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Short- and Medium-Term Efficacy of Radioiodine Therapy in the Management of Graves' Disease at the Nuclear Medicine Department of HOGIP

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Abstract

Objectives: To evaluate the short-term (3 months) and medium-term (6 months) response to radioiodine therapy in patients treated for Graves' disease. **Patients and Methods:** A prospective, longitudinal follow-up study conducted at the Nuclear Medicine Department of IDRISSA POUYE General Hospital in Dakar (Senegal) over a 10-month period (November 1, 2023, to August 31, 2024), involving 25 consecutive patients with confirmed Graves' disease who provided informed consent. All 25 patients completed the 3-month follow-up visit; 25 patients also completed the 6-month follow-up visit. **Results:** The median age was 42 years [15 - 67 years] and the female-to-male ratio was 4:1, indicating a clear female predominance. Stress and weight loss were reported by all patients (100%). On clinical examination, goiter was found in 21 patients (84%). Biochemically, at initial diagnosis, free T4 (FT4) levels were elevated and TSH levels were suppressed in all patients (100%). TRAK tests were positive in 24 patients (96%). Fourteen patients (56%) underwent neck ultrasound revealing a median thyroid volume of 32.3 ml [10 - 52 ml]. The median dose of radioiodine therapy was 18.2 mCi (range: 12.6 - 20.2 mCi), administered as second-line treatment in 24 patients (96%). At 3 months post-radioiodine therapy, clinical euthyroidism was observed in 6 patients (23.8%), clinical and laboratory euthyroidism in 6 patients (23.8%), hypothyroidism in 7 patients (28.6%), and persistent hyperthyroidism in 6 patients (23.8%). At 6 months, outcomes were more favorable: 11 patients (44%) achieved clinical euthyroidism, 5 (20%) clinical and biochemical euthyroidism, 6 (24%) developed hypothyroidism, and 3 (12%) had persistent hyperthyroidism. **Conclusion:** Iodine-

131 demonstrated short- and medium-term effectiveness in most patients with Graves' disease, with most achieving euthyroidism or hypothyroidism within 6 months. Persistent hyperthyroidism remained in a minority of cases. Safety outcomes, including adverse events and ophthalmopathy evolution, were not systematically assessed in this study.

Keywords

Graves' Disease, Radioiodine Therapy, Efficacy, Short-Term, Medium-Term

1. Introduction

Graves' disease accounts for 60 to 80% of cases of hyperthyroidism. It is a common autoimmune disease that primarily affects people aged 20 to 50, with a predominance in women [1] [2]. Its management relies on three main therapeutic approaches: medical treatment with synthetic antithyroid drugs (SATs), surgical treatment, and treatment with radioactive iodine [3]. Most patients with Graves' disease are treated with SATs as first-line therapy [3]. Following medical treatment with SATs, the relapse rate ranges from 30% to 40% during the first 12 months and from 50% to 60% in the long term. If medical treatment fails, radical treatment via surgery or radioactive iodine should be considered [4].

As a single dose, radioactive iodine has an efficacy of approximately 66% to 93% [5]. After radioiodine therapy, thyroid hormone levels should be monitored every four to six weeks for six months or until the patient becomes hypothyroid. Once the patient is on a stable dose of levothyroxine, thyroid hormone levels can be rechecked every six to twelve months. Persistent hyperthyroidism beyond six months of radioactive iodine treatment is generally considered a treatment failure, and repeat radioiodine therapy may be necessary [2].

Studies have been conducted in many countries on the efficacy of radioiodine therapy in the management of hyperthyroidism [3] [5]. These data are not available to the Nuclear Medicine Department at IDRISSA POUYE General Hospital. This study was therefore undertaken to evaluate the short-term (3 months) and medium-term (6 months) therapeutic response to iodine-131 in patients treated for Graves' disease at the Nuclear Medicine Department of IDRISSA POUYE General Hospital.

2. Patients and Methods

2.1. Study Setting and Design

This was a prospective, longitudinal follow-up study covering a 10-month period (November 1, 2023, to August 31, 2024), conducted at the Nuclear Medicine Department of IDRISSA POUYE General Hospital in Dakar (Senegal). Patients were assessed at three time points: before radioiodine therapy (baseline), at 3 months, and at 6 months post-treatment.

