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Assessment of variations in intrahepatic bile duct by magnetic resonance cholangiopancreatography

Muhammad Arslan
Nawaz Sharif Medical College, Gujrat Pakistan

Abbas Ahmad
Senior Registrar Radiology, Mian Gul Abdul Haq Jehanzeb Kidney Hospital, Swat Pakistan
Corresponding author email: abbax80@gmail.com

Abdul Qudoos
Nawaz Sharif Medical College Gujrat, Punjab

Iram Iqbal
Associate Professor Radiology, HBS Medical and Dental College, Islamabad Pakistan

Muhammad Tehseen Hussain
Mohtarma Benazir Bhutto Shaheed Medical College, Mirpur AJK

Usman Amjad
Jinnah Hospital, Lahore Pakistan

***Abstract*---**For any biliary system or liver surgery, it is crucial to have a thorough understanding of the normal branching pattern of the intrahepatic bile duct and its deviations in order to prevent serious post-surgical problems and morbidity. Aim: This study's goal was to assess the variations in intrahepatic bile ducts appeared during Magnetic Resonance Cholangiopancreatography (MRCP) examinations. Place and Duration: In the Radiology department of Mian Gul Abdul Haq Jehanzeb Kidney Hospital Swat from January 2022 to June 2022. Methods: This cross-sectional, quantitative study was conducted among people who had been referred for MRCP examinations for a number of clinical reasons. A total of 70 patients done with MRCP examinations were selected by convenience sampling technique being used. The data of 1.5T Magnetom Amira Siemens MRI scanner was used for anlaysis. Using visual analysis, the 3D MRCP images were categorized into 7 Types using the Choi et al

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classification. Results: Among the 36(51.4%) patients in this analysis had Type 1/normal IHBD, 13(18.6%) had Type 2 IHBD, Type 3A was seen in 2(2.8%), and Type 3B was noticed in 5.7% of subjects. 3 subjects had Type 5A IHBD, 5 had Type 5B IHBD, Type 6 was seen in 2 patients and IHBD Type 7 was noticed in 5 patients. There were no patients with Type 4 and Type 3C IHBD variations. Among total Type-1 cases 29(67.44%) were female, and the remaining cases were male. Conclusions: Only 47.8% of patients had typical IHBD, and other common variations were also observed in our population. In 18.6% and 7.1% of patients, respectively, Type 2 and Type 5B IHBD were identified.

***Keywords*---**cystic duct, common bile duct, magnetic resonance cholangiopancreatography, intra hepatic bile duct, variations.

Introduction

Just 58% of people have normal biliary architecture. The non-invasive imaging method magnetic resonance cholangiopancreatography (MRCP) is ideal for viewing precise biliary architecture[1-2]. For biliary tract and liver surgical procedure, such as tumour excision, laparoscopic hepatobiliary procedures and liver transplantation a precise understanding of the standard branching pattern of the intrahepatic bile duct and their deviations is essential[3-4]. The most frequent anatomical variation in biliary system seen in about 31% of individuals, is right posterior duct drainage into the left hepatic duct or at right anterior duct confluence[5-6]. The majority of surgical difficulties in these procedures are brought on by the bile ducts' anatomical variations, which make anastomosis challenging and increase morbidity[7-8]. There is little information known about the epidemiology of intrahepatic biliary abnormalities, despite the fact that extrahepatic biliary abnormalities are frequently characterized in the literature, particularly with regard to pancreaticobiliary duct mal-junction[9-10]. There is actually very little information available about extrahepatic biliary anatomy and its racial or geographical variations or their relationship to other demographic factors. Numerous authors have proposed various IHBD classifications[11]. We adopted Choi et al classification for our study. Due to little prior knowledge of biliary channel anatomy, there are more and more cases of post-cholecystectomy strictures[12]. This study's goal was to assess the variations in intrahepatic bile ducts appeared during Magnetic Resonance Cholangiopancreatography (MRCP) examinations.

