

ORIGINAL RESEARCH ARTICLE

**ROLE OF MR CHOLANGIOPANCREATOGRAPHY IN
DETERMINING THE ETIOLOGY OF BILIARY
OBSTRUCTION IN ADULTS**

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ABSTRACT

BACKGROUND

MRI-MRCP is a noninvasive imaging technique for the visualization of the biliary ducts with cholangiographic images similar to those obtained with ERCP.

Objectives and Aims

Aim of the study is to evaluate the etiology of biliary obstructions and associated bile duct stricture.

METHODS

It is a Cross-Sectional study carried out on 30 patients with clinical or laboratory and ultrasound findings suggestive of biliary obstruction, who were referred to the Department of Radiodiagnosis and underwent MRCP. The study was carried out between July 2022 to July 2023. MRCP was performed with 1.5 tesla (16 channel Philips Ingenia).

RESULTS

- MRCP was able to diagnose, CBD dilatation and hence differentiating surgical from medical jaundice.

- MRCP was accurately able to detect the level of obstruction in 100% of cases and the most common location of the obstruction and stricture was in terminal CBD in 95% cases.
- In our study etiology of obstruction was benign in 57% of the total cases with choledocholithiasis and inflammatory stricture seen in all the cases.
- Malignant obstruction was seen in 17% of the cases with definite mass lesion.
- In malignant obstruction, the majority (80%) showed abrupt cut off of the CBD and absence of long segment narrowing. The irregularity of the margins also was not well appreciated. The benign stricture showed short segment narrowing. Thus the morphology of the strictures were not helpful to distinguish benign from the malignant stricture.
- In 26% of the cases, a diagnosis of indeterminate stricture was made. These cases had no Periapillary mass / Pancreatitis / CBD calculus / GB calculus. No iatrogenic history was there too. These cases should be referred to higher centers for further investigations like ERCP, EUS - FNA. (Endoscopic ultrasound with fine needle aspiration.)/ Cholangioscopy / intraductal ultrasound to rule out malignancy.

CONCLUSION

MRI-MRCP is a highly sensitive noninvasive technique in the detection of the presence, level and characterization of biliary obstructions. However, in indeterminate strictures, MRCP proved to be a significant limitation for the radiologist to pin point the diagnosis such cases require endoscopic procedures in gastro-enterology department for reaching the diagnosis.

KEYWORDS

MRI-Magnetic Resonance Imaging MR Cholangiopancreatography (MRCP), Biliary Duct Strictures, Endoscopic Retrograde Pancreatic Cholangiography (ERCP), Common Bile Duct (CBD).

INTRODUCTION

Biliary obstruction is a commonly encountered condition in surgical practice, encompassing both intrahepatic and extrahepatic scenarios with causes ranging from benign to malignant bile duct blockages.^[1] Benign biliary obstructions often result from conditions such as choledocholithiasis, inflammatory strictures, and post-cholecystectomy strictures. Malignant obstructions are primarily attributed to cholangiocarcinoma, pancreatic adenocarcinoma, and ampullary and peri-ampullary carcinomas.^[1,2] Achieving precise and early detection of the underlying pathology requires a meticulous and systematic diagnostic approach. Following biochemical tests, noninvasive imaging techniques, including ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI), play pivotal roles in evaluating biliary obstruction.^[3]

Although ultrasonography serves as an accessible and cost-effective initial screening procedure, its diagnostic accuracy is limited by operator dependence.^[4] While CT is recognized for its heightened sensitivity compared to ultrasonography, the advent of MRI

and MRCP has expanded the diagnostic landscape. Notably, these modalities provide superior soft tissue resolution of the biliary tree without exposing patients to ionizing radiation.^[4,5]

Among these, MRCP stands out as the premier diagnostic method due to its exceptional accuracy in imaging the lumen of biliary tree.^[6,7] The conventional method of distinguishing malignant from benign strictures relies on ERCP coupled with histopathological or surgical assessments. However, the invasive and costly nature of ERCP and potential risk of contrast mediated cholangitis and acute pancreatitis, has prompted exploration of the distinctive advantages offered by MRI-MRCP. Noteworthy benefits include a) noninvasive, b) cheaper, c) uses no radiations, d) requires no anesthesia, e) less operator dependent, f) allows better visualization of ducts proximal to an obstruction.^[8,9]

This study aims to assess the pivotal role of MRI-MRCP in identifying the etiology of adult bile duct obstructions.

Objectives and Aims

1. To explore the diverse etiology of biliary obstruction in adults and to aim for accurate diagnosis and thus help in optimal patient management.
2. To evaluate associated biliary strictures and differentiate between benign and malignant strictures.

MATERIALS AND METHODS

This cross sectional retrospective study was conducted from July 2022 to July 2023, utilizing patient data collected from district government hospital attached to SIMS during the specified period. The study focused on patients exhibiting clinical and laboratory findings of biliary obstructions, who underwent further assessment with MRCP at our facility. The imaging procedures were carried out using a 16-channel Philips Ingenia 1.5 Tesla MR system, employing a phased-array body coil to optimize the visualization of ducts. The study was done on patients who had fasted for 12 hours to promote gall bladder distention. Oral negative contrast agent (iron containing syrup) was given to patient 15 minute before examination to improve quality and contrast.

