CLINICAL STUDY

EFFECTS OF FASTING AND SATIETY ON THYROID HORMONE VALUES

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SUMMARY

Aim: In our study, we thought that the thyroid hormone levels could be affected by the food and we investigated the changes that may occur in measurements made as fasting or satiety in different time zones.

Method and Materials: FT3, FT4, TSH values of 66 adult subjects included in the study were measured between 08:00 and 08:30 and the same tests were repeated 2 hours after breakfast. In order to investigate the effect of the time factor on the thyroid hormone, postprandial blood was taken at 8:00 am after breakfast at 6:00 am the next day.

Results: The FT4 levels increased and FT3 and TSH level was decreased during satiety at the same day.

Conclusion: Thyroid hormones should be checked at the same time and during fasting in the morning for each control.

Keywords: Fasting, satiety, time, thyroid hormones, diurnal rhythm

TİROİT HORMON DEĞERLERİNDE AÇLIK VE TOKLUĞUN ETKİSİ

ÖZET

Amaç: Biz çalışmamızda, tiroit hormon düzeylerinin gıdalardan etkilenebileceğini düşünerek, saatin farklı dilimlerinde aç ya da tok olarak yapılan ölçümlerde oluşabilecek değişiklikleri araştırmak istedik.

Yöntem ve Gereçler: Çalışmaya dahil edilen 66 erişkin bireyin FT3, FT4, TSH değerleri 08:00 - 08:30 saatleri arasında ölçüldü ve aynı testler kahvaltıdan 2 saat sonra tekrarlandı. Zaman faktörünün tiroit hormonu üzerindeki etkisini araştırmak için, ertesi gün sabah saat 6.00'da kahvaltı yapıldıktan sonra sabah 8'de postprandiyal kan alındı.

Bulgular: FT4 seviyeleri artmış ve FT3 ve TSH seviyesi aynı gün içinde tokluk sırasında azalmıştır.

Sonuç: Tiroit hormonları her kontrol için aynı saatte ve sabah aç olarak kontrol edilmelidir.

Anahtar Sözcükler: Açlık, tokluk, zaman, tiroit hormonları, diurnal ritm

INTRODUCTION

The thyroid gland is the largest endocrine gland located on the trachea, consisting of the right and left lobes.[1] Thyroid gland pathologies can both occur as subclinical hormonal abnormalities and can lead to conditions such as, heart disease ,mental decline, weight gain, infertility, muscle weakness that impair quality of life.[2] In the diagnosis of thyroid diseases, the determination of hormone levels is very significant. “Thyroid function test” is one of the most common hormonal assays performed in any hospital laboratory setup. Thyroid-stimulating hormone (TSH) level is dependent on free thyroid hormones. The normal state of TSH indicates that the hypothalamic pituitary-thyroid cycle is normal.[3] TSH and FT4 levels are the most important hormones secreted from the anterior pituitary gland and the thyroid gland, respectively, which are used as primary in the diagnosis of thyroid diseases.[4]

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TSH release has a diurnal rhythm, with the highest concentrations between 11.00 pm and 05.00 am and the lowest concentrations between 05.00 pm and 08.00 pm.[5] Despite continuous TSH secretion, there are no significant changes in hormone levels due to the low amplitude of the release and the long half-life of TSH.[6] Thyroid hormone levels can be affected by many factors. Previous studies have investigated the effects of external factors such as radiation, iodine insufficiency and asphyxia as well as fine needle aspiration, sonography and gland palpation on thyroid hormone levels.[7-9] It has also been reported that these hormones may be affected in the absence of sleep or after heavy exercises.[10,11] Even small changes in thyroid hormone levels are sometimes very important in the diagnosing of diseases. Therefore, standardization is essential when determining hormone levels.

The studies investigating changes in starvation and post-meal thyroid hormone levels are very few in the literature. In this study, we wanted to investigate this relationship on 60 healthy volunteers. In our hypothesis, we thought that thyroid hormone

levels could be affected by the food and the measurements should be carried out in the morning in order to be unaffected by any factors, and this type of measurement should be in our routine. In order to test this hypothesis, we evaluated FT3, FT4 and TSH levels before and after meals.

MATERIAL and METHODS

This study was conducted on volunteers working in Adana City Research and Training Hospital between January 2017 and March 2017. Sixty-six patients (30 women and 36 men, aged 25-55, mean age 35.82 ± 6.088) who were excluded from thyroid disease after head-neck examination and ultrasonography were included in the study.