2.2. Patients

The study included all consecutive patients treated with radioiodine therapy for Graves' disease during the study period who provided written informed consent. Graves' disease was diagnosed based on clinical signs of thyrotoxicosis, suppressed TSH with elevated FT4, and positive TRAK serology, or thyroid scintigraphy showing diffuse homogeneous uptake in clinically typical cases. Patients with other causes of hyperthyroidism (toxic nodular goiter, toxic adenoma), pregnant or breastfeeding women, and patients who did not complete follow-up were not included in the final analysis. All 25 patients who received radioiodine therapy completed both the 3-month and 6-month follow-up visits and were included in all analyses.

Thyroid function was categorized as follows: hyperthyroidism was defined as suppressed TSHus (<0,4 mIU/L) with elevated FT4 (>22 pmol/L); hypothyroidism as elevated TSHus (>4.5 mIU/L) with low or low-normal FT4; clinical euthyroidism as resolution of symptoms without biochemical confirmation; and clinical-biological euthyroidism as symptom resolution with TSHus and FT4 within the normal reference range (TSHus: 0.4 - 4.5 mIU/L; FT4: 10 - 22 pmol/L).

2.3. Parameters Studied

The parameters studied were:

- Age and sex;
- Medical history (cervical irradiation, family history of thyroid dysfunction or goiter, stress related to psychosocial factors);
- Data on thyrotoxicosis prior to radioiodine therapy: symptoms (weight loss, nervousness, anxiety, asthenia/muscle fatigue, palpitations, insomnia, diarrhea, tremors, erectile dysfunction, changes in the menstrual cycle); clinical signs (exophthalmos, goiter, myxedema, tachycardia); laboratory findings (TSHus, free T4, TRAK, thyroid scintigraphy, cervical ultrasound); medical treatment (SATs, beta-blockers, anxiolytics);
- Data on radioiodine therapy: indication (1st, 2nd, or 3rd line), dose administered;
- Post-radioiodine therapy outcome at 3 and 6 months: symptom progression, serum TSH and FT4 levels, thyroid function status.

2.4. Radioiodine Protocol

The dose of iodine-131 was calculated based on body weight, following the standard protocol used at the department. A fixed dosing approach was applied, with the dose adjusted according to body weight; thyroid volume and baseline FT4 level were also considered in dose individualization for selected patients. SATs were discontinued 5 to 7 days before radioiodine administration and restarted, when clinically indicated, 4 to 6 weeks after treatment if persistent hyperthyroidism was documented. Beta-blockers were continued until symptomatic control was achieved.

2.5. Statistical Analysis

The data were entered and analyzed using SPSS version 27.0. Spearman's correlation coefficient was used to assess correlations between the radioiodine therapy dose and other parameters (goiter volume, baseline FT4). The McNemar test was used to compare the proportions of different symptoms and thyroid function status across evaluation periods. The Friedman test was used to compare FT4 and TSHus values throughout follow-up. Statistical significance was set at $p < 0.05$.

3. Results

3.1. Age and Sex

The median age of the study population was 42 years, with a range of 15 to 67 years. The [30 - 40[age group accounted for 32% of the total. The female-to-male ratio was 4:1, reflecting the known female predominance of Graves' disease.

3.2. History

The patients' personal and family medical histories are reported in Table 1. Psychosocial stress was the most frequently reported historical factor, identified in 100% of patients. Stress was recorded based on patient self-report during the structured medical interview; no formal psychometric scale was used. It is acknowledged that thyrotoxicosis itself may induce psychiatric symptoms such as anxiety and stress, and the causal direction cannot be established retrospectively in this study.

Table 1. Distribution of patients by medical history.

History	Number of patients (N = 25)	Frequency (%)
Cervical irradiation	0	0
Family history of thyroid dysfunction	8	32
Family history of goiter	8	32
Stress	25	100

3.3. Data on Thyrotoxicosis Prior to Radioiodine Therapy

INITIAL SYMPTOMS AND CLINICAL SIGNS

Weight loss was reported in 100% of patients. Table 2 shows the distribution of patients according to initial symptoms and clinical signs.

LABORATORY FINDINGS

TRAKs were present in 24 patients (96%). Table 3 presents the patients' laboratory data. One patient underwent a thyroid scan with iodine-123, which revealed diffuse, homogeneous hyperfixation of the radiotracer. Fourteen patients (56%) underwent cervical ultrasound. The median goiter volume was 32.3 ml [10 - 52 ml]. Table 4 reports the findings from the thyroid ultrasound.

MEDICAL TREATMENT

All patients (100%) were on SATs, 22 patients (88%) were on beta-blockers, and 10 patients (40%) were on anxiolytics.

Table 2. Distribution of patients according to initial symptoms and clinical signs.

