

Influence of Cigarette Smoking on Thyroid Gland Volume: An Ultrasonographic Approach

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Abstract: The aim of the present prospective study was to investigate the influence of smoking on ultrasonographically determined thyroid gland volume and echo-texture in a large randomly selected group of 500 healthy subjects of both sexes from a non-iodine deficient area.

An accurate ultrasonographic technique and the Brunn method were used to determine the thyroid volume of each volunteer. The examiners had no idea of the smoking habits of the volunteers.

In 257 non-smokers the mean value of the right thyroid lobe volume and the left thyroid

lobe volume were 7.97 ± 5.27 ml and 6.94 ± 4.82 ml respectively, whereas they were found to be 8.68 ± 5.97 ml and 7.03 ± 3.05 ml respectively in 243 smokers. Thyroid gland volume was higher in male and female smokers than in non-smokers ($p > 0.05$).

Smoking does not present a significant heightening effect on mean thyroid gland volume in smokers and has no influence on the echogenicity or echo-texture of the thyroid gland.

Key Words: Thyroid, Thyroid gland volume, Smoking, Ultrasonography

Radiology Clinic, Ankara Research and Training Hospital, Ankara - Turkey

Introduction

The harmful effects of smoking on various organs and systems have become the subject of an ever increasing number of investigations lately. These investigations have been concentrated on the pulmonary and cardiovascular systems, which are directly affected by smoking. Ischemic heart disease and lung cancer are the most widely recognized lethal complications.

The effects of smoking on the thyroid gland were studied by several investigators. Nevertheless, these studies mainly concentrated on basic laboratory parameters and Graves'disease (1-3). Several studies have shown that cigarette smoking is associated with increased thyroid gland volume (4,5). In contrast, other publications could not demonstrate any significant difference in thyroid volume between smokers and non-smokers (6,7).

The aim of the present study was to investigate the correlation between smoking and thyroid gland volume and echo-texture, which was determined by ultrasound in a large (500 volunteers) randomly selected group of healthy subjects of both sexes from a non-iodine deficient area.

Materials and Methods

Sonographic examinations of the thyroid gland were performed in 500 healthy employees and their relatives in our hospital (295 female, 205 male). Of 500 healthy volunteers, 243 smokers (109 female, 134 male) had been smoking more than 15 cigarettes daily for more than 5 years and 257 non-smokers (186 female, 71 male) had not smoked at all for the last 5 years. Intermediate smokers smoking less than 15 cigarettes daily were not included in this study.

Age, height, weight, family history of any thyroid disease, histories of diabetes mellitus, chronic kidney disease and acute hepatitis, country of origin, smoking habits, drinking habits, and medication taken were recorded for each patient. These interviews were carried out before the volume of the thyroid gland was determined. The radiologist (ÖK) performing the ultrasonographic scanning had no knowledge of prior investigations, including smoking habits.

Women were examined ultrasonographically in the first half of the menstrual cycle as different volume values in the two phases of the menstruation period were revealed due to the effect of female sex hormones (8). All volunteers were examined in the winter over three

months taking into consideration Hegedus' article that suggested seasonal variation in thyroid gland volume (9). Individuals originally from the Black Sea region, known to be an iodine deficient area, were excluded from this study.

Thyroid gland volume for each subject was determined ultrasonographically using the Toshiba Tosbee scanner (Japan) and a 7.5 MHz linear transducer focused at 1-3 cm. All examinations were performed in our radiology department and interpreted by the same radiologist. The subjects were examined in the supine position with hyperextended neck and skin covered by acoustic gel. Longitudinal and transverse scans were performed, allowing the measurement of the depth, width and length of each lobe. The volume of each lobe was calculated by the Brunn method (length x thickness x width x 0.479 in mm) (10). The width and thickness of each lobe were measured from the largest transverse section. Total thyroid volume was the sum of both lobes, and the isthmus was not included (7,11). In the literature, in those cases where the isthmus could not be measured, the calculation is based on the estimation of its volume being 5% of the volume of the lobes (11). In this study, isthmus exclusion is preferred to avoid differences and difficulties due to its anatomic location. Additionally, echogenicity was classified as homogeneous or heterogeneous and as increased or decreased when identified. Echo-texture was classified as nodules and/or cysts, or otherwise normal.

Statistical analyses were performed using Student's t test for unpaired data (tested with the Kolmogorov-Smirnov test), and Pearson's correlation test. The Chi-square test was used to compare frequencies and $p < 0.05$ was considered statistically significant.

