"ROLE OF MAGNETIC RESONANCE CHOLANGIO PANCREATOGRAPHY IN THE EVALUATION OF NORMAL ANATOMICAL VARIATIONS AND ANOMALIES IN BRANCHING PATTERN OF BILIARY SYSTEM -HOSPITAL BASED 1 YEAR OBSERVATIONAL STUDY"

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LIST OF ABBREVIATIONS

MRCP	Magnetic resonance cholangiopancreatography
ERCP	Endoscopic retrograde cholangiopancreatography
GB	Gall bladder
CD	Cystic duct
RPSD	Right posterior sectoral duct
RASD	Right anterior sectoral duct
RHD	Right hepatic duct
LHD	Left hepatic duct
CHD	Common hepatic duct
CBD	Common bile duct
IHD	Intrahepatic bile ducts
EHD	Extrahepatic bile duct
CDC	Choledochal cysts
BA	Biliary atresia
BH	Biliary hamartomas
USG	Ultrasonography
CBD	Computed tomography
IVC	Intravenous cholangiography
DIC	Drip infusion cholangiography
PTC	Percutaneous transhepatic cholangiography
SSFP	Steady State Free Precision
CE-FAST	Enhanced Fourier Acquired Steady State Technique

RARE	Rapid acquisition with relaxation enhancement
MIP	Maximum intensity projection
FSE	Fast spin-echo
TSE	Turbo spin-echo
HASTE	Half fourier single-shot turbo spin-echo

ABSTRACT

BACKGROUND

Biliary tree systems have many anatomical variants and anomalies, thorough knowledge of anatomical variants and anomalies of the biliary tree is of paramount importance as there is a substantial increase in the operative procedures being performed on the biliary tree, such as resection and replacement of liver, drainage of biliary obstructions and radiological interventional procedures.

Bile duct injuries are frequently associated with surgical intervention procedures due to no prior knowledge of the variations in the anatomy of the biliary system. Wrong evaluation of the biliary anatomic variations might lead to inadvertent ligature or aberrant ducts section can lead to significant complications like leakage of bile or atrophy of the residual liver. Thus, accurate information of the anatomy of the biliary tree and its variants frequency is critically important during surgical procedures, especially when it comes to anatomic areas with high rates of variations, such as the hepatobiliary system.

Magnetic Resonance Cholangiopancreatography (MRCP) is a non-invasive modality, doesn’t require contrast, lack of exposure to radiation that can produce highly accurate images and provide knowledge of biliary tree anatomical variations and anomalies.

The purpose of the study is to identify the normal structural variations and anomalies in the branching pattern of the bile ducts by using Magnetic Resonance Cholangiopancreatography

MATERIALS AND METHODS

This is a cross sectional study carried out on 58 patients who were referred to Department of Radiodiagnosis over a period of 1 year duration at KLE’s Dr. Prabhakar Kore Hospital & MRC, Belagavi. The study participants underwent magnetic resonance cholangiopancreatography (MRCP).

The current study was a hospital based cross sectional study, conducted in the Department of Radiodiagnosis at the KLE’s Dr.PRABHAKAR KORE Hospital & MRC, BELAGAVI. Patients who were referred to Department of Radiodiagnosis at the KLE’s Dr.PRABHAKAR KORE Hospital & MRC, BELAGAVI for magnetic resonance cholangiopancreatography (MRCP) between January 2020 & December 2020 were considered for the study.

The study included 58 patients who satisfied the inclusion criteria. All the patients underwent MRCP by using 3.0 tesla Magnetom Spectra MRI manufactured by Siemens. Once the MRCP is done, the findings of the MRCP were assessed and analyzed.

Descriptive analysis was carried out for the quantitative data. Data was represented using appropriate diagrams like bar diagram and charts.

RESULTS

- The study was a hospital-based cross-sectional observational study
- Patients referred to the Department of Radiodiagnosis, KLES Dr Prabhakar Kore Hospital & MRC, Belagavi for MRCP were included in the study. 58 patients were included in the study after observing the inclusion and exclusion criteria.
- All patients underwent MRCP to evaluate and categorize biliary anatomical variations and anomalies. Biliary tree variations were classified according to Huang's classification.
- Majority 31(53.45%) of patients were males and male-female ratio was 1.14:1.
- 48.28% of patients were aged between 30 to 60 years. The mean age was 43.37 years.
- The most common anatomical variation of RHD among our study population was the Type A1 (79.31%) followed by Type A2 variant (15.52%). The most common anatomical variations of LHD was Type B1 (93.10%) followed by Type B2 variant (5.17%) The most common anatomical variations of CD was right lateral insertion (36.21%) followed by proximal insertion (27.59%). 13.79% of patients had accessory duct.
- 13.79% of patients had anomalies, the most common anomaly was choledochal cysts (10.34%). Choledochal cysts was classified according to the Todani classification, Most common was Type Ia (50%) followed by Type IVa (33.33%).

CONCLUSION

MRCP is a highly accurate, non-invasive, sensitive, non-ionizing and superior diagnostic modality which is very useful for evaluation of the biliary system and identifying the normal biliary anatomical variants and anomalies. Precise information regarding the different types of variants and anomalies of RHD, LHD and CD be easily identified and categorized accordingly. Huang's classification is simple, easy and helps to classify the biliary tree variations. The most common type of anatomical variations of RHD was Type A1 and of LHD was Type B1. The most common type of anatomical variation of CD was low medial insertion. The most common anomaly observed was Choledochal cysts in which Type Ia choledochal cysts was most common according to the Todani classification.

Limitations:

- MRCP drawbacks
    a) Claustrophobia
    b) Breath holding is not possible in elderly, children and debilitated patients
    c) Time consuming

KEYWORDS: Magnetic resonance cholangiopancreatography, right hepatic duct, left hepatic duct, cystic duct

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INTRODUCTION

Biliary tree systems have many different variants and anomalies, proper knowledge of its variant anatomy is necessary for surgeons to operate and prevent complications. Magnetic resonance cholangio-pancreatography (MRCP) is a secure and precise method to analyze biliary system anatomy and variations[1].

In liver donors the right portion of the liver is frequently used in adults and in pediatric recipients, part of the left lobe, II and III liver segments are used. A thorough understanding of the biliary system anatomical variations is of significant importance to prevent complications that may arise intraoperatively or in the preliminary postoperative period. Biliary cirrhosis can occur because of ligation of aberrant ducts or accessory ducts, crossover and trifurcation anomalies, thus it is imperative to detect these variations.

Cholecystectomy is one of the commonest surgical procedures performed on the abdomen and it is mostly done by laparoscopic means. During the procedure it a crucial to adequately assess the Calot's triangle and need to have information of variations associated in conjunction with biliary ducts and blood vessels[2]. During surgery, Biliary tracts can get injured which is a serious complication, seen to occur in 1 in 200 to 300 operations. It is one of the major problems of the surgery and is feared as it is followed by significant illness and sometimes mortality with huge health care expenses and repeated litigation[3]. Variations of Cystic duct can be in the length, confluence site, complete absence or double cystic duct. Presence of subvesical bile duct, an anomaly should be anticipated during cholecystectomy, which can be injured and cause bile leak in 1 out of every 633 operations[4]. Cholecystectomies done by laparoscopic means have two times more frequency of bile duct injuries as compared to open cholecystectomies[5].

Surgeons and radiologists should be aware of the presence of these variations of the biliary system which are common and particularly of substantial importance in liver replacement or resection surgeries thus understanding their variations and clinical significance help to minimize postoperative complications[6].

MRCP is a non-invasive modality for evaluation of the bile and pancreatic duct systems with the use of specific sequences having specific gradients. Endoscopic retrograde cholangiopancreatography (ERCP) in comparison with MRCP, is diagnostically highly precise but due to invasiveness can lead to complications.

AIM AND OBJECTIVES

AIM:

To study and identify the normal structural variations and anomalies in the branching pattern of the bile ducts by using Magnetic Resonance Cholangiopancreatography (MRCP)

OBJECTIVES:

- To find out the age, gender distribution and prevalence of the biliary tree anatomical variations and anomalies

REVIEW OF LITERATURE

As there is a substantial increase in the operative procedures being performed on the biliary tree, such as resection and replacement of liver, drainage of biliary obstructions and radiological interventional procedures, hence thorough knowledge of anatomical variants and anomalies of the biliary tree are of paramount importance[7].

Biliary system

It is formed by bile ducts inside and outside the liver, gall bladder (GB) and cystic duct (CD) which transports bile. The biliary tract is a pathway through which the bile secreted from the liver is transported to the duodenum

Anatomy

Couinaud defined normal biliary anatomy, 2 major branches drain the right lobe of the liver. The duct which drains segments VI and VIII is the right posterior sectoral duct (RPSD) and the duct which drains segments V and VIII is the right anterior sectoral duct (RASD). RPSD has a more horizontal course and RASD has a more vertical course. RPSD joins RASD posteromedially leading to the formation of RHD. The segmental tributaries which drain the left lobe liver segments II-IV join to form the left hepatic duct (LHD). Duct draining the caudate lobe usually joins at the origin of the LHD or RHD. Union of RHD and LHD leads to the formation of the common hepatic duct (CHD). CD joins the CHD to form a common bile duct (CBD). This is the normal anatomy of the biliary system which is thought to be present in 58% of the population [8].

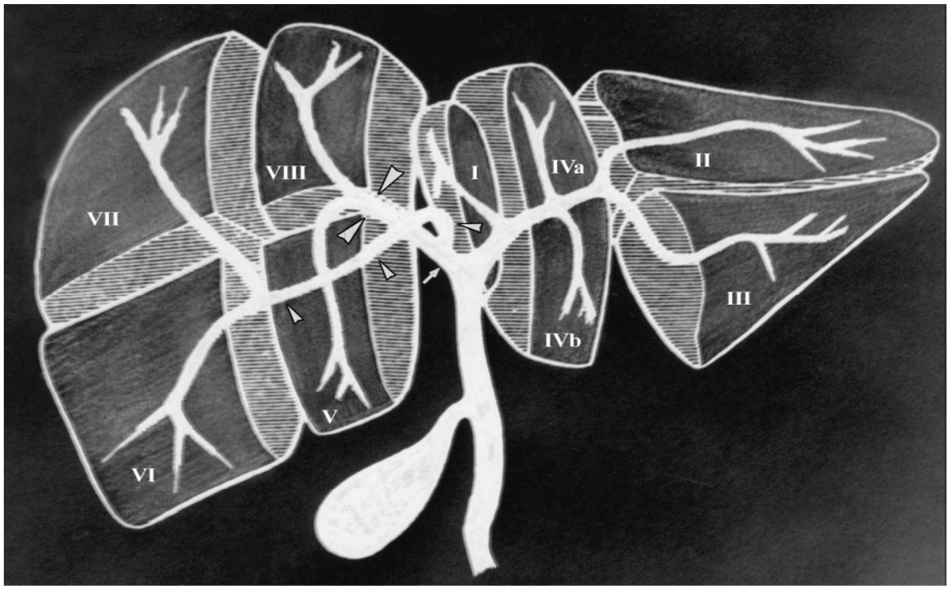


Figure 1. Diagrammatic illustration Couinaud normal anatomy of the liver and biliary tree system[8].

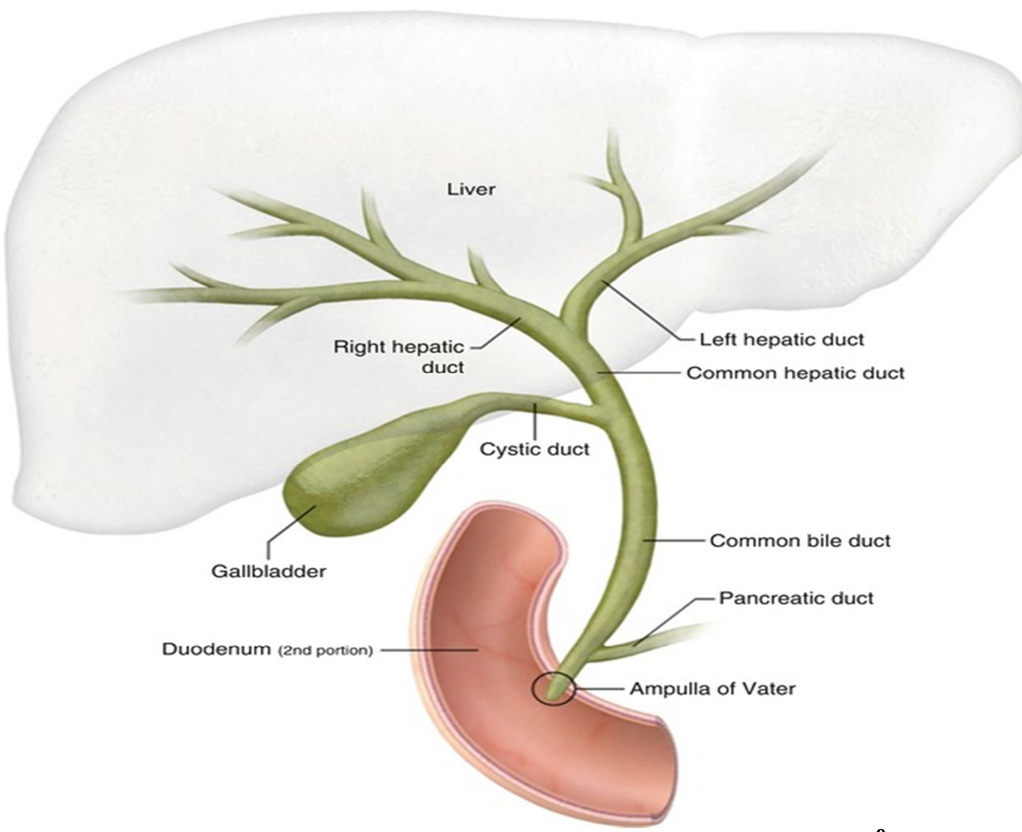


Figure 2. Diagrammatic illustration of the biliary tree[9].

Embryology

The biliary system is derived from embryogenic foregut. The ventral surface of the foregut develops a diverticulum by the fourth week. The caudal and cranial portions of the hepatic diverticulum are the primary divisions of the liver. Cystic duct (CD) and gall bladder (GB) are formed from caudal portion and the cranial aspect forms the intra-hepatic and hilar bile ducts. Hepatic cells cords and epithelial lining of intrahepatic bile ducts (IHD) are formed by the differentiation of endodermal cells. The similarity between the branching configuration of the portal vein and ducts, as the ductal cells follow the growth pattern of the connective tissues surrounding portal vein branches. Initially, epithelial cells cause occlusion of the extrahepatic biliary system, but as they start to degenerate it later gets canalized. Between the hepatic and cystic ducts, there is a stalk that unites with the duodenum and separates into CBD. The duct is first linked to the duodenum's ventral surface but as duodenum undergoes rotation, CBD repositions to dorsal side of the duodenal wall[10].

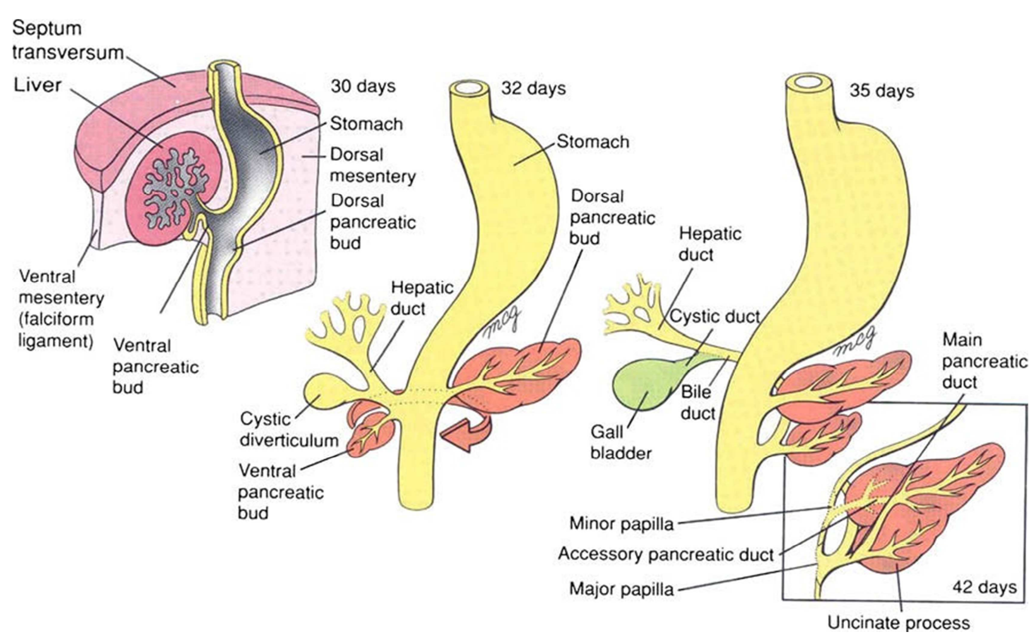


Figure 3. Diagrammatic illustration of embryological development of the biliary system[10].

Many anatomical variations can occur throughout the process of formation of the liver and biliary tree, resulting in significant challenges for the concerned practitioner in diagnosing and treating the patient. In order to plan radiological, surgical, endoscopic, and other interventional methods a detailed understanding of biliary anatomical variations is essential[10].

Biliary Anatomical Variations

Several classifications suggested by Couinaud, Choi, Champetier, Karakas, Ohkubo, Yoshida, and Huang, were used to classify intrahepatic biliary anatomical variations. Certain anatomical changes cannot be categorized using any of the above classification systems presented, thus far, since each classification method has benefits and drawbacks[11].

In 1996 Huang and co-workers proposed a classification for donor liver transplantation. Accordingly, RHD variations are divided into five types depending upon the insertions of the RASD & RPSD. In Type A1 variant in which the RPSD drains in the RASD and forms RHD, in Type A2 there is trifurcation in which the RPSD joins the common insertion of RASD and LHD, in Type A3 the RPSD is attached to LHD, in Type A4 the RPSD attaches to the CHD and in Type A5 the RPSD attaches to the CD[12].