Methods

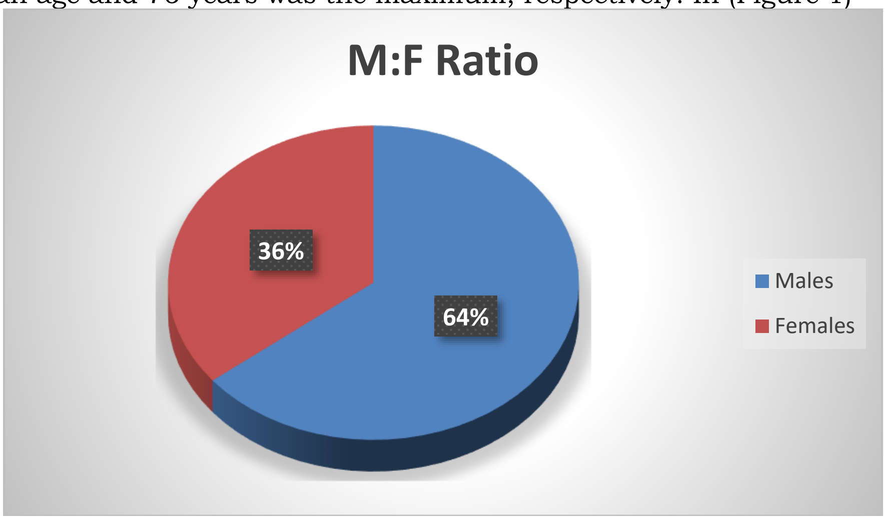
This cross-sectional, quantitative study was conducted in the Radiology department of Mian Gul Abdul Haq Jehanzeb Kidney Hospital Swat from January 2022 to June 2022, among people who had been selected for MRCP examinations for a number of clinical reasons. A total of 70 patients done with MRCP examinations were selected by convenience sampling technique being used. Individuals who have undergone hepatic or biliary surgery in the past were not included in the study. The data of 1.5T Magnetom Amira Siemens MRI scanner was used for anlaysis. Patients who met the criteria for inclusion gave their informed consent. For the MRCP examination, the standard departmental protocol was followed. According to departmental guidelines, the patients underwent a thorough examination for any ferromagnetic material. Prior to the examination, patients were given freshly crushed pineapple juice to help decrease signals of fluid from the stomach. The following categorizations are normally obtained in TUTH:

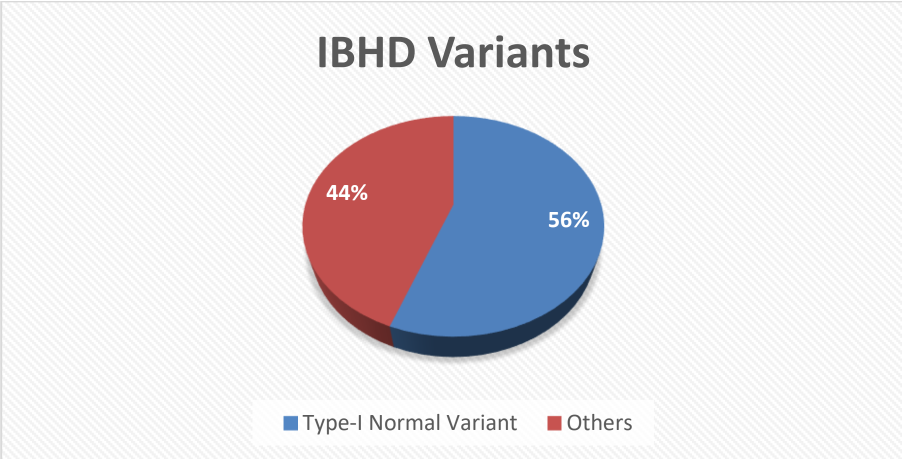
T2 HASTE coronal respiratory triggering parameters: FOV 350mm, 2000ms TR, slice thickness of 4.5mm, 50% distance factor, 93ms TE, 25 slices, 1.1x1.1x4.5mm voxel size and PAT 2. • T2 HASTE transverse respiratory triggering: slice thickness 5mm, 370mm of FOV, TE 99ms, 2000ms of TR, 40% distance factor, slices 30, 1.4x1.4x5mm of voxel size and PAT 2. • T2 FATSAT FBLADE respiratory triggering: FOV 380 mm, TR 3000 ms, slice thickness 6 mm, distance factor 30%, TE 90 ms, slices 30, 1.2 x 1.2 x 6 mm of voxel size and PAT 2 • T2 FATSAT HASTE coronal thick slab breath hold: 350mm FOV, 2000ms TR, 4.5mm slice thickness, 25 slices, 93ms TE, PAT 2, 1.1x1.1x4.5mm voxel size and 50% distance factor. T2 SPACE coronal respiratory triggering: • 380mm FOV, TR 2500ms, 1mm of slice thickness, slabs 1, TE 520ms, no slice oversampling, slices per slab 72, voxel size 0.5x0.5x1mm and PAT 2.