This study was approved by Adana Numune Training and Research Hospital local ethics committee (2017- 34), written informed consent was obtained from the subjects. Abnormal thyroid function test results and those with thyroid disease, drug users, gastrointestinal disease, and systemic disease were excluded from the study. This study was a randomized and prospective clinical trial. First, free T3, free T4, TSH values of the volunteers were measured between 08:00 and 08.30 am in the morning after 8-12 hours fasting, and the same tests were repeated 2 hours after breakfast between 10:00-10.30 am on the same day. To investigate the effect of the time factor on the thyroid hormone, the following day, postprandial blood was taken from 46 patients at 8 am after having breakfast at 6:00 am. On 2nd day, twenty patients did not give consent for blood intake. Blood samples were taken 5 ml from antecubital veins and TSH, FT3, FT4 levels were analyzed using the Access Immunoassay System on the Backman Coulter DX 1800 hormone analyzer via chemiluminescence. We compared the fasting and postprandial values of the volunteers at different times on the same day, and the fasting and postprandial values that were measured at the same time for 2 consecutive days.

Statistical Analysis

Data obtained in this study were analyzed with SPSS 20 package software. In the statistical analysis, because TSH values weren't distributed normally the Wilcoxon test was used as the nonparametric test which is corresponding test of the paired t test and the paired two test was used for the normal distribution of FT3 and FT4. The statistical significance level was established $p<0.05$ and the confidence interval was %95.

RESULTS

We investigated the fasting and postprandial FT3, FT4, TSH levels in 66 volunteers consisting of 30 female and 36 male volunteers (mean age: 35.82 ± 6.088). The fasting and postprandial levels of serum FT3, FT4, TSH levels were shown in Table I. The FT3 level decreased from 3.38±0.36689 to 3.33±0.30363 pg/mL (normal values: 2,0-4,4 pg/ml) during satiety state, and this decrease was not statistically significant ($P < 0.068$). The FT4 level increased from 1.25±0.17492 to 1.27±0.17742 ng/dL (normal values: 0,94-1,7 ng/dl) and this increase, unlike the FT3 level, was statistically significant ($P < 0.009$). The TSH level was 2.13±1.328138 uIU/mL during fasting and 1.624±0.783916 uIU/mL (normal values: 0.27-4,2 uIU/mL) during satiety and differences were statistically significant ($P <0,001$) (Table I).

The levels of serum FT3, FT4, TSH levels fasting at 8:00 am and postprandial levels next day at the same time were shown in Table II. The FT3 level decreased from 3.3683±0.39929 to 3.1861±0.44208 pg/mL (normal values: 2.0-4.4 pg/ml) during satiety next day at 08.00 am, and this decrease was statistically significant ($P < 0.001$). The FT4 level increased from 1.2762±0.17420 to 1.4308±0.19102 ng/dL (normal values: 0.94-1.7 ng/dl) and this increase was statistically significant ($P < 0.001$). The TSH level was 2.2008±0.97649 uIU/mL during fasting and 1.8340±1.00309 uIU/mL (normal values: 0.27-4.2 uIU/mL) during satiety next day at the same time. Differences were statistically significant ($P <0,001$) (Table II).

Table I: Comparison of fasting (8:00 am) and postprandial (10:00 am) FT3, FT4, TSH Levels

	Study Groups	**Min-Max**	**Mean ± SD**
	n: 66(%)		
Age	66 (100)	25-55	35.82 ±6.088
Gender			
Male	36(55)		
Female	30 (45)		
Free T3			
Before	66 (97)	2.91-3.82	3.38±0.36689
After	66 (97)	3.16 - 3.64	3.33 ±0.30363
*P**		*0.068*	
Mean difference between pre-post levels (95% CI)		0.04455 ± 0.13572(-0.00358 / 0.09267)	
Free T4			
Before	66(97)	0.94 - 1.35	1.25± 0.17492
After	66 (97)	0.98 - 1.41	1.27±0.17742
*P**		***0.009***	
Mean difference between pre-post levels (95% CI)		-0.01612 ± 0.03315 (-0.02787 / -0.00437)	
TSH			
Before	66 (97)	1.1 -4.42	2.13 ±1.328138
After	66(97)	0.98 - 3.51	1.624 ±0.783916
*P***		***0.001***	

Mean difference between pre-post levels (95% CI)

P=** The nonparametric Wilcoxon Test was used since TSH(Before and After) weren't distribute normally

Table II: Comparison of FT3, FT4, TSH levels at 8:00 am during fasting and next day at 8:00 am during postprandial state