The following MRCP sequences were used:

Axial- T2, BTFE, FFE-BH, DIXON and DW

Coronal-T2 and BTFE

SSH MRCP RAD, sMRCP 3D HR

Inclusion Criteria

- Patients presenting with complaints of abdominal pain, altered liver function tests, an obstructive jaundice profile, or evidence/ suspicion of choledocholithiasis, referred to the Department of Radiodiagnosis.
- Patients aged 18 years or older.
- Both genders were be included in the study.

Exclusion Criteria

- Patient who has contraindications for MRI like any
 - (a) electrically, magnetically or mechanically activated implant (E.g. cardiac pacemaker, insulin pump bio stimulator, neurostimulator, cochlear implant, and hearing aids)
 - (b) Intracranial aneurysm clips or staples,
 - (c) Metallic foreign body in the eye, metal shrapnel or bullet.
 - (d) Claustrophobic patients
- Patients who declined to provide consent for the study.
- Patient with age less than 18 years.

Observations made during MRCP included assessments of biliary channels, their symmetrical / asymmetrical dilatation, pancreatic duct, presence of calculi, stricture site, stricture margins (regular/irregular), tapering pattern (abrupt/gradual), length of stricture (short/long), gall bladder status, presence of lymph nodes and metastases, and any mass lesions. Based on these findings, the 30 patients were categorized into five distinct groups (Table1 & FIG 1).

Statistical Analysis

Data entry will be performed using Microsoft Excel spreadsheet software, and statistical analysis will be conducted using the SPSS version 24.0 statistical software. The collected data will be subjected to descriptive statistical analyses, including percentage proportions, and graphical representations such as graphs, charts, and tables wherever applicable. These statistical methods will provide a comprehensive overview of the data, facilitating a clear understanding of the study's findings.

RESULTS

In this comprehensive retrospective study involving 30 patients who underwent MRCP for the assessment of biliary obstruction, a thorough analysis reveals a nuanced understanding of the patient population, clinical presentations, diagnostic outcomes, and limitations. The study encompassed a diverse patient population, including both genders and a wide age range. Age distribution showed a notable proportion of patients above 40 years old, emphasizing the relevance of biliary complications in the older demographic. A slight female preponderance (60%) (Table 2 & Graph 2) was observed in biliary obstructive disease. The most prevalent presenting complaints were pain abdomen and obstructive jaundice, reflective of the obstructive nature of the conditions under investigation.

MRCP was successful in identifying ductal dilatation and precisely determining the level of obstruction in all cases. Terminal CBD strictures were the most frequently observed, constituting 95% of cases.

Etiology includes (Fig 4)

Benign Causes (57%)

- Cholangitis with cholelithiasis and tiny CBD calculus: 7 cases (23.3%) (fig 6)
- Iatrogenic stricture post- cholecystectomy: 2 cases (6.7%) (fig 4 & 5)

- Pancreatitis with inflammatory stricture: 1 case (3.3%) (fig 9)
- Cholelithiasis with impacted CBD calculus: 5 cases (17%)
- Mirrizi syndrome: 1 case (3%) (fig 1 & 2)
- Type I choledochal cyst: 1 case (3%) (fig 12)

Malignant Causes (17%)

- Periampullary carcinoma: 2 cases (6.7%) (fig 10)
- Carcinoma of the head of the pancreas: 2 cases (6.7%) (fig 11)
- Cholangiocarcinoma: 1 case (3.3%)

Indeterminate Causes (26%)

- Cases requiring further investigation (ERCP): 8 cases (26.6%) (fig 3 & 7)

The varies etiologies based on gender and age are illustrated in the table below (Table 3 and Graph 3)

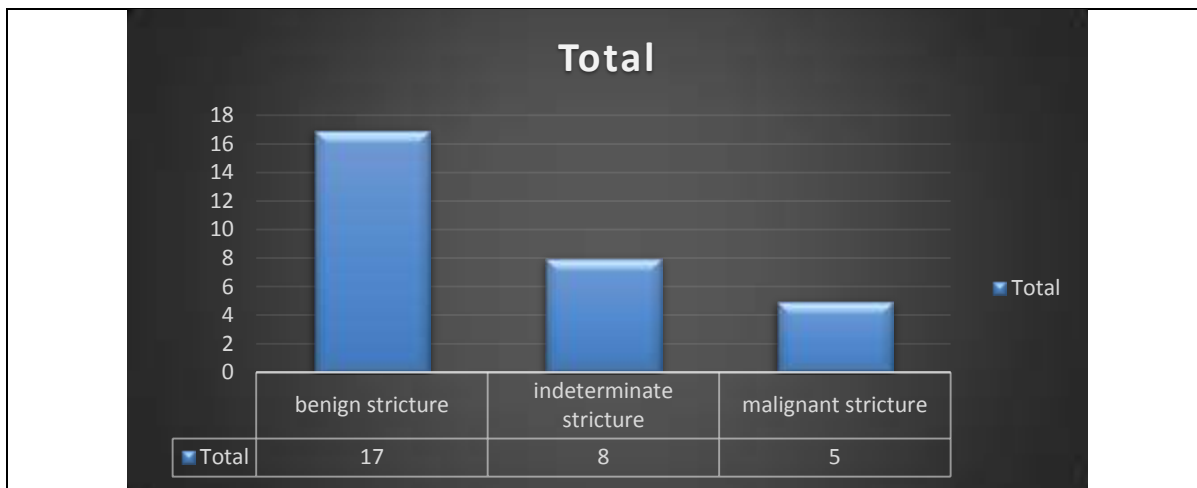
Patients with malignant obstruction were, on average, older than those with benign obstruction. A slight female preponderance (60%) was observed in biliary obstructive disease. The study recognizes certain limitations, particularly in cases with indeterminate strictures (26%).

