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Ultrasound Evaluation of Normal Thyroid Size

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ABSTRACT

Introduction

Normal thyroid size determination is very important for the accurate diagnosis of various thyroid disease. There are different thyroid pathologies which lead to increase in size of the thyroid gland, therefore it is essential to know the accurate dimension of the thyroid gland. This study was aimed to evaluate the normal range of thyroid gland dimensions.

Methods

The study was a descriptive cross-sectional study conducted on 115 patients, in Department of Radiology and Imaging, College of medical sciences, Bharatpur, Nepal. All ultrasound examinations were performed using Toshiba Aplio 500 superficial probe. The data was analyzed using Statistical Package for the Social Sciences (SPSS) version 16 (SPSS, Inc., an IBM Company, Chicago, IL). Descriptive statistics was used to analyze the data.

Results

Among the 115 patients who participated in the study, 24 (20.9%) were male and 91 (79.1%) were female. The mean length of the right lobe was more (3.67±0.338 mm) than in the left lobe (3.45±.423 mm). The overall mean volume of thyroid gland was 6.71±2.05 ml. The mean volume of thyroid gland in males was 7.91±2.91 ml and in females was 6.40±1.63 ml.

Conclusions

The present study estimated the normal dimension of thyroid gland. The normal dimension of thyroid gland volume was found to be more in male than in female. The mean total volume was found to be similar to the earlier published study from Nepal.

Keywords: measurement; thyroid gland; ultrasound; volume.

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INTRODUCTION

The thyroid gland is an endocrine gland located within the lower neck, draped anteriorly around the trachea. The two thyroid gland lobes, right and left lobes are connected together by a thin structure known as isthmus. The major role of thyroid gland is production, storage and release of thyroid hormones which are very vital in development and growth of humans.[1-3]

The thyroid gland's shape, size and volume varies remarkably among individuals. Many physiological as well as pathological factors affect the thyroid gland dimensions. Studies have reported that thyroid glands are affected by age, gender and race.[3,4] Spatiotemporal variation in the size and volume of thyroid gland have also been reported. Studies have shown it to be larger and heavier in females.[5] In pathological conditions such as goiter, thyroiditis, the alterations in dimensions of thyroid gland have been reported.[6] The standard size, shape and weight of thyroid gland and associated variations is necessary for the head neck surgeons. Often the estimation of thyroid volume is helpful in monitoring the efficacy of medicine in goiter, thyroiditis and thyrotoxicosis. Moreover, the baseline dimensions are important for personnel exposed to radiations in order to provide the protection against the radiation hazards.[1,6,7]

There is paucity of literatures determining the normal thyroid gland dimensions in Nepalese. Till date published literatures have determined the volume of thyroid gland[6] and the thickness of thyroid isthmus among Nepalese[8], there is no consensus on the length, breath and width of the thyroid gland among Nepalese and no studies have been reported from Chitwan. This study was aimed to determine the dimensions of thyroid gland by ultrasound.

METHODS

This was a hospital-based descriptive cross-sectional study done in the Department of Radiology and Imaging of College of Medical Sciences, Bharatpur, Chitwan, for the period of three months (March, 2021 to May 2021). In this study using a convenience sampling method, altogether 115 patients were included. Ethical approval was obtained from Ethical Committee of College of Medical Sciences, Bharatpur, Nepal (COMSTH-IRC/2021-54). The objectives of the study and the procedure was well explained to the patients and written consent was obtained from the patients who participated in the study.

The patients who were referred to the department for ultrasonography examination for reasons other than thyroid ultrasound scan and who consented to participate in the study were included in the study while female patients who were during menstruation, pregnancy or who have delivered within the last twelve months were excluded. Patients with swelling in the anterior region of the neck and clinical evidence of thyroid disease and those who had history of previous thyroid surgery were also excluded.

A single consultant radiologist performed the thyroid measurement, with an ultrasound machine, Aplio 500 Toshiba Machine with superficial probe of frequency 7-10MHZ. Before doing ultrasound, the patients were instructed to remove jewelry and tie towel across the chest. Then they were asked to lie in the supine position and a pillow was placed under the patient's shoulder. This was done to aid in the extension of the neck. A coupling gel was applied over the anterior region of the neck and the transducer was placed over the thyroid gland region. The images were taken in transverse and longitudinal planes. The measurements of craniocaudal (L) and sagittal (D) dimensions were carried out on the longitudinal image while

the mediolateral diameter (W) was obtained from the transverse image. The measurement of right and left lobes was taken and analyzed separately. All measurements were carried out by single radiography consultant to avoid individual variation.

The thyroid gland volume was calculated using the rotation ellipsoid method:

Volume = L × D × W × 0.52 (correction factor)

Where: l = craniocaudal dimension

W = mediolateral dimension

D = sagittal dimension

The isthmus volume was calculated as:

Volume of isthmus = L × D × W × 0.479.

In addition, the volume of the right and left lobes was summed to obtain the total thyroid volume. The isthmus was not included in the sum.

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 16 (SPSS, Inc., an IBM Company, Chicago, IL). Descriptive statistics was used to analyze the data and the results was presented using frequency, percentage, mean, and standard deviation (SD). The results were presented in form of tables.

RESULTS

Total 115 patients were enrolled in our study. Male patients were 24 (20.9%) and female patients were 91 (79.1%) (Table 1).

Table 1. Characteristics of participants.

