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Imaging Features of Congenital Anomalies and Anatomic Variants of Pancreatiocobiliary Tract in MRCP

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Abstract:

- ***Objective***

This study explores a range of congenital anomalies and anatomical variants of the pancreas, pancreatic ductal system, and biliary tree, emphasizing the critical role of Magnetic Resonance Cholangiopancreatography (MRCP) in their diagnosis.

- ***Methods***

The study was conducted over six months and involved the use of MRCP imaging to diagnose anomalies and variations in the pancreas, pancreatic ductal system, and biliary tree of patients presenting with obstructive jaundice.

- ***Subjects***

Twenty patients with obstructive jaundice participated in this prospective study.

- ***Results***

The study identified several common anomalies:

- **Congenital Anomalies: Observed in 65% of patients. The most frequent anomaly was choledochal cysts, found in 76.9% of these cases, followed by pancreatic divisum, von Meyenburg complexes, and distal pancreas agenesis.**
- **Anatomic Variants: Found in 40% of patients, including cystic duct low medial insertion and variations in the right posterior hepatic duct.**

MRCP imaging effectively revealed variations such as cystic duct low medial insertion and atypical bile duct branching patterns.

- ***Conclusion***

The findings underscore the importance of understanding embryological development and normal anatomy to avoid diagnostic pitfalls and optimize interventional planning. MRCP proved effective in detailed visualization, aiding in accurate diagnosis and preoperative evaluation. If you need further elaboration or additional information, feel free to ask!

Keywords: *Anatomical Variants, Biliary Tree, Choledochal Cysts, Congenital Anomalies, Jaundice, Magnetic Resonance Cholangiopancreatography (MRCP), Pancreas, Pancreatic Divisum.*

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I. INTRODUCTION

Radiologic evaluations often uncover a wide spectrum of anomalies in the pancreas, pancreatic ductal system, and biliary tree. These anomalies encompass various anatomic variants (1) and developmental anomalies, such as pancreas divisum, annular pancreas, ectopic pancreas (2), pancreatic agenesis, and hypoplasia. Additionally, congenital diseases like congenital pancreatic cysts, von Hippel–Lindau disease (3), and choledochal cysts (4) are frequently encountered. Diagnostic challenges also arise due to potential imaging pitfalls, such as uneven fat distribution and "pseudomasses."

Understanding the intricacies of biliary anatomy and its variations is crucial in medical procedures like living donor transplantation, radiological hepatobiliary interventions, laparoscopic cholecystectomy, and liver resections. An in-depth knowledge of embryologic development and normal anatomy aids in accurately identifying these anomalies and ensuring precise diagnosis and treatment.

II. MATERIALS AND METHODS

A prospective study was conducted on 20 patients presenting with obstructive jaundice at Dr. KLE's Prabhakar Kore Hospital, Radiology Department, Belagavi. Magnetic Resonance Cholangiopancreatography (MRCP) was performed using a 3.0 Tesla Siemens MRI machine (Magneton Spectra) over six months, from March 2024 to August 2024.

III. RESULTS

A. *Demographics:*

- **Gender Distribution:** Of the 20 subjects, 11 were male (55%) and 9 were female (45%).
- **Age Distribution**: 25% of the subjects were under 10 years of age.

B. *Congenital Anomalies:*

- **Prevalence**: Congenital anomalies were seen in 13 patients (65%).
- **Common Anomalies**:

✓ Choledochal Cysts: The most common congenital anomaly, seen in 10 patients (76.9%). Of these, Type 1 and Type 4 choledochal cysts were present in 8 patients.

✓ Other Anomalies:

- One case of pancreatic divisum.
- One case of Von Meyenburg complex.
- One case of distal pancreas agenesis.

