Scientific Research Publishing

Open Journal of Biophysics, 2024, 14, 56-72
https://www.scirp.org/journal/ojbiphy
ISSN Online: 2164-5396
ISSN Print: 2164-5388

Iodine 131 Treatment in Graves' Disease in a West African Country: Preliminary Study about 25 Cases in Senegal

El Hadji Amadou Lamine Bathily[1,2*], Serigne Moussa Badiane[3], Mamoudou Salif Djigo[1,2], Gora Thiaw[1,2], Kalidou Gueye[1,2], Ousseynou Diop[2,4], Boucar Ndong[2,4], Kokou Fofo Toussaint Adambounou[5], Alphonse Rodrigue Djiboune[6], Papa Mady Sy[6], Mamadou Soumbounou[6], Mohamed Chekhma[2], Louis Augustin Diaga Diouf[6], Gora Mbaye[6], Omar Ndoye[2], Mounibé Diarra[6], Mamadou Mbodj[1,2]

[1]Nuclear Medicine Department, General Hospital of Idrissa Pouye (HOGIP), Dakar, Senegal
[2]Biophysical Laboratory, Cheikh Anta Diop University (UCAD), Dakar, Senegal
[3]Biophysical Laboratory, Gaston Berger University (UGB), Saint-Louis
[4]Nuclear Medicine Department, Hospital Dalal Jamm, Dakar, Senegal
[5]Biophysical Laboratory, University of Lome, Lome, Togo
[6]Laboratory of Physical and Pharmaceutical Biophysics, Cheikh Anta Diop University, Dakar, Senegal
Email: *bathilyssd@yahoo.fr, *elhadji.bathily@ucad.edu.sn

How to cite this paper: Bathily, E.H.A.L., Badiane, S.M., Djigo, M.S., Thiaw, G., Gueye, K., Diop, O., Ndong, B., Adambounou, K.F.T., Djiboune, A.R., Sy, P.M., Soumbounou, M., Chekhma, M., Diouf, L.A.D., Mbaye, G., Ndoye, O., Diarra, M. and Mbodj, M. (2024) Iodine 131 Treatment in Graves' Disease in a West African Country: Preliminary Study about 25 Cases in Senegal. *Open Journal of Biophysics*, **14**, 56-72.
https://doi.org/10.4236/ojbiphy.2024.141003

Received: November 14, 2023
Accepted: January 26, 2024
Published: January 29, 2024

Abstract

Introduction: Graves' disease is the most common cause of hyperthyroidism. Its treatment uses synthetic antithyroid drugs but the use of aggressive radical therapy such as surgery or non-aggressive therapy such as iodine-131 is not uncommon. Treatment of Graves' disease with radioactive iodine or iratherapy is a simple, inexpensive, well-tolerated treatment. It was introduced in Senegal in 2016. We report through this work the preliminary assessment of the only nuclear medicine service in Senegal in the management of Graves' disease by iodine-131. **Patients and Methods**: Retrospective study of the first cases of Graves' disease treated with iratherapy in Senegal. Socio-demographic, clinical, paraclinical, therapeutic and evolutionary aspects were studied. Radiation protection rules have been implemented and contraception has been effective for six months in women of childbearing age. **Results:** 25 patients were collected with a mean age of 45 years, twenty women (80%), a family goiter in 24% and a psycho-affective context in 64% of cases. Thyrotoxicosis syndrome was associated with goiter in 68% of patients and exophthalmos in 64%. Thyroid ultrasound performed in 20 patients showed vascular goiter in 80% and thyroid scintigraphy in 3 patients, homogeneous and diffuse hyperfixation. TRAK dosed in 8 patients was still positive. All patients had received first-line medical treatment. The average duration of this treatment was more

than 18 months in 92%. The empirically used iodine-131 activity averaged 15.35 mCi. Oral corticosteroid therapy was prescribed in 7 patients for the prevention of malignant orbitopathy. No early side effects were noted. The remission rate at 3 months was 52% and at 6 months was 88% to 92%. **Conclusion**: The effectiveness of radioactive iodine, in particular ablative doses in the treatment of hyperthyroidism, is no longer to be demonstrated. Taking into account our socioeconomic context, iratherapy should be a treatment of choice for hyperthyroidism with a good quality/price ratio and excellent tolerance.

Keywords

Graves' Disease, Iratherapy, Iodine-131, Senegal

1. Introduction

Graves' disease (GD) is the leading cause of hyperthyroidism worldwide [1]. It occurs at all ages but willingly in young women with a ratio of 10 women to 1 man [1] [2] [3] [4] [5]. The detection of anti-TSH receptor antibodies is a strong argument in favor of Graves' origin of hyperthyroidism. Factors contributing to this disease could be genetic or environmental such as tobacco and stress [6]. Graves' disease is manifested by hyperthyroidism (unstoppable hypersecretion of thyroid hormones), homogeneous goiter and sometimes exophthalmos [4]. Thyroid acropathy is exceptional and manifests as a Hippocratic deformation of the fingers [7].

First-line treatment for Graves' disease (BD) does not follow a particular consensus [8]. Three therapeutic modalities dominate treatment:

- Medical treatment with synthetic antithyroid drugs (SAT) that effectively restore euthyroidism [9]. Medical treatment with SAT is usually offered for the first episode of autoimmune hyperthyroidism.
- Surgical treatment after the diagnosis of moderate autonomic hyperthyroidism on uni, multinodular or bulky goiter or in case of failure of medical treatment, and
- Treatment with iodine-131 by oral administration of a single capsule containing radioactive iodine (vectorized internal radiotherapy process or metabolic radiotherapy).

Treatment of hyperthyroidism with radioactive iodine or iodine therapy is a simple, effective, inexpensive and well-tolerated treatment. It is prescribed in the United States as a first-line treatment in 50% to 75% of cases except for young subjects where it represents only 30% of the options [10]. In Europe, it is more used as a second line after synthetic antithyroid drugs (SAT) [4]. However, its availability and prescription in developing countries, particularly in sub-Saharan Africa, remain even weaker. Introduced in Senegal in 2016, iodotherapy is increasingly important in the management of hyperthyroidism. We report through this work the preliminary assessment of the only nuclear medicine department in Senegal in the management of Graves' disease by iodine-131.

2. Patients and Methods

This is a retrospective study from January 2016 to December 2017 and involved all patients diagnosed with Graves' disease and who received iodotherapy at the nuclear medicine department of Idrissa POUYE General Hospital (HOGIP) in Dakar (Senegal). Senegal located in West Africa is the first country in this part of Africa to start iratherapy in Graves' disease.

