Original Research Article

Magnetic resonance cholangiopancreatographic evaluation of cystic duct anatomical variants in Pondicherry population

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Abstract

Background: It is very important to know the variant anatomy of the cystic duct as it is a very small structure which is often given less importance to identify the anatomical variant that can end up in severe complications during invasive procedures. The aim of this study was to identify the various anatomical variations in the cystic duct that are found in the Pondicherry population by Magnetic Resonance Cholangiopancreatography (MRCP) and to correlate the length and width of the cystic duct with the sex and age of the patient to see that if there is any correlation.

Materials and methods: This study included 226 cases that were referred for MRCP for various indications. All the patients between 20 to 80 years of age were included in the study which the exception of those having pathologies involving the gallbladder or the cystic duct itself. The images were evaluated and the variants, the length and the width of the cystic duct were documented.

Results: A total of 120 male and 10 female patients were evaluated. The most common variant identified was the posterior insertion of the cystic duct (CD) into the common hepatic duct (CHD) (33.2%). The second and third most common variants included proximal lateral (23%) and middle lateral (14.6%) insertion of the CD into the CHD. The mean length of the cystic duct in males and females were found to be 27.41±5.20 mm and 27.79±7.43 mm respectively. Similarly, width of the cystic duct was 2.67±0.51 mm in males and 2.85±0.53 mm in females. On correlating with the age, the width of the cystic duct was found to have strong correlation.

Conclusion: MRCP is an optimal imaging modality to identify the anatomical variants to guide the surgeons. In Pondicherry population, the most common anatomical variant of cystic duct is the posterior insertion of the CD with the CHD. There is significant correlation with the width of the cystic duct and the age of the patient.

Key words

Cystic Duct (CD), Common hepatic duct (CHD), Magnetic Resonance Cholangiopancreatography (MRCP), Variants, Length, Width.

Introduction

Cystic duct is a very small structure measuring about 2-4 cm long and 1–5 mm in caliber forming a bridge between the neck of gall bladder and the common hepatic duct (CHD). The anatomical variations occur with respect to its point of insertion to the CHD. The most common anatomy is its insertion at the right lateral insertion to the CHD [1]. Some variations that were mentioned in the literature includes anterior or posterior course of cystic duct with medial and lateral insertion to CHD, anterior or posterior insertion to CHD, parallel course with CHD, aberrant drainage of cystic duct into right or left hepatic duct or into an intrahepatic duct and a short (<5mm) or absent cystic duct [2-4]. The normal length of cystic duct (CD) is 2-4cm while the diameter or width is around 1-5 mm [1].

Various modalities like the ultrasound (US), computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are available to evaluate the biliary tree. Magnetic Resonance Cholangiopancreatigraphy (MRCP) is the non-invasive modality used in analyzing the biliary tree for pathologies compared to ERCP which is invasive although more specific. It is very much important to know the anatomy of the cystic duct to guide the surgeons while undergoing invasive procedures as the duct is commonly under-evaluated because of its size. Therefore, we aimed to evaluate the variant anatomies that are commonly found in the Pondicherry population and also correlated the length and width of the cystic duct with the age and sex of the population.

Materials and methods

This prospective study was conducted for a period of one year from 2013 to 2014 in Mahatma Gandhi Medical College and Research Institute, Pondicherry after obtaining approval from the Institutional Ethics Committee. A total of 226 consecutive patients from 20 years of age without previous history of biliary, hepatic or gallbladder surgeries referred for MRCP for various indications other than suspected or known carcinoma were included in the study. The obtained images were evaluated for the anatomical variants in the cystic duct and its length and width. The analysis was performed by two radiologists who were blinded to each other and the average measurements of them were noted. Kappa statistics test was used to analyse the variants. One way ANOVA was used to correlate the length and width of the cystic duct with age. All statistical analyses were done using SPSS 12.0.