LHD was divided into 6 types depending upon the insertion of duct of segment 4, in type B1 the duct of segment IV drains into LHD, in type B2 the duct of segment IV duct drains into CHD, separately of segments II and III ducts, in type B3 duct of segment IV drains into RASD, in type B4 the duct of segment IV drains in

CBD, in type B5 the duct of segment IV drains in duct of segment II and in type B6, segmental ducts of II and III with duct of segment 4 to forms the LHD[12]

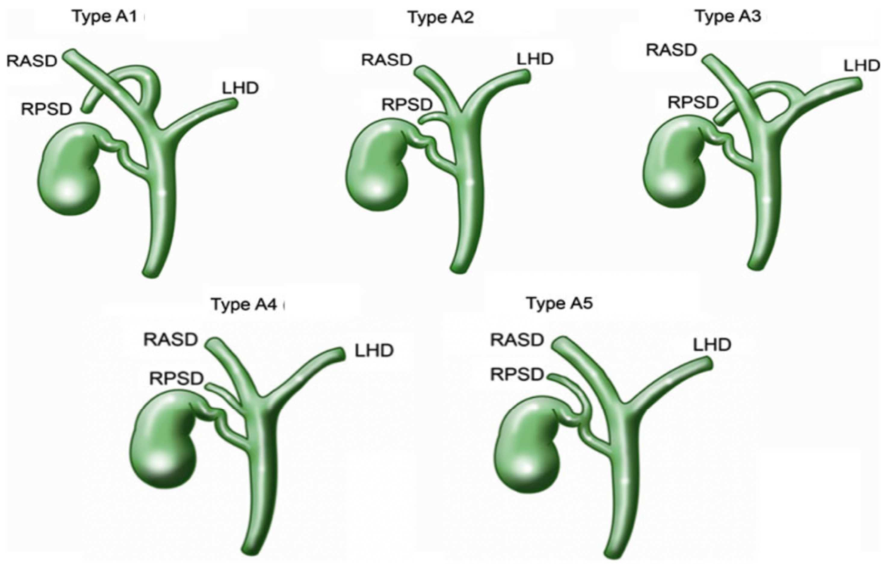


Figure 4. Diagrammatic illustration of RHD classified by Huang classification[12].

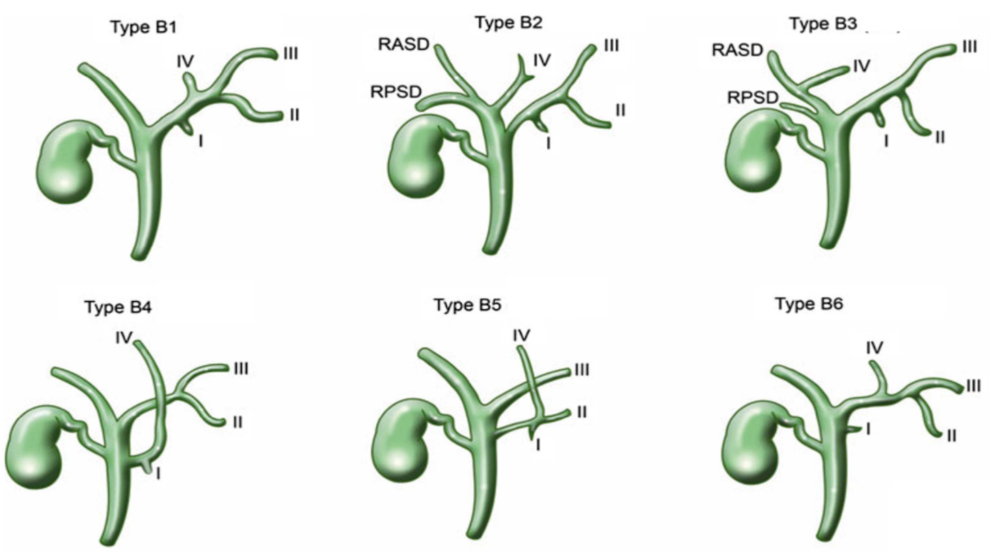


Figure 5. Diagrammatic illustration of LHD classified by Huang classification[12].

Accessory Ducts

Ducts of Luschka also called subvesicular or supravesicular ducts[13], are the accessory ducts that are seen in the GB fossa around 1.0 to 2.0 mm in diameter which don’t drain any liver area/ parenchyma, they have blind ends distally and are proximally attached to RHD or CHD or rarely CD. Occur in 20-50% of population. Most commonly, the ducts of Luschka are encountered in clinical practice as a result of their injury during laparoscopic or open cholecystectomy, manifested as a bile leak[14].

Aberrant ducts

These are the bile ducts that drain only a specific segment of the liver and does not communicate with other biliary segments[15]. Cysto-hepatic duct is an aberrant bile duct that drains the right lobe of the liver and traverses through the GB fossa to open in the CD or RHD. The cholecystohepatic duct also known as Hepaticocholecystic duct[13] is a type of aberrant duct, these are rare ducts that drain an area of the right lobe of the liver and traverse through the Calot’s triangle and then directly open into the lumen of the gallbladder. One of the extremely rare structural deviation is GB interposition, in which there is drainage of the proper and LHD into the GB. Vaginali ductuli are described as the small intercommunications between two bile ducts and CD[16].

Cystic duct variations

They are classified according to their insertion into the CHD, the most prevalent CD variant is the right lateral insertion, in which the insertion of the CD into the CHD is from the right side, Spiral CD has spiral shape and is inserted into the CHD either anteriorly or posteriorly, high or proximal insertion into the CHD, low insertion of CD in the distal third of CHD which can be medially or laterally[16].

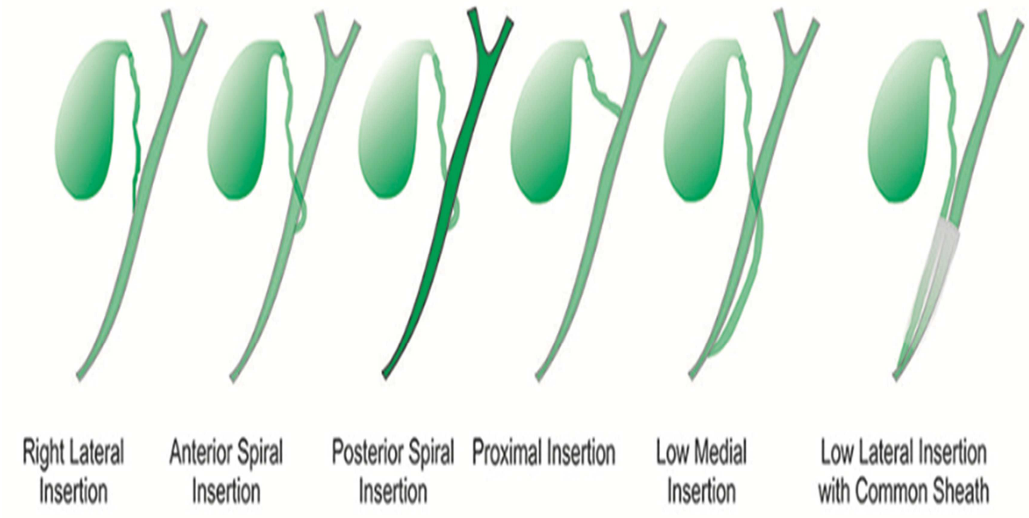


Figure 6. Diagrammatic illustration CD variations[16].

The most common variation in CD attachment is the parallel course of CD, which is defined as parallel coursing of the cystic duct to the common hepatic duct for at least 2.0 cm. Other variants of CD include Short CD is defined when length < 5.0 mm. When the diameter of CD is more than 5.0 mm it is known as CD hypertrophy. Rest of the uncommon variations are double CD, absent CD, and CD entering the RHD[16].

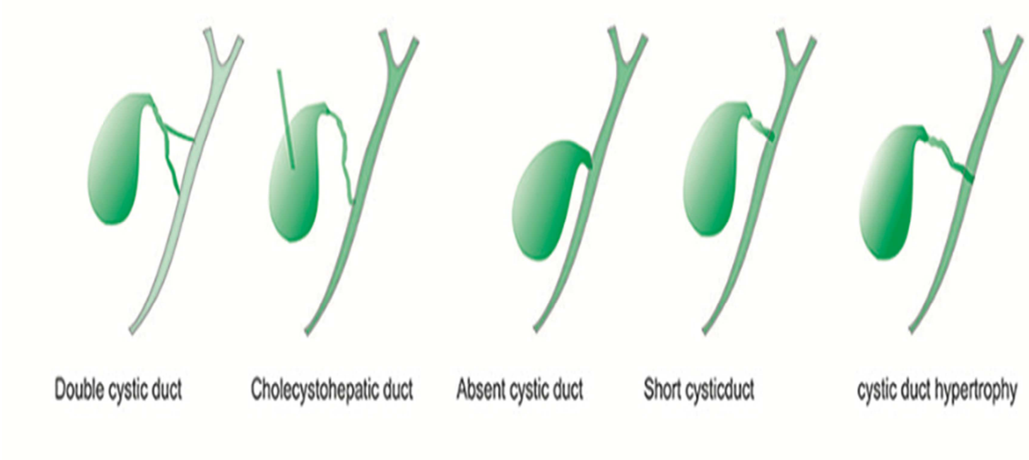


Figure 7. Diagrammatic illustration of uncommon variation of CD[16].

Biliary tract congenital anomalies and variations include accessory or aberrant bile ducts, aberrant insertion cystic duct; cysts of bile duct and biliary tract alterations which are often associated with situs anomalies and junction anomalies of the CBD and the pancreatic duct. Prior knowledge of these normal variants and anomalies may circumvent diagnostic errors, help in surgical planning, and prevent unintentional injuries to duct[17].

ANOMALIES

Choledochal cysts (CDC) are anomalies that are present congenitally, these are mainly disproportional dilatations of the extrahepatic bile duct (EHD). Disproportionate dilatation of EHD in absence of tumour, stones, and inflammation, can guide to the diagnosis of a choledochal cyst. Incidence is 1 in 150,000 people in western countries, however, in Asia rate of incidence is higher and more commonly seen in the female population. Stomach discomfort, jaundice and a mass in the abdomen are the most frequent clinical findings in the pediatric age group. In adults, stomach discomfort is the most prevalent symptom[18].

Todani et al classified Choledochal cysts into 5 types[19].

Type I cysts are more commonly limited to EHD and can be divided into

IA – involve the entire EHD

IB – there is the involvement of a focal segment of the EHD

IC – involves CBD only

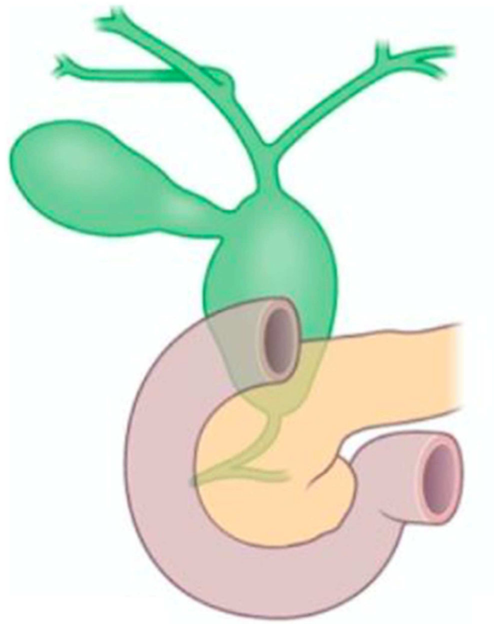


Figure 8. Diagrammatic illustration of Choledochal cyst Type I[20].

Type II cysts, these are described as true diverticula of the EHD

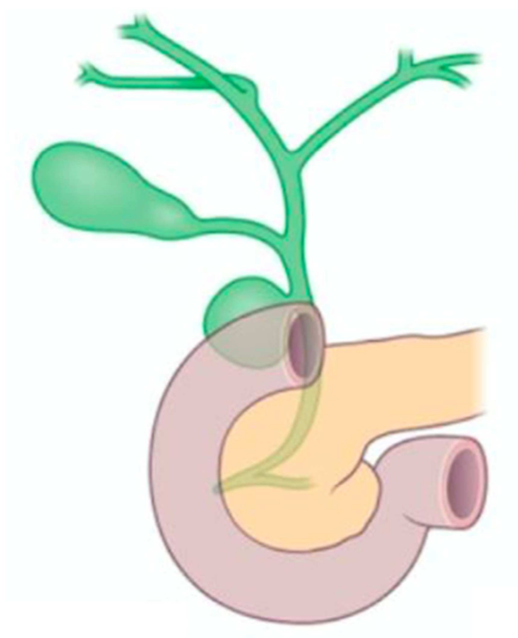


Figure 9. Diagrammatic illustration of Choledochal cyst Type II[20].

Type III cysts are confined to the EHD within the duodenal wall, described as choledochocele.

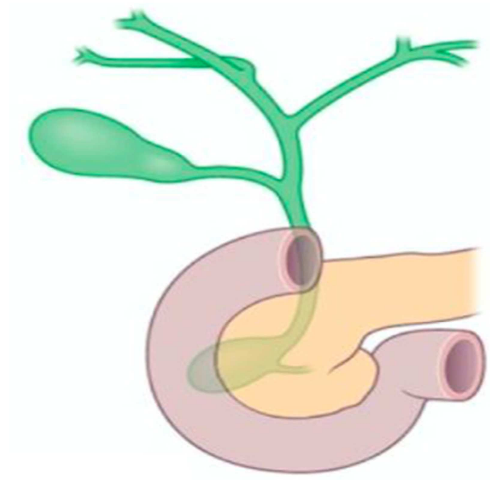


Figure 10. Diagrammatic illustration of Choledochal cyst Type III[20].

Type IV cysts there is involvement of the extra and intrahepatic bile ducts which are subdivided into type IVA and type IVB. Type IVA there is involvement of EHD and intrahepatic bile duct (IHD) and type IVB there is involvement of EHD only with multiple segmental dilatations.

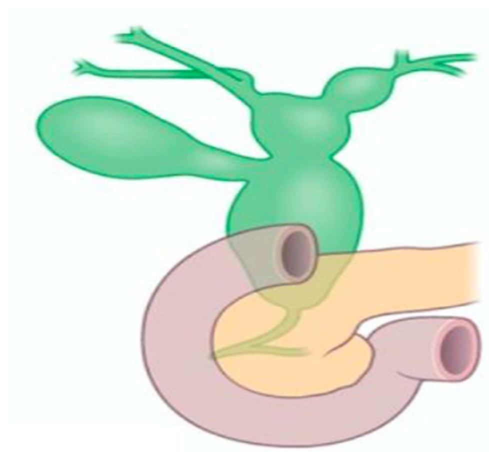


Figure 11. Diagrammatic illustration of Choledochal cyst Type IV[20].

Type V (Calori's disease) cysts involve the IHD.

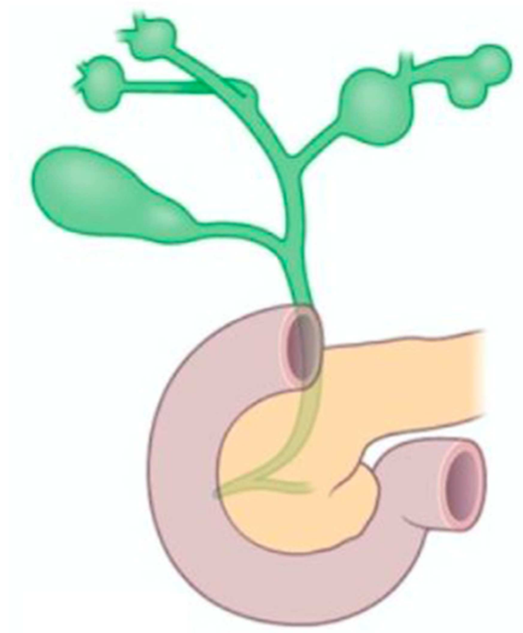


Figure 12. Diagrammatic illustration of Choledochal cyst Type V[20].

The most frequent type of CDC in all age groups is Type I, whereas in adults Type IV is more prevalent[21]. Usually, the maximum diameter of CDC is not more than 6.0 cm. A giant choledochal cyst is a variant of CDC which is referred to as a CDC with a size greater than 10 .0 cm[22]. Choledochal cyst requires surgical intervention to prevent hepatobiliary and pancreatic complications like cholangitis, biliary cirrhosis, portal hypertension, lithiasis, rupture, pancreatitis, and carcinoma[23]. Cystenterostomy, an internal drainage procedure without resection, carries a high malignant change rate and often requires surgical repair[24]. Malignant transformation can occur in CDC, most commonly seen with Todani Type I and IV cysts, cholangiocarcinoma being the most common[25].

Most frequent hepatobiliary disorder is biliary atresia (BA), which is the leading cause of obstructive jaundice in the first 3 months of life, occurring in approximately 1 in 8,000 to 1 in 15,000 live births, and is the reason for 50–60% of liver transplants performed in children. It is a condition in which the extrahepatic biliary tree is either completely absent, or severely deficient[26]. Obstruction of bile flow leads to cholestasis, progressive fibrosis, and, ultimately, cirrhosis and death[27].BA can arise during the embryogenesis or perinatal period. Embryonic BA can be associated with congenital anomalies like polysplenia, absence of it suggest perinatal BA[28]. Kasai classification /Japanese and Anglo-Saxon classification is used to describe the three main anatomical types of biliary atresia. In Type I there is reduction of the liver's primary route of excretion (patent CD and CHD). In type II there are two types, type IIa, there is obliteration of CHD (patent CD and CBD), in IIb there is obliteration of CD, CHD and CBD and in type III there is obliteration of left and right main hepatic ducts at the level of porta hepatis which is most common[29].