In our study, indeterminate strictures refer to cases where MRCP imaging did not conclusively categorize the nature of the biliary stricture, making it challenging to differentiate between benign and malignant causes solely based on imaging findings. Indeterminate strictures highlight a diagnostic uncertainty that necessitates further investigations for a definitive diagnosis and appropriate treatment planning. Such Patients should be referred for additional investigations like ERCP and tissue sampling, especially when there is no clear evidence of periampullary mass, pancreatitis, CBD calculus, GB calculus, or iatrogenic history.

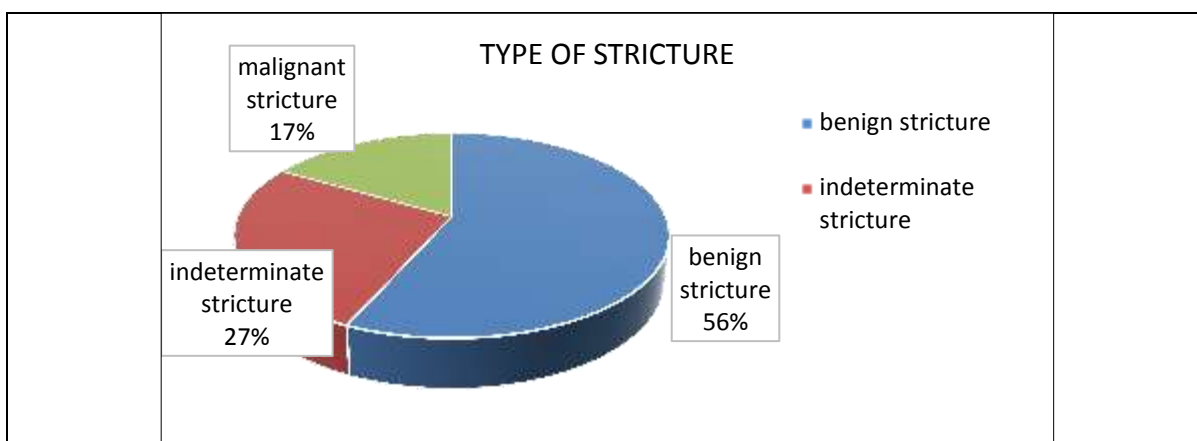
ERCP allows for direct visualization of the biliary tree and provides the opportunity for tissue sampling, enabling a more accurate determination of the nature of the stricture.

Type of Stricture	Total Number of Pateints
benign stricture	17
indeterminate stricture	8
malignant stricture	5
Grand Total	30