Results

Among the 226 patients, 120 were male (53.1%) and 106 were female (46.9%) patients. The mean age of the patients ranging from 20 to 81 years was 43.59 with SD of 14.82 years. It was observed that the most common anatomic variant is the posterior insertion of CD to the CHD (33.2%) found in 27 male and 48 female patients (**Figure - 1**). The second most common variation is the proximal lateral insertion of the CD to the CHD (23.0%) seen in 37 males and 15 female patients (**Figure - 2**). About 14.6% of the total patients had middle lateral insertion of the CD to the CHD seen in about 19 and 14 male and female patients respectively. Anterior insertion to the CHD and parallel course of CD with CHD

were found in about 5-10% of patients with <10% patients having proximal, middle and distal medial insertion of CD to the CHD (**Table - 5**). Spiral course of the cystic duct was noted only in 42 patients out of which 27 were males (22.5%) and 15 were female (14.2%) patients (**Table - 6**).

Figure – 1: Posterior view of the biliary tree showing the posterior insertion of the Cystic Duct to the common hepatic duct (arrow).

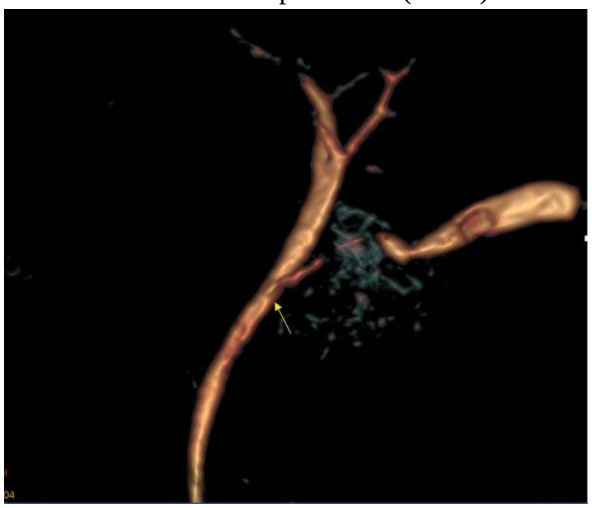
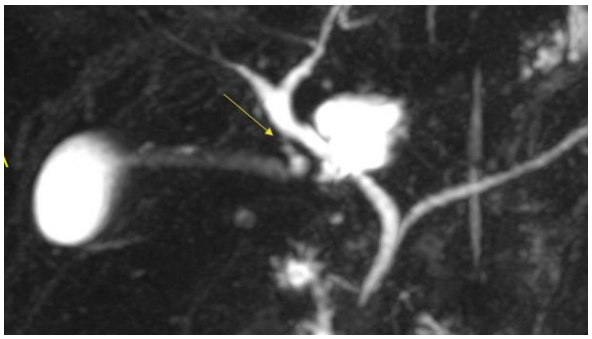


Figure – 2: MRCP image showing proximal lateral insertion of the cystic duct to the common hepatic duct (arrow).



The average length of the cystic duct was found to be 27.58±6.34mm ranging between 15 and 51 mm while the width measures about 2.76±0.53 mm ranging between 1.9 and 3.9 mm. The females were found to be having a slightly increased length and width of the CD compared to mean (**Table – 1, 2**).

On correlating the width of the CD with age of the patients, a significant correlation (<0.05) was found between the width of CD and age of the patients. On comparing between the different age groups, a difference in values were noted between 20-29 years and 60-69 years age group, 30-39 and 60-69 and 70+ age groups and 50-59 and 60-69 age groups. No significant correlation was found between the length of the CD and the patient age (**Table – 3, 4**)

Table – 1: Cystic duct insertion related to sex.

Cystic Duct Insertion	Sex				Total	
	Male		Female			
	N	%	N	%	N	%
Anterior	11	9.2	6	5.7	17	7.5
Proximal Lateral	37	30.8	15	14.2	52	23.0
Middle Lateral	19	15.8	14	13.2	33	14.6
Distal Lateral	-	-	4	3.8	4	1.8
Proximal Medial	3	2.5	-	-	3	1.3
Middle Medial	11	9.2	8	7.5	19	8.4
Distal Medial						
Posterior	27	22.5	48	45.3	75	33.2
Absent Cystic Duct	0	0	0	0	0	0
Short Cystic Duct (<5mm)	0	0	0	0	0	0
Parallel Course	12	10.0	11	10.4	23	10.2

Table – 2: Spiral course.

