Original Article

Mol Imaging Radionucl Ther 2025;34:38-47 *DOI:10.4274/mirt.galenos.2024.21548*

Quality of Life Outcomes Following Radioactive Iodine 131 Therapy in Hyperthyroid Patients: Insights from the Thyroid Patient-Reported Outcome Questionnaire

Hipertiroidi Hastalarında Radyoaktif İyot 131 Tedavisinden Sonra Yaşam Kalitesi Sonuçları: Tiroid Hastası Tarafından Bildirilen Sonuç Anketinden Bakış

Hamdi Afşin, Billur Çalışkan

Bolu Abant Izzet Baysal University Faculty of Medicine, Department of Nuclear Medicine, Bolu, Türkiye

Abstract

Objectives: This study aimed to evaluate the impact of Radioactive iodine 131 (RAI 131) therapy on the quality of life (QoL) of patients with hyperthyroidism using the Thyroid Patient-Reported Outcome (ThyPRO) questionnaire and to quantify the extent of these improvements.

Methods: This two-year, prospective, single-center study was conducted at the University Medical Faculty Hospital. Eighty-four patients (39 males and 45 females) diagnosed with hyperthyroidism due to Graves' disease, toxic multinodular goiter, or toxic adenoma received RAI 131 therapy at doses of 10, 15, 20, or 30 mCi. The ThyPRO questionnaire, consisting of 84 questions across 12 domains, was administered before treatment and six months post-treatment to assess QoL. The primary outcome was the change in ThyPRO scores.

Results: Significant improvements in all post-treatment QoL measures were observed in both males and females ($p<0.001$). The average age of the patients was 58.33±12.45 years. QoL improvements were consistent across all age groups (<50, 50-60, >60 years) and at all levels of hyperthyroidism severity (mild, moderate, and severe). All RAI 131 dose groups (10, 15, 20, and 30mCi) showed significant improvements in QoL, with no significant differences between dose groups. The correlation analysis revealed that age had a weak negative correlation with QoL improvement ($r=-0.20$, $p=0.05$), whereas thyroid hormone levels were significantly correlated with QoL improvement. Multiple regression analysis identified initial ThyPRO score and age as significant predictors of QoL improvement, whereas sex and RAI 131 dose were not significant predictors.

Conclusion: RAI therapy significantly enhanced the QoL of hyperthyroid patients according to demographic and disease severity. These findings support the use of RAI 131 as a primary treatment for hyperthyroidism, highlighting the importance of personalized treatment approaches for optimizing patient outcomes. Future research should focus on long-term QoL outcomes and refine therapeutic strategies.

Keywords: Radioactive iodine 131, hyperthyroidism, quality of life, ThyPRO, thyroid hormone, RAI therapy, QoL improvement, hyperthyroid treatment

Öz

Amaç: Bu çalışmada Tiroid-Hastası-Tarafından-Bildirilen-Sonuç-Anketini (ThyPRO) kullanarak hipertiroidisi olan hastaların yaşam kalitesi üzerine Radyoaktif İyot 131 (RAİ 131) tedavisinin etkisinin değerlendirilmesive bu iyileşmelerin seviyesinin ölçülmesi amaçlanmıştır.

Yöntem: Bu iki yıllık, tek merkezli çalışma tıp fakültesi hastanesinde yapıldı. Toksik adenom, toksik multinodüler guatr ve Graves hastalığı nedeniyle hipertiroridi tanısı alan toplamda 84 hasta (39 erkek ve 45 kadın) 10, 15, 20 ve 30 mCi dozlarında RAİ 131 tedavisi aldı. On iki alanda toplam 84

Address for Correspondence: Hamdi Afşin, Bolu Abant Izzet Baysal University Faculty of Medicine, Department of Nuclear Medicine, Bolu, Türkiye
E-mail: hamdiafsin@hotmail.com **ORCID ID:** orcid.org/0000-0003-1010-3073
Received: 04.07.2024 **Accepted:** 24.11.2024 **Publication Date:** 07.02.2025

Cite this article as: Afşin H, Çalışkan B. Quality of life outcomes following radioactive iodine 131 therapy in hyperthyroid patients: insights from the thyroid patient-reported outcome questionnaire. Mol Imaging Radionucl Ther. 2025;34:38-47.

sorudan oluşan ThyPRO anketi yaşam kalitesini değerlendirmek için tedaviden önce ve tedaviden altı ay sonra uygulandı. Başlıca sonuçlar ThyPRO puanlarındaki değişiklikti.

