ORIGINAL ARTICLE

MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY EVALUATION OF INTRAHEPATIC BILIARY TREE VARIANTS IN NEPALESE POPULATION BASED ON YOSHIDA CLASSIFICATION

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ABSTRACT

Introduction: *The meticulously arranged hierarchical structure of the biliary tree is pivotal for liver function. This biliary tree is divided into intra and extrahepatic components. The anatomic variations of the biliary tree are notoriously common with studies reporting variations in 20% to 55% of the population in different parts of the world. This may result in misdiagnosis and serious injury to the biliary system during surgical procedures. Thus, an accurate knowledge of the biliary tree is essential for the interpretation of radiological examination and presurgical planning for hepatobiliary surgery such as laparoscopic cholecystectomy and liver transplant. Magnetic Resonance Cholangiopancreatography (MRCP) is a non-invasive and safe modality for accurate evaluation of biliary tree.*

Materials and Methods: *It was a prospective cross-sectional study performed using a 1.5 Tesla MRI machine. The complete morphology of intrahepatic bile ducts was evaluated and categorized as per Yoshida classification and compared with past literatures.*

Results: *A total of 76 patients were studied during the period out of which 24 (31.6%) were males and 52 (68.4%) were females. The normal morphology of intrahepatic ducts (Yoshida type I) was found only in 44 (57.9%) cases and rest of the cases (42.1%) showed variant anatomy. Yoshida type II was the next most common morphology. The study also found no significant correlation between the sex of the patient and the morphological variant.*

Conclusion: *Morphological variation of intrahepatic biliary ducts is very common. MRCP is a non-invasive and reliable method for evaluation of intrahepatic biliary anatomy and its variants.*

Keywords: *intrahepatic bile duct; magnetic resonance cholangiopancreatography; Nepal*

INTRODUCTION

The meticulously arranged hierarchical structure of the biliary tree is pivotal for liver function. This biliary tree is divided into intra and extrahepatic components. Classically the intrahepatic biliary tree comprises of the right main hepatic duct (RHD) and left main hepatic duct (LHD) converging into the common hepatic duct (CHD). RHD has two main components, the more horizontally oriented right anterior hepatic duct (RAD) draining segments V and VIII of liver and the vertically oriented right posterior hepatic duct (RPD) draining segments VI and VII. Similarly the LHD comprises of the sectoral ducts draining segment II, III and IV.[1] The anatomic variations of the biliary tree is notoriously common with studies reporting variations in 20% to 55% of the population in different parts of the world.[2-9] This may result in misdiagnosis and serious injury to the biliary system during surgical procedures. Thus, an accurate knowledge of the biliary tree is essential for the interpretation of radiological examination and presurgical planning for hepatobiliary surgery such as laparoscopic cholecystectomy and liver transplant. Magnetic Resonance Cholangiopancreatography (MRCP) is a non-invasive and safe modality for accurate evaluation of biliary tree with the results comparable to invasive procedures like Endoscopic Retrograde Cholangiopancreatography (ERCP) and percutaneous transhepatic cholangiography (PTC).[10] Very few data regarding the variation of intrahepatic biliary duct based on Nepalese population is available. So, this study was conducted to see the prevalence of normal and variant anatomy of intrahepatic biliary tree based on Nepalese population.

MATERIALS AND METHOD

Study population:

It was a prospective cross-sectional study based on convenience sampling. The patients referred to the department of Radiodiagnosis and Imaging of Lumbini Medical College and Teaching Hospital (LMC-TH) for MRCP from within or outside the hospital were included in the study. The study, after being approved by the local ethical committee (Protocol number IRC-LMC 11E/019), was done over a period of 12 months from July 2019 to June 2020. Patients with gross hepatobiliary pathology obscuring the normal anatomy of hepatobiliary system and inadequate imaging details in MRCP were excluded from the study.

Imaging and evaluation:

The MRI examinations were performed using a 1.5 Tesla MRI MAGNETOM Sempra with Tim+Dot System (Siemens company, Germany) by a qualified technician. The MRI protocol used included the following: 1. Single slice T2 HASTE FatSat Coronal (TR=4500 ms, TE=945 ms, Slice thickness=50mm, FOV=300 mm), 2. Multislice T2 HASTE (TR=2000 ms, TE=92 ms, Slice thickness 6 mm for transverse and 4 mm for coronal, FOV=350-370 mm) and 3. Respiratory triggered high resolution 3D T2 SPACE CORONAL (TR=2500 ms, TE=519 ms, Slice thickness=1mm, FOV=350-380 mm). The post processing of the images was done by maximum intensity projection (MIP). Complete anatomical assessment of the biliary ducts was done on Osirix® workstation. The complete morphology of intrahepatic bile ducts was evaluated and categorized as per Yoshida classification[1] as follows:

Type I: This is the normal morphology where RAD and RPD join to form RHD which combines with LHD to form CHD.

Type II: This is the triple confluence morphology where RAD, RPD and LHD join at the same point.

Type IIIa: RPD emptying on LHD

Type IIIb: An aberrant RPD draining into CHD

Type IIIc: RPD draining into the cystic duct.

