

Influence of cigarette smoking on serum TSH concentration

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Objective: To evaluate the influence of cigarettes smoking on serum TSH concentrations.

Methodology: This cross sectional study included 275 patients with no history of thyroid disorder. There were 190 smokers and 85 non-smokers. The study was conducted in Prince Ali Military Hospital in Al-Karak, Jordan from September 2014 to February 2015. Blood samples were collected for serum TSH, free T4 and free T3 measurements. All statistical analysis was performed using SPSS for windows 20.0.

Results: Serum TSH concentrations were significantly lower in the smokers in comparison with non-smokers (2.26 ± 0.89 $\mu\text{IU/ml}$ Vs

2.87 ± 0.74 $\mu\text{IU/ml}$ ($p=0.029$). The mean serum free T4 and free T3 concentrations were significantly higher in smokers (1.42 ± 0.67 Vs 1.13 ± 0.56 ng/dl ($p=0.039$) and 2.75 ± 0.97 Vs 2.32 ± 0.66 pg/ml ($p=0.041$), respectively.

Conclusion: We found that smokers had lower TSH and higher free T4 and free T3 levels when compared to non-smokers. Therefore, it seems that it should be taken into consideration when evaluating and treatment of subjects with subclinical hypothyroidism. (Rawal Med J 201;41:407-409)

Key words: Hypothyroidism, Graves's disease, euthyroid, cigarettes smoking, TSH.

INTRODUCTION

Cigarettes' smoking has been found to harm nearly every body organs and organs system. It is a leading cause of cancer and death from cancer and causes cancers of the lung, esophagus, larynx, mouth, throat, kidney, bladder, liver, pancreas, stomach, cervix, colon, and rectum, as well as acute myeloid leukemia.¹⁻³ Smoking causes heart disease, stroke, aortic aneurysm, chronic obstructive pulmonary disease (COPD), diabetes, osteoporosis, rheumatoid arthritis, age-related macular degeneration, and cataracts, and worsens asthma symptoms in adults. In addition, it causes inflammation and impairs immune function.¹

Smoking has complex effects on endocrine organs, thyroid function and thyroid volume including physiologically changes in thyroid hormones and thyrotropin concentrations,⁴⁻⁷ central and peripheral anti-thyroid activities.^{8,9} Cigarette smoke contains many compounds including more than 200 toxicant or endocrine disruptors some of which may interfere with thyroid function hormonogenesis,^{10,11} or with peripheral thyroid hormone action.^{8,9} Smoking may have anti- and pro-thyroid action because of

chemical components such as thiocyanate, nicotine and benzpyrene.^{12,13}

Cigarette smoking increases the risk factors for developments of Graves's disease and Graves's opththalmopathy and thyroid multinodularity.^{14,15} However, the TSH concentrations in smoker subjects had been reported to be lower in comparison with non-smokers,^{15,16} whereas free T4 and free T3 had been reported to be higher.^{4,6,17} In recent years much attention has been focused on the association between cigarettes smoking and serum TSH levels. The current study was designed to identify whether there is any relationship cigarettes smoking and serum TSH levels patients in Jordanian adult population.

METHODOLOGY

This study was carried out on 275 patients (mean age 49.5 ± 14.2). The control group includes 50 (mean age 52.8 ± 11.2). All patients were attending the oncology clinic at in Prince Ali Bin Al-Hussein Military Hospital, Al-Karak, Jordan from September 2014 to February 2015. The members of both groups were enrolled in the study voluntarily.

Ethical Committee approval was obtained and all participants gave their written informed consent.

Venous blood samples were collected between 8:00 and 10:00 h into separated jell tubes. And were analyzed for thyroid function parameters. Serum TSH, free T4 and free T3 were measured using Cobas e 411 auto-analyzer (Roche Diagnostics GmbH, Mannheim, Germany), the corresponding Roche Diagnostics kits were used in analysis of all parameters. The normal references ranges were: TSH (0.4-4.2 μ IU/ml), free T4 (0.5-1.9 ng/ml) and free T3 (0.4-4.0 μ g/ml). Hypothyroidism was defined by TSH $>$ 4.5 μ IU/ml.

All statistical analysis were performed using SPSS for windows 20.0. Differences in mean values were analyzed using Student's t-test. *p*-value $<$ 0.05 was considered to be statistically significant.