Table 1: Distribution of Patients by Type of Stricture



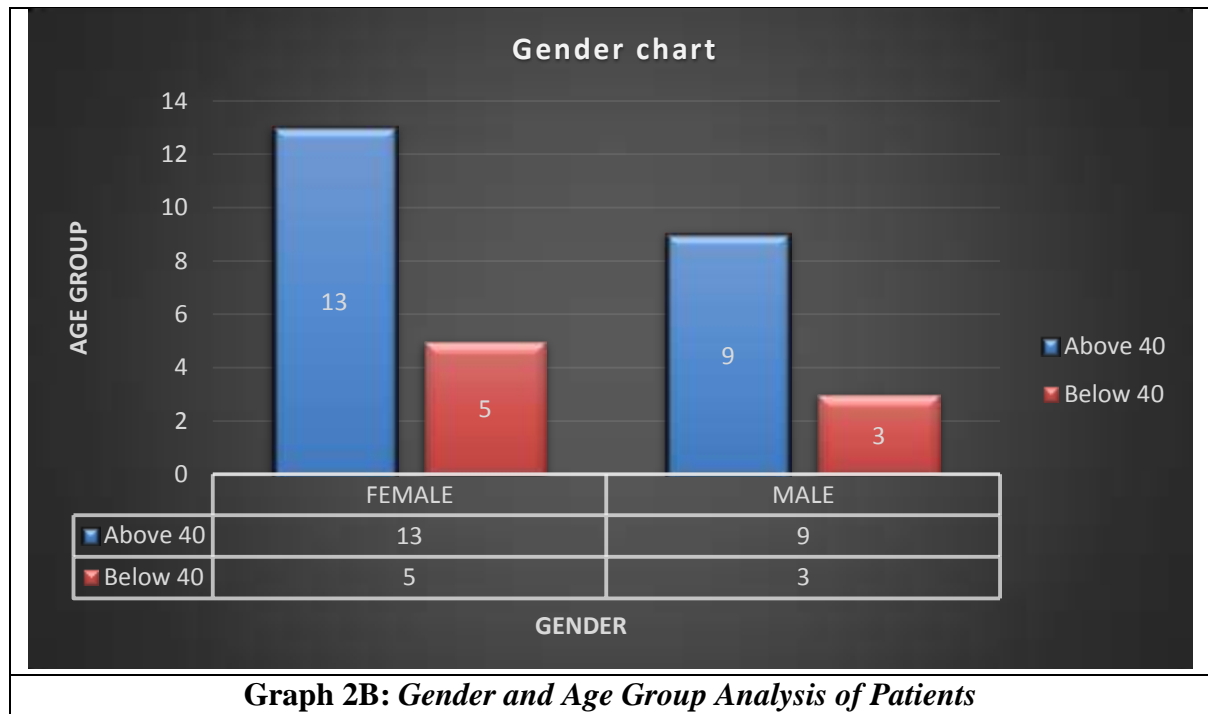
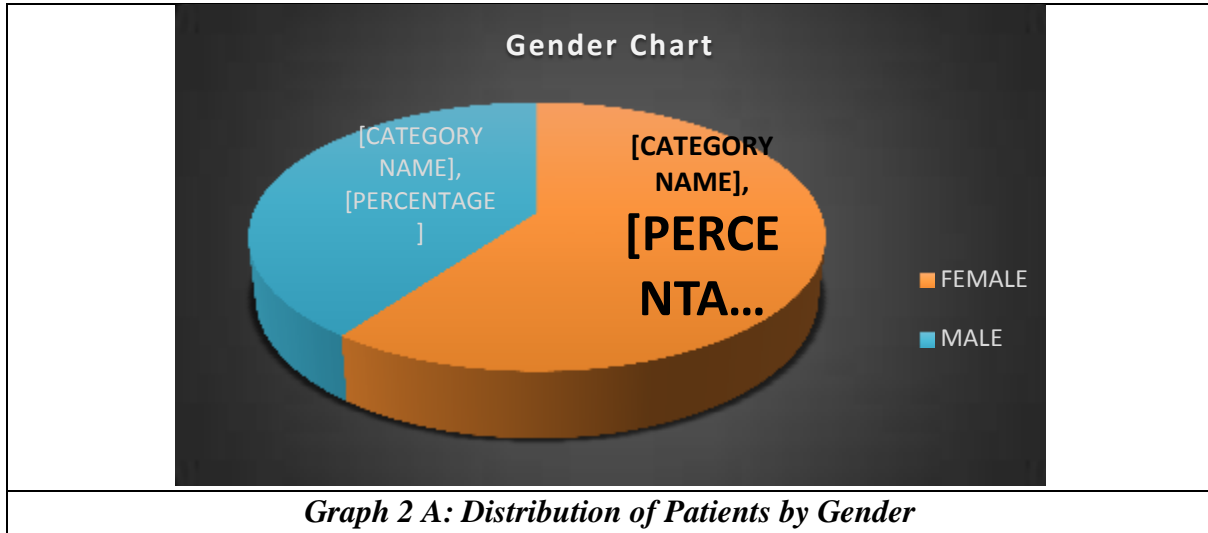
Graph 1 A: Classification and Count of Stricture Types in Patients



Graph 1 B: Percentage Breakdown of Stricture Types in Patients

Gender	Count of SEX
FEMALE	18
MALE	12
Grand Total	30

Table 2A: Gender Demographics of Patient Cohort



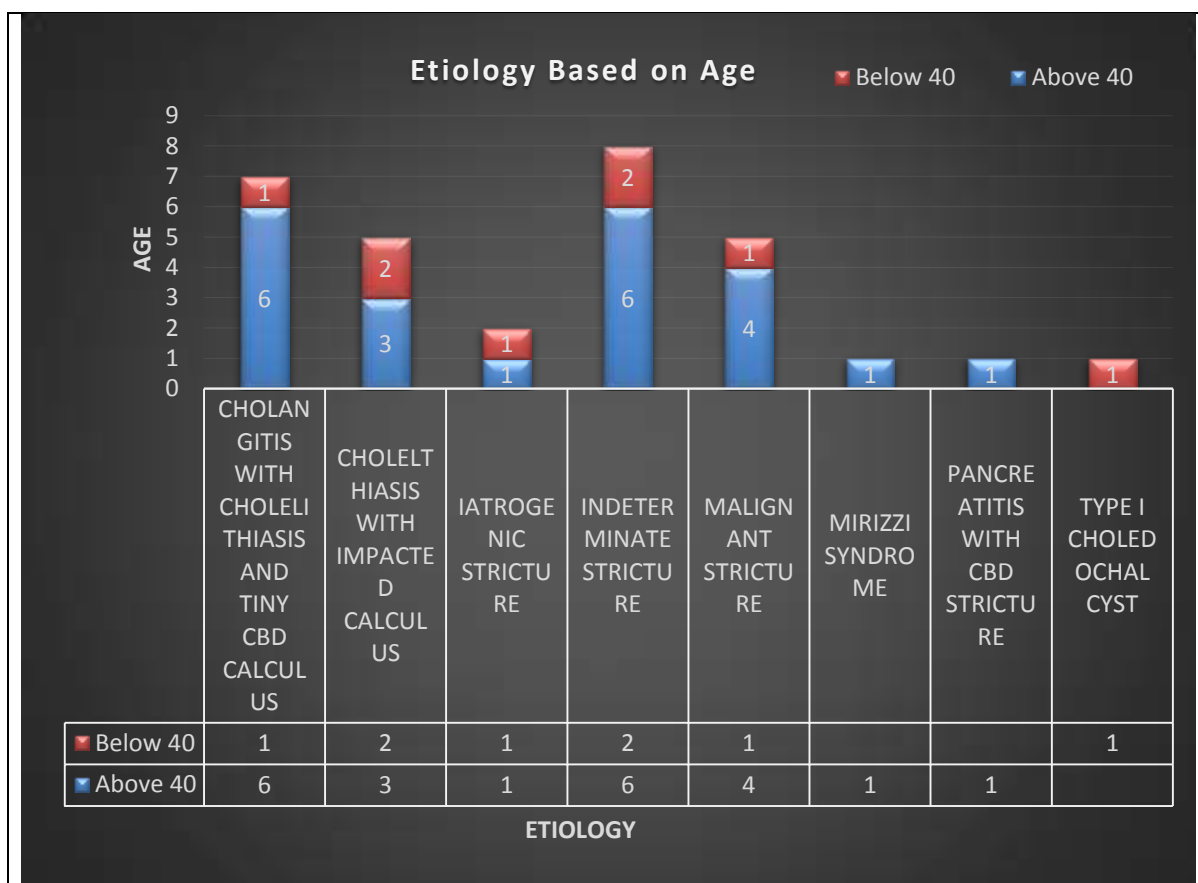
Count of Sex	Column Labels		
Gender	Above 40	Below 40	Grand Total
Female	13	5	18
Male	9	3	12
Grand Total	22	8	30