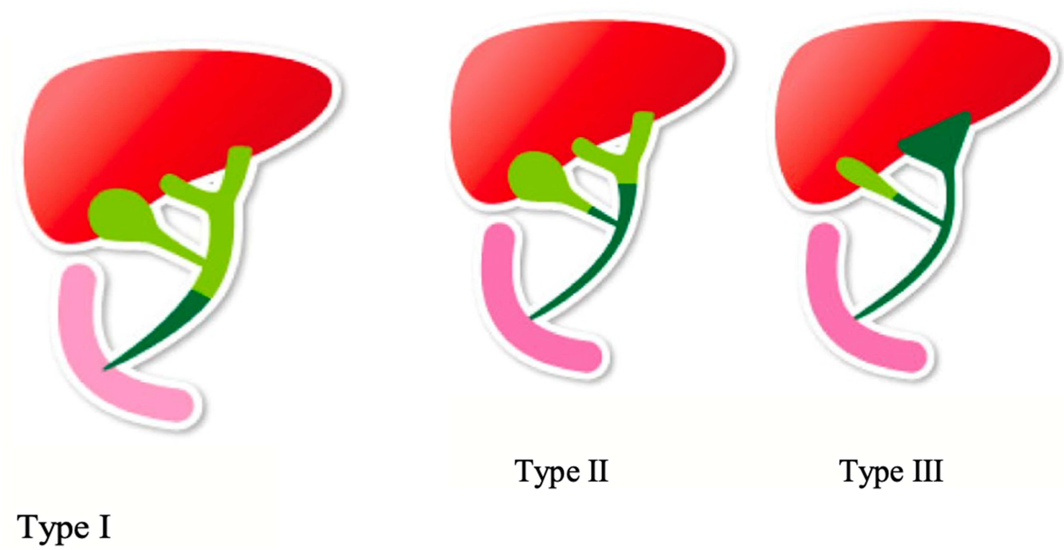


Figure 13. Diagrammatic illustration of BA[30]

Biliary Hamartomas (BH) or Von Meyenburg Complexes (VMC) are rare benign malformations of the intrahepatic bile ducts first described by von Meyenburg in 1918 [31.] These are cystic benign lesions of the liver that consist of focal collections of duct like structures that are embedded in a fibrous stroma and it involves the small interlobular bile ducts resulting in malformation of the ductal plate. Prevalence of the BH on autopsy series ranges from 0.69 to 2.8% and on biopsies they are incidentally found in 0.6%. They appear usually as well-defined parenchymal or subcapsular nodules which are greyish-white and less than 0.5 cm in diameter. On imaging, they range from 0.5 to 3 cm and appear larger. They are most commonly seen in older people but can occur at all ages. In women, they are 3 times more common. On imaging, they can be confused with metastases of liver, micro abscesses, cysts of liver, dilated bile ducts and adenoma of the biliary tree[32]. On MRI, BH typical features are hypointense lesions on T1-WI compared to the liver parenchyma and intense hyperintense lesions on T2-WI. Hamartomas show no diffusion restriction on DWI sequences. 90% of cases of hamartoma can be found containing a mural nodule that is T1 isointense and T2 intermediate and show endocystic enhancement. Thin rim of enhancement around the lesion was correlated with the hepatic parenchyma which is compressed and inflammatory cells that are present around the lesion[33].

Evaluation of Biliary system

Biliary system can be evaluated by various imaging modalities which include, Ultrasonography (USG), computed tomography (CT), MRCP and invasive procedures like intravenous cholangiography (IVC), Endoscopic Retrograde Cholangio-Pancreatography (ERCP) and Percutaneous Transhepatic Cholangiography(PTC)[34]. USG is the most routinely used modality for abdomen evaluation but there are limitations as there can be suboptimal images due to artefacts caused by bowel gas, debris, fluid and obesity. Biliary tree visualization is significantly important from a management point of view, because of this there is a need for modalities like IVC, PTC and ERCP. IVC has drawbacks, as in 30-40% of cases the biliary system does not get adequately opacified. The diagnostic and therapeutic functions of PTC are similar to ERCP but has a higher risk of complications. The severity of sepsis ranges from 1% – 4%[35]. Anatomical evaluation of very tiny bile ducts can be provided by Drip Infusion Cholangiography technique using drip infusion technique on CT (DIC-CT). DIC-CT has certain drawbacks, including the risk of adverse responses to contrast material and the inability to see bile ducts owing to liver disease or obstruction. ERCP is an invasive procedure and operator dependent, which can be associated with morbidity (1%-7%) and mortality (0.2%-1.0%)[36].

MRCP in evaluation of pancreatico-biliary diseases is a rapidly developing modality, its evolution has been one amongst the best successes of recent radiology, it produces highly accurate images with no requirement of contrast, lack of exposure to radiation, non-invasive modality with additional advantages of patient comfort and safety like ultrasound. Unable to provide therapeutic intervention is its only limitation, compared to ERCP[37].

MRCP is a the new gold standard for assessing extrahepatic and intra-hepatic bile ducts, as it gives in-depth information. Enhanced MRCP by Gadolinium ethoxy benzyl diethylenetriamine Penta acetic acid may help in the assessment of biliary structure and its excretion[38]. MRCP with its excellent diagnostic capabilities and has certainly carved a niche for itself for evaluation of biliary system.

First clinical use of MRCP was done in 1991, by Wallner BK et al by using breath hold 2D T2W gradient echo sequence with Steady State Free Precision (SSFP). Morimoto et al and Hall-Craggs et al used the 3D Contrast Enhanced Fourier Acquired Steady State Technique to follow (CE-FAST), for obtaining cholangiograms, the T2-weighted 3D CE-FAST is a fast-imaging approach that uses a maximum intensity projection (MIP) algorithm. Using a modified Fast Spin-Echo (FSE) approach, Takehara et al. demonstrated a 3D reconstruction of pancreatic ducts using images that took 20-40 seconds to obtain. Rapid acquisition with relaxation enhancement (RARE) was first developed by Henning et al, since then, it has been used in a wide range of applications, including turbo or fast spin-echo (TSE or FSE) and half fourier single-shot turbo spin-echo (HASTE) imaging. Images may be acquired in a few seconds with a single breath-hold, which dramatically reduces motion artefacts and significantly improves the picture quality of MRCP using these sequences[39].

Bile duct injuries are frequently associated with surgical intervention procedures due to no prior knowledge of the variations in the anatomy of the biliary system. Wrong evaluation of the biliary anatomic variations might lead to inadvertent ligature or aberrant ducts section can lead to significant complications like leakage of bile or atrophy of the residual liver. Thus, accurate information of the anatomy of the biliary tree and its variants frequency is critically important during surgical procedures, especially when it comes to anatomic areas with high rates of variations, such as the hepatobiliary system. Several anatomical studies have been conducted in order to determine the specific anatomical variations, using cadaveric material, intraoperative data, or imaging modalities such as USG and MRCP[5,40].

Study done by Aljiffry M et al. in Saudi Arabia from January 2015 to December 2017, on 375 patients, MRCP data were retrospectively reviewed. RHD, LHD and cystic duct were classified according to Huang classification. According to the study, RHD variants which were most frequently found were A1 type 34.2%, in which RPSD drains into RASD and followed by A2 type 32.2% in which there was tri-confluence of RASD, RPSD and LHD. LHD variants that were most frequently found were B1 type 71.4% in which segment IV drains into the LHD. CD was classified according to the insertion of the CD into the CHD, variants which were most frequently found were insertion of CD right laterally into CHD seen in 27.7% of patients[12].

Chaib E et al. did a retrospective analysis 2,032 anatomical variants of RHD and 1,014 anatomical variations of LHD. RHD was categorized according to Huang, Nakamura and Varotti classifications. Frequencies of variations of RHD were Type A1-61.3 %, Type A2 was 14.5 %, Type A3 was 13.3 %, Type A4 was 6.1 %, Type A5 was 1 %. LHD variations were as follows, Type B1 was 76.2 %, Type B2 was 15 %, Type B3 was 3.7 %, Type B4 was 0.8 %, Type B5 was 2.8% and others was 1.1%[41].

De Filippo M et al. conducted a study on 350 patients who underwent MRCP for clinically suspected lithiasic, neoplastic or inflammatory disease of the bile and pancreatic ducts. On MRCP the study showed the prevalence of bile and pancreatic ducts normal anatomy was detected in 57% of cases, anatomical variations in 41% of patients and congenital anomalies 1.3% of patients. In 21 % intrahepatic bile tree variations were noted, which included 7.9% hilar trifurcation due to the confluence of posterior and anterior branches of RHD which drain into LHD, 6.7% crossover of the right bisgemented posterior bile duct is s into the LHD. In 3.3%, posterior bile duct drains into the CHD. In 4.5% had low insertion of the CD into the CHD. 1.3% showed congenital anomalies which were choledochal cyst seen in 0.3%, bile duct atresia seen in 0.3% and biliary hamartomatosis seen in 0.7%[42].

Sharma V et al. conducted study on 253 patients. The patients for different indication underwent endoscopic retrograde cholangiograms. Variations in IHD anatomy were divided according to the branching pattern of the RASD and RPSD, depending upon the first-order branch of LHD and accessory hepatic duct. In 52.9% of cases, the anatomy of the IHD was normal. Variations in IHD was found in 47% of patients, the two most frequent variations were RPSD draining into the LHD seen in 18.2% and the second one was RASD, RPSD and LHD forming the triple confluence was seen in 11.5%. Other variations were, RPSD drained into the CHD seen in 7.1%, in 0.4% RHD drained into the CD, in 4.7% accessory duct drained into the CHD or RHD, individual LHD draining into the RHD or CHD was seen in 2.4% and other unclassified or complex variations in 2.7%[43].

Khanduja N et al. conducted a study at Indira Gandhi Medical College, Himachal Pradesh, from 2009-2012 on 100 adult patients. Huang classification was used for Biliary anatomical variations. MRCP demonstrated normal IHD anatomy in 63% and variations in 37%, most variation common was A2 type seen in 18%, followed by A3 type seen in 9 % and A4 type seen in 8% of cases[44].

Sarawagi R et al. conducted a study which showed observations similar to the present study, most frequent variation of RHD was Type A1 variant in which RASD and RPSD join to form RHD was the most common, seen in 55.3%, followed by type A3 in which RPSD drains into LHD was seen in 27.6%, followed by type A2

Trifurcation pattern which was seen in 9.3%, Type A4 was seen in 4%, in RPSD drain into CHD. The accessory duct was observed in 4.9%. The most common type of LHD branching pattern was a common trunk of segment 2 and 3 ducts joining the segment 4 duct in 67.8% of subjects [45].

A study was conducted by Chijiiwa K et al. showed prevalence of choledochal cysts was common in females 89%, as compared to males 11%. According to the Todani classification system, 57% had type I cysts, 4% had type II, and 39% had type IV[46].

MATERIALS AND METHODS

Study site: This study was conducted in the Department of Radiodiagnosis at KLE Hospital, Belgaum.

Study population: All the cases who are referred to the radiology department for Magnetic resonance cholangiopancreatography (MRCP).

Study design: This is a cross-sectional study.

Sample size: 58

Sampling method: All the eligible subjects were recruited into the study consecutively by convenient sampling till the sample size is reached.

Study duration: The data collection was done between January 2020 to December 2020 for a period of 1 year.

Inclusion Criteria:

1. Patients were referred to the radiology department for Magnetic resonance cholangiopancreatography (MRCP).
2. Patients who give consent to take part in the study.

Exclusion criteria:

- Patients who are contraindicated for MRI: Patients with a cardiac pacemaker, prosthetic heart valves, bypass surgery, aneurysmal clips, Iron rods/plates in bones, nails in bones, joint replacement, cochlear implants and metallic implants of any kind were excluded from the study.
- Patients with pathologies like carcinomas or benign tumours.

Ethical considerations: The institutional human ethics committee approved this study. From all the study participants informed written consent was obtained. Only those participants willing to sign the informed consent were included in the study. The risks and benefits that were involved in the study and the voluntary nature of participation were explained to the participants before obtaining consent. The confidentiality of the study participants was maintained.

Data collection tools: All parameters that were relevant was documented in a structured study proforma.

Methodology: Informed written consent was taken from the patient or patient's relatives. A pre-structured proforma was used for collection of baseline data. A detailed history was noted in the form of a systematic proforma. Considering criteria of inclusion and exclusion, the patients were considered for the study. All the selected patients underwent MRCP by using 3.0-tesla Magnetom Spectra MRI machine manufactured by Siemens.

MRCP

Patient preparation-

- Patients are advised to fast for at least 4-5 hours before the study to decrease fluid discharges inside the stomach and duodenum, lessen peristalsis of the bowel and stimulate distension of the gallbladder.
- Patients are asked to remove all metallic objects including keys, coins, wallets, hair clips/ pins, jewellery and hearing aid.
- Patients are asked to change dress into the hospital gown

- A negative oral contrast agent is given (Hematinic syrup-dexorange) 15min before MRCP to suppress the gastrointestinal tract signal during the scan
- Instructions are given to the patients to hold breath for breath-hold scan and gently breathe for gated scans.
- Claustrophobic patients may be accompanied by their relatives with proper precautions.
- Headphones are offered to patients for ear protection and communication.
- To sedate pediatric patients pedicloryl (Triclofos 500mg/5 ml) oral solution is given for <1 year 25-30 mg/kg and for 1-5 year 250-500mg/kg

Positioning

- Patient is positioned in the supine position with head pointing towards the magnet.
- A phased array body coil is placed and securely strapped to prevent respiratory artefacts

Protocol

MRCP scan is done by using 3.0 tesla Magnetom Spectra MRI machine manufactured by Siemens. All protocols obtain heavily T2 weighted sequences.

MRCP sequences

- Localizer
- T2 Half Fourier Single-shot Turbo spin-Echo (HASTE) coronal and axial plane
- T2 HASTE fatsat (FS) coronal and axial plane
- T1 Volumetric interpolated breath-hold examination (VIBE) coronal, sagittal and axial plane

- T2 true fast imaging with steady-state free precession (True FISP) coronal and axial plane
- T2 HASTE thick slab sequence
- T2 turbo spin echo (TSE) and 3D T2-SPACE sequences in coronal plane.

MRCP Process- First a 2D breath-hold HASTE axial sequence is taken and 2 acquisitions are acquired by holding breath, so that the liver is visualized completely, till the ampulla of Vater. After that, two T2 heavily weighted 3D respiratory-triggered images are obtained in the coronal oblique plane. From the axial T2-weighted images the initial imaging plane is selected with 1st acquisition aligned to the common bile duct (CBD) in the head of the pancreas and 2nd acquisition is aligned to the pancreatic duct which is around 90 degrees to the earlier imaging plane. The navigator is placed over the diaphragm edge on localisers coronal and sagittal and when the position of this diaphragm interface with the lung falls within a pre-specified acceptance window, image acquisition is triggered. This allows imaging slices to be obtained inconsistent positions. 3-5 min are required to acquire acquisition and the throughout the process patient is asked to breathe regularly. 40 stack of slices that are conterminous with the thickness of each measuring 1.5 mm is obtained. Maximum intensity projection (MIP) reformat can be converted to various coronal and sagittal oblique planes from this data volume. In the coronal plane, a thick collimation slab is acquired by taking a fat-saturated HASTE sequence in a 1- to 2-s breath-hold and getting a single slab of data which is 40 mm in thickness. Thus helping in depicting the whole pancreaticobiliary tree and without the requirement of post-processing. Once the MRI is done, Sequences will be noted and analysed for anatomical variations.

Statistical Methods: Demographic parameters were considered as primary explanatory variables, like age, gender etc. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagrams, pie diagrams and tables.

RESULTS

This one-year cross-sectional observational study was undertaken in the Department of Radiodiagnosis, KLES Dr Prabhakar Kore Hospital & MRC, Belagavi from January 2020 to December 2020. During the study period, 58 patients referred to the department of radiodiagnosis were subjected to MRCP, to evaluate the normal anatomical variations and anomalies in the branching pattern of the biliary system.

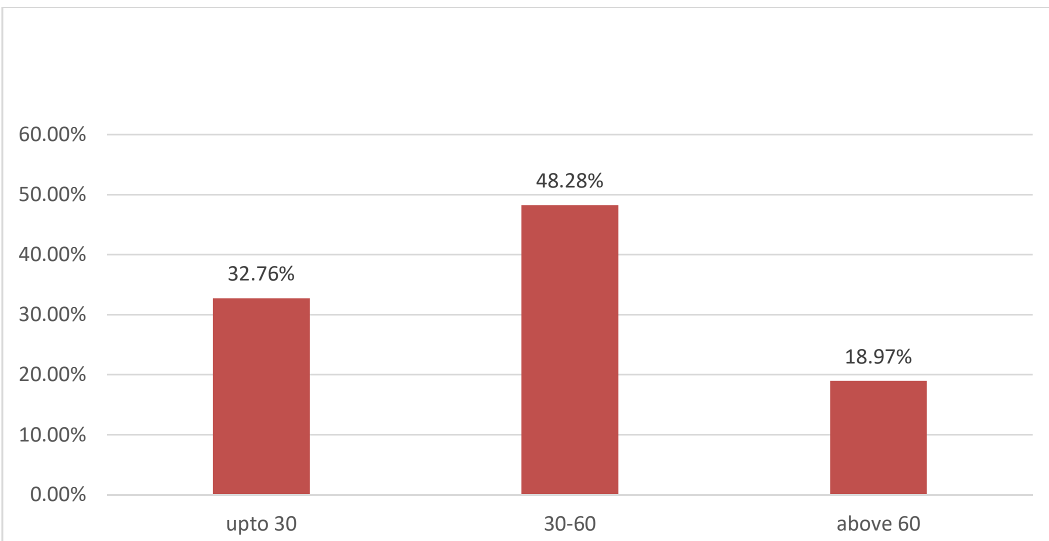
Huang's classification was used to categorise biliary tree variations and Todani classification was used to categorise choledochal cysts.

The data obtained was analysed and the final results and observations were tabulated and interpreted as below.

Table 1: Descriptive analysis of age distribution in the study population (N=58)

Age Group	Frequency	Percentage
Less than 30 years	19	32.76%
30 to 60 years	28	48.28%
More than 60 years	11	18.97%

Graph 1: Age distribution among the study population

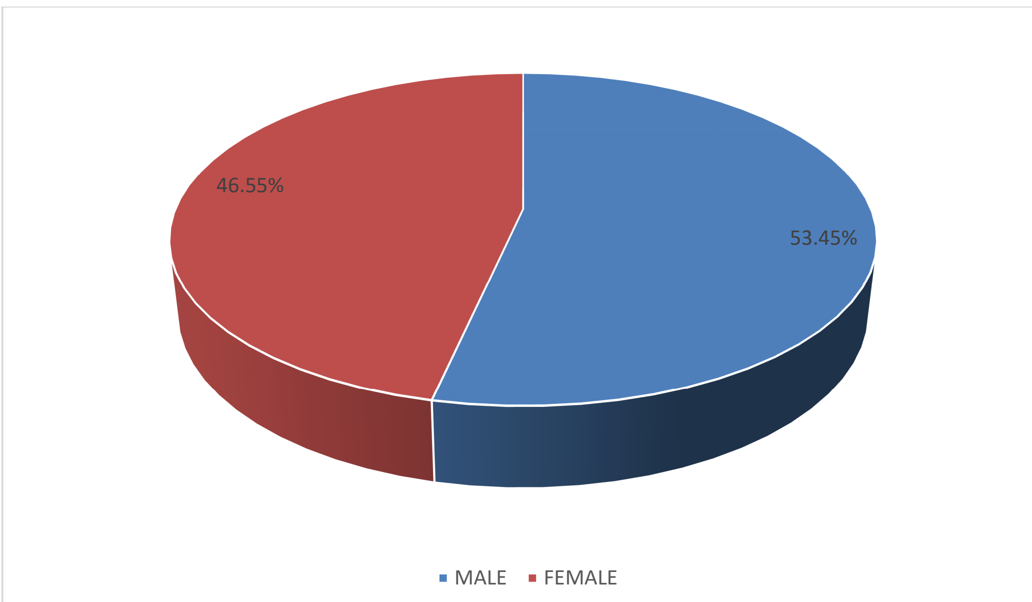


Among the study population, 19 (32.76%) were aged less than 30, 28 (48.28%) were aged between 30 to 60 years and 11 (18.97%) were aged above 60 years.