Symptoms	Number of patients (N = 25)	Frequency (%)
Weight loss	25	100
Nervousness/Anxiety	16	64
Weakness/Muscle fatigue	12	48
Heart palpitations	24	96
Insomnia	13	52
Motility-related diarrhea	3	12
Finger tremors	16	64
Changes in the menstrual cycle	2	8
Exophthalmos	13	52
Myxedema	1	4
Tachycardia	23	92
Goiter	21	84

Table 3. Laboratory data for the patients.

Variables	Median	Min-Max
FT4 (pmol/L)*	38.4	19.9 - 97
TSHus (microIU/L)**	0.002 (0.002 - 0.004)	0,0001 - 0.8
TRAK	1.8 (1.1 - 11.9)	1 - 15.3

Table 4. Findings on thyroid ultrasound.

Characteristics of the thyroid	Number of patients (N = 14)	Frequency (%)
Homogeneous	6	42.9
Heterogeneous	8	32
Nodular	3	21.4
Hypervascular	11	78.6

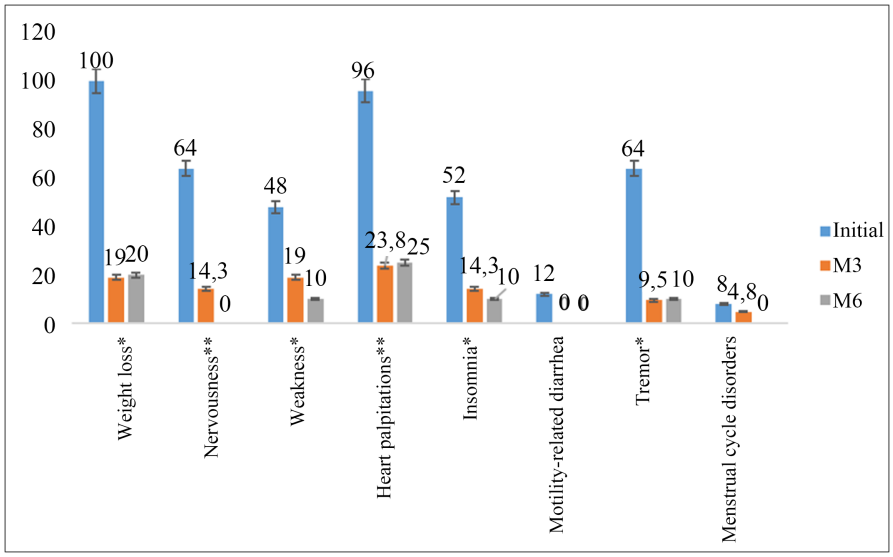
3.4. Radioiodine Therapy

The median dose of radioiodine therapy was 18.2 mCi (range: 12.6 - 20.2 mCi). Radioiodine therapy was indicated as second-line treatment in 24 patients (96%) and as third-line treatment in 1 patient (4%).

3.5. Post-Radioiodine Therapy Outcome

SYMPTOMS PROGRESSION

Most symptoms significantly improved after radioiodine therapy. Of the 25 study participants, 5 showed clinical signs of hypometabolism at 3 months after radioiodine therapy, compared to 3 at 6 months. **Figure 1** shows the distribution of patients according to post-radioiodine therapy symptom progression.



*p < 0.05; **p < 0.001.

Figure 1. Distribution of patients according to the progression of symptoms following radioiodine therapy.

CHANGES IN TSH

A significant increase in TSH was observed at 3 months before decreasing again at 6 months, though it remained significantly higher than the baseline TSH level. **Figure 2** illustrates the distribution of patients according to changes in TSH following radioiodine therapy.