The iratherapy was carried out after the informed consent of all patients and under the following prerequisites:

- After stopping synthetic antithyroid drugs, for at least 3 days;
- No iodine intake in the month prior to the treatment (seafood, medicines, injected CT scan…);
- Check of hormonal thyroid test and thyroid ultrasound;
- Checking of the absence of pregnancy and the introduction of effective contraception in women of childbearing age;
- Adherence to radiation protection measures after iratherapy.

An ablative dose was recommended for all patients to reduce the risk of treatment failure. Treatment was outpatient and clinical-biological monitoring was observed at 3 and 6 months in all patients.

We spoke of therapeutic success if euthyroidism or hypothyroidism was observed at the 3rd and/or 6th month after taking iodine 131. On the other hand, we spoke of failure in the case of the persistence of frank hyperthyroidism in the 6th month. The overall cost of iratherapy in Senegal: $309.

3. Results

3.1. Descriptive Study

➢ **Socio-demographic data**

▪ **The Age**

We collected 25 patients ranging in age from 19 to 65 years with an average of 45 years. The age groups (31 to 40 years) and (41 to 50 years) were the most represented. The peak frequency was between the ages of 41 and 50. Table 1 illustrates the percentage distribution of patients by age group in our series.

Table 1. Distribution of patients by age group.

Age groups	Staff	Percentage
[11 - 20 years]	1	**4%**
[21 - 30 years]	3	**12%**
[31 - 40 years]	6	**24%**
[41 - 50 years]	7	**28%**
[51 - 60 years]	3	**12%**
[61 - 70 years]	5	**20%**
Total	**25**	**100%**

- **Sex**

There were twenty women (80% of the population) (Figure 1).

- **Family history of goiter**

Twenty-four percent (24%) of patients had a notion of familial goiter. The following table (Table 2) illustrates the prevalence of familial goiter.

- **Psycho-affective context**

The existence of psycho-emotional context was found in 64% of patients.

➢ **Paraclinical data before Iratherapy**

- **Thyroid Hormones and Thyroid Function**

The results showed 72% of patients in hyperthyroidism, compared to 28% in euthyroidism. Thus, no patient was in hypothyroidism.

- **Anti-TSH receptor antibodies**

In our study, the determination of anti-TSH receptor antibodies (TRAK) was performed in 32% of patients (n = 8) and the result was positive in 100% of cases. All of these patients also had exophthalmos. One (1) patient had TRAK positivity without exophthalmos.

- **Thyroid ultrasound**

In our series, 20 patients had undergone thyroid ultrasound. Of these patients, 80% had homogeneous hypervascular goiter. The rest had other ultrasound aspects with varying proportions as shown in Table 3.

The volume of the thyroid gland measured on ultrasound ranged from 21 to 66 cm^3 with an average volume of 39.6 cm^3.

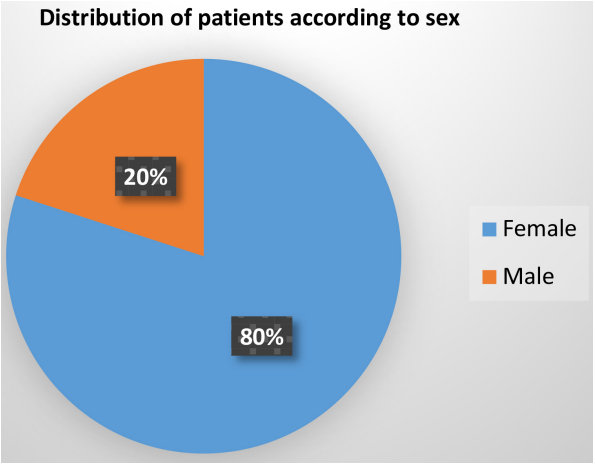

Figure 1. Distribution of patients according to sex.

Table 2. Prevalence of familial goiter.

	Number	Percentage %
Presence of family goiter	06	**24**
Absence of family goiter	19	**76**
Total	**25**	**100**

Table 3. Ultrasound proportions and aspects of goiter.

Ultrasound aspect	Number	Percentage
Hypervascular homogeneous goiter	16	80%
Heterogeneous goiter	3	15%
Hypervascular nodular goiter	1	5%
Total	20	100%

▪ **Thyroid scintigraphy**

Three patients (12%) had undergone a thyroid scintigraphy that showed homogeneous and diffuse hyperfixation consistent with Graves' disease.

➢ **Initial Treatment of Graves' Disease**

Synthetic antithyroids (SAT) were prescribed to all our patients as a first-line trait. Carbimazole was used in 92% of cases, and Thiamazole and Bensylthiouracil were used each in 4% of cases. The average duration of this treatment was greater than 18 months in 92% of cases.

Beta Blockers (Propanolol) were prescribed in all our patients (100%) and Mexazolam-type anxiolytics in 80% of cases.

➢ **Iratherapy in Graves' disease**

▪ **Indications for Iratherapy in the management of Graves' disease**

Metabolic radiotherapy with radioactive iodine has been proposed as a second-line treatment in all our patients after medical treatment has failed.

In our series, 19 patients relapsed after treatment with ATS. In patients with relapsed hyperthyroidism, 21% had positive TRAK. On the other hand for those who were in euthyroidism, 66% had positive TRAK. Figure 2 shows the percentage of each of these indications.

▪ **Drug prescriptions before iratherapy**

- **Corticosteroid therapy**

Sixteen patients or 64% had exophthalmos. Of these patients, 44% had received corticosteroid therapy prior to radioactive iodine treatment. The following table (Table 4) shows the distribution of patients on corticotherapy before iratherapy.

- **Contraception**

Among women, 40% were in genital activity (8 women). They all received effective contraception during the six (6) months following taking radioactive iodine.

- **Delay between iratherapy and stopping synthetic antithyroid drugs**

The time between stopping ATS and taking iodine-131 was 3 to 7 days in 52% of cases, 7 days to 3 months in 44% of cases and less than 3 days in 4% of cases (Figure 3).