Yes				No			
Male		Female		Male		Female	
N	%	N	%	N	%	N	%
27	22.5	15	14.2	93	77.5	91	85.8

Table – 3: Length of cystic duct related to sex.

Length of Cystic Duct (mm)	Sex		Total
	Male	Female	
N	120	106	226
Mean Value	27.41	27.79	27.585
SD	5.207	7.439	6.34
Minimum	15	16	15
Maximum	37	51	51

Discussion

The cystic duct measures about 2-4 cm in length and 1-5 mm in width. Several studies were done to evaluate the variations in cystic duct course and insertion both in India and the rest of the

World. In a study by Sarawagi, et al. in 2016, the most common variant found was middle lateral insertion of CD to the CHD in about 51.5% cases whereas in our study, the same variant was found only in 14.6% of cases. The most commonly identified variant in our study, the posterior insertion of CD to the CHD was found in only <10% of patients in their study [5].

Table – 4: Width of cystic duct related to sex.

Width of Cystic Duct (mm)	**Sex**		**Total**
	Male	**Female**	
N	120	106	226
Mean Value	2.677	2.856	2.761
SD	0.5149	0.5344	0.5306
Minimum	1.9	2.0	1.9
Maximum	3.9	3.9	3.9

Table – 5: Length of cystic duct related to age.

Length Of Cystic Duct (mm)	**Age (Years)**						**Total**	**p-value**
	20-29	**30-39**	**40-49**	**50-59**	**60-69**	**70+**		
N	54	42	45	49	30	6	226	**0.145**
Mean	26.16	26.86	27.24	28.66	29.64	28.80	27.58	
SD	6.67	5.06	4.60	8.55	5.43	0.32	6.34	
Minimum	17	15	20	16	19.3	28.5	15	
Maximum	40	34	37	51	37	29.1	51	

p-value one way ANOVA 0.145 (Not significant)

Table – 6: Width of cystic duct related to age.

Width Of Cystic Duct (mm)	**Age (Years)**						**Total**	**p-value**
	20-29	**30-39**	**40-49**	**50-59**	**60-69**	**70+**		
N	54	42	45	49	30	6	226	**<0.05***
Mean	2.58	2.54	2.84	2.78	3.13	3.20	2.76	
SD	0.418	0.49	0.53	0.43	0.63	0.54	0.53	
Minimum	2	1.9	1.9	2.1	2.2	2.7	1.9	
Maximum	3.5	3.5	3.7	3.5	3.9	3.7	3.9	

p-value (one way ANOVA) – <0.05 (Significant)

There are a few studies which reported medial insertion of the cystic duct as the most common variant which was found only in <10% of cases in our study [6-8].

The presence of a short or absent cystic duct is a very rare phenomenon and it was found only in 1-3% of cases in a few studies done previously but no cases were found in our study [6, 9, 10].

The mean length of the cystic duct was found to be in the range of 24.3±9.0 mm to 29.1±6.2 mm while the diameter was found to be 14.7±5.0 mm to 29.5±6.0 mm in a cadaveric study done by Nurun Nahar in 2011 [11]. The range is found to be slightly more in the present study. In the same study, no correlation was found between the cystic duct length and a strong correlation between different age group patients and cystic duct diameter, similar to the observations in the present study.

There were only a few studies that correlated the length and width of the cystic duct with the age and sex of the patient even though there were many studies that were done for the Common

Bile Duct using MRCP [12, 13, 14]. A recent study by Fadil Sherifi, et al. in 2018 showed no significant correlation between the length and width of cystic duct with the age of the patient whereas in our study, we found a strong correlation between the width of cystic duct and patient's age as well as between different age groups [15].