Maximum Intensity Projection was used to convert the 3D SPACE images. The IHBD variants were then identified visually from these images. Cross tabulations of the percentages of IHBD variants by gender were done. It was calculated what proportion of instances were normal (Type 1) and what proportion were aberrant (Types 2/3A/3B/3C/4/5A/5B/6/7). The IHBD variance statistical significance in men and women and female was assessed with chi-square test.

Results

Seventy patients in total were selected. There were 25(64%) females and 45(36%) males. It was determined that the mean age was 47.10±12 years. Three years was the mean age and 76 years was the maximum, respectively. In (Figure 1)





Type 1, 2, 3A, 3B, 4, 5A, 5B, 6, and 7 were the variations of IHBD. (Figures 3 through 9). Type 1 was regarded as typical. Additional variations were labelled as aberrant IHBD variants. 70 patients were chosen for the study, and 36 of them had Type 1 IHBD. This made up 51.4% of the population with the typical form of IHBD, in which the RHD and LHD fuse to form the common hepatic duct. The RPSD drains the VI and VII posterior segments, fuse to form the RHD and RASD drains the anterior segments VIII and V. (Figure 2)

The remaining 13(18.6%) had Type 2 IHBD, Type 3A was seen in 2(2.8%), and Type 3B was noticed in 4(5.7%) of subjects. 3(4.3%) subjects had Type 5A IHBD, 5(7.14%) had Type 5B IHBD, 2(2.8%) patients had Type 6 and IHBD Type 7 was noticed in 5(7.14%) patients. There were no patients with Type 4 and Type 3C IHBD variations. Among total Type-1 cases 24(66.7%) were female, and the remaining cases were male. (Table 1)

Table I
shows the Percentage of IHBDs

Type	Frequency	Percentage (%)
Type 1	36	51.4
Type 2	13	18.6
Type 3A	2	2.8
Type 3B	4	5.7
Type 3C	0	0
Type 4	0	0
Type 5A	3	4.3
Type 5B	5	7.1

