EJMI

DOI: 10.14744/ejmi.2021.60388
EJMI 2021;5(1):95–100

Research Article

An Analysis of the Differences of Gallstone Presence with Respect to the Variations of Biliary Tracts and Gender

Mahmut Sabri Medisoglu,[1] Tuncay Colak,[1] Ahmet Yalniz,[2] Isa Cam,[3] Mesut Sezikli,[4] Yusuf Atakan Baltrak[5]

[1]Department of Anatomy, Kocaeli University Faculty of Medicine, Kocaeli, Turkey
[2]Department of Radiology, University of Health Sciences, Derince Training and Research Hospital, Kocaeli, Turkey
[3]Department of Radiology, Kocaeli University Faculty of Medicine, Kocaeli, Turkey
[4]Department of Gastroenterology, Hitit University Corum Erol Olcok Training and Research Hospital, Corum, Turkey
[5]Department of Pediatric Surgery, University of Health Sciences, Derince Training and Research Hospital, Kocaeli, Turkey

Abstract

Objectives: This study aims to investigate the gender in which gallstone formation is seen more frequently and whether hepatic and extrahepatic biliary tract variations are associated with gallstone formation.

Methods: 60 patients who underwent endoscopic intervention and MRCP between 2017-2019 were included in the study. Patients with gastrointestinal complaints such as gallstones, gall bladder inflammation, Ductus choledochus (DCH) stones who have been admitted to the SBU Derince Training and Research Hospital's gastroenterology clinic were included in the study, and patients with secondary diseases such as diabetes, hypercholesterolemia were excluded from the study. In this way, 33 male and 27 female patients were included in the study and MRCP was carried out with all of them. Measurements were performed in all patients participating in the study. Variation types and the presence of gallstones were examined in MRCP images.

Results: In 60 cases examined, the presence of gallstones was observed to be statistically significantly higher in women compared to men. There was no statistically significant relationship between biliary tract variations and gallstone formation (p=0.504).

Conclusion: Gallbladder formation is found to be more common in women. The presence of biliary tract variations did not affect the development of the gallstone presence. It may be necessary to consider this phenomenon especially before surgical and radiological examinations to determine variational conditions and to conduct studies examining the relationship between this situation and gallstone formation.

Keywords: Biliary tract variations, gall bladder, gallstones

Cite This Article: *Medisoglu MS, Colak T, Yalniz A, Cam I, Sezikli M, Baltrak YA. An Analysis of the Differences of Gallstone Presence with Respect to the Variations of Biliary Tracts and Gender. EJMI 2021;5(1):95–100.*

Gallstones and common bile duct stones are common gastrointestinal problems. The prevalence of gallstones and common bile duct stones has increased due to the prolonged average life span and the change in eating habits.[1,2] Cholelithiasis and choledocholithiasis are common causes of elective surgery and endoscopic procedures. Although mortality is low during the diagnosis and treatment of gallstones and common bile duct stones, morbidity is high. Therefore, the diagnosis and treatment processes of the disease should be carefully evaluated with regards to the effects on health economy. In order to understand the causes of gallstone and common bile duct

Address for correspondence: Mahmut Sabri Medisoglu, MD. Kocaeli Universitesi Tip Fakultesi, Anatomi Anabilim Dali, Kocaeli, Turkey
Phone: +90 505 394 07 55 **E-mail:** sabrimed@gmail.com

Submitted Date: November 23, 2020 **Accepted Date:** January 25, 2021 **Available Online Date:** April 01, 2021

stone formation, it is of utmost importance to consider the normal anatomical structure of the bile ducts as well as their variations. When the literature is examined, there are many studies on the risk factors in the formation of gallstones and common bile duct stones; however, few studies analyze the relationship between biliary tract variations and gallstone formation. This clinical study aimed to evaluate and compare the effects of anatomical variations of biliary tract on gallstones and common bile duct stones, and to discuss the results.