Table 2: Descriptive analysis of gender-wise distribution among the study population (N=58)

GENDER	FREQUENCY	PERCENTAGE
MALE	31	53.45%
FEMALE	27	46.55%
TOTAL	58	100%

Graph 2: Gender-wise distribution among in the study population (N=58)

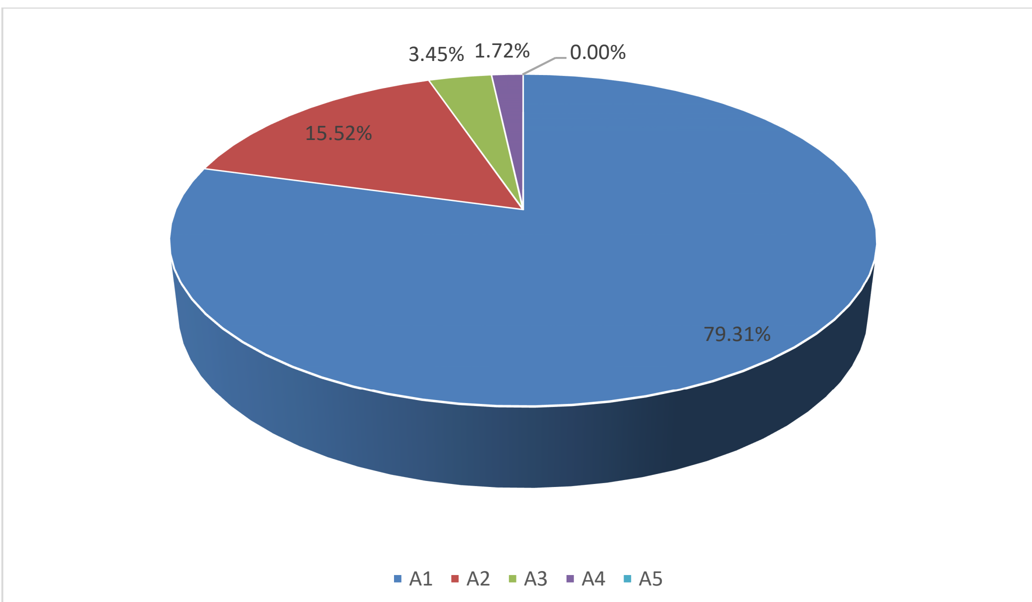


Among the study population, 31 (53.45%) were males and 27(46.55%) were females.

Table 3. Descriptive analysis of RHD variants among the study population (N=58)

RHD VARIANT	A1	A2	A3	A4	A5	TOTAL
Number	46	9	2	1	0	58
Percentage	79.31%	15.52%	3.45%	1.72%	0%	100%

Graph 3: RHD variants in the study population (N=58)

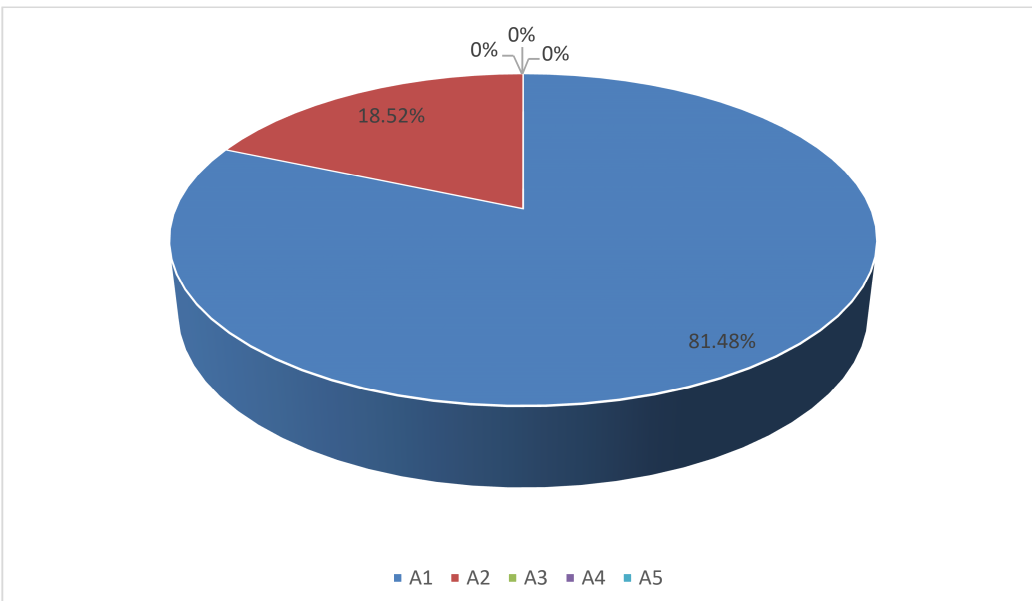


Among the study population, 46 **(**79.31%) were Type A1 variant, 9(15.52%) were Type A2 variant, 2(3.45%) were Type A3 variant which is drainage of RPSD into LHD and 1 (1.72%) were Type A4 variant. Type A5 variant in which the RPSD drains in the CD was not observed among the study population.

Table 4. Descriptive analysis of RHD variants in females among the study population

RHD VARIANTS	A1	A2	A3	A4	A5	TOTAL
Number	22	5	0	0	0	27
Percentage	81.48%	18.52%	0%	0%	0%	100%

Graph 4: RHD variants in females among the study population

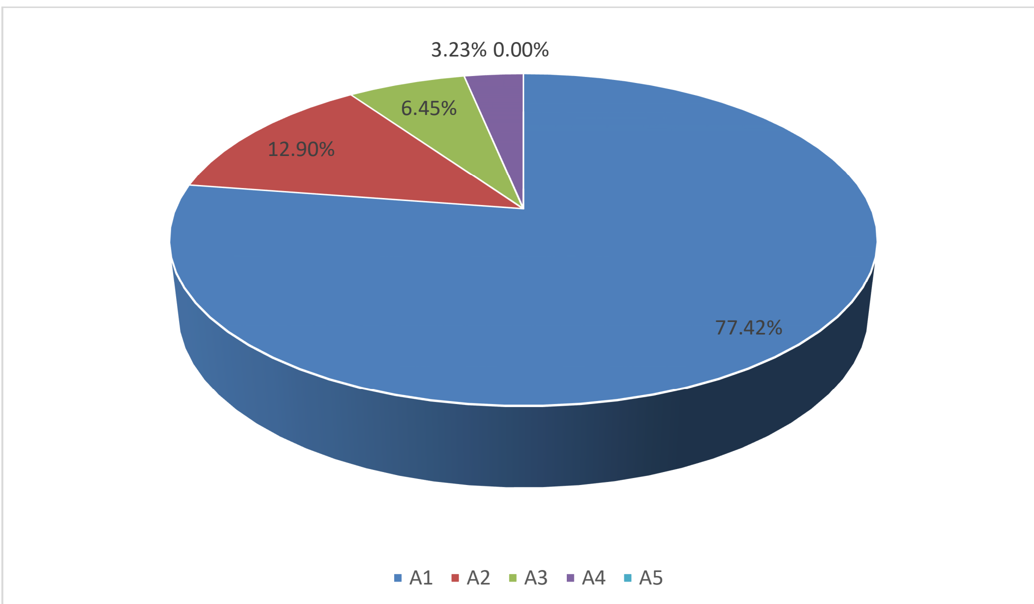


RHD variants in females among the study population, 22(81.48%) were Type A1 and 5(18.52%) were Type A2 variant.

Table 5. Descriptive analysis of RHD variants in males of the study population

RHD Variants	A1	A2	A3	A4	A5	TOTAL
Number	24	4	2	1	0	31
Percentage	77.42%	12.90%	6.45%	3.23%	0%	100%

Graph 5. RHD variants in males of the study population

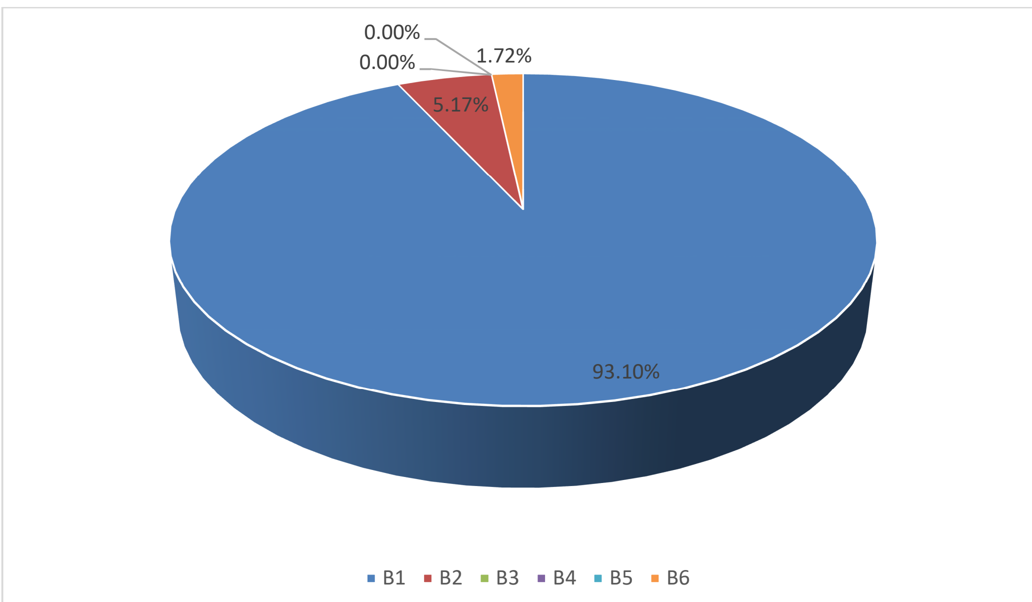


RHD variants in males among the study population, 24(77.42%) were Type A1 variant, 4 (12.9%) Type A2 variant, 2 (6.45%) were Type A3 variant and 1(3.23%) was type A4 variant.

Table 6. LHD variants in the study population (N=58)

LHD VARIANTS	B1	B2	B3	B4	B5	B6	Total
Number	54	3	0	0	0	1	58
Percentage	93.10%	5.17%	0%	0%	0%	1.72%	100%

Graph 6. LHD variants in the study population (N=58)

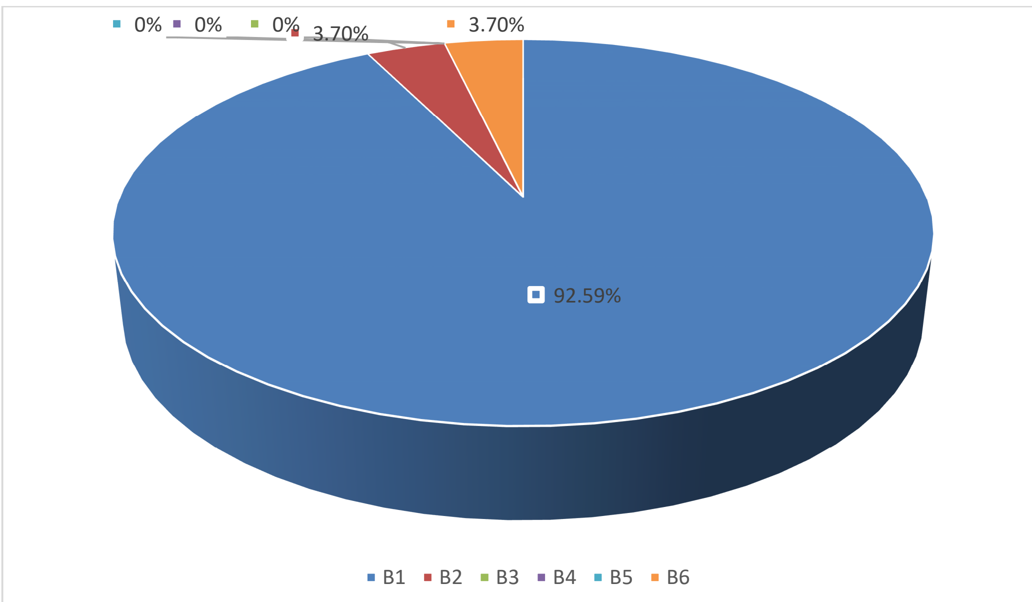


Among the study population, 53(9.38%) were Type B1 variant, 3(5.17%) were Type B2 variant, 1(1.72%) were Type B3 variant and 1(1.72%) were Type B6 variant.

Table 7. LHD variants in females of the study population

LHD VARIANTS	B1	B2	B3	B4	B5	B6	Total
Number	25	1	0	0	0	1	27
Percentage	92.59%	3.7%	0%	0%	0%	3.7%	100%

Graph 7. LHD variants in females of the study population

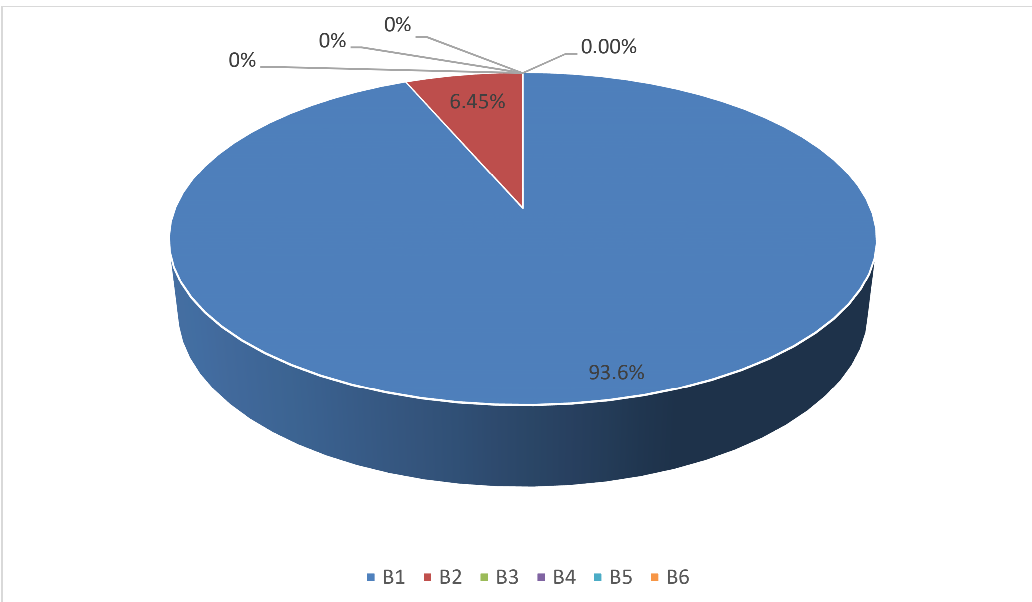


LHD variants in females among the study population, 25(92.59%) were Type B1 variant, 1(3.7%) were Type B2 variant and 1(3.7%) were Type B6 variant.

Table 8. LHD variants in males of the study population

LHD VARIANTS	B1	B2	B3	B4	B5	B6	total
Number	29	2	0	0	0	0	31
Percentage	93.55%	6.45%	0%	0%	0%	0%	100%

Graph 8. LHD variants in females of the study population

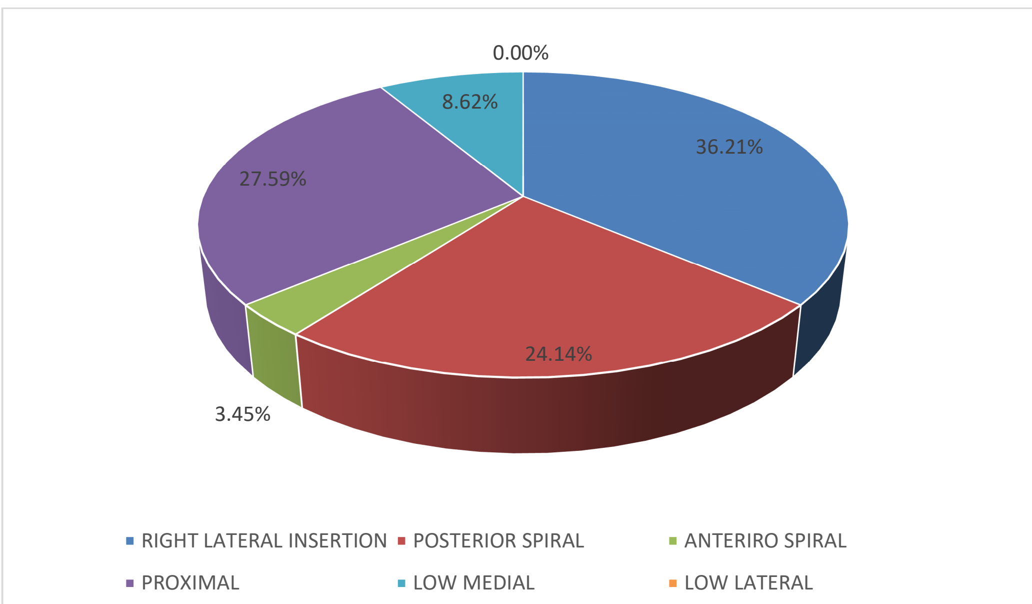


LHD variants in males among the study population, 29(93.55%) were Type B1 variant and 2(6.45%) were Type B2 variant.

