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Research Article

Research into Predictive Factors for the Success or Failure of Radioiodine Therapy in the Treatment of Hyperthyroidism in Senegal

Ousseynou Diop[1, 3, *], Woury Sow[1], Mamoudou Salif Djigo[1, 2], Gora Thiaw[1], Hien Mwinbele Stephane[1], El Hadji Amadou Lamine Bathily[1, 2], Boucar Ndong[1, 3]

[1]Faculty of Medicine, Pharmacy and Odontology, Cheikh Anta Diop University, Dakar, Senegal
[2]Department of Nuclear Medicine, Idrissa Pouye General Hospital, Dakar, Senegal
[3]Department of Nuclear Medicine, Hospital Dalal Jamm, Dakar, Senegal

Abstract

Radioiodine therapy, a treatment method for hyperthyroidism, has been practiced in Senegal since 2016. The objective of our study was to identify predictive factors for the success or failure of radioiodine therapy in the management of hyperthyroidism in Senegal. A retrospective study was initiated in the nuclear medicine department of the Idrissa Pouye Hospital in Grand Yoff. It included the medical records of 172 patients followed for hyperthyroidism and treated with iodine-131. Demographic, clinical, paraclinical, and therapeutic aspects, as well as the evaluation of thyroid function at 3 and 6 months post-radioiodine therapy, were studied. The therapeutic efficacy at 3 months was 44.1%. Among the 17 patients who failed treatment, 12 were under 50 years of age. No statistically significant relationship was found between treatment failure and age ($p = 0.877$. However, the difference was statistically significant between men and women in terms of treatment failure ($p=0.043$). Vascular goiter, etiology, initial antithyroid drug use, and a short interval between antithyroid drugs (ATDs) discontinuation were factors contributing to treatment failure. A strong correlation existed between therapeutic efficacy and the administered dose ($p=0.000$). The 6-month success rate was 62.4%. The final therapeutic efficacy was 73.75%. Radioiodine therapy is an effective treatment for hyperthyroidism, achieving a high remission rate.

Keywords

Hyperthyroidism, Radioiodine Therapy, Therapeutic Success, Therapeutic Failure

1. Introduction

Hyperfunctioning of the thyroid gland due to increased production of thyroid hormones is called hyperthyroidism, the ultimate consequence of which is thyrotoxicosis. The management of thyrotoxicosis involves a range of therapeutic options, including medication, surgery, and nuclear medicine. [6].

Nuclear medicine using radioactive iodine (^{131}I) is a radical

*Corresponding author: ousseynou.diop@ucad.edu.sn (Ousseynou Diop)

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treatment that has established itself as an effective and non-invasive method of inducing controlled hypothyroidism, thereby relieving symptoms and reducing the complications associated with this condition.

The treatment of hyperthyroidism with radioactive iodine (RAI) is a major therapeutic advance, offering an effective alternative to drug treatments and surgery. However, the effectiveness of this treatment varies from patient to patient, raising the crucial question of identifying the factors that predict success or failure. [3]. It is in this context that we undertook this study to evaluate the factors predictive of success or failure in patients who underwent radioactive iodine (^{131}I) treatment between 2016 and 2023 at the nuclear medicine department of the Idrissa Pouye General Hospital in Dakar.

2. Methods

This is a retrospective descriptive and analytical single-center study conducted between January 2016 and November 2023, analyzing the records of patients with hyperthyroidism treated with iodine-131 at the nuclear medicine department of Idrissa Pouye General Hospital. Patients who underwent iodine therapy for hyperthyroidism during the above-mentioned period and for whom clinical and biological follow-up data at 3 and/or 6 months or more were available were included. The parameters studied included epidemiological, clinical, and radioimmunological data, etiological diagnoses, the therapeutic window, the dose of iodine-131 received, and the evaluation of thyroid function (3 months, 6 months, and/or more). The treatment is delivered in the form of a single oral capsule. Patients were monitored jointly by the attending physician and the nuclear medicine physician, with TSH and T4L levels measured 3 months and 6 months after taking ^{131}I, and beyond. Therapeutic success is defined as a return to euthyroidism or hypothyroidism. Therapeutic failure is defined as the persistence of hyperthyroidism after 6 months or more of treatment.

The data were processed and analyzed using Stata 2016 and Microsoft Excel 2019 software.

