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Anatomy

ANATOMICAL VARIATIONS OF INTRAHEPATIC BILE DUCT DETECTED BY MAGNATIC RESONANCE CHOLANGIOPANCREATOGRAPHY (MRCP) AT TERTIARY CARE CENTRE OF NORTH INDIA.

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ABSTRACT

INTRODUCTION- Intrahepatic bile duct anatomy shows many variations. Preoperative knowledge of intrahepatic bile duct anatomy is critical for planning liver resection, liver transplantation and complex biliary reconstructive surgery.

AIM- The purpose of the study is to know the prevalence of variations in our population.

MATERIAL & METHOD- MRCP was conducted on 200 adult patient and were evaluated retrospectively.

RESULT- In 200 adult patients 108 were female and 92 were male. Out of 200 patients Huang Type A_1 were found in 138 patients [69%], type A_2 in 26 patients [13%] ,type A_3 in 16 patients [8%], type A_4 in 8 patients [4%] and none of the patient was of A_5type. 12 patients [6%] show other type of variations.

CONCLUSION- Intrahepatic bile duct anatomy is complex with many common and uncommon variations. Accurate knowledge of the biliary anatomy and its variation is needed to plan the surgery and minimize post operative complications.

KEYWORDS : Intrahepatic bile duct, biliary variations, MRCP

INTRODUCTION -

An accurate knowledge of normal branching pattern of intrahepatic bile duct and their variations is of crucial importance for any kind of hepatobiliary surgery. Normal biliary anatomy is seen in only 58% of the population[1]. MRCP is an excellent non-invasive imaging technique for visualization of detailed biliary anatomy. In this article, we will discuss the different pattern of right and left hepatic duct variations and variations in cystic duct anatomy. The individual biliary drainage system runs parallel to the portal venous supply system. Therefore, the normal biliary anatomy is similar to portal venous anatomy. The right hepatic duct drain the segments of the right liver lobe (V-VIII). The right hepatic duct has two major branches: The right posterior duct draining the posterior segments, VI and VII, and the right anterior duct draining the anterior segments, V and VIII. The right anterior duct has a more vertical course, whereas the right posterior duct has an almost horizontal course.

The right posterior duct usually runs posterior to the right anterior duct and fuses with it from a left (medial) approach to form the right hepatic duct . The left hepatic duct is formed by segmental tributaries draining segments II-IV .

Normal anatomy of extrahepatic bile ducts The fusion of right and left hepatic ducts forms the common hepatic duct. The right hepatic duct is usually shorter than the left hepatic duct. Biliary confluence angle is said to be narrow when the angle is less than 90^0. The bile duct draining the caudate lobe usually joins the origin of the left or right hepatic duct. The cystic duct classically joins the common hepatic duct below the confluence of the right and left hepatic ducts . The normal cystic duct measures 2-4 cm in length and 1-5 mm in diameter. It contains the spiral valves of Heister and frequently follows a tortuous course. Normally, the right posterior sectoral duct passes posterior to the right anterior sectoral duct and joins it from the left to form the right hepatic duct (Type I) . The most common anatomic variation in the branching of the biliary tree involves the fusion of right posterior sectoral duct with the left hepatic duct . Other variations encountered are right posterior sectoral duct opening into the common hepatic duct or cystic duct and trifurcation anomaly . More than one anomaly coexisting can also be seen like two accessory right ducts opening into common hepatic duct, trifurcation anatomic variation (Type II) with high insertion of cystic duct , trifurcation anomaly with ansa pancreatica , crossover anomaly with spiral course of cystic duct , coexisting Type III and Type V anomaly , and quadrifurcation anomaly . Normal left-sided biliary ductal anatomy consists of a common trunk of segment II and segment III duct which joins the segment IV duct (Type A). Other variations are triconfluence of segment II, III, and IV duct and segment II duct draining into a common trunk of segment III and segment IV duct.

Aberrant and accessory bile ducts

An aberrant bile duct has an anomalous confluence pattern and is the only bile duct draining a particular segment of the liver. An accessory bile duct is an additional bile duct draining a particular area of the liver . Accessory hepatic ducts are present in 2% of the patients. Cystohepatic duct is an aberrant bile duct usually draining the right liver parenchyma and courses through the gallbladder fossa. It may have its opening in the cystic duct or in the right hepatic duct. Cholecystohepatic duct is a rare aberrant hepatic duct draining a portion of the right lobe and coursing through the Calot's triangle [anatomic space bordered by the common hepatic duct medially, the cystic duct laterally, and the cystic artery (liver) superiorly. It opens directly into gallbladder lumen.