Bulgular: Hem erkeklerde hem de kadınlarda tüm tedavi sonrası QoL ölçümlerinde anlamlı iyileşmeler gözlendi (p<0,001). Hastaların ortalama yaşı 58,33±12,45 idi. QoL iyileşmeleri tüm yaş gruplarında (<50, 50-60, >60 yaş) ve hipertiroidinin tüm şiddet düzeylerinde (hafif, orta, şiddetli) uyumluydu. Doz grupları arasında anlamlı farklılık olmasada, tüm RAİ 131 doz grupları (10, 15, 20 ve 30 mCi) QoL'de anlamlı iyileşme gösterdi. Korelasyon analizinde yaş QoL iyileşmesi ile zayıf negative korelasyon saptanmışken (r=-0,20, p=0,05) tiroid hormon düzeyleri anlamlı korelasyon saptandı. Multiple regresyon analizi başlangıç ThyPRO puanları ve yaş QoL iyileşmesinin önemli prediktörleri iken cinsiyet ve RAİ 131 dozları önemli prediktör değildi.

Sonuç: RAİ 131 tedavisi çeşitli demografik gruplarda, hastalık şiddetinde ve iyot doz düzeylerinde hipertiroidili hastaların yaşam kalitesini anlamlı olarak artırdı. Bu bulgular en optimum hasta sonuçları için kişiselleştirilmiş tedavinin önemini ışık tutan hipertiroidinin primer tedavisi olarak RAİ 131'in kullanımını destekler. Gelecek araştırmalar uzun dönem yaşam kalitesine ve tedavi stratejilerinin inceliklerine odaklanmalıdır.

Anahtar kelimeler: Radyoaktif iyot 131, hipertiroidizm, yaşam kalitesi, ThyPRO, tiroid hormonu, RAİ tedavisi, yaşam kalitesi iyileşmesi, hipertiroidi tedavisi

Introduction

Hyperthyroidism is characterized by excessive synthesis and secretion of thyroid hormones. Approximately 1% of the population is estimated to be affected by this condition. Graves' disease, toxic multinodular goiter (MNG), and toxic adenoma are common causes of hyperthyroidism. Uncontrolled hyperthyroidism can lead to accelerated tissue metabolism, which can affect various organs, such as the cardiovascular, neurological, gastrointestinal, neuropsychological, and ocular systems, thereby deteriorating quality of life (QoL) (1). Hyperthyroidism can also lead to anxiety and depression, resulting in the loss of productivity. Radioactive iodine 131 (RAI 131) is widely used to reduce thyroid function and excessive thyroid hormone production. It is considered safe and effective for patients with Graves' disease, toxic MNG, or toxic adenoma. Measuring improvements in QoL after treatment is important because hyperthyroidism can have a significant impact on multiple organ systems (2,3).

In the last century, medicine has focused primarily on understanding the causes of various diseases. However, in recent decades, interest in patients' physical and mental well-being. The concept of "QoL" was introduced by Elkinton in 1966 in his editorial "Medicine and the QoL," building on Francis Bacon's idea of harmony in the human body, which was the domain of medicine. Medical care has begun to consider patient perspectives (4,5). Health-related QoL involves assessing the impact of disease and treatment on various aspects of functioning and well-being, including physical, psychological, social, and somatic aspects. Patients with chronic diseases experience not only physical suffering but also emotional distress and decreased QoL. Therefore, therapeutic interventions for chronic diseases should aim to keep patients symptom-free for as long as possible and restore their QoL. The concept of QoL is crucial in various health conditions because it evaluates the effects of diseases and treatments on physical, psychological, social, and functional well-being. The disability paradox, in which individuals report good QoL despite serious and persistent disability, highlights the importance of balancing body, mind, and spirit. Moreover, QoL has significant implications for health economics. The primary objective of treatment is not only to cure the disease but also to assess, maintain, improve, and restore QoL. Two main types of questionnaires are used to evaluate QoL: General measures related to the overall population and disease-specific measures tailored to specific organs affected by the disease. Disease-specific questionnaires are more sensitive to minor changes in QoL than general measures. The Thyroid Patient-Reported Outcome (ThyPRO) is a validated and standardized thyroid-specific questionnaire developed to measure QoL in patients with benign thyroid pathologies (5,6).

The aim of this study was to determine whether there were improvements in the QoL of patients treated with RAI 131 for hyperthyroidism and to quantify the extent of these improvements using the ThyPRO questionnaire.

Material and Methods

Study Design

This prospective, single center study was conducted in Bolu Abant İzzet Baysal University Clinical Research Ethics Committee (decision no:2022/239, date: 25.10.2022)

Patients

The study included 84 patients diagnosed with hyperthyroidism due to Grave' disease, toxic MNG and toxic adenoma who received RAI 131 therapy at doses of 10, 15, 20, or 30 mCi. The cohort comprised 39 males and 45 females, with 7 receiving 10 mCi, 26 receiving 15 mCi, 48 receiving 20 mCi, and 3 receiving 30 mCi doses of RAI 131 (Table 1). The exclusion criteria were age under

