

Assessment of Common Bile Duct Diameter on Trans-abdominal Ultrasound at a Tertiary Care Centre in Nepal

Nishant Mishra, MBBS, MD, DM¹, Gauri Mukhiya, MBBS, MD, DM^{1*}, Shekhar Panta², Samip Bhattarai², Binod Acharya Jaishi² and Krishnanand Paswan²

¹Department of Radio-diagnosis and Medical Imaging, B. P. Koirala Institute of Health Science, Dharan, Nepal.

²MBBS Student, B. P. Koirala Institute of Health Science, Dharan, Nepal.

*Correspondence:

Dr. Gauri Mukhiya, MBBS, MD, DM, Department of Radio-diagnosis and Medical Imaging, B. P. Koirala Institute of Health Science, Dharan, Nepal, Contact No: 009779841281382.

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ABSTRACT

Aims: To understand the significance of the CBD, it is essential to be aware of the normal variations in CBD diameter.

Materials and Methods: Referred patients aged 18 years and above who were coming for abdominal ultrasonography were included. Detailed history, including age, gender, and complaints as noted in a semi-structured pro forma after obtaining informed consent. Data analysis was performed using Microsoft Excel spread sheet, and statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS version 11.5) software. Mean, standard deviation, percentage and range were calculated for descriptive statistics

Results: Among the total 145 participants 60 (41.4%) were male and 85 (58.6%) were female, with a male to female ratio of 0.7:1. The age of the participants ranged from 18 years and above with mean age of 47.94 ± 18.02 years. The mean age of the male and female participants was 53.35 ± 19.36 and 44.12 ± 16.06 years, respectively. The mean CBD diameter was found to be 4.74 ± 1.14 mm. The normal range of CBD diameter was 2.30 mm to 7.50 mm. The mean and standard deviation of the common bile duct diameter in males and females were 4.91 ± 1.03 mm and 4.62 ± 1.21 mm respectively. The mean common bile duct diameter in males was slightly higher than in females but was not found to be statistically significant ($P=0.123$).

Conclusions: The mean CBD diameter in males and females was four point nine one and four point sixty two millimetres respectively, showing that males had a slightly larger CBD diameter than females. However, an independent *t*-test showed no significant difference in mean diameter between genders. The mean CBD diameter in different age groups showed a gradual increase with age, and a significant increase occurred after the age of sixty one.

Keywords

Common bile duct, CBD diameter, Ultrasonography, Abdominal ultrasonography, Biliary tract, Age-related variation, Gender, Normal reference range.

Introduction

The CBD is formed from the confluence of the common hepatic duct and cystic duct, located at the free edge of the lesser omentum

with the hepatic artery on its left and the portal vein lying posteriorly. The CBD passes behind the first part of the duodenum together with the gastroduodenal artery, then behind the pancreas to join with the pancreatic duct and the ampulla of Vater [1].

The length of the common bile duct (CBD) ranges from 5 to 15 cm, with an average length of 7 cm [2]. This variance is contingent upon the location where the adult cystic duct joins the common

hepatic duct; in most cases, its diameter is approximately 6 mm. It exits the lesser omentum, descends posteriorly to the duodenum's first segment, and then enters the pancreatic head's posterior region. In terms of anatomy, the CBD is located ahead and to the right of the portal vein and the hepatic artery in the gastrohepatic ligament and porta hepatis. This ongoing partnership helps illustrate the CBD and set it apart from the hepatic artery and portal vein using sonography [2].

Real-time ultrasonography is a well-established method for evaluating the extrahepatic biliary system and is a major diagnostic tool for suspected bile duct obstruction [3]. The upper limit of the normal common bile duct (CBD) diameter is controversial because factors such as age, height, weight, BMI, previous cholecystectomy, drugs, and the imaging modality itself can affect its measurement [4-7]. Diseases and biliary disorders associated with biliary system obstruction affect a significant portion of the world's population [8]. The size of the CBD is a predictor of obstruction and a crucial factor the evaluation of the biliary system. Knowledge of the normal variations in CBD diameter can help distinguish obstructive causes of jaundice from non-obstructive causes [6,8]. To evaluate the importance of CBD, it is necessary to know about the normal variations of CBD diameter [9,10].