Table 2B: Demographics of Patients by Age and Gender

Etiologies	Above 40	Below 40	Grand Total
Cholangitis with Cholelithiasis and Tiny CBD Calculus	6	1	7
Cholelithiasis with Impacted Calculus	3	2	5
Type I Choledochal Cyst		1	1

Mirizzi Syndrome	1		1
Iatrogenic Stricture	1	1	2
Indeterminate Stricture	6	2	8
Malignant Stricture	4	1	5
Pancreatitis with CBD Stricture	1		1
Grand Total	22	8	30

Table 3A: Analysis of Etiologies in Patients Above and Below 40 Years



Graph 3A : Age-Based Distribution of Patient Etiologies

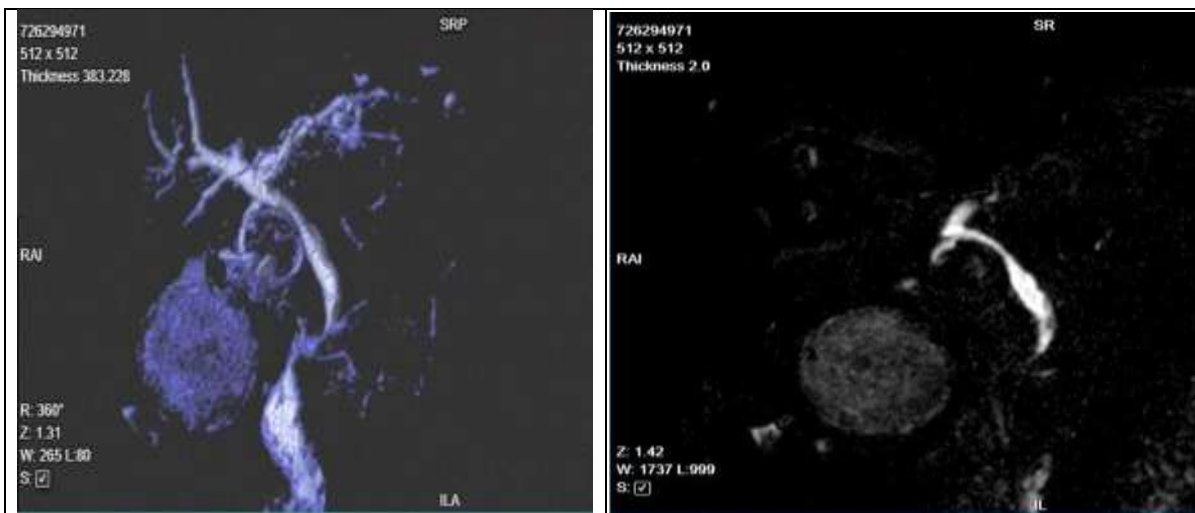


Figure 1 &2: Large Impacted Calculus in Neck with Mirrizi Syndrome

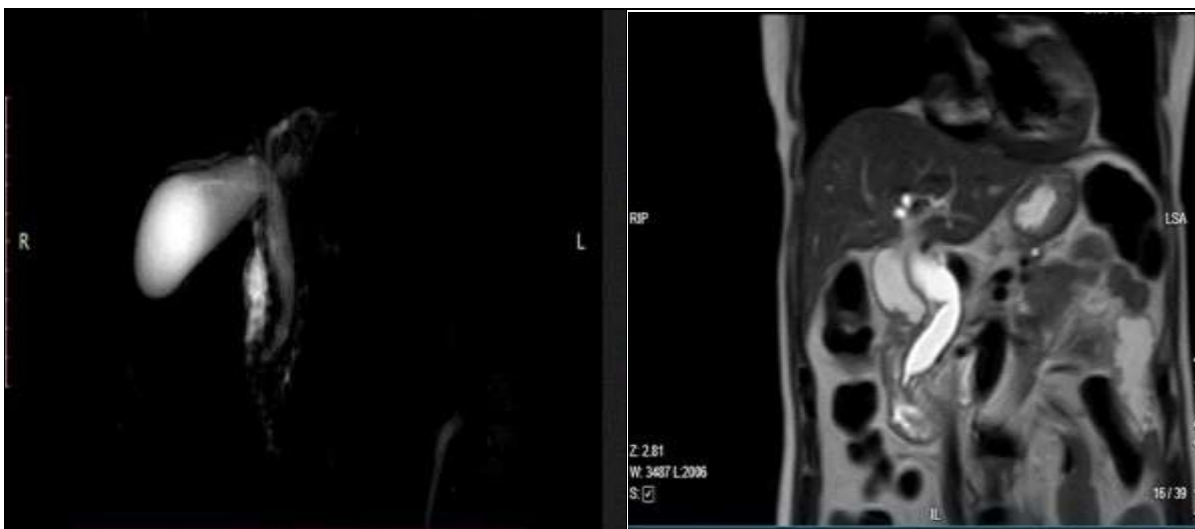


Figure 3: Indeterminate Stricture

Figure 4: Post Cholecystectomy with Terminal CBD Benign Stricture and Residual CBD Calculi