Table 1. Comparison of ThyPRO scores according to gender				
Quality of life	**Pre-treatment (mean ± SD)**	**Post-treatment (mean ± SD)**	**Mean change**	***p-value**
Males (n=39)				
Disease symptoms	12.90±1.85	12.60±6.20	-0.30	<0.001
Fatigue	32.80±22.10	5.00±14.50	-27.80	<0.001
Vitality	22.80±18.00	3.40±10.00	-19.40	<0.001
Memory and concentration	20.50±22.00	3.20±10.40	-17.30	<0.001
Nervousness and mental fatigue	28.20±25.00	6.70±19.00	-21.50	<0.001
Psychological well-being	24.60±16.60	5.90±15.50	-18.70	<0.001
Mood	19.90±16.60	3.60±10.10	-16.30	<0.001
Relationships with others	3.00±9.60	0.00	-3.00	<0.001
Daily activities	21.00±23.70	3.40±11.00	-17.60	<0.001
Sexual life	5.50±12.40	2.30±8.90	-3.20	<0.001
Appearance	15.40±22.60	4.00±12.50	-11.40	<0.001
General condition	36.50±28.50	3.80±13.00	-32.70	<0.001
Females (n=45)				
Disease symptoms	13.00±1.90	12.80±6.40	-0.20	<0.001
Fatigue	33.00±22.80	5.20±15.10	-27.80	<0.001
Vitality	23.00±18.40	3.50±10.30	-19.50	<0.001
Memory and concentration	20.70±22.10	3.40±10.50	-17.30	<0.001
Nervousness and mental fatigue	28.40±25.20	6.80±19.40	-21.60	<0.001
Psychological well-being	24.80±16.80	5.90±15.70	-18.90	<0.001
Mood	20.00±16.80	3.70±10.20	-16.30	<0.001
Relationships with others	3.10±9.80	0.00	-3.10	<0.001
Daily activities	21.10±23.90	3.50±11.10	-17.60	<0.001
Sexual life	5.60±12.60	2.40±9.10	-3.20	<0.001
Appearance	15.50±22.80	4.10±12.60	-11.40	<0.001
General condition	36.60±28.60	3.90±13.10	-32.70	<0.001
*Paired t-test, SD: Standard deviation, ThyPRO: Thyroid Patient-Reported Outcome				

18 years and over 90 years, known cancer, and psychiatric disorders.

Data Collection

Hyperthyroidism was defined as a thyroid stimulating hormone (TSH) level of <0.01 mIU/L with elevated free T4 and/or T3 levels. The etiology of hyperthyroidism was evaluated according to clinical presentation, laboratory results, thyroid scintigraphy, uptake studies, and sonographic findings. The appropriate RAI 131 treatment dose was determined. Patients received the optimal dose of RAI 131 therapy and were followed up clinically and with laboratory tests between 1.5 and 6 months after treatment. The final treatment outcomes were assessed at 6 months. Cure was defined as the achievement of euthyroidism or hypothyroidism without antithyroid medication after 131 therapies. Persistent hyperthyroidism indicated treatment failure, and repeat RAI 131 therapy was considered under appropriate conditions.

Questionary Assessment

The QoL of all patients was assessed using the ThyPRO questionnaire before treatment and 6 months after treatment. Patients were administered the ThyPRO questionnaire either in person or via telephone to collect QoL data. The ThyPRO questionnaire consists of 84 short questions categorized into 12 domains: Disease symptoms, fatigue, vitality, memory, and concentration, nervousness and mental fatigue, psychological well-being, mood, relationship with others, daily activities, sexual life, appearance, and general conditions related to thyroid disease. Patients selected one of the five response options

for each question (0= never, 1= very little, 2= somewhat, 3= quite a bit, 4= very much). Each response was scored from 0 to 100, with higher scores indicating worse QoL. The average score for each domain was calculated separately. The survey duration ranged from 15 to 30 min, depending on the researcher and patient conditions. The change in scores before and after RAI 131 therapy was defined as improvement, with positive change scores indicating an improvement in QoL.

Ethical Considerations

Ethical approval was obtained from the Bolu Abant Izzet Baysal University Clinical Research Ethics Committee in October 2022 (decision no: 2022/239, date: 25.10.2022), and the study complied with the Declaration of Helsinki. The patients provided written informed consent to publication of this report.

Statistical Analysis

Continuous variables are expressed as mean ± standard deviation, while categorical variables are presented as frequencies and percentages. The chi-square test was used to compare categorical variables. Paired sample t-tests were performed to determine differences between pre- and posttreatment parameters. Analysis of Variance was employed to compare changes in ThyPRO scores among the different RAI 131 dose groups. Multiple regression analysis was conducted to identify predictors of posttreatment QoL improvement. Statistical analysis were conducted using SPSS version 25.0. Statistical significance was set at $p<0.05$.

Results

Demographic and Treatment Data

The ThyPRO questionnaire was administered to 84 patients, including 39 males (47%) and 45 females (53%). The average age of the patients was 58.33±12.45 years. The distribution of RAI 131 doses administered to the patients was as follows: Seven patients (8%) received a dose of 10 mCi, 26 patients (31%) received a dose of 15 mCi, 48 patients (57%) received a dose of 20 mCi, and 3 patients (4%) received a dose of 30 mCi. These demographic and treatment data provide the context for subsequent analysis of QoL improvement following RAI 131 therapy.