Type IV: RHD drains into cystic duct

Type Va: An accessory duct from the right lobe draining into CHD

Type Vb: An accessory duct from the right lobe draining into RHD

Type VI: Individual drainage of segment II and III of left lobe of liver into RHD or CHD.

Any other variations were categorized under "Others/ Unclassified".

The data were entered and analyzed using Statistical Package for Social Sciences (SPSS™) version 20. The descriptive results were presented in terms of mean, standard deviation, frequency and percentage. Chi Square test was used for inferential statistics.

RESULTS

A total of 87 patients were evaluated during the study period out of which 11 cases were excluded due to suboptimal imaging. Thus a total of 76 patients were studied out of which 24 (31.6%) were males and 52 (68.4%) were females. The median age of the patients was 40 years with an interquartile range of 25.75 years. The normal morphology of intrahepatic ducts (Yoshida type I) was found only in 44 (57.9%) cases (Figure 1) and rest of the cases (42.1%) showed variant anatomy as shown in Table 1.

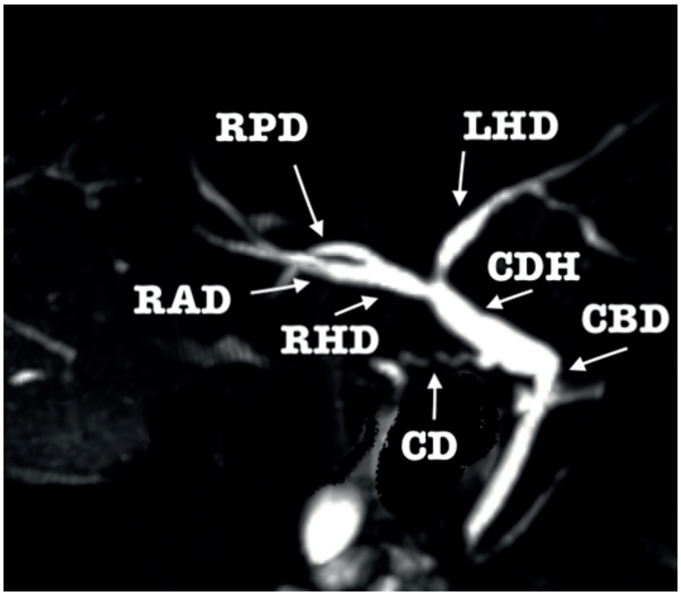

Figure 1. Normal morphology (Yoshida type I)

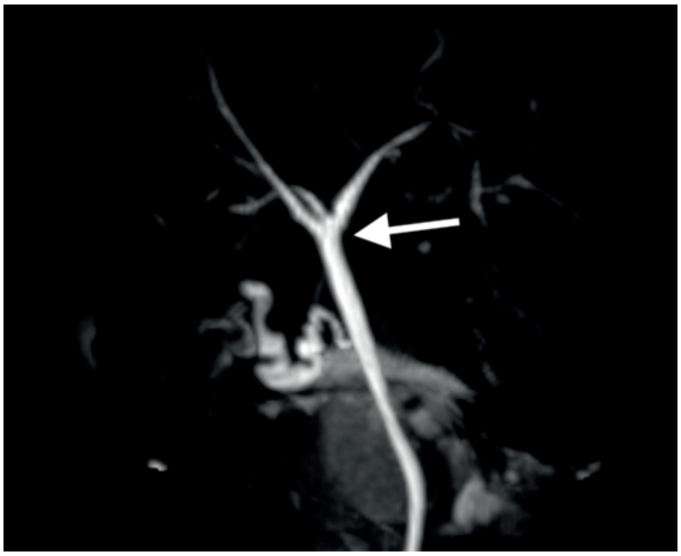

Figure 2: Yoshida type II/Trifurcation type (Arrow)

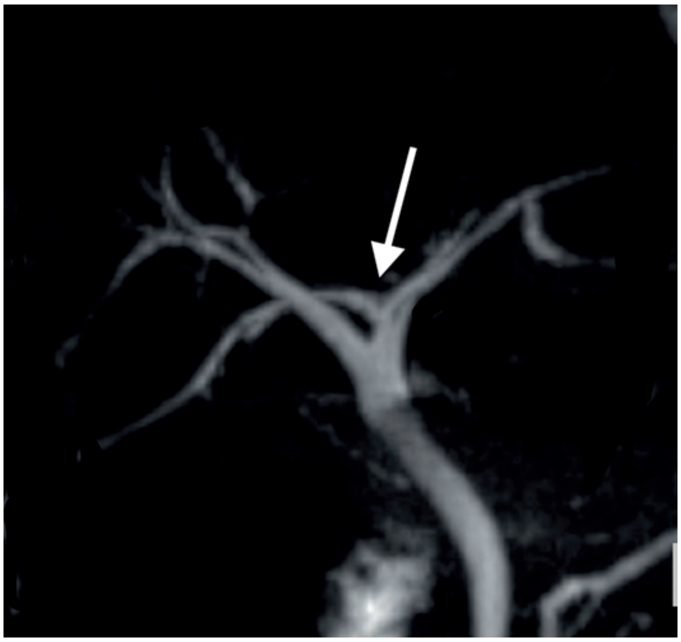

Figure 3: Yoshida type IIIa (RDP draining into LHD, arrow)