RESULTS

Out of 275 subjects, 225(82%) were smokers and 50(18%) healthy patients. Serum TSH concentrations were significantly lower in the smokers group in comparison with non-smokers (2.26 \pm 0.89 μ IU/ ml Vs 2.87 \pm 0.74 μ IU/ ml (*p*=0.029). The mean serum free T4 and free T3 concentrations were significantly higher in smokers (1.42 \pm 0.67 Vs 1.13 \pm 0.56 ng/dl (*p*=0.039 and 2.75 \pm 0.97 Vs 2.32 \pm 0.66 pg/ml (*p*=0.041), respectively (Table).

Table. Characteristics of the both groups.

| | Smokers | Non smokers | P-value |
|--------------------------|-----------------|-----------------|---------|
| Number | 225 | 50 | 0.43 |
| Age (years) | 51.9 \pm 12.6 | 46.7 \pm 18.7 | 0.035 |
| BMI (kg/m ²) | 25.3 \pm 3.8 | 23.4 \pm 4.1 | 0.16 |
| Cigarettes/day | 8.9 \pm 4.8 | | |
| Serum TSH μ IU/ ml | 2.26 \pm 0.89 | 2.87 \pm 0.74 | 0.029 |
| Serum T4 ng/ ml | 1.42 \pm 0.67 | 1.13 \pm 0.56 | 0.039 |
| Serum T3 pg/ ml | 2.75 \pm 0.97 | 2.32 \pm 0.66 | 0.041 |

Nonsmokers were younger and had lower BMI than smokers, serum TSH levels were lower 0.4 mIU/ ml in smoker subjects in comparison with nonsmokers.

DISCUSSION

Cigarette contains as many as 4000 chemical constituents and its composition may vary

substantially. At least 200 toxic compounds have been identified in cigarette smoke that may affect directly the thyroid function, such as aromatic amines, nitroso compounds and polycyclic aromatic hydrocarbons.⁹ Thiocyanate, a major component of smoke, derived from hydrogen cyanide, leads to increased excretion of iodine, inhibits iodine uptake by the thyroid, competes with iodide in the organification process.¹⁹ and inhibits thyroid hormone synthesis.¹³ Thiocyanate may have both anti- and pro-thyroid actions: a pro-thyroid action in normal subjects and an antithyroid action in patients with subclinical and overt hypothyroidism. Nevertheless, it seems more likely that this dual mode of action of smoking is a result of the effects of multiple components of smoke, such as nicotine, hydroxypyridine metabolites and benzpyrenes, which may also interfere with thyroid function.^{9,10,19}

Variations in iodine intake might also modulate the response to smoking, the predominant action of smoking being antithyroid when iodine intake is low and immunogenic when it is adequate. Smoking might also alter thyroid function indirectly, either through a chronic sympathetic stimulation resulting in increased secretion of thyroid hormones or by causing immunological disturbances.⁹

We have found that the serum TSH concentrations were significantly lower in smokers than non-smokers. This is in agreement with an epidemiological study,¹⁷ from USA which included more than 15000 subjects and from Denmark which included more than 4000 subjects,¹⁵ and some other studies.^{9,16} On other hand, Muller et al found the TSH levels were similar in both groups.⁸

Also, we found that serum free T4 and free T3 levels were significantly higher in smokers when compared with nonsmokers. This is in agreement with previous studies.^{9,16} Ericsson et al found similar free T3 levels¹⁰ and Christensen et al found similar T4 levels in smokers and nonsmokers.⁴ Muller et al found the free T4 and free T3 levels were similar in both groups.⁸ This difference in findings may be due to small number included in some studies and population differences. The increase in free T4 and free T3 concentrations could be caused by different numerous toxic compounds such as nicotine, thiocyanate and benzpyrene in cigarettes.

The limitations of our study are as follows: inadequate sampling for analyzing the influence of smoking cessation in former smokers on thyroid function and difficulties of evaluation of data of females because cultural limitations in our country.

CONCLUSION

There was an association between smoking and decrease in TSH levels. This finding may help the physician in taking the correct decision in the treatments of subjects with subclinical hypothyroidism.

Author contributions:

Conception and design: Aisha Abdalhameed Alkalaileh
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