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ORIGINAL ARTICLE

Frequency of bile duct variant anatomy on MRCP on 3.0t in liver donors.

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ABSTRACT… Objective: To determine the frequency of bile duct variant using magnetic resonance cholangiopancreatography (MRCP) on a magnetic field strength of 3.0 Tesla in liver donors. **Study Design:** Descriptive Cross-sectional study. **Setting:** Department of Radiology, Armed Forces Institute of Radiology and Imaging, Military Hospital Rawalpindi. **Period:** May 2019 to November 2019. **Methods:** The research comprised people who went to the hospital for magnetic resonance cholangiopancreatography. 85 liver transplant recipients between the ages of 20 and 70 were chosen for the research. According to Yoshida categorization, bile duct variation was noted. The MRCP methodology includes multiplanar imaging, maximum intensity projection pictures, thin slab axial HASTE, thick slab coronal HASTE, and T2 3D sequence. The Siemens Avanto 3 Tesla machine was used for the study. **Results:** The study's participants ranged in age from 20 to 70, with a mean age of 41.73 ± 10.03 years. The majority of the 54 patients (63.53 percent) were aged 20 to 45. The male to female ratio was 1:1 among the 85 patients, with 43 (50.59 percent) men and 42 (49.41 percent) women. In my research of liver donors, 57 (67.05 percent) showed normal biliary tree structure and 28 (32.95 percent) exhibited abnormalities. **Conclusion:** This study concluded that normal biliary tree anatomy was seen in 67.05% and 32.95% had variations in biliary anatomy on MRCP on 3.0T in liver donors.

Key words: Biliary Tree Variation, Liver Donors, Magnetic Resonance Cholangiopancreatography.

INTRODUCTION

The liver's biliary ducts are divided into intrahepatic and extrahepatic. The intrahepatic ducts have 8 segments each with its own bile drainage.[1] The right hepatic duct is formed by the union of two channels while the left hepatic duct unites ducts serving 3 regions.[2] The right hepatic duct is smaller, and both unite to form the common hepatic duct, which later becomes the extrahepatic duct. This is a typical bile duct system.[3]

The field of hepatic and biliary treatments, such as biliary drainage, liver transplantation, and cholecystectomy, is advancing. However, there are still challenges with these treatments, such as complications in 3.6-8.1% of patients after liver tumor removal[4-7] and 7-10% of donors after liver transplantation. Preoperative examination of the vascular and biliary system is important to determine the best treatment strategy and avoid any unintended biliary problems.[8]

The anatomy of the biliary system can be studied using techniques such as MRCP[9], ERCP, PTC, intravenous cholangiography, and T-tube cholangiography. MRCP is becoming more popular as a pre-surgical diagnostic tool as it is non-invasive, easier and safer than ERCP.[10] MRCP uses fluid in the bile ducts as a contrast agent and doesn't require external contrast medication. The patient needs to fast for 4 hours prior to the exam for accurate results. The exam is performed using a 1.5 Tesla or higher MRI system with a phased array body coil.

Yoshida's classification is a method to categorize the anatomical variations of the bile duct. It is based on the input of the right posterior hepatic duct. The most common variation is the fusion

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of the right hepatic duct and left hepatic duct (type I). Other variations include trifurcation, the right posterior duct entering the common hepatic or cystic duct, and trifurcation anomalies with multiple anomalies co-existing (type II). The typical structure of the left bile duct is a common trunk of the second and third segment joined to the fourth segment (type A), but other variations exist like the confluence of multiple ducts.

The study aims to determine the frequency of bile duct variant anatomy in liver donors using MRCP on 3.0T. The accuracy of MRCP in detecting such variations is also assessed to inform the selection of imaging modalities for liver transplantations, which are important for safe and successful outcomes.

Objective of the Study

In order to reduce dangers to donors and increase benefits to recipients, the goal of this study was to investigate the anatomical differences in the biliary tree prior to liver transplantation. When many biliary anastomoses are necessary, biliary problems are more typical. Right lobe grafts with varying biliary architecture usually require several biliary anastomoses. For surgical planning and estimating the risks of biliary complications, a precise preoperative imaging assessment of biliary anatomy is essential. There are several categorization schemes utilized, and biliary tract differences are frequent.