Results

The 500 healthy subjects were divided into four groups according to smoking habits and sex. Smokers (mean: 63.2 kg) had a lower body weight than non-smokers (mean: 64.5 kg). Female smokers (mean: 34.0 years) were slightly older than male smokers (mean: 32.4 years). Values for body weight were in correlation with values for thyroid gland volume in both male and female subjects ($p < 0.05$).

Thyroid gland volume was higher in male and female smokers than in non-smokers ($p > 0.05$) (Table 1). In 257 non-smokers, the mean values of the right thyroid lobe volume and the left thyroid lobe volume were 7.97 ± 5.27 ml and 6.94 ± 4.82 ml respectively whereas they were 8.68 ± 5.97 ml and 7.03 ± 3.05 ml for males and females respectively in 243 smokers.

P values referring to differences in mean values between smokers and non-smokers of the same sex were 0.17 for the right lobe, 0.82 for the left lobe and 0.34 for total thyroid gland volume (Table 2). Among 243 smokers 16 had heterogeneous thyroid gland

	Number	Age	Body weight(kg)	Thyroid Volume(ml).
Female smoker	109	34.0	58.0 •	15.25 ± 9.41 *
Female Non-smoker	186	28.0	62.1	14.55 ± 8.52 *
Male smoker	134	32.4	67.4 •	16.13 ± 9.00 *
Male Non-smoker	71	34.5	71.0	15.38 ± 8.61 *

* $p > 0.05$, • $p < 0.05$

Table 1. Age, body, weight, thyroid gland volume in smokers and non-smokers (mean values are presented).

Smoking	Positive	Negative	p values
Right V	8.68 ± 5.97 ml	7.97 ± 5.27 ml	0.17
Left V	7.03 ± 3.05 ml	6.94 ± 4.82 ml	0.82
Total V	15.72±7.80 ml	14.91 + 9.57 ml	0.34

Table 2. Right lobe volume, left lobe volume and total thyroid gland volume in smokers and non-smokers (mean).

parenchyma and nine had nodules and/or cysts. Among 257 non-smokers 15 had heterogeneous thyroid gland echogenicity and 10 had nodules and/or cysts. In statistical analysis, the Chi-square test was used to compare values between the groups and $p < 0.05$ was considered statistically significant.

In this study, when smokers and non-smokers were evaluated, the correlation between smoking and ultrasonographically determined thyroid gland volume, although positive, did not reach statistical significance ($p > 0.05$). The difference in the prevalence of abnormal echogenicity and echo-texture was found to be insignificant separately ($p > 0.05$).

Discussion

Inspection and palpation are the traditional methods used to examine the thyroid gland, especially when thyroid disease is suspected. Although previous studies (12) have suggested that the presence of clinically detectable goiter is not always associated with increased thyroid volume, studies of the accuracy of clinical thyroid size estimation are sparse. Ultrasonographically determined thyroid size accuracy estimates thyroid volume in vivo (13,14).

Christensen et al. (1984), in a study with middle-aged women, found a significant difference in the frequency of goiter between smokers and ex-smokers, but not between smokers and people who had never smoked (1). The method they used for the evaluation of thyroid size was palpation.

Hegedus et al. (1983) found a correlation between thyroid gland volume determined by ultrasound and body weight (8), as in this study. Hegedus et al. (1985) found a significant correlation in a study on a randomly selected group of 219 subjects. They found that thyroid gland volume and frequency of goiter are increased in cigarette smokers by using an accurate ultrasonographic technique (4). They explained their findings citing Christensen, who had evaluated thyroid size by palpation and the increase of thyroid gland volume and iodide deficiency by inhalation of thiocyanate (15).

Nevertheless, Fexa and Nemeč (1990) reported that there was no definite proof of the effect of smoking on thyroid gland volume and precise ultrasonographic measurements had not proven a correlation between the volume of the thyroid gland and basic laboratory parameters (16).

In view of the increasing suggestion of an effect of cigarette smoking on thyroid disease Berthelsen and Hegedus (1994) investigated thyroid hormones and thyroid stimulating hormones receptor autoantibodies in relation to smoking habits in healthy subjects. No difference between smokers and non-smokers could be demonstrated. They also stated that smokers had a higher frequency of goiter and thyroglobulin levels, especially in iodine deficient areas (17).

