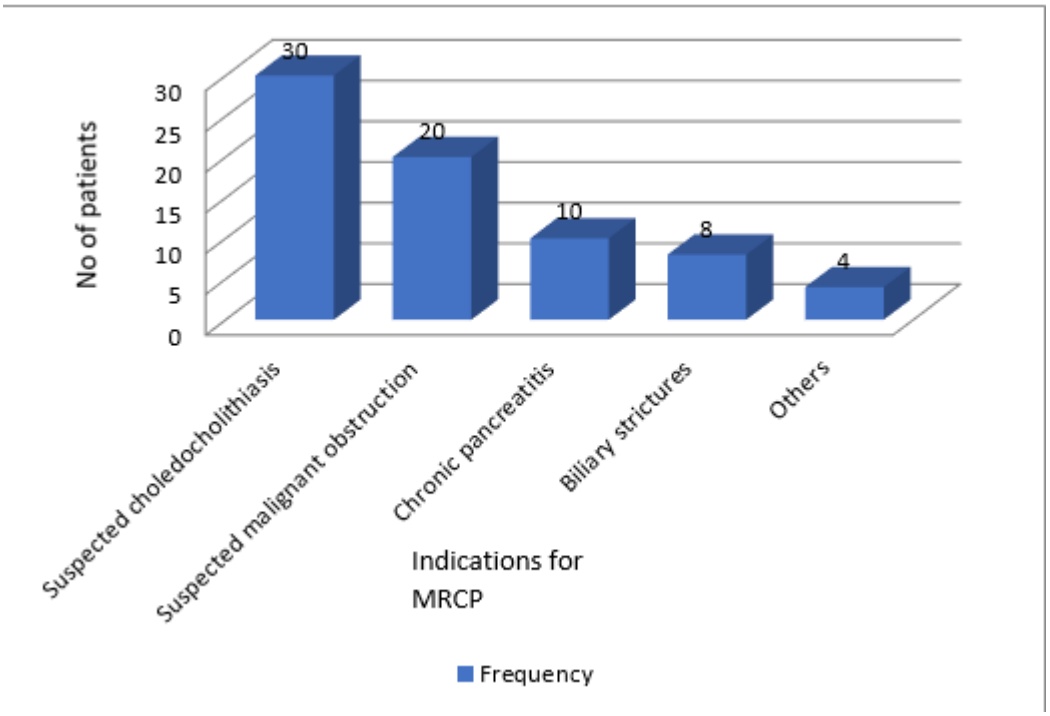

Figure 4 depicts the indication of MRCP in which the predominant indication was choledocholithiasis in 30 patients (41.7%) followed by suspected malignant obstruction in 20 patients (27.8 %)

6. MRCP Findings – Biliary Duct Abnormalities

Normal studies were observed in 10 patients (13.9%), whereas 25 patients (34.7%) exhibited a dilated common bile duct. Choledocholithiasis was detected in 20 patients (27.8%), and biliary strictures were found in 10 cases (13.9%). Other findings, including uncommon ductal anomalies, were present in 7 patients (9.7%).

Table 6: MRCP Findings – Biliary Duct Abnormalities

Finding	Frequency	Percentage
Normal study	10	13.9%
Dilated common bile duct (CBD)	25	34.7%
Choledocholithiasis	20	27.8%
Biliary strictures	10	13.9%
Other findings (cystic duct calculus , malignant obstruction, cholangitis)	7	9.7%

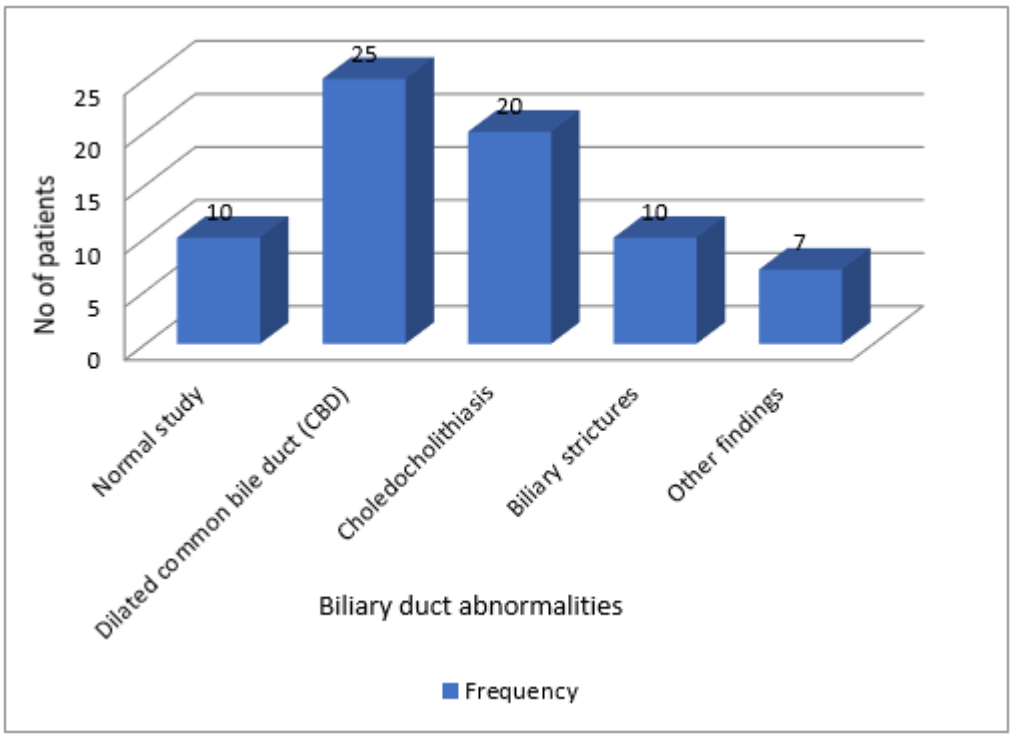

Figure 5 depicts predominance of biliary duct abnormalities in suspected case of pancreaticobiliary pathologies in which the predominant finding was found to be dilated CBD in 25 patients (34.7 %) , followed by choledocholithiasis in 20 patients (27.8%)

7. MRCP Findings – Pancreatic Duct Abnormalities

Assessment of pancreatic duct abnormalities via MRCP in 72 patients revealed a normal study in 20 patients (27.8%). A dilated pancreatic duct was identified in 15 patients (20.8%), while signs indicative of chronic pancreatitis were noted in 20 patients (27.8%). Pancreatic masses were observed in 10 patients (13.9%), and other abnormalities were detected in 7 patients (9.7%). These results demonstrate that 72.2% of patients exhibited some form of pancreatic duct abnormality.

Table 7: MRCP Findings – Pancreatic Duct Abnormalities

Finding	**Frequency**	**Percentage**
Normal study	20	27.8%
Dilated pancreatic duct	15	20.8%
Signs of chronic pancreatitis	20	27.8%
Pancreatic masses	10	13.9%
Other abnormalities (annular pancreas , pancreatic divisum ,pancreatic duct stricture)	7	9.7%

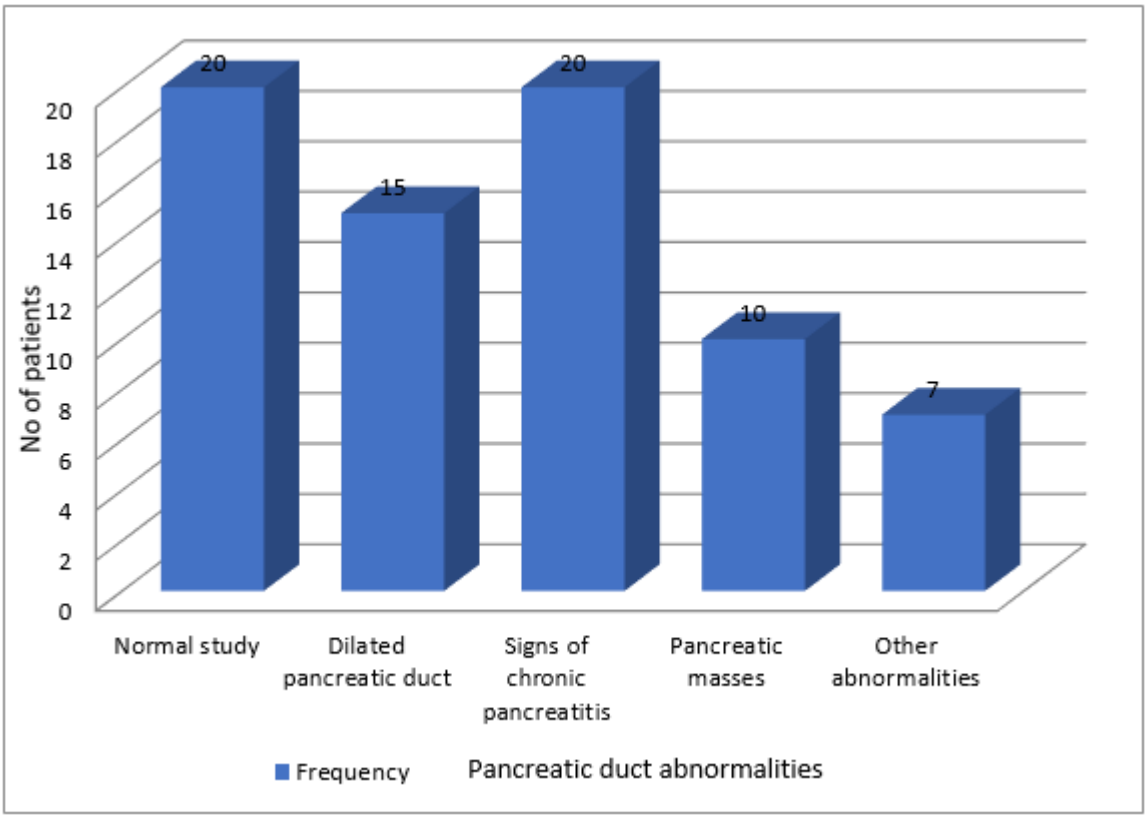

Figure 6 depicts predominance of pancreatic duct abnormalities in suspected case of pancreaticobiliary pathologies in which the predominant finding was found to be either normal study in 20 patients or signs of chronic pancreatitis in 20 patients (27.8%)