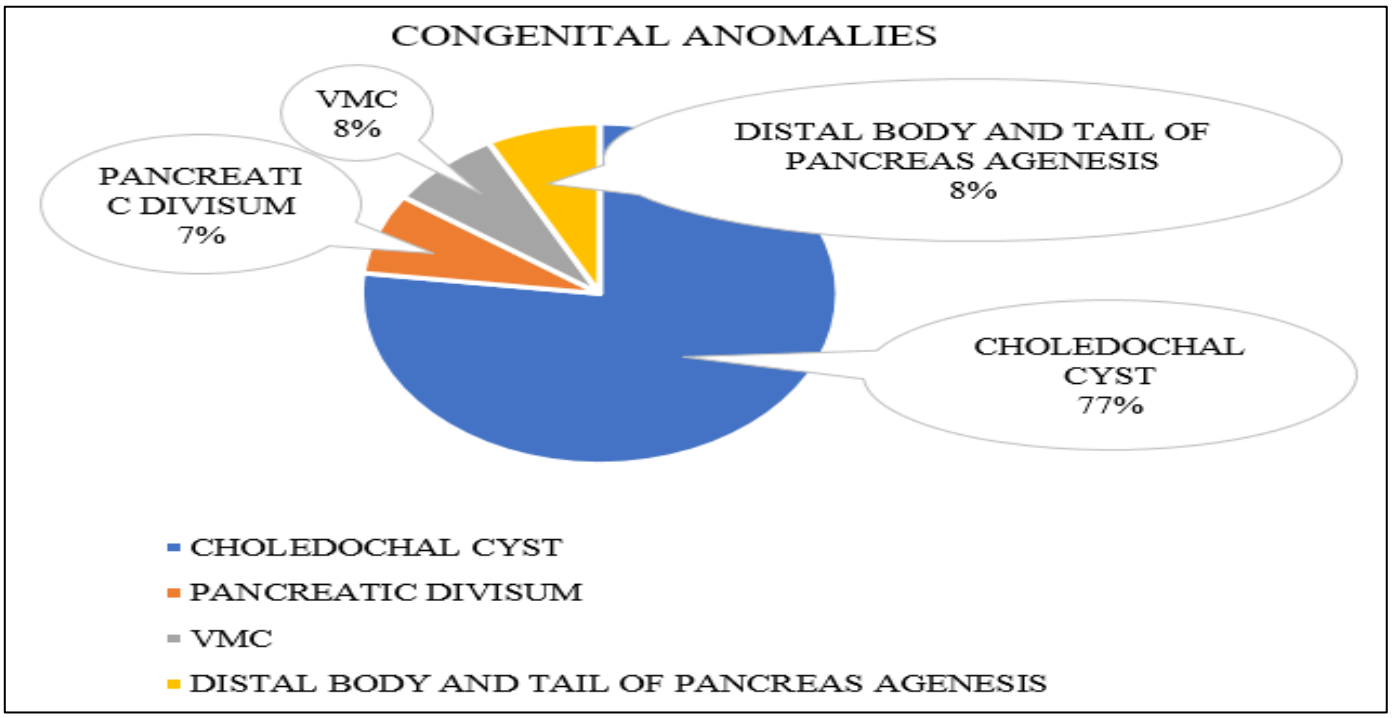

Fig 1: Cogenital Anomalies

C. *Anatomic Variants:*

- Prevalence: Anatomic variants were observed in 8 patients (40%).
- Specific Variants:

✓ Cystic Duct Low Medial Insertion: Seen in 3 patients.

✓ Right Posterior Hepatic Duct Variations: Observed in 4 patients.

✓ Pancreatic Duct Variants:

- One case showed a loop-shaped pancreatic duct.
- One case exhibited a bifid pancreatic duct with dominant Wirsung drainage.

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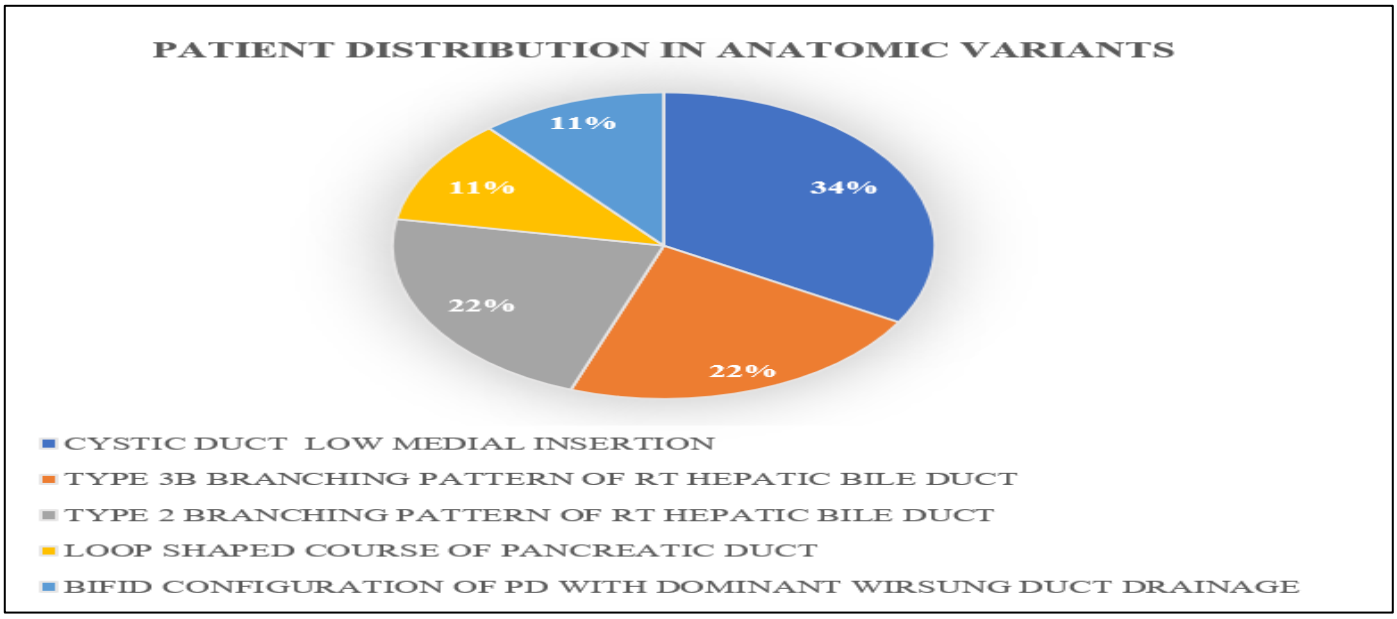