Cystic duct variations

- Parallel course of cystic duct i .e. cystic duct coursing parallel to the common hepatic duct for at least a 2 cm segment
- Medial insertion of the cystic duct, i.e. drainage of the cystic duct into the left side of the common hepatic duct
- Low cystic duct insertion i.e. fusion of the cystic duct with the distal third of the extrahepatic bile duct.
- Spiral course of the cystic duct
- High fusion of the cystic duct with the common hepatic duct
- Short cystic duct is defined as cystic duct having a length of less than 5 mm.
- Cystic duct hypertrophy
- Hepatico-cystic duct is an anomalous duct draining directly into the cystic duct

MATERIAL AND METHODS :

The study is retrorespective cohort study and performed on 200 patients referred to department of radiodiagnosis, Indira Gandhi Institute of Medical Sciences Patna for Magnetic Resonance Cholangiopancreatography (MRCP) evaluation. These patients were assessed for Magnetic Resonance Cholangiopancreatography (MRCP) at Indira Gandhi Institute of Medical Sciences Patna from December 2018 to June 2019. Patients with MRI incompatible prosthesis and implants were excluded from the study patients with motion artefact and large neoplastic lesion which causing distortion of biliary anatomy was excluded from the study. MRCP was done on a 1.5T MR machine (GE Signa). The MRI sequences commonly acquired are axial T2 sequence, Axial T2 fat sat sequence, coronal

single shoot fast spine echo (SSFSE), axial 3D MRCP (T2 WI), Axial fat sat T1 sequence and Diffusion weighted imaging sequence (DWI). Post contrast study was not done as it is not required for biliary mapping . Biliary Mapping Cholangiograms were retrospectively evaluated by two radiologists and a consensus was reached as to the branching pattern of the Right anterior hepatic duct (RAHD), Right posterior hepatic duct (RPHD), and the Left hepatic duct (LHD). Biliary classification was done as per to the ERCP findings of Huang et al. These were A1 (right and left hepatic ducts forming a common hepatic duct), A2 (trifurcation formed by the right anterior hepatic duct), A3 (drainage of the right posterior hepatic duct into the left hepatic duct), A4 (drainage of the right posterior hepatic duct into the common hepatic duct) and A5 (right posterior hepatic duct into the cystic duct).

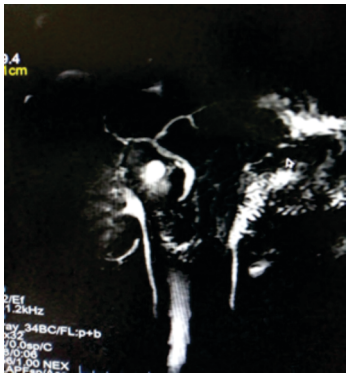

Figure 1- normal anatomy of hepatic ducts as delineated by MRCP

Figure 3: segment vi duct join into left hepatic duct

Table 1 Classification of right and left hepatic duct variations according to Huang et al. and Karakas et al..

	Huang type	Karakas type
A1	Right posterior sectoral duct (RPSD) drains into the right anterior sectoral duct (RASD)	K1 – distance of RPSD and RASD junction >1 cm from the confluence of RHD and LHD K2a – distance of RPSD and RASD junction ≤1 cm from the confluence of RHD and LHD
A2	Trifurcation pattern of insertion of RPSD, RASD and left hepatic duct (LHD	K2b
A3	RPSD drains into LHD	K3a – junction of RPSD and LHD ≤1 cm from the confluence. K3b-junction of RPSD and LHD > 1 cm from confluence.
A4	RPSD drains into the common hepatic duct (CHD)	K4
A5	RPSD drains into the cystic duct	K5

RESULTS :

This study included 200 patients out of which 108 were females and 92 were males, referred for MRCP.