Conclusion

MRCP is the most optimal modality to evaluate the cystic duct to identify the variations in its course. This will be useful for the surgeons while performing invasive procedures to avoid unnecessary complications. The mean length and width of the cystic duct in males and females were 27.58±6.34 mm and 2.76±0.53 mm respectively. On correlating the length and width of cystic duct with the age of the patient, the width is found to be strongly correlating the patient's age concluding that the width of cystic duct increases with the patient's age whereas no significant correlation was found with the length of cystic duct.

Limitations

The variants that were not found in this study compared to other studies could have been still found if the study was done for more extended period of time including much more cases.

References

1. M. A. Turner, A. S. Fulcher. The cystic duct: normal anatomy and disease processes. RadioGraphics, 2001; 21(1): 3–22.
2. Y.H. Wu, Z.S. Liu, R. Mrikhietal. Anatomical variations of the cystic duct: two case reports. World Journal of Gastroenterology, 2008; 14(1): 155–157.
3. T. Fujikawa, H. Takeda, S. Matsusue, Y. Nakamura, S. Nishimura. Anomalous duplicated cystic duct as a surgical hazard: report of a case. Surgery Today, 1998; 28(3): 313– 315.
4. M. Hashimoto, M. Hashimoto, T. Ishikawa, T. Iizuka, M. Matsuda, G. Watanabe. Right hepatic duct emptying into the cystic duct: report of a case. Surgical Endoscopy, 2002; 16(2): 359.
5. Sarawagi R., Sundar S., Gupta K.S., Raghuwanshi S. (2016) Anatomical variations of cystic ducts in magnetic resonance cholangiopancreatography and clinical implications. Radiol. Res. Pract., 2016; 3021484, 6 pages.
6. H. Onder, M. S. Ozdemir, G. Tekbas, F. Ekici, H. Gum US, A. Bilici. 3-TMRI of the biliary tract variations. Surgicaland RadiologicAnatomy, 2013; 35(2): 161–167.
7. M.J. Shaw, P.J. Dorsher, J.A. Vennes. Cysticductanatomy: an endoscopic perspective. American Journal of Gastroenterology, 1993; 88(12): 2102–2106.
8. K. J. Mortel´e, P. R. Ros. Anatomic variants of the biliary tree: MR cholangiographic findings and clinical applications. American Journal of Roentgenology, 2001; 177(2): 389–394.
9. K.A.H. Talpur, A.A. Laghari, S.A. Yousfani, A.M. Malik, A.I. Memon, S.A. Khan. Anatomical variations and congenital anomalies of extra hepatic biliary system encountered during laparoscopic cholecystectomy. Journal of the Pakistan Medical Association, 2010; 60(2): 89–93.
10. L. G. Awazli. Anatomical variations of extrahepatic biliary system. Iraqi Journal of Medical Science, 2013; 11(3): 258–264.
11. Nurun Nahar, Shamim Ara, Mushfika Rahman, Halima Afroz. Length and diameter of the cystic duct: A Postmortem Study. Bangladesh Journal of Anatomy, July 2011; 9(2): 89-92.
12. Kaude JV. The width of the common bile duct in relation to age and stone disease. An ultrasonographic study. Eur J Radiol., 1983; 3: 115-117.
13. Karamanos E, Inaba K, Berg R, J, Resnick S, Okoye O, Alexopoulos S, Chouliaras K, Demetriades D. The

Relationship between Age, Common Bile Duct Diameter and Diagnostic Probability in Suspected Choledocholithiasis. Dig Surg., 2017; 34: 421-428.

14. Mahour GH, Wakim KG, Ferris DO. The common bile duct in man: its diameter and circumference. Ann Surg., 1967; 165: 415-419.
15. Fadil Sherifi, Ismet Bajraktari, Sadi Bexheti, Ali Lahu, Zaim Gashi, Jeton Shatri. Anatomic variations of the cystic duct assessed by magnetic resonance cholangiopancreatography. Italian Journal of Anatomy and Embryology, 2018; 123(2): 158-164.