METHODS

The following investigation used MRCP technology to identify differences in the anatomical biliary tree. At order to do so, descriptive cross-sectional research was conducted in the Department of Radiology at the Armed Forces Institute of Radiology and Imaging at the Military Hospital Rawalpindi. The research was conducted in 2019 between May and November. 85 people of either sex who visited the hospital for an MRCP assessment were included in the research. Participants ranged in age from 20 to 70 years old. Participants in this trial were not permitted to have a history of biliary surgery, a biliary tract that was twisted owing to a tumor or other lesion, an internal cardiac pacemaker, claustrophobia, or a refusal to have a biopsy.

Patients who agreed to participate in the trial after receiving full disclosure were then included. The bile duct variance in the patients was then noted using MRCP in accordance with the Yoshida categorization. The MRCP methodology includes multiplanar imaging, MIP pictures, thin slab axial HASTE, thick slab coronal HASTE, and T2 3D sequence with post processing. The Siemens Avanto 3 Tesla machine was used for the study. Following data collection, SPSS version 16.0 was used to analyse the results. Gender, relationship with patient, and anatomical differences' frequency distributions and percentages were discovered. The mean and standard deviation were used to depict quantitative data, including age. Age and gender were effect modifiers that were controlled by stratification, and the post-stratification chi-square test was used to determine whether there was a significant difference between them. P0.05 was considered to be significant.

The study received ethical approval (Ref.2139) before commencing from the hospital and concerned department. The oral informed consent was obtained from the participants.

RESULTS

Frequency distribution of patient's age, gender and family relation

The table below displays the frequency distribution of patient ages. There were 85 patients in all, 54 of them were between the ages of 20 and 45 and 31 between the ages of 46 and 70.

Age (in years)	No. of Patients	%age
20-45	54	63.53
46-70	31	36.47
Total	85	100.0

Table-I. Age distribution of patients visiting hospital for MRCP

Mean ± SD = 41.73 ± 10.03 years

The Figure-1 shows the gender distribution of the study's participants. 42 women and 43 men participated in the study, according to the data gathered.

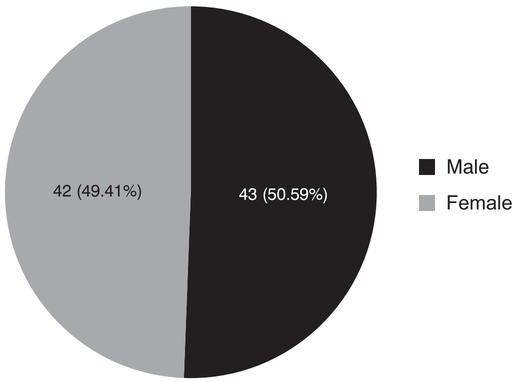

Figure-1. Gender distribution of the participants

The distribution of patients in relation to the donors are presented in the Figure-2.

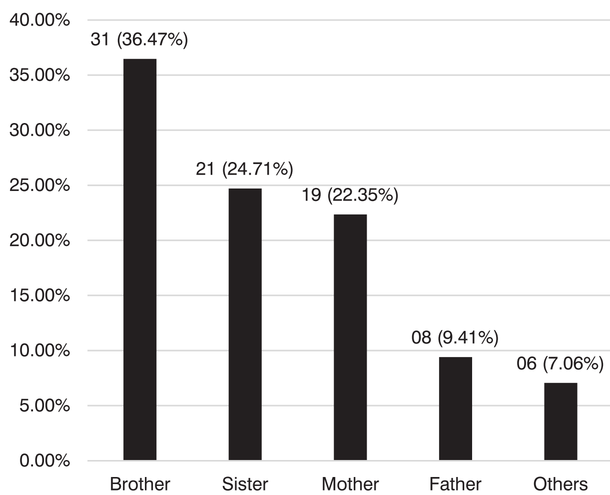

Figure-2. Distribution of patients according to their relations with the donors.

Frequency of bile duct variant anatomy on the MRCP on 3.0T in liver donors

Table-II displays the variance in bile duct structure identified by MRCP in liver donors.