Fig 2: Patient Distribution in Anatomic Variants

D. Combination of Anomalies and Variants:

- One patient had both a congenital anomaly and an anatomic variant.
- Specifically, this patient exhibited Type 3B anatomic variant of the right hepatic bile duct and low medial insertion of the cystic duct**.**

IV. DISCUSSION

- **Prevalence of Anomalies**: The high prevalence of congenital anomalies (13 out of 20 patients) and anatomic variants (8 out of 20 patients) highlights the importance of detailed radiologic assessments in identifying these conditions. The presence of both congenital anomalies and anatomic variants in one patient further emphasizes the complexity of these cases.
- **Common Congenital Anomalies**: The predominance of choledochal cysts (76.9% of congenital anomalies) indicates a significant area of concern for healthcare providers. Recognizing these cysts, especially the common types (Type 1 and Type 4), is crucial for early intervention and management (5).
- **Anatomic Variants**: The variety of anatomic variants observed, such as low medial insertion of the cystic duct and right posterior hepatic duct variations, underscores the need for radiologists to be well-versed in normal and variant anatomy. This knowledge is vital for avoiding diagnostic errors and planning surgical or interventional procedures effectively.
- **Combination of Anomalies and Variants**: The occurrence of both a congenital anomaly and an anatomic variant in a single patient highlights the complexity and potential for multiple coexisting abnormalities. This finding reinforces the necessity for comprehensive and meticulous radiologic evaluations to ensure accurate diagnosis and appropriate treatment planning (6).
- **Diagnostic Challenges**: The potential imaging pitfalls, such as uneven fat distribution and pseudomasses, demonstrate the challenges faced by radiologists in distinguishing between true pathological findings and normal anatomical variations. Awareness of these pitfalls is essential to improve diagnostic accuracy and reduce the risk of misdiagnosis.

Overall, the results of this study provide valuable insights into the prevalence and variety of pancreatic and biliary anomalies, emphasizing the critical role of detailed and accurate radiologic assessments in diagnosing and managing these conditions. The study's findings contribute to enhancing the knowledge base and diagnostic capabilities of healthcare professionals, ultimately improving patient outcomes.

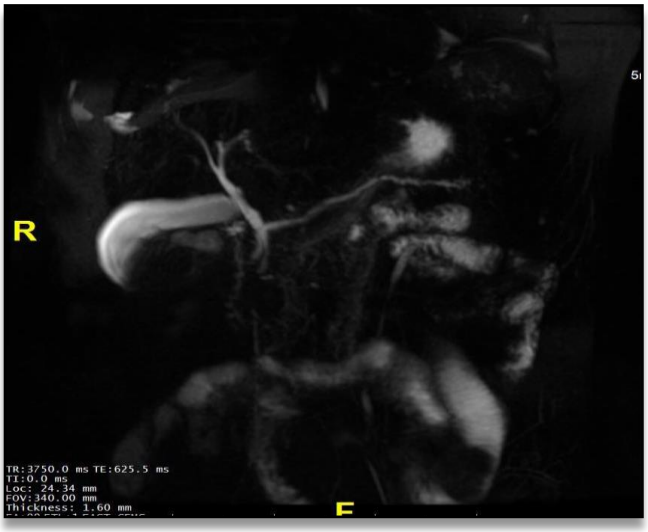

Fig 3: Pancreatic Divisum – 3D MRCP Image Showing the Main Pancreatic Duct Opening at the Minor Papilla with a Prominent Dorsal Duct and a Small Ventral Duct Opening at the Major Papilla along with the CBD

