NORMAL THYROID VOLUME BY ULTRASONOGRAPHY IN HEALTHY CHILDREN

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ABSTRACT

Purpose: *The objective of this study was to standardize thyroid gland volume measured by ultrasonography in 0-16 age group of children.* ***Methods:*** *Thyroid volumes of 302 healthy children (150 males, 152 females) in the age group of 0-16 years were measured. Transverse (x), sagittal (y), and anteroposterior (z) lengths of right and left lobes and isthmus were measured and then their volumes were calculated with elipsoid formula ($V = (\pi/6).x.y.z$). Volumes of two lobes and isthmus were added to each other in order to get thyroid gland volume. For statistical analysis Kruskal Wallis and student t tests were used.* ***Results:*** *The cases were divided into six and eight groups in respect of age and height. Volumes of thyroid measured in age groups were: 1.8 ± 0.7 cm^3 in 0-2 years, 2.9 ± 0.6 cm^3 in 3-5 years, 3.6 ± 1.2 cm^3 in 6-8 years, 4.8 ± 1.5 cm^3 in 9-11 years, 9.6 ± 5.7 cm^3 in 12-14 years and 12.8 ± 5.8 cm^3 in 15-16 years. Volumes of thyroid measured in height groups were: 2.1 ± 0.8 in 99 cm and below, 3.2 ± 0.9 in 100-109 cm, 3.4 ± 0.9 in 110-119 cm, 4.4 ± 0.8 in 120-129 cm, 4.6 ± 1.8 in 130-139 cm, 5.7 ± 1.6 in 140-149 cm, 10.4 ± 5.1 in 150-159 cm, and 13.6 ± 6.6 cm^3 in 160 cm and over. The differences between these groups were statistically significant.* ***Conclusion:*** *Positive correlation was found between age and height and thyroid gland volume. Thyroid volumes in groups of 12 years and over were significantly different from the smaller age group. This difference was thought to depend on physical and endocrinological changes in adolescence.*

Key Words: *Thyroid Volume, Healthy Children, Ultrasonography.*

INTRODUCTION

True measurement of thyroid gland size is important in examination of the thyroid and evaluating pathologies of the thyroid gland. The size of the thyroid can be determined by palpation, scintigraphy or ultrasonography (US). Today ultrasound (US) and scintigraphy are used in examining the adult thyroid gland (1-3). Due to the risk of radiation in determining the size, localisation and function of thyroid glands of children, isotopic investigation is not suggested. The reliability of palpation especially in children is low. Therefore US is the most useful method in determining the thyroid gland size in children (4). In addition, US can be used succesfully in examining the cystic or solid lesions of thyroid and in distinguishing extrathyroidal or intrathyroidal lesions (3, 5, 6). The aim of this

study was to form a standard by measuring the normal thyroid gland volumes of the healthy children.

MATERIAL AND METHODS

Thyroid volume measurements of 302 children (150 males, 152 females) in the 0-16 year age group were made. None of the children had any thyroid pathology. Age, height and weight of the cases were recorded. The ultrasonographic evaluation was made by GE Radius and Hitachi-515EUB ultrasounds with the 7.5 MHZ linear probe. The children were told to lie in the supine position with hyperextension of the neck. Transverse (x), anteroposterior (y) and sagittal (z) lengths of the right lobe, left lobe and isthmus were measured and the volumes were calculated by the ellipsoid formula ($V=(\pi/6).x.y.z$). The volumes of the two lobes and the isthmus were added together and thyroid gland volumes were found. Cases were classified into six groups (0-2, 3-5, 6-8, 9-11, 12-14, 15-16) and eight groups (...-99, 100-109, 110-119, 120-129, 130-139, 140-149, 150-159, 160-...) according to age and height respectively. In males and females the thyroid volumes were evaluated statistically with the correlation of age and height. In the statistical evaluation the variance analysis of Kruskal Wallis and Student t test were used.

RESULTS

Mean thyroid volume and the mean body weight were found to be statistically different among the age groups. There were significant differences in the age groups of 12 and above with respect of the other groups. The volume of the thyroid gland was different statistically among the height groups. In table I-VI and figure 1-2 thyroid volumes are seen measured with respect to age and height There was a statistically significant positive correlation between the thyroid volume and age, height and weight.