Table1: Frequency of intrahepatic duct configuration in MRCP (Yoshida Classification)

S.N.	Yoshida Classification	Frequency (n=76)
1.	Type I	44 (57.9%)
2.	Type II	16 (21.1%)
3.	Type IIIa	8 (10.5%)
4.	Type IIIb	4 (5.26%)
5.	Type IV	0 (0%)
6.	Type Va	4 (5.26%)
7.	Type Vb	0 (0%)
8.	Type VI	0 (0%)
9.	Others/Unclassified	0 (0%)

	Type I	Type II	Type IIIa	Type IIIb	Type Va
Male (n=24)	67%	17%	17%	0%	0%
Female (n=52)	54%	23%	7.6%	7.6%	7.6%

A total of 16 (67%) males and 28 (54%) of the females had the normal Yoshida type I morphology. Yoshida type II was the next most common morphology (Figure 2). It was observed that type II, IIIb and Va were more common in females and type IIIa was more common in males (Figure 3) as shown in Table 2. The study also found no significant correlation between the sex of the patient and the different morphological variants {$X^2(df=1, N=76)=1.107, p=0.328$}.

DISCUSSION

MRCP provides an excellent non-invasive alternative to invasive cholangiographic imaging techniques such as ERCP and PTC. It has some added advantages because of the absence of ionizing radiation and its ability for tumour staging which are not always possible with other techniques. In our study, the patient compliance was excellent with no associated major or minor complication, except for a few transient halt of the examination in some claustrophobic patients which were eventually uneventful.

The knowledge of embryonic development of biliary system helps better appreciate the anatomic variations. In early embryonic period during 4th-5th week of gestation, the cranial portion of liver bud gives rise to intrahepatic and hilar bile ducts. The further development of these ducts is governed by many of the complex cell signalling pathways. Lack of remodelling of the ductal plate is found to be associated with major or minor structural variations in branching pattern.[11]

Our study found the normal morphology, often termed Yoshida type I, in 57.9% of cases with the remaining 42.1% showing variant anatomy. Studies in the past, based on MRCP, ERCP, PTC and cadaveric cases, have reported upto 55% cases showing variant anatomy as shown in Table 3. Our findings are comparable to the studies done elsewhere, [2,3,4,5,6,7,14,15] except for one MRCP based study done in France where 80% cases showed the normal morphology.[8]

This difference is probably due to demographic variation. Moreover, the most common variant anatomy in our study was Yoshida type II (trifurcation) which was similar in majority of the studies.[3,4,6,7] We didn't find any variant of type IV, Vb, VI and others/unclassified probably because of a smaller sample size. The intrahepatic biliary duct morphological variation has also been classified differently based on Huang et al[12] and Cho et al.[13] Nonetheless whatever be the classification system, with the variant anatomy of intrahepatic biliary ducts being so common, it becomes necessary to accurately describe the morphology before image interpretation of biliary pathology and hepatobiliary intervention or surgery to avoid unwanted complications.

The major limitation of our study was the small sample size. Perhaps a multicentric study incorporating a larger sample size would yield a better information. Also some inherent limitation of MRCP such as non-visualisation of thin and collapsed biliary ducts couldn't be avoided. A simultaneous comparison with invasive cholangiogram would have served better in this regard but was beyond the scope of this study.

Table 3: Incidence of Morphological variations of intrahepatic biliary duct based on Yoshida Classification described in previous literature

Study	Year	Country	Total cases	Imaging technique	Type I (%)	Type II (%)	Type IIIa (%)	Type IIIb (%)
Nakamura et al[14]	2002	Japan	120	Cholangiogram	65	9.2	15.8	8.3
Vidal et al[8]	2007	France	45	MRCP	80	4.4	2.2	6.6
Karakas et al[2]	2008	Turkey	112	MRCP	54.5	14.3	21	10
De Filippo et al[3]	2008	Italy	350	MRCP	57.7	7.9	6.7	3.3
Mariolis-Sapsakos et al[7]	2012	Greece	73	Cadaveric	65.7	9.6	4.1	2.7
Chaib et al[4]	2013	Brazil	2032	Combined	61.3	14.5	13.3	6.1
Sarawagi et al[5]	2016	Poland	224	MRCP	55.3	9.3	27.6	4
Gupta A et al[15]	2016	India	458	MRCP	65.7	12.2	14	4.4
Taghavi et al[6]	2017	Iran	362	ERCP	45	21.5	13.3	3.6
Present study	2020	Nepal	76	MRCP	57.9	21.1	10.5	5.3

CONCLUSION

Morphological variation of intrahepatic biliary ducts is very common, and a thorough knowledge of this anatomy is essential for image interpretation of biliary pathology and presurgical planning of hepatobiliary surgery. MRCP is a non-invasive and reliable method for evaluation of intrahepatic biliary anatomy and its variants.

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