Bile Duct Variant Anatomy	No. of Patients	%age
Type I	57	67.05
Type II	06	7.06
Type III	06	7.06
Type IV	04	4.71
Type V	05	5.88
Type VI	04	4.71
Type VII	03	3.53

Table-II. Frequency distribution of bile duct variant among the patients

Correlation of bile duct variation with respect to age and gender

The stratification of bile duct variation with respect to age and gender is shown in the Table-III and Table-IV, respectively.

Age (Years)	Bile Duct Variation		P-Value
	Yes	No	
20-45	20	34	0.289
46-70	08	23	

Table-III. Stratification of bile duct variation with respect to age

Gender	Bile Duct Variation		P-Value
	Yes	No	
Male	12	31	0.318
Female	16	26	

Table-IV. Stratification of bile duct variation with respect to gender

Pictorial visualization of the variation in the right biliary duct system has attached as supplementary file (Supply-1 a to d)

The Figures show the details related to the Pictorial visualization of the variation in the right biliary duct system from the original work.

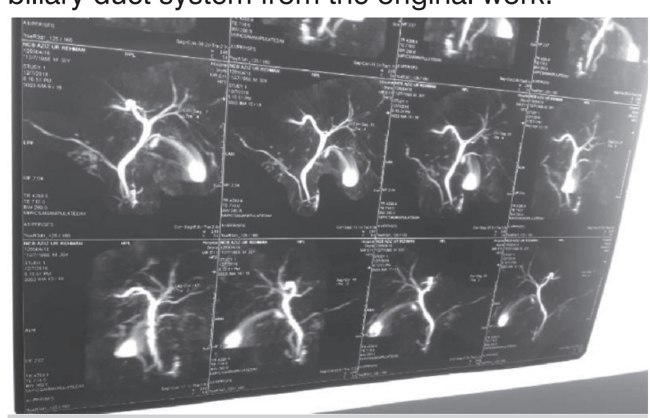

Figure-(a)

DISCUSSION

The hazards associated with nephrotoxic contrast chemicals and ERCP are avoided by the radiation-free, non-invasive diagnostic procedure known as MRCP. In typical bile duct mapping, pancreatic bile exocrine hyperintensities with a black backdrop may be recognized (sensitivity up to 90 percent).[17]

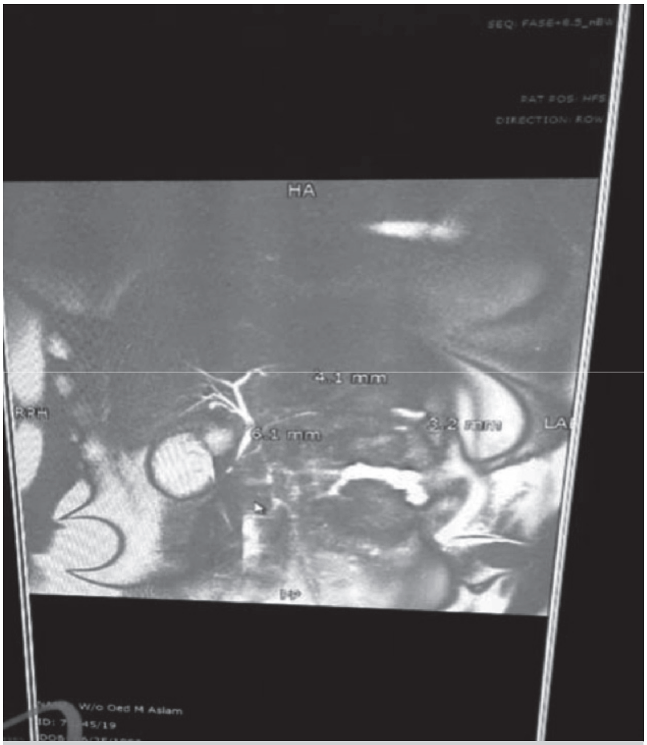

Figure-(b)

