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Radioactive Iodine Therapy for Graves' Disease in Childhood and Adolescence: A Single-Center Saudi Experience

El Bez I, Alsakran S, Tulbah R, Alghmlas F and Alharbi M*

Department of Nuclear Medicine, King Fahad Medical City, Riyadh, Saudi Arabia

Abstract

Objective: The aim of the present study was to evaluate the utility of radioiodine treatment for thyrotoxicosis in childhood and adolescence and to evaluate its outcomes.

Materials and Methods: This was a retrospective monocentric study of 15 patients (ages 7 to 18 years) with a diagnosis of thyrotoxicosis who received iodine-131 (I-131) treatment from January 2015 to July 2019 in the Nuclear Medicine department of King Fahd Medical city. The collected data of the patients included gender, age, previous Antithyroid Drug Treatment (ATD), thyroid technetium uptake, the dose of iodine 131 administrated and the number of radioiodine therapy, as well as the thyroid status at 6 months after treatment.

Results: The study included 15 patients (100% female) treated with fixed dose of radioactive iodine. All children and adolescents underwent 99m technetium thyroid scan with uptake before the procedure. There was no case of associated unilateral or bilateral exophthalmia. Thyroid uptake value was calculated using Sodium Pertechnetate. The average of the treatment activity of iodine 131 was 340.4 MBq (247.9-555). There was no vomiting in all cases. Six months after treatment, 7/15 were euthyroid, and 8/15 were hypothyroid. There was no hyperthyroid. All the patients received single radioiodine treatment.

Conclusion: The results of the present study redemonstrate the efficiency of the radioiodine treatment in childhood and adolescence and support the safe use of radioiodine in treating hyperthyroidism in this particular population. It is well suitable as a good second-line therapy for patients who fail to respond to ATD treatment. Although special treatment precautions may be required in this age group, the ease of administration, effectiveness and safety of radio dine 131 continue to make it more and more attractive for initial treatment of hyperthyroidism, especially when the appropriate treatment activity is prescribed.

Keywords: Radioiodine treatment; Thyrotoxicosis; Children; Adolescence

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Correspondence:
Intidhar EL BEZ, Department of Nuclear Medicine, King Fahad Medical City, Riyadh 11525, Saudi Arabia, Tel: 966553320337;
E-mail: elbez.intidhar@yahoo.fr

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Introduction

Hyperthyroidism is an infrequent endocrinopathy in childhood and adolescence, accounting only 0.02% of all cases [1]. The most common cause of juvenile thyrotoxicosis is Graves' Disease (GD), affecting about 10% to 15% of all thyroid diseases [2]. However, GD is even rare for young child, under the age of 5 years; reaching a peak incidence at age 10 years to 15 years, with significant female predominance [2,3]. The management of juvenile hyperthyroidism remains a therapeutic challenge and remains controversial until now [4]. The current therapeutic methods of thyrotoxicosis include the treatment with Antithyroid Drugs (ATD) as a first line followed by definitive therapy including both Radioactive Iodine (RAI) therapy and thyroidectomy, which usually considered in cases of relapse, ATD toxicity, or lack of compliance [4].

However, it is well known and clearly established that medical treatment by ATD is commonly associated with a high relapse rate in addition to high risk of side effects and low compliance associated with prolonged therapy [3,4]. The last one is a real limitation, reported in several literature reviews [2-4]. Moreover, authors revealed that 35% to 60% of patients relapsed after ATD discontinuation [3]. Therefore, several authors recommended definitive therapy as the first line treatment [4].

RAI was proposed for the treatment of juvenile GD, more than 60 years ago [5]. In the years since, the use of radioactive iodine to treat Graves' disease has been reported for 1000 children,

with administered iodine-131 doses ranging from 1.85 Mbq/g to 14.5 Mbq/g [6,7–14]. Follow up studies have not revealed increases in rates of thyroid cancer or genetic abnormalities in children or in the off spring of such children treated with moderate or high doses of radioactive iodine [15]. These observations coupled with saddening results associated with medical therapy for most patients conduct to the increased use of radioactive iodine for treating Graves' disease in children [7,13].

Due to its very high cure rate, exceeding almost 95%, with single dose, less toxicity and less relapse rate, there is a significant increasing tendency to favorite RAI treatment as the first therapeutic line in this particular population [16]. To obtain a successful treatment, RAI should be administered at appropriate doses [16]. The RAI had double effect, due to physical radioiodine-mediated destruction via gamma emission and also a particular effect on thyroid autoimmunity [16].

The present study reviews our local experience in the treatment of infants and adolescent patients, with hyperthyroidism and evaluates the effectiveness and the outcome of this simple radical treatment. Emphasis was placed on the reasons for a change in medical treatment, utility of treatment, need for treatment and development of hypothyroidism, thus encourage preferring the radioiodine as first line in the treatment of hyperthyroidism in children and adolescents.

