Gallbladder Volume in Sikkimese Population

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ABSTRACT

Background

Gall bladder volume can have clinical and therapeutic implications and possibly affect certain pathophysiological mechanisms of many diseases affecting the gallbladder including gall stones.

Objective

The objective of the study was to establish baseline indices of gallbladder volume for the Sikkimese population and determine its correlation with age, sex and Body Mass Index.

Method

A prospective epidemiologic study on selected 100 patients (equal male to female ratio) over the age of 36 years, undergoing ultrasound scan of abdomen, was undertaken. Age, sex, Body Mass Index and gall bladder volume for each subject were collected and analysed statistically. Spearman's correlation test was performed to look for significant variables.

Result

The overall mean gallbladder volume in the present study was 15.47±7.9 ml with 17.2±8.9 ml and 13.74±6.4 ml being average volumes in males and females respectively, which gives the baseline indices for the Sikkimese population. Gall bladder volume was strikingly increased in obese subjects. There was a positive correlation between gall bladder volume and age (r=0.114), gender (r=0.182) and BMI (r= 0.175) but the strength of correlation was weak and not statistically significant ($p < 0.001$).

Conclusion

Ultrasonography is an easy and effective method for evaluation of gall bladder volume. Sikkimese males have a larger fasting gall bladder volume which is directly correlated with higher body mass index. Fasting gall bladder volume has a weak correlation with advancing age.

KEY WORDS

Age, body mass index, gall bladder, ultrasonography

INTRODUCTION

Diseases of gall bladder have been ailing the mankind since pre historic times, as evidenced by their discovery in ancient Egyptian mummy.[1] Gallbladder volume (GBV) can have clinical and therapeutic implications and probably influence some pathophysiological mechanisms of certain disorders of the gall bladder including gall stones.[2] Fasting volume of gallbladder may be an essential factor modulating gallbladder motility thus affecting its postprandial emptying. It is possible that an increase in GBV could result in impaired gallbladder motility leading to biliary stasis.[3]

It has been observed that fasting GBV is larger in lean healthy as well as in obese males than females. It increases with age in lean males and with body size in healthy lean females. It is also observed that it is larger in patients with gallstones. This might account for the defective gallbladder motor function in patients with gall stones.[4]

Present study was planned with an aim to determine fasting GBV in Sikkimese population by ultrasonography, to measure correlation between fasting GBV and parameters like age, sex, body mass index and to establish baseline indices for the study population.

METHODS

The study, designed as a prospective cross sectional descriptive study, was conducted in the department of Physiology and department of Radiodiagnosis in Sikkim Manipal Institute of Medical Sciences and associated Central Referral Hospital, Gangtok for the period May -June 2014. Inclusion criteria included all consenting individuals who were more than twelve years of age, residing in the state of Sikkim for at least five years, coming for ultrasonography of the abdomen with overnight fasting. Individuals with hypertension, diabetes mellitus, cardiac illness, hepatobiliary disease including gall stones, malignancy, alcohol dependency, pregnancy or who had undergone abdominal surgery in the past were excluded from the present study. A total of 100 individuals fulfilled the selection criteria and were included in the study. Due approval of Institutional Ethics Committee was obtained before commencing the study. Well informed written consent was taken from the participants.

A fact sheet containing information regarding age, sex, height, weight, body mass index (BMI), fasting gallbladder volume from ultrasonographic evaluation and history for any co-existing diseases was maintained for subsequent analysis.

Height and weight

It was measured against a vertical board with an attached metric rule and a horizontal head board was brought in contact with the upper most point of the head. It was recorded barefoot with the person standing on flat surface and weight distributed evenly on both feet and heels together and head positioned so that the line of vision is perpendicular to the body. The arms were hanging freely by the sides and the head, neck, buttocks and back were in contact with the vertical board. The individual was asked to inhale deeply and maintain an erect position. The topmost point on the head with sufficient pressure to compress the hairs was taken as height to the nearest 0.1 cm. Weight was recorded without foot wear and with light clothes on in the fasting state, standing straight on the centre of the weighing machine with body weight evenly distributed between both feet on an Indian standards institute (ISI) certified weighing machine to the nearest 100 grams.

Ultrasonography

The individuals with overnight fasting subsequently underwent ultrasonography of the abdomen in the early morning hours using a 3.5/5 MHz transducer on a General Electric (GE) LOGIQ P-5 ultrasound machine. The probe was placed on the right subcostal or intercostal area while the patients were in supine position and angled to obtain images showing largest longitudinal diameter of the gallbladder. The maximum length (L) and maximum transverse width (W) were measured in the above plane. Then the probe was rotated and placed perpendicular to the previous plane and the anteroposterior dimension (H) was measured. Each of these diameters is such that they are orthogonal to each other. The gallbladder volume (V) was calculated by the ellipsoid formula ($V= \pi/6 \times L \times W \times H$) by a single, experienced observer with the help of inbuilt software of the ultrasonography machine.