Table 9. Descriptive analysis of CD variants among the study population

TYPE	RIGHT LATERAL	SPIRAL		PROXIMAL	LOW		TOTAL
	INSERTION	POSTERIOR	ANTERIOR	INSERTION	MEDIAL	LATERAL	
Number	21	14	2	16	5	0	58
Percentage	36.21%	24.14%	3.45%	27.59%	8.62%	0.00%	100.00%

Graph 9. CD variants among the study population

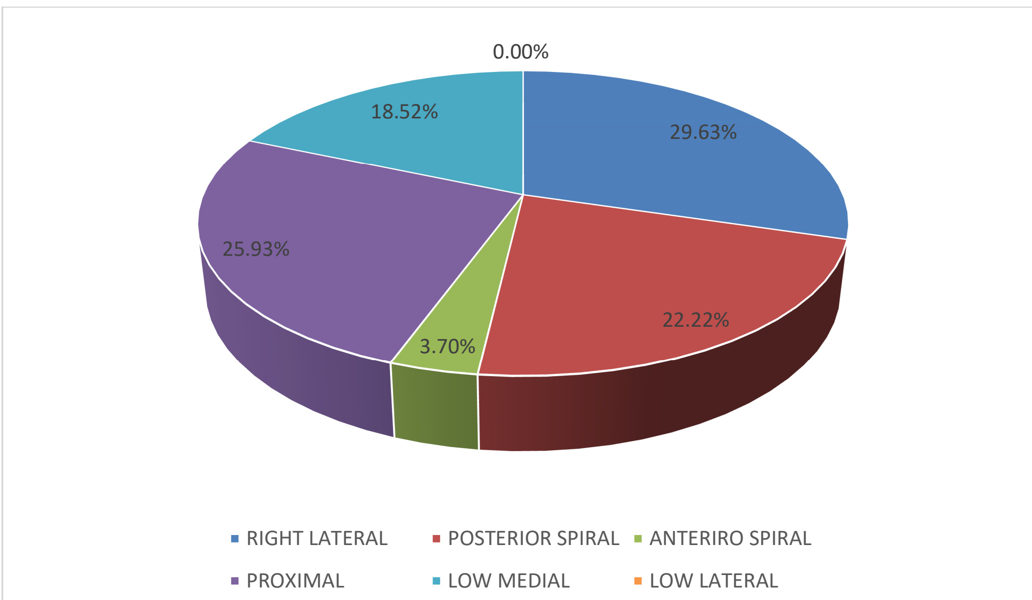


CD variations among the study population, 21(36.21%) were right lateral insertion, 16(27.59%) were proximal insertion, 14(24.14%) were posterior spiral insertion, 5(8.62%) were medial insertion and 2(3.45%) were anterior spiral insertions.

Table 10. Descriptive analysis of CD variants in females among the study population

TYPE	RIGHT LATERAL INSERTION	SPIRAL		PROXIMAL INSERTION	LOW		TOTAL
		POSTERIOR	ANTERIOR		MEDIAL	LATERAL	
Number	8	6	1	7	5	0	27
Percentage	29.63%	22.22%	3.70%	25.93%	18.52%	0.00%	100.00%

Graph 10. CD variants in females among the study population

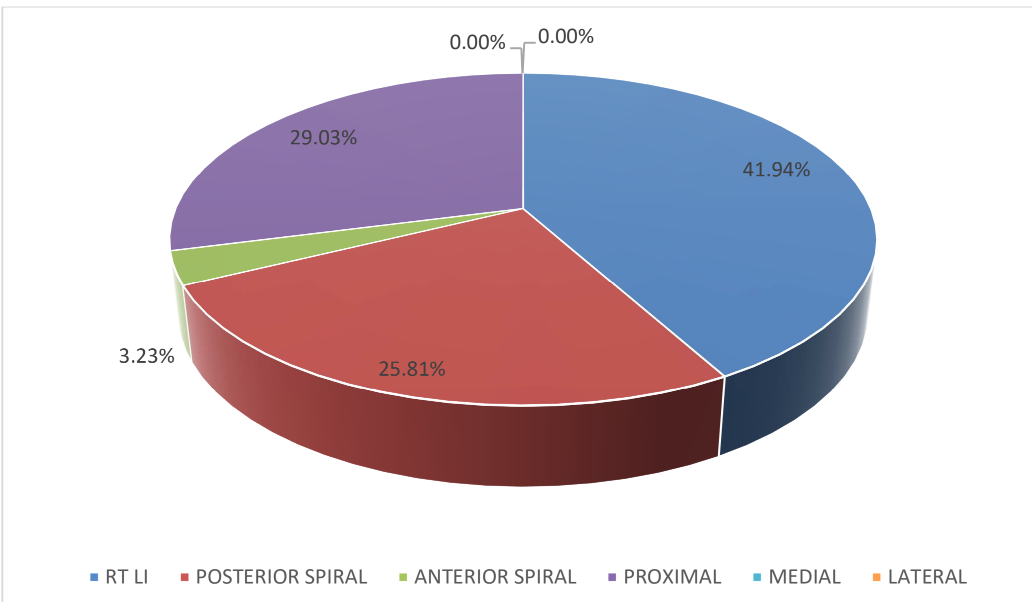


CD variants in females among the study population, 8(29.63%) were right lateral insertion, 7(25.93%) were proximal insertion, 6(22.22%) were posterior spiral insertion, 5(18.52%) were low medial insertion and 1(3.7%) were anterior spiral insertion.

Table 11. Descriptive analysis of CD variants in males among the study population

TYPE	RIGHT LATERAL INSERTION	SPIRAL		PROXIMAL INSERTION	LOW		TOTAL
		POSTERIOR	ANTERRIOR		MEDIAL	LATERAL	
Number	13	8	1	9	0	0	31
Percentage	41.94%	25.81%	3.23%	29.03%	0.00%	0.00%	100.00%

Graph 11. CD variants in males among the study population

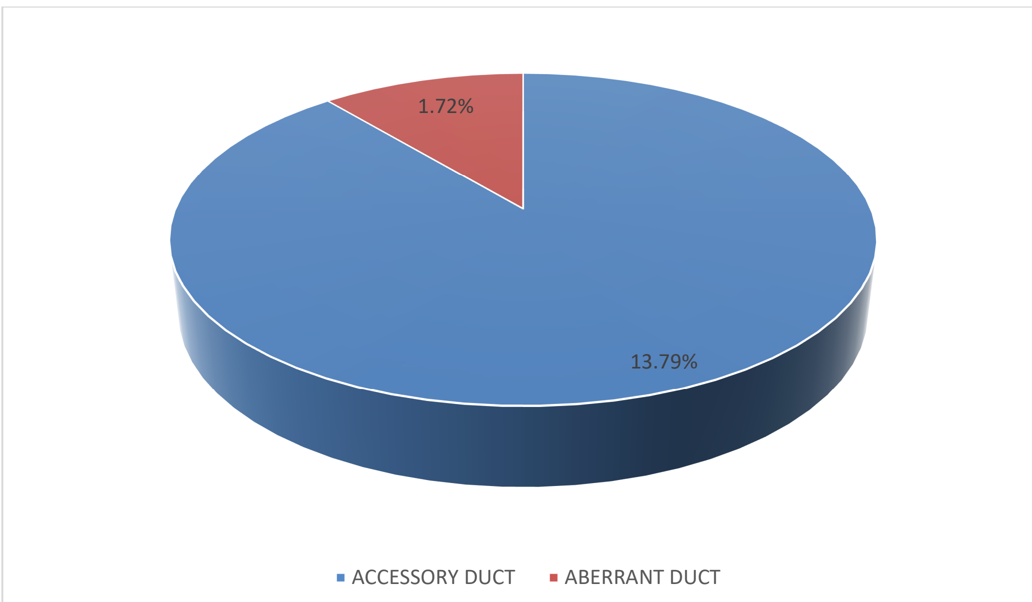


CD variants in males among the study population, 13(41.94%) were right lateral insertion, 9(29.03%) were proximal insertion, 8(25.81%) were posterior spiral insertion and 1(3.23%) were anterior spiral insertion.

Table 12. Descriptive analysis of accessory and aberrant ducts among the study population

DUCT TYPES	ACESSORY DUCT	ABERRANT DUCT
Number	8	1
Percentage	13.79%	1.72%

Graph 12. Accessory and aberrant ducts among the study population

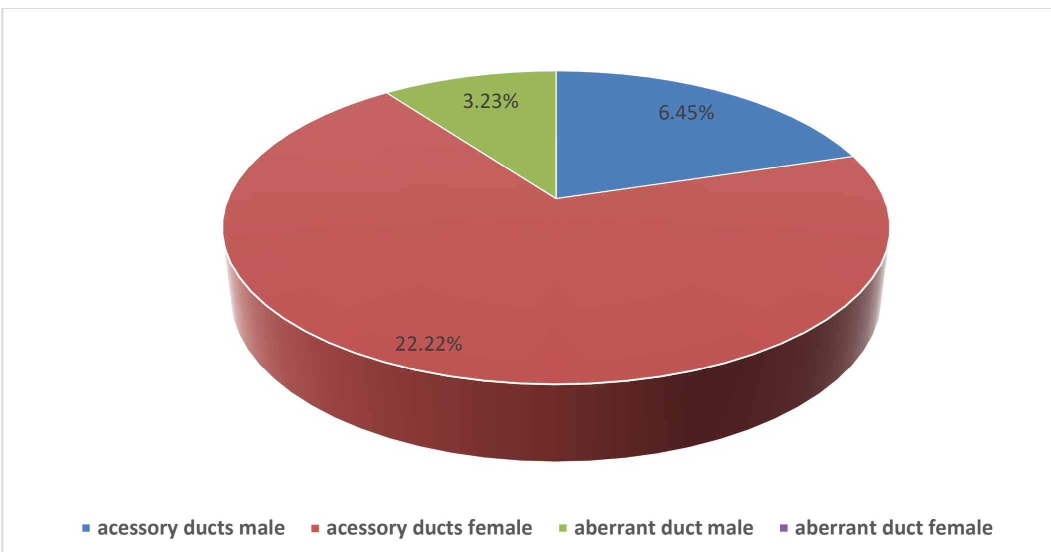


Among the study population, 8(13.79%) were accessory ducts and 1(1.72%) were aberrant duct.

Table 13. Descriptive analysis of accessory and aberrant ducts in males and females among the study population

DUCT TYPES	ACCESSORY DUCT		ABERRANT DUCT	
GENDER	MALE	FEMALE	MALE	FEMALE
Number	2	6	1	0
Percentage	6.45%	22.22%	3.23%	0%

Graph 13. Accessory and aberrant ducts in males and females among the study population

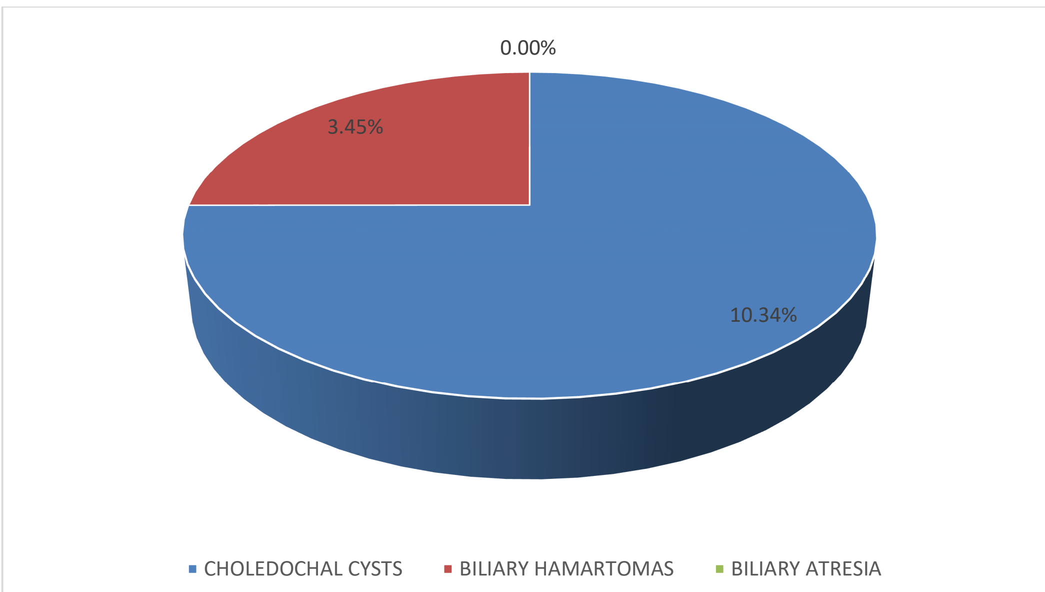


In females among the study population, 6(22.22%) were accessory ducts In males among the study population, 2(6.45%) were accessory ducts and 1(3.23%) were aberrant ducts

Table 14. Descriptive analysis of biliary tree anomalies among the study population

ANOMALIES TYPES	CHOLEDOCHAL CYSTS	BILIARY HAMARTOMAS	BILIARY ATRESIA
Number	6	2	0
Percentage	10.34%	3.45%	0 %

Graph 14. Biliary tree anomalies among the study population

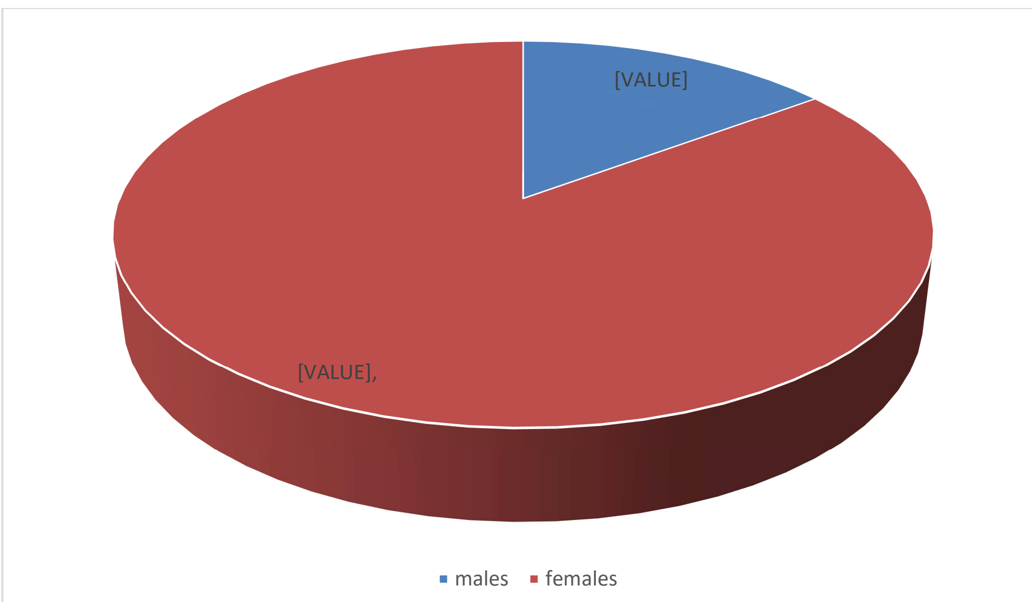


Among the study population, 6(10.34%) were choledochal cysts and 2(3.45% were biliary hamartomas.

Table 15. Descriptive analysis of choledochal cysts in males and females among the study population

ANOMALY	CHOLEDOCHAL CYSTS	
GENDER	MALE	FEMALE
Number	1	5
Percentage	3.23%	18.52%

Graph 15. Choledochal cysts gender-wise distribution among the study population

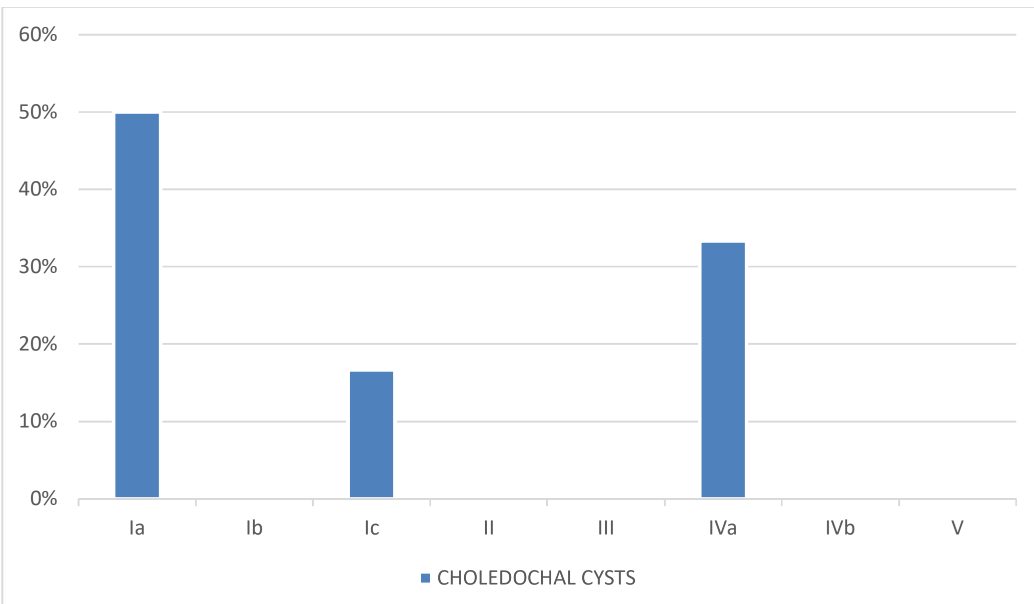


Among the study population, 5(18.52%) were in females and 1(3.23%) in males.

Table 16. Descriptive analysis of choledochal cysts by Todani classification among the study population

CHOLEDOCHAL CYSTS: TODANI CLASSIFICATION									
Types	Ia	Ib	Ic	II	III	IVa	IVb	V	Total
Number	3	0	1	0	0	2	0	0	6
Percentage	50.00%	0.00%	16.67%	0%	0%	33.33%	0%	0%	100%

Graph 16. Descriptive analysis of choledochal cysts types among the study population



Among the study population, 3(50%) were of type Ia, 2(33.33%) were of type IVa and 1(16.67%) were of type Ic.

DISCUSSION

This one-year cross-sectional observational study was undertaken in the Department of Radiodiagnosis, KLES Dr Prabhakar Kore Hospital & MRC, Belagavi from January 2020 to December 2020. During the study period, 58 patients referred to the department of radiodiagnosis were subjected to MRCP, to evaluate the normal anatomical variations and anomalies in the branching pattern of the biliary system.

Age & Sex distribution:

In the Current study included 58 individuals, the number of male patients was more, 31(53.45%) as compared to the female patients who were 27(46.55%). The male to female ratio was 1.14:1.