8. Distribution of Final Diagnosis

The final diagnosis among the 72 patients revealed diverse pancreaticobiliary conditions. Choledocholithiasis was confirmed in 22 patients (30.6%), benign biliary strictures in 12 patients (16.7%), and malignant obstruction, including cholangiocarcinoma and pancreatic cancer, in 18 patients (25.0%). Chronic pancreatitis was diagnosed in 10 patients (13.9%), with other conditions also in 10 patients (13.9%).

Table 8: Distribution of Final Diagnosis

Diagnosis	Frequency	Percentage
Choledocholithiasis	22	30.6%
Benign biliary stricture	12	16.7%
Malignant obstruction	18	25.0%
Chronic pancreatitis	10	13.9%
Others (cholangitis , congenital anomalies of pancreas , cystic duct calculus , cholangitis)	10	13.9%

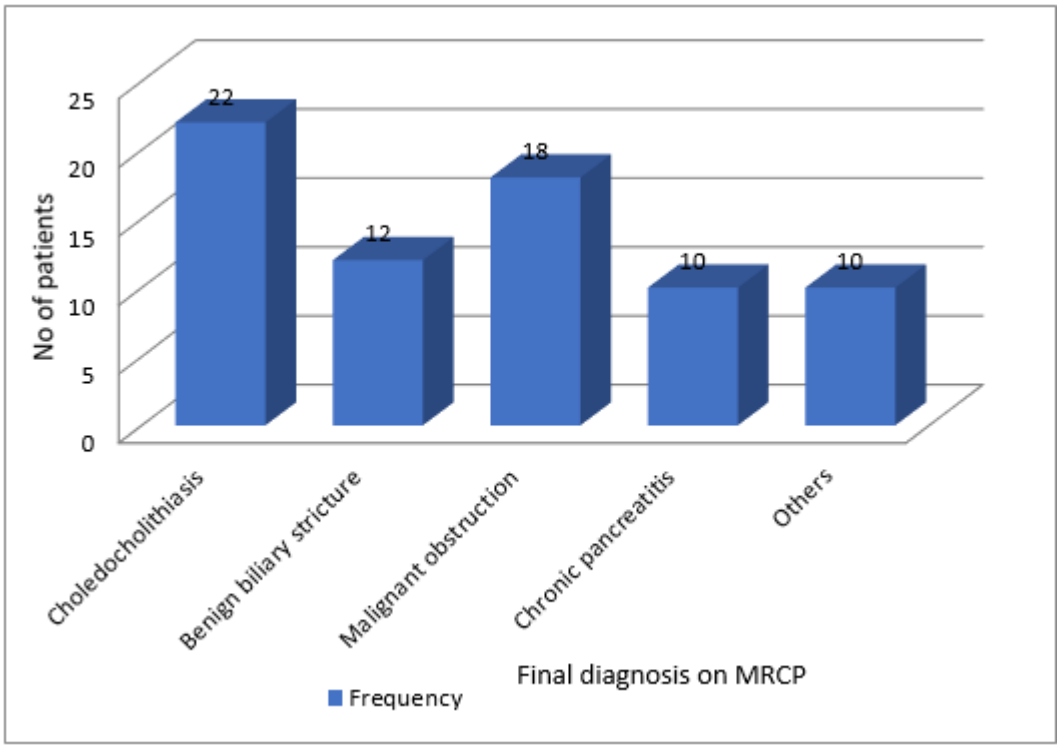

Figure 7 depicts final diagnosis in suspected case of pancreaticobiliary pathologies in which the predominant diagnosis was found to be choledocholithiasis in 22 patients (30.6 %) , followed by malignant obstruction in 18 patients (25.0 %)

9. Anatomical Variants of the Biliary Tree Detected on MRCP

MRCP provided detailed visualization of biliary anatomy, revealing anatomical variants in some patients. Out of 72 patients, 50 (69.4%) showed normal biliary branching, while 8 patients (11.1%) had a low insertion of the cystic duct. Aberrant right hepatic duct was identified in 7 patients (9.7%), and other variants were seen in another 7 patients (9.7%).

Table 9: Anatomical Variants of the Biliary Tree Detected on MRCP

Variant Type	Frequency	Percentage
Normal branching	50	69.4%
Low insertion of cystic duct	8	11.1%
Aberrant right hepatic duct	7	9.7%
Other variants (accessory hepatic duct , low insertion of right hepatic duct to CBD)	7	9.7%

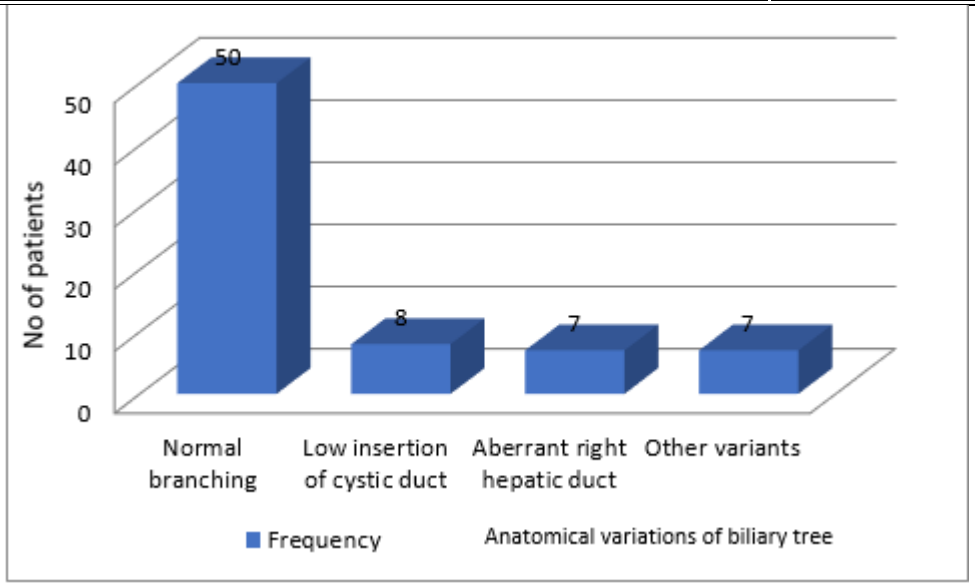

Figure 8 depicts anatomical variants on patients with suspected pancreaticobiliary pathologies in MRCP where predominant finding was normal branching in 50 patients (69.4 %).

10. Correlation of MRCP Findings with ERCP (Subset of 30 Patients)

In a subset of 30 patients who underwent both MRCP and ERCP, a direct correlation of imaging findings was evaluated. Among these patients, MRCP identified choledocholithiasis in 15 cases, which was confirmed by ERCP in 14 cases, yielding a concordance of 93.3%. Biliary strictures were observed in 8 patients by both modalities, demonstrating 100% concordance, while pancreatic duct abnormalities were noted in 7 patients on MRCP and in 6 patients on ERCP, resulting in an 85.7% concordance rate.