▪ **The activity of radioactive iodine administered**

The dose of iodine 131 was on average 15.35 mCi with extremes ranging from 11.6 to 22 mCi. Our patients were distinguished according to the activity received into four groups (Figure 4):

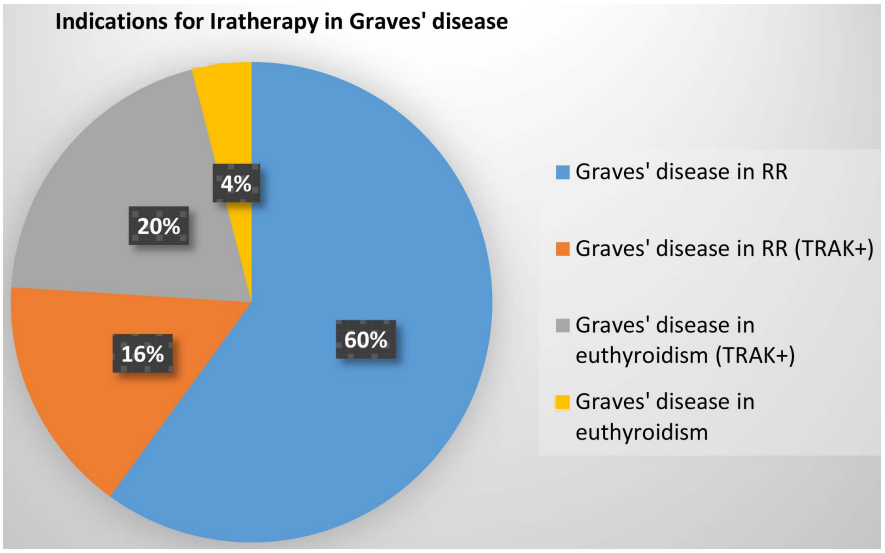

Figure 2. Indications for iratherapy in Graves' disease.

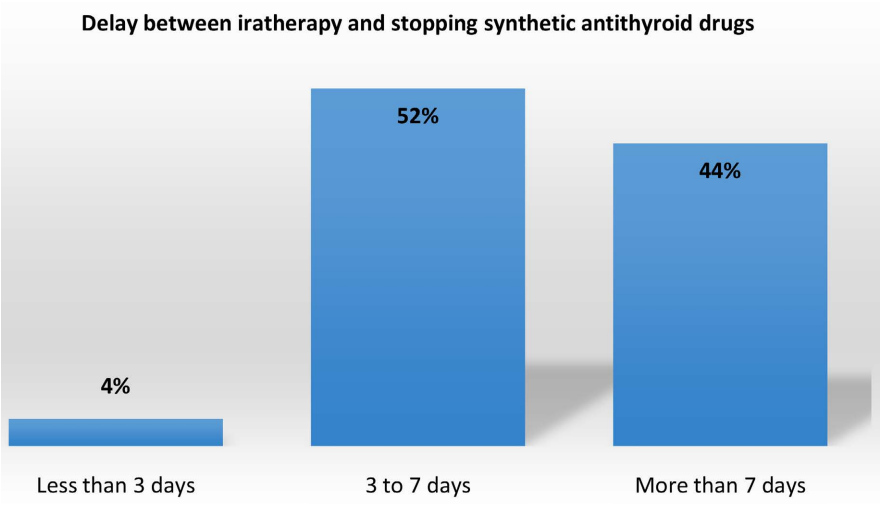

Figure 3. Delay between iratherapy and stopping synthetic antithyroid drugs.

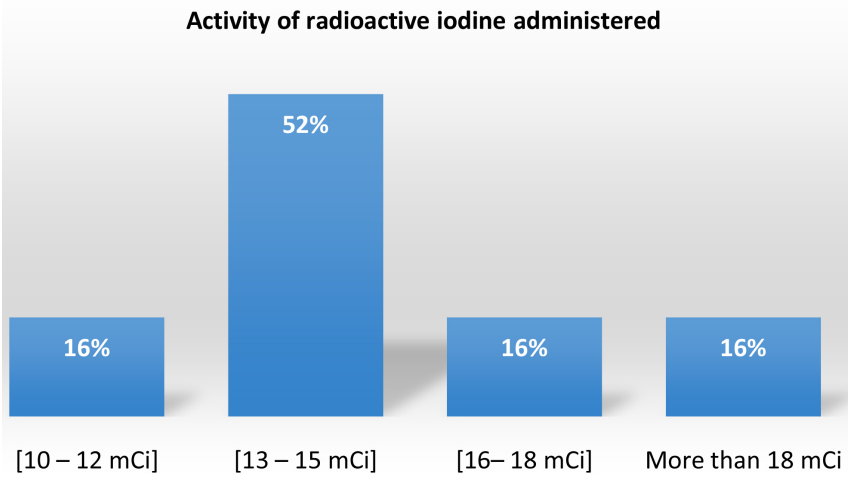

Figure 4. Activity of radioactive iodine administered.

Table 4. Distribution of patients on corticosteroid therapy prior to therapy.

	Number	Taking corticosteroid therapy	Percentage
Inflammatory exophthalmos	1	1	100%
No Inflammatory Exophthalmos	15	6	40%
Total	16	7	44%

The first group included patients who received activity between 10 and 12 mCi (4 patients or 16%);

The second group, patients who had received between 13 and 15 mCi (13 patients or 52%);

The thirteenth group, those who received activity between 16 and 18 mCi (4 patients or 16%);

The fourth group was doses greater than 18 mCi (4 patients or 16%).

- **Incidents - Accidents**

In our study, no patient had a cervical inflammatory reaction. An early side effect, acute thyroiditis, exacerbation of thyrotoxicosis and/or exophthalmos was noted after days after taking radioactive iodine.

- **Evaluation of thyroid function after iratherapy**

- **3 months post-iodotherapy**

There was 52% therapeutic success: 28% of patients in euthyroidism (n = 7) and 24% in hypothyroidism (n = 6). These patients were put on hormone replacement therapy. On the other hand, 32% of patients were in frank hyperthyroidism (n = 8) and 16% in subclinical hyperthyroid or partial remission (n = 4). In these patients, just monitoring was recommended and hormonal dosage considered at the sixth month (Figure 5).

In summary, we had 52% total remission, 16% partial remission and 32% persistence of frank hyperthyroidism (Figure 6).

- **6 - 7 months post-iodotherapy**

At month 6, there was 80% therapeutic success: euthyroidism was observed in 60% (n = 15) of patients and hypothyroidism in 20% (n = 5) of cases. In contrast, 12% of patients had infraclinic hyperthyroidism (n = 3) and 8% of patients had frank hyperthyroidism (n = 2).

In patients with persistent frank hyperthyroidism, one was subsequently treated with surgery with a good course of the disease, and the other was not reviewed for further management.

Among the 3 patients with subclinical hyperthyroidism, a check-up in the 7th month found two cases of remission (one case of hypothyroidism and one case of euthyroidism) and one case of persistent crude hyperthyroidism. At the end of 7 months of follow-up after therapy, there was 88% total remission (64% euthyroidism and 24% hypothyroidism), 4% partial remission and 8% treatment failure (persistence of frank hyperthyroidism) (Figure 7 and Figure 8).