Methods

Ethics committee approval was obtained from Kocaeli University Ethics Committee for this clinical study with the date of 07.03.2018 and no. KÜ GOKAEK 2018/48. In this clinical study, patients aged 18 years and over who were scheduled for an endoscopic procedure and MRCP due to gallstones, common bile duct stones and/or related complaints were determined to be the study group as a result of being examined the gastroenterology outpatient clinic with gastrointestinal complaints. Patients with diabetes, hypercholesterolemia, biliary duct tract surgery or biliary tract infection were excluded from the study by examining the anamnesis, patient records and Hospital Information Management System (HIMS) among the patient groups. As a result of determining these criteria, a total of 60 patients (33 males and 27 females) were included in the study. Bile ducts were measured and analyzed by evaluating the biliary tract anatomy with US and MRCP for all the patients included in the study.

MRCP procedure was performed in SBÜ Derince Training and Research Hospital, and Amira model of Siemens brand 1.5 Tesla MRI device was used in the study. For measurements the sequences of "haste-localizer, t2-haste-cor-p2-mph, t2-haste-Fs-+ra-p2-mph-320, t2-haste-tra-p2-mbh-320, t1-F12d-opp-in-tra-p2-bh, t1-vibe-dixon-tsa-p4-bh-pre, t2-space-cor-p2-LD-trig-384-iso" were used with axial and coronal sections, and measurements and evaluations were performed on the MRCP images by the radiologist in the same hospital. Variation types, gallbladder condition, and presence of gallstones were examined in each patient by the same physician and from pre-determined points (Fig 1, 2).

Huang classification was used in this study for the classification of biliary tract anatomical variations. Huang classification is one of the radiological measurement and examination methods for biliary tracts. To put it simply, Huang classification is based on the way Ductus Hepaticus Posterior Dexter (DHPD) drains into Ductus Hepaticus Dexter (DHD), and Ductus Hepaticus Sinister (DHS). In type A1,

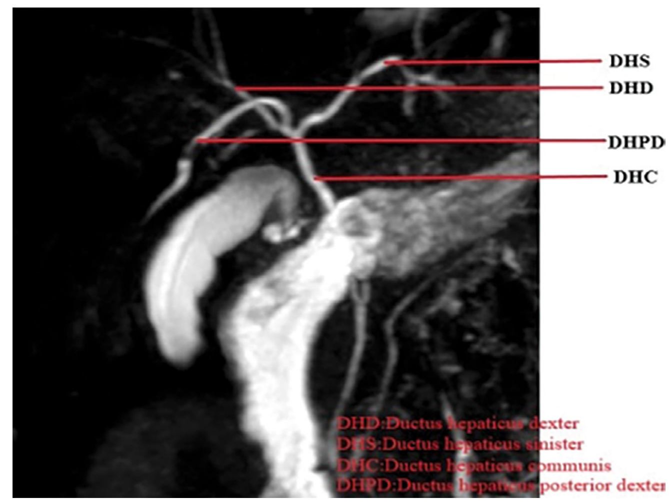

Figure 1. Huang, type A1 MRCP image.

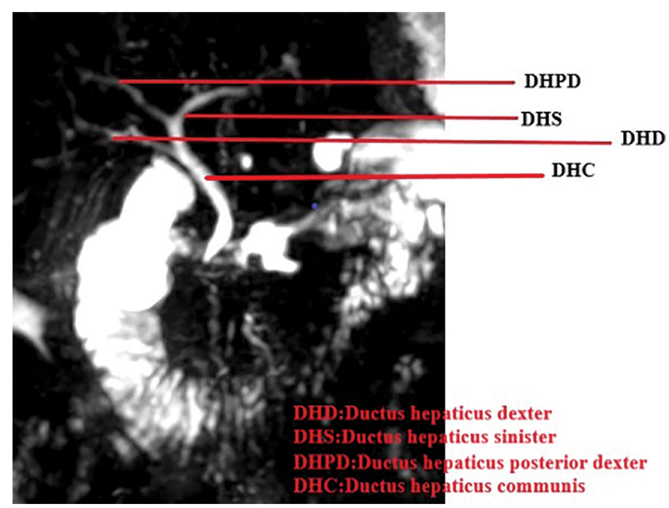

Figure 2. Huang, Type A3.