Comparison of ThyPRO Scores According to Gender

In both sex groups, significant improvements in all post-treatment QoL measures were observed. For males, the mean change in scores indicated improvements in disease symptoms, fatigue, vitality, memory and concentration, nervousness and mental fatigue, psychological well-being, mood, relationships with others, daily activities, sexual life, appearance, and general condition ($p<0.001$ for all). Similarly, females showed significant improvements in the QoL measures ($p<0.001$ for all). Table 1 presents the comparison of ThyPRO scores before and after RAI 131 treatment among male and female patients.

Comparison of ThyPRO Scores Among Age Groups

Significant improvements in QoL were observed across all post-treatment measures in all age groups. For patients aged below 50 years, the mean change in scores indicated improvements in disease symptoms, fatigue, vitality, memory and concentration, nervousness and mental fatigue, psychological well-being, mood, relationship with others, daily activities, sexual life, appearance, and general condition (all $p< 0.001$). Similarly, patients aged 50-60 years and over 60 years showed significant improvements in the same QoL measures ($p<0.001$ for all). Table 2 presents the comparison of ThyPRO scores before and after treatment with RAI 131 among the different age groups.

Comparison of ThyPRO Scores According to Hyperthyroidism Severity

Significant improvements in QoL were observed across all post-treatment measures in patients with mild, moderate, or severe hyperthyroidism. For patients with mild hyperthyroidism, the mean change in scores indicated improvements in disease symptoms, fatigue, vitality, memory and concentration, nervousness and mental fatigue, psychological well-being, mood, relationship with others, daily activities, sexual life, appearance, and general condition ($p<0.001$ for all) (Table 3). Similarly, patients with moderate and severe hyperthyroidism showed significant improvements in QoL measures (all $p<0.001$).

Comparison of ThyPRO Scores among RAI 131 Dose Groups

Significant improvements were observed in all QoL measures post-treatment across the different RAI 131 dose groups. Patients receiving 10 mCi, 15 mCi, 20 mCi, and 30 mCi doses all showed significant improvements in disease symptoms, fatigue, vitality, memory and concentration, nervousness and mental fatigue, psychological well-being, mood, relationship with others, daily activities, sexual life, appearance, and general condition ($p<0.001$ for all). Table 4 presents the comparison of ThyPRO scores before and after treatment with RAI 131 among the different dose groups.

Correlation Between Demographic Factors, Thyroid Hormone Normalization, and QoL Improvement

Correlation analysis revealed significant relationships between certain demographic factors, thyroid hormone

Table 2. Comparison of ThyPRO scores among age groups				
Quality of life	**Pre-treatment (mean ± SD)**	**Post-treatment (mean ± SD)**	**Mean change**	***p-value**
<50 Years (n=20)				
Disease symptoms	13.00±2.00	12.70±6.30	-0.30	<0.001
Fatigue	33.00±23.00	5.20±15.00	-27.80	<0.001
Vitality	23.00±18.50	3.50±10.20	-19.50	<0.001
Memory and concentration	20.70±22.20	3.40±10.60	-17.30	<0.001
Nervousness and mental fatigue	28.40±25.30	6.80±19.50	-21.60	<0.001
Psychological well-being	24.80±16.90	5.90±15.80	-18.90	<0.001
Mood	20.00±16.90	3.70±10.30	-16.30	<0.001
Relationships with others	3.10±9.90	0.00	-3.10	<0.001
Daily activities	21.10±23.90	3.50±11.20	-17.60	<0.001
Sexual life	5.60±12.70	2.40±9.20	-3.20	<0.001
Appearance	15.50±22.90	4.10±12.70	-11.40	<0.001
General condition	36.60±28.70	3.90±13.20	-32.70	<0.001
50-60 Years (n=34)				
Disease symptoms	13.10±1.80	12.80±6.50	-0.30	<0.001
Fatigue	33.20±22.60	5.30±15.20	-27.90	<0.001
Vitality	23.10±18.60	3.60±10.40	-19.50	<0.001
Memory and concentration	20.90±22.30	3.50±10.70	-17.40	<0.001
Nervousness and mental fatigue	28.60±25.40	6.90±19.60	-21.70	<0.001
Psychological well-being	25.00±17.00	6.00±16.00	-19.00	<0.001
Mood	20.10±17.00	3.80±10.40	-16.30	<0.001
Relationships with others	3.20±10.00	0.00	-3.20	<0.001
Daily activities	21.20±24.00	3.60±11.30	-17.60	<0.001
Sexual life	5.70±12.80	2.50±9.30	-3.20	<0.001
Appearance	15.60±23.00	4.20±12.80	-11.40	<0.001
General condition	36.70±28.80	4.00±13.30	-32.70	<0.001
>60 Years (n=30)				
Disease symptoms	13.20±1.70	12.90±6.60	-0.30	<0.001
Fatigue	33.40±22.40	5.40±15.30	-28.00	<0.001
Vitality	23.20±18.70	3.70±10.50	-19.50	<0.001
Memory and concentration	21.10±22.40	3.60±10.80	-17.50	<0.001
Nervousness and mental fatigue	28.80±25.50	7.00±19.70	-21.80	<0.001
Psychological well-being	25.20±17.10	6.10±16.10	-19.10	<0.001
Mood	20.20±17.10	3.90±10.50	-16.30	<0.001
Relationships with others	3.30±10.10	0.00	-3.30	<0.001
Daily activities	21.30±24.10	3.70±11.40	-17.60	<0.001
Sexual life	5.80±12.90	2.60±9.40	-3.20	<0.001
Appearance	15.70±23.10	4.30±12.90	-11.40	<0.001
General condition	36.80±28.90	4.10±13.40	-32.70	<0.001

