



RELATIONSHIP BETWEEN AGE AND COMMON BILE DUCT DIAMETER IN ADULTS: ULTRASONOGRAPHIC STUDY

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ABSTRACT

There is controversy regarding whether with increasing age, the common bile duct (CBD) diameter on ultrasound examination increases or not. We decided to assess relationship between age and CBD diameter in healthy individuals. A total of 190 patients underwent trans-abdominal ultrasound. In supine position, first a brief evaluation of the liver, pancreas, gallbladder, and bile ducts was done. Then, on sagittal plan, when the CBD was visualized in longitudinal axis, during deep inspiration, in its proximal portion the antero-posterior distance from inner borders was measured. There was a statistically significant correlation between age and the CBD diameter ($P < 0.001$, $r = 0.47$). When the analyses were done separately for genders, these values were also found to be significant as $r = 0.5$ ($P < 0.001$) in males and $r = 0.542$ ($P < 0.001$) in females. There was a significant relationship between age and the CBD diameter. In normal individuals, the normal size of the CBD increases as they get older.

KEYWORDS: *Age; aging; common bile duct; ultrasound*

INTRODUCTION

Trans-abdominal ultrasound is one of the imaging modalities commonly used in the evaluation of the extra-hepatic biliary system pathologies. It is a non-invasive, accurate and inexpensive imaging method with high sensitivity for detection of the biliary system diseases¹. Ultrasound is still the first imaging study widely available to examine the biliary system. One of the major measurements done in ultrasound examination of the extra-hepatic biliary system is common bile duct (CBD) diameter. CBD dilation usually indicates obstructive pathologies such as choledocholithiasis or malignant/benign strictures and is a critical factor in distinguishing obstructive vs. non-obstructive causes of jaundice. Normal accepted range for diameter of the CBD is 2 to 7 mm^{2, 3}. Some authors have proposed the cut-off value of 6

mm⁴. But this cut-off has been addressed to be interpreted with caution as non-dilated CBD may not necessarily indicate that there is no stone in the duct⁵. There are reports that with increase in age the diameter of CBD also increases normally. There have been some studies examining the relationship between aging and CBD diameter variation. The first study which backs to 1984 reported that under normal conditions, the inner diameter of the CBD can be up to 10 mm and a mild change exists with aging⁶. After this report, some studies found similar results that aging can have significant effect on the CBD size. For instance, a study showed that CBD diameter increased significantly from 3.9 mm in age range of 18 to 25 years to 4.7 mm in those older than 55 years⁷. However, other studies have not reached similar conclusion⁸. Considering the above mentioned controversy and the fact that there are variations in the anthropometric characteristics

of different races ⁷, we decided to determine the relationship between normal CBD diameter and age. We think that the results of this study will add more information about the normal size of the CBD and the effect that aging can have on this.

MATERIALS AND METHODS

Study population and sampling

In this cross-sectional study, the study population consisted of individuals who were referred to our department for regular check-ups by trans-abdominal ultrasound. Those who were older than 30 years were included. Exclusion criteria were history of cholecystectomy, pregnancy, diseases of the hepatobiliary system (including cholelithiasis), liver, or pancreases, cardiovascular diseases, serum total bilirubin level of greater than 1.5 mg/dL, and opioid addiction. The sampling method was probability sampling. The minimum sample size considering $\alpha=0.05$ and $\beta=10\%$, and using the information in the literature was calculated as 142 subjects.

Design

The participants were asked to fast overnight. In supine position, first a brief evaluation of the liver, pancreas, gallbladder, and bile ducts was done. Then, on sagittal plan, when the CBD was visualized in longitudinal axis, during deep inspiration, in its proximal portion the antero-posterior distance from inner borders was measured. In cases that the CBD was not visualized properly, the right-side of the patient's body was raised or the intercostal space was used for better

visualization. Ultrasound scanner Sonix G40 (Siemens, Germany) was used. The ultrasound examinations were done by one board-certified radiologist.

STATISTICAL ANALYSES

The data gathered were entered into the SPSS software (ver. 16.0) and using descriptive indices, Pearson's correlation coefficient, and linear regression, the statistical analyzes were done. The significance level was set at 0.05.

Ethics

The participation in the study was on voluntary basis. The objectives of the study were explained to the participants. The informed consent was obtained. The protocol of the study was approved by the Ethics Committee of our medical university.

RESULTS

A total of 190 healthy subjects were studied. There were 59 males (31.1%) and 131 females (68.9%). The age range of the sample was 30 to 107 years. Mean (\pm SD) age of the total sample was 54.74 (\pm 14.43) years. Mean (\pm SD) age of males was 54 (\pm 15.73) years and in females it was 55.08 \pm (13.85) years; $P=0.636$. Table 1 presents mean (\pm SD) of the CBD diameter in different age groups. As observed the highest CBD diameter average was seen in those who were older than 80 years of age. Mean (\pm SD) CBD diameter in males was 5.15 (\pm 1.51) mm and in females this measurement was 5.15 (\pm 1.52) mm; $P=0.99$.