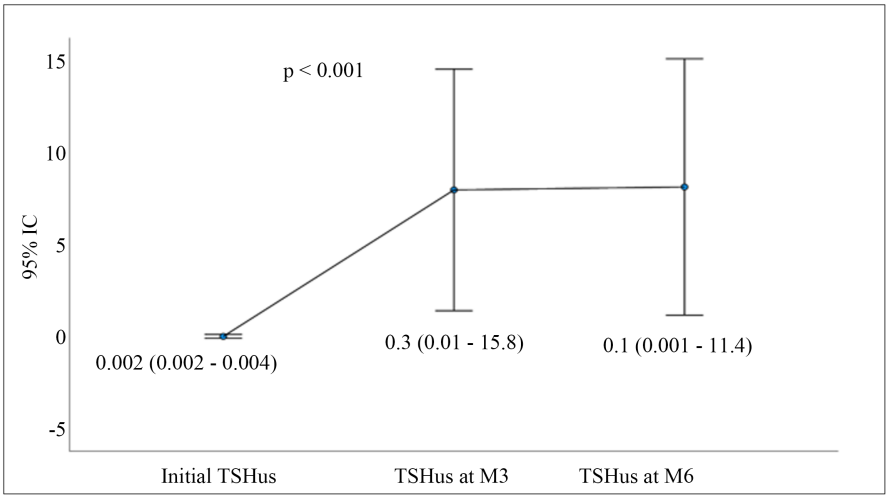


Figure 2. Distribution of patients according to changes in TSH levels following radioiodine therapy.

CHANGES IN FT4

Overall, a significant decrease in FT4 was observed during post-radioiodine therapy follow-up, with a decrease at 3 months before rising again at 6 months, though remaining significantly lower than the initial FT4. **Figure 3** illustrates the distribution of patients according to FT4 trends after radioiodine therapy.

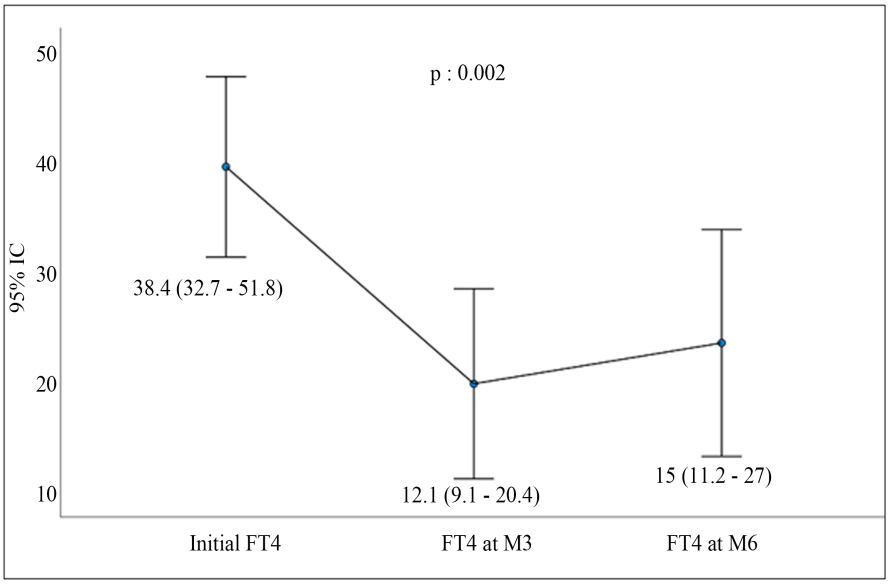


Figure 3. Distribution of patients according to changes in FT4 levels after radioiodine therapy.

CHANGES IN THYROID FUNCTION

At 3 months (n = 25), there were as many participants with clinical euthyroidism alone as with clinical and laboratory euthyroidism. However, by 6 months (n = 25), the proportion of participants with clinical euthyroidism alone was notably higher. Nevertheless, these differences between the two follow-up periods were not statistically significant (Figure 4).

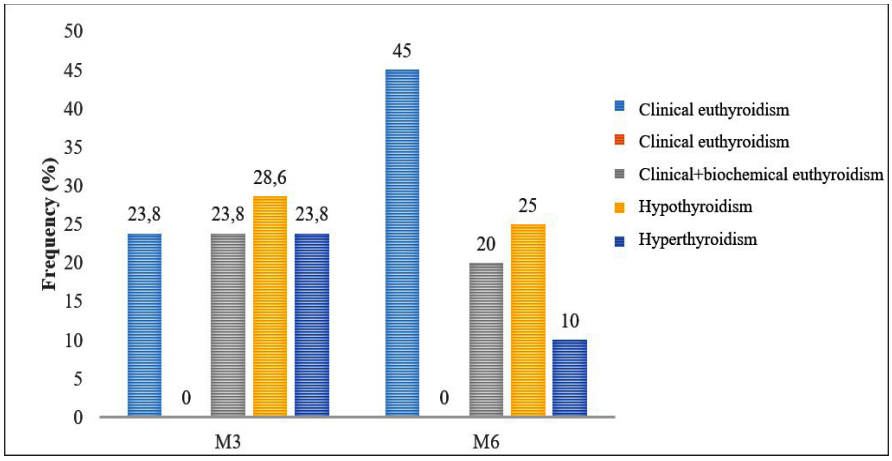


Figure 4. Distribution of patients according to changes in thyroid function.