Quantitative variables were expressed as means, while qualitative variables were expressed as numbers and percentages. Comparisons between variables were made using Student's t-test. The significance threshold was set at $p < 5\%$.

2.1. Procedure for Implementing IRA Therapy

Before administering radioactive iodine, there are several mandatory phases in the implementation process:

1) Compiling the patient's file, including an interview to determine:
   The history of the disease, clinical signs, the patient's medical and surgical history, any family history of thyroid disorders, predisposing factors, tests performed, and previous and current treatment.
2) Explain the principles of iodine therapy to the patient, including the procedure, expected results, absolute contraindications, rules for radiation protection after taking iodine-131
3) Obtain the patient's informed consent.
4) Patient preparation: Advise the patient to stop taking Antithyroid drugs if this is their current treatment) at least 3 days before taking iodine (ideally 7 days before) and to avoid iodine intake. Perform a pre-treatment assessment by performing a thyroid scintigraphy to confirm the diagnosis and assess thyroid uptake. Inform the patient to come on an empty stomach and bring a bottle of water.

Protocol for administering radioactive iodine-131

Verification of the time since discontinuation of Antithyroid drugs, elimination of iodine intake, and absence of contraindications, especially in women. Therapeutic doses of iodine-131 have always been administered under the following conditions:

1) After discontinuing synthetic antithyroid drugs, the desired delay is 5 to 7 days;
2) Iodine intake should be avoided during the month prior to treatment (seafood, medications, injectable scans, etc.);
3) Thyroid hormone levels are checked before radioactive iodine is taken.
4) An empirical dose (average of 15 mCi) has been administered.
5) This treatment is delivered in capsule form in a single oral dose in the “hot” room; the patient then returns home. No hospitalization is necessary.
6) Radiation protection measures are taken before and after the intake of radioactive iodine:

Ensure that the patient is well hydrated before, during, and after taking radioactive iodine to limit gastric exposure, and encourage frequent bladder emptying to limit irradiation of the bladder.

For women of childbearing age, ensure that they are not pregnant (perform a pregnancy test systematically if there is any doubt). After taking radioactive iodine, they should use effective contraception.

Protective measures for those around the patient and verbal recommendations were provided by the department staff, and a document was made available to each patient to better inform them about individual radiation protection measures and those for those around them.

At the end of this process, the treatment report (see Appendix 3) will be given to the patient, along with the follow-up check-up to be carried out in 3 months.

Inform the patient to return if there is a significant recurrence of the symptoms of hyperthyroidism within 3 months of iodine therapy.

2.2. Patient Follow-up

Patient follow-up was provided jointly by the attending physician and the nuclear medicine physician, with TSH and

T4F measurements at 3 months and 6 months after I131 administration, and beyond if necessary. The expected therapeutic outcome will be a return to euthyroidism or hypothyroidism. Therapeutic failure will be defined as the persistence of hyperthyroidism after 6 months or more of treatment.

3. Results

3.1. Age and Sex

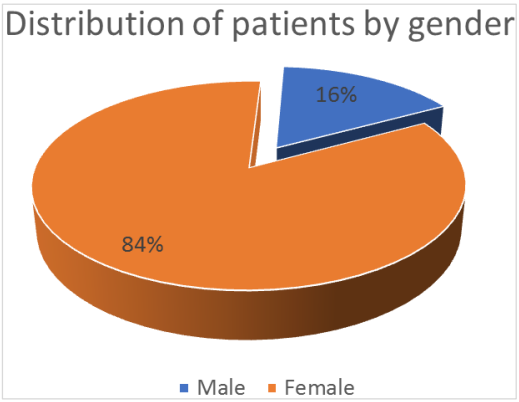

Figure 1. *Distribution of patients by gender.*

We identified a total of 172 patients aged 16 to 72, with an average age of 43.2 and a standard deviation of 13.21.

A female predominance was noted, with a sex ratio of 0.19. (Figure 1).

3.2. Dose Administered

The average activity of radioactive iodine administered to our patients was around 17 mCi, with extremes ranging from 10 to 22 mCi. (Figure 2).