DHPD drains directly into DHD and is commonly referred to as the right-dominant type. In type A2, DHPD does not drain into DHD or DHS, but these three combine into a trifurcation to form Ductus Hepaticus Communis (DHC). In type A3, DHPD drains into DHS before the formation of DHC. In type A4, DHPD drains directly into DHC after the formation of DHC. In type A5, DHPD drains into Ductus Cysticus (DCY) (Fig. 3).[3]

Chi-square analysis, T-test in independent groups, Kolmogorov-Smirnov test, and descriptive statistics were used when analyzing the data, and values below a p value of 0.05 were considered to point out a significant relationship at the end of the analysis.

Results

When the relationship between the angle of DCY-DCH and the presence of gallstones were evaluated, the mean angle

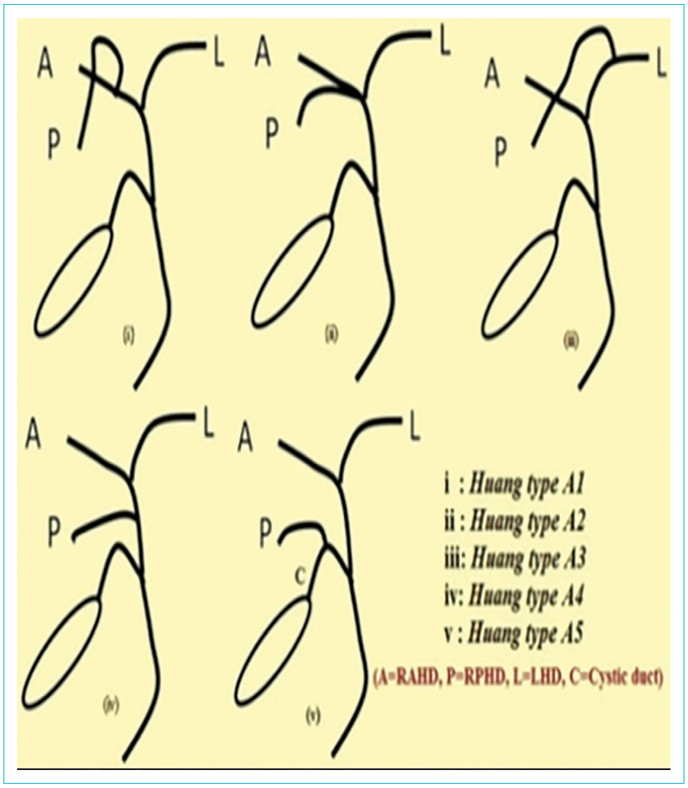

Figure 3. Huang classification.

of DCY-DCH was measured in the group without gallstones (35.72°±16.29°), which was slightly higher than that of the group with gallstones (31.75°±16.08°). However, this difference was not statistically significant (p=0.34) (Table 1).

Table 1. Relationship between DCY-DCH angle and presence of gallstone

	Gallstone	Number	Mean	SD	p
Angle of DCY-DCH	Yes	28	31.75°	16.085°	0.348
	No	32	35.72°	16.296°	

With regards to the effect of DCH diameter on the presence of DCH stones, when the average DCH diameter (11.65mm±5.24) of those with DCH stones was compared with those without DCH stones (6.12 mm±3.08), the DCH diameter was found to be statistically significantly increased in those with a DCH stone (p=0.001) (Table 2).

