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Radiodiagnosis

SONOGRAPHIC MEASUREMENTS OF THYROID AT TERTIARY CARE HOSPITAL OF SOUTH WESTERN MAHARASHTRA

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ABSTRACT

Introduction: The need to generate normative data for thyroid volume from the local population has been suggested. We aimed to establish reference values for thyroid volumes in healthy adults from south western Maharashtra and correlate it with their anthropometric variables.

Methodology: Thyroid sonography scans were performed on clinically healthy persons between age 30-50 years attending the Department of Radiodiagnosis of Bharati hospital, Sangli to measure volume of each lateral lobe, calculated using prolate ellipsoid method in the anterior cervical area through the suprasternal area. The correlation of thyroid volume anthropometric indices were evaluated using the Pearson's correlation test.

Results: Mean total thyroid volume was 8.02 ± 2.92 ml and was found to be significantly higher among males as compared to females. For the right lobe, transverse diameter and volume were significantly higher among male subjects as compared to female subjects. While for the left lobe, transverse diameter, CC diameter and volume were significantly higher among males as compared to females. It was found that the mean transverse diameter and CC diameter of the right lobe were significantly higher than that of the left lobe. Thyroid volume was found to positively correlate with height, weight, and body surface area in all subjects ($r=0.23$, $r=0.24$ and $r=0.27$, respectively; $p<0.01$ for all).

Conclusions: Ours is the first study to present normative data of thyroid volume using sonography in adult healthy population from south western Maharashtra. Similar studies are required from other centres in India to make comparisons.

KEYWORDS : thyroid sonography; thyroid volume; references thyroid values

INTRODUCTION

Thyroid abnormalities can be detected by clinical examination, however, the accuracy of diagnosis is low. It is very important to objectively and accurately measure the size of the thyroid, which is helpful for diagnosis, treatment, and the prognosis. Sonography of the thyroid gland is accurate, safe, non-invasive, comparably inexpensive, and reproducible and is useful for determining the size and volume of thyroid gland.The WHO has published normative reference range of thyroid volume for subjects of various age groups for iodine deficient areas. But Indian studies have shown that the WHO criteria for goitre are not directly applicable to Indian population probably due to the smaller body built and racial differences and Marwaha et al suggested the need to generate normative data for thyroid volume from the local population. In addition, with increasing usage of mobile phones and other microwave emitters, the incidence of clinical thyroiditis is on the rise and there is a need to re-establish the normal thyroid volume and compare it with previously known values. Studies have also shown that thyroid size is not only related to iodine intake and disease factors but also related to other factors, such as region, age, height, and weight. Thus, we sought to establish reference values for thyroid volumes in healthy adults from south western Maharashtra and correlate it with anthropometric variables.

METHODOLOGY

Study Design and Setting

This was an observational study conducted at the Department of Radiodiagnosis of Bharati Vidyapeeth (Deemed To Be) University Medical College and Hospital, Sangli from January 2019 for a period of three months. Bharati Hospital, an attached teaching hospital of Bharati Vidyapeeth University Medical College Sangli, is a 750 bedded multi-specialty, tertiary care hospital providing modern diagnostic as well as therapeutic facilities to the immediate vicinity area and nearby districts. In the present study thyroid sonography scans were performed on clinically healthy persons between age 30-50 years attending the Department of Radiodiagnosis of Bharati hospital, Sangli during the study period and various sonographic findings were noted. The purpose of the study was explained to the patients and an informed written consent was obtained from them before commencement.

Sample population

Patients of either gender coming for ultrasonography in our department without any diagnosed thyroid pathology between age 30-50 years were included in the study. Patients in whom sonography revealed altered echogenecity, echo-appearances, nodules, mass or calcifications in thyroid gland were excluded from the study, as were those who refused to consent for the study.

Data Collection and Data Analysis

Clinically healthy individuals attending the Department of Radiodiagnosis between the age 30-50 years underwent B-mode panoramic ultrasonography(5-12 MHz linear probe Phillips Affinity 50) and pre- warmed gel after obtaining informed consent. The sonogram was evaluated for volume of each lateral lobe calculated by measuring three dimensions and for presence or absence of ectopic thyroid tissue and echogenecity of the gland in the anterior cervical area through the suprasternal area. The following equations were used for analysis:

1. Thyroid volume (ml) = volume = length × breadth × depth × $\pi/6$ (prolate ellipsoid method)
2. Body mass index = Weight (kg)/Height $(m)^2$
3. Body surface $(m^2) = \sqrt{[\text{height (cm) x weight (kg)}/3600]}$
4. Body fat percentage = $(1.2 \times \text{BMI}) + (0.23 \times \text{age}) - (10.8 \times 1) - 5.4$ for males and $(1.2 \times \text{BMI}) + (0.23 \times \text{age}) - (10.8 \times 0) - 5.4$ for females.