The data collected was tabulated and analysed by Statistical Package for the Social Sciences (SPSS) software 20.0 for windows as well as Microsoft excel 2010 with inbuilt statistical analysis tool. Appropriate statistical methods were used to determine the significance of differences between various comparisons. P value <0.05 was taken as significant and <0.01 as strongly significant.

RESULTS

A total of 100 individuals participated in the study. Number of female and male participants were equal (female to male ratio 1:1). Mean age of participants was 36.3 years. Female participants (mean age: 31.1 years) were ten years younger to male participants (mean age: 41.4 years). (Table 1)

Mean BMI of the study population was 24.3 (Females: 24.7 and males: 23.9). Individuals in the 5th decade had a higher BMI than the rest [Figure 1]. More than half of the male participants had a BMI of 28 (56%) while 52% of the females had BMI of 26. Only 6 (4 females and 2 males) had a BMI of >30 [Figure 2].

Gallbladder volume was calculated after measuring the maximum length, maximum width and maximum antero-

Table 1. Demography of study population

Age Group	Sex		Total
	Male	Female	
11-20	0	12	12
21-30	10	10	20
31-40	12	18	30
41-50	20	8	28
51-60	6	2	8
71-80	2	0	2
Total	50	50	100

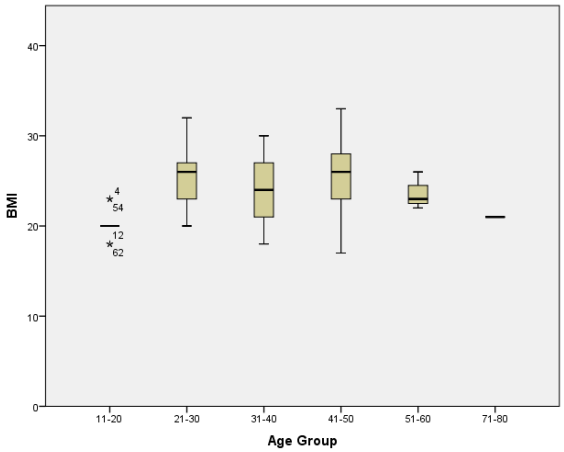

Figure 1. Boxplot showing the distribution of BMI among various age groups.

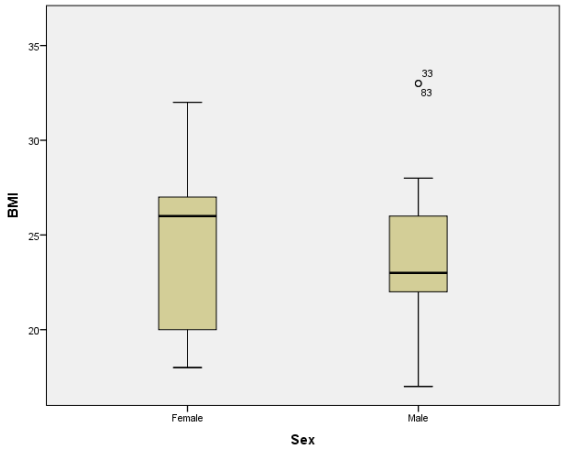

Figure 2. Boxplot showing distribution of BMI between two genders.

posterior (AP) diameter. Maximum length was 9.7 cm in males and 8.3 cm in females with a mean value of 5.8 cm. Mean of the maximum width was 2.1 cm, value being higher in males (2.2 cm) as compared to females (1.2 cm). Mean of the maximum AP diameter was 2.3 cm (females: 2.2 cm, males: 2.4 cm). Mean gallbladder volume was 15.5 ml. Male participants had a higher volume (mean: 17.2 ml) than that of females (mean: 13.8 ml). Maximum volume was 46.5 ml and minimum was 4.7 ml [Figure 3]. A striking observation was that the value of mean and maximum volumes was more in participants who had a higher BMI. Mean volume in participants with normal BMI was 14.8 ml and in overweight was 16 ml [Figure 4]. No such

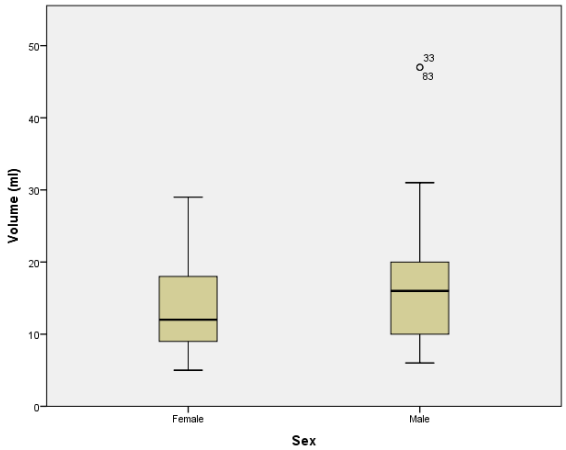

Figure 3. Boxplot showing gallbladder volume between two genders.