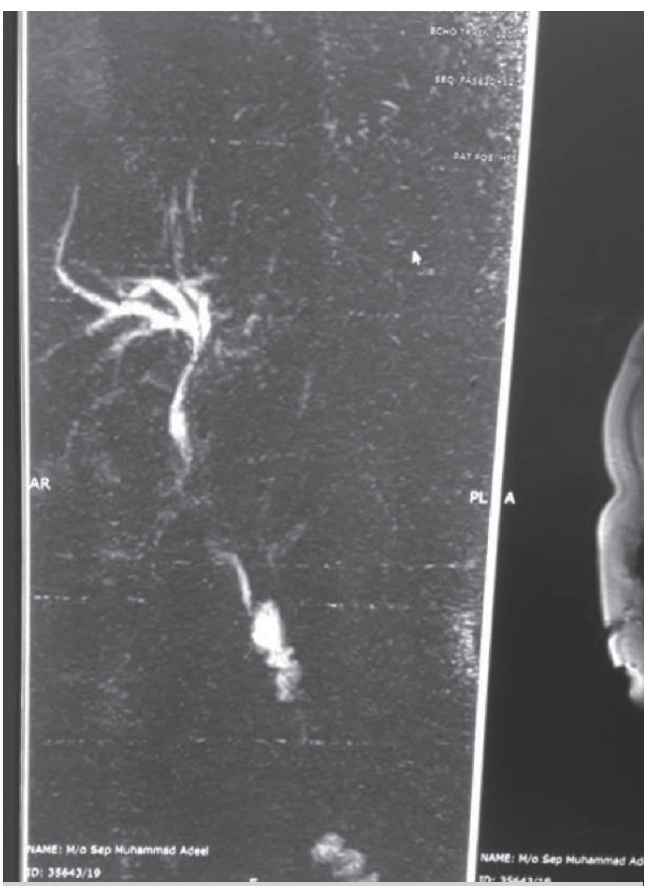

Figure-(c)

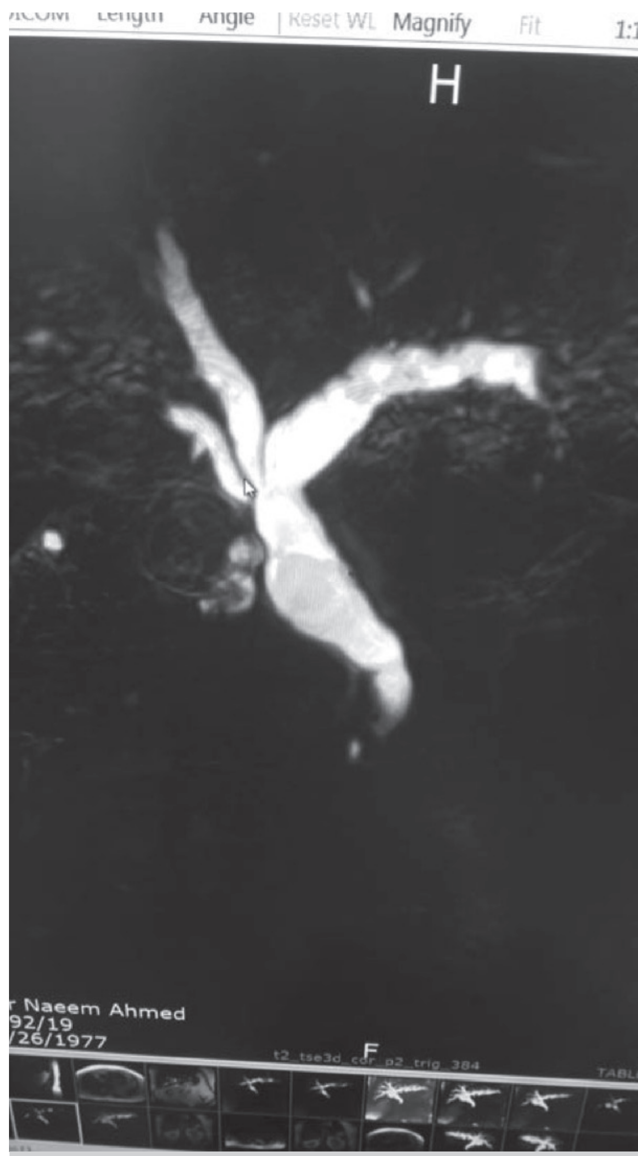

Figure-(d)