The maximum number of cases in this study population were from the age group of 30-60 years, 28 cases (48.28%) followed by age group of less than 30 years which had 19 cases (32.76%) and then followed by age group above 60 years which had 11 cases (18.97%). 8 years was the minimum age in our study population. and the maximum age was 83 years. The mean age was 43.37 years. A study conducted by Deka P et al. to analyze biliary anatomy had an age range of 9– 82 years with Median age being 40 years[11].

Prevalence of Variations:

Among the study population, variations of RHD and LHD were classified according to Huang's classification.

Prevalence of RHD Variations

The most common anatomical variation of RHD among our study population was the Type A1 variant, in which RPSD drains into the RASD and forms RHD which was seen in 79.31%, followed by Type A2 variant, in which there is trifurcation of RASD, RPSD and LHD, which was seen in 15.52%, followed by Type A3 variant in which RPSD drains into LHD, which was seen in 3.45% and followed by Type A4 variant in which RPSD drains in CHD, which was seen in 1.72% of the study population. Type A5 variant in which RPSD drains in the CD was not observed among our study population. The prevalence of RHD variation in females among the study population was 22(81.48%) of Type A1 and 5(18.52%) of Type A2 variants. The prevalence of RHD variants in males among the study population was 24(77.42%) of Type A1 variant, 4 (12.9%) of Type A2 variant, 2 (6.45%) of Type A3 variant and 1(3.23%) of Type A4 variant. On comparing RHD variations in males and females among our study population, it was observed that Type A1 and A2 variants were more common in females compared to males, while the rest of the variants were more common in males. A study was conducted by Aljiffry M et al. showed similar findings in which, the most frequently found variants were Type A1, seen in 34.2%, in which RPSD drains into RASD and followed by Type A2, seen in 32.2% in which there was tri-confluence of RASD, RPSD and LHD[12]. A study was done by Chaib E et al. showed that the most common RHD variation was Type A1 variant in which RHD is formed by joining of the RAHD with the RPHD seen in 61.3% of cases, in Type A2 variant, RAHD joins the confluence of RPHD and the LHD which leads to the formation of CHD, was seen in 14.5% of cases, Type A3 in which RAHD opens directly into the LHD was seen in 13.3% of cases, Type A4 variant in which the RAHD (type 4a) or the RPHD (type 4b) directly opens into CHD seen in 6.1% of cases[41], these findings were consistent with the present study. De Filippo M et al. conducted a study in which 21 % variations of intrahepatic bile tree were noted, which included 7.9% hilar trifurcation due to the confluence anterior and posterior branches of RHD which drain into LHD, 6.7% crossover of the right posterior bile duct drains into the LHD[42], similar findings were noted in the present study. A similar study was conducted by Khanduja N et al. in which the most common variation was Type A1, RASD joining RPSD and forming RHD seen in 63% of cases, which was more commonly seen in females as compared to males, followed by Type A2, trifurcation of RASD, RPSD and LHD seen in 18% of the cases which was followed by Type A3, RPSD draining into LHD seen in 9 % of cases and then Type A4 drainage of the RPHD into the CHD was seen in 8% of cases, Type A5 variant in which RPSD drains in the CD was not observed[44], these findings were similar to present study. In another study conducted by Sarawagi R et al. showed that the most frequent variation of RHD was Type A1 variant in which RASD and RPSD join to form RHD was the most common, seen in 55.3%, followed by Type A3 in which RPSD drains into LHD was seen in 27.6%, followed by type A2 Trifurcation pattern which was seen in 9.3%, Type A4 was seen in 4%, in RPSD drain into CHD[45], these observations similar to the present study.

Prevalence of LHD Variations

The most common anatomical variations of LHD among our study population was Type B1 in which the segment IV duct drains into LHD, which was seen in 54(93.10%), followed by Type B2 in which the segment IV duct drains into CHD which was seen in 3(5.17%) and then followed by type B6 in which the ducts of segments II and III attaches with the duct of segment IV and forms the LHD, which was seen in 1(1.72%) patient among our study population. Type B3 in which the duct of segment IV drains into the RASD, type B4 in which the duct of segment IV drains in CBD and Type B5 in which the duct of segment IV drains into the duct of segment II were not observed among our study population. The prevalence of LHD variation in females among the study population was 25(92.59%) of type B1, 1(3.7%) of Type B2 and 1(3.7%) of Type B6. The prevalence of LHD variants in males among the study population was 29(93.55%) of Type B1 and 2(6.45%) of Type B2 variants. On comparing LHD variations in males and females among our study population, it was observed that LHD variants in males were more common compared to females, the only exception was the Type B6 variant, which was only seen in a female, among the study population. A study conducted by Aljiffry M et al. showed that the most frequently found variant was Type B1 seen in 71.4%, in which segment IV drains into the LHD followed by Type B2 in which the segment IV duct drains into CHD, seen in 2.5% cases[12], these findings were similar to the present study. A study was conducted by Chaib E et al. the study showed that the most common LHD variant was Type B1 which was observed in 76.2 %, followed by Type B2 which was seen in 15 %[41], these findings were similar to current study. In another study conducted by Sarawagi R et al. showed the most frequent variation of LHD branching pattern was a common trunk of segment 2 and 3 ducts joining the segment IV duct in 67.8% of subjects[45], these findings were similar to the present study.

<u>Prevalence of CD Variations</u>

The most common anatomical variations of CD among the study population was right lateral insertion seen in 21(36.21%), followed by proximal insertion seen in 16(27.59%), followed by posterior spiral insertion seen in 14(24.14%), followed by low medial insertion seen in 5(8.62%) and then followed by anterior spiral insertions seen in 2(3.45%). Low lateral insertion was not observed among our study population. Prevalence of CD variants in females among the study population was 8(29.63%) of right lateral insertion, 7(25.93%) of proximal insertion, 6(22.22%) of posterior spiral insertion, 5(18.52%) of low medial insertion and 1(3.7%) of anterior spiral insertion. Prevalence of CD variants in males among the study population was 13(41.94%) of right lateral insertion, 9(29.03%) of proximal insertion, 8(25.81%) of posterior spiral insertion and 1(3.23%) of anterior spiral insertion. On comparing CD variations in males and females among our study population, it was observed that CD variants were more commonly found in males as compared to females, the only exception was the low medial insertion of CD which was seen only in females. A study conducted by Aljiffry M et al. showed that the most frequently found CD variant was right laterally insertion which was seen in 27.7% followed by proximal insertion of CD which was seen in 14.2%[12], these findings were consistent with the present study. In a study conducted by Sarawagi R et al. showed that the most common CD variation was normal lateral insertion seen in 51.5%, spiral course with medial insertion was seen in 16.1%, high/proximal insertion CD was seen in 5.5% and in 4% low medial insertion of CD was observed[47], these finding was similar to the present study.

Prevalence of accessory and aberrant ducts

The accessory ducts were more common than the aberrant duct among the study population, 8(13.79%) were (Ducts of Luschka) accessory ducts and 1(1.72%) were (cholecysto-hepatic duct) aberrant duct. Prevalence of accessory ducts in females among the study population was 6(22.22%). In males among the study population, 2(6.45%) were accessory ducts and 1(3.23%) was aberrant duct. On comparison in males and females among our study population, it was observed that accessory duct was more common in females compared to males, while aberrant duct was common in males. A similar study was done by Ko K et al. in which Ducts of Luschka was observed in 4.6 % [48.] A study done by Kocabiyik N et al. showed the prevalence of Ducts of Luschka was seen in 21.9% in fetal cadevars [49]. A study done by Hirao K et al. showed aberrant bile ducts in 18%[15].

Prevalence of Anomalies

Congenital anomalies were found in 13.79% among the study population. The most common anomaly found among the study population was choledochal cysts, seen in 6(10.34%) followed by biliary hamartomas which was seen in 2(3.45%). Biliary atresia anomaly was not observed among the study population. De Filippo M et al. conducted a similar study in which 1.3% had congenital anomalies which were choledochal cyst seen in 0.3%, bile duct atresia seen in 0.3% and biliary hamartoma 0.7%[42].

Prevalence of Choledochal Cysts

Choledochal cysts are classified according to the Todani classification. The most common type of choledochal cysts among the study population was Type Ia seen in 3(50%), followed by Type IVa seen in 2(33.33%) and Type Ic seen in 1(16.67%). Types Ib, II, III and V choledochal cysts was not observed. Choledochal cysts was more commonly observed in 5(18.52%) females as compared to 1(3.23%) male among the study population. Giant choledochal cysts a rare variant of Choledochal cysts, classified as type IVa according to Todani classification was found among the study population. Harikrishnan S et al. reported a case of Giant choledochal cysts Type IVa[22]. A study was conducted by Chijiiwa K et al. showed the prevalence of choledochal cysts was common in females 89%, as compared to males 11%. As per the Todani classification system, 57% had type I cysts, 4% had type II, and 39% had type IV[46], similar findings were observed in the present study. A retrospective study done by Machado NO et al. showed the prevalence of choledochal cysts was common in females seen in 80%, as compared to males 20%. According to the Todani classification system, in 80% type I choledochal cysts was observed[50], similar findings were observed in the present study.

CONCLUSION

MRCP is a highly accurate, non-invasive, sensitive, non-ionizing and superior diagnostic modality which is very useful for evaluation of the biliary system and identifying the normal biliary anatomical variants and anomalies. Precise information regarding the different types of variants and anomalies of RHD, LHD and CD be easily identified and categorized accordingly. Huang's classification is simple, easy and helps to classify the biliary tree variations. The most common type of anatomical variations of RHD was Type A1 and of LHD was Type B1. The most common type of anatomical variation of CD was low medial insertion. The most common anomaly observed was Choledochal cysts in which Type Ia choledochal cysts was most common according to the Todani classification.

Limitations:

- MRCP drawbacks

a) Claustrophobia

b) Breath holding is not possible in elderly, children and debilitated patients

c) Time consuming

SUMMARY

- The study was a hospital-based cross-sectional observational study

- Patients referred to the Department of Radiodiagnosis, KLES Dr Prabhakar Kore Hospital & MRC, Belagavi for MRCP were included in the study. 58 patients were included in the study after observing the inclusion and exclusion criteria.

- All patients underwent MRCP to evaluate and categorize biliary anatomical variations and anomalies. Biliary tree variations were classified according to Huang's classification.

- Majority 31(53.45%) of patients were males and male-female ratio was 1.14:1.

- 48.28% of patients were aged between 30 to 60 years. The mean age was 43.37 years.

- The most common anatomical variation of RHD among our study population was the Type A1 (79.31%) followed by Type A2 variant (15.52%). The most common anatomical variations of LHD was Type B1 (93.10%) followed by Type B2 variant (5.17%) The most common anatomical variations of CD was right lateral insertion (36.21%) followed by proximal insertion (27.59%). 13.79% of patients had accessory duct.

- 13.79% of patients had anomalies, the most common anomaly was choledochal cysts (10.34%). Choledochal cysts classified according to the Todani classification, most common was Type Ia (50%) followed by Type IVa (33.33%).

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ANNEXURE I-CONSENT FORM

INFORMED CONSENT

TITLE OF THE STUDY: "ROLE OF MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY (MRCP) IN THE EVALUATION OF NORMAL ANATOMICAL VARIATIONS AND ANOMALIES IN BRANCHING PATTERN OF BILIARY SYSTEM -HOSPITAL BASED 1 YEAR OBSERVATIONAL STUDY"

PRINCIPAL INVESTIGATOR: REGISTRATION NO. BS0119004

INTRODUCTION AND PURPOSE:

Biliary anatomical variations and anomalies are of substantial clinical significance in living donor transplantation, in hepatobiliary system radiological interventions, laparoscopic cholecystectomy, and resection of the liver (hepatectomy, segmentectomy) to prevent post-operative complications. The purpose of this study is to describe the anatomic variations and anomalies of the intrahepatic and extrahepatic biliary tree using the magnetic resonance cholangiopancreatography (MRCP), which is a safe and noninvasive modality and has become the modality of choice for evaluation of biliary tree anatomical variants and anomalies.

PROCEDURE:

I request you to kindly participate in the study titled **"ROLE OF MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY (MRCP) IN THE EVALUATION OF NORMAL ANATOMICAL VARIATIONS AND**

ANOMALIES IN THE BRANCHING PATTERN OF THE BILIARY SYSTEM -HOSPITAL BASED 1 YEAR OBSERVATIONAL STUDY" at Dr Prabhakar Kore Hospital and Medical Research Centre, Belagavi" being conducted by **REGISTRATION NO. BS0119004** postgraduate in Radiodiagnosis at J. N. Medical College Belagavi.

We request you to participate in this study as you are eligible to be included. During the study, you will be asked questions regarding your present and past medical history and you will be required to answer to the best of your knowledge.

If you agree to participate in the study please furnish the details pertaining to the study.

BENEFITS:

1. Noninvasive
2. Accurate diagnosis.
3. Cost effective.

RISKS:

No significant risk to the patient has been documented from magnetic resonance cholangiopancreatography (MRCP).

ALTERNATIVES:

If the patient is not willing to take part in the study, his / her treatment or any other further investigations the patient wants to undergo, in future, in KLE will not be affected by his / her decision

VOLUNTARY PARTICIPATION/WITHDRAWAL:

Taking part in this study is voluntary. I may choose not to take part in this study, or if I decide to take part, I can later change my mind and withdraw from the study. My decision will not change the present or future health care or other services that I receive. The study doctor or the sponsor may stop my participation in this study. I will tell if any important new findings that may change my willingness to continue to take part. If I choose not to take part in the study, I will receive the standard treatment for patients with my condition.

COSTS:

NIL (The study is to be conducted on the participants who are advised MRCP as an investigation by the referring consultant and the participants will bear the charges for it.)

PAYMENT FOR PARTICIPATION: No incentive will be paid to you for participating in this study.

COMPENSATION:

In the event that I become injured as a result of taking part in this study, treatment whatever available at KLE hospital, Belagavi, will be offered to me. No reimbursement, compensation or free medical care is given.

CONFIDENTIALITY:

All information collected about me during the course of the study will be kept confidential to the extent permitted by the law. The code numbers will identify me in this research record. Information from this study may be published but my identity will be confidential in any publication.

If any enquiries in the future or in case of research related injury illness, you may contact the following person.

REG. NO. BS0119004	**Dr. ______________**	**Dr. Roopa Bellad**
Post-Graduate, Department of Radio-Diagnosis J.N.Medical College, Belagavi	Guide, Professor and head, Department of Radio- Diagnosis J.N.Medical College, Belagavi	Professor Of Paediatrics Chairperson, J.N. Medical College Institutional Ethical Committee for Human Subjects Research, Belagavi

CONSENT TO PARTICIPATE IN RESEARCH STUDY:

1. I understand that I am participating in the study, which includes MRCP.

2. I confirm that I have read and understood the information in the patient information sheet. The procedure is explained to me in detail along with information about the advantages and disadvantages of taking part in the study. I have been given the opportunity to discuss all aspects of the trial, to ask questions and hereby consent to participation in the trial outlined above.

3. I understand that the decision to take part in this study is completely voluntary and I am aware that I can choose to withdraw from the study at any point of time.

4. I consent to the photographing or recording of the procedure to be performed including portions of my body, for medical, scientific or educational purposes provided my identity is not revealed in the pictures or by the descriptive texts accompanying them.

5. I understand that there is no significant risk involved in the test that would be done in this study.

6. No guarantee or assurance has given by anyone as to the results that may be obtained.

7. My signature on this form signifies that I have willingly decided to participate after understanding the above information.

Participant's / legally authorized representatives name___________

Signature _____________________

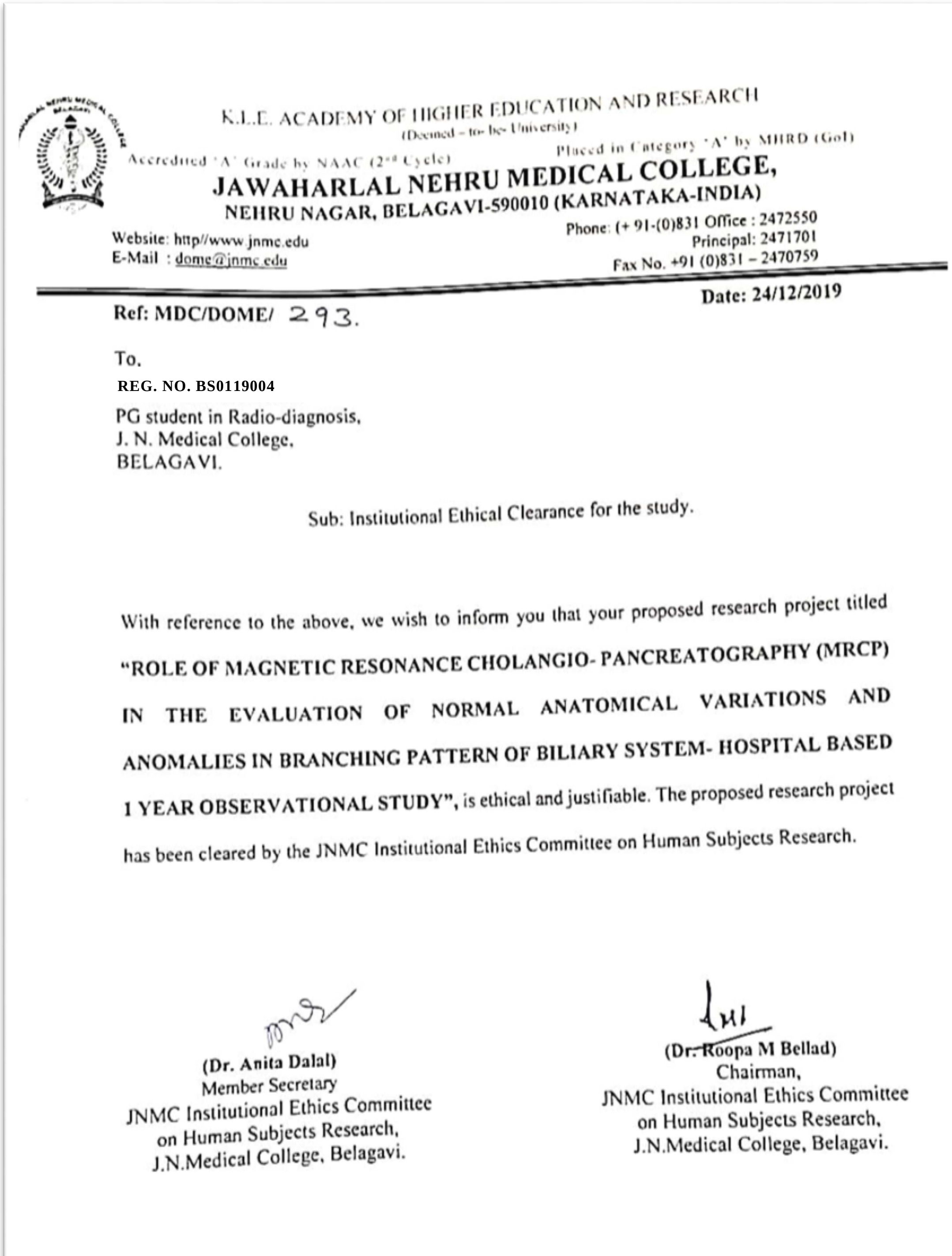
Name and signature of witness _____________________

Investigators name and Signature: ……………………………….