Type 6	2	2.8
Type 7	5	7.1


Figure 3. Type 1. RHD and LHD fused


Figure 4. Type 2. simultaneous RASD, emptying of form CHD

The RHD is formed by LHD and RPSD into the CHD RPSD and RASD fusion


Figure 5. Type 3A, abnormal drainage

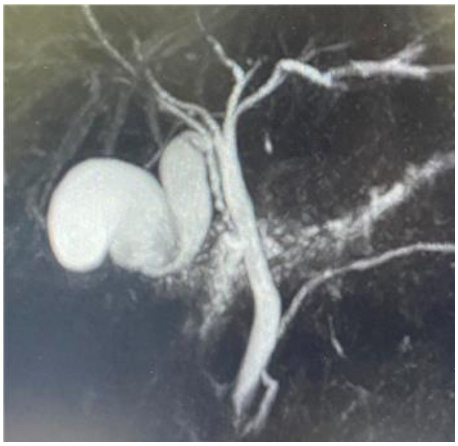


Figure 6. Type 3B, abnormal RPSD drainage into the of RPSD into LHD

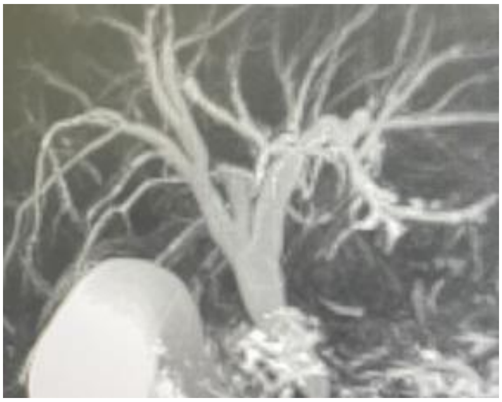


Figure 7. Type 5B, drainage of accessory duct

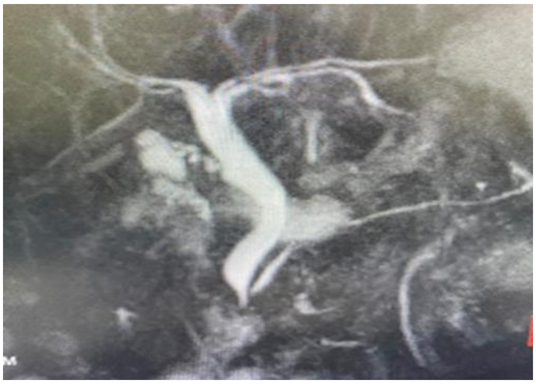


Figure 8. Type 6, Segments II and III of the segmental into the Right Hepatic Duct duct individually drain into the CHD or RHD

Discussion

Presently, due to non-invasive nature, high sensitivity, and lack of ionizing radiation, MRI is thought to be the best approach for studying the biliary system[12]. We are now able to examine the morphology of intrahepatic bile ducts and cystic ducts using MRCP due to various technical advancements that have been made to its procedure in recent years[13]. For biliary interventional procedures, liver surgery such as liver resection and transplantation, as well as to lessen biliary complications, detailed intrahepatic biliary anatomy is required[14]. Although biliary anatomical variations do not rule out liver donation, precise identification pre-operatively is crucial to prevent serious complications and post-surgical morbidity. The incidence of biliary variations is very high, as several earlier studies have demonstrated. Only 36 patients, or 51.4% of the 70 patients selected for this study had normal or Type 1 IHBD. We applied Choi et al classification in the current analysis[15]. In their study; IHBDs anatomical variations were categorized conferring to the right posterior and anterior segmental duct branching patterns (RPSD and RASD, correspondingly) and the absence or presence of an accessory hepatic duct and the 1st-order left hepatic duct (LHD) branch. They noticed IHBD Type 1 in 64% of the individuals (n=190). In this analysis, there were fewer subjects with normal IHBD (47.8%)[16-17]. The fact that our study used a smaller sample size (70 vs. 300 in the previous study) may have contributed to this difference. An intraoperative cholangiogram was performed on carefully chosen liver donors in the Choi et al study. As a result, our research might be more reflective of the overall public. Similar to this, Cocuzza G et al found Type 1 or normal IHBD in 55% of subjects[18-19]. They examined the results of 534 patients done with MRCP examination. In 62% of cases, Nayman et al found normal IHBD[20-21].

In our study, 18.6% of individuals (n=13) had Type 2 IHBD or triple confluence. In 10% of cases, similar type of biliary anatomy was noticed Coccuza G and Choi study. In a research by Nayman et al., 9% of the cases had type 2 IHBD[22-23]. Choi et al classified type 3 into 3A, 3B, and 3C, representing abnormal draining of the right posterior sectoral duct. It was the second most common IHBD variant, according to Cocuzza et al found in 19.8% of cases[24]. About 6% of the cases in the Choi study, Type 3B IHBD was observed. This type of variation was observed by Cocuzza in 6.74% of cases[24]. We did not come across Type 3C RPSD, or RPSD draining into the cystic duct, in our study. In 11% of cases, Nayman et al. found Type 3 IHBD. In our study, we found no cases of Type 4 IHBD[25]. Just one Type 4 IHBD patient was found in the Choi investigation. The accessory duct-present in Type 5 was further classified into Type 5A and Type 5B. The accessory duct enters the CBD in 5A. In our study, 4.3% of the cases (n=3) had this type. Choi discovered this type in 3% of subjects. The right hepatic duct receives drainage from accessory duct 5B.

Conclusions

The preferred modality for assessing hepatobiliary anatomy is MRCP. Only 51.4% of patients had the typical IHBD, and our population also had some common other variations. 18.6% of the patients had Type 2 and 7.1% had Type 5B. We did not find variations of Type 3C or Type 4. To prevent serious post-operative morbidity and complications, precise, thorough pre-operative identification of biliary anatomical variations is crucial.

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