

Thyroid Index in Patients with Vitiligo

Khamidova Farida Muinovna, Toshev Suhrob Uktamjon ugli

Samarkand State Medical University, Samarkand, Uzbekistan

Abstract Vitiligo is a chronic autoimmune skin disorder characterized by progressive destruction of melanocytes, leading to depigmented skin lesions. Increasing evidence suggests that autoimmune thyroid diseases are among the most common comorbid conditions associated with vitiligo. Thyroid hormones, including triiodothyronine (T3) and thyroxine (T4), play an important role in regulating cellular metabolism, proliferation, differentiation, and immune homeostasis. Thyroid-stimulating hormone (TSH) regulates thyroid function via a negative feedback mechanism and serves as a sensitive marker of thyroid dysfunction. Assessment of thyroid status in patients with vitiligo is clinically relevant, as thyroid dysfunction may influence disease progression and therapeutic outcomes. For a more comprehensive evaluation of thyroid hormonal activity, an integral thyroid functional index ($TTF = T3 \times T4$) can be used.

Keywords Vitiligo, Thyroid hormones, T3, T4, TSH, Thyroid functional index, TTF, Autoimmune diseases, Hypothyroidism

1. Introduction

The thyroid gland is involved in important vital processes of the body, it regulates the process of metabolism, division and differentiation of cells in the body, and also regulates the normal functioning of the immune status of the body. The key hormones of the thyroid gland are thyroxine (T4) and triiodothyronine (T3), whose function is to enhance metabolism, synthesize proteins and regulate fat and carbohydrate metabolism. A more active form of hormones synthesized in the thyroid gland is T3, since it is formed directly in the gland itself, T4 unlike T3, is formed as a result of peripheral generation [1,3].

The thyroid gland itself is regulated by thyroid-stimulating hormone (TSH), which is synthesized in the pituitary gland. TSH balances the secretion and production of thyroid hormones through a negative feedback mechanism. This is achieved by increasing the secretion of TSH while decreasing the concentration of thyroid hormones, thereby enhancing the secretory function of the thyroid gland itself. Also, an increase in the concentration of T3 and T4 in the blood reduces the release of TSH, thereby inhibiting secretion in the thyroid gland [4,6].

Thyroid dysfunction is common in the population and can manifest as hypothyroidism or hyperthyroidism. Disruptions in normal thyroid function can impact the course of various diseases, including dermatological ones, and affect the effectiveness of treatment. Based on this, the determination of concentrations of T3, T4 and TSH is important for determining the pathogenesis and increasing the effectiveness

of treatment of diseases, including dermatological ones [2,5].

To determine the overall impact of thyroid hormones on the body, it is advisable to use a complex indicator that determines the overall impact of thyroid hormones: $TTF = T3 \times T4$ [4].

Objective of the study: Determination and comprehensive assessment of the thyroid gland condition based on the concentration of thyroid hormones and TSH by integrating the thyroid index (TTF).

2. Materials and Methods

The study involved 45 patients diagnosed with vitiligo, whose serum T3, T4, and TSH levels were measured. The studies were conducted exclusively using accepted clinical protocols and standard immunoassay and chemiluminescent methods. Statistical analysis of the data was performed using a descriptive method.

Statistical processing of the obtained results was performed using descriptive statistics. For quantitative indicators, the mean (M), standard deviation (SD), median (Me), interquartile range (Q1–Q3), and minimum and maximum values were calculated.

Standard TSH levels in the blood range from 0.4 to 4.0 mIU/L. A TSH level of 4.0 or higher can be considered a laboratory indicator of possible hypothyroidism, while a level of 0.4 or lower may indicate increased thyroid function (hyperthyroidism).

3. Results

The analysis revealed that the average triiodothyronine

(T3) level in the examined patients was 2.84 ± 0.66 , with a median of 3.03 (2.33–3.38). The minimum value was 1.45, and the maximum was 4.38. These data indicate that, on average, T3 levels were within physiological limits.