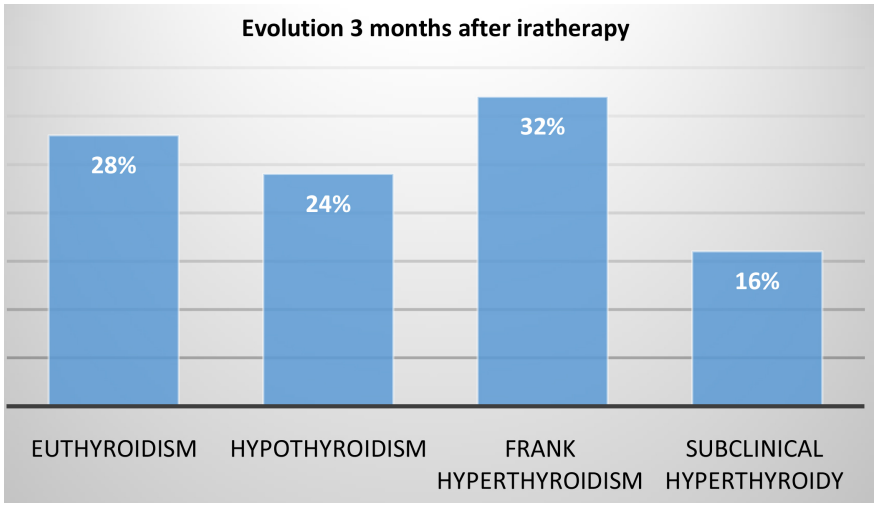

Figure 5. Evolution 3 months after iratherapy.

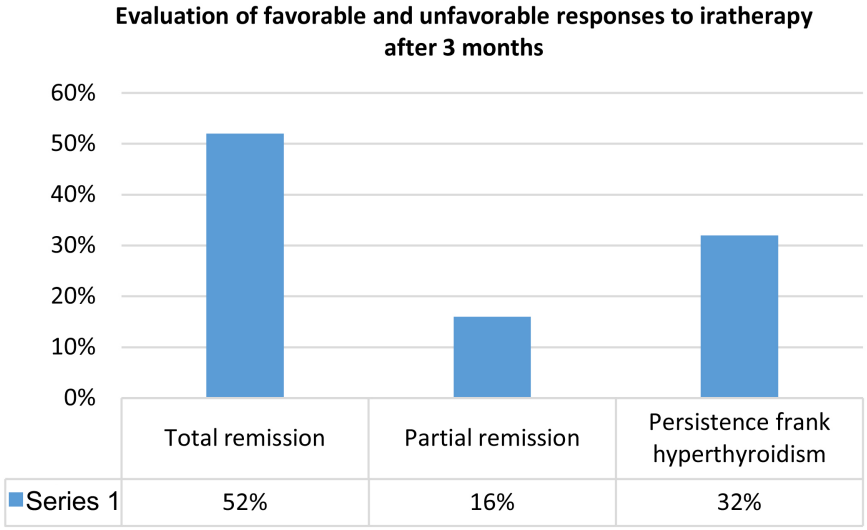

Figure 6. Evaluation of favorable and unfavorable responses to iratherapy after 3 months.

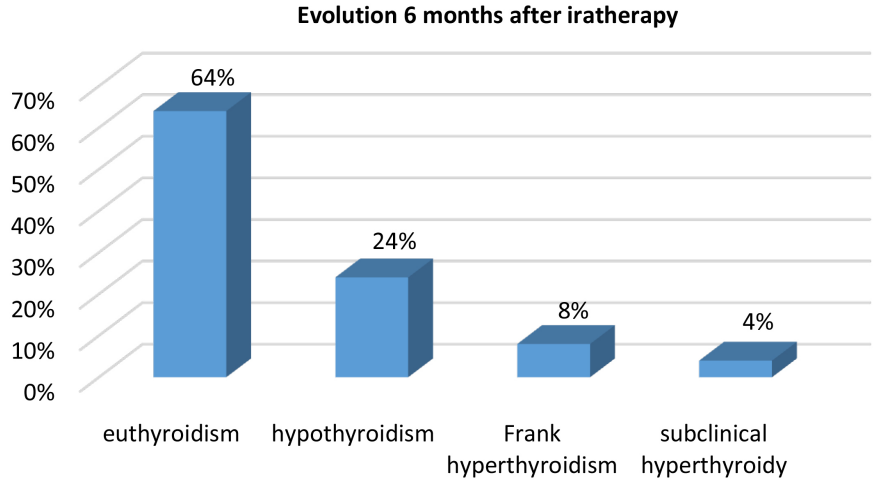

Figure 7. Evolution 6 months after iratherapy.

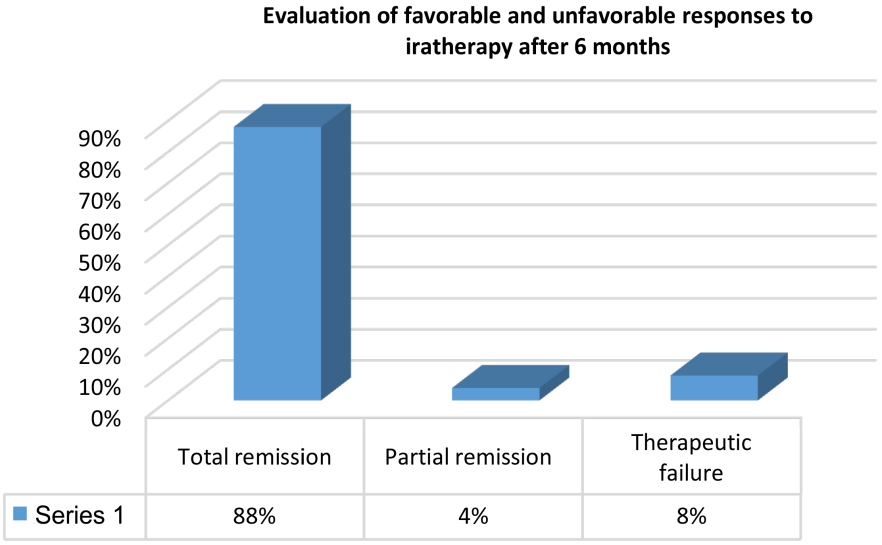

Figure 8. Evaluation of favorable and unfavorable responses to iratherapy after 6 months.

Fertility after iratherapy

In our series, 8 women were in the period of genital activity. One of them had a subsequent pregnancy after a delay of more than one (1) year and whose evolution was marked by a miscarriage.

