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Sonographic evaluation of gallbladder dimension in healthy adults of a South-Eastern Nigerian population

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Abstract

The study was carried out to evaluate the gallbladder dimension in healthy adults of Abakaliki Area of Ebonyi State, South-Eastern Nigeria. Sixty healthy adult volunteers, consisting of thirty one (31) males and twenty nine (29) females were assessed by ultrasound following an overnight fast. They were students and staff of Ebonyi State University and their age varied from 18 – 41 years. Gallbladder Length, Width, Height, Wall Thickness and anthropometric variables (Body Height and Weight) were measured for each subject. Gallbladder volume was calculated by the ellipsoid formula. The result shows the mean values of the parameters as follows: Weight 63.2 ± 8.15 kg, Height 1.68 ± 0.07 m, BMI 22.6 ± 2.85 kg/m2, Gallbladder Wall Thickness 0.28 ± 0.06 cm, Gallbladder Width 3.33 ± 0.92 cm, Gallbladder Height 2.71 ± 0.79 cm, Gallbladder Length 5.54 ± 0.53cm and Gallbladder Volume 19.78 ± 9.63 cm3. The study is relevant for medical advice and reference purposes.

Keywords: Ultrasonography, Gallbladder volume, Gallbladder wall thickness, Gallbladder length, Abakaliki.

INTRODUCTION

Gallbladder is a bluish piriform structure that is partly sunk in a fossa in the visceral surface of the right lobe of liver[1]. It functions in the storage and concentration of bile which is later released into the duodenum during the digestion of fatty substances[1][2]. Anatomically, the gallbladder is divided into Fundus, Body and Neck[1]. The Fundus is a rounded end that faces the front of the body while the body is in contact with the liver lying in a depression at the bottom of the liver[3] . The neck tapers and is continuous with the cystic duct part of the biliary tree. The cystic ducts unite with the common hepatic duct to become the common bile duct. The size of the normal adult gallbladder is approximately 8cm long and 4cm in diameter when fully distended[4]. It has capacity of about 50ml and varies in shape and size between the fasting and post prandial states. The gallbladder wall thickness is influenced by the degree of distension of the organ[5]. Clinically, a normal gallbladder cannot be palpated unless it is enlarged. Alteration in the size of gallbladder is therefore likely to be indicative of health complications in the individual. Therefore, the assessment of normal size of the organ in a healthy individual is paramount in checking the health complications associated with the organ.

Imaging methods used for assessing normal or diseased gallbladder include cholecystography, ultrasonography, computed tomography (CT) and magnetic resonance imaging (MRI)[5][6]. However, ultrasonography is the modality of choice because it is cheap, non-invasive and reproducible and, does not utilize ionizing radiation[6][7]. Consequently, the technique of ultrasound has rapidly evolved, leading to its wide spread use in almost all fields of medical practice. Ultrasonography provides information about gallbladder size, gallbladder volume and gallbladder wall thickness. Traditionally, ultrasound is used as the initial imaging technique for evaluating patients with suspected gallbladder disease because of its high specificity and sensitivity in the detection of gallbladder dimensions, real-time character, speed and portability[8][9]. Also, it is paramount in identifying gallbladder pathologies like distension, contraction, sludge, stones and tumors[5].

The present study tries to evaluate the normal mean gallbladder dimensions of healthy adult subjects in the Abakaliki Area of Ebonyi State, South-Eastern Nigeria. This is clinically important in monitoring the health status of the individuals considering the notable variation in gallbladder size/volume in certain disease conditions which could predispose the individual to stone formation, especially in those with

larger fasting gallbladder volume[10]. There is no previous documentation of such study in the area. The study therefore fills this gap for both medical and reference purposes.

MATERIALS AND METHODS

The data for this study was collected from 60 apparently healthy and physically active volunteers, comprising 31 males and 29 females. They were students and staff of Ebonyi State University, Abakaliki in the South-Eastern Nigeria. Their age range falls between 18 – 41 years.

The gallbladder dimensions were assessed using Digital Real Time Ultrasound System, Model CTS-7700 (SIUI Inc China) with a 3.5 MHZ Convex Transducer by a trained Sonographer. The Study Centre was at Life Scan Ultrasound Centre, Felix Memorial Hospital, Abakaliki, Ebonyi State. Ethical Approval was collected from the Research and Ethical Committee of the Centre and the Faculty of Basic Medical Sciences of Ebonyi State University, Abakaliki. Also, informed consent of the Volunteers was accorded before the study started.