Imaging while holding your breath can get rid of breathing motion artefacts and increase spatial resolution by employing longer acquisition periods. It demonstrates the benefit of generating results in very little time, but the image quality is compromised by a low signal-to-noise ratio and a lack of spatial resolution. Extended acquisition times for greater spatial resolution are made possible by breathing technology. The most frequent liver surgeries include laparoscopic cholecystectomy, transplantation, liver resection, and tumour surgery, and problems linked to bile duct changes are among the most frequent causes of morbidity and death.[18] In order to lower morbidity and mortality after surgery, a thorough study of bile duct morphology should be carried out because bile duct variability affects about 42% of the population. Furthermore, prior to lobectomy or lobectomy and before harvesting the left or right liver for living donor liver transplantation, a comprehensive assessment of the architecture of the intrahepatic bile duct branches is essential. Understanding the branching patterns and alterations in the bile duct can help avoid difficulties during surgical, endoscopic, or percutaneous procedures.[19] In a laparoscopic cholecystectomy, the removal of extra segments or segmental ducts can result in bile leakage, and biliary peritonitis, while an incorrect duct ligation can bring on a relapse of cholangitis, a liver abscess, and atrophy of the affected segment.

63 percent of the study's subjects, according to Choi et al., had either type I or typical anatomy. Type IIIa (RPSD to LHD) is the most prevalent of these types, accounting for 11% of donors.[20] Type 2 (trifurcation), on the other hand, accounts for 10% of donors. In larger population studies[21], it has been shown that typical hepatobiliary confluence patterns occur between 55 and 67 percent of the time. According to the study, a typical pattern (type I) was seen in 67.05 percent of the subjects, which was consistent with other investigations. Despite the diverse anatomy, type II and III were the variants that were most frequently seen, accounting for 7.06 percent of all patients. Choi et al. found that type III was the most prevalent variant, while our investigation found that it was the third most prevalent variant, with only 9.4% of patients having it.

Prior research on LPLD evaluation by MRCP has mainly concentrated on differentiating between conventional and variable anatomy. But not only is the presence of anatomical contrast significant; the precise type of anatomical contrast is crucial for formulating the best surgical plan. Cervanci et al. found a sensitivity of 84 percent, a specificity of 100 percent, and an accuracy of 95.1 percent in a study of 67 donors, which included a sample size of 47 donors.

The bile duct variability is correlated with age and gender in the study's second section. The results showed that the stratification between variation and age had a p value of 0.289 and that between variation and gender had a p value of 0.318. The high p values indicate that there is no connection between the factors stated. In earlier investigations, comparable findings were attained. No clear statistical correlation between the occurrence of anatomical variations and sex (26.7 percent versus 30.3 percent; $P = 0.717$) was observed, which is consistent with the findings of the current study.[22] In a research conducted in Thailand, Thungsuppawattanakit et al. reported that of the 163 cases, 65% (n = 106) had an intrahepatic bile duct with a typical anatomy.[23] The remaining 57 individuals did not follow the conventional pattern; 17.2% (n = 28) had trisomy, 5.5% (n = 9) had anomalous RPD draining to CHD, and 9.2% (n = 15) had abnormal RPD draining to LHD. The surgical success of living donor liver transplantation depends on a detailed examination of bile duct architecture because several studies have revealed a high occurrence of 40–42 biliary variations. After surgery, there might be significant bile leakage if even minor intrahepatic branches beyond anatomical borders are missed.

CONCLUSION

This study concludes that normal biliary tree anatomy was seen and had variations in biliary anatomy on MRCP on 3.0T in Liver donors. Therefore, we advise that precise preoperative imaging evaluation of biliary architecture is essential for surgical planning and for estimating the risks of biliary complication.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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2	Humaira Riaz	Data collection and method.	
3	Zainab Riaz	Data entry and management.	
4	Maria Younas	Provide support in the manuscript.	
5	Syeda Ambreen Gulab	Data analysis.	
6	Sayed Haider Yadain	Result part.	
7	Zainab Shehzadi	Project admin.	
8	Sidra Batool	Project admin.	
9	Faiz Ullah Khan	Review and editing the final manuscript.	