DISCUSSION

Accurate knowledge about the size of the thyroid gland is important in following the

Table 1: Mean weight and mean volume with respect to age.

AGE (YEARS)	CASE	WEIGHT (KG)	VOLUME (mm^3)	RANGE (mm^3)
0-2	41	10.1 ± 2.2	1782 ± 729	329-3999
3-5	55	17.2 ± 3.3	2892 ± 646	870-4561
6-8	54	21.6 ± 3.8	3656 ± 1174	1744-6445
9-11	60	28.7 ± 7.5	4768 ± 1511	3003-8705
12-14	54	42.5 ± 9.5	9608 ± 5756	3074-25264
15-16	38	51.3 ± 6.7	12860 ± 5770	5450-30956

For the volume: $F=75.2$, $P<0.0001$ For the weight: $F=282.1$, $P<0.0001$

Table 2: Thyroid volume with respect to age in males.

AGE (YEARS)	CASE	WEIGHT (KG)	VOLUME (mm^3)	RANGE (mm^3)
0-2	23	9.9 ± 1.3	1829 ± 656	512-2858
3-5	27	18.0 ± 3.5	2793 ± 584	870-3674
6-8	29	22.9 ± 4.1	4022 ± 1080	2009-6445
9-11	27	31.3 ± 7.0	5216 ± 1585	3429-8705
12-14	27	43.5 ± 10.0	11953 ± 7025	3470-25264
15-16	17	55.5 ± 6.0	14922 ± 7322	6036-30956

For the volume: $X^2=120.2$, $P<0.0001$ For the weight: $X^2=129.9$, $P<0.0001$

Table 3: Thyroid volume with respect to age in females.

AGE (YEARS)	CASE	WEIGHT (KG)	VOLUME (mm^3)	RANGE (mm^3)
0-2	18	10.5 ± 3.0	1723 ± 829	329-3999
3-5	28	16.4 ± 3.0	2988 ± 697	1766-4561
6-8	25	20.2 ± 2.8	3231 ± 1155	1744-6207
9-11	33	26.5 ± 7.3	4400 ± 1363	3003-8703
12-14	27	41.5 ± 9.1	7263 ± 2603	3074-15514
15-16	21	47.9 ± 4.9	11191 ± 3486	5450-17783

For the volume: X^2=113.2, P<0.0001 For the weight: X^2=130.2, P< 0.0001

Table 4: Mean volume with respect to height.

HEIGHT (cm)	CASE	VOLUME (mm^3)	RANGE (mm^3)
- 99	65	2063 ± 806	329 - 4361
100 - 109	31	3185 ± 862	2293 - 6207
110 - 119	33	3375 ± 884	2009 - 5498
120 - 129	33	4418 ± 754	3405 - 6840
130 - 139	36	4624 ± 1769	1962 - 8703
140 -149	30	5724 ± 1644	3884 - 8705
150 - 159	35	10394 ± 5073	3075 - 23149
160 -	39	13619 ± 6560	3883 - 30956

F=68.1, P< 0.0001

Table 5: Thyroid volume with respect to height in males.

HEIGHT (cm)	CASE	VOLUME (mm^3)	RANGE (mm^3)
- 99	30	1901 ± 653	512-2875
100 - 109	14	2918 ± 369	2366-3674
110 - 119	19	3519 ± 942	2009-5498
129 - 129	18	4631 ± 841	3429-6840
130 - 139	18	4420 ± 1238	2327-7519
140 - 149	15	6101 ± 1730	3948-8705
150 - 159	15	12564 ± 5966	6072-23149
160 -	21	16368 ± 7178	6036-30956

X^2=128.2, P< 0.0001

Table 6: Thyroid volume with respect to height in females.