Date:

Place: Belagavi

ANNEXURE II - ETHICAL CLEARANCE LETTER



K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed – to- be- University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

JAWAHARLAL NEHRU MEDICAL COLLEGE,
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Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref: MDC/DOME/ 293.

Date: 24/12/2019

To,
REG. NO. BS0119004
PG student in Radio-diagnosis,
J. N. Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"ROLE OF MAGNETIC RESONANCE CHOLANGIO- PANCREATOGRAPHY (MRCP) IN THE EVALUATION OF NORMAL ANATOMICAL VARIATIONS AND ANOMALIES IN BRANCHING PATTERN OF BILIARY SYSTEM- HOSPITAL BASED 1 YEAR OBSERVATIONAL STUDY"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Anita Dalal)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

(Dr. Roopa M Bellad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

ANNEXURE III -PROFORMA

PROFORMA FOR DATA COLLECTION

PATIENT PARTICULARS:

NAME		**DATE**	
AGE		**SEX**	
ADDRESS AND MOBILE NO		**MRI NO.**	

CHIEF COMPLAINTS:

PAST HISTORY:

INVESTIGATIONS:

MRCP FINDINGS:

1. **Biliary tree variations by Huang classification**

Right hepatic duct:

Left hepatic duct:

Cystic duct:

Accessory ducts: PRESENT/ABSENT

Aberrant ducts: PRESENT/ABSENT

2. **ANOMALIES**

- **CHOLEDOCHAL CYSTS-TODANI CLASSIFICATION: PRESENT/ABSENT, IF PRESENT TYPE**
- **BILIARY ATRESIA: PRESENT/ABSENT**
- **BILIARY HARMATOMAS: PRESENT/ABSENT**

Other findings

ANNEXURE-IV: FIGURES

NORMAL ANATOMY

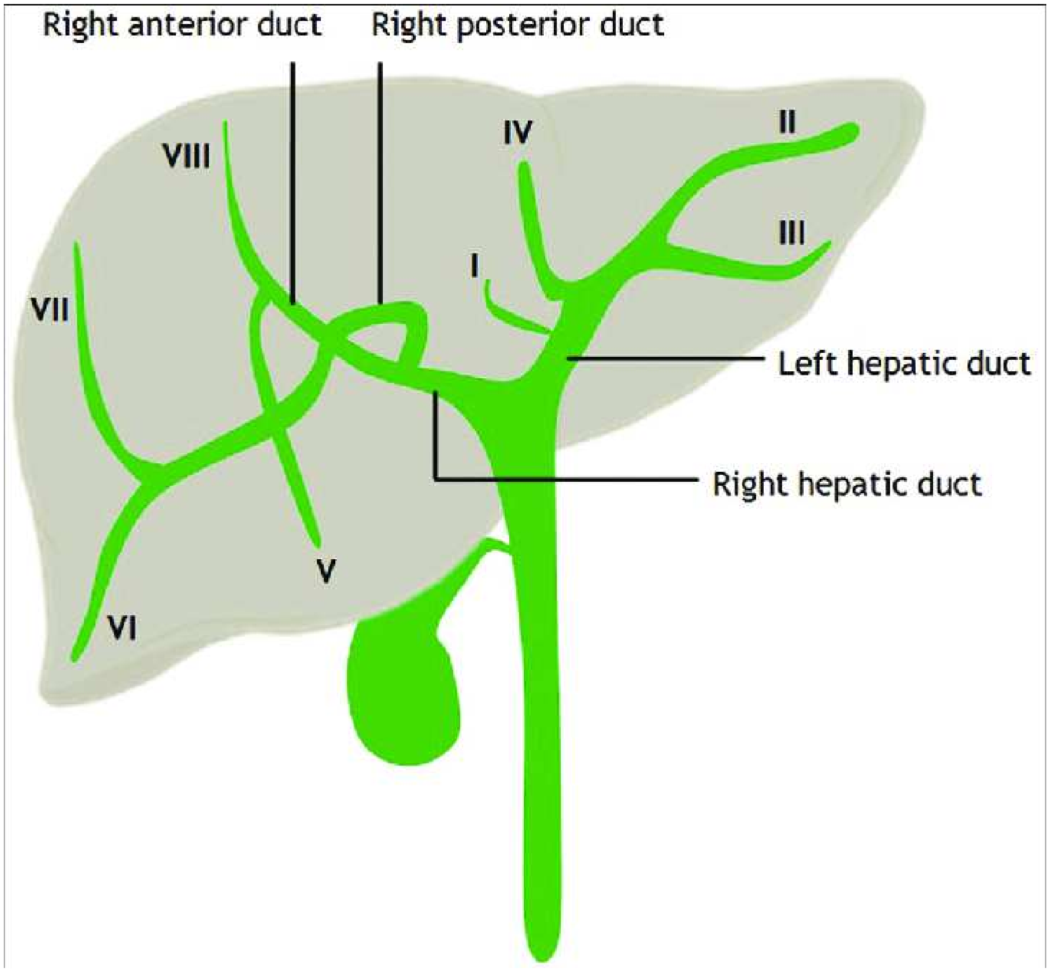


Figure 14. Diagrammatic illustration of normal hepatic biliary segmental anatomy[15]

.

Figure 15: IMAGE OF RHD TYPE A1 VARIANT

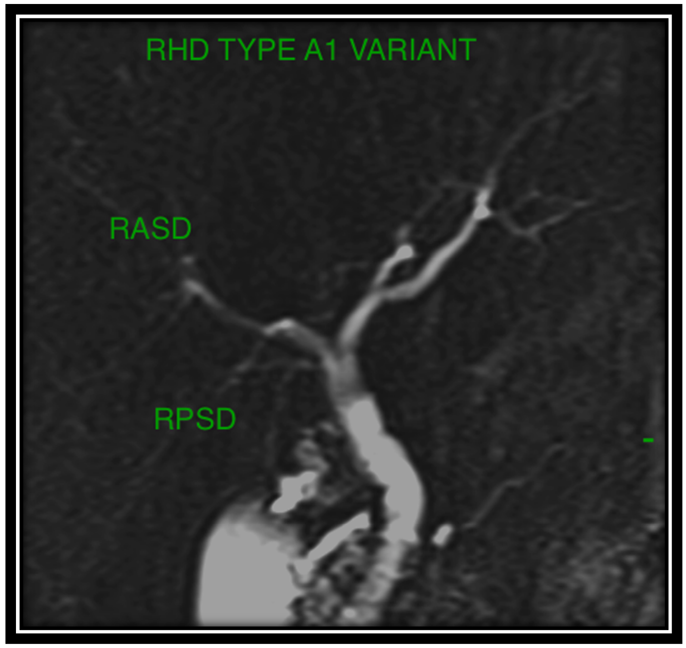
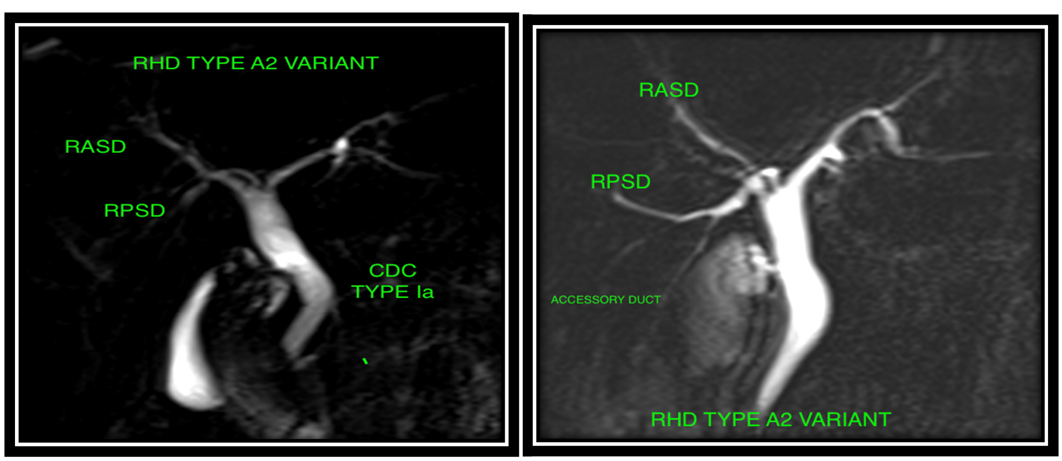


Image show draining of RPSD into the RASD and forming RHD which is a Type A1 variant by Huang Classification

Figure 16: IMAGES OF RHD TYPE A2 VARIANT



Images show trifurcation of RASD, RPSD and LHD which is a Type A2 variant by Huang Classification

Figure 17. IMAGE OF RHD TYPE A3 VARIANT

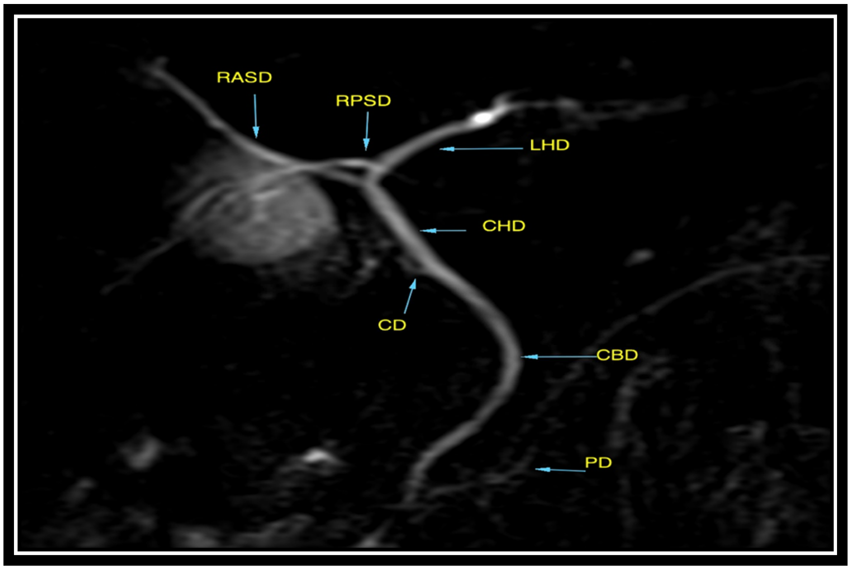


Image show RPSD draining into LHD which is a Type A3 variant by Huang Classification

Figure 18. IMAGE OF RHD TYPE A4 VARIANT

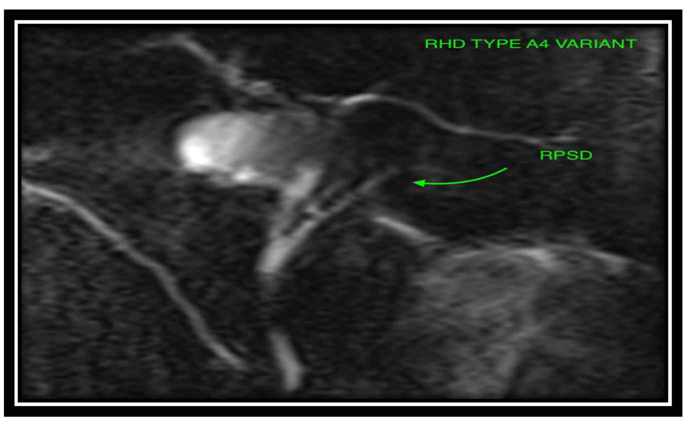


image show RPSD draining into CHD which is a Type A4 variant by Huang Classification

Figure 19. IMAGE OF LHD TYPE B1 VARIANT

Image show Type B1 variant by Huang Classification

Figure 20. IMAGE OF LHD TYPE B2 VARIANT

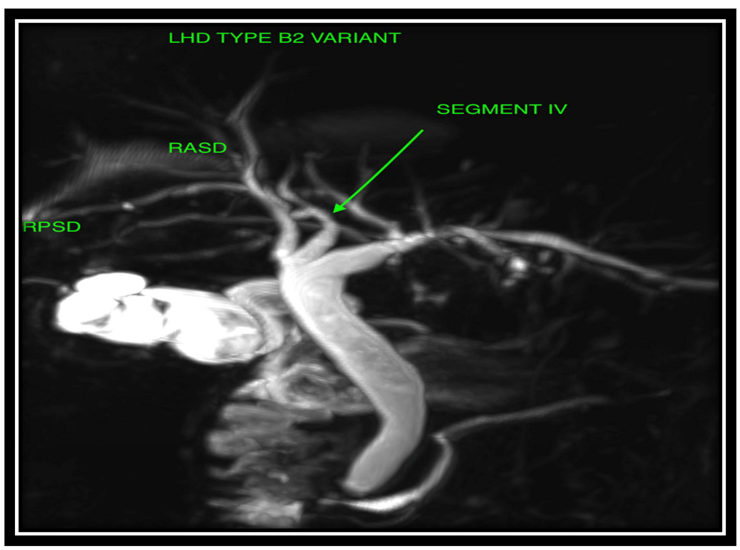


Image show segment IV duct drains into CHD is a Type B2 variant by Huang Classification

Figure 21. IMAGE OF LHD TYPE B6 VARIANT

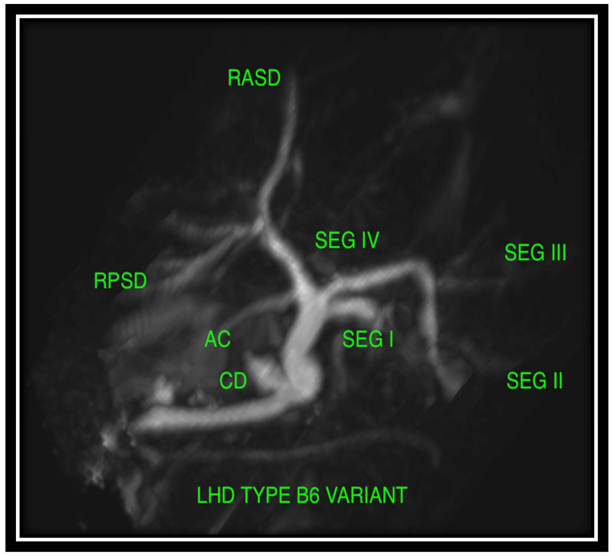


Image show ducts of segments II and III joins with duct of segment 4 to form the LHD, is a Type B6 variant by Huang Classification