Materials and Methods

Study area and Period: A hospital based cross-sectional study was conducted at Department of Radiodiagnosis and Imaging, B.P. Koirala Institute of Health Science over a period of one month.

Data Collection Tools and Procedure

After obtaining the ethical clearance from Institutional Review Unit, informed verbal consent was obtained from each individual participating in the study. Referred patients aged 18 years and above coming for abdominal ultrasonography to the Department of Radiodiagnosis and Imaging for reasons other than hepatic or biliary pathology were enrolled for this study. Detailed history from the patients, including age, gender, and history regarding the complaints were noted in a semi-structured pro forma after taking informed consent.

Ultrasonography was performed by radiologists as per the department protocol using available ultrasound machines in the department. The diameter of the common bile duct was measured for each patient undergoing USG abdomen after 4 hours of fasting. After following all the exclusion and inclusion criteria, the diameter was measured at posterior part of Common Bile Duct and data was recorded on pro forma for the purpose of analysis.

Data Entry and Analysis

The collected data were tabulated in Microsoft Excel spread sheet and statistical analysis was done in Statistical Package for the Social Sciences (SPSS version 11.5) software. Mean, Standard deviation, Percentage and Range were calculated for descriptive statistics and distribution of data assessed through histogram (Figure 1). For inferential statistics, independent 't' test was applied to compare mean value between male and female. Pearson's correlation was

applied to correlate CBD diameter with age. One-way ANOVA test was done to assess the difference in mean diameter in different age groups which was further confirmed by using Post hoc Tukey HSD test. P value less than 0.05 was considered statistically significant.

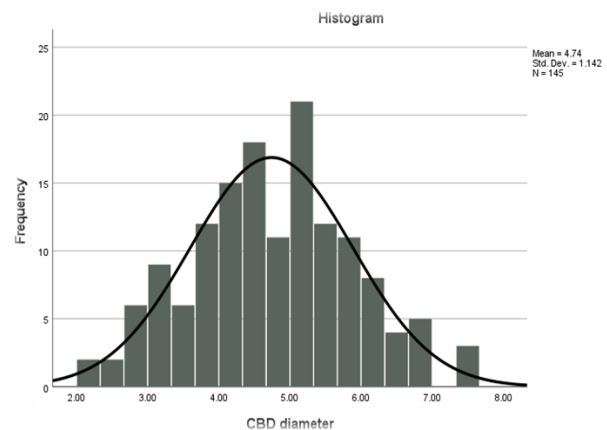


Figure 1: Histogram showing frequency distribution of CBD diameter.

Results

A total of 145 participants were included in this study. Among total 145 participants 60 (41.4%) were male and 85 (58.6%) were female with the male to female ratio of 0.7:1. Age of the participants ranged from 18 years and above with mean age 47.94 ± 18.02 years. The mean age of the male and female participants were 53.35 ± 19.36 and 44.12 ± 16.06 years respectively. The frequency distribution according to the age and gender is summarized in table 1 and table 2 respectively.

Table 1: Distribution of the participants according to age.

Age (years)	Frequency (N =145)	Percentage (%)
18 - 30	23	15.9
31 - 40	36	24.8
41 - 50	29	20.0
51 - 60	18	12.4
≥61	39	26.9

Table 2: Distribution of participants according to gender.

Gender	Frequency (N =145)	Percentage (%)
Male	60	41.37
female	85	58.62

The mean CBD diameter was found to be 4.74 ± 1.14 mm. The observed CBD diameter ranged from was 2.30 mm to 7.50 mm. The mean and standard deviation of common bile duct diameter in male and female were 4.91 ± 1.03 mm and 4.62 ± 1.21 mm respectively. The mean common bile duct diameter in male was found to be slightly higher than female but was not statistically significant ($P=0.123$). The mean and range value of common bile duct in male and female are presented in table 3.