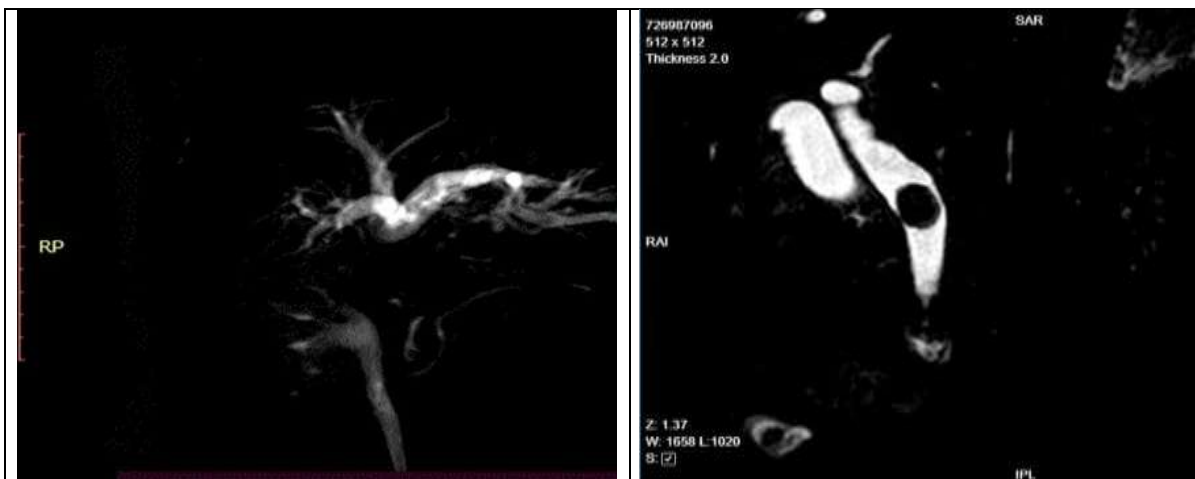


Figure 5: Post Cholecystectomy with Iatrogenic Stricture

Figure 6: Choledocholithiasis and Terminal CBD Inflammatory Stricture

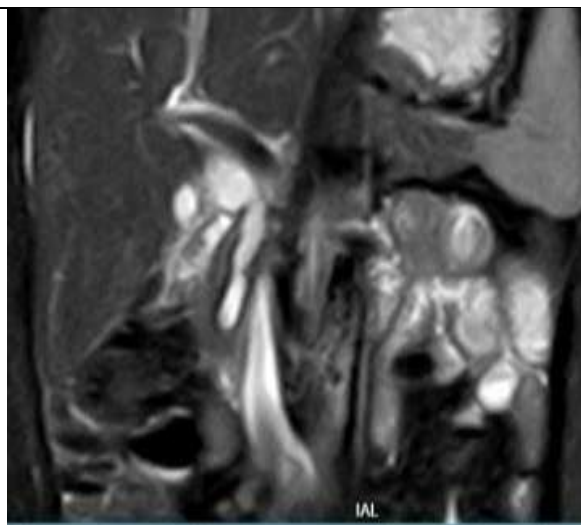


Figure 7: Indeterminate Stricture- ? S/o Recently Passed Out Calculi. GB Sludge

Figure 8: GB Malignancy with Terminal CBD Stricture- ? Metastatic

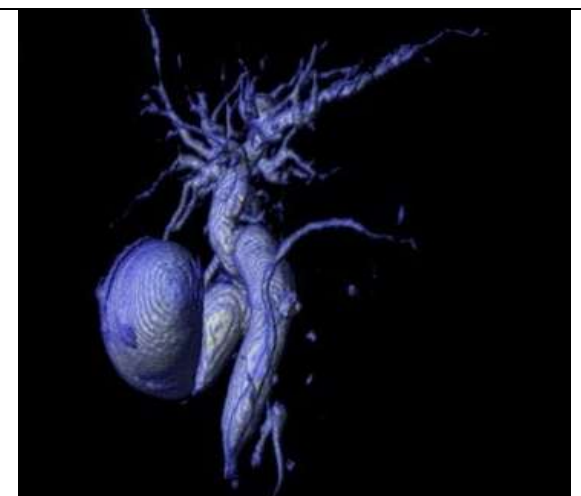
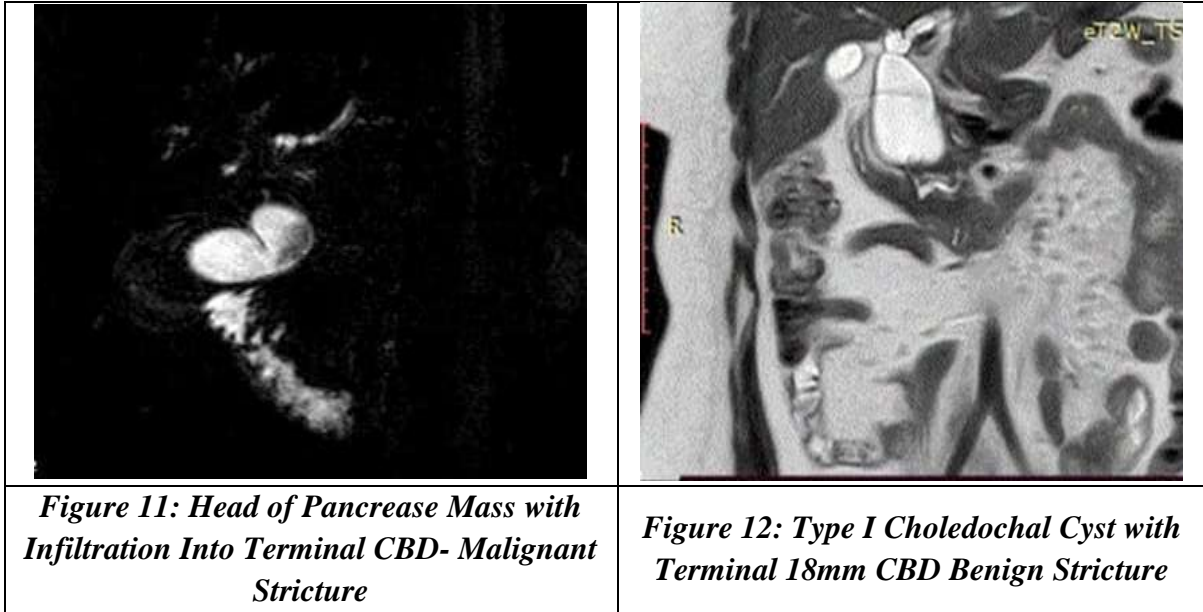


Figure 9: Chronic Pancreatitis with Terminal CBD Stricture

Figure 10: Perampullary Mass with Terminal CBD Obstruction- Malignant Stricture



DISCUSSION

Differentiating between benign and malignant biliary obstructions through imaging alone poses a challenge for radiologists. Our cross-sectional retrospective study utilized MRCP to distinguish between these obstructions. Adult bile duct obstruction with stricture is a complex clinical condition with diverse etiologies, encompassing both benign and malignant causes.

In our study, MRCP demonstrated exceptional diagnostic accuracy in identifying ductal dilatation and determining the level of obstruction. Terminal common bile duct (CBD) strictures were most prevalent, constituting 95% of cases. Benign causes included cholangitis with cholelithiasis, inflammatory strictures, choledochal cyst, and iatrogenic strictures. Malignant causes comprised periampullary carcinoma, carcinoma of the head of the pancreas, and cholangiocarcinoma^[8].

In our study, we observed a higher incidence of biliary obstructive disease in females than males, with a ratio of 3:2. Benign and malignant causes were more prevalent in females compared to males, in contrast to the literature in case of malignant causes, where males are more involved than females. Patients aged over 40 years had a higher incidence of biliary obstruction. Our study found that benign obstructive