Table 10: Correlation of MRCP Findings with ERCP (Subset of 30 Patients)

Finding	MRCP (n)	ERCP (n)	Concordance (%)
Choledocholithiasis	15	14	93.3%
Biliary strictures	8	8	100%
Pancreatic duct abnormalities	7	6	85.7%

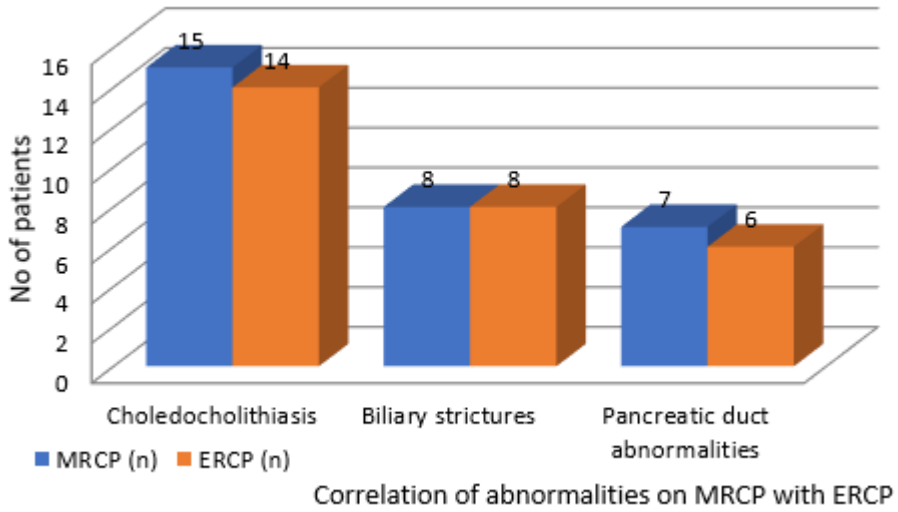

Figure 9 depicts correlation of MRCP Findings with ERCP in a subset of 30 patients where the findings state that out of the 15 patients who were diagnosed with choledocholithiasis on MRCP , 14 patients had choledocholithiasis which was confirmed on ERCP , 8 patients who were diagnosed with biliary strictures on MRCP , all of the 8 patients had biliary strictures which was confirmed on ERCP.

11. Correlation of MRCP with Surgical Findings (Subset of 20 Patients)

In a focused subgroup of 20 patients who underwent surgical intervention, MRCP findings were compared with intraoperative observations. MRCP identified biliary stones in 10 patients, and surgery confirmed these findings in 9 patients, corresponding to a 90% concordance rate. Biliary strictures were detected in 5 patients by both MRCP and surgery, demonstrating a perfect 100% agreement. Additionally, pancreatic lesions were identified in 5 patients on MRCP, with 4 cases confirmed surgically, resulting in an 80% concordance rate.

Table 11: Correlation of MRCP with Surgical Findings (Subset of 20 Patients)

Finding	MRCP (n)	Surgical (n)	Concordance (%)
Biliary stones	10	9	90%
Biliary strictures	5	5	100%
Pancreatic lesions	5	4	80%

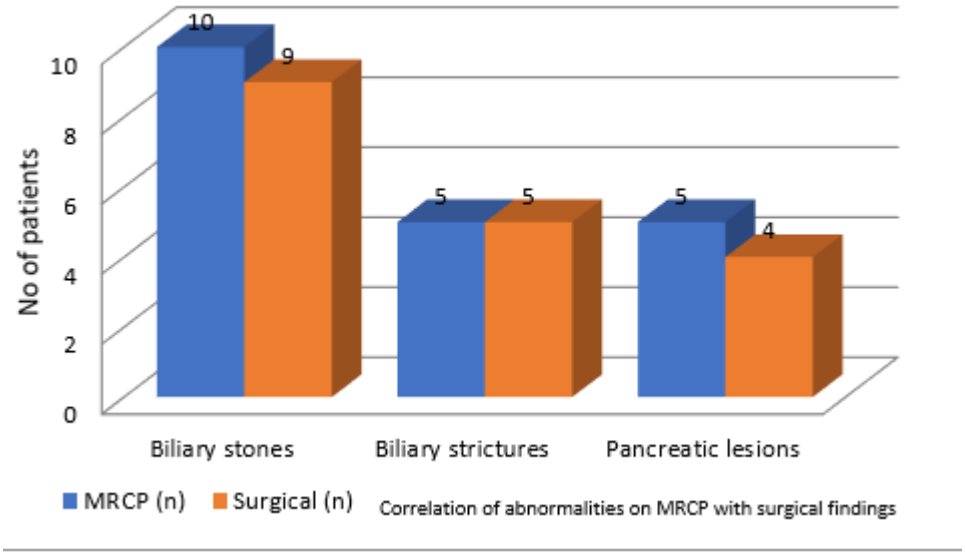

Figure 10 depicts correlation of MRCP Findings with surgical findings in a subset of 20 patients where the findings state that out of the 10 patients who were diagnosed with choledocholithiasis on MRCP , 9 patients had choledocholithiasis which was confirmed on ERCP , 5 patients who were diagnosed with biliary strictures on MRCP , all of the 5 patients had biliary strictures which was confirmed on ERCP.

12. Overall Diagnostic Performance of MRCP

MRCP demonstrated an overall sensitivity of 88%, a specificity of 92%, a positive predictive value of 85%, and a negative predictive value of 94%. The accuracy of the procedure was calculated at 90%.

Table 12: Overall Diagnostic Performance of MRCP

Parameter	**Value**
Overall Sensitivity	88%
Overall Specificity	92%
Positive Predictive Value	85%
Negative Predictive Value	94%
Accuracy	90%

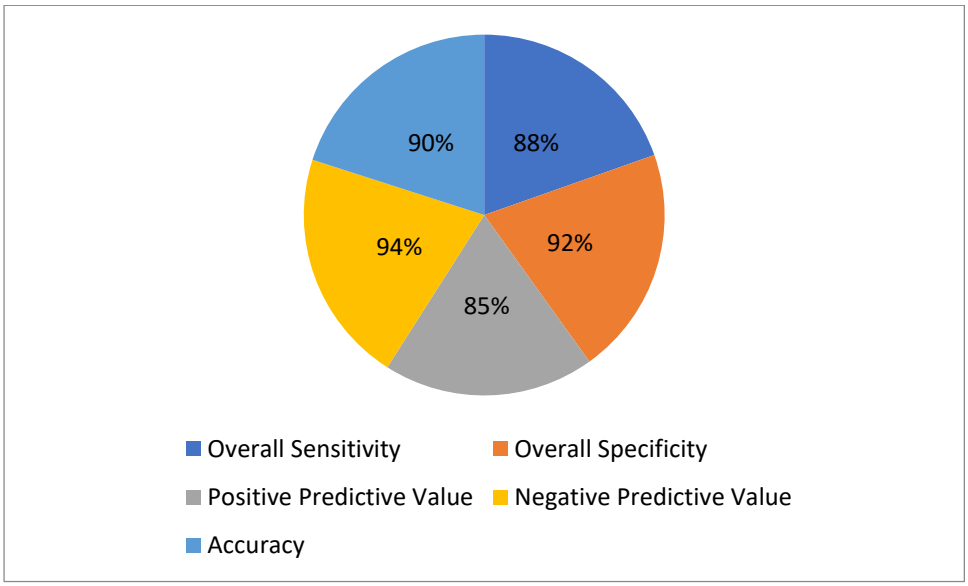

Figure 11 shows a pie chart depicts overall diagnostic performance of MRCP in comparison to ERCP and surgical findings resulting in 90 % sensitivity, 92 % overall specificity, positive predictive value of 85 %, negative predictive value of 94 % and overall accuracy of 90 %

DISCUSSION

The majority of the participants in the study belonged to the age group of 46-60 years in 41.7% (n = 30) followed by 61–80 years in 27.8% (n = 20), followed by 31-45 years in 16.7% (n = 12) and 18-30 years in 13.9% (n = 10). This demographic spread underscores that pancreaticobiliary disorders predominantly affect middle-aged and older individuals suggesting that age-related obstructive changes in the biliary system are common, reinforcing the need for MRCP. Our findings align with earlier observations that the incidence of biliary and pancreatic pathologies increases with age, a trend noted in studies such as Halefoglu (2008) [71] and Sahni & Mortelé (2008) [72] which reported that the majority of patients undergoing MRCP for biliary evaluation were middle-aged, thereby supporting our age distribution data.

The gender distribution was relatively balanced with 40 males (55.6%) and 32 females (44.4%) demonstrating that male patients slightly outnumber females, which may reflect underlying epidemiological trends in pancreatico-biliary diseases. Previous investigations, such as those by Al-Dhuhli (2009) [73] and Griffin et al. (2011) [76], have reported a slightly higher prevalence of biliary and pancreatic conditions among males, attributing this to differences in lifestyle and hormonal influences., The balanced gender distribution in our cohort is critical because it ensures that the diagnostic accuracy and safety profiles of MRCP are not skewed by gender bias. Moreover, studies like Sahni and Mortelé (2008) [72] have highlighted that MRCP is equally effective in both genders.

The clinical presentation in our study was dominated by jaundice, reported by 50 patients (69.4%), followed by abdominal pain in 40 (55.6%), weight loss in 25 (34.7%), pruritus in 15 (20.8%), fever in 10 (13.9%), and other symptoms in 5 (6.9%). These findings reflect the classic symptomatology associated with pancreaticobiliary disorders. Jaundice, a hallmark of biliary obstruction, was the most common presentation, corroborating the findings of Halefoglu (2008) [71] who emphasized MRCP's utility in detecting obstructions that manifest clinically as jaundice where early intervention may prevent further complications such as cholangitis or hepatic dysfunction. Furthermore, weight loss and pruritus, while less common, indicate the systemic effects of chronic biliary obstruction and inflammation, which have been documented in prior studies of Al-Dhuhli (2009) [73]. The diversity in presenting symptoms reinforces the complexity of pancreaticobiliary diseases and underscores the need

for a comprehensive diagnostic approach. MRCP, with its high-resolution T2-weighted imaging, enables clinicians to accurately visualize fluid-filled biliary structures, a benefit noted by Prabhakar et al. (2010) [74] and Griffin et al. (2011) [76]. In our study, the varied symptom profile highlights its capability to detect a spectrum of pathologies that correlate with the clinical severity of the presentation.