3.2. Analytical Study

In our series, we looked for a correlation between response to iodine therapy (remission and failure) with the following parameters: age, sex, baseline thyroid function, iodine-131 activity and the age of the clinical picture. A statistically significant relationship was not found with therapeutic activity. The table below (**Table 5**) provides information on the evolution of Graves' disease after iodine-131 according to the different parameters.

4. Discussion

Age:

The peak frequency between 41 and 50 years found in our series, is similar to the results obtained by: Aziz Karam M *et al.* in Fez [11], Hiro Baba Gon D *et al.* in Ivory Coast [12] on a descriptive cross-sectional study and by Mbodj M *et al.* in Senegal through a retrospective study in Rabat [10] which found respectively a peak between 40 and 59 years, 36 and 55 years and 41 and 50 years. A Canadian study also found a peak between 40 and 50 years testifying to its ubiquitous nature [13].

The average age of 45 years found in our study was also reported by studies carried out in Guadeloupe [14], Rabat [10] and Tunis [15], with respective age averages of 46 years, 45 years and 42.5 years. It is the same for W. El Ajmi in Tunis [16], N Charfi *et al.* [17], N. El Yaagoubi in Rabat [18], Samya TOURARI [19] in Marrakech with respectively average ages of 42, 41 and 40 (19 - 65 years).

Table 5. Evolution of the disease according to the different parameters.

	Evolution		P-value
	Remission	Failed	
	Age		
Under 40	10 (100%)	0 (0%)	0.534 NS
Over 40 years	12 (80%)	3 (20%)	
	Sex		
Male	4 (80%)	1 (20%)	1 NS
Female	16 (80%)	4 (20%)	
	Baseline thyroid function		
Hyperthyroidism	16 (84%)	3 (16%)	0.838 NS
Euthyroïdie	4 (66.7%)	2 (33.3%)	
	Therapeutic activity		
Less than 15mCi	12 (80%)	5 (20%)	0.042*
16mCi and more	8 (100%)	0 (0%)	
	Disease progression time		
Less than 18 months	1 (50%)	1 (50%)	0.659 NS
More than 18 months	19 (79%)	4 (21%)	

*: statistically significant link, **NS**: statistically non-significant link.

However, slightly lower average ages were found in Dakar (35 years) [5], Tunis (38 years) [20], and Ivory Coast (36.5 years) [12]. This difference can be explained in our cohort, because of the therapeutic choice that has often been proposed in the elderly, menopausal.

Sex:

The female predominance in our study at 80% was also reported by: Ben Sellem D *et al.*, Tunis [15] (80%), Alaya W *et al.* [8], Mahdia [9] (80%), DohoHiro BG *et al.* in Bamako, [12] (83%), Mbodj M *et al.*, Rabat [10] (79%).

The strong female predominance is widely reported in the literature with even higher proportions, especially with Ndour O *et al.* [5] (98%); Diagne N *et al.* [21], and Joubij M *et al.* [22] (88%). In Switzerland, Jacques P [23] reported that it is more common in women than in men with a ratio of about 5 - 10/1.

Graves' disease is thus a woman's condition whose distribution is independent of race and geographical location.

Family history of goiter:

The family goiter found in 24% of cases in our series is similar to the result reported by Ndour O *et al.* [5] and Samya TOURARI [19], with respectively 25% and 23% of cases. A genetic predisposition to Graves' disease is reported in the literature. A lower rate of around 17% was found in 2017 by Oum-Kheltoum [2] in Fez.

The psycho-affective context:

Generally, Graves' disease appears after an emotional episode and/or psycho-affective shock. In our study, 64% of patients or 16 patients had a psycho-affective context at the beginning of the disease that could be an irritative thorn or a triggering factor.

Lower values were found by Ndour O [5] and Oum-Kheltoum [2] with respectively 15% and 8%.

Indeed, Graves' disease is considered an autoimmune condition that occurs secondarily to an irritative spine on a genetically predisposed terrain.

Paraclinical aspects before iratherapy:

- **Thyroid hormones and thyroid function**

Seventy-two percent (72%) of our patients were in biological but clinically stable hyperthyroidism compared to 28% in euthyroidism. Joubij M *et al.* [22] found in their study in Rabat, 87% of patients in euthyroidism; 6.7% in hyperthyroidism and 6.3% in hypothyroidism. On the other hand, Mbodj M *et al.* [10] found in their series opposite results: a percentage of 75.96% of patients had euthyroidism; 11.62% had hypothyroidism and 12.42% of patients had hyperthyroidism.

This discrepancy could be explained by the fact that most of our patients were in relapse.

- **The determination of anti-TSH receptor antibodies (TRAK)**

In this study, antibody testing was not performed systematically. Anti-RTSH antibodies had been performed in 8 patients or 32% and were 100% positive. This positivity was found one hundred percent by Diagne N *et al.* [21] but also by Oum-Khaltoum B [2].

The non-systematic demand for antibodies could be explained initially by the high frequency of exophthalmos, which is a specific sign of Graves' disease, but also because of the economic context that limited the demand for these expensive immunological tests in our study.

- **Thyroid ultrasound**

In our series, 20 out of 25 patients had benefited from thyroid echography with homogeneous hypervascular goiter patients in 80% of cases, heterogeneous goiter in 15% and hypervascular nodular goiter in 5% of cases. Samya TOURARI [19], in his series of 16 cases had reported 25% vascular goiter, 18.75 nodular goiter, 31.25% goiter without precision, 12.5% appearance thyroiditis.

Doppler ultrasound of the thyroid gland is not essential and is very operation-dependent. However, it is a non-invasive, inexpensive examination that can quickly provide information on etiology and prognosis. In Graves' disease, the thyroid parenchyma is globally hypo-echogenic and heterogeneous and hypervascular ("infernal thyroid"). The Doppler is useful for the demonstration of the global hyper-vascularization of the parenchyma, and the calculation of velocities in the inferior thyroid artery.

Later these data will have a predictive value since the presence of hyper-vascularization testifies to the persistence of a thyrostimulating process

while its disappearance is in favor of its cure [23].

In our study, the mean volume of 39.6 cm^3 thyroid measured on ultrasound and extremes of 21 to 66 cm^3 was consistent with the realization of iratherapy. Indeed, a thyroid mass greater than 80 grams is a relative contraindication of iodotherapy [24].

- **Thyroid scintigraphy**

Three patients (12%) had undergone a thyroid scintigraphy that showed homogeneous and diffuse hyperfixation consistent with Graves' disease.

In the study of Samya TOURARI [19], there were 4 patients (23%) with 3 patients who presented an intense and homogeneous fixation goiter and regular contours and one patient with a discrete asymmetrical fixation goiter (left medio-lobar warm zone).