Thereafter, the subjects were scanned in the morning after an overnight fast. They were asked to lie in supine position with their hands placed under their heads to widen intercostal spaces. The gallbladder was scanned both longitudinally and transversely. Measurements (cm) in maximal longitudinal and transverse axis of gallbladder were taken and recorded. The gallbladder length (GBL) and wall thickness (GBT) were taken in the longitudinal and axial planes, while the width (GBW) and height (GBH) were taken in the transverse section. The wall thickness (GBT) was measured at the midpoint of the gall bladder adjacent to the liver. This technique is in line with the method used by Adeyekun and Ukadike[11]. The GBT was measured in each subject at the midpoint of the gallbladder wall adjacent to the liver. Gallbladder volume (GBV) was calculated using the ellipsoid formula.

The body height (Ht) in meters (m) was measured with a Metre-Rule while the subject was standing barefooted in normal straight posture (anatomical position). The body weight (Wt) in Kg was measured using a Weighing Balance while the subject was standing on the Weighing Balance barefooted with no object in the pocket. The BMI was then calculated (BMI = Wt (kg)/Ht^2 (m^2)) and all the data recorded and documented for analysis. All statistical analyses were carried out in Microsoft Excel data base using Statistical Package for Social Science for windows (SPSS Inc., USA) Version 15.0 and expressed as Means and Standard deviations.

RESULT

Table 1 shows the descriptive statistics of all the parameters in the study. The mean values of the gallbladder parameters are as follows: GBT 0.28 ± 0.06 cm, GBW 3.33 ± 0.92 cm, GBH 2.71± 0.79 cm, GBL 5.54 ± 0.53 cm and Gallbladder volume 19.78 ± 9.63 cm^3. The gallbladder range values are as follows: GBT, 0.22-0.40cm; GBW, 1.30-4.80 cm; GBL, 3.60-6.10cm; GBH, 1.50-4.60 cm and Gallbladder volume, 10.14-26.98 cm^3.

Table 1: Descriptive statistics of anthropometric parameters and gallbladder dimension

Parameters	Minimum	Maximum	Mean	Std. Deviation
Age (yrs)	18.00	41.00	24.80	6.10
Weight(kg)	45.00	81.00	63.18	8.15
Height(m)	1.50	1.82	1.68	0.07
BMI (kg/m^2)	17.58	29.39	22.55	2.85
GBT (cm)	0.22	0.40	0.28	0.06
GBW (cm)	1.30	4.80	3.33	0.92
GBL (cm)	3.60	6.10	5.54	0.53
GBH (cm)	1.50	4.60	2.71	0.79
GB Volume (cm^3	10.14	26.98	19.78	9.63

Table 2 shows the descriptive statistics of the parameters by age groups showing the mean values. There is no significant difference in all the parameters ($p > 0.05$). This implies that age did not affect any of the parameters in the study.

Table 2: Descriptive statistics of anthropometric parameters and gallbladder dimension by age

Parameters	18-23 N= 34	24-29 N= 13	30-35 N= 7	36-41 N= 6	P- Value
Weight(kg)	62.50±9.02	63.23±8.49	65.29±4.50	64.50±6.20	0.84
Height(m)	1.67±0.06	1.67±0.07	1.68±0.12	1.68±0.11	0.97
BMI(kg/m^2)	22.32±2.80	22.41±3.67	23.58±2.52	22.95±2.93	0.75
GBT (cm)	0.27±0.06	0.26±0.05	0.29±0.03	0.25±0.06	0.48
GBW (cm)	3.29±0.92	3.16±0.95	3.76±0.98	3.40±0.92	0.56
GBL (cm)	5.53±0.92	5.43±0.50	5.69±0.39	5.65±0.72	0.73
GBH (cm)	2.79±0.84	2.48±0.50	2.84±0.87	2.60±1.01	0.64
GB volume	19.99±9.32	16.46±5.79	20.05±0.10	24.71±0.15	0.34

Table 3 shows that the mean values of weight, height and BMI were significantly higher in the male subjects than in the females ($P < 0.05$). Also, in the gallbladder dimensions the mean values of GBT, GBV, and GBL were significantly higher compared to their female counterparts.