The laboratory data in our study revealed a mean total bilirubin of 5.2 ± 3.0 mg/dL (range: 1.0–12.0 mg/dL), ALP levels averaging 280 ± 150 IU/L (range: 80–600 IU/L), and ALT levels at 60 ± 30 IU/L (range: 20–120 IU/L) which help in corroborating clinical suspicion of biliary obstruction and hepatic dysfunction and serves as an important baseline for monitoring therapeutic outcomes post-intervention. Elevated bilirubin and ALP levels strongly suggest cholestasis, while ALT elevations reflect hepatocellular injury—findings that are consistent with previous reports by Halefoglu (2008) [71] and Al-Dhuhli (2009) [73]. Sahni and Mortelé (2008) [72] also emphasized that laboratory markers, when used in conjunction with high-resolution imaging, provide a comprehensive picture of the underlying pathology. In our study, the wide ranges observed in these parameters indicate a heterogeneity in disease severity. The concordance between laboratory abnormalities and MRCP findings enhances the reliability of non-invasive diagnostics. For instance, patients with higher bilirubin and ALP levels often exhibited a dilated common bile duct or choledocholithiasis on MRCP, mirroring observations from previous studies by Prabhakar et al. (2010) [74] and Aydelotte et al. (2015) [79].

The primary indications for MRCP in our study were suspected choledocholithiasis (41.7%, $n = 30$), suspected malignant obstruction (27.8%, $n = 20$), chronic pancreatitis (13.9%, $n = 10$), biliary strictures (11.1%, $n = 8$), and other indications (5.6%, $n = 4$) which reflect a wide spectrum of clinical scenarios necessitating detailed imaging of the biliary and pancreatic ducts. The significant number of cases suspected of malignant obstruction echoes the findings of Sahni and Mortelé (2008) [72], where MRCP was noted for its high resolution in differentiating malignant from benign strictures. The indication of chronic pancreatitis in 13.9% of cases is supported by the work of Al-Dhuhli (2009) [73], who reported that MRCP is invaluable for evaluating chronic inflammatory changes in the pancreas without radiation exposure. Our study's indication profile, therefore, not only demonstrates the broad applicability of MRCP but also reinforces its role as a first-line diagnostic tool in complex pancreatico-biliary diseases, particularly in patients where invasive procedures are

contraindicated or have failed which aligns well with findings from Büyük and Gökharman (2012) [77] and Sacher and Davis (2013) [78]

The MRCP analysis of the biliary tree revealed that 13.9% (n = 10) of patients had a normal study, while 34.7% (n = 25) exhibited a dilated common bile duct (CBD), 27.8% (n = 20) had choledocholithiasis, 13.9% (n = 10) showed biliary strictures, and 9.7% (n = 7) presented with other biliary abnormalities. These findings indicate that approximately 86% of patients demonstrated some form of biliary abnormality, emphasizing the high sensitivity of MRCP in detecting ductal changes. Such a high prevalence of abnormal findings is consistent with studies of Halefoglu's (2008) [71], which highlighted MRCP's capability to accurately delineate fluid-filled structures in the biliary system using T2-weighted sequences. Similarly, Sahni and Mortelé (2008) [72] emphasized the diagnostic precision of MRCP in identifying obstructive lesions, which is corroborated by our detection of choledocholithiasis in 27.8% of cases. The presence of biliary strictures in 13.9% of patients further supports the utility of MRCP in evaluating both benign and malignant obstructions, as also reported by Al-Dhuhli (2009) [73]. In addition, our observation of a dilated CBD in 34.7% of patients aligns with previous studies where ductal dilatation was a common finding in obstructive jaundice. The detection of "other" biliary abnormalities in 9.7% of cases demonstrates MRCP's ability to uncover less common anomalies such as anatomical variants or subtle ductal irregularities which aid in preoperative planning and therapeutic decision-making. Our findings support previous research by Prabhakar et al. (2010) [74] and Griffin et al. (2011) [76]

The MRCP evaluation of the pancreatic duct demonstrated that 27.8% (n = 20) of patients had a normal study, while 20.8% (n = 15) exhibited a dilated pancreatic duct. Signs indicative of chronic pancreatitis were observed in 27.8% (n = 20) of cases, pancreatic masses were identified in 13.9% (n = 10), and other pancreatic duct abnormalities were noted in 9.7% (n = 7). This means that 72.2% of the patients displayed some form of pancreatic duct abnormality. These findings are in line with the observations made by Al-Dhuhli (2009) [73], who underscored the high diagnostic accuracy of MRCP in detecting chronic inflammatory changes and ductal dilatation. Similarly, Sahni and Mortelé (2008) [72] emphasized the ability of MRCP to capture detailed images of the pancreatic duct without the risks associated with ionizing radiation. The identification of chronic pancreatitis in 27.8% of patients mirrors the results from earlier studies, which have shown that MRCP can effectively identify ductal irregularities and parenchymal changes in patients with chronic inflammation. The detection of pancreatic masses in 13.9% of our cases further highlights MRCP's role in differentiating

between benign and malignant lesions—a point also discussed by Prabhakar et al. (2010) [74]. Moreover, the presence of other pancreatic abnormalities in nearly 10% of the cohort suggests that MRCP can reveal subtle ductal variations that might be missed by other imaging modalities. When compared with prior studies such as those by Griffin et al. (2011) [76], our data confirm that MRCP provides a reliable and non-invasive assessment of the pancreatic duct

The final clinical diagnoses derived from our integrated assessment of clinical, laboratory, and MRCP findings revealed a distribution as follows: choledocholithiasis was diagnosed in 30.6% (n = 22) of patients, benign biliary strictures in 16.7% (n = 12), malignant obstructions (including cholangiocarcinoma and pancreatic cancer) in 25.0% (n = 18), chronic pancreatitis in 13.9% (n = 10), and other conditions in 13.9% (n = 10) which demonstrates the heterogeneity of pancreaticobiliary disorders encountered in clinical practice. The prevalence of choledocholithiasis in our study is supported by previous research, such as Halefoglu (2008) [71] and Prabhakar et al. (2010) [74], who reported similar rates of choledocholithiasis as a primary cause of biliary obstruction. The diagnosis of benign biliary strictures in 16.7% of cases further corroborates the findings of Sahni and Mortelé (2008) [72], who noted that non-malignant strictures are frequently encountered in patients with chronic inflammatory conditions. The detection of malignant obstructions in 25.0% of patients highlights the critical role of MRCP in early identification of potentially life-threatening conditions, echoing the results of Al-Dhuhli (2009) [73] and Aydelotte et al. (2015) [79], who emphasized the importance of MRCP in differentiating malignant from benign lesions. Chronic pancreatitis, identified in 13.9% of cases, aligns with previous studies demonstrating MRCP's sensitivity in recognizing inflammatory ductal changes. Finally, the categorization of "other" conditions in 13.9% of patients signifies the modality's capacity to detect a diverse range of atypical or less common pathologies.

The study identified anatomical variants in the biliary tree out of which, 69.4% (n = 50) of patients exhibited normal biliary branching, while 11.1% (n = 8) demonstrated a low insertion of the cystic duct, 9.7% (n = 7) had an aberrant right hepatic duct, and another 9.7% (n = 7) displayed other variants which aids in surgical planning and interventional procedures[71, 72, 74, 77]. The identification of such variants is consistent with previous literature; Halefoglu (2008) [71] and Sahni and Mortelé (2008) [72] emphasized the importance of detailed MRCP imaging in mapping biliary anatomy, particularly in preoperative assessments where anatomical variations may increase the risk of bile duct injuries. The low insertion of the cystic duct and

aberrant right hepatic ducts observed in our study corroborate the findings of Prabhakar et al. (2010) [74], who noted that MRCP is highly effective in delineating subtle anatomical differences. Furthermore, Büyük and Gökharman (2012) [77] documented similar percentages of anatomical variants in their cohort study. The detection of other rare variants in 9.7% of patients highlights the comprehensive nature of MRCP imaging and its ability to capture even atypical anatomical presentations as they can alter surgical approaches and reduce the risk of intraoperative complications. The high prevalence of normal branching (69.4%) in our study also confirms that while anatomical variations exist, the majority of patients exhibit standard biliary anatomy.