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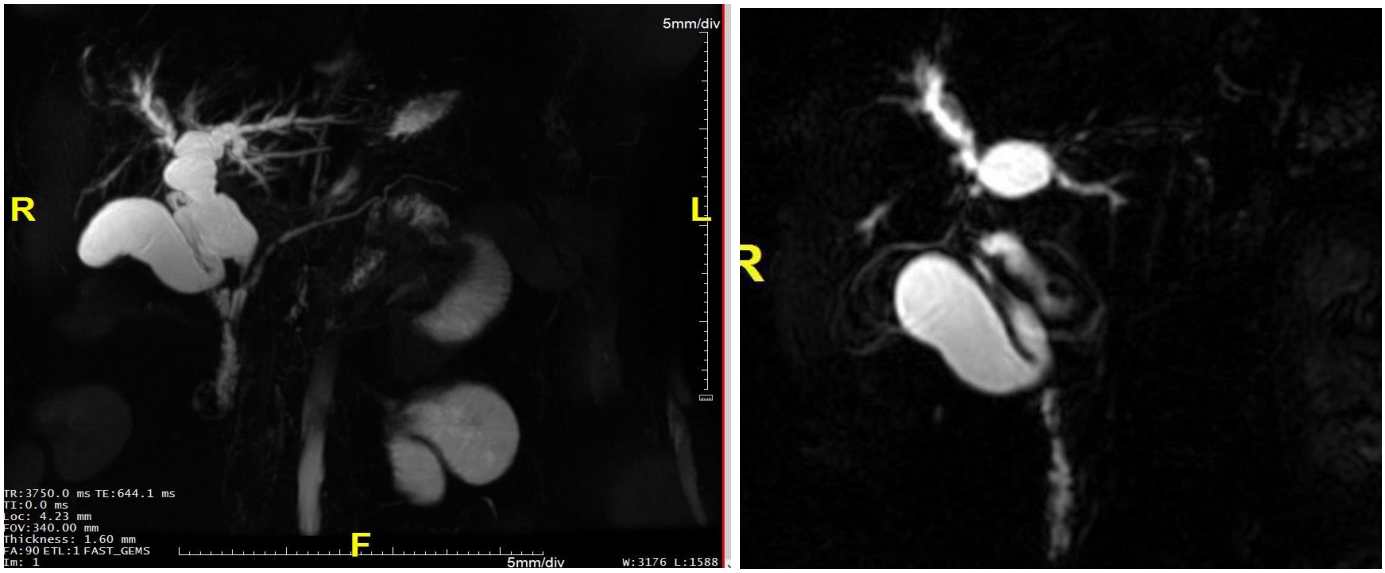

Fig 4: TYPE 4 A Choledochal Cyst: a) Diffusely Dilated CHD, Proximal CBD with Smooth Tapering Noted in Distal CBD. b) Beaded Appearance and Moderate Dilated Central and Peripheral Biliary Radicles