Figure 22. IMAGE OF RIGHT LATERAL INSERTION Of CD

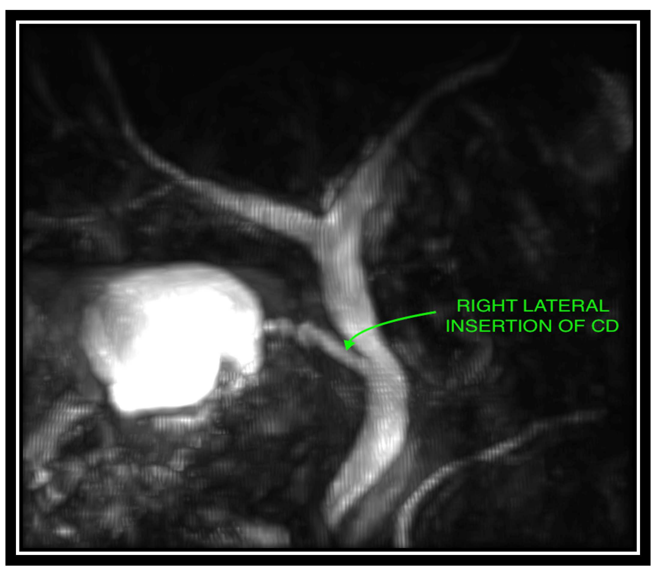


Figure 23. IMAGE OF POSTERIOR SPIRAL INSERTION OF CD

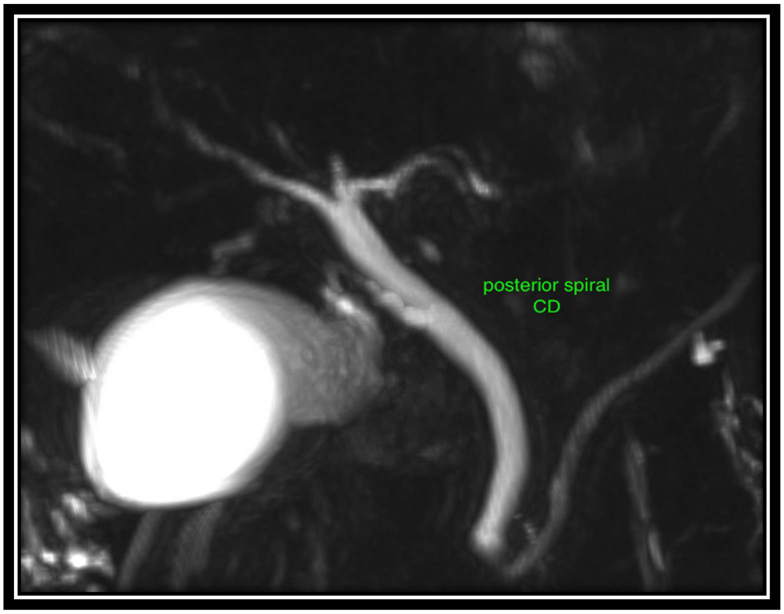


Figure 24. IMAGE OF ANTERIOR SPIRAL INSERTION OF CD

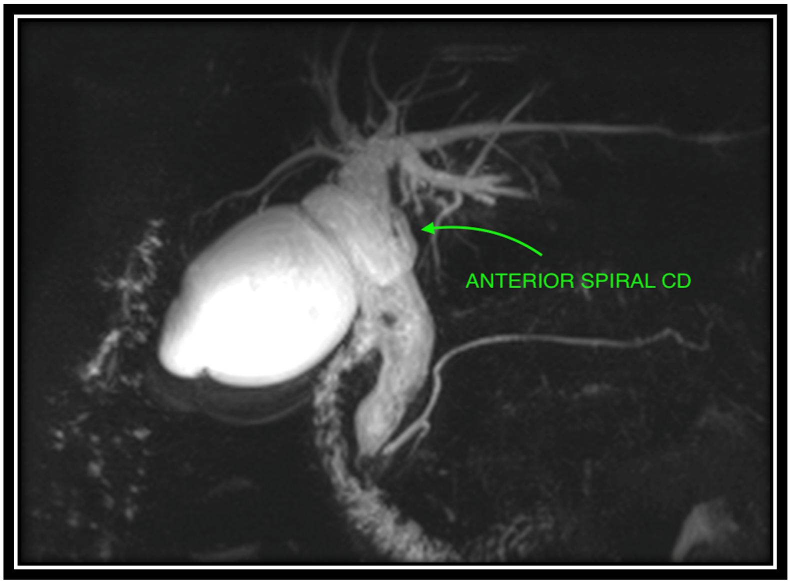


Figure 25. IMAGE OF LOW MEDIAL INSERTION OF CD

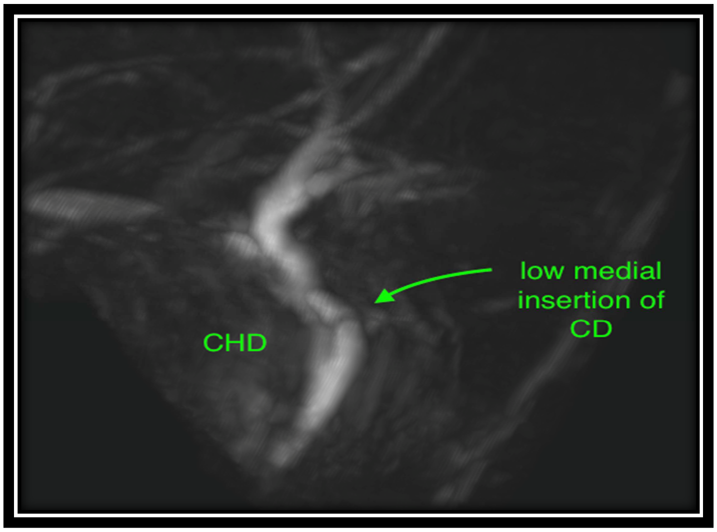


Figure 26. IMAGE OF ACCESSORY AND ABERRANT DUCTS

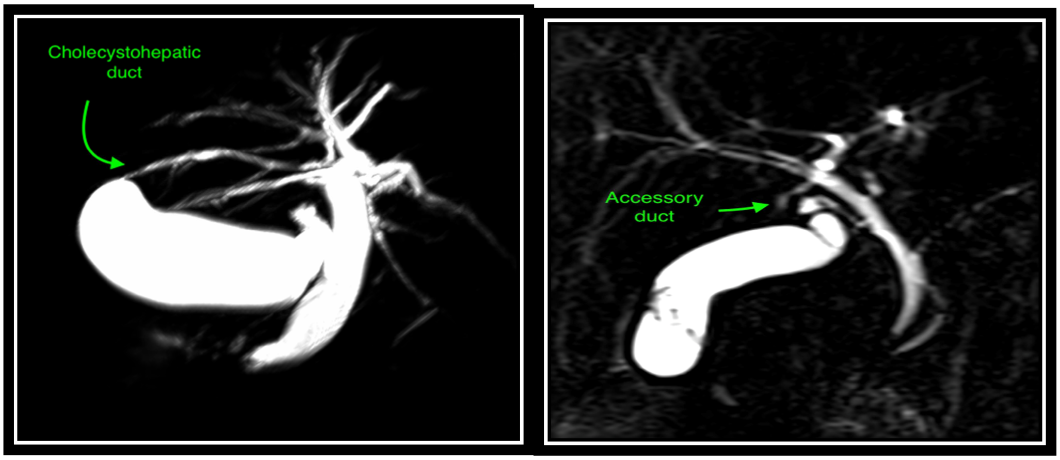


IMAGE CHOLECYSTOHEPATIC DUCT AND ACCESSORY DUCT

Figure 27. CHOLEDOCHOCYSTS TYPE IA

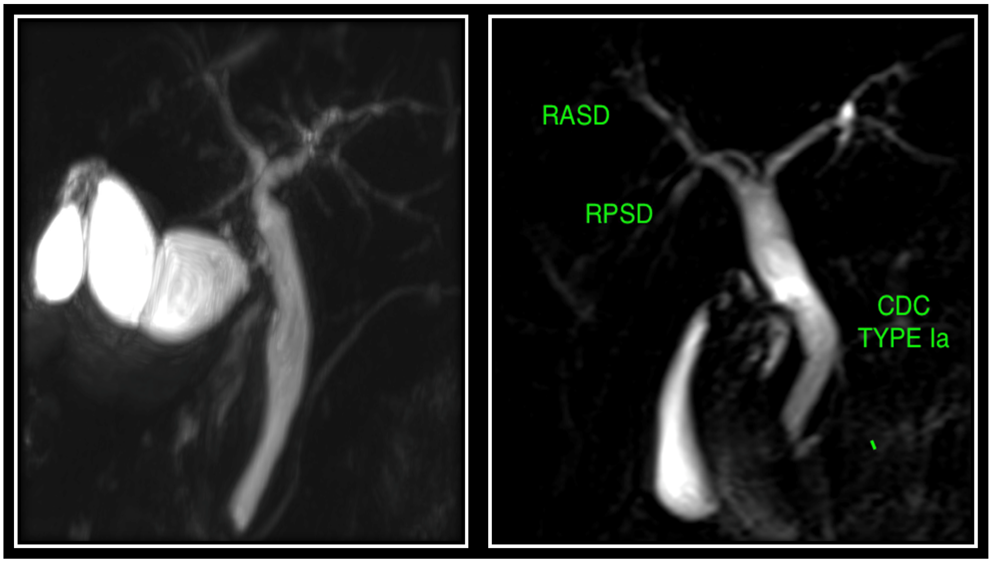


Figure 28. CHOLEDOCHOCYST TYPE IC

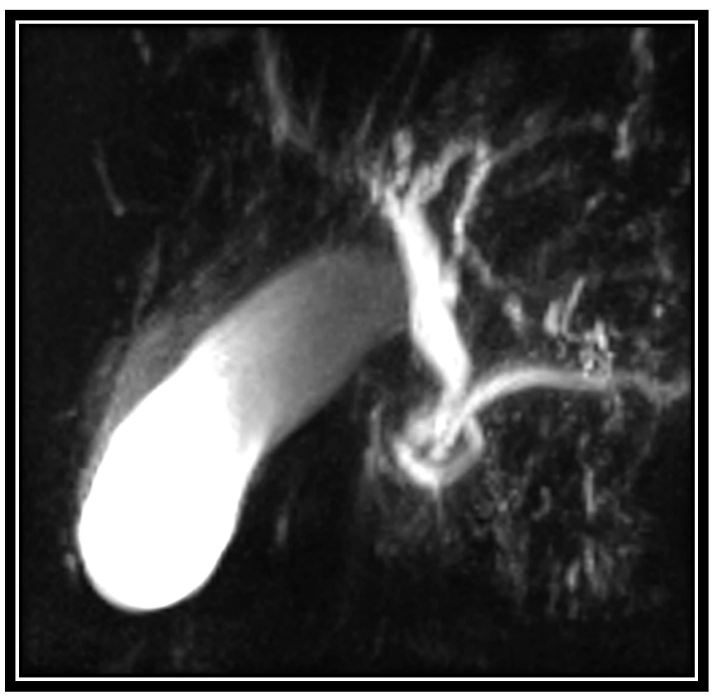


Figure 29. IMAGE OF GIANT CHOLEDOCHOCYST Type IVa

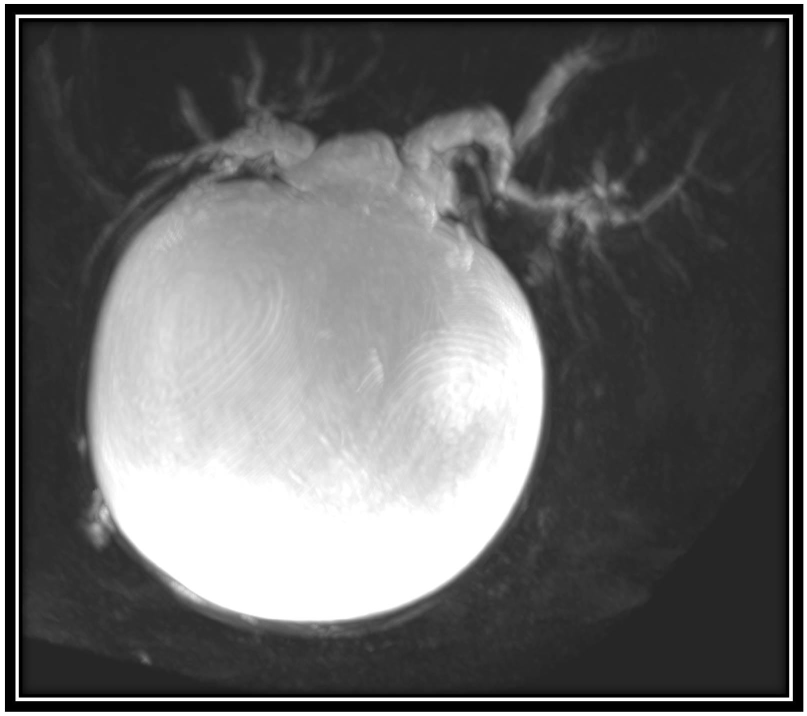
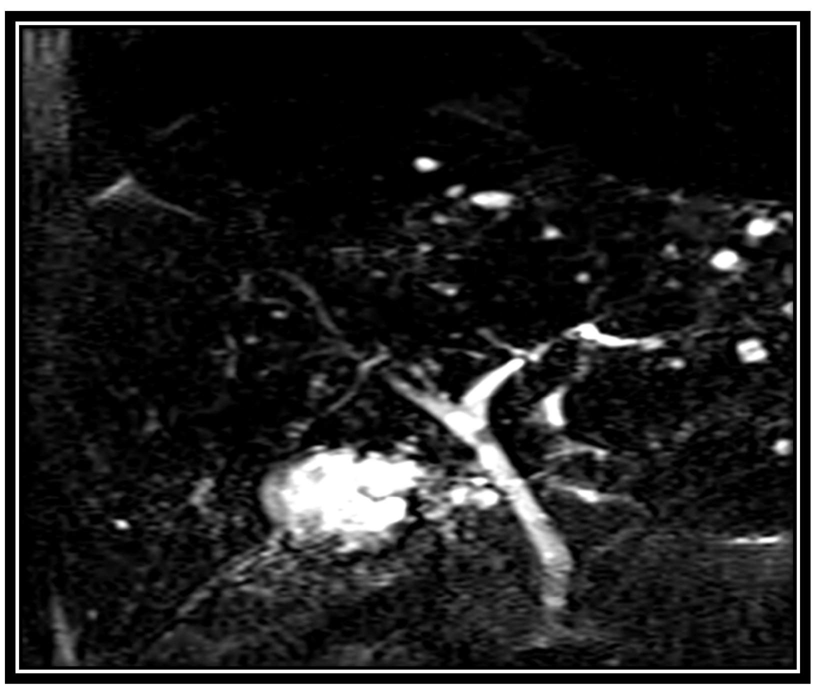


Figure 30. IMAGE OF BILIARY HAMARTOMAS



ANNEXURE V: KEY TO MASTERCHART

Sl No.	**Serial number**
-	**Absent**
+	**Present**
RHD	**RIGHT HEPATIC DUCT**
LHD	**LEFT HEPATIC DUCT**
CD	**CYSTIC DUCT**
AC	**ACCESSORY DUCT**
AB	**ABERRANT DUCT**
CDC	**CHOLEDOCHAL CYST**
BA	**BILIARY ATRESIA**
BH	**BILIARY HAMARTOMAS**
PI	**PROXIMAL INSERTION**
AI	**ANTERIOR INSERTION**
RTLI	**RIGHT LATERAL INSERTION**
LMI	**LOW MEDIAL INSERTION**
LLI	**LOW LATERAL INSERTION**
PSI	**POSTERIOR SPIRAL INSERTION**

ASI	**ANTERIOR SPIRAL INSERTION**
PD	**PANCREATIC DIVISUM**
CDL	**CHOLEDOCHOLITHIASIS**
CL	**CHOLELITHIASIS**
HM	**HEPTOMEGALY**
CALC	**CALCULOUS CHOLECYSTITIS**
PD	**PANCREATIC DIVISUM**
SM	**SPLENOMEGALY**
CLD	**CHRONIC LIVER DISEASE**
CDL	**CHOLEDOCHOLITHIASIS**
MWT	**MAXIMUM WALL THICKNESS**
TW	**THICKENNED WALLS**
NVOP	**NOT VOSUALIZED OPERATED**
PE	**PLEURAL EFFUSION**
BL	**BILATERAL**
M	**MALE**
F	**FEMALE**

																										ANOMALIES																					
				RHD VARIANTS						DUCTS		LHD VARIANTS							CYSTIC DUCT						CHOLEDOCHOL CYST TODANI CLASSIFICATIOMN										Calculus										GALL BLADDER		
SR. NO	MRI NO.	M/F	AGE	TYPE A1	TYPE A2	TYPE A3	TYPE A4	TYPE A5	OTHERS	AC	AB	TYPE B1	TYPE B2	TYPE B3	TYPE B4	TYPE B5	TYPE B6	OTHERS	RTLI	PI	PSI	ASI	LMI	LLI	TYPE Ia	TYPE Ib	TYPE Ic	TYPEII	TYPE III	TYPE IVa	TYPE IVb	TYPE V	BA	H	GB	CBD	CHD	CD	PD	IHBRD	CBD DIA CM	CBD STRICTURE	PD DIA mm	pancreas	GB	GB wall	DIAGNOSIS
1	16982	M	9	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	6	atrophic calcified	-	normal	chronic calcific pancreatitis
2	16992	M	11	+	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	Mild	1.4	-	-	-	distended with sludge	Mild TW, MWT 3.5 mm	CALC
3	16885	F	21	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	1.1	-	3.5	-	NVOP	-	CDL & HM
4	16871	F	39	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	0.6	-	-	-	-	-	CL,HM & SM
5	16797	M	40	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	1	-	-	-	-	-	CL
6	16324	M	83	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	Mild	1.3	-	-	-	-	-	CL
7	15413	F	30	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.9	-	-	-	-
8	15207	M	68	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	15699	M	74	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	15201	M	73	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	14881	F	20	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	CDL & HM
12	20422	M	54	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	TW , MWT 6.0 mm	CALC & Hemangioma seg IVa
13	16830	F	42	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Mild	1	-	-	-	-	-	-
14	14727	F	42	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	CL
15	15767	M	27	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PD 2, SM, mild ascites & BL thin rim PE
16	14984	M	35	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	18	-	-	-	-
17	14708	F	65	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Mild	-	-	-	-	-	-	-
18	15898	M	39		+	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-Hepatic cyst seg V
19	14689	F	32	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	16792	M	52	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	Mild	1.2	-	-	-	-	-	-
21	15039	M	73	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	0.8	-	-	-	-	-	-
22	14767	M	52	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	15295	F	36	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Mod	1.2	+	-	-	-	-	CBD stricture & HM
24	14696	F	76	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	Mild	2	-	3.5	Bulky	-	-	CDL, CL, Acute pancreatitis & Mild SM
25	14872	M	25	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Bulky	-	-	Acute pancreatitis & HM
26	14886	M	16	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Bulky	-	-	Acute pancreatitis, Peripancreatic collection & Ascites
27	15419	M	15	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	15742	M	25	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	15463	F	45	+	-	-	-	-	-	+	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NVOP	-	min fluid in GB fossa, min ascites & min BL PE
30	15741	M	46	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	Mild	0.74	-	-	-	-	-	CL & CDL & ERCP STENT
31	15011	M	77	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	Mod	1.2	-	-	-	-	-	CL, CDL & BL MILD PE
32	16814	F	56	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	Mild	1.5	-	-	-	-	-	CL & HM
33	16818	F	60	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	CL,HM & thin rim BL PE
34	16761	M	42	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	15100	F	52	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36	15638	M	15	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	CL & CD CAL
37	15832	M	60	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	13175	F	21	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	Mild	1.3	+	7.2	-	-	-	PD I
39	20869	M	29	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	cystic in lesion tail	-	-	pancreatic pseudocyst/walled of necrosis, hepatomegaly, thin rim BL PE and mild ascites
40	20000	F	61	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-		-	-	CDC TYPE Ic
41	20926	M	27	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MIN	1	+	-	-	-	-	CBD stricture
42	20860	M	38	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	CL& HM
43	20747	F	33	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	CLD & SM
44	22502	M	8	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	0.78	-	-	-	-	-	CDC TYPE Ia, CL & CD calculi, HM & SM
45	20283	F	18	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	MIN	1.8	-	Opens into minor	-	-	-	CDC TYPE Ia,PD type III & CDL
46	18992	F	52	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	1.4	-	-	-	-	-	CDC TYPE Ia & CL
47	18535	F	19	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	1.1	-	-	-	-	-	Giant cdc type IV a, MILD HYDRONEPROSIS DUE TO PELVIS CALCULUS
48	16817	M	70	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	Mild	1.7	-	-	-	distended	-	CL, CDL,CD calculi, HM & SM
49	23262	F	65	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	23261	F	30	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NVOP	-	HM
51	15027	M	55	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	Mild	1.2	-	-	-	-	-	CDL
52	23630	F	14	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	CDC TYPE IVa & HM
53	20882	F	42	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	CL
54	15600	F	39	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Mod	1.8	+	-	-	-	-	HM
55	20514	F	28	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	Min	-	-	-	-	distended	-	CL, CDL & HM
56	16784	M	59	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	Mild	1.5	-	-	-	-	-	CDL
57	23508	F	18	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.7	-	-	-	PD I
58	20772	M	47	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	Mod	1.2	+	16	atrophic	-	-	chronic calcific pancreatitis & pseudocyst pancreas

Table 1 Pivot

	Columns
Rows	Values