While the mean DCH diameter was measured to be 9.19mm±4.53 in cases with gallstones, DCH diameter was measured to be 7.41mm±5.00 in those with no gallstones detected. However, there was no statistically significant difference between the two groups (p=0.156) (Table 3).

Gallstones and common bile duct stones were detected in 28 (46.66%) patients included in the study. 10 out of these 28 cases in whom stones were detected by imaging methods were male and 18 were female. A significant difference was found between male and female groups with regards to the presence of gallstones according to gender. The presence of gallstones in women is significantly higher (p=0.011) (Table 4).

When the presence of gallstones was investigated according to Huang variation types, no statistically significant difference was found between the presence of stones with regards to the Huang variation types (p=0.82) (Table 5).

Discussion

The development of biliary tracts and related variational formations occur during the embryological stages.[4]

DHC forms the initial part of the extrahepatic biliary tracts. DHC is 2-4 cm in length and 4mm in diameter. At the end of its course, they form an acute angle inside the omentum minus and combine with DCY to form DCH.[5-7]

In addition to this classical anatomical formation, there are variational biliary tract structures in different shapes. It has now become crucial to be aware of the formation and pres-

Table 2. Relation of the presence of DCH stone with diameter of DCH

	Levene's test for equality of variances		T-test for equality of means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
								Lower	Upper
Age									
Equal variances assumed	0.001	0.982	-2.689	58	0.009	-13.632	5.070	-23.78	-3.484
Equal variances not assumed			-2.620	42.914	0.012	-13.632	5.203	-24.12	-3.139
DCH diameter									
Equal variances assumed	8.790	0.004	-5.149	58	0.000	-5.52515	1.07313	-7.673	-3.37704
Equal variances not assumed			-4.583	31.552	0.001	-5.52515	1.20563	-7.982	-3.06798

Table 3. Relationship between of the presence of gallstone with diameter of DCH.

	Levene's test for equality of variances		T-test for equality of means						
	F	Sig.	T	Df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
								Lower	Upper
Age									
Equal variances assumed	0.136	0.713	-1.198	58	0.236	-6.201	5.176	-16.562	4.160
Equal variances not assumed			-1.190	55.017	0.239	-6.201	5.211	-16.643	4.241
DCH diameter									
Equal variances assumed	0.019	0.890	-1.438	58	0.156	-1.78393	1.24048	-4.26703	0.69917
Equal variances not assumed			-1.448	57.924	0.153	-1.78393	1.23216	-4.25044	0.68258

Table 4. Number and percentages of Vesica Biliaris stone presence

	Gallstone		Common bile duct stone	
	Yes	No	Yes	No
Gender, n (%)				
Male	10 (16.7)	23 (38.3)	12 (20)	21 (35)
Female	18 (30)	9 (15)	11 (18.3)	16 (26.7)

Table 5. Relationship between variation type and presence of vesica biliaris stone

	Gallstone presence (%)	No gallstone presence (%)	p
A1	11 (18.3)	13 (21.7)	0.821
A2	7 (11.7)	10 (16.7)	
A3	8 (13.3)	6 (10)	
A4	2 (3.3)	3 (5)	

ence of these structures. The distribution and/or drainage of the opaque material administered during the detection of biliary tract drainage anomalies with imaging methods affect the success in liver operations and transplantation due to the difficulties in evaluating the image. It becomes important to be aware of the anatomy of intra and extra hepatic biliary tracts in order to reduce morbidity and complications in similar operations.