Georgiadis et al. (1997), in a study where subjects with a family history of goiter in first degree relatives were excluded from the statistical analysis, demonstrated that the differences between smokers and non-smokers, in both sexes, regarding the mean ratio thyroid volume/weight as well as where the serum level of TSH has disappeared (6) are in agreement with a recent study which did not find any correlation between thyroid volume and smoking habits (7). No separate study has elucidated the effects of cessation of smoking on thyroid gland volume in the literature.

Our study does not support the assumption that smoking increases thyroid gland volume. Using an accurate ultrasonographic technique in 500 healthy Turkish volunteers we have concluded that thyroid gland volume did not increase in smokers significantly. No difference in the prevalence of abnormal echogenicity and echo-texture (nodules and cysts) between smokers and non-smokers was detected. To our knowledge, no equivalent study has been done in any Mediterranean country that has similar eating habits and climate conditions to compare our results with.

Corresponding author:

Fatma Gül AKSOY

Gül Sokak 5/4, Cebeci 06340 Ankara, Turkey

E-mail address: fgaksoy@hotmail.com

References

1. Christensen, SB. B, Ericson, UB, Janson L, Tibblin S, Melander A. Influence of cigarette smoking on goiter formation, thyroglobulin and thyroid hormone levels in women. *J Clin Endocrinol Metab* 58: 615-618, 1984.
2. Melander A, Nordenskjöld E, Lundh B, Thorell J. Influence of smoking on thyroid activity. *Acta Med Scand* 209:41-43, 1981.
3. Sepkovic DW, Haley NH, Wynder EL. Thyroid activity in cigarette smokers. *Arch Intern Med* 144: 501-503, 1984.
4. Hegedus L, Karstrup S, Veiergang D, Jacobsen B, Skovsted L, Feldt-Rasmussen U. High frequency of goitre in cigarette smokers. *Clin Endocrinol (Oxf)* 22:287-292, 1985.
5. Ericsson U-B and Lindgarde F. Effects of cigarette smoking on thyroid function and the prevalence of goitre, thyrotoxicosis and autoimmune thyroiditis. *J Intern Med* 229: 67-71, 1991.
6. Georgiadis E, Papapostolou, Korakis T, Evagelopoulou K, Mantzoros, Batrinos M. The influence of smoking habits on thyroid gland volume: an ultrasonic approach. *J R Soc Health* 117(6): 355-358, 1997.
7. Gomez JM, Maravall FS, Gomez N, Guma A, Soler J. Determinants of thyroid volume as measured by ultrasonography in healthy adults randomly selected. *Clin Endocrinol (Oxf)* 53: 629-634, 2000.
8. Hegedus L, Perrild H, Poulsen LR, Andersen JR, Holm B, Schnohr P, Jensen G, Hensen JM The determination of thyroid volume by ultrasound and its relationship to body weight, age and sex in normal subjects. *J Clin Endocrinol Metab* 56: 260-263, 1983.
9. Hegedus L, Rasmussen N, Knudsen N. Seasonal variation in thyroid size in healthy males. *Horm Metab Res* 19(8): 391-392, 1987.
10. Brunn JB, Ruf G. Volumetrie der schild drusen lappen mittels realtime sonographie. *Dtsch Med Wochenschr* 106: 1338-1340, 1981
11. Szebeni A, Belezny E. New simple method for thyroid volume determination by ultrasonography. *J Clin Ultrasound* 20: 329-337, 1992.
12. Berghout A, Wiersinga WM, Smits NJ, Touber JL. The value of thyroid volume measured by ultrasonography in the diagnosis of goitre. *Clin Endocrinol(Oxf)* 28:409-414, 1988.
13. Jarlov AE, Hegedus L, Gjørup J, Hansen JEM. Accuracy of the clinical assessment of thyroid size. *Dan Bull Med* 38:87-89, 1991.
14. Gonczi J, Szabolcz I, Magyar E. Sonographic volumetry of the thyroid. *Aktuelle Radiol* 3 (5): 283-285, 1993.
15. Hegedus L. Thyroid size determined by ultrasound: Influence of physiological factors and non-thyroidal disease. *Dan Med Bull* 37 (3): 249-263, 1990.
16. Fexa J, Nemeč J. Normal thyroid gland volume and factors which affect it under physiologic conditions. *Cas Lek Cesk* 129 (4): 109-112, 1990.
17. Berthelsen JB, Hegedus L. Cigarette smoking and the thyroid. *Thyroid* 4 (3): 327-331, 1994.