In a subset of 30 patients who underwent both MRCP and ERCP, the correlation of imaging findings between the two modalities was thoroughly evaluated. Our results indicated that for choledocholithiasis, MRCP detected 15 cases compared to 14 cases on ERCP, yielding a concordance rate of 93.3%. For biliary strictures, both MRCP and ERCP identified 8 cases, resulting in a perfect 100% concordance. Additionally, pancreatic duct abnormalities were identified in 7 patients by MRCP and 6 by ERCP, corresponding to an 85.7% concordance rate which strongly support the diagnostic reliability of MRCP alternative to ERCP. Halefoglu (2008) [71] highlighted its ability to capture high-resolution images of the entire pancreatico-biliary tract in a single breath-hold, thus reducing the procedural risks associated with ERCP. Sahni and Mortelé (2008) [72] also documented comparable diagnostic accuracy between MRCP and ERCP, particularly emphasizing that MRCP can obviate the need for invasive diagnostic procedures in many patients. Our high concordance rates, particularly the 100% agreement in biliary stricture detection, mirror the excellent performance metrics reported by Al-Dhuhli (2009) [73] and Prabhakar et al. (2010) [74]. Although a slight discrepancy was noted in the detection of pancreatic duct abnormalities (85.7% concordance), this minor variation may be attributed to differences in spatial resolution and technique between the modalities. The overall findings from our study suggest that MRCP provides a safe alternative to ERCP, minimizing the risk of procedure-related complications which is in conjunction with prior research [71, 72, 73, 74],

In a subgroup of 20 patients who subsequently underwent surgical intervention, MRCP findings were compared with intraoperative observations to assess the accuracy which revealed that MRCP identified biliary stones in 10 patients, with 9 of these cases confirmed during surgery, reflecting a 90% concordance rate. Biliary strictures were detected in 5 patients by both MRCP and surgery, yielding a perfect 100% concordance. Pancreatic lesions

were observed in 5 patients on MRCP, with surgical findings confirming 4 cases (80% concordance) highlighting the reliability of MRCP in preoperative planning and decision-making. The findings are consistent with previous research; Halefoglu (2008) [71] and Sahni and Mortelé (2008) [72] emphasized MRCP's superior imaging capabilities in visualizing biliary and pancreatic ductal abnormalities, thereby facilitating accurate surgical planning. The 100% concordance in detecting biliary strictures is noteworthy, as it confirms MRCP's ability to accurately delineate ductal narrowing and obstruction, a critical factor in surgical management. Although a slight discrepancy was observed in the identification of pancreatic lesions, with an 80% concordance, attributed to the subtle nature of pancreatic abnormalities that are easily missed which are supported by earlier findings from Prabhakar et al. (2010) [74] and Aydelotte et al. (2015) [79], who documented similar accuracy metrics when comparing MRCP with surgical findings.

The overall diagnostic performance of MRCP in our study was exceptional, with an overall sensitivity of 88%, specificity of 92%, PPV of 85%, NPV of 94%, and an accuracy of 90% indicating it to be highly effective in detecting pancreaticobiliary pathologies and differentiating between benign and malignant conditions and aids in preoperative planning [71, 72, 73, 74, 79],. Our results are consistent with those reported in earlier studies. Halefoglu (2008) [71] and Sahni and Mortelé (2008) [72] have both documented high diagnostic accuracies for MRCP, emphasizing its ability to provide detailed images of the biliary and pancreatic ducts. Similarly, Al-Dhuhli (2009) [73] and Prabhakar et al. (2010) [74] reported that MRCP is reliable in identifying ductal abnormalities with high sensitivity and specificity. The high NPV of 94% in our study is particularly significant, as it suggests that a negative MRCP effectively rules out the presence of pathology, thereby reducing the need for ERCP. The overall accuracy of 90% is in line with reports by Aydelotte et al. (2015) [79], who noted that MRCP's is an ideal screening tool for pancreatico-biliary disorders and guiding treatment decisions & surgical planning.

CONCLUSION

In this study, MRCP was helpful in diagnosing a spectrum of pancreatico biliary pathologies.

The study conclusively demonstrates that patients in the middle age group with clinical symptoms like jaundice and abdominal pain and high laboratory parameters (total bilirubin and ALP) should undergo non-invasive procedures like MRCP in diagnosing pathologies in the earlier stage , thereby reducing invasive procedures and to plan good treatment strategies.

Out of all the indication for patients with suspected pancreatico-biliary pathologies, The indications for MRCP were suspected choledocholithiasis being the most common, followed by malignant obstruction , chronic pancreatitis and biliary strictures

The study also highlighted that it effectively identified anatomical variants in both the biliary and pancreatic duct emphasizing the importance of MRCP in preoperative planning and surgical risk reduction.

The strong correlation of MRCP findings with those from ERCP and surgical observations—demonstrated by high concordance rates, particularly a 100% match for biliary strictures—confirms MRCP's diagnostic reliability and its potential to serve as a first-line investigative tool.

Limitations

- Limited sample size , which does not capture the full spectrum of pancreaticobiliary pathologies which are seen in broader populations
- Even though the study demonstrated high diagnostic accuracy, certain subtle or small lesions may remain undetected due to inherent limitations in spatial resolution. Patient-related factors, such as motion artifacts during imaging and variations in breath-hold capability, may also impact image quality and diagnostic reliability.
- The inability of MRCP to provide therapeutic interventions like ERCP.
- The study did not incorporate long-term follow-up data, which could have provided insights into the prognostic value of MRCP findings and their impact on patient outcomes.

SUMMARY

- A total of 72 patients with suspected pancreatico-biliary pathologies underwent MRCP examination.
- Male patients constituted majority of the patients.
- Maximum number of patients belonged to age group of 46-60 years.
- Jaundice, abdominal pain and weight loss were the most frequent presenting complaints.
- The most prevalent final diagnosis in MRCP in patients with suspected pancreaticobiliary pathologies were choledocholithiasis in 22 patients (30.6%) followed by malignant obstructions in 18 patients (25.0%) followed by benign biliary strictures in 12 patients (16.7%) and chronic pancreatitis and other conditions in 10 patients (13.9%).
- MRCP identified anatomical variations of pancreatic and biliary duct system in which normal biliary branching was seen in 50 patients (69.4%) followed by low insertion of the cystic duct in 8 patients (11.1%), followed by aberrant right hepatic duct in 7 patients (9.7%) and other variants in 7 patients (9.7%).
- MRCP and ERCP findings were compared for the concordance in which for choledocholithiasis, MRCP detected 15 cases versus 14 on ERCP (93.3% concordance); for biliary strictures, 8 cases were identified by both modalities (100% concordance); for pancreatic duct abnormalities, MRCP detected 7 cases versus 6 on ERCP (85.7% concordance).
- MRCP and surgical findings were compared for the concordance in which MRCP identified biliary stones in 10 patients (with 9 confirmed surgically, 90% concordance), biliary strictures in 5 patients (100% concordance), and pancreatic lesions in 5 patients (4 confirmed surgically, 80% concordance).
- Overall, MRCP achieved a sensitivity of 88%, specificity of 92%, PPV of 85%, NPV of 94%, and an accuracy of 90% concluding that MRCP is a reliable diagnostic modality to accurately detect pancreatico-biliary pathologies

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ANNEXURE – I

INFORMED CONSENT FORM

ROLE OF MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY IN PATIENTS WITH PANCREATICO-BILIARY PATHOLOGY: A ONE YEAR HOSPITAL BASED CROSS - SECTIONAL STUDY

Principal Investigator: REGISTRATION NO : BS0122007

Introduction: You are being invited to participate in this study to estimate the role of MRCP in patients with pancreatico biliary pathology.

Explanation of procedure: If, you agree to be part of the research study, you will be asked relevant history and you will be subjected to relevant clinical examination.

Withdrawal from participation in the study: Participation in this study in voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will not get any benefits by participating in this study. The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations done during the course of study will be paid by the Participant.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact:

REG NO. BS0122007 Post graduate, Department of Radiodiagnosis, J.N.Medical College, Belagavi	DR. Guide, Professor, Department of Radiodiagnosis, J.N.Medical College, Belagavi	Dr.Harsha Hegde Chairperson, JNMC, IEC & Scientist D, ICMR, National Institute Of Traditional Medicine, Belagavi

Legal rights: By signing this consent form, we are not waving any of your legal rights

CONSENT STATEMENT

I am making a voluntary decision to participate in the study "**ROLE OF MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY IN PATIENTS WITH PANCREATICO-BILIARY PATHOLOGY: A ONE YEAR HOSPITAL BASED CROSS - SECTIONAL STUDY"**. My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE – II

PROFORMA FOR DATA COLLECTION

Patient particulars:

Name

Age

Sex

Occupation

IP/OP No:

Address:

Ph.No:

Date:

Ref Dr:

Clinical examination:

Presenting complaints

Past history (any history of surgery)

3)Laboratory investigations:

A) HB%, TLC, DLC

B) Urine routine and microscopic examination, bile salts/ bile pigments

C)Biochemistry

i) Serum bilirubin

ii)AST/ALT

iii)serum alkaline phosphatase

iv)serum amylase

v)others

Clinical diagnosis:

S NO	PATHOLOGY	PRESENT	ABSENT
1	IHBR stricture		
2	IHBRD		
3	Common bile duct variants		
4	Common bile duct stricture		
5	Common bile duct dilatation		
6	Common bile duct stone		
7	Bile duct tumor		
8	Gall bladder variants		
9	Gall bladder stone		
10	Gall bladder tumour		
11	Pancreatic duct dilatation		
12	Pancreatic duct variants		
13	Ampulla stones		
14	Ampulla stricture		
15	Ampulla tumour		
16	Features of chronic pancreatitis		