Table 1
Mean (standard deviation) common bile duct diameter in different age groups among 190 patients who underwent trans-abdominal ultrasound

Age group, year	Number	Mean, mm	SD, mm
30-39	36	3.908	1.265
40-49	35	4.806	1.322
50-59	43	5.177	1.251
60-69	44	5.270	1.130
70-79	24	6.721	1.247
> 80	8	6.750	1.703
Total	190	5.151	1.512

SD= standard deviation

There was a statistically significant correlation between age and the CBD diameter ($P<0.001$, $r=0.47$). When the analyses were done separately for genders, these values were also found to be

significant as $r=0.5$ ($P<0.001$) in males and $r=0.542$ ($P<0.001$) in females. Comparison of the correlation coefficients between males and females was not significant ($P=0.85$, $Z=0.189$) which

showed that the correlation between age and CBD diameter did not affected by gender. According to the linear regression analysis, it was revealed that a significant association existed between age and the CBD diameter ($P < 0.001$, $r = 0.28$). In other words,

$$\text{Linear regression model for CBD diameter} = 0.55 (\text{age}) + 2.12$$

A separate regression analysis was done in those older than 60 years. In this age group, the correlation between age and the CBD diameter was also significant ($r = 0.48$, $P < 0.001$). With each year increase in age in this group, the CBD diameter increased by 0.076 mm and by 10 years increase in age of this group, the CBD diameter increased by 0.8 mm.

DISCUSSION

In clinical practice, documenting obstruction of the CBD in a jaundiced patient is of paramount importance. Hence, knowledge of the correct range and normal upper limit of the CBD is important. Therefore, the studies to determine the normal range of the CBD on ultrasound examination in different races and geographic locations are necessary. The literature indicates that there is variation between age and CBD size in normal individuals. We observed a positive significant correlation between normal CBD diameter and age. This finding has been reported previously in some studies. In a former study on 251 patients with a mean age of 52 years (those who were older than 20 years were included), mean CBD measurement was reported as 3.66 mm with a significant association between age and CBD diameter. Similar to our results, they also found that 28% of the variation in CBD size can be explained by age. The rate of increase in CBD in this study was reported as 0.4 mm per year [9]. The mean CBD size we observed here (5.15 mm) is higher than the one reported by the latter article which is 3.66 mm⁹. This can be due to the fact the mean age of our patients (54 years) is a little higher than 52 years reported by the authors and also we included those who were older than 30 years. In another study on 200 patients⁷, the mean CBD size was reported as 4.1 mm and a significant relationship was found between age and CBD size. They found that the upper limit normal for CBD size is 7.9 mm. They reported that CBD size increased progressively from 3.9 mm in age group of 18-25 years to 4.7 mm in those who were older than 55 years. In another study³ which included a large cohort of elderly persons (1,018 subjects, 60 to 96 years) and

about 30% of the changes seen in the CBD diameter increase are justified by age. With each decade increase in age, the CBD diameter increased about 0.55 mm.

followed them over 4 years, a small but still significant increase in CBD diameter was observed. The mean CBD size increased from 3.6 mm in 60 years to 4 mm in those older than 85 years. In contrast to the mentioned studies and our results, a previous study⁸ including 258 patients older than 18 years (151 men and 107 women) with a mean age of 55 years did not find such relationship between age and CBD size. In both the two mentioned studies^{7,9}, the proportions of male and female subjects were similar. Although in our study we had more females than males, but statistical analyses did not show any differences regarding CBD diameter by gender. There are variations regarding accepted normal range for CBD. This variability can be due to several factors namely the ultrasound machine sensitivity, anthropometric variations, sonographer expertise, demographics of the population studied. Our findings support this suggestion that with increasing age, the CBD diameter increases. This is important in clinical practice as to consider this fact when evaluating older patients. The reason that why CBD in older persons has a larger size seems to be the result of aging process with less blood flow to the CBD walls which causes abnormalities in tissue metabolism and fragmentation of the smooth muscle which results in decreased contractility of the CBD^{9,10}. We here did not evaluate all anthropometric indices such as weight, height, or hip circumference. Also, as described above, decreased blood flow to the CBD may justify the changes in CBD size in aging process. We suggest that in future studies, atherosclerosis risk factors as well as anthropometric variables be included in the study design. Also, here sonography was done by one radiologist. As determination of the CBD size is difficult and needs expertise, it would be useful to have two radiologists measure the CBD size and agreement between the two radiologists determined with a mean value used as the final measurement.

CONCLUSION

There was a significant relationship between age and the CBD diameter. In normal individuals, the normal size of the CBD increases as they get older.

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