Pathological Findings of 200 patients- gall bladder carcinoma is the most common etiology found in 46 cases (23 %) Common bile duct stone in 27 cases (13.5 %), Acute pancreatitis in 17 cases (8.5%) , chronic pancreatitis in 17 cases (8.5%), gall bladder stone without mass in 17 cases (8.5%), choledochal cyst in 6 cases (3%), benign common bile duct stricture in 7 cases (3.5%) , periampullary mass in 7 cases (3.5%), pancreatic divisum in 7 cases (3.5%),localised collection in 6 cases (3%), cholangiocarcinoma in 5 cases (2.5 %), liver mass in 3 cases (1.5%), acute cbd injury in 2 cases (1%) , benign pancreatic cyst in 2 cases (1%), liver abscess in 2 cases (1%), peritoneal carcinomatosis in 2 cases (1%) , chronic liver disease in 2 cases (1%) , portal vein thrombosis in 2 cases (1%) and 15 patients (7.5%) had no radiological evidence of hepatobiliary pathology .

Bile duct configurational variations -Anatomic variations of biliary system were classified according to Huang classification. Out of 200 patients, 138 had Type A1 , biliary branching pattern, 26 had Type A2 , 16 had Type A3 , 8 had Type A4 , Type A5 was not found in any patient whereas, in 12 (6%) patients other type of variations seen**.**

DISCUSSION -

This study shows that IHBD anatomy and variations can be evaluated safely and noninvasively by MRCP . Variations in arterial, venous, and ductal structures of the hepatopancreaticobiliary system are frequently observed. The reason for the frequency of IHBD variations in this system is clockwise rotation at the fourth to seventh embryologic weeks at the level of the midgut and foregut junction[2] . The number of hepatobiliary surgeries has increased, which particularly includes laparoscopic cholecystectomy, transplantation surgery, hepatic resection, and tumor surgery. Complications related to the biliary system constitute one of the most common reasons for morbidity and mortality in these surgeries.[3]

To minimize peri- and postoperative morbidity and mortality, a detailed evaluation of the biliary anatomy is essential before surgery . In traumatic or iatrogenic biliary damage, in which biliary drainage is disrupted, jaundice, bilioma, biliary peritonitis, sepsis, and biliary fistula may develop within 1–2 weeks[3,5]. Various diagnostic methods can be used to evaluate the biliary anatomy in the preoperative period (conventional T2-weighted MRCP, contrast-enhanced T1-weighted MRCP, and multidetector row CT cholangiography) or during surgery (intraoperative cholangiography). Among these, the most commonly used method is MRCP, since it is non-invasive and does not require a contrast material. MRCP relies on heavily T2-weighted images that produce a high signal from the static fluid. This method can noninvasively display the anatomy of the intra- and extrahepatic biliary tract, with a high sensitivity and specificity . The proper evaluation of the IHBD anatomy and its variations. before liver transplantation and extensive liver resection is very important [6]. Many studies reported that the variations of the biliary system were frequently observed, and these variations were not contraindicated for transplantation; however, an accurate pre- and intraoperative evaluation was required for successful transplantation planning. In a patient with Type A3 bile duct variations according to the Yoshida classification, the right posterior branch can be ligated during left hepatectomy, which can cause cirrhosis development at segments 6/7. However, studies have reported that Type A2 bile duct pattern is contraindicated for safe right lobe donation and the Huang type A3 bile duct pattern is also contraindicated for both right and left lobe donations [7,8]. In addition, biliary variations are a major source of morbidity and mortality after transplantation.[3,9] As biliary tract variations are observed quite often, an evaluation of bile duct variations with MRCP before laparoscopic cholecystectomy is very important to prevent biliary complications because of ductal injuries such as bile leakage, bile peritonitis, biliary stricture, obstructive jaundice, and liver abscess .[10] Poor visualization of the cystic duct during surgery may cause accidental bile duct injury. An unnoticed bile duct during surgery may cause bile peritonitis or bilioma that develop 5–7 days postoperatively. If not treated, the mortality rate can be as high as 44%[11]. Except iatrogenic complications during surgery, other complications include bile duct calculi formation, pancreatitis, and cholangitis.

CONCLUSION-

MRCP is a non-invasive and reliable method to evaluate the IHBD anatomy and its variations in the preoperative period. Biliary tract related complications in hepatobiliary surgery are important causes of morbidity and mortality. Preoperative biliary mapping by MRCP is very helpful in reducing biliary complications, post operative morbidity and mortality.

Conflict of interest- nil.

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