The total thyroid volume was measured by combining the volume of both the lobes obtained by using formula for prolate ellipsoid. Statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS) program (Version 21.0; SPSS Inc., Chicago, IL, USA). Parameters in this test were expressed as means and standard deviations. The comparisons of means were performed using Student's t test. The correlation of thyroid volume with body weight, height, body mass index and body surface were evaluated using the Pearson's correlation test. Statistical significance was measured at p value less than 0.05.

RESULTS

During the study period 100 subjects were enrolled, 53% of which were females. Mean age of the study population was 36.76 ± 5.70 years. Mean height, weight and BMI of the whole study population was 160.18 cm, 62.96 kg and 24.04 kg/m^2respectively. Height, weight, BSA and body fat percentage of male subjects were significantly higher as compared to female subjects (Table 1). For the right lobe, transverse diameter and volume were significantly higher among male subjects as compared to female subjects. While for the left lobe, transverse diameter, CC diameter and volume were significantly higher among males as compared to females. For the right thyroid lobe,

mean transverse diameter, AP diameter, CC diameter and volume were 1.41 ± 0.3 cm, 1.36 ± 0.23 cm, 4.36 ± 0.62 cm and 4.23 ± 1.5 ml respectively (Table 2). For the left thyroid lobe, mean transverse diameter, AP diameter, CC diameter and volume were 1.28 ± 0.26 cm, 1.33 ± 1.17 cm, 4.17 ± 0.56 cm and 3.79 ± 1.3 ml respectively. It was found that the mean transverse diameter and CC diameter of the right lobe were significantly higher than that of the left lobe. Mean length of the isthmus of the thyroid gland was 0.25 ± 0.08 cm, which was not significantly different between male or female subjects. Mean total thyroid volume was 8.02 ± 2.92 ml and was found to be significantly higher among males as compared to females. Figure 1 illustrates the correlation of total thyroid volume with various anthropometric variables. Thyroid volume was found to positively correlate with height, weight, and body surface area in all subjects (r=0.23, r=0.24 and r=0.27, respectively; p<0.01 for all). BMI also correlated positively with total thyroid volume, however the correlation was not statistically significant.

DISCUSSION

There are a few studies which assessed thyroid volume among healthy adult subjects in India. The present study found that the mean total thyroid volume was 8.02 ± 2.92 ml and was significantly higher among males (9.65 ± 3.42ml) as compared to females (6.58 ± 1.23 ml). One of the first studies from India to report thyroid volumes by sonography in healthy population aged more than 35 years was by Menon et al in 2010, who reported mean thyroid volume to be 8.80 + 3.1 ml in healthy subjects from central Kerala.Similar results have been reported from other geographical areas like from Nepalese population and Sudanese healthy subjects.Moghadam et al found that the mean of thyroid volume in male Iranians (9.08 ± 2.49 ml) was significantly higher than that of females Iranians (7.93 ± 3.2 ml).We also found the left lobe's transverse diameter and CC diameter were significantly higher among males as compared to females. Normative values of thyroid volume from around the world have shown a wide range of differences, most likely due to regional and ethnic factors as well as to the iodine status of the population, and diet.Zimmermann et al reported reference values for thyroid volume by ultrasound in iodine-sufficient schoolchildren from various countries, highlighting the importance of establishing normative values at the local level. Moreover, Italian and Turkish studies have demonstrated that within country variations exist as well., Total thyroid volume was found to positively correlate with height, weight, and body surface area in all subjects. Gomez et al showed that body surface area accounts for much of the variation of thyroid volume. In children thyroid volume has been found to increase with increasing anthropometric measures.Menon et al found a significant positive correlation of triceps and subscapularis skinfold with thyroid volume, suggest an indirect correlation between body fat and thyroid volume.4Present study found positive correlation between BMI and Thyroid volume though not statistically significant .Similar findings were found in study by Menon et al.

Though the present study did not collect smoking related information, smoking, by activating the sympathetic nervous system, is associated with a decrease in serum thyroid stimulating hormone and a rise in serum free thyroid hormones. Furthermore, Weirsinga suggested that the effect of smoking is higher in thyroid deficit areas.In a large French cohort, thyroid volume was significantly greater in current smokers and in former smokers than in non- smokers, in either gender. Type of residence was also associated with thyroid volume by Kim et al.They found the mean thyroid volume to be larger in urban than rural school children. The authors suggested that it could be because the weight and height of children in urban areas were larger than in rural ones.

There are a few limitations of this study. Firstly, urine samples were not collected for iodine level estimation. Secondly, dietary history could not be obtained to ascertain the association of dietary iodine with thyroid volume in this population.

CONCLUSION

Ours is the first study to present normative data of thyroid volume using sonography in adult healthy population from south western Maharashtra. From the previously reported mean total thyroid volume from India (8.8 ± 3.1 ml), value in our study population (8.02 ± 2.92 ml) was not statistically different. We found that the right lobe volume was higher among males as compared to females, though the right and left lobe volume in the whole study population were not statistically different. Total thyroid volume was higher among males as compared to female and it correlated significantly with height, weight and body surface area of the study subjects.