4)Final outcome: by correlation with findings on

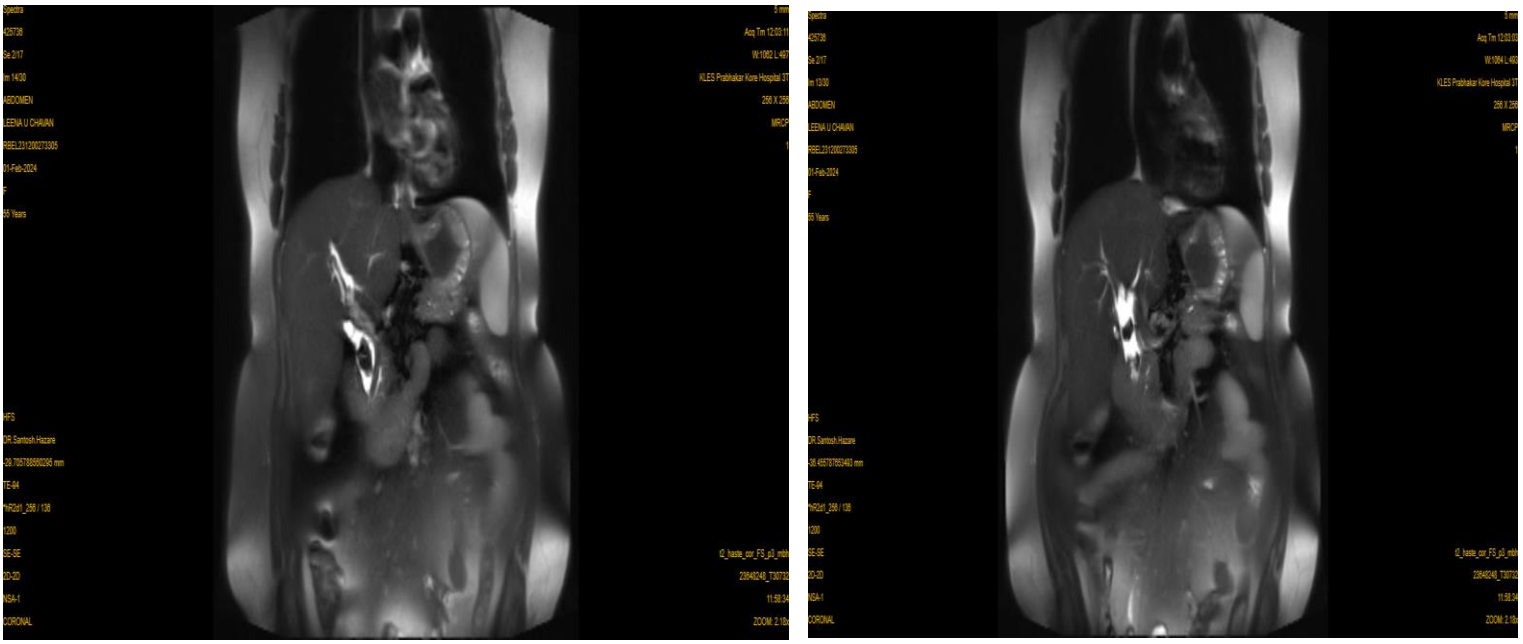
i)ERCP if any

ii) biopsy

iii)operative findings

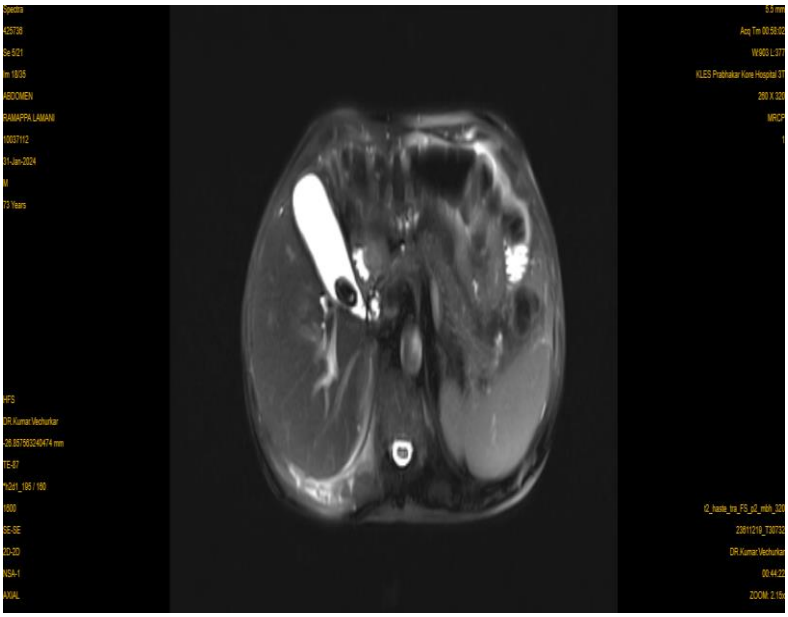
5)MRCP report:

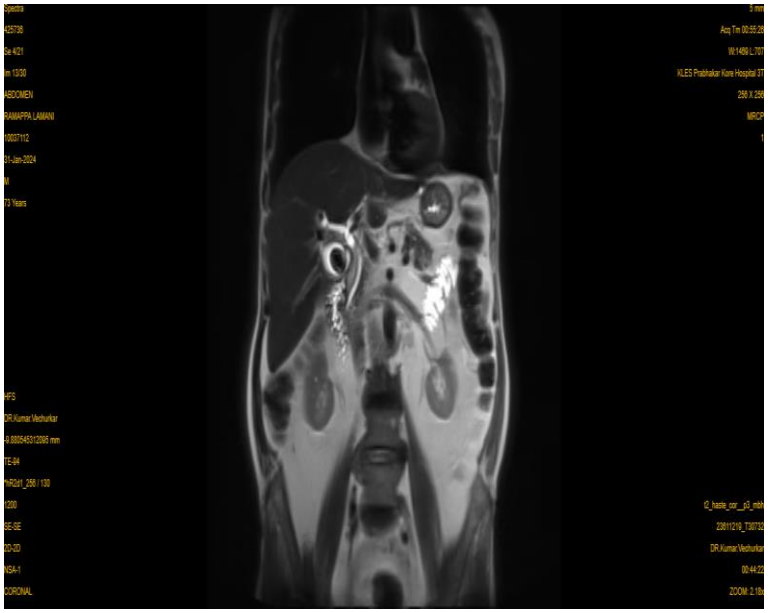
ANNEXURE – III: FIGURES



CASE 1: 55 year old female complaints of right hypochondriac pain

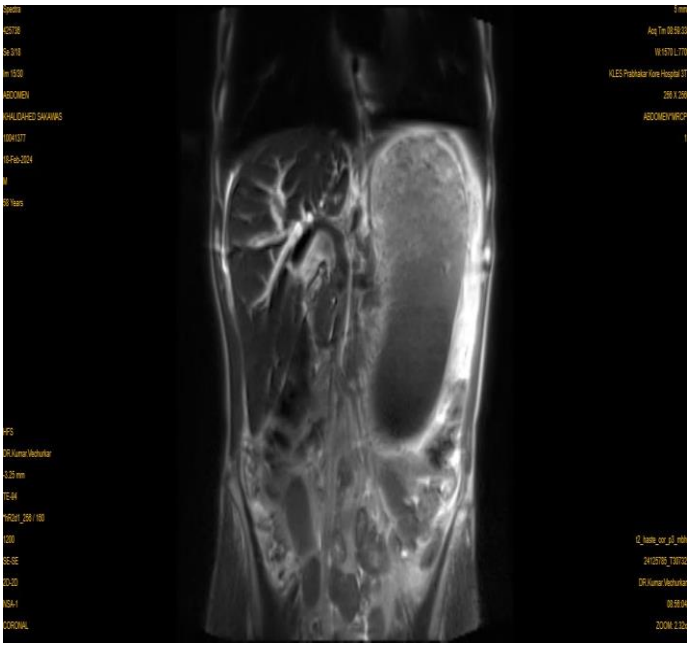
Coronal images show T2 hypointense calculus in the mid CBD resulting in upstream dilatation of CBD and mild IHBRD