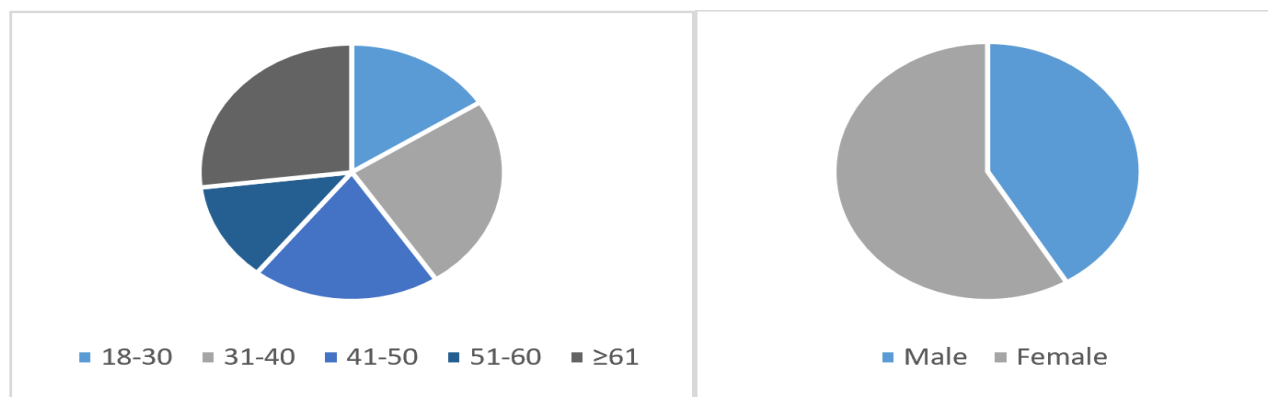


Figure 2: Pie charts showing the distribution of participants according to age group and gender.

Table 3: Mean Common Bile Duct (CBD) diameter according to gender.

Gender	CBD Diameter (mm) (Mean ± SD)	Range (mm)	P* value	Remarks
Male	4.91±1.03	2.40 to 7.50	0.123	Not Significant
Female	4.62±1.21	2.30 to 6.80		

P* value: - independent t test.

The correlation of CBD diameter with age is shown in table 4 which showed the significant strong positive correlation of CBD diameter with age.

Table 4: Correlation of Common Bile Duct (CBD) diameter with age (Pearson's Correlation).

Diameter CBD	Age		
	r value	p value	Remarks
	0.650	<0.001	Significant

The mean and standard deviation of common bile duct diameter at different age group ranging from 18 – 30 years, 31 – 40 years, 41 – 50 years, 51 – 60 years and ≥61 years are 3.73±1.03 mm, 4.33±0.99 mm, 4.59±0.92 mm, 4.89±0.83 mm and 5.76±0.79 mm respectively. The mean and range value of common bile duct diameter at different age group are presented in the Table 5.

Table 5: Mean, Standard Deviation and Range of CBD diameter by age group.

Different Age Group (years)	CBD Diameter (mm) (Mean ± SD)	Range (mm)
18 – 30	3.73±1.03	2.30 – 5.70
31 – 40	4.33±0.99	2.30 – 6.88
41 – 50	4.59±0.92	2.80 – 6.80
51 – 60	4.89±0.83	3.6 – 6.56
≥61	5.76±0.79	4.50 – 7.50

The mean diameter of common bile duct was compared by using one way ANOVA test which showed the significant difference ($p < 0.05$).

Table 6: One Way ANOVA test done for mean Common Bile Duct (CBD)

diameter difference between different age groups.

CBD Diameter	Age Group		
	F value	P value	Remarks
	21.404	<0.001	Significant

As ANOVA test showed the significant difference, Post hoc (Tukey HSD) test was done to identify age groups which had significant mean CBD diameter difference.

Table 7: Post hoc (Tukey HSD) test done for mean Common Bile Duct (CBD) diameter difference between different age groups.