Thyroid scintigraphy (iodine-123 or, failing that, technetium) is not essential in typical forms of Graves' disease (diffuse blowing goiter, typical Basedowian orbitopathy). It would reveal a diffuse and homogeneous hyperfixation of the isotope within the thyroid parenchyma. However, it remains the most useful examination to determine the mechanism of hyperthyroidism of difficult diagnosis. It is also essential before a possible radio-isotopic treatment [25].

Therapeutic aspects:

- **Synthetic antithyroid drugs (SAT)**

In our study, all patients received SAT as initial treatment. Indeed SAT in the first choice is widely shared in the literature especially in Africa and Europe with the studies of Bouziane T *et al.* [26] in Fez, Diagne N *et al.* [21] in Dakar, **El Mokhtari** M *et al.* [14] in Guadeloupe 2015, Samya TOURARI in Marrakeche and **Morax M *et al.*** [27] in Paris.

- **Iratherapy**

➢ **Indications of iratherapy in the management of Graves' disease**

Initially proposed in elderly, inoperable, or refusing surgery, it currently represents a possible alternative to surgery, in goiters not suspected of malignancy. No study has been able to demonstrate, despite the hindsight of more than 30 years in some studies, the existence of genetic effects or increased risk of extra-thyroid cancers in patients treated with iratherapy. Its prescription is no longer limited to the elderly but extends to younger and younger patients.

The choice of radioactive iodine as a first- or second-line treatment in Graves' disease varies from country to country or center.

Iratherapy has been offered as a second-line treatment in all our patients, which is consistent with European practice [4]. In principle, treatment with synthetic antithyroid drugs is continued for twelve to eighteen months with an attempt to wean and, if possible, stop before considering radioiodine treatment if remission does not occur [4]. Unlike the United States where it is prescribed as a first-line treatment in 50% to 75% of cases except for young subjects where it represents only 30% of the options [10]. N. Charfi *et al.* [17] in Tunisia found that iratherapy was prescribed immediately in 76.3% of cases and second-line in 23.7% of cases. On the other hand, W. El Ajmi *et al.* [16] still in Tunisia had re-

ported 63.5% of patients initially treated with SAT. N. For N. El Yaagoubi *et al.* [18] in Morocco, iodine-131 was indicated as a 1st line in 15 patients or 14%, in 2nd line in 91 patients or 86%. Stills in Maroc, S. El Issami *et al.* [28] had found that iratherapy has often been proposed as a second- or even third-line treatment. Thus, on 25% of patients were initially treated with iodine-131, while 75% of patients had received iodine-131 after failure of medical treatment and/or recurrence after surgical treatment.

In our study, 76% of indications were patients with treatment failure manifested by relapse after treatment with SAT. Bouziane T *et al.* [26] (Morocco) in 2017 had recovered a rate of 70%.

Twenty-four percent (24%) of the patients in our cohort were in remission, which is also close to the 31% found during the same year in Tunis by Alaya W *et al.* [29].

In the study by I. Oueslati *et al.* [30], I-131 treatment was indicated as a first-line treatment in 71.6% of patients and as a second-line treatment in 28.4%: in 20% of cases after failure of synthetic antithyroid drugs (SAT), 7.6% after intolerance to SAT and 0.8% of cases after subtotal thyroidectomy.

In the study by Samya TOURARI [19] in Marrakech, there was 70.6% after recurrence, 23.5% after resistance to SAT and 5.9% after intolerance to SAT.

- **Taking corticosteroid therapy before iratherapy**

Sixteen patients had exophthalmos. Seven (7) patients or 44% had benefited from corticosteroid therapy including one case of inflammatory exophthalmos. There was stabilization and improvement of exophthalmos in 100% of our cases. The same result was obtained by Oueslati I *et al.* [31] and Hebaili N *et al.* [32].

- **The activity of radioactive iodine administered**

The choice of the activity to be administered and the modalities of its evaluation were the subject of lengthy discussions. This choice depends essentially on the therapeutic objective and the expected effect: ablative dose treatment with the appearance of hypothyroidism or a lower dose treatment called antitoxic aimed at restoring euthyroidism.

We opted for a high ablative dose in all our patients to reduce the risk of treatment failure. On had administered empirical radioactive iodine activity taking into account age, thyroid volume, and degree of hyperthyroidism and also the socioeconomic level of the patient. Thus an average dose of 15.35 mCi was our objective with modulation sometimes according to the aforementioned parameters. In addition to its widely proven effectiveness, the advantage of our choice over the choice to give an activity according to the percentage of thyroid fixation is threefold: reduction in the cost of care, reduction of the time to care and better radiation protection of staff and patient. S Fieffe *et al.* [33] also described the same benefits in their study.

Similar averages of activity werefound in Tunisian studies by Ben Sellem D *et al.* 15 mCi [15], de Hebaili N *et al.* [32] 15 mCi, de Bennour M *et al.* [34] 13.95 mCi et I. Oueslati *et al.* [30] 13.86 mCi.

Lower means were described by El Feleh E *et al.* 12.34 mCi [35], N. El Yaagoubi [18] 11.13 mCi and N. Charfi et al, 6 mCi. The choice of low doses seems to be less successful compared to high doses. Indeed N. Charfi *et al.* [17] with an average dose of 6 mCi had 31% failure against 8% in our series. I. Oueslati *et al.* [30] had also reported in their study a greater effectiveness of high doses. Samya TOURARI [19], with an average activity of 9.7 mCi had noted 23.5% failure.

➢ **Incidents - Accidents**

In our series, no patient had experienced cervical inflammatory manifestation within 15 days of taking radioiodine, or early side effects. The same observation was made in the series of Hebaili N *et al.* [32] in Tunis, Mbodj M *et al.* [10] in Rabat, Joubij M *et al.* [22] in Casablanca. Boumelit A *et al.* [36] in Tlemcen and S. El Issami *et al.* [28] in Rabat. N. Charfi *et al.* [17] noted a worsening of ocular signs in 9.9% of patients.

➢ **Evaluation of thyroid function 3 months after Iratherapy**

We had about 68% remission or 52% total remission and 16% partial remission, against a persistence of frank hyperthyroidism of 32%. Our results were comparable to those of Aschawa H *et al.* [37], El Yaagoubi *et al.* [38] and Joubij M *et al.* [22] with remission rates of 84.4%, 66% and 65% respectively .