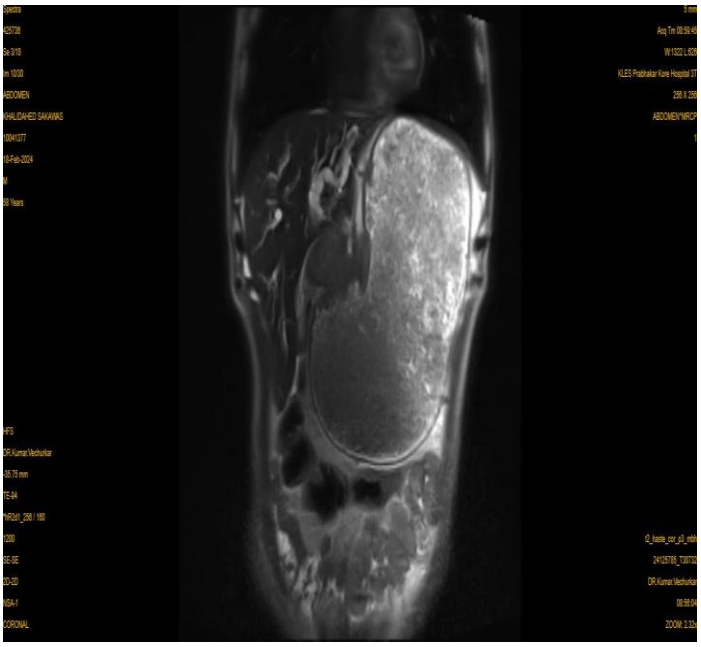


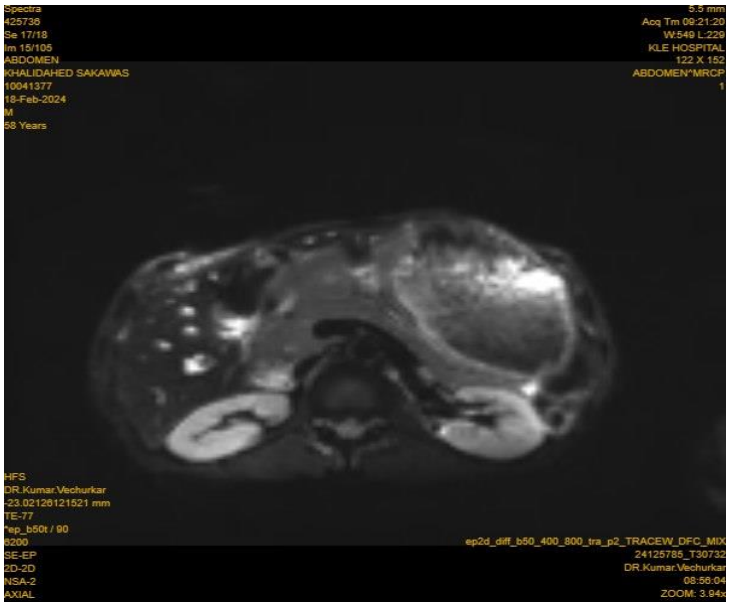


Case 2: 73 yearold male complaints of diffuse abdominal pain

Axial and coronal images shows T2 hypointense calculus in the neck of GB





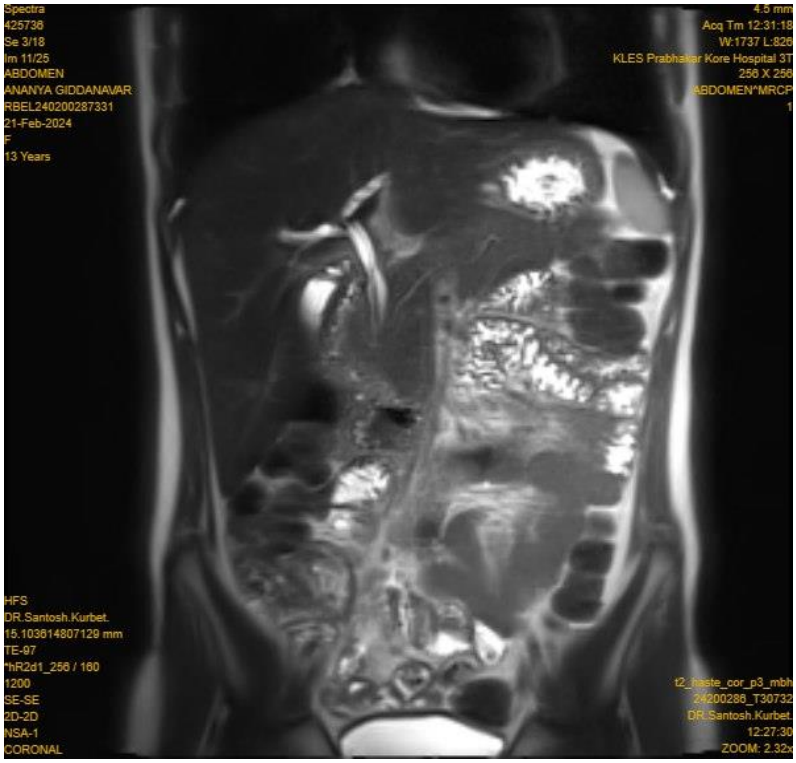


Case 3: 58 yr old patient complaints of diffuse abdominal pain with weight loss

Axial and coronal images show ill-defined region at porta hepatis with IHBRD with circumferential mural thickening …likely malignant obstruction

Case 4: Known case of chronic calcific pancreatitis complaints of diffuse abdominal pain

Axial images show Moderate IHBRD , dilated CHD and cystic duct …likely due to malignant obstruction



Case 5 : 13 year old female came with the complaints of diffuse abdominal pain

Coronal images show dilated CBD with abrupt distal tapering …likely stricture resulting in minimal IHBRD

ANNEXURE – IV: KEY TO MASTERCHART

F	**Female**
M	**Male**
C	**Cholelithiasis**
SC	**Suspected cholelithiasis**
TB	**Total bilirubin**
SMO	**Suspected malignant obstruction**
CP	**Chronic pancreatitis**
BS	**Biliary stricture**
PM	**Pancreatic mass**
SCP	**Signs of chronic pancreatitis**
OA	**Other abnormalities**
MO	**Malignant obstruction**
BBS	**Benign biliary stricture**
AVBT	**Anatomical variants of biliary tree**
LICD	**Low insertion of cystic duct**
ARHD	**Aberrant right hepatic duct**
NB	**Normal branching**
OV	**Other variants**
DPD	**Dilated pancreatic duct**
O	**Others**