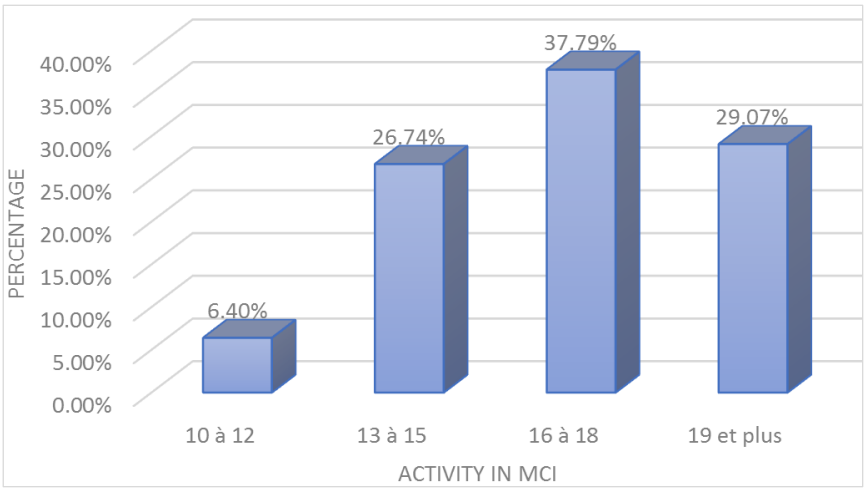

Figure 2. *Activity of radioactive iodine administered as a percentage.*

3.3. Progress 3 Months After Therapy

The assessment of thyroid function 3 months after iodine therapy showed a therapeutic efficacy rate of 44.1%, as shown in Figure 3.

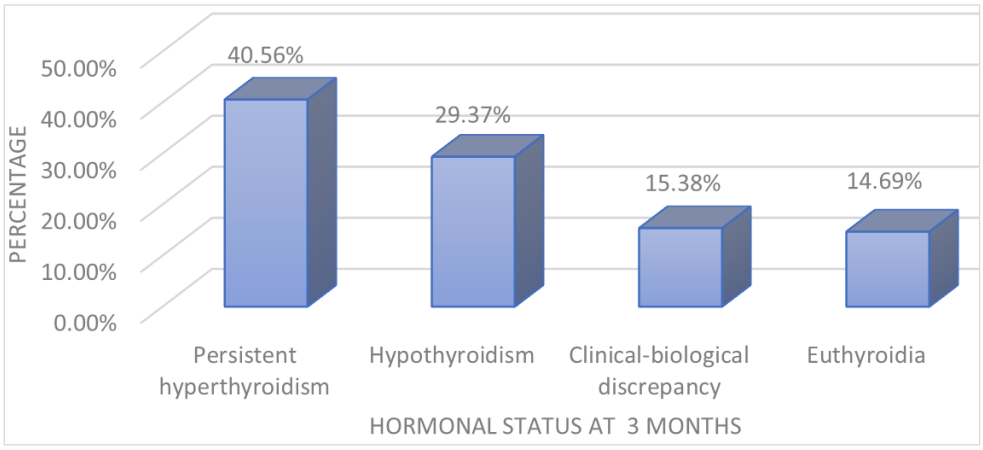

Figure 3. *Patient progress 3 months after radioiodine treatment.*

3.4. Progress 6 Months After Treatment

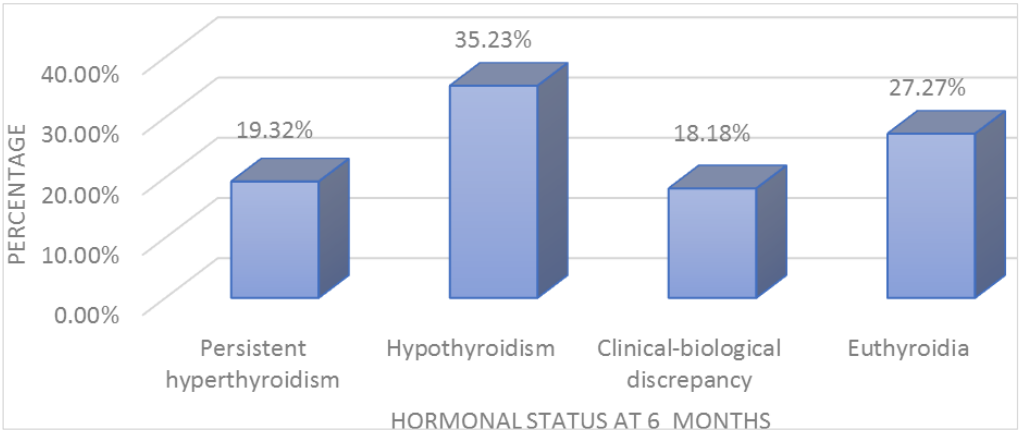

Figure 4. *Patient progress 6 months after radioiodine treatment.*

At 6 months, 62.4% of patients had achieved favorable progress (euthyroidism or hypothyroidism) Figure 4. After 6 months of treatment, 17 cases of treatment failure were noted.