➢ **Evaluation of thyroid function 6 months after Iratherapy**

In total, after 7 months of follow-up after iratherapy, we had about 92% remission or 88% total remission (64% euthyroidism and 24% hypothyroidism) and 4% partial remission, against 8% therapeutic failure. Our remission rate of 88 or even 92% is very satisfactory compared to the remission rates reported in the literature: Ben Sellem D *et al.* [15] (91%), El Feleh E *et al.* [35] (90%), Hebaili N *et al.* [32] (92%), Joubij M *et al.* [22] (79%), I. Oueslati *et al.* [30] (59%), N. El Yaagoubi *et al.* [18] (66%), S Fieffe *et al.* [33] (80%) and Mbodj M *et al.* [10] (92.24%), S. El Issami *et al.* [28] (92%).

In Senegal, iratherapy is less costly than surgical treatment ($309 versus $584)

Analytical study

In our series, we did not note a correlation of therapeutic response (remission and failure) with age, sex, baseline thyroid function and age of hyperthyroidism. For N. Charfi *et al.* [17], sex, age, severity of hyperthyroidism, antithyroid antibody (TRAK) positivity and iodine activity administered were not correlated with the occurrence of hypothyroidism. The shorter duration of hyperthyroidism before therapy as well as the small volume of goiter were correlated with progression to hypothyroidism.

However, for iodine activity we noted in our series a correlation with the effectiveness of treatment. EL Feleh E *et al.* [35] showed in their study that patients who achieved a cure received a significantly higher dose of iodine (13.81 ± 2.13 mCi). Dejax C *et al.* [39] through their series specified in his study that it would seem that the activity of iodine 131 administered plays a role in the occurrence of hypothyroidism. The more iodine activity increases, the greater the likelihood of the occurrence of hypothyroidism. Ben Sellem D *et al.* [15], in their series, had shown that the administration of high therapeutic doses of iodine 131 led to a

very good efficacy from the first course with a success rate of 91%. The response was early, averaging 4 months.

In our study, the cure rate was higher in younger patients. There was 100% in patients under 40 years of age compared to 80% in patients over 40 years of age. En Tunis Hebaili N *et al.* [40] found in 2014 that 37.4% of patients over 65 years of age were in remission. This difference could be explained by the small size of our series.

5. Conclusions

Management of Graves' disease requires accurate diagnosis and appropriate treatment. Nevertheless, diagnosis and treatment are relatively simple. The effectiveness of radioactive iodine, in particular ablative doses in the treatment of hyperthyroidism, is well established. As a result, the radical treatment of Graves' disease should no longer be limited to surgery in our areas since iodine-131 has proven its effectiveness and especially since it is not as aggressive as surgery.

Taking into account our socio-economic context, iratherapy should be a treatment of choice for hyperthyroidism with a good quality/price ratio, simplicity of realization and excellent tolerance. As for its indication, obtaining prior euthyroidism through SAT is not necessarily necessary, unlike surgery.

The iratherapy must be popularized in Senegal and in general in Africa

Conflicts of Interest

None.

References

[1] Wémeau, J.L., Klein, M., Sadoul, J.L. and Céphise, F.L. (2020) Consensus on Graves' Disease. http://www.chu-fes.ma/endo/ftp/basdaw.pdf

[2] Bennis, O.K. (2017) Epidemiological Profile, Clinical Profile and Management of Graves' Disease. Master's Thesis, Sidi Mouhamad Ben Abdallah University Faculty of Medicine and Pharmacy, Morocco.

[3] Duran, F. (2006) Endocrinology: Goiter. Pierre and Marie Curie Faculty of Medicine.

[4] Jacques, P. (2009) Graves' Disease in 2009. *Revue Médicale Suisse*, **5**, 764-768.

[5] Ndour, O. (2014) Surgical Treatment of Graves' Disease. Master's Thesis. Cheikh Anta Diop University Faculty of Medicine, Pharmacy and Odonto-stomotology. Dakar.

[6] Teissier, M.P. and Lopez, S. (2004) Dysthyroid Orbitopathy: Pathophysiology, Hormonal Balance. *French Journal of Ophthalmology*, **27**, 806-809. https://doi.org/10.1016/S0181-5512(04)96219-5

[7] Foulet-Rogé, A., Josselin, N., Guyetant, S., *et al.* (2002) Incidental Langerhans Cell Histiocytosis of Thyroid: Case Report and Review of the Literature. *Endocrine Pathology*, **13**, 227-233. https://doi.org/10.1385/EP:13:3:227

[8] Alaya, W., Charrada, I., Berriche, O., *et al.* (2017) Therapeutic and Progressive Modalities of Graves' Disease: About 146 Patients. *Annales d'Endocrinologie*, **78**, 326-352. https://doi.org/10.1016/j.ando.2017.07.372

[9] Bouziane, T., Larwanou, M. and El Ouahabi, H. (2017) Predictors of Relapse of Graves' Disease Treated with ATS: About 72 Cases. *Annales d'Endocrinologie*, **78**, 326-352. https://doi.org/10.1016/j.ando.2017.07.370

[10] Mbodj, M., Guerrouj, H., Amjad, I., *et al.* (2009) Contribution of Iodine-131 in the Treatment of Graves' Disease in the Nuclear Medicine Department of the Ibn Sina Hospital in Rabat. *Nuclear Medicine*, **33**, 592-598. https://doi.org/10.1016/j.mednuc.2009.07.019

[11] Aziz Karam, M. (2014) Diagnostic and Therapeutic Strategy in the Management of Differentiated Cancers of the Thyroid Gland. Master's Thesis, Sidi Mohammed Ben Abdallah University Faculty of Medicine and Pharmacy, Fez.

[12] Doho Hiro, B.G. (2005) Carbimazole in the Treatment of Graves' Disease in Côte d'Ivoire: Study of Biological Efficacy and Collateral Effects. Master's Thesis, University of Bamako Faculty of Medicine of Pharmacy and Odonto-stomatology, Bamako.

[13] Karam, R. (2013) Iodine-131 and Therapy for Thyroid Disorders: The Blue Pages. https://docplayer.fr/47118665-L-iode-131-et-la-therapie-des-troubles-thyroidiens.html

[14] El Mokhtari, M., Corvo, L. and Popescu, M. (2015) Graves' Disease about 20 Cases. *Annales d'Endocrinologie*, **75**, 412-453.

[15] Ben Sellem, D., Zabar, L., Dhaouadi, B., *et al.* (2015) Graves' Disease: Effectiveness of Strong Iratherapy Activities. *Annales d'Endocrinologie*, **76**, 422. https://doi.org/10.1016/j.ando.2015.07.396

[16] El Ajmi, W., Slim, I., Rmadi, S., Yeddes, I., Krimi, S., Ltaief, B., Mhiri, A. and Ben Slimene, M.F. (2009) Evaluation of Treatment of Graves' Disease with a Fixed Dose of Iodine-131 Nuclear Medicine. *Functional and Metabolic Imaging*, **33**, 242.