The mean thyroxine (T4) concentration was 1.36 ± 0.31 , with a median of 1.35 (1.16–1.52). The minimum and maximum T4 values were 0.88 and 2.75, respectively. Overall, T4 levels showed moderate variability and were within the reference range in most patients.

The mean thyroid-stimulating hormone (TSH) level was 2.65 ± 1.63 mIU/L, the median was 1.73 (0.96–3.48). The minimum TSH value was 0.89 mIU/L, the maximum was 5.96 mIU/L, indicating the presence of isolated cases of deviation from physiological values (Table 1).

Table 1. Main indicators of thyroid function

Indicator	n	M \pm SD	Me (Q1–Q3)	min–max
T3	45	2,84 \pm 0,66	3,03 (2,33–3,38)	1,45–4,38
T4	45	1,36 \pm 0,31	1,35 (1,16–1,52)	0,88–2,75
TSH	45	2,65 \pm 1,63	1,73 (0,96–3,48)	0,89–5,96

An analysis of the patient distribution by thyroid-stimulating hormone levels revealed that the majority of subjects (80.0%) had values within the reference range, which corresponds to a euthyroid state. Elevated TSH values (>4.0 mIU/L) were detected in 9 patients (20.0%), which may indicate decreased thyroid function and hypothyroid changes. Decreased TSH values (<0.4 mIU/L) were not detected in the study sample (Table 2).

Table 2. Distribution of patients by TSH level

Functional status	TSH level (mIU/L)	n	%
Euthyroidism	0,4–4,0	36	80
Hypothyroidism	$>4,0$	9	20
Hyperthyroidism	$<0,4$	0	0

Using the integrated thyroid function index (TTF = T3 \times T4) allowed for a comprehensive assessment of the total hormonal activity of the thyroid gland. TTF values were also within normal limits in most patients, confirming the maintenance of overall thyroid function even with isolated TSH deviations. This approach is particularly useful for assessing the functional status of patients with borderline values of individual hormones, as well as for dynamically monitoring the effectiveness of therapy.

Identified cases of subclinical hypothyroidism require clinical attention, since if left uncorrected, they can progress to the manifest form of the disease and affect metabolism, the cardiovascular system, and dermatological conditions.

A limitation of this study is the relatively small sample size, which may reduce the statistical significance of individual observations, as well as the lack of long-term follow-up to assess the dynamics of thyroid status and TTF over time. Future studies would benefit from expanding the sample size, including patients of different ages and genders, and correlating the obtained data with clinical manifestations

and comorbidities.

Thus, a comprehensive assessment of thyroid hormone and TSH levels using the integral TTF index allows for a more complete characterization of the functional state of the thyroid gland and serves as an additional tool for the early detection of subclinical disorders and clinical decision-making.

4. Conclusions

In the majority of patients examined, thyroid hormone levels (T3 and T4) were within physiological norms, and the average thyroid-stimulating hormone (TSH) level was 2.65 ± 1.63 mIU/L, corresponding to a euthyroid state. This indicates that baseline thyroid hormone activity was maintained in the majority of the sample.

Elevated TSH levels (>4.0 mIU/L) were detected in 20% of patients, which may indicate subclinical hypothyroidism. Such changes require clinical monitoring, as, if left uncorrected, they can progress to overt hypothyroidism and impact metabolic processes and overall health.

Calculating the integrated thyroid function index (TTF = T3 \times T4) allowed for a comprehensive assessment of the total hormonal activity of the thyroid gland. TTF values were within normal limits in most patients, confirming the maintenance of overall functional activity even with isolated TSH deviations.

A comprehensive laboratory assessment of thyroid status using T3, T4, TSH and TTF is an informative tool for early detection of subclinical disorders, dynamic monitoring of thyroid status and timely clinical decision-making.

To improve the accuracy of diagnosis and assessment of the functional activity of the thyroid gland, further research with an expanded sample of patients, including different age and gender groups, as well as an assessment of the relationship of TTF indicators with clinical manifestations and concomitant diseases is recommended.

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