Table 2: Descriptive statistics of anthropometric parameters and gallbladder dimension by age

Parameters	Male N =31	Female N = 29	T	Df	p-value
Age (yrs)	26.40±6.10	23.10±5.70	2.194	58	0.320
Weight (kg)	65.50±7.60	60.70±8.10	2.350	58	0.021
Height(m)	1.70±0.08	1.65±0.06	3.024	58	0.004
BMI (kg/m2)	22.70±2.84	22.40±2.90	0.419	58	0.010
GBT (cm)	0.29±0.56	0.26±0.55	2.425	58	0.018
GBW (cm)	3.21±0.86	3.45±0.98	1.003	58	0.320
GBL (cm)	6.70±0.55	6.38±0.47	2.416	58	0.019
GBH (cm)	2.82±0.76	2.60±0.82	1.093	58	0.279
GB Volume (cm3)	20.94±0.85	18.69±8.37	0.902	58	0.015

DISCUSSION

This study was carried out to sonographically evaluate gallbladder dimension in healthy adults of Abakaliki Area of Ebonyi State in the South-eastern Nigeria. In this study, the mean values of the gallbladder dimensions of the subjects were established as follows: GBV, 19.78 ± 9.63cm^3; GBL, 5.54 ± 0.53cm; GBW, 3.33 ± 0.92cm; GBH, 2.71 ± 0.79cm and GBT, 0.28 ± 0.06cm.

The mean GBV reported in the present study is low compared to some of the mean values reported in previous studies within and outside Nigeria. Adeyekun and Ukadike[11] reported a mean GBV of 27.2±12.8cm^3 in Benin City while Akintomide and Eduwem[12] reported a fasting gallbladder volume of 27.7 ± 12.3cm^3 in healthy adults in Calabar. Similar high mean GBV values have been recorded in some studies outside Nigeria with mean GBV of 28.2 cm^3 in Egypt[13] or even higher values in China[14]. These not-withstanding, studies in some other parts of Nigeria have presented moderately lower values of mean GBV. Olokoba et al[10] reported a mean GBV value of 24.3 ± 12.8 cm^3 as healthy control in the study of effect of type 2 diabetes Mellitus on fasting gallbladder volume in Ilorin, Kwara State while a recent study by Idris et al[15] recorded a mean GBV of 24.2 cm^3 on healthy adults in Northwest Nigeria. This may be suggestive of a significant variation in gallbladder volume among Nigerians. Reports have shown that gallbladder dimensions vary in individuals in different parts of the world and in diseased conditions[9][12][13][14][15][16]. The mean GBV of 19.78 ± 9.63 cm^3 recorded in the present study in Abakaliki, Southeastern Nigeria is low compared to all the cited values. The lower GBV could be attributed to the influence of age on gallbladder volume. It has been reported that there is an increase in GB size/volume with age[17]. Moreover, Caroli-Bosc et al[9] reported that age correlated with GBV. Their study showed statistically significant increased GBV in subjects of 50 years and above ($P = 0.001$). This report is similar to that of Idris et al[15] where fasting GBV was maximum at the highest class of 50 – 60 years of age ($P = 0.000$). The GBV in the present study is also maximum at the highest age class (36 – 41 years) but this is not significant ($P = 0.340$). This age class is smaller in comparison with those of Caroli-Bosc et al[9] and Idris et al[15]. Moreover, the mean age (24.8 ± 6.1 years) in the present study is smaller than 32 ± 13.2 years, Mohammed et al[18] and 35.6 ± 12.9, Idris et al[15] reported in the previous studies. According to Ugwu and Agwu[19] the increased fasting GBV at higher age brackets is thought to be due to hypocontractility of the gallbladder with consequent decrease in gallbladder contraction index. This could be attributed to ageing which leads to replacement of normal muscle fibers with fibrous tissue, or differences in hormonal and neurological profiles between the young and the elderly. Therefore, the low mean GBV recorded in the present study could be attributed to the fact that the study was carried out on younger adults with age range of 18 – 41 years. Consequently, the present study did not show any significant effect of age on any of the parameters studied. This is similar to the findings by Mohammed et al[18] who reported that GBT has no significant correlation with age.