3.5. Distribution of Treatment Failures According to Associated Factors

All patients who failed treatment had initially taken Antithyroid drugs. Table 1.

Table 1. *Analysis of factors contributing to treatment failure.*

Predictive factors of failure	Effective	Percentage
Vascular goiter	11	64,70%
Thyrotoxicosis	14	82,40%
Severe biological indicators of hyperthyroidism	15	88,20%
Etiology	16	94,10%
Antithyroid drugs	17	100%

3.6. Variations in Therapeutic Response Depending on the Dose

The statistical analysis concluded that there was a statistically significant correlation (P=0.000) between therapeutic response and radioactive iodine dose. Table 2.

Table 2. Variation in efficiency and treatment failure in relation to the dose of radioactive iodine.

Results	N	P value	Average dose	95% Confidence Interval
Therapeutic failure	17	0,000	16,018	14,86-17,38
Therapeutic efficiency	118	0,000	17,182	16,63-17,73

3.7. Variations in Therapeutic Response Depending on the Gender

The treatment failure rate was higher in men, reaching 10.71%. Statistical analysis showed that the relationship was significant at the 5% threshold (p = 0.043). Table 3.

Table 3. Variation in treatment failure according to gender.

Therapeutic failure			
Sex	No Effective	YES Effective	P Value
Female	130	14	0,043
Male	25	3	

3.8. Variations in Therapeutic Response Depending on the Age

Among the 17 patients who failed treatment, 12 were under 50 years of age. No statistically significant relationship was found between treatment failure and age (p = 0.877). Table 4.

Table 4. Variation in treatment failure by age.

Therapeutic failure			
AGE	No Effective	YES Effective	P Value
< 50 years	110	12	0,877
≥ 50 Years	42	5	

4. Discussion

The above results prompt comments when compared with data from the literature. The analytical study comparing average ages and treatment outcomes concluded that there was no statistically significant link between age and therapeutic response, with P=0.877.

This lack of correlation between age and treatment success was also described in the Diop study (P=0.661) [6] and the Nwatsock study with a p=0.881 [16]. This leads us to conclude that the patient's age does not influence the therapeutic response to iodine-131.

The predominance of hyperthyroidism in women, at 83.72% (a sex ratio (F/M) of 6/1), has also been found in various series in the literature [19]. Studies by Diop [6] and Diagne [5] in Senegal, Goichot [9] in France, and Feleh in Tunisia [8] show proportions similar to ours, with 87%, 88%, 85%, and 72.2%, respectively.

Younger patients, particularly women, may respond better to iodine-131 therapy, while older patients show increased resistance [12]. Treatment failure was more prevalent in men (10.71%). The statistical study showed that the difference between men and women in terms of treatment failure was significant (p = 0.043). This trend has also been described by other authors. Indeed, Nneka M. M. et al. [14] and Khessairi N. et al. [12] also identified male gender as a factor in the failure of iodine therapy. Thyrotoxicosis was noted in patients who failed therapy in 14 out of 17 cases (82.4%). This finding is consistent with the studies by Schneider et al. [19] and Khessairi N. et al. [12], which indicate that the severity of thyrotoxicosis is a predictive factor for failure. Sixty-four-point seven percent (64.8%) of patients who failed therapy had vascular goiter. This result is consistent with the study by Khessairi N. et al. [12], which identifies vascular Basedow's goiter as a factor in resistance to radioiodine therapy. 88.2% had hyperthyroidism before therapy. These results are consistent with those of Schneider et al. [19] and Erem et al. [7], who emphasize that severe biological indicators of hyperthyroidism are predictive factors for failure of iodine therapy. Etiology influences the effectiveness of iodine-131 treatment. According to Brent G. A. et al. [4], Graves' disease generally responds well to radioactive iodine, as do toxic adenomas [1]. All patients who failed treatment had initially been treated with antithyroid drugs. This is consistent with the study by Luster M. et al. [13], which found that antithyroid drugs could inhibit the uptake of radioactive iodine, thereby reducing the effectiveness of treatment. The study by Kartamihardja A. H. S. et al. [11] showed a success rate of over 60% in patients who had never taken antithyroid drugs, compared to around 56% in those who had stopped taking antithyroid drugs at least three days before radioiodine

therapy. In our series, the average time to discontinuation was 11.3 days. Mazzaferri E. L. et al. [15] demonstrated that stopping 4 to 6 weeks before iridium therapy significantly improved the response to treatment.

