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Original Research Article

A MORPHOMETRIC STUDY ON AGE RELATED CHANGES OF HUMAN THYROID GLAND

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ABSTRACT

Background: Now-a-days study on normal anatomy of thyroid gland is very important because of higher incidences of thyroid surgeries and interventions. To perform safe and effective surgery and for diagnosis of thyroid gland disorders knowledge of normal anatomy is essential. The aim of this study is to find out whether there is any change in weight of thyroid gland as age advances and to find out the dimensions of normal thyroid gland.

Materials and Methods: Hundred specimens of thyroid gland dissected from autopsied bodies were weighed using automated weighing machine. Length, width and thickness of right and left lobes are measured using Vernier callipers. Pyramidal lobe and isthmus were also studied.

Results: The mean weight of thyroid gland was lowest in ≤20 years (11±4.7g) and became 17.64±6.4g in 20-40 age group and maximum weight noticed in 41-60 age group (18.13±5.5g). There was a reduction in mean weight of thyroid gland after 60 years (15.55±5.2g). Incidence of absent isthmus was 3% in the study specimens. Pyramidal lobe observed in 36% of specimens of which majority, 18% was in left side 11% on right and in rest 7% in the median plane.

Conclusion: Weight of the thyroid gland gradually increase till 60 years of age and decline thereafter and is positively correlated with BMI, height and weight of the individual. Pyramidal lobe observed in 36%. Hence surgeon should examine anterior neck carefully during surgery, otherwise it can cause recurrence of disease after surgery.

Keywords: Thyroid gland, pyramidal lobe, isthmus.

INTRODUCTION

The thyroid gland is brownish-red in colour, highly vascular, situated anteriorly in the lower neck. Thyroid gland consists of right and left lobes connected by an isthmus [Figure 1]. It usually weighs 25 g, but this varies. Estimation of the size of the thyroid gland is clinically important in the evaluation and management of thyroid disorders and can be achieved non-invasively by means of diagnostic ultrasound.[1] Each lobe is usually 5 cm long, its greatest transverse (width) and antero-posterior (thickness) extents being 3 cm and 2 cm respectively. The isthmus is a median band that connects the lower parts of the two lobes and is usually anterior to the second to fourth tracheal cartilages. Occasionally it may be absent. A slender pyramidal lobe frequently extends superiorly from the upper border of the isthmus or the adjacent part of either lobe, usually to the left of the median plane. A fibrous or fibromuscular band, the levator of the thyroid gland, musculus levator glandulae thyroideae [Figure 2], sometimes descends from the body of the hyoid to the isthmus or pyramidal lobe.[2]

Now-a-days study on normal anatomy of thyroid gland is very important because of higher incidences of thyroid surgeries and interventions. To perform safe and effective surgery and for diagnosis of thyroid gland disorders knowledge of normal anatomy is essential. To rule out pathology it is very important to know about the normal weight and dimensions of thyroid gland in different age groups. The aim of this study is to find out whether there is any change in weight and volume of thyroid gland as age advances and to find out the dimensions of

normal thyroid gland. In this study the incidence of pyramidal lobe was also included. This is a common occurrence and a potential risk for recurrence after surgery.

MATERIALS AND METHODS

This cross-sectional study was started after getting permission from the Institutional Review Board. Hundred specimens of thyroid gland were collected during autopsy. The thyroid gland was dissected en-mass from autopsied bodies. Specimen number, age and sex were labelled. Height and weight of the person were noted. The gland was weighed using automated weighing machine. Length, width and thickness of right and left lobes are measured using Vernier callipers. Photograph of the specimen was taken using digital camera. After collecting the data from all the samples, the data was numerically coded and entered in MS EXCEL Spreadsheet. Specimens were grouped according to the age of the individual into 0-20 years, 21-40 years, 41-60 years and >60 years and the age-related changes were assessed. The analysis was done using SPSS software package. Frequency, mean score etc were calculated for summary statistics.

Inclusion Criteria

Specimens collected from autopsied bodies from the Department of Forensic Medicine within 24 hours of death.

Exclusion Criteria

Decomposed bodies, hanging cases, any crush or cut injury of neck, specimens with nodular enlargements and death following chronic illness were excluded.

RESULTS

There were 87 specimens from males and 13 from females. 5% of specimens where from 0-20 years of age, 33% from 21 – 40 years, 40% from 41-60 years and rest 22% were from >60years. Mean weight and volume of thyroid gland were measured and compared in different age groups.