3.6. Data Correlation Studies

CORRELATION BETWEEN RADIOIODINE THERAPY DOSE AND INITIAL FT4 LEVEL

A positive and significant correlation between FT4 levels and radioiodine therapy dose was found; the radioiodine therapy dose increased in proportion to the FT4 level (Figure 5).

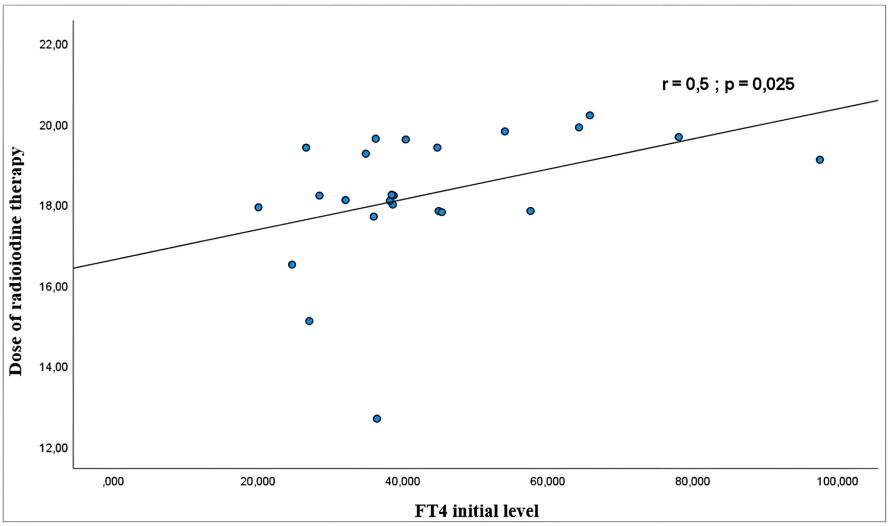


Figure 5. Correlation between baseline FT4 levels and the dose of radioiodine therapy received.

CORRELATION BETWEEN GOITRE VOLUME AND RADIOIODINE THERAPY DOSE

A positive and significant correlation was found between goiter volume and radioiodine therapy dose; the radioiodine therapy dose increased in proportion to the goiter volume (**Figure 6**).

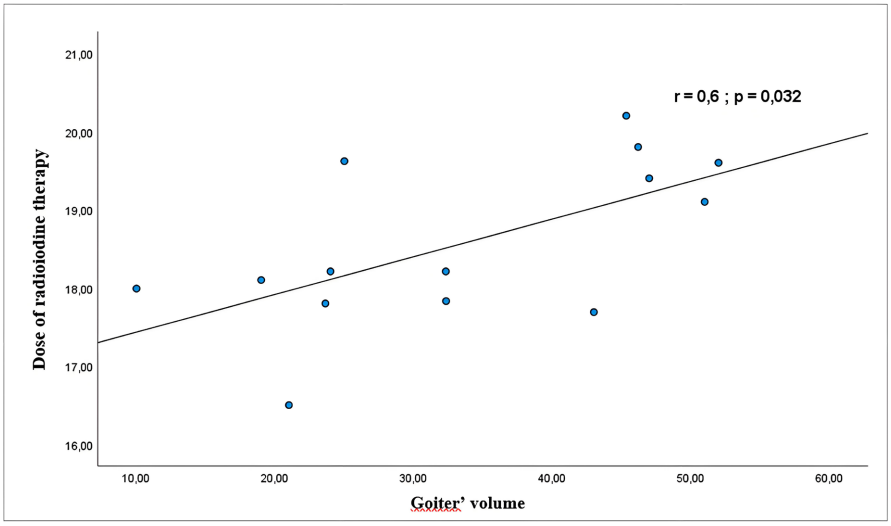


Figure 6. Correlation between goiter volume and the dose of radioiodine therapy received.

4. Discussion

4.1. Epidemiological Characteristics

The median age of the patients was 42 years, and the most common age group was [30 - 40[years. Several studies report similar age ranges for Graves' disease [6] [7]. The female predominance in this series (female-to-male ratio 4:1) is consistent with the literature [7]-[10]. Hormonal and immunological factors explain this dif-

ference, as estrogen promotes TRAK production through immunological stimulation, unlike testosterone [11] [12].