causes were more predominant than malignant ones, aligning with the findings of Meena Suthar et al. In our study of 30 cases, choledocholithiasis was the most common pathology in 40% of cases, consistent with the study of Meena Suthar et al who found choledocholithiasis in 24 %. Also all cases of choledocholithiasis associated with GB calculi^[10]. Similar results were obtained by Yuk Tong Lee et al who found an association of 95%.

We identified 10 cases of benign causes associated with stricture formation, characterized by short segment, smooth margin, gradual tapering without mass effect, and symmetrical dilatation of biliary radicles. This aligns with the findings of Katabathina V S et al and Meena Suthar et al^[8].

Contrary to the findings of Kenneth M et al, Vaishali et al, and Meena Suthar et al, our study revealed that iatrogenic factors, post-cholecystectomy, accounted for only 6.7% (2 cases). This could be because our institution faces unique challenges, including the absence of a dedicated superspeciality gastroenterology department. This emphasizes the significance of considering institutional context when interpreting study results^[3].

Cholecystectomy is the surgical procedure most commonly associated with strictures of the extrahepatic bile ducts. Post-cholecystectomy strictures are frequently located at the junction of the cystic duct with the common hepatic duct (CHD) and the confluence of the left and right hepatic ducts. MRCP is demonstrated to be as sensitive as direct cholangiography and typically reveals a short-segment smooth stricture of the CHD or CBD with associated intrahepatic biliary dilatation^[11,12].

We did not get any case of etiologies like primary sclerosing cholangitis, autoimmune cholangiopathies, infections (such as recurrent pyogenic cholangitis), trauma, and ischemic strictures.