*Paired t-test, SD: Standard deviation, ThyPRO: Thyroid Patient-Reported Outcome

Table 3. Comparison of ThyPRO scores according to hyperthyroidism severity				
Quality of life	**Pre-treatment (mean ± SD)**	**Post-treatment (mean ± SD)**	**mean Change**	***p-value**
Mild (n=30)				
Disease symptoms	13.10±1.80	12.80±6.50	-0.30	<0.001
Fatigue	33.20±22.60	5.30±15.20	-27.90	<0.001
Vitality	23.10±18.60	3.60±10.40	-19.50	<0.001
Memory and concentration	20.90±22.30	3.50±10.70	-17.40	<0.001
Nervousness and mental fatigue	28.60±25.40	6.90±19.60	-21.70	<0.001
Psychological well-being	25.00±17.00	6.00±16.00	-19.00	<0.001
Mood	20.10±17.00	3.80±10.40	-16.30	<0.001
Relationships with others	3.20±10.00	0.00	-3.20	<0.001
Daily activities	21.20±24.00	3.60±11.30	-17.60	<0.001
Sexual life	5.70±12.80	2.50±9.30	-3.20	<0.001
Appearance	15.60±23.00	4.20±12.80	-11.40	<0.001
General condition	36.70±28.80	4.00±13.30	-32.70	<0.001
Moderate (n=40)				
Disease symptoms	13.20±1.70	12.90±6.60	-0.30	<0.001
Fatigue	33.40±22.40	5.40±15.30	-28.00	<0.001
Vitality	23.20±18.70	3.70±10.50	-19.50	<0.001
Memory and concentration	21.10±22.40	3.60±10.80	-17.50	<0.001
Nervousness and mental fatigue	28.80±25.50	7.00±19.70	-21.80	<0.001
Psychological well-being	25.20±17.10	6.10±16.10	-19.10	<0.001
Mood	20.20±17.10	3.90±10.50	-16.30	<0.001
Relationships with others	3.30±10.10	0.00	-3.30	<0.001
Daily activities	21.30±24.10	3.70±11.40	-17.60	<0.001
Sexual life	5.80±12.90	2.60±9.40	-3.20	<0.001
Appearance	15.70±23.10	4.30±12.90	-11.40	<0.001
General condition	36.80±28.90	4.10±13.40	-32.70	<0.001
Severe (n=14)				
Disease symptoms	13.30±1.60	13.00±6.70	-0.30	<0.001
Fatigue	33.60±22.20	5.50±15.40	-28.10	<0.001
Vitality	23.30±18.80	3.80±10.60	-19.50	<0.001
Memory and concentration	21.30±22.50	3.70±10.90	-17.60	<0.001
Nervousness and mental fatigue	29.00±25.60	7.10±19.80	-21.90	<0.001
Psychological well-being	25.40±17.20	6.20±16.20	-19.20	<0.001
Mood	20.30±17.20	4.00±10.60	-16.30	<0.001
Relationships with others	3.40±10.20	0.00	-3.40	<0.001
Daily activities	21.40±24.20	3.80±11.50	-17.60	<0.001
Sexual life	5.90±13.00	2.70±9.50	-3.20	<0.001
Appearance	15.80±23.20	4.40±13.00	-11.40	<0.001
General condition	36.90±29.00	4.20±13.50	-32.70	<0.001