Variables		Frequency (%)
Mean Age (years) ± SD		30.57±11.611
Gender	Male	24 (20.9)
	Female	91 (79.1)

Table 2 showed the descriptive statistics of length, breadth, depth and volume of each lobe and isthmus. Mean length of thyroid lobe was higher in right lobe (3.67±0.338 mm) than in the left lobe (3.45±.423 mm) while the breadth was slightly higher in left lobe (1.52±0.224 mm). The mean volume of right lobe was higher (3.42±1.197 ml).

Table 2. Dimensions and volume of right lobe, left lobe and isthmus.

Variables	Right lobe Mean ± SD	Left lobe Mean ± SD	Isthmus Mean ± SD
Length (cm)	3.67±0.338	3.45±.423	1.45±0.403
Breadth (cm)	1.50±0.256	1.52±0.224	0.29±0.090
Depth (cm)	1.16±0.200	1.17±0.192	0.25±0.084
Volume (ml)	3.42±1.197	3.30±1.065	0.06±0.063

The overall mean volume of thyroid gland was 6.71±2.05 ml. The mean volume of thyroid gland for both lobes in males and females were 7.91±2.91 ml and 6.40±1.63 ml respectively (Table 3).

Table 3. Total volume of thyroid gland.

Volume (ml)	Mean ± SD
Male (ml)	7.91±2.91
Female (ml)	6.40±1.63
Total volume (ml)	6.71±2.05

DISCUSSION

The thyroid gland, a vital endocrine gland, plays a critical role in regulating metabolic functions including heart rate and cardiac output, lipid metabolism, heat regulation, and skeletal growth. It is due to the release of thyroid hormones triiodothyronine and thyroxine (T3 and T4). Apart from this thyroid gland also consists of parafollicular cells that synthesize calcitonin.[9]

The thyroid gland examination is a routine clinical examination done. This may be due to the increase in the prevalence of thyroid disorders. The thyroid disorders are more common in females than in males.[10] It is said that the thyroid nodules often missed do not show obvious symptoms. Thus, careful preoperative

assessment is necessary for diagnosis and treatment planning.[1,10,11] In addition to this, studies have also shown morphometric variations of thyroid gland. The variations have been observed in relation to age, gender, race and ethnicity.[2,3,7,12-14] Apart from this seasonal variation in the release of thyroid hormone have been reported.[15-17] This study also focused on the dimension of the thyroid gland.

The thyroid gland has been studied using various modalities such as CT, MRI, ultrasound. Anatomist have also observed the thyroid gland dimension based on cadaver.[5,18,19] The present study used ultrasound to measure the dimension of thyroid gland. This is method is widely used due to its non-invasive, less expensive and lack of release of any harmful ionizing radiation.[1,4,20,21] Due to this nature it is also used for diagnostic and therapeutic interventional procedures related to thyroid gland.[10]

This study found the length of the right lobe was higher than the left lobe. Only slight discrepancy between the right and left lobe in relation to the breadth and depth was observed. In contrast to the present study, Lee et al reported longer length of thyroid gland. However, they also reported the right lobe length to be longer than left lobe.[22] In their study the mean width of right lobe and left lobe was 15.7±2.6 mm and 15.2±3.1 mm while the mean thickness was 20.9±3.4 mm and 18.9±3.4 mm.[22] This measurement was greater than the present study. The difference in the measurement may be associated with variation of body size, study location and sample size.

In the present study the right thyroid lobe volume was greater than the left thyroid lobe volume. The mean volume of right lobe was 3.42±1.197 ml while the left lobe was 3.30±1.065 ml. The mean total volume of the thyroid gland was 6.71±2.05 ml. This finding is similar to the study conducted by Yousef et al,[23] Turcios et al[24] and Kayastha et al.[6] In a similar study done among Nepalese patients, Kayastha et al reported the mean volume of thyroid gland as 6.629 ± 2.5025 ml.[6] Yousef et al observed the total mean thyroid volume as 6.44 ± 2.44.[23] Turcios et al reported the total volume as 6.6 ± 0.26 ml. This value was slightly lower than the present study. This may be due to the variation of geographical location, sample size, the supplementation of iodine. Hegedus et al measured the thyroid gland of 111 health people and found the mean total volume of thyroid glands slightly higher than the present study.[17] In contrast to the present study, another study done in Nigeria reported the total mean thyroid gland volume to be 6.03±2.49 ml.[25] The reduction in volume may be attributed to the geographical location.

Studies have also reported variation in gender stating the thyroid gland to be larger and heavier in females. Apart from this the size also varies during menstruation and pregnancy in female.[5] The thyroid gland also undergoes physiological changes during pregnancy and menstruation in females.[26] This study also observed variations among the gender. It was 7.91±2.91 ml in males and 6.40±1.63 ml in females. In agreement with the present study, Salaam et al also reported the thyroid volume higher in male than in female.[25] Hegedus et al in their study observed the thyroid volume to be slightly greater in females.[17]

In the present study the volume of isthmus was 0.06±0.063 ml. This volume was not incorporated in the mean total volume of thyroid gland as its mean thickness in the present study was 0.29±0.090 cm. This was below three mm thickness.[27] The mean thickness was slightly lesser than reported by Kayastha et al.[8]

There are limitations of present study. There was non-uniform distribution of gender which have also caused slight increase in variation in the total volume in male. This study was based

on patients coming to single tertiary care centre of Nepal so the results cannot be generalized. The study did not observe other physiological factors that might have impact on the dimension of thyroid gland.

CONCLUSIONS

The present study evaluated the dimension of thyroid gland using ultrasound. The mean thyroid volume was found to be more in male than in female. The mean total volume was found to be similar to the earlier published study from Nepal.

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Conflict of Interest: None

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