Weight of thyroid gland

Mean weight of thyroid gland in the study population was 17.04g with a standard deviation of 5.33g. There was a significant difference in the mean weight of thyroid gland in different age groups. As shown in graph1 mean weight of thyroid gland was lowest in ≤20 years age group (11±4.7g), it gradually increased and became 17.64±4.64g in 21-40 age group and maximum weight observed in 41-60 age group (18.13±5.5g). There after the mean weight of the gland reduced. Mean weight of thyroid gland was 15.55±5.2g in >60 years group. This difference in mean weight of thyroid gland with age was statistically significant with p value 0.015.

In the present study weight of thyroid gland was lowest in a 5year old boy who was youngest in the population (≤20 years group). Weight of the thyroid gland was 4g. Maximum weight of thyroid gland noted in a 54year old male (41-60 years group), weight was 33g. Mean weight of thyroid gland in males of the study population was 17.26 ± 5.28g and that of females was 15.54 ± 5.65g. This difference in mean weight between males and females was not significant statistically.

BMI and weight of thyroid gland

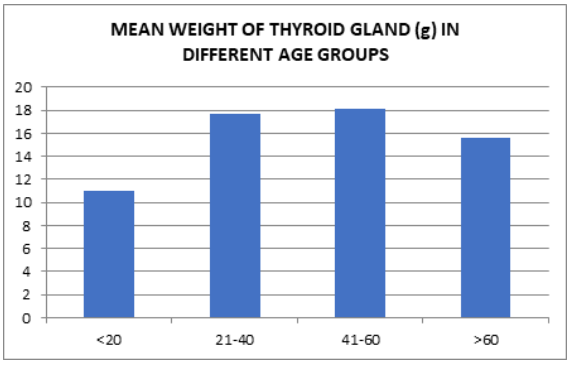
Individuals were classified according to BMI into underweight (BMI <18.5), normal (18.5 – 24.9), overweight (25 -29.9) and obese (>30). As the BMI of the person increases there is a significant increase in the weight of thyroid gland. Mean weight of thyroid gland in underweight group was 15g, gradually increased to 16.39g in subjects with normal BMI, became 19.2g in over weight individuals. Highest mean weight of thyroid gland observed in obese group and was 20.17g. Similarly, weight of thyroid gland showed positive correlation with weight and height of the person.

Length, width and thickness of lobes of thyroid gland

Mean length, width, thickness of right lobe thyroid gland was 4.37±0.56cm, 2.01±0.4cm and 1.96±0.39cm respectively and that of left lobe was 4.14±0.61cm, 2.02±0.41cm and 1.73±0.38cm respectively. Gross measurements of thyroid gland did not significant correlation with age, except the mean length of thyroid gland. Length showed a significant positive correlation with correlation coefficient 0.288 and p value 0.006 (<0.05). But similar to other measurements length was also significantly positively correlated with BMI, height and weight of the person.

Volume of thyroid gland

Mean volume of thyroid gland was calculated by adding the volume of each lobe.[3] (Volume of a lobe= 0.479(correction factor) X length X width X thickness of the lobe). Mean volume of the study population was 15.49ml. Mean volume of thyroid gland did not show any significant correlation with age or sex. But the volume of thyroid gland shows significant positive correlation with BMI, weight and height of the person.



Graph 1: Bar diagram showing mean weight of thyroid gland (g) in different age groups

Pyramidal lobe and isthmus of thyroid gland 36% of thyroid glands were having pyramidal lobe. There was a higher incidence of pyramidal lobe arising

from left lobe of thyroid gland, 18% had left pyramidal lobe [Figure 4], 11% specimens had right pyramidal lobe [Figure 3]. 7% thyroid glands had median pyramidal lobe [Figure 5], which was extending upwards from isthmus of thyroid gland in the median plane. 97% of specimens were having isthmus where as 3% were having no isthmus.

Figure 1: A normal thyroid gland specimen of a 43 year old male showing right and left lobes & isthmus

Figure 2: Thyroid gland of a 55year old male showing relation of gland with larynx and trachea, levator glandulae thyroidea present (pointed).

Figure 3: Thyroid gland of a 40 year old male with right pyramidal lobe (weight 26g).

Figure 4: Thyroid gland of a 56 year old male showing left pyramidal lobe (weight 18g).

Figure 5: Thyroid gland of a 94 year old male with median pyramidal lobe (weight 22g).