The present study presented a mean gallbladder wall thickness (GBT) of 0.28 ± 0.06cm and GBT range of 0.22 - 0.40cm. This value is higher than that of Mohammed et al[18] who reported a mean GBT range of 1.8 – 2.8 ± 0.05 in Maiduguri, Northeast Nigeria. However, values recorded in some other parts of Nigeria, are not significantly different from that of the present study. Olokoba et al[20] in Ilorin, Nigeria studied the relationship between gallstone disease and GBT and recorded a mean GBT of 2.1 ± 1.2 mm while Adeyekun and Ukadike[11] found a mean GBT of 2.5 ± 0.4 mm in their study in Benin. Again, similar values have been recorded outside Nigeria. Wolson et al[21] and Cooperberg et al[22] reported in separate studies in USA that gallbladder wall thickness measured 2 – 3 mm and ≤3 mm respectively. Reports have shown that in adults as well as in children, an increase in thickness may result from a large spectrum of pathological conditions. However, it is known that greater GBT may be a non-specific finding[23][24].

On sexual dimorphism, the present study indicates that the male subjects were statistically taller and heavier than their female counterparts and most of the gallbladder dimensions studied were statistically higher in the males than in the females ($P < 0.05$). The study observed that the mean values of GBT, GBV, and GBL were significantly higher compared to their female counterparts. It has been reported that the gallbladder dimensions have significant higher male mean values than their female counterparts. Akintomide and Eruwem[12] assessed the fasting GBV in healthy adults in Calabar, Nigeria and reported higher values in males than females. Similar observations have been reported in other places[15][25][26][27][28]. The present study recorded the male mean GBV as 20.94 ± 0.85 cm^3 and female mean GBV as 18.69 ± 8.37 cm^3. This is statistically significant ($P = 0.015$). However, Caroli-Bosc et al[9] could not establish any significant correlation between sex and GBV. Again, Mohammed et al[18] studied sonographic gallbladder wall thickness (GBT) in normal adult population in Northeastern Nigeria and reported that the average GBT was significantly higher in men than in women ($P < 0.000$). Similar finding was also reported by Caroli-Bosc et al[9]. Again, this was observed in

the present study. The male mean GBT was 0.29 ± 0.56 cm while that of the female was 0.26±0.55 cm. This is statistically significant (P = 0.018; P < 0.05). Mohammed et al[18] attributed this to the fact that organ sizes in men are generally larger than those in women. This fact could also be extended to the greater male mean value in gallbladder dimension compared to that of female in the present study.

CONCLUSION

This study has successfully established the mean values of gallbladder dimensions in healthy young adults of southeastern Nigeria. The gallbladder dimensions are sexually dimorphic with the male values significantly higher than the female values. However, there is no significant difference in the gallbladder dimensions with respect to difference in the age of the subjects. This is important for both clinical and reference reasons.