4.2. Medical History

Stress was the most common factor in the medical history, reported in 100% of cases based on self-report. Intense and chronic stress disrupts the immune system and can act as a trigger or aggravating factor for Graves' disease [13] [14]. Furthermore, thyrotoxicosis itself can cause psychiatric symptoms characterized by stress and anxiety [15] [16], making it difficult to determine whether stress preceded or resulted from the disease in retrospective assessment.

4.3. Data on Thyrotoxicosis before Radioiodine Therapy

Initially, weight loss was the most common symptom, followed by palpitations. In Tunisia, Sellem *et al.*, 2020 [3], in a study of 54 patients, found weight loss to be the most prominent symptom, followed by tremors and palpitations. Despite the variability of symptoms, weight loss, palpitations, and tremors remain the most common symptoms of thyrotoxicosis [17]. Regarding clinical signs, tachycardia was the most prominent in this series, followed by goiter. The tachycardia associated with hyperthyroidism, which patients perceive as palpitations, may be absent in elderly patients with conduction disorders [18] [19].

Regarding the initial laboratory findings, the hyperthyroidism observed in all patients is consistent with the classic pathophysiology of Graves' disease. This diagnosis is generally confirmed by the detection of elevated TRAK [20] [21]. However, one patient had negative TRAK results. TRAK-negative Graves' disease may be explained by a genetic mutation in the TSH receptor, the course of the disease (remission or early testing), or poor sensitivity of laboratory tests [22] [23].

4.4. Post-Radioiodine Therapy Outcomes

Most symptoms improved significantly after radioiodine therapy. Radioiodine therapy is recognized as an effective treatment for hyperthyroidism, particularly in cases of Graves' disease [3] [5] [6].

The FT4 level decreased during the post-radioiodine therapy period starting at 3 months. This FT4 level was significantly associated with treatment outcome three months after ablation ($p = 0.002$). Some studies report that an elevated FT4 level is associated with treatment failure and subclinical hyperthyroidism [24] [25]. At 6 months, the FT4 level increased again but remained lower than the initial FT4 level. The TSHus level increased significantly 3 months post-irradiation ($p < 0.001$), followed by a decrease at 6 months, while remaining significantly higher than the initial TSH level. Some studies have revealed that radioiodine therapy in Graves' disease initially causes an increase in TRAK levels, followed by a decrease that remains significantly slower than that observed with drug therapy or surgery [26] [27]. This may explain the observed variations in free TSH and free T4.

For most patients, the trend in thyroid function was favorable at 3 months post-radioiodine therapy and even more satisfactory at 6 months. However, the differences observed between the two follow-up periods were not statistically significant.

4.5. Correlation between Dose of Radioiodine Therapy, Initial FT4 Level, and Goiter Volume

Although the radioiodine therapy dose was primarily administered based on body weight, a positive and significant correlation was found between baseline FT4 value and the radioiodine therapy dose received (the radioiodine therapy dose increased in proportion to the FT4 value).

Similarly, a positive and significant correlation existed between goiter volume and the radioiodine therapy dose (the radioiodine therapy dose increased with goiter volume). Administering a radioiodine therapy dose based on goiter volume and FT4 levels could therefore be beneficial [28].

4.6. Limitations

This study has several limitations that should be acknowledged. First, the sample size was small (n = 25), limiting statistical power and generalizability. Second, the study was conducted at a single center, which may restrict external validity. Third, psychosocial stress was assessed by self-report without a validated psychometric instrument, introducing potential recall and social desirability biases. Fourth, thyroid scintigraphy was performed in only one patient, and cervical ultrasound was performed in 14 patients (56%), which limits the completeness of baseline imaging data. Fifth, adverse events and the evolution of ophthalmopathy were not systematically recorded, precluding a formal safety assessment. Finally, the 6-month follow-up period, while informative, does not capture long-term outcomes such as the need for repeat radioiodine therapy or permanent hypothyroidism rates.

5. Conclusion

Graves' disease in Dakar affects relatively young individuals, with a clear female predominance. All patients reported experiencing stress and weight loss at baseline. Radioiodine therapy demonstrated short- and medium-term effectiveness in most patients, with most achieving euthyroidism or hypothyroidism within 6 months of treatment. A minority of cases showed treatment failure defined as persistent hyperthyroidism at 6 months. Formal safety assessment, including adverse event monitoring and ophthalmopathy evaluation, was beyond the scope of this study and should be addressed in future prospective investigations. These findings support the role of iodine-131 as an effective therapeutic option for Graves' disease in our setting, pending larger studies to confirm long-term safety and efficacy.

Conflicts of Interest

The authors declare no conflicts of interest.

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