DISCUSSION

Weight of thyroid gland

In this study mean thyroid weight was compared in 4 different age groups and the difference was significant statistically. Weight was minimum in ≤20 years of age (11±4.74g), it gradually increased, 17.64±4.64g in 21- 40 years group, maximum in 41-60 years group (18.13±5.49g) and decreased thereafter. Mean weight was 15.55±5.20g in >60 years of age.

Similar study conducted by Enayetullah,[4] (1996) reported average weight of thyroid gland in group ≤20 years is 5.97±3.55g, group 21-40 years is 17.85±6.75g and group 41-78years is 14.35±5.86g. Begum M,[5] (2004) reported the average weight of thyroid gland <20years is 8.18±3.32g, 21-50 years is 15.96±5.06g and >50 years is 13.56±3.60g. These studies also show a gradual increase in weight of thyroid gland till middle age and a gradual decline in elderly. Same observation was made by Banna et al,[6] (2010), mean weight of thyroid in ≤20 years was 8.65±5.43g, in 21-50 years was 14.9±5.3g and in >50 years was 14.53±3.61g. Herman and Lacka,[7] (2006) reported that by the age of 70 years, the weight of the thyroid gland is about 20-30% less than that at the age of 20 years due to atrophy of 40% of follicles and loss of about 30- 40% of total number of follicles.

Khatun M,[8] (1991) noted highest mean weight of thyroid gland in 21-40 year group, lesser in 11-20 and 41-65 group and lowest in 5-10 year group. O. Taniover,[9] (2011) observed the mean thyroid weight as 26.11±8.14g. In males it was 26.93±7.96g and 21.93±7.98g in females. He reported significant positive correlation between the weight of male subjects and thyroid weight. This study also showed a similar relation between weight of the person and weight of the thyroid gland. As the weight of the person increased weight of thyroid gland also increased. But mean weight of thyroid gland obtained in this study group was 17.04±5.33g which is less compared to the above-mentioned study. In addition to body weight, height and BMI of the person were also found to be positively correlated with the weight of the thyroid gland. Present study showed positive correlation between BMI and weight of thyroid gland.

Mortenson et al,[10] (1955) observed that average weight of normal thyroid gland depends almost entirely on the age of the patient and is not consistently affected by sex. Present study also showed the same result. Gender was not significantly affecting the weight of thyroid gland in the study population. Similar observation was also made by Narongchai duo,[11] (2008), who studied weight of different organs in Thai population. Specimens from 269 males and 230 females were included in that study. They found that mean weight of thyroid gland shows no difference in either sex.

Harjeet et al,[12] (2004) studied 210 cadaveric thyroid glands in Chandigarh zone of northwest India and found the mean weight of thyroid gland as 15.01±7.69 gm in males and 13.16±5.64 gm in females. Gender and age wise difference found statistically insignificant. In present study mean weight in males was 17.26±5.28g and in females was 15.54±5.65g and the sex wise difference was statistically insignificant but age wise difference was found significant.

The value obtained for mean weight of thyroid gland in this study was almost similar to the value obtained Snyder et al,[13] (1973), he reported the weight of the gland to be 17.5±6.8g in males and 14.9±6.7g in females.

Length, width and thickness of lobes

Gross measurements of thyroid gland were taken in this study. Mean length, width and thickness of right lobe was 4.37±0.56cm, 2.01±0.4cm and 1.96±0.39cm respectively and that of left lobe was 4.14±0.61cm, 2.02±0.41cm and 1.73±0.38cm respectively. Most of these measurements did not show any age-related changes. Previous studies also show comparable results.

O. Tanriover et al,[9] (2011) demonstrated mean length, width and thickness of right lobe 5.26±0.96, 2.97±0.77, 2.39±0.54 and that of left lobe were 5.21±1.03, 2.9±0.71 and 2.33±0.55cm respectively, which was slightly higher than the result obtained by this study. But Thimmiah Prakash et al,[14] in 2012 obtained values closer to this study. He reported that mean length, width and thickness of right lobe was 4.43, 2.54 and 1.69cm and that of left lobe was 4.21, 2.63 and 1.7cm respectively. Laxmi et al,[15] (2023) reported average length and thickness of right lobe 4.96 and 1.53cm and that of left lobe 4.48 and 1.45cm respectively.

Volume of thyroid gland

In the present study the volume of thyroid gland was found to be positively correlated with weight of the person, height and body mass index (BMI) of the person but volume of thyroid gland did not show any correlation with age.