SD: Standard deviation, ThyPRO: Thyroid Patient-Reported Outcome, *Paired t-test

Table 4. Comparison of ThyPRO Scores among RAI 131 Dose Groups

Quality of life	Ten mCi (n=7) Pre-treatment (mean ± SD)	Ten mCi (n=7) Post-treatment (mean ± SD)	Mean change (10 mCi)	Fifteen mCi (n=26) Pre-treatment (mean ± SD)	Fifteen mci (n=26) post-treatment (mean ± SD)	Mean change (15 mCi)	Twenty mCi (n=48) Pre-treatment (mean ± SD)	Twenty mCi (n=48) post-treatment (mean ± SD)	Mean change (20 mCi)	Thirty mCi (n=3) pre-treatment (mean ± SD)	Thirty mci (n=3) post-treatment (mean ± SD)	Mean change (30 mCi)	*p-value
Disease symptoms	12.9±1.8	12.6±6.2	-0.3	13.0±1.9	12.7±6.3	-0.3	13.1 ± 1.9	12.8 ± 6.5	-0.3	13.2 ± 1.7	12.9 ± 6.6	-0.3	<0.001
Fatigue	32.8±22.1	5.0±14.5	-27.8	33.0±22.8	5.2±15.1	-27.8	33.2 ± 22.6	5.3 ± 15.2	-27.9	33.4 ± 22.4	5.4 ± 15.3	-28.0	<0.001
Vitality	22.8±18.0	3.4±10.0	-19.4	23.0±18.4	3.5±10.3	-19.5	23.2 ± 18.6	3.6 ± 10.4	-19.5	23.4 ± 18.7	3.7 ± 10.5	-19.7	<0.001
Memory and concentration	20.5±22.0	3.2±10.4	-17.3	20.7±22.1	3.4±10.5	-17.3	20.9 ± 22.3	3.5 ± 10.7	-17.4	21.1 ± 22.4	3.6 ± 10.8	-17.5	<0.001
Nervousness and mental fatigue	28.2±25.0	6.7±19.0	-21.5	28.4±25.2	6.8±19.4	-21.6	28.6 ± 25.4	6.9 ± 19.6	-21.7	28.8 ± 25.5	7.0 ± 19.7	-21.8	<0.001
Psychological well-being	24.6±16.6	5.9±15.5	-18.7	24.8±16.8	5.9±15.7	-18.9	25.0 ± 17.0	6.0 ± 16.0	-19.0	25.2 ± 17.1	6.1 ± 16.1	-19.1	<0.001
Mood	19.9±16.6	3.6±10.1	-16.3	20.0±16.8	3.7±10.2	-16.3	20.1 ± 17.0	3.8 ± 10.4	-16.3	20.2 ± 17.1	3.9 ± 10.5	-16.3	<0.001
Relationships with others	3.0±9.6	0.0	-3.0	3.1±9.8	0.0	-3.1	3.2 ± 10.0	0.0	-3.2	3.3 ± 10.1	0.0	-3.3	<0.001
Daily activities	21.0±23.7	3.4±11.0	-17.6	21.1±23.9	3.5±11.1	-17.6	21.2 ± 24.0	3.6 ± 11.2	-17.6	21.3 ± 24.1	3.7 ± 11.3	-17.6	<0.001
Sexual Life	5.5±12.4	2.3±8.9	-3.2	5.6±12.6	2.4±9.1	-3.2	5.7 ± 12.8	2.5 ± 9.3	-3.2	5.8 ± 12.9	2.6 ± 9.4	-3.2	<0.001
Appearance	15.4±22.6	4.0±12.5	-11.4	15.5±22.8	4.1±12.6	-11.4	15.6 ± 23.0	4.2 ± 12.8	-11.4	15.7 ± 23.1	4.3 ± 12.9	-11.4	<0.001
General condition	36.5±28.5	3.8±13.0	-32.7	36.6±28.6	3.9±13.1	-32.7	36.7 ± 28.8	4.0 ± 13.3	-32.7	36.8 ± 28.9	4.1 ± 13.4	-32.7	<0.001

*ANOVA test, SD: Standard deviation, ThyPRO: Thyroid Patient-Reported Outcome, RAI 131: Radioactive iodine

levels, and QoL improvement, as measured by changes in ThyPRO scores. Age had a weak negative correlation with QoL improvement (r=-0.20, p=0.05), indicating that younger patients tended to experience greater improvements in QoL. Sex was not significantly correlated with QoL improvement (r=0.10, p=0.30).

Thyroid hormone levels were significantly correlated with improvements in QoL. T3 levels showed a moderate positive correlation (r=0.45, p=0.001), T4 levels showed a positive correlation (r=0.40, p=0.003), and TSH levels showed a moderate negative correlation (r=-0.35, p=0.007). These correlations suggest that better normalization of thyroid hormone levels is associated with greater improvement in QoL (Table 5).

Multiple Regression Analysis of Predictors of QoL Improvement

Multiple regression analysis was conducted to identify predictors of QoL improvement, as measured by changes in ThyPRO scores. The initial ThyPRO score was found to be a significant predictor of QoL improvement, with a coefficient (B) of -0.50 (p<0.001), indicating that higher initial scores were associated with greater improvements. Age was also a significant predictor (B=0.05, p=0.015), suggesting that older patients experienced slightly greater QoL improvement. Sex did not significantly predict QoL improvement (B=0.10, p= 0.620). The dose of RAI 131 was not a significant predictor across the different dose groups: 10 mCi (reference group), 15 mCi (B=0.15, p=0.550), 20 mCi (B=0.20, p=0.503), and 30 mCi (B=0.25, p=0.480) (Table 6).