(I) Age Category	(J) Age Category	Mean Difference (I-J)	P value	Significance
18-30	31-40	-0.60	0.105	Not Significant
	41-50	-0.87*	0.008	Significant
	51-60	-1.16*	<0.001	Significant
	≥61	-2.03*	<0.001	Significant
31-40	18-30	0.60	0.105	Not Significant
	41-50	-0.27	0.767	Not Significant
	51-60	-0.56	0.211	Not Significant
	≥61	-1.43*	<0.001	Significant
41-50	18-30	0.87*	0.008	Significant
	31-40	0.27	0.767	Not Significant
	51-60	-0.30	0.817	Not Significant
	≥61	-1.17*	<0.001	Significant
51-60	18-30	1.16*	<0.001	Significant
	31-40	0.56	0.211	Not Significant
	41-50	0.30	0.817	Not Significant
	≥61	-0.87*	0.009	Significant
≥61	18-30	2.03*	<0.001	Significant
	31-40	1.43*	<0.001	Significant
	41-50	1.17*	<0.001	Significant
	51-60	0.87*	0.009	Significant

Tukey HSD showed that there was a significant mean difference in CBD diameter of the age group of 18–30 years as compared to the age group of 41–50 years, 51-60 and ≥ 61 years, however there was no significant difference while comparing the age group of 18-30 years with age group 31-40 years. Similarly, there was a significant mean diameter difference in the age group of 31-40 years, 41-50 years and 51-60 years with the age group of ≥ 61

years. There was no significant mean difference observed between subsequent age groups starting from 31–40 years onward, except when compared with the age group ≥ 61 years.

Discussion

The common hepatic and cystic ducts merge to form the CBD, which plays a crucial role in bile transportation. The size of the CBD is important for assessing biliary health [1,2]. Several studies have suggested that the normal diameter of the CBD may increase with age, weight, and certain physiological changes, such as age-related dilation [4-7]. Ultrasonography is a reliable and non-invasive method for measuring CBD size and establishing normal reference ranges to differentiate between healthy and pathological conditions [9,10]. A study conducted at B.P. Koirala Institute of Health Sciences in Dharan, Nepal, evaluated CBD diameter in 145 adults without hepatic or biliary disease to establish baseline values. The study found that the mean CBD diameter increased significantly with age, from 3.73 ± 1.03 mm in the 18-30 age group to 5.76 ± 0.79 mm in the 61 age group, with no significant difference between males and females. These findings are consistent with previous literature, indicating that age, rather than gender, is a more influential factor in CBD dilation due to probable physiological changes in ductal elasticity over time.

A statistically significant positive correlation between the CBD diameter and age was noted in this study ($r = 0.650$, $p < 0.001$). These findings were in agreement with those of Nalaini et al. [12] and Farate et al. [13], who also showed that the diameter of the CBD increases with age increment ($r = 0.47$ and $r = 0.798$, respectively). This hypothesis was further confirmed by the current study through Tukey HSD analysis of the variation in CBD diameter among these age groups, which has proved to be highly significant. Wu et al. [11] demonstrated variation in the diameter of the CBD from 1 to 10 mm with a positive correlation with age, $r = 0.60$, $p < 0.001$. Lal et al. [8] also observed a significant rise in CBD diameter with advancing age in the Rajasthani population. These trends reinforced physiological changes in bile duct dimensions due to aging, to which reduced tissue elasticity and altered biliary dynamics with time are likely attributed.

The current study did not show a statistically significant difference in CBD diameter between males (4.91 ± 1.03 mm) and females (4.62 ± 1.21 mm) as per an independent t test ($p = 0.123$). Similar findings were reported by Admassie [6], Nalaini et al. [12] and Elgak et al. [14], which also showed no significant difference in CBD diameter. These findings indicate that gender is not likely a major determinant of CBD size in individuals not suffering from any hepatobiliary diseases.

One of the limitations of our study can be attributed to errors in the measurements made by individual radiologists, which may have affected the overall mean value in our study results. Therefore, further studies with larger samples are needed to support the data and results of our study.

Conclusion

In this study, the mean CBD diameter was found to be four point seventy four millimetres. The mean CBD diameter in males and females was four point nine one and four point sixty two millimetres respectively, showing that males had a slightly larger CBD diameter than females. However, an independent t-test showed no significant difference in mean diameter between genders. The mean CBD diameter increased gradually with age, with the ≥ 61 -year age group showing significantly higher values compared with several younger age groups.”

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