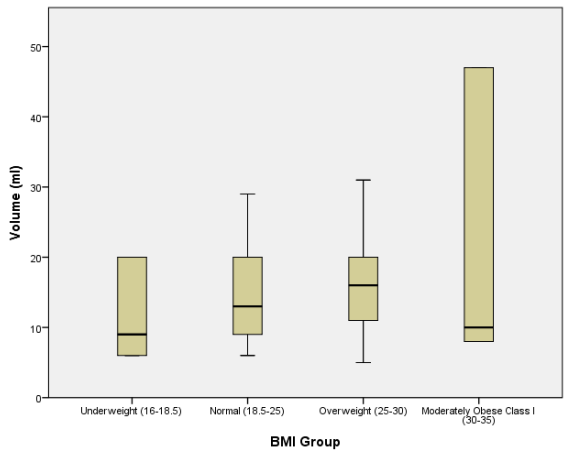

Figure 4. Boxplot showing gallbladder volume among various BMI groups.

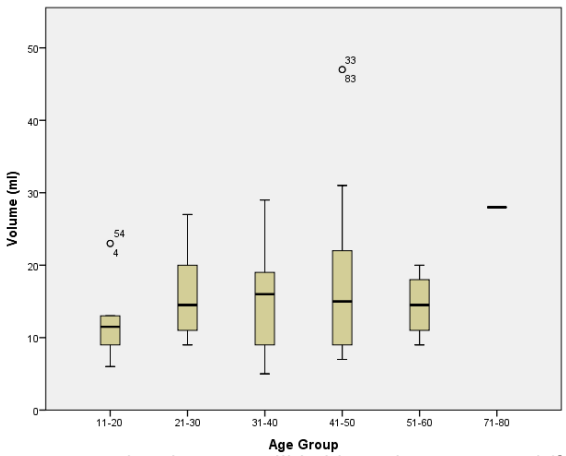

Figure 5. Boxplot showing gallbladder volume among different age groups.

observation was noted when data was compared among various age groups [Figure 5]. Comparing the means by method of analysis of variances established statistically significant difference within the groups [Age: $F=3.565$, $p<0.001$; gender: $F=3.555$, $p<0.001$; BMI: $F=3.423$, $p<0.001$ (Table 2)]. A positive correlation was found by Spearman's

correlation test in case of age, gender and BMI [age 0.114, gender 0.182, BMI 0.175] but the strength of correlation was weak and not statistically significant.

Table 1. Demography of study population

		Sum of squares	df	Mean square	F	sig.
Age group	Between groups	85.570	24	3.565	3.624	<0.001
	Within groups	73.790	75	0.984		
	Total	159.360	99			
Gender	Between groups	13.305	24	0.554	3.555	<0.001
	Within groups	11.695	75	0.156		
	Total	25.000	99			
BMI	Between groups	25.426	24	1.059	3.423	<0.001
	Within groups	23.214	75	0.310		
	Total	48.640	99			

DISCUSSION

The present cross sectional descriptive study was carried out with the idea of assessing the fasting gallbladder volume in the Sikkimese population and find its correlation with age, sex and the BMI within the study population.

The average BMI of the study population was 24.3±3.8, with a minimum of 17.30 and maximum of 33.06. The mean BMI in males was 23.90 whereas the same in the females was 24.70.

The average BMI of the participants reported in a previous study was 24.4±1.02 which is similar to that in present study.[5] Another study found the average BMI of the participants in their study to be 20.4±1.5 which was less than that in present study.[6] Mean BMI in all these studies was within normal limits (18.5-25).

The mean GBV in the present study was 15.47±7.9 ml with 17.2±8.9 ml and 13.74±6.4 ml being the average volumes in the males and females respectively, which gives the baseline indices for the Sikkimese population. A previous study reported the average GBV in males and females as 13.0±3.45 ml and 13.02±3.3 ml.[6] The present study shows that the Sikkimese males have a larger fasting gallbladder volume.

Previous studies found a positive correlation of GBV with advancing age.[4-6] Present study also shows a positive correlation between the two, though the strength was not statistically significant.

Mean GBV in participants with normal BMI was 14.84±6.9 ml, in overweight was 15.97±6.2 ml and in moderately obese was 21.80±7.99 ml which shows a positive correlation with the increasing BMI as proved by the Spearman correlation test, however it was not significant statistically. Other studies also reported that fasting gallbladder volume increases with the increase in body mass index.[5-7]

Limitations

The study was conducted over a short duration of 2 months and had a small sample size and therefore the results cannot be extrapolated over a larger population. The fasting period of all the individuals under evaluation were not the same even though efforts were made to standardize the same.

CONCLUSION

We conclude that ultrasonography is an easy and effective method for evaluation of gall bladder volume. Sikkimese males have a larger fasting gall bladder volume and fasting gall bladder volume is directly correlated with higher BMI. Fasting gall bladder volume also has a weak correlation with advancing age and is statistically not significant. The fasting gall bladder volume in the population and its clinical implications needs to be further studied on a larger group of population to get an overall insight into it.

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