The research conducted by Ajay Pal Singh et al and Kenneth M. Vitellas et al suggested that pancreatic neoplasm was the primary cause of malignant obstruction, a scenario that our study also revealed. Pancreatic Adenocarcinoma is the most common malignant neoplasm of the pancreas in adults. About 70% of tumors occur in the head, neck, and uncinate process and usually manifest with obstructive jaundice secondary to stricture of the intrapancreatic portion of the CBD. We found two cases of ampullary and periampullary carcinomas where there was extensive infiltration of the terminal CBD and MPD and abrupt cut off. There are one case of hilar cholangiocarcinoma with abrupt cut off of the CHD.

Long segment narrowing or wall thickening or irregularity was not appreciated in the malignant causes. These cases had MPD obstruction and proximal dilatation also. The degree of CBD dilatation was more than in benign causes. Asymmetrical dilatation of the intrahepatic biliary radicles was also noted.

Ampullary carcinoma is defined as carcinoma arising in the ampullary complex distal to the confluence of the pancreatic duct and CBD. Malignant tumors arising within 2 cm of the major duodenal papilla can be categorized as periampullary carcinomas and include carcinoma of the ampulla of Vater, distal CBD, head and uncinate process of the pancreas, and periampullary portion of the duodenum. Identification of an ampullary mass, papillary bulging, irregular asymmetric luminal narrowing of the distal CBD, and diffuse upstream intra- and extrahepatic biliary dilatation are signs of malignant ampullary obstruction, whereas smooth symmetric luminal narrowing of the CBD and central biliary dilatation without an ampullary mass or papillary bulging are expected with a benign obstruction^[13,14].

Indeterminate strictures, requiring further investigation (ERCP) and tissue sampling, constituted 26% of cases. These cases did not have Periampullary mass / Pancreatitis / CBD calculus / GB calculus. No iatrogenic history was there too. These cases should be referred to higher centers for further investigations like ERCP, EUS - FNA. (Endoscopic ultrasound with fine needle aspiration.)/ Cholangioscopy / intraductal ultrasound to rule out malignancy. One of the cases had borderline CBD dilatation. The cause of this could be recently passed out calculus or sphincter of Odi dysfunction^[15].

In summary, MRCP proves to be an effective tool for identifying the etiology of bile duct obstructions, assessing luminal changes, segment involvement, presence of mass lesions, and other imaging features. However, distinguishing between benign and malignant strictures may not always be straightforward, emphasizing the need for a multidisciplinary approach to ensure accurate diagnosis and effective treatment planning. Contrast MRI studies are also recommended in cases of malignant obstructions.

Limitations of Our Study Inability to Confirm Accuracy of MRCP Findings

- This being a retrospective study, data collection is based on past medical records and imaging reports, and the information available is limited to what was documented at the time of MRCP. This prevented us from validating the accuracy.
- ERCP, being a real-time procedure, allows dynamic visualization and intervention in the biliary tree. The absence of ERCP in our institute prevented us from establishing a correlation between MRCP findings and the actual intraoperative or ERCP observations.

Diagnostic Challenge Strictures with Indeterminate Etiology

- ✓ The study recognizes the inherent difficulty in conclusively characterizing indeterminate strictures based on imaging alone. The lack of a definitive diagnosis for 23% of cases poses a significant limitation, emphasizing the need for additional investigations to enhance diagnostic accuracy and referral to higher center.
 - These limitations emphasize the need for prospective studies with surgical gastroenterology superspecialist backup where ERCP is routinely performed, along with EU (endoscopic ultrasound) and tissue sampling facilities to establish a more robust understanding of the diagnostic and therapeutic implications of biliary strictures.

CONCLUSION

In conclusion, this comprehensive retrospective study sheds light on the diagnostic utility of MRCP in assessing biliary obstruction. The study involved a diverse patient population, predominantly above 40 years old, with a slight female preponderance. The most common presenting complaints were abdominal pain and obstructive jaundice, indicative of the obstructive nature of the conditions studied.

The etiological spectrum of biliary strictures included a variety of benign and malignant causes. Benign obstructions, comprising 57% of cases, were predominantly associated with conditions such as cholangitis with cholelithiasis, inflammatory strictures, choledochal cyst, iatrogenic stricture, and pancreatitis with inflammatory stricture.

Malignant obstruction, accounting for 17% of cases, were primarily attributed to periampullary carcinoma, carcinoma of the head of the pancreas, and cholangiocarcinoma.

The morphology of the malignant stricture as described in the literature was not seen in our cases especially the long segment narrowing. The diagnosis was made mainly by the presence of associated mass lesion.

Notably, indeterminate strictures, representing 26% of cases, posed a diagnostic challenge, necessitating further investigations, particularly ERCP, in 23.3% of patients.

However, the study acknowledges certain limitations, particularly in cases with

indeterminate strictures. These limitations include the inability to definitively categorize the nature of the stricture based on imaging alone, highlighting the need for additional investigations like ERCP. The absence of patient follow - up, characteristic of retrospective studies, limits the ability to assess the long - term outcomes and treatment efficacy. Furthermore, the unavailability of ERCP procedures in the institute hinders the ability to perform a direct visualization of the biliary tree and obtain tissue samples for accurate diagnosis.

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