HEIGHT (cm)	CASE	VOLUME (mm^3)	RANGE (mm^3)
- 99	35	2201 ± 903	1328-3346
100 - 109	17	3405 ± 1080	2344-6207
110 - 119	14	3181 ± 789	2009-3000
120 - 129	15	4162 ± 558	3819-5202
130 - 139	18	4828 ± 2196	3023-7048
140 - 149	15	5348 ± 1518	3884-6102
150 - 159	20	8766 ± 3651	3075-15514
160 -	18	10412 ± 3921	6776-13801

X^2= 102.6, P< 0.0001

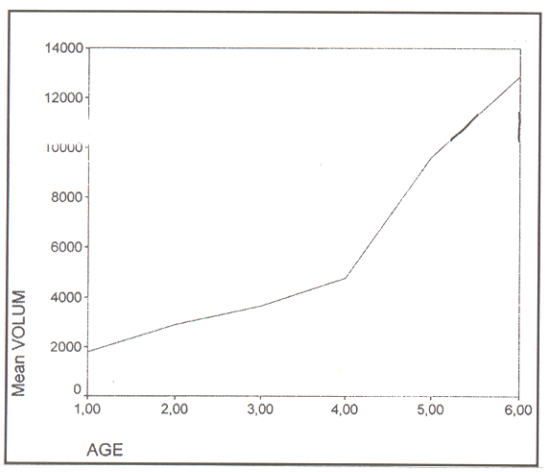

Fig. 1: The relationship between age groups and the mean volume.

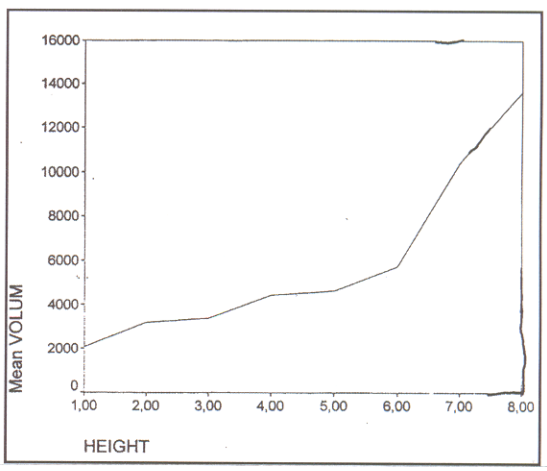

Fig. 2: The relationship between height and the mean volume.

thyroid diseases and the examination of the gland. Observation of the efficiacy of the therapy in goitre is one of the most useful indicators for the prognosis of hyperthyroidism. However, in diffuse thyroid diseases the value of US may be limited (7-10).

Because it is a simple, non-invasive and useful method, thyroid palpation is used in epidemiologic studies. Although it is a reliable method for adults, it is not suitable for children and newborns. While its sensitivity in adults in 91%, this rate decreases to 63.5% for children (4). Ultrasonographic thyroidal evaluation is advocated as a non-invasive and a simple method. This is a highly reliable method for children and newborns. By employing ultrasound, the volume of the thyroid can be calculated, the echogenity of the thyroid can be evaluated and the pathologies can be diagnosed (11,12).

In the evaluation of thyroid volume, measurement of the thickness of one lobe with multiple regresion analysis may be a single and simple method, but the rate of reliability is low. Although we can measure the gland volume from two dimensions, in order to know the true volume we must to know the nine dimensions (3).

In several studies the thyroid volumes of children taller than 160 cm are reported to be

similar to adults' volumes. In addition, thyroid gland volumes of subjects taller than 130 cm are reported to be changed because of physical and endocrinological changes in adolescence (2, 3, 11).

In our study thyroid gland volumes of children taller than 160 cm were found to be similar to the adults' volumes. In the height group there was a statistical difference between cases taller than 150 cm and shorter than this limit. Similarly, children aged 12 and older were found to be statistically different from the younger groups. These differences may be the result of the physical and endocrinological changes.

Comparison of our results with those of a similar study made by Kurtoğlu et al. (14) in the Kayseri region, showed no significant difference for the thyroid volumes of the same age groups.

No difference is reported in thyroid gland volumes of male and female children of the same age and height groups (1). Similarly, in our study mean values of both sexes at the same age and height groups were analysed by student t test and no statistical difference was found ($t=1.75$, $p>0.05$).

A positive correlation between thyroid volume and body weight, height and age was reported in different studies (1, 3). A similar positive correlation between thyroid volume and age, height and weight was found in our study ($r=0.69$ $p<0.0001$, $r=0.69$ $p<0.0001$, $r=0.80$ $p<0.0001$).

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