

Research Article - Basic and Applied Anatomy

Anatomic variations of the cystic duct assessed by magnetic resonance cholangiopancreatography

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Abstract

The cystic duct is known for its anatomical variability. The purpose of this research was to evaluate the anatomical variations of the cystic duct based on the number, size, and its insertion into the common hepatic duct. This study included 63 patients (32 males and 31 females). The examinations were carried out using the Siemens Type of MRCP in the Aloka Clinical Surgery Clinic in Prishtina as well as at the Radiologic Clinic in the University Clinical Centre of Kosovo in Prishtina. The average length of the cystic duct was 27.3 mm ranging from 10 to 54 mm. The longest cystic duct length was in patients aged 30-39 years. The average cystic duct width was 3.2 mm ranging from 2 to 6 mm. The greatest cystic width were in patients aged 20-29 years. The cystic duct in 58.7% of cases had lateral proximal insertion (males 50.0%, females 67.7%); middle lateral insertion was 11.1% (males 12.5%, females 9.7%); middle medial insertion was seen in 6.3% of males; medial distal insertion was seen in 3.2% of females; and anterior insertion was seen in 3.1% of males. In 4.8% of cases the insertion position could not be evaluated. Cystic duct anatomic variations are very important for diagnostic and therapeutic approach, because the duct is part of the Calot Triangle and must be handled carefully during operation.

Key words

Cystic duct, anatomic variations, insertion, MRCP.

Introduction

The bile ducts are divided into intra and extrahepatic bile ducts (Vela, 1997). The biliary system is known for its anatomical variability (Kashyap et al., 2008). Laparoscopic technique has become standard for cholecystectomy. Identifying anatomical cystic variants eliminates complications. It is better not to touch cystic duct remnant in low insertion because it is likely to become complicated in cases of postcholecystectomy syndrome (Mortele and Ros, 2001; Turner and Fulcher, 2001; Elakkary, 2006).

The cystic duct joins the common bile duct approximately between the portal hepatic vein and Vater ampoule. However, this point may be variable. Usually the cystic duct joins the lateral side of the common bile duct. It is inserted on the medial aspect in up to 19% cases, but can be inserted even on the front and on the back of common bile duct. Its course may be parallel or spiral with respect to common bile duct. Its length can range from 1.5 to 9.5 cm (Netter, 1957; Friedman, 1987; Zeman, 1987; Shaw, 1993).

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The purpose of this research was to evaluate the anatomical variations of the cystic duct with regard to number, size, and insertion into the common hepatic duct, on the basis of gender and age.

Material and methods

Anatomical variations of the cystic duct were assessed in patients at the Clinic of Gastroenterology with Hepatology of the University Clinical Centre of Kosova, in Prishtina. Our research was observational, comparative, analytical, prospective. The investigation was conducted in the time period January 2016-February 2017.

This study included hospitalized and outpatient patients. Seventy-four patients were analyzed by magnetic resonance cholangiopancreatography (MRCP), where 11 patients had cystic duct pathologies so at the end only 63 patients (32 males and 31 females) were studied. All patients were notified of the ongoing study and have given their consent to be part of our research.

The examinations were carried out using the Siemens Type of MRCP in the Aloka Clinical Surgery Clinic in Prishtina as well as at the Radiologic Clinic in the University Clinical Center of Kosova.

Data are given as mean and standard deviation (SD). Mann-Whitney and Kruskal-Wallis tests and one-way analysis of variance were used to evaluate differences, with significance limit set at $P < 0.05$.

Results

Of the total 74 patients recruited only 63 cases were analyzed, as 11 cases were with pathological cystic ductus.