In this study thyroid gland volume was measured by adding the volume of each lobe. Volume of a lobe = length X width X thickness X correction factor (0.479). Mean volume calculated by this method,[3] was 15.49±5.9 ml. This value is less than the thyroid volume obtained by Hegedus et al,[16] (18.6±4.5 ml) and slightly higher than the volume obtained by Yokoyama et al,[17] (13.4±4.1 ml). Mean thyroid volume observed by Nikhil et al [28] was only 7.48±2.22ml may be because they included 100 students between 17-24 years for their study. But similar to present study they also noticed the significant relation between volume of gland and anthropometric parameters of the individual.

In 1953 Hegedus et al,[16] by using ultrasonic scanning technique noticed that thyroid volume was significantly correlated with both body weight and age and the influence of body weight on thyroid volume was 3 times that of age. Similar to this observation volume of thyroid showed positive correlation with weight of the person in the present study but not with age.

In 1974 Roberts et al,[18] observed that during first 20 years of life the volume of the thyroid gland rises in a linear fashion. With senescence the volume of the gland becomes reduced. Similar observation was made by Brown et al,[19] (1986), the volume increases with age during childhood and adolescence, remains stable in young adults, and declines in older subjects. Olbricht et al,[20] (1833) conducted echographic study on 542 persons in Germany. Volume of thyroid gland in male was found to be 16.7ml in males and 13.5ml in females. He observed the sex difference as significant. But the present study did not show significant difference in volume of thyroid gland with gender.

Pyramidal lobe: Prevalence of pyramidal lobe in this study group was 36%. Majority, 50% of pyramidal lobe arises from left lobe [Figure 4] of thyroid gland, 31% from the right lobe [Figure 3] and pyramidal lobe was attached to isthmus in the median plane in 19% of specimens [Figure 5]. Joshi et al,[21] (2010) from India reported that pyramidal lobe was present in 37.77% cases and found that 47.05% arose from left lobe. This result is very much similar to the present study. Vidya et al,[22] (2019) noted pyramidal lobe in 22.5% of cases and Laxmi et al,[15] (2023) in 32.14%. Other studies show higher incidence of pyramidal lobe than the present study. Zivic et al,[23] (2011) reported 61%

pyramidal lobes in 100 thyroid surgeries and Kim et al,[24] (2014) reported a prevalence of 59.8%. Gurleyik et al,[25] (2015) observed the incidence of pyramidal lobe in 65.7% of patients. Base of pyramidal lobe located in isthmus in 52.3%, left lobe in 29.4% and right lobe in 18.3%. But present study showed higher incidence left pyramidal lobe than median pyramidal lobe. Hollinshead,[26] underlined that as the pyramidal lobe is a common occurrence surgeon should examine anterior neck carefully during surgery, otherwise it can cause recurrence of disease after surgery.

Isthmus of thyroid gland: Isthmus was absent in 3% specimens in the present study [Figure 6]. Similarly, O.Tanriover,[9] (2011) observed absent isthmus in 2.22% cadavers during midline dissection. Thimmiah Prakash et al,[14] (2012) noticed higher incidence of absent isthmus about 9.6% in male and 5.6% in female cadavers. Braun et al,[27] (2007) also noticed that isthmus did not exist in 4 cases out of 48 cadavers studied (6.89%). Similarly, Harjeet et al,[12] (2004) observed failure of isthmus to fuse in the midline in 7.9% cases in study conducted in Northwest Indians. Vidya et al,[22] (2019) noted absent isthmus in 6.7%. Joshi et al,[21] (2010) observed that isthmus was absent in 16.66% of their cases which is much higher than the prevalence of absent isthmus in the present study.

CONCLUSION

There was a significant difference in mean weight of thyroid gland in different age groups. It was lowest in ≤20 years (11±4.7g) and became 17.64±6.4g in 20-40 age group and maximum weight noticed in 41-60 age group (18.13±5.5g). There was a reduction in mean weight of thyroid gland after 60 years (15.55±5.2g). Mean weight of thyroid gland in the entire study population was 17.04±5.33g. Weight of thyroid gland showed significant positive correlation with BMI, weight and height of the person. But it did not show significant difference with gender of the person.

Mean volume of thyroid gland in the study population was 15.49±5.9ml. It didn't show any significant correlation with age but shows significant positive correlation with BMI, weight and height of the person.

Incidence of absent isthmus was 3% in the study specimens. Pyramidal lobe observed in 36% of specimens of which majority was in left side (18%). Incidence of right pyramidal lobe was 11% and in rest 7% had pyramidal lobe in the median plane. Hence surgeon should examine anterior neck carefully during surgery, otherwise it can cause recurrence of disease after surgery.

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