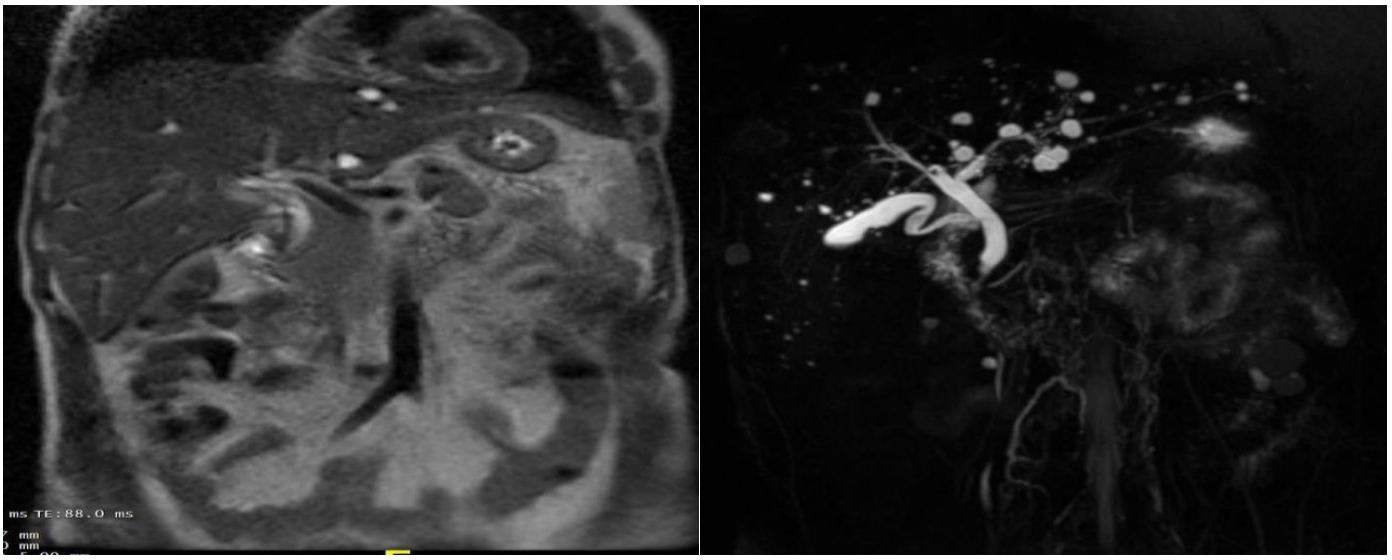

Fig 5: Von Meyenburg Complexes (Biliary Hamartomas) – Prominent CBD with Gradual Tapering of Distal CBD; Multiple Cystic Structures (~10mm) in the Biliary System Without Obvious Communication

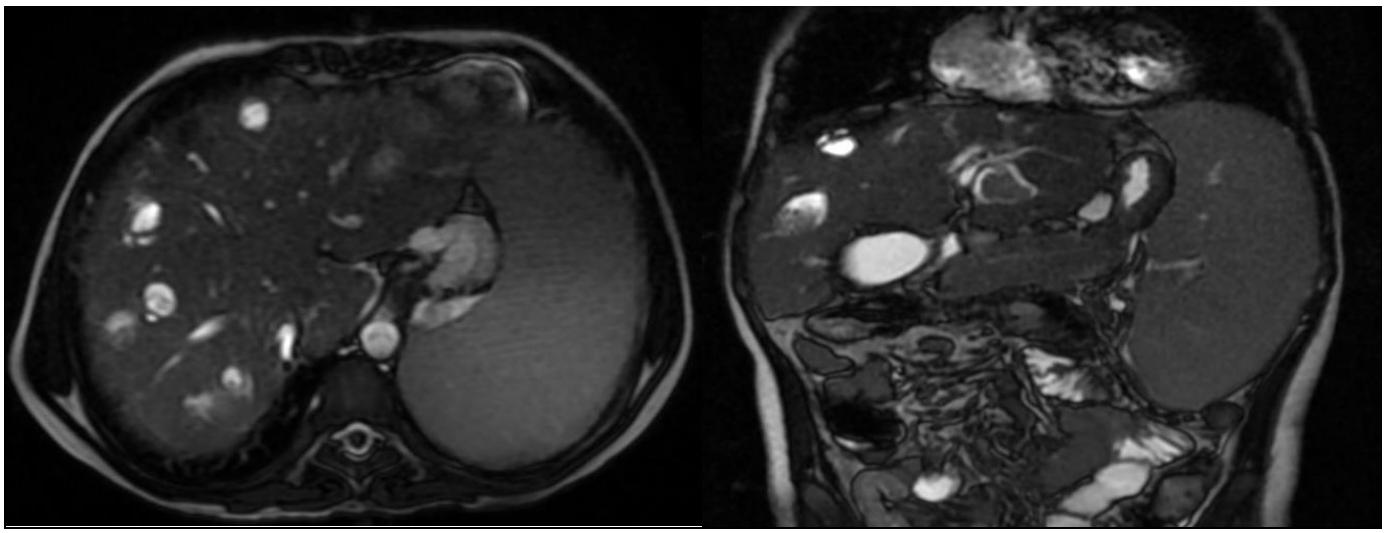

Fig 6: Caroli Disease – T2 hyperintense fusiform cystic ectasia in intrahepatic biliary radicles communicating with biliary radicles in both liver lobes; numerous T2 hypointense foci within the cystic dilations.

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V. CONCLUSION

MRCP plays a crucial role in diagnosing congenital anomalies and anatomical variants of the pancreatiocobiliary tract. A thorough understanding of embryology and normal variations helps avoid diagnostic pitfalls and improves the accuracy of preoperative and interventional planning.

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