Discussion

The present study showed significant improvements in QoL among patients with hyperthyroidism treated with RAI 131, as assessed using the ThyPRO questionnaire. These improvements were consistent across various

Table 5. Correlation between demographic factors, thyroid hormone normalization, and quality of life improvement (change in ThyPRO score)		
Demographic factor	**Pearson's correlation coefficient (r)**	***p-value**
Age	-0.20	0.05
Gender (male= 0, female= 1)	0.10	0.30
Hormone level		
T3	0.45	0.001
T4	0.40	0.003
TSH	-0.35	0.007
*Pearson correlation coefficient, ThyPRO: Thyroid Patient-Reported Outcome, TSH: Thyroid-stimulating hormone		

Table 6. Multiple regression analysis of predictors of quality of life improvement (change in ThyPRO score)					
Predictor Variable	**Coefficient (B)**	**Standard error (SE)**	**Beta (β)**	**t-value**	***p-value**
Initial ThyPRO score	-0.50	0.10	-0.60	-5.00	<0.001
Age	0.05	0.02	0.20	Şub.50	0.015
Gender (male= 0, female= 1)	0.10	0.20	0.05	0.50	0.620
Dose of RAI 131 (10 mCi)					
Dose of RAI 131 (15 mCi)	0.15	0.25	0.10	0.60	0.550
Dose of RAI 131 (20 mCi)	0.20	0.30	0.12	0.67	0.503
Dose of RAI 131 (30 mCi)	0.25	0.35	0.15	0.71	0.480
*Regression analysis, RAI 131: Radioactive iodine, ThyPRO: Thyroid Patient-Reported Outcome					

demographic groups, including sex, age, disease severity, and RAI 131 dose levels. Our findings align with those of previous studies, emphasizing the efficacy and safety of RAI 131 in enhancing QoL in patients with hyperthyroidism.

Significant improvements were observed across all QoL measures for both males and females post-treatment. Both genders showed notable enhancements in disease symptoms, fatigue, vitality, memory, and concentration, nervousness and mental fatigue, psychological well-being, mood, relationships with others, daily activities, sexual life, appearance, and general condition.

These findings align with Kaniuka-Jakubowska et al. (7) study on patients with nontoxic goiter treated with RAI 131, in which significant QoL improvements were reported regardless of thyroid gland size. Our results corroborate their conclusion that RAI 131 effectively enhances QoL across different demographic groups, although our study did not find a significant gender difference in QoL improvement, which is consistent with the existing literature.

Improvements in QoL were significant across all age groups: <50 years, 50-60 years, and >60 years. Younger patients (<50 years) experienced slightly greater improvements in vitality, memory, and concentration than older age groups. The age-related differences in QoL improvement were modest, indicating that RAI 131 was effective across all ages.

Larisch et al. (8) reported similar findings in their study on subclinical hyperthyroidism, where RAI therapy improved QoL and biochemical parameters, emphasizing the importance of pretreatment QoL assessment in therapeutic decision-making. Our results support this finding, showing that age is a factor but not a barrier to significant improvement in QoL after 131 weeks of therapy.

Patients with mild, moderate, and severe hyperthyroidism showed significant improvements in QoL after treatment. Consistent mean changes across different severity levels highlight the efficacy of RAI 131 in improving QoL, regardless of initial disease severity. This finding is consistent with that of Mirallié et al. (9). Who reported QoL improvements in thyroidectomy patients, and Helvacı et al. (10). Who found no significant differences in depression and anxiety scores between RAI-treated and untreated thyroid cancer survivors. Our study extends these findings to patients with hyperthyroidism, confirming that RAI 131 effectively enhances QoL across various severity levels of the disease.

All dose groups (10, 15, 20, and 30 mCi) showed significant improvement in QoL across all measures, with no significant differences between dose groups. This suggests that a low dose of 10 mCi is sufficient to achieve substantial improvement in QoL in patients with

hyperthyroidism. Törring et al. (11) reported negative QoL impacts in patients with Graves' disease treated with RAI, which is in contrast with our findings. However, our study included patients with various hyperthyroid etiologies, which may explain this discrepancy. Our results suggest that RAI 131 dosage can be tailored to patient needs without compromising QoL outcomes, supporting the safety and efficacy of lower doses.

The correlation analysis revealed that age had a weak negative correlation with QoL improvement, indicating that younger patients tend to experience greater QoL improvement. Thyroid hormone levels were significantly correlated with QoL improvement, emphasizing the importance of hormone normalization for improving QoL outcomes. These findings align with those of Wu et al. (12), who found significant improvements in QoL and reductions in depression and anxiety symptoms among patients with thyroid cancer receiving RAI and behavioral support. Our study reinforces the importance of achieving a hormonal balance for optimal QoL improvement in patients with hyperthyroidism.

Multiple regression analysis identified initial ThyPRO score and age as significant predictors of QoL improvement. Higher initial ThyPRO scores were associated with greater QoL improvement, and older patients experienced slightly greater QoL improvement. Sex and RAI 131 dose were not significant predictors. This finding supports the findings of Taïeb et al. (13) Who emphasized the importance of early levothyroxine initiation post-RAI therapy for improving QoL in patients with Graves' disease. Our findings suggest that although demographic factors and initial QoL levels influence outcomes, the dosage of RAI 131 can be flexible without adversely affecting QoL improvement.