	Study Groups n: 36 (%)	**Min-Max**	**Mean ± SD**
Free T3			
Before	36 (100)	2.66-4.24	3.3683±0.39929
After	36 (100)	2.23 - 4.10	3.1861±0.44208
*P**		***0.001***	
Mean difference between pre-post levels (95% CI)		0.18222±0.25528(0.09585 / 0.26860)	
Free T4			
Before	36 (100)	0.94 - 1.55	1.2762±0.17420
After	36 (100)	1.11 - 1.79	1.4308±0.19102
*P**		***0.001***	
Mean difference between pre-post levels (95% CI)		-0.15467± 0.09007 (-0.18514 / -0.12419)	
TSH			
Before	36 (100)	1.22 - 5.02	2.2008 ± 0.97649
After	36 (100)	0.78 - 5.01	1.8340 ±1.00309
*P***		***0.001***	
Mean difference between pre-post levels (95% CI)		0.53476±0.66669 (0.29836 / 0.77116)	

P*= FT3, FT4 (before and after) distributed normally and therefore, the parametric paired sample T test was employed.
P=** TSH (before and after) did not distribute normally and therefore, the nonparametric Wilcoxon Test was used

DISCUSSION

Since thyroid hormone levels can be affected by many factors, the correct detection of these hormones is crucial in the diagnosis of diseases and therefore, in the determination of their treatments. Although FT3, FT4, and TSH are being the most frequently requested examinations in thyroid pathology, TSH is the most prevalent and accepted ones among these tests. TSH is a glycoprotein hormone that is released in a pulsatile manner and its release is affected by TRH and somatostatin.[12] This hormonal cycle can be affected by many factors as well as by food. In our study, we aimed to investigate the possible changes in thyroid hormone levels after fasting and postprandial, and as a consequence, we aimed to contribute providing a general standardization. In a study conducted on total of 57 patients by Nair et al., 3 groups were formed and FT4 and TSH levels during fasting and postprandial in healthy, subclinical hypothyroid and clinical hypothyroid patients were examined. They determined that FT4 values did not change, whereas postprandial TSH levels decreased significantly in all three groups.[13] Kamat et al. and Scobbo et al. reported a decrease in postprandial TSH levels in the normal population.[14,15] Since thyroid hormones could be affected by various factors and diseases, we constituted our study voluntary and healthy individuals. Thus, we aimed to find the relationship of hormones, which are very important in the detection of thyroid diseases, to the food without being affected by diseases. It was shown that there was a significant drop in postprandial TSH level in our results. A possible mechanism in this regard is that somatostatin, an inhibitory hormone that rises after meals, causes TSH suppression.[14] In our study, a significant change was detected in FT4 levels along with TSH change. While TSH value was determined to be decreased, FT4 value increased with meal.

Apart from fasting-postprandial, another factor that may affect results is the time that samples were taken. It is important that the time of the thyroid hormones should be examined due to the diurnal rhythm of the thyroid hormones. In a study conducted on total of 200 cases by Bandhopadhyay et al., hormone levels in hypothyroid, hyperthyroid, euthyroid and replacement patients from various clinics were investigated.[4] Hormone levels in a postprandial state 2 hours after breakfast were checked and a significant decrease in TSH level was found while no change in FT3 and FT4 values was observed. When the effect of diurnal rhythm on hormone level was investigated, it was reported that the diurnal rhythm-related time factor rather than the food factor was effective on the hormone. If we consider the diurnal rhythm of thyroid hormone release, it is likely that results will be affected when hormone levels are monitored at different time intervals. We, in addition to hormonal changes with meal intake, looked at the fasting and postprandial hormone levels at the same time in the same individuals to exclude the effects of diurnal release. In our study, we found that the TSH value decreased in a postprandial state. At the time, we took the fasting blood of first day and when we got the satiety blood the next day from the same individuals at the same time, we again saw a decrease in TSH levels. Thus, this results demonstrated that change with meal intake is meaningful.

In a study conducted on 198 patients, the patients were divided into 5 groups, and the thyroid hormone changes were investigated at different times and fasting and postprandial states. As a consequence of this study, the samples taken at different times as well as the intake of food can cause changes in hormone levels and it was reported that standardization must be definitely performed.[16]

Although there is still no clear data on the time that blood samples are obtained, standardization in this regard will both eliminate the ambiguity about whether the patient's blood should be taken while fasting or postprandial and will increase the accuracy of our diagnosis.

CONCLUSION

TSH values are significantly reduced after meals based on our results. Thyroid hormones should be checked at the same time and during fasting in the morning for each control. In this subject, conducting studies with more cases will contribute to the literature.

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