The average dose administered was 17 mCi, with extremes ranging from 10 to 22 mCi. A single course of treatment achieved remission in 62.4% of cases at 6 months. Longitudinal analysis revealed a positive correlation between therapeutic efficacy and the dose administered (p=0.000).

The therapeutic success rate at 6 months was 62.4%. The study by Rezgani et al. [17] reported a rate of 79.5% after 6 months.

In our series, the final therapeutic efficacy was 73.75%, with a statistically significant p value (p=0.000), showing a significant correlation between the empirical dose administered and treatment success.

In the Nwatsock study in Marseille, where patients received doses ranging from 370 to 740 MBq, no statistically significant link was found between the dose received and the therapeutic response, with p=0.885 [16]. This therefore raises the issue of patient radiation protection, invoking the ALARA principle, which suggests dose optimization. This means that some patients received more than the dose they needed to achieve the same result with the fixed dose of 555 MBq, while others received less than they needed. In the Ejeh study [10], the result of Ira therapy after 6 months in 66.6% of patients with a dose of 370 MBq was identical to that in 62.5% of patients who received a dose of 555 MBq.

In France, the 2016 FSE consensus suggests the so-called “ablative” strategy in its recommendation 30 (R30), while recommendation R31 states that no method for determining the iodine-131 activity to be administered can be favored. Methods with fixed activities or dosimetry methods can therefore be used. The simplicity of fixed and semi-fixed methods is nevertheless a factor to be taken into account.

R32 states that regardless of the method chosen, ultrasound and thyroid scintigraphy are recommended [6]. In the United States, the ATA 2106 guideline proposes doses of 370-555 MBq in its recommendation 8 [18].

The study by Bathily et al. [2], conducted as part of a preliminary activity assessment of the nuclear medicine department at Grand-Yoff General Hospital (Dakar), concludes that radioactive iodine is highly effective, particularly at high doses, in the treatment of Graves' disease. This contrasts with the study [6].

This may be related to the size of the samples studied but also suggests a genetic study.

5. Conclusion

Treatment with iodine-131, which is simple, non-invasive, and inexpensive, is currently considered the treatment of choice for hyperthyroidism. This research contributes to a better understanding of the mechanisms influencing the effectiveness of iodine therapy in the treatment of hyperthyroidism. It calls for the development of more targeted and tailored protocols, and for the training of clinicians in a comprehensive and integrated approach to this condition.

Abbreviations

ALARA	As Low As Reasonably Achievable
ATA	American Thyroid Association
^{131}I	Iodine 131
MBq	Megabecquerel
mCi	Millicurie
R	Recommendation
FSE	French Society of Endocrinology
FT4	Free Thyroxine
TSH	Thyroid Stimulating Hormone

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Bahn, R. S. «Graves’ disease.» New England Journal of Medicine, 2010 Feb 25; 362(8): 726-38. https://doi.org/10.1056/NEJMra0905750

[2] Bathily EHAL, Diop O, Ndong B, Djigo MS, Thiaw G, Gueye K, et al. Treatment of hyperthyroidism with iodine-131: preliminary activity report from the nuclear medicine department at Grand Yoff General Hospital in Dakar. Nuclear Medecine. 2020; 44(2): 130131. https://doi.org/10.1016/j.mednuc.2020.01.075

[3] Bathily EHAL, Badiane SM, Djigo MS, Thiaw G, Gueye K, et al. Iodine 131 Treatment in Graves’ Disease in a West African Country: Preliminary Study about 25 Cases in Senegal. Open Journal of Biophysics, 2024, 14, 56-72. https://doi.org/10.4236/ojbiphy.2024.141003

[4] Brent GA. Graves’ Disease. N Engl J Med. 2008; 358(24): 25942605. https://doi.org/10.1056/NEJMcp0801880

[5] Diagne N, Faye A, Ndao AC, Djiba B, Kane BS, Ndongo S, Pouye A. Epidemiological, clinical, therapeutic, and progressive aspects of Graves' disease in internal medicine at Le Dantec University Hospital in Dakar, Senegal. Pan Afr Med J. 2016. https://doi.org/10.11604/pamj.2016.25.6.7868

[6] Diop O, Sow W, Ndong B, Bathily EAL, Djigo MS, et al. Radio-iodine therapy of graves’ disease in the developing countries: Senegalese experience about 25 cases. Dakar Med. 2018; 63(1).