Variational conditions of the biliary tracts have been described and classified in different ways by the researchers (Couinaud, Champetier, Onkubu, Choi and Huang). The classification of biliary tract variation is based on the way ductus hepaticus posterior dexter located in the right lobe of the liver connects to other biliary tracts.[8] Despite the recent technological developments in the literature in liver surgery, an important cause of morbidity and mortality of biliary tract complications is the inability to fully control anatomical structures and variations.[9,10] In addition, anatomical awareness of segmental hepatic biliary structures is crucial for both staging and localization of intrahepatic neoplasms or biliary tract tumors. It is of prime importance for the diagnosis and treatment to have an understanding of anatomical variations in biliary tract diseases. Since not all gallstones are radio-opaque, they are at the risk of not being seen in routine examination. Size of DCH diameter should guide clinicians for a more careful examination with regards to stone presence. Stone formation may be seen mostly in the gallbladder depending on topographic and physical factors since they cannot remain in DCH for a long time in terms of stone presence and DCH obstruction manifests itself clinically with acute symptoms.

When the relationship between the angle of DCY-DCH and the presence of gallstones was examined, the present study found no statistically significant relationship (p=0.348) (Table 1). Considering the relationship between the presence of DCH stones and the diameter of DCH, the mean DCH diameter of those with DCH stones (11.65mm±5.24) was observed to be statistically significantly higher than the mean DCH diameter of those without DCH stones (6.12mm±3.08) (p=0.001) (Table 2). When the presence of gallstones was examined with respect to the DCH diameter, the mean DCH diameter of those with gallstones (9.19mm±4.53) was slightly higher than the average DCH diameter of those without DCH stones (7.41mm±5.00). However, this difference was not statistically significant (p=0.156) (Table 3). The existence of a statistically significant relationship between the diameter of DCH in our study and the presence of DCH stone may be a result that should be taken into account both radiologically and clinically.

All studies show that women experience cholelithiasis more often than men. There are many studies examining the reasons for this phenomenon. Sun et al. (2009) stated in their study that the prevalence of cholelithiasis in women more than men may be due to factors such as fertility and sex hormones, and that the increase in estrogen hormone levels increases cholesterol secretion and causes super-saturation of cholesterol.[11] In line with this, some studies state that the risk of cholelithiasis increases in women who receive hormone replacement therapy due to menopause.[12,13] There are a high number of studies in the literature analyzing the relationship between gender and cholelithiasis, and also studies on women experiencing stone formation more often. Studies have been conducted on the relationship between the normal structure of the biliary tracts and the relationship between gender and stone formation, as well as the relationship between the angle of DCY and gallbladder formation.[14-16]

When the relationship between the presence of gallstones was evaluated with regards gender in this study, the presence of gallstones was observed to be significantly higher in women compared to men (p=0.011). However, the relationship between the presence of DCH stones did not show a statistically significant difference by gender (p=0.936) (Table 4).

The present study analyzed whether there was any significant relationship between variation types and stone formation in biliary tract, and no statistically significant relationship was found between the variation condition and the presence of stone based on the Huang variation types (p=0.82) (Table 5). When the literature is examined, Khayaat et al. (2014) concluded that anatomical variational anomalies are not correlated to stone formation in their study.[17]

Conclusion

In accordance with the literature, gender difference is crucial in the diagnosis and treatment procedures related to the gall bladder; however, the size of DCH diameter in procedures related to the biliary tracts may be related to the presence of DCH stones. However, our study found no significant relationship between biliary tract variations and stone formation in biliary tract.

We conducted our study by making measurements on the existing images taken at the hospital. The small number of patients and the retrospective nature of the study were the main limitations. Another important limitation is that there is no previous study conducted on this phenomenon.

Disclosures

Ethics Committee Approval: The study protocol was approved by Kocaeli University Non-Interventional Clinical Research Ethics Committee with 07/03/2018 and KÜ GOKAEK 2018/48 number.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The author declare no potential conflict of interest.

Financial Support: None declared.

Authorship Contributions: Concept – M.S.M., T.C.; Design – M.S.M, T.C, M.S.; Supervision – T.C, M.S.; Materials – A.Y, İ.C, M.S.M.; Data collection &/or processing – M.S.M., Y.A.B., T.C.; Analysis and/or interpretation – T.C., M.S.M.; Litearture search – M.S.M.; Writing M.S.M., T.C., Y.A.B., Critical Review – T.C.