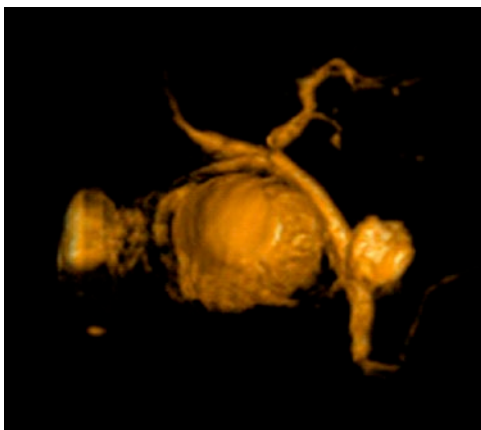


Figure 1. Union of cystic duct with right and left hepatic duct. There is no common hepatic duct.



Figure 2. Posterior insertion of cystic duct into hepatic duct.



Figure 3. Posterior view of extrahepatic biliary ducts. The joint of cystic duct with common hepatic duct is in lateral position and of angular type.

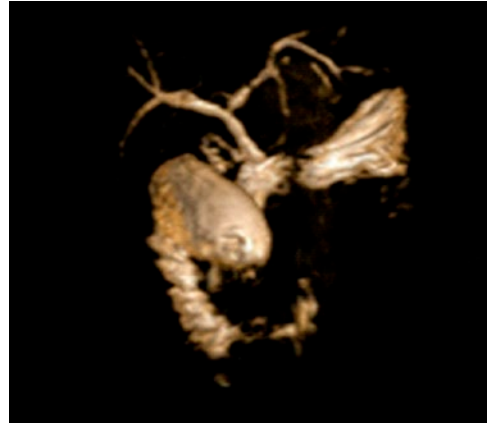


Figure 4. The cystic duct has shape of an overturned U, with lateral insertion to the hepatic duct.



Figure 5. Long cystic duct parallel to common hepatic duct. The insertion of the cystic duct is lower lateral.

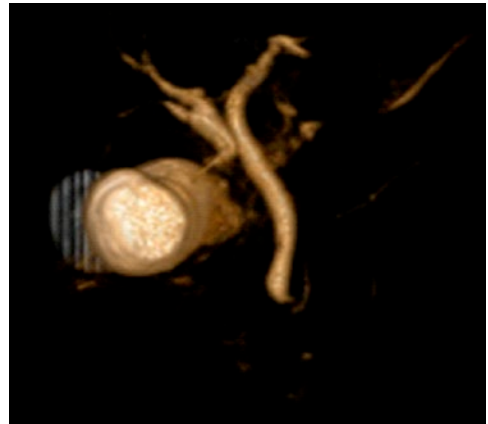


Figure 6. Union of cystic duct with right hepatic duct.

There were no significant differences in the length nor width of cystic duct between males and females (Mann-Whitney test; Tables 1, 2).

The longest cystic duct length was in patients aged 30-39 years. One way ANOVA did not show significant differences among age groups (Table 3).

The greatest cystic width was in patients aged 20-29 years. Kruskal Wallis test did not show significant differences among age groups (Table 4).

The insertion of cystic duct was lateral proximal in 58.7% of cases; second in frequency was lateral middle insertion (Table 5).

Table 1. Length of cystic duct related to sex.

Length of cystic duct (mm)	Sex		Total
	males	females	
N	32	31	63
Mean value	26.1	27.6	27.3
SD	10.4	10.5	11.0
Minimum	11	10	10
Maximum	54	50	54
P (Mann-Whitney test) not significant			

Table 2. Width of cystic duct related to sex.

Width of cystic duct (mm)	Sex		Total
	males	females	
N	32	31	63
Mean value	3.2	3.3	3.2
SD	1.1	1.2	1.1
Minimum	2	2	2
Maximum	6	5	6
P (Mann-Whitney test) not significant			

Table 3. Length of cystic duct related to age.