Study Limitations

Although our study demonstrated significant results, there are some limitations that should be acknowledged. A sample size of 84 patients is sufficient, limiting the generalizability of the findings. A larger sample size would provide more robust data and increase external validity. The results of this study were conducted at a single center, and they may not be applicable to other settings or populations. The ThyPRO questionnaire, which relies on self-reported data, is susceptible to response bias and inaccuracy. Future studies should incorporate objective measures of health and quality of life. The exclusion of patients with known cancers or psychiatric disorders limits the applicability of the findings. Including a more diverse patient population would provide a more comprehensive understanding of RAI 131 therapy's impact. The absence of a control group receiving alternative treatments or no treatment impedes direct comparisons of the effectiveness of RAI 131 with other interventions.

Conclusion

RAI 131 therapy significantly enhances the QoL of hyperthyroid patients, with improvements observed across various demographic groups, disease severity, and dosage levels. These findings support the continued use of RAI 131 as a primary treatment modality for hyperthyroidism, emphasizing the importance of personalized treatment approaches to optimize patient outcomes. Further research should focus on long-term QoL outcomes and refine therapeutic strategies to maximize patient well-being.

Ethics

Ethics Committee Approval: This prospective, single center study was conducted in Bolu Abant İzzet Baysal University Clinical Research Ethics Committee (decision no:2022/239, date: 25.10.2022)

Informed Consent: The patients provided written informed consent to publication of this report.

Footnotes

Authorship Contributions

Surgical and Medical Practices: H.A., B.Ç., Concept: H.A., Design: H.A., B.Ç., Data Collection or Processing: H.A., Analysis or Interpretation: H.A, B.Ç., Literature Search: H.A., Writing: H.A.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

References

1. Wiersinga WM, Poppe KG, Effraimidis G. Hyperthyroidism: aetiology, pathogenesis, diagnosis, management, complications, and prognosis. Lancet Diabetes Endocrinol. 2023;11:282-98.
2. Lutterman SL, Zwaveling-Soonawala N, Verberne HJ, et al. The efficacy and short- and long-term side effects of radioactive iodine treatment in pediatric graves' disease: a systematic review. Eur Thyroid J. 2021;10:353-63.
3. Liu X, Wong CKH, Chan WWL, et al. Outcomes of graves' disease patients following antithyroid drugs, radioactive iodine, or thyroidectomy as the first-line treatment. Ann Surg. 2021;273:1197-206.
4. Marquez DX, Aguiñaga S, Vásquez PM, et al. A systematic review of physical activity and quality of life and well-being. Transl Behav Med. 2020;10:1098-109.
5. Vita R, Caputo A, Quattropani MC, Watt T, Feldt-Rasmussen U, Puleio P, et al. Quality of life in patients with hyperthyroidism: where do we stand? Mediterranean Journal of Clinical Psychology. 2020;8.
6. Cramon PK, Bjorner JB, Groenvold M, et al. Implementation of thyroid-related patient-reported outcomes in routine clinical practice. Front Endocrinol (Lausanne). 2022;1000682.
7. Kaniuka-Jakubowska S, Lewczuk A, Majkowicz M, Piskunowicz M, Mizan-Gross K, Zapaśnik A, et al. Nontoxic goiter (NTG) and radioiodine:

what do patients think about it? Quality of life in patients with NTG before and after 131-I therapy. Frontiers in Endocrinology. 2018;9:114.

8. Larisch R, Midgley JEM, Dietrich JW, et al. Effect of radioiodine treatment on quality of life in patients with subclinical hyperthyroidism: a prospective controlled study. Nuklearmedizin. 2024:176-87.
9. Mirallié E, Borel F, Tresallet C, et al. Impact of total thyroidectomy on quality of life at 6 months: the prospective ThyrQoL multicentre trial. Eur J Endocrinol. 2020;182:195-205.
10. Helvacı BC, Yalçın MM, Yalcın ŞNG, et al. Differentiated thyroid cancer: effect on quality of life, depression, and anxiety. Hormones (Athens). 2023;22:367-74.
11. Törring O, Watt T, Sjölin G, et al. Impaired quality of life after radioiodine therapy compared to antithyroid drugs or surgical treatment for graves' hyperthyroidism: a long-term follow-up with the thyroid-related patient-reported outcome questionnaire and 36-item short form health status survey. Thyroid. 2019;29:322-31.
12. Wu HX, Zhong H, Xu YD, et al. Psychological and behavioral intervention improves the quality of life and mental health of patients suffering from differentiated thyroid cancer treated with postoperative radioactive iodine-131. Neuropsychiatr Dis Treat. 2016;12:1055-60.
13. Taïeb D, Bournaud C, Eberle MC, et al. Quality of life, clinical outcomes and safety of early prophylactic levothyroxine administration in patients with Graves' hyperthyroidism undergoing radioiodine therapy: a randomized controlled study. Eur J Endocrinol. 2016;174:491-502.