References

1. Hartleb J, Schafmayer C, Tepel J, Albert S, Freitag S, Völzke H, et.al. Predictors of gallstone composition in 1025 symptomatic gallstones from northern germany. BMC Gastroenterol 2006;6:36.
2. Çavuş B, Karaca Ç, Safra Taşı Hastalığı, İç Hastalıkları Dergisi 2013;20:151–160.
3. Huang T.L ,Cheng YF, Chen TY, Chen TL, Lee TY. Variations of the intrahepatic bile ducts: application in the potential donor of living-related hepatic transplantation. Clin transplant 1997;11:337–340.
4. Moore K, Persaud T.V.N., (Çeviri editörleri:Yıldırım M., Okar İ.,Dalçık H), İnsan Embriyolojisi Klinik yönleri ile, Nobel Tıp Kitapevleri, İstanbul, 2002.
5. Özsoy M, Karaciğer vericilerindeki vasküler ve biliyer varyasyonlar, Uzmanlık Tezi, 2009.
6. Arıncı K, Elhan A, Anatomi 1.Cilt, Güneş Kitabevi, İstanbul,2001.
7. Mortele K, Ros P.R, Anatomic variants of the biliary tree: MR cholangiographic findings and clinical applications. AJR Am J Roentgenol 2001;177:389–394.
8. Hyodo T, Kumano S, Kushihata F, Okada M, Hirata M, Tsuda T, et.al. CT and MR colangiography: advantage and pitfalls in perioperative evaluation of biliary tree. Brit J Radiol 2012;85:887.
9. Sin L. Y, Kuang T. P, Sung Y. C, Mıng Y. H, Chien M. C, Chien F. H, Jeng H.T Common and Rare variants of Biliary Tree: Magnetic Resonance Cholangiographic Findings and Clinical Implications, J. Radiol Sci 2012;37:59–67.
10. Jin C.W, Tae K.K, Kyoung W.K, Pyo N.K, Hyun K.H, Moon-gyu L, Anatomic variations in intrahepatic bile ducts: an Analysis of Intraoperative Cholangiograms in 300 Copnsecusive Donors for Living donor Liver Transplantation. Korean J Radiol.April-June 2003;4:85–90.
11. Sun H, Tang H, Jiang S, Zeng L, En-Qiang C, Tao Z, You-Juan W. Gender and metabolic difference of gallstone disease. World J Gastroenterol 2009;15:1886–1891.
12. Tierney S, Nakeeb A, Wong O, Lipsett PA, Sostre S, Pitt HA,

Lillemoe KD. Progesterone alters biliary flow dynamics. Ann. Surg 1999;229:205–209.

13. Youming D, Bin W, Weixing W, Binghua W, Ruoyu L, Bangchang C. The effect of h (1) calponin expression on gallstone formation in pregnancy. Saudi Med J 2006;27:1661–1666.
14. Sanal B, Korkmaz M, Zeren S, Can F, Elmalı F, Bayhan Z, Does gallbladder angle affect gallstone formation? Pan Afr Med 2016;24:165.
15. Jin S.P, Don H.L, Jun H.L, Seok J, Young S.J, Morphologic factors of biliary trees are associated with gallstone-related biliary events. World J Gastroenterol 2015;21:276–82.
16. Ressurreiçao J, Batista L, Soares T, Marques I, Matos E, Andrade L, Almeida A, et all. Normal anatomy and anatomic variants af the biliary tree and pancreatic ductal system at MRCP- what clinicians want know , educational exhibit, Poster No: C-1696, ECR 2014, Vienna, 6-10 March 2014,Vienna, Austria.
17. Khayat F.M, Munaser S.A, Saleh M.A, Sibiany A, Abnormal anatomical variations of extra-hepatic biliary tract and their relation to biliary tract injuries and stone formations.Gastroenterology Res 2014;7:12–16.