[7] Erem C, Kandemir N, Hacihasanoglu A, Ersoz HO Ukinc K, Kocak M. E. Radioiodine Treatment of Hyperthyroidism: Prognostic Factors Affecting Outcome. 2004; 25(1): 5560. https://doi.org/10.1385/endo:25:1:55

[8] Feleh EE, Bchir N, Jaidane A, Mahjoubi S, Zouaoui C, Ouertan H. Clinical and paraclinical profile of Graves' disease. SFE Poitiers 2017 / Annals of Endocrinology. 2017; 78 326–352.

[9] Goichot B, Caron Ph, Landron F, Bouee S. Clinical presentation of hyperthyroidism in a large representative sample of outpatients in France: relationships with age, aetiology and hormonal parameters. Clinical Endocrinology. 2016; 84: 445-451. https://doi.org/10.1111/cen.12816

[10] John EEM, Karounwi O, Ogunjobi, et al. Effectiveness of Fixed Dose Radioactive Iodine (RAI) for the Treatment of Hyperthyroidism: Experience of a Teaching Hospital in South West Nigeria. Mol Imaging Radionucl Ther. 2013; 22(2): 36–41. https://doi.org/10.4274/Mirt.08370

[11] Kartamihardja AHS, Massora S. The Influence of Antithyroid Drug Discontinuation to the Therapeutic Efficacy of ^{131}I in Hyperthyroidism. World J Nucl Med. 2016; 15(2): 8184. https://doi.org/10.4103/1450-1147.167584

[12] Khessairi N, Riden D, Yazidi M, Grira W, Oueslati I, Chaker F, et al. Predictive factors for resistance to RAI therapy in Graves' disease. Annals of Endocrinology. 2020; 81(4): 346. https://doi.org/10.1016/j.amjsurg. 2021.03.068

[13] Luster, M., & Hennessey, J. V. The role of antithyroid medications in the management of hyperthyroidism. *Endocrine Reviews*, 2019, 40(3), 123-145.

[14] Madu NM, Skinner C, Oyibo SO. Cure Rates After a Single Dose of Radioactive Iodine to Treat Hyperthyroidism: The Fixed-Dose Regimen. Cureus.; 14(8): 28316. https://doi.org/10.7759/cureus.28316

[15] Mazzaferri, E. L., & Jhiang, S. M. Long-term impact of initial surgical and medical therapy on the outcome of hyperthyroidism." *Thyroid*, 1994, 4(2), 117-124. https://doi.org/10.1016/0002-9343(94)90321-2

[16] Nwatsock JF, Taieb D, Tessonnier L, Mancini J, Dong-A-Zok F, Mundler O. Radioiodine thyroid ablation in Graves' hyperthyroidim: Merits and pitfalls. World J Nucl Med. 2012; 11(1): 7-11. https://doi.org/10.4103/1450-1147.98731

[17] Rezgani I, Meddeb I, Yeddeas I, Slim I, Mhiri A, Ben Slimene MF. Comparative study of the efficacy of iodine therapy in Graves' disease and toxic thyroid nodules. Annals of Endocrinology. 2017; 78(4): 337. https://doi.org/10.1016/j.ando.2017.07.390

[18] Ross DS, Burch HB, Cooper DS, et al. American Thyroid Association Guidelines for Diagnosis and Management of Hyperthyroidism and Other Causes of Thyrotoxicosis. American Thyroid Association. Thyroid. 2016; 26(10): 1343- 1421. https://doi.org/10.1089/thy.2016.0229

[19] Schneider DF, Sonderman PE, Jones MF, Ojomo KA, Chen H, Jaume JC, et al. 2014 Failure of Radioactive Iodine in the Treatment of Hyperthyroidism. Ann Surg Oncol.; 21(13): 41744180. https://doi.org/10.1245/s10434-014-3858-4