Length of cystic duct (mm)	Age (years)						Total
	20-29	30-39	40-49	50-59	60-69	70+	
N	3	5	10	14	11	20	63
Mean value	28.0	33.3	29.3	23.1	27.1	27.4	27.3
SD	22.6	14.6	9.8	6.5	13.0	11.8	11.0
Minimum	12	18	15	12	13	10	10
Maximum	44	49	45	35	54	57	57
P (One Way ANOVA) not significant							

Discussion

The cystic duct usually measures 2-4 cm in length and contains prominent concentric folds known as the spiral valves of Heister. The cystic duct frequently exhibits a tortuous or serpentine course.

Table 4. Width of cystic duct related to age.

Width of cystic duct (mm)	age						Total
	20-29	30-39	40-49	50-59	60-69	70+	
N	3	5	10	14	11	20	63
Mean value	3.5	3.3	3.3	3.2	3.0	3.2	3.2
SD	0.7	1.5	0.8	1.5	1.1	1.1	1.1
Minimum	3	2	2	2	2	2	2
Maximum	4	5	5	6	5	5	6
P(Kruskal Wallis test)	not significant						

Table 5. Cystic duct insertion related to sex.

Cystic duct insertion	Sex				Total	
	males		females		N	%
	N	%	N	%		
Anterior	1	3.1	-	-	1	1.6
Proximal lateral	16	50.0	21	67.7	37	58.7
Middle lateral	4	12.5	3	9.7	7	11.1
Distal lateral	-	-	1	3.2	1	1.6
Proximal medial	4	12.5	1	3.2	5	7.9
Middle medial	2	6.3	-	-	2	3.2
Distal medial	-	-	1	3.2	1	1.6
Posterior	4	12.5	2	6.5	6	9.5
Artefacts	1	3.1	2	6.5	3	4.8
Total	32	100.0	31	100.0	63	100.0

The normal diameter of cystic duct variable, ranging from 1 to 5 mm. The cystic duct usually joins the extrahepatic bile duct approximately halfway between the porta hepatis and the ampulla of Vater. However, the point at which the cystic duct joins the extrahepatic bile duct is variable, ranging from high at the level of the porta hepatis to low at the level of the ampulla (Netter, 1957). A short cystic duct was reported from 1.3-2.6% of cases (Talpur, 2010; Awazli, 2013).

In a previous study (Sarawagi et al., 2016) a normal lateral insertion of cystic duct at the middle third of common hepatic duct was seen in 51.5% of cases. Medial insertion was seen in 16% of cases, of which 4% were of low medial insertion. Low insertion was noted in 9% of cases. A course of cystic duct parallel to common hepatic duct was present in 7.5% of cases. A high insertion of the cystic duct was noted in 6% of cases and a short cystic duct in 1% of cases. In 1 case the cystic duct drained into the right hepatic duct.

Griffin et al. (2012) reported that the cystic duct joined lateral common hepatic duct in 50% of cases, it was inserted in the front and back in 30% of cases, and was inserted medially in 20% of cases.

It should be noted that medial insertion was reported in 10- 18% of cases in other studies (Önder, 2013; Shaw, 1993; Morteale and Ros, 2001). Low middle insertion has been reported to occur in 8-11% of cases (Talpur, 2010; Awazli, 2013).

The cystic and common hepatic duct run parallel for at least 2 cm in 1.2-25% according to some studies (Netter, 1957; Shaw, 1993). It is crucial to diagnose a high point of union of the cystic duct with the choledochus, an aberrant cystic duct drainage into the right hepatic duct and an aberrant union of intrahepatic bile ducts to the cystic duct, as these variants can be misdiagnosed during surgery, leading to inadvertent transaction and ligation (Carbajo, 1999).

Low joint with the common hepatic duct possibly with partial fusion before anastomosis gives the chance for the cystic duct to be longer than normal.

Occasionally the cystic duct may enter into the right hepatic duct and the danger here is that the right hepatic duct itself may be mistaken for cystic duct and divided where it joins the left hepatic duct, or if the latter duct is damaged inadvertently at operation bile leakage would contaminate the field (Benson, 1976; Eisendrath, 1918).

Acknowledgements

Conflict of interests: none declared

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