[17] Charfi, N., Ben Mrad, N., *et al.* (2005) Results of Treatment of Graves' Disease with Radioactive Iodine (about 137 Cases). *Annales d'Endocrinologie*, **66**, 493. https://doi.org/10.1016/S0003-4266(05)82072-4

[18] El Yaagoubi, N., Belhaj, L., Chraïbi, A., Mouzouri, H. and Kadiri, A. (2005) Iodine-131 in Graves' disease. *Annales d'Endocrinologie*, **66**, 496. https://doi.org/10.1016/S0003-4266(05)82083-9

[19] Tourari, S. (2014) Place of Iratherapy in the Treatment of Graves' Disease: Experience of the Department of Endocrinology of the Avicenna Military Hospital Marrakech. Master's Thesis, Cadi Ayyad University, Marrakech.

[20] El Feleh, E., Bchir, N., Jaidane, A., *et al.* (2017) Clinical and Paraclinical Profile of Graves' Disease. *Annales d'Endocrinologie*, **78**, 326. https://doi.org/10.1016/j.ando.2017.07.352

[21] Diagne, N., Faye, A., Ndao, A.C., *et al.* (2016) Epidemiological, Clinical, Therapeutic and Progressive Aspects of Graves' Disease in Internal Medicine at Le Dantec Dakar University Hospital (Senegal). *The Pan African Medical Journal*, **25**, Article 6. https://doi.org/10.11604/pamj.2016.25.6.7868

[22] Joubij, M., El Aziz, S., Chadli, A., *et al.* (2012) Iratherapy in Graves' Disease. The Experience of the Endocrinology Department of the CHU Ibn Rochd: About 103 Cases. *Annales d'Encronilogie*, **73**, 301 p.

[23] Leung, A.M. and Braverman, L.E. (2014) Consequences of Excess Iodine. *Nature Reviews Endocrinology*, **10**, 136-142. https://doi.org/10.1038/nrendo.2013.251

[24] French Society of Nuclear Medicine and Molecular Imaging (SFMN): Working Group (2006) Endocrine Surgery Nuclear Medicine Endocrinology. Guide for

Writing Protocols for the Treatment of Hyperthyroidism with Iodine-131, 1-19.

[25] Schlienger, J.L., Goichot, B. and Grunenberger, F. (1997) Iodine and Thyroid Function. *La Revue de Médecine Interne*, **18**, 709-716. https://doi.org/10.1016/S0248-8663(97)83750-2

[26] Bouziane, T., Belmahi, N. and El Ouahabi, H. (2017) Graves' Disease in Humans: Clinical and Therapeutic Features. *Annals of Endocrinology*, **48**, 326-352.

[27] Morax, S. and Badelon, I. (2009) Exophtalmie Basedowienne. *Journal Français d'Ophtalmologie*, **32**, 589-599. https://doi.org/10.1016/j.jfo.2009.09.001

[28] El Issami, S., Sarroukh, F., Elrhoul, M., Guerrouj, H., Ghfir, I. and Ben Rais Aouad, N. (2011) Treatment of Hyperthyroidism with Iodine-131: About 280 Cases. *Nuclear Medicine*, **35**, 528-532. https://doi.org/10.1016/j.mednuc.2011.08.001

[29] Alaya, W., Charrada, I., Berriche, O., *et al.* (2017) Therapeutic and Progressive Modalities of Graves' Disease: About 146 Patients. *Annals of Endocrinology*, **78**, 326-352.

[30] Oueslati, I., Belhadj Hassen, H., *et al.* (2015) Radioactiveiode in the Treatment of Graves' Disease. *Annals of Endocrinology*, **76**, 414.

[31] Oueslati, I., Melki, A., Khessairi, N., *et al.* (2015) Evaluation of Basdowian Exophthalmia after Treatment with Radioactive Iodine. *Annales d'Endocrinologie*, **75**, 353-357.

[32] Hebaili, N., El Bez, L., Ben Sellem, D., *et al.* (2013) Evolution of Exophthalmos Basedowienne after Iratherapy: Impact of Corticosteroid Therapy. *Annales d'Endocrinologie*, **74**, 349. https://doi.org/10.1016/j.ando.2013.07.373

[33] Fieffe, S., *et al.* (2009) Traitement des Hyperthyroïdies par l'iode 131: Dose calculée versus dose fixeTreatment of Hyperthyroidism by 131-Iodine. *Nuclear Medicine*, **33**, 313. https://doi.org/10.1016/j.mednuc.2009.02.008

[34] Bennour, M., Rojbi, I., Rezgani, I., *et al.* (2017) Graves' Disease: Therapeutic and Evolutionary Aspects. *Annales d'Endocrinologie*, **78**, 326-352.

[35] El Feleh, E., Mahjoubi, S., Bchir, N., *et al.* (2017) Place of Iratherapy in the Treatment of Graves' Disease Thyroid. *Annals of Endocrinology*, **78**, 326. https://doi.org/10.1016/j.ando.2017.07.352

[36] Boumelit, A., Zemalech, A., Mehjahdi, A., *et al.* (2017) The Contribution of Iodine-131 in the Treatment of Graves' Disease. About 71 Cases. *Nuclear Medicine*, **41**, 207-208. https://doi.org/10.1016/j.mednuc.2017.02.193

[37] Aschawa, H., Touil, S., Shimi, Y., *et al.* (2017) Hyperthyroidism: Short-Term Effectiveness of Radioactive Iodine Treatment. *Moroccan Journal of Public Health*, **4**, 7-12.

[38] El Yaagoubi, N., Belhaj, L., Chraïbi, A., *et al.* (2005) Iodine-131 in Graves' Disease. *Annales d'Endocrinologie*, 66, 496 p.

[39] Dejax, C., Vennat, J.C.I. and De Freitas, D. (2005) Treatment of Hyperthyroidism in the Elderly with Iodine-131. About 180 Patients. Radiation Protection and Waste Management Problems Related to Iodine-131 Treatment. *Médecine Nucléaire et Imagerie Fonctionnelle*, **29**, 609-619.

[40] Hebaili, N., El Bez, I., Ben Sellem, D., *et al.* (2014) Hypothyroidism Post-Metabolic Iodine Radiation Therapy. *Annales d'Endocrinologie*, **75**, 488. https://doi.org/10.1016/j.ando.2014.07.740