ANNEXURE IV: MASTER CHART

Patient ID	Age	Gender	Clinical Symptoms	TB (mg/dL)	ALP (IU/L)	ALT (IU/L)	Indication for MRCP	MRCP Findings(Biliary Duct)	MRCP Findings(Pancreatic Duct	Final Diagnosis	AVBT
P001	49	F	Abdominal Pain	2.5	572	103	Suspected Choledocholithiasis	Dilated CBD	Normal	Chronic Pancreatitis	Other Variants
P002	44	M	Others	9.5	572	80	Others	Biliary Stricture	Pancreatic Masses	Malignant Obstruction	Other Variants
P003	28	M	Jaundice	3.5	133	106	Others	Dilated CBD	Pancreatic Masses	Chronic Pancreatitis	Low Insertion of Cystic Duct
P004	26	F	Fever	2.6	169	29	Others	Biliary Stricture	Pancreatic Masses	Others	Normal Branching
P005	45	M	Fever	3.7	345	103	Biliary Strictures	Other Findings	Pancreatic Masses	Others	Normal Branching
P006	65	M	Pruritus	2.6	136	54	Biliary Strictures	Other Findings	Pancreatic Masses	Others	Aberrant Right Hepatic Duct
P007	74	F	Weight Loss	11.8	456	70	Others	Normal	Normal	Benign Biliary Stricture	Other Variants
P008	78	M	Weight Loss	7.1	589	38	Biliary Strictures	Biliary Stricture	Signs of Chronic Pancreatitis	Others	Low Insertion of Cystic Duct
P009	74	F	Pruritus	7.6	144	45	Biliary Strictures	Normal	Pancreatic Masses	Choledocholithiasis	Low Insertion of Cystic Duct
P010	60	F	Jaundice	11.8	382	115	Biliary Strictures	Normal	Pancreatic Masses	Benign Biliary Stricture	Aberrant Right Hepatic Duct
P011	64	F	Jaundice	3	283	21	Chronic Pancreatitis	Dilated CBD	Other Abnormalities	Others	Normal Branching
P012	74	M	Jaundice	11	282	45	Chronic Pancreatitis	Dilated CBD	Signs of Chronic Pancreatitis	Malignant Obstruction	Aberrant Right Hepatic Duct
P013	34	F	Pruritus	11.5	439	32	Chronic Pancreatitis	Normal	Signs of Chronic Pancreatitis	Others	Normal Branching
P014	43	M	Fever	4.1	361	69	Others	Normal	Normal	Others	Other Variants
P015	77	M	Pruritus	1.9	328	76	Biliary Strictures	Normal	Other Abnormalities	Benign Biliary Stricture	Other Variants
P016	39	F	Abdominal Pain	4.8	580	114	Suspected Malignant Obstructic	Choledocholithiasis	Other Abnormalities	Malignant Obstruction	Other Variants
P017	18	M	Others	3.2	551	38	Biliary Strictures	Other Findings	Pancreatic Masses	Malignant Obstruction	Aberrant Right Hepatic Duct
P018	65	M	Abdominal Pain	1.3	201	50	Suspected Choledocholithiasis	Other Findings	Pancreatic Masses	Benign Biliary Stricture	Other Variants
P019	70	F	Abdominal Pain	2.7	430	94	Suspected Choledocholithiasis	Dilated CBD	Pancreatic Masses	Malignant Obstruction	Aberrant Right Hepatic Duct
P020	80	M	Jaundice	6.4	196	43	Others	Dilated CBD	Normal	Malignant Obstruction	Aberrant Right Hepatic Duct
P021	33	F	Others	9.3	279	45	Suspected Malignant Obstructic	Other Findings	Signs of Chronic Pancreatitis	Chronic Pancreatitis	Other Variants
P022	60	F	Pruritus	11.9	448	100	Suspected Malignant Obstructic	Dilated CBD	Normal	Others	Low Insertion of Cystic Duct
P023	75	F	Abdominal Pain	5.7	478	120	Others	Normal	Pancreatic Masses	Others	Aberrant Right Hepatic Duct
P024	26	M	Pruritus	5	549	109	Suspected Malignant Obstructic	Other Findings	Other Abnormalities	Malignant Obstruction	Other Variants
P025	75	M	Others	12	469	21	Suspected Malignant Obstructic	Normal	Normal	Chronic Pancreatitis	Aberrant Right Hepatic Duct
P026	70	F	Fever	3.6	398	95	Others	Choledocholithiasis	Dilated Pancreatic Duct	Choledocholithiasis	Low Insertion of Cystic Duct
P027	49	M	Weight Loss	8.7	337	66	Others	Biliary Stricture	Other Abnormalities	Chronic Pancreatitis	Aberrant Right Hepatic Duct
P028	20	M	Fever	7.3	497	112	Suspected Choledocholithiasis	Biliary Stricture	Other Abnormalities	Malignant Obstruction	Aberrant Right Hepatic Duct
P029	43	M	Weight Loss	8.1	213	84	Suspected Malignant Obstructic	Normal	Pancreatic Masses	Choledocholithiasis	Other Variants
P030	79	F	Fever	3.1	561	36	Suspected Choledocholithiasis	Biliary Stricture	Other Abnormalities	Benign Biliary Stricture	Normal Branching
P031	61	M	Others	5.5	242	43	Suspected Choledocholithiasis	Dilated CBD	Other Abnormalities	Chronic Pancreatitis	Low Insertion of Cystic Duct
P032	44	F	Abdominal Pain	6.6	589	36	Chronic Pancreatitis	Biliary Stricture	Dilated Pancreatic Duct	Malignant Obstruction	Other Variants
P033	58	M	Weight Loss	8.7	91	117	Chronic Pancreatitis	Choledocholithiasis	Dilated Pancreatic Duct	Malignant Obstruction	Aberrant Right Hepatic Duct
P034	63	M	Others	10.6	82	53	Suspected Choledocholithiasis	Other Findings	Other Abnormalities	Malignant Obstruction	Aberrant Right Hepatic Duct
P035	25	M	Others	5.7	460	71	Biliary Strictures	Normal	Dilated Pancreatic Duct	Others	Low Insertion of Cystic Duct
P036	37	F	Weight Loss	6.3	433	116	Others	Choledocholithiasis	Normal	Malignant Obstruction	Low Insertion of Cystic Duct
P037	80	F	Weight Loss	1.7	540	54	Chronic Pancreatitis	Dilated CBD	Dilated Pancreatic Duct	Choledocholithiasis	Aberrant Right Hepatic Duct
P038	31	F	Others	5.6	249	37	Chronic Pancreatitis	Biliary Stricture	Dilated Pancreatic Duct	Malignant Obstruction	Low Insertion of Cystic Duct
P039	46	F	Weight Loss	8.5	190	82	Suspected Choledocholithiasis	Other Findings	Dilated Pancreatic Duct	Malignant Obstruction	Aberrant Right Hepatic Duct
P040	78	M	Abdominal Pain	7.8	429	25	Chronic Pancreatitis	Other Findings	Signs of Chronic Pancreatitis	Malignant Obstruction	Other Variants
P041	30	F	Weight Loss	2.1	299	94	Others	Other Findings	Dilated Pancreatic Duct	Others	Aberrant Right Hepatic Duct
P042	28	M	Abdominal Pain	3.8	193	29	Chronic Pancreatitis	Biliary Stricture	Other Abnormalities	Malignant Obstruction	Normal Branching
P043	63	M	Weight Loss	3.2	540	29	Biliary Strictures	Dilated CBD	Signs of Chronic Pancreatitis	Choledocholithiasis	Low Insertion of Cystic Duct
P044	31	M	Abdominal Pain	8.8	432	29	Others	Biliary Stricture	Normal	Choledocholithiasis	Low Insertion of Cystic Duct
P045	41	M	Fever	6.5	234	61	Chronic Pancreatitis	Biliary Stricture	Other Abnormalities	Benign Biliary Stricture	Aberrant Right Hepatic Duct
P046	26	F	Fever	1.4	368	80	Suspected Malignant Obstructic	Normal	Normal	Chronic Pancreatitis	Low Insertion of Cystic Duct
P047	28	M	Jaundice	3.2	306	20	Chronic Pancreatitis	Dilated CBD	Normal	Others	Normal Branching
P048	27	F	Weight Loss	3.8	217	90	Chronic Pancreatitis	Biliary Stricture	Dilated Pancreatic Duct	Benign Biliary Stricture	Low Insertion of Cystic Duct
P049	38	M	Others	9.4	446	66	Suspected Choledocholithiasis	Normal	Other Abnormalities	Chronic Pancreatitis	Normal Branching
P050	52	M	Fever	11.3	410	73	Biliary Strictures	Dilated CBD	Dilated Pancreatic Duct	Chronic Pancreatitis	Normal Branching
P051	53	F	Weight Loss	8.4	559	115	Others	Choledocholithiasis	Other Abnormalities	Choledocholithiasis	Low Insertion of Cystic Duct
P052	66	F	Jaundice	2.3	381	112	Others	Other Findings	Other Abnormalities	Others	Normal Branching
P053	53	F	Abdominal Pain	7.9	561	69	Chronic Pancreatitis	Normal	Other Abnormalities	Others	Low Insertion of Cystic Duct
P054	80	F	Jaundice	2.6	395	75	Suspected Choledocholithiasis	Other Findings	Other Abnormalities	Benign Biliary Stricture	Low Insertion of Cystic Duct
P055	31	M	Weight Loss	1.9	275	72	Biliary Strictures	Biliary Stricture	Other Abnormalities	Others	Low Insertion of Cystic Duct
P056	66	F	Fever	1.2	396	60	Biliary Strictures	Biliary Stricture	Signs of Chronic Pancreatitis	Benign Biliary Stricture	Normal Branching
P057	34	M	Pruritus	9.8	342	117	Suspected Malignant Obstructic	Biliary Stricture	Signs of Chronic Pancreatitis	Chronic Pancreatitis	Normal Branching
P058	67	F	Weight Loss	4.6	279	110	Biliary Strictures	Biliary Stricture	Other Abnormalities	Chronic Pancreatitis	Normal Branching
P059	72	M	Weight Loss	7.5	221	33	Others	Normal	Normal	Benign Biliary Stricture	Low Insertion of Cystic Duct
P060	37	M	Pruritus	11.5	154	90	Chronic Pancreatitis	Choledocholithiasis	Normal	Malignant Obstruction	Low Insertion of Cystic Duct
P061	40	F	Fever	6.1	464	115	Suspected Malignant Obstructic	Choledocholithiasis	Normal	Malignant Obstruction	Normal Branching
P062	65	M	Others	4.2	131	64	Chronic Pancreatitis	Dilated CBD	Pancreatic Masses	Chronic Pancreatitis	Other Variants
P063	51	M	Abdominal Pain	4.9	83	24	Others	Biliary Stricture	Signs of Chronic Pancreatitis	Choledocholithiasis	Aberrant Right Hepatic Duct
P064	69	F	Fever	7.8	387	80	Biliary Strictures	Normal	Pancreatic Masses	Others	Low Insertion of Cystic Duct
P065	43	F	Jaundice	5.3	410	98	Suspected Malignant Obstructic	Choledocholithiasis	Normal	Malignant Obstruction	Aberrant Right Hepatic Duct
P066	71	M	Weight Loss	1.8	89	42	Chronic Pancreatitis	Dilated CBD	Normal	Others	Low Insertion of Cystic Duct
P067	55	M	Pruritus	3.4	208	96	Biliary Strictures	Normal	Pancreatic Masses	Malignant Obstruction	Low Insertion of Cystic Duct
P068	20	F	Others	4.2	385	52	Biliary Strictures	Normal	Pancreatic Masses	Others	Other Variants
P069	22	M	Weight Loss	9.5	122	100	Biliary Strictures	Dilated CBD	Dilated Pancreatic Duct	Choledocholithiasis	Low Insertion of Cystic Duct
P070	44	M	Pruritus	9.1	325	75	Chronic Pancreatitis	Other Findings	Pancreatic Masses	Benign Biliary Stricture	Aberrant Right Hepatic Duct
P071	44	M	Weight Loss	8.4	443	51	Suspected Choledocholithiasis	Normal	Other Abnormalities	Others	Low Insertion of Cystic Duct
P072	55	M	Pruritus	11.7	463	79	Others	Biliary Stricture	Dilated Pancreatic Duct	Choledocholithiasis	Normal Branching