Table 1. Comparing baseline characteristics of male and female subjects

	Males (n=47)		Females (n=53)		p value*
	Mean	SD	Mean	SD	
Age (years)	36.83	6.40	36.70	5.06	0.91
Height (cm)	166.05	8.32	154.97	8.15	<0.01
Weight (kg)	67.04	12.36	59.33	11.13	<0.01
BMI (kg/m2)	23.83	4.34	24.23	3.79	0.62
Body Surface Area (m2)	1.75	0.18	1.59	0.17	<0.01
Body Fat percentage	20.87	5.79	32.11	4.79	<0.05
Right lobe TD (cm)	1.56	0.29	1.27	0.23	<0.01
Right lobe AP (cm)	1.39	0.21	1.33	0.25	0.24
Right lobe CC (cm)	4.47	0.59	4.27	0.63	0.10
Right lobe volume (ml)	4.90	1.53	3.64	1.19	<0.01
Left lobe TD (cm)	1.36	0.28	1.22	0.22	<0.01
Left lobe AP (cm)	1.52	1.67	1.16	0.26	0.11
Left lobe CC (cm)	4.32	0.62	4.03	0.46	<0.01
Left lobe volume (ml)	4.75	2.03	2.94	0.40	<0.05
Isthmus AP length (cm)	0.25	0.08	0.24	0.08	0.94
Total thyroid volume (ml)	9.65	3.42	6.58	1.23	<0.01

TD: transverse diameter; AP: antero-posterior diameter; CC: cranio-caudal

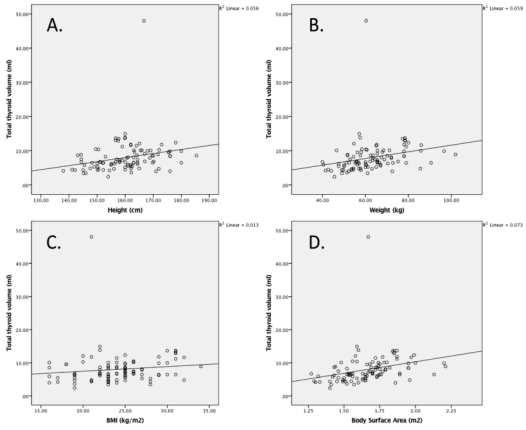
*compares mean of various variables between males and females using student's t test

Table 2. Comparing the sonographic measurements of right and left lobe thyroid for the whole sample (n=100)

Thyroid lobe measurements	Right lobe	Left lobe	p value*
Transverse diameter (cm)	1.41 ± 0.30	1.28 ± 0.26	<0.01
Antero-posterior diameter (cm)	1.36 ± 0.23	1.33 ± 1.17	0.81
Cranio-caudal diameter (cm)	4.36 ± 0.62	4.17 ± 0.56	<0.05
Lobe volume (ml)	4.23 ± 1.50	3.79 ± 1.30	0.29

*using paired sample t test

Figure 1. Correlation of total thyroid volume with various anthropometric variables for all subjects



A: Thyroid volume-height; B: Thyroid volume-body weight; C: Thyroid volume-body mass index; D: Thyroid volume-body surface area

Figure 2. Anteroposterior diameter of isthmus of thyroid gland on sonography of thyroid gland

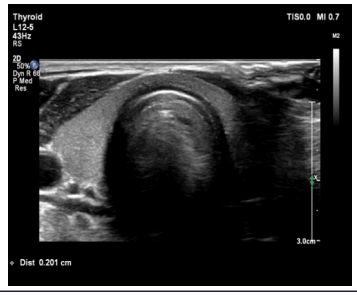


Figure 3. Transverse diameter measurement of right (a) and left (b) thyroid lobe using sonography

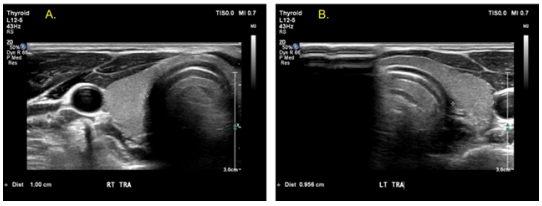
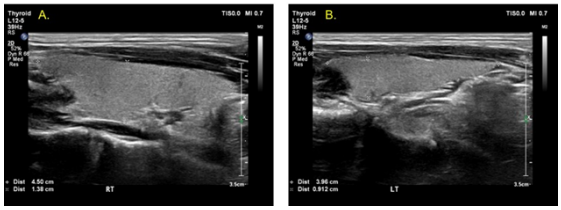


Figure 4. Craniocaudal and anteroposterior diameter of right (a) and left (b) lobe of thyroid gland on sonography



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