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REFERENCES

1. Sinnatamby, C.S. Last Anatomy, Regional and Applied. 10th Edition. Churchill Livingstone. 1999; p. 257
2. Berman M.C. Gallbladder and biliary system. In: Kwamura DM, editor. Diagnostic Medical Sonography: A Guide to Clinical Practice, Abdomen and Superficial Structures. 2 nd ed. Philadelphia: Lippincott-Raven. 1997; 191-235.
3. Drake, Richard L.; Vogl, Wayne; Tibbitts, Adam W.M. Mitchell; illustrations by Richard; Richardson, Paul. Gray's anatomy for students. Philadelphia: Elsevier/Churchill Livingstone. 2005; 287. ISBN 978-0-8089-2306-0.
4. Meilstrup, J.W. Imaging Atlas of the Normal Gallbladder and Its Variants. Boca Raton: CRC Press. 1994; 4.
5. Karani J. The abdomen. In: Sutton D, editor. Textbook of Radiology and Imaging. 7th ed.Vol.1. Philadelphia: Churchill Livingstone. 2003; 711-8.
6. Berthold B. The Practice of Ultrasound: A Step to Step Guide to Abdominal Scanning. Stuttgart: George Thieme Verlag. 2004; 106-39.
7. Braverman D.Z.; Johnson M.L.; Kern F. Jr. Effects of pregnancy and contraceptive steroids on gallbladder function. N Engl J Med. 1980; 302: 362-364
8. Wolson A.H. Ultrasound measurements of the gall bladder. In: Goldberg BB, Kurtz AB, eds. Atlas of Ultrasound Measurements. Chicago: Year Book Medical Publishers 1990; 108-109.
9. Caroli-Bosc FX, Pugliese P, Peten EP, et al. Gallbladder volume in adults and its relationship to age, sex, body mass index, body surface area and gallstones. An epidemiologic study in a non-selected population in France. Int J Gastroenterol 1999; 60(4): 344-348.
10. Olokoba, B.; Bojuwoye, B.J.; Olokoba, L.B.; Wahab, K.W.; Braimoh, K.T.; Inikori, A.K. et al. The relationship between gallstone disease and gallbladder wall thickness. Afr Sci. 2006; 7:171-6.
11. Adeyekun, A. A and Ukadike, I.O. Sonographic evaluation of gallbladder dimensions in healthy adults in Benin City, Nigeria. West Afr J Radiol. 2013; 20:4-8
12. Akintomide, A. O and Eduwem D.U. Ultrasonographic Assessment of the Fasting Gallbladder Volume in Healthy Adults in Calabar; Correlation with Body Weight Journal of Dental and Medical Sciences. 2013; 4 (6): e-ISSN: 2279-0853, p-ISSN: 2279-0861.
13. Kishk SM, Darweesh RM, Dodds WJ, Lawson TL, Stewart ET, Kern MK, et al.(1987) Sonographic evaluation of resting gallbladder volume and postprandial emptying in patients with gallstones. AJR Am J Roentgenol. 1987; 148:875‑9.
14. Huang,S.M.; Yao,C.C; Pan,H; Hsiao,K.M; Yu,J.K.; Lai,T.J; Huang, S.D. Pathophysiological significance of gallbladder volume changes in gallstone diseases. World J Gastroenterol. 2010; 16(34): 4341-4347.
15. Idris N, Idris SK, Saleh MK, Suwaid MA, Tabari AM, Isyaku K, et al. Sonographic measurement of fasting gallbladder volume in healthy adults in North-West, Nigeria. Niger J Basic Clin Sci. 2016; 13:23-9.
16. Ugbaja,C.A.; Ayoola, O.O.; Ikem, R.T.; Idowu, B.M. Gall bladder volume and Contractility in type 2 diabetes mellitus. African Journal of Diabetes Medicine. 2015; 23(2)
17. Van Bodegraven,A.A; Bohmer,C.J; Manoliu, R.A et al. Gallbladder contents and fasting gallbladder volumes during and after pregnancy, Scandinavian Journal of Gastroenterology. 1998; 33(9): 993 - 997.
18. Mohammed, S.; Tahir, A.; Ahidjo, A.; Mustapha, Z.; Franza,, O.; Okoye, I; A Shugaba, A. Sonographic gallbladder wall thickness in normal adult population in Nigeria. SA J. Radiology. 2010; 14: 84 – 87.
19. Ugwu, A.C. and Agwu, K.K. Ultrasound quantification of gallbladder volume to establish baseline contraction indices in healthy adults: A pilot study. The South African Radiographer. 2010; 48 (2): 9-12
20. Olokoba AB; Bojuwoye BJ; Olokoba LB; Wahab KW; Salami AK,; Braimoh KT, et al. The relationship between gallstone disease and gall bladder volume. Niger J Clin Pract. 2008; 11:89‑93.
21. Wolson, A.H. Ultrasound measurements of the gall bladder. In: Goldberg BB, Kurtz AB. eds. Atlas of Ultrasound Measurements. Chicago: Year Book Medical Publishers. 1990; 108-109.
22. Cooperberg, PL; Gibney, RG. Imaging of the gallbladder. Radiology. 1987; 163: 605-613.
23. Callen, PW; Filly, RA (1979). Ultrasonographic localization of gallbladder. Radiology. 1979; 133: 687-691.
24. Rall PW, Quinn MF, Juttner HU. Gallbladder wall thickening: Patients without intrinsic gallbladder disease. Am J Roentgenol. 1981; 13: 65-68.
25. Donald JJ, Fache JS, Buckley AR, Burhenne HJ. Gallbladder contractility: Variation in normal subjects. AJR Am J Roentgenol. 1991; 157:753‑6.
26. Palasciano G, Serio G, Portincasa P, Palmieri V, Fanelli M, Velardi A, *et al*. Gallbladder volume in adults, and relationship to age, sex, body mass index, and gallstones: A sonographic population study. Am J Gastroenterol. 1992; 87:493‑7.
27. Chapman BA, Chapman TM, Frampton CM, Chisholm RJ, Allan RB, Wilson IR, *et al*. Gallbladder volume: Comparison of diabetics and controls. Dig Dis Sci. 1998; 43:344‑8.
28. Guliter S, Yilmaz S, Karakan T. Evaluation of gall bladder volume and motility in non-insulin-dependent diabetes mellitus patients using real-time ultrasonography. J Clin Gastroenterol. 2003; 37: 288–91.