Materials and Methods

In this retrospective monocentric study, all children and adolescent patients who received RAI treatment for hyperthyroidism, at the Nuclear Medicine Department of King Fahd Medical City, Riyadh, Kingdom of Saudi Arabia, from January 2015 to July 2019, was included. The indication for therapy among all patients was failure of the prior medical treatment. The collected data of the patients included gender, age, previous Antithyroid Drug Treatment (ATD), thyroid technetium uptake, the dose of iodine 131 administrated and the number of radioiodine therapy, as well as the thyroid status at 6 months after treatment.

All patients were performed Technetium-99m pertechnetate scintigraphy to calculate the thyroid uptake value. Approximately 185 MBq of 99mTc-pertechnetate was administrated to the patient intravenously. Fifteen min after the administration, anterior planar images of the neck and chest were acquired using a gamma camera equipped with high resolution parallel whole collimator (Bright view, Philips, USA) with an acquisition time of 10 min, using a 20% window centered on the 140 KeV peak of 99mTc and a 128 × 128 computer matrix. Thyroid uptake value was calculated using Sodium Pertechnetate. The normal range was between 0.5% to 3.5%.

Images were analyzed by an experienced board-certified nuclear medicine physician

All patients were treated, conformed to the department protocol with a fixed dose. All patients were followed and evaluated 6 months after therapy. We classified our patients into 2 groups according to success or failure of therapy. Success treatment included euthyroidism and hypothyroidism, while treatment failure included persistent hyperthyroidism.

Results

Between January 2015 and July 2019, 15 patients (100% female) were collected. The mean age was 14.6 years (range, 7 to 18 years). All patients had been treated medically by ATD before receiving RAI. There was no case of unilateral or bilateral exophthalmia. The thyroid scintigraphy features showed in all cases enlarged thyroid gland with markedly increased radiotracer trapping with homogenous distribution (Figure 1). The thyroid uptake Thyroid uptake value was calculated using sodium pertechnetate and it was high in all cases with an average of 20% (range, 17% to35 %) (Figure 1). The average of the treatment activity of iodine 131 was 340.4 MBq (247.9 to 555). There was no vomiting in all cases.

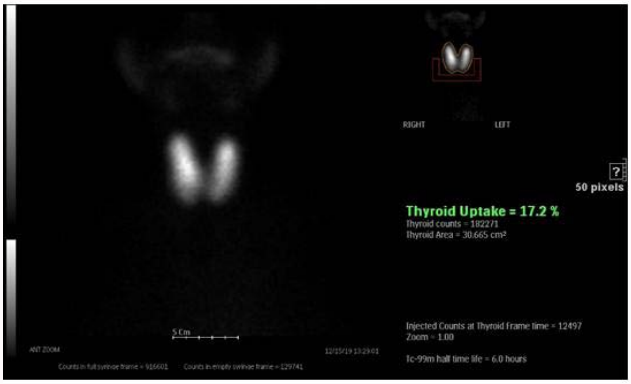

Figure 1: Technetium-99m pertechnetate scintigraphy showed enlargement thyroid gland, with increased homogeneous radiotracer uptake. There is a decrease in background activity. Thyroid uptake value: 17.2 % (normal range between 0.5% to 3.5%). The findings are consistent with Diffuse Toxic Goiter (Graves' disease).

The analysis showed that at 6 months after treatment 7/15 was euthyroid, and 8/15 was hypothyroid. There was no hyperthyroid. As the patients were classified into 2 groups according to treatment success (euthyroid and hypothyroid) and treatment failure (hyperthyroid). The treatment success was 15/15. All the patients received single radioiodine treatment.

Discussion

The treatment of thyrotoxicosis using RAI was introduced, about 80 years ago, since the 1940s and was initially limited to adult patients [17]. However, this treatment has lately included children and adolescents [4,16-19]. The objective of RAI treatment in hyperthyroidism was to reach the hypothyroid state [17]. In adult patients, there is a clear emphasis of the RAI as a first line therapy in many countries, while, it remains restricted in young patients, until nowadays [4,16-19]. There is no clear consensus guideline on RAI treatment for juvenile hyperthyroidism, concerning the indication and the appropriate dose [16]. The dose used for treatment in this population varies among investigators [16-25]. Empiric RAI dose is estimated based on thyroid gland volume and Iodine uptake [17]. Some recent studies included thyroid gland size estimated clinically or by ultrasound and I-131 delivered dose to thyroid tissue, that could influence treatment outcome [4,21,26].

In 2003, Rivkees et al. [21] reported a statically significant relation between the hypothyroidism rates and the iodine 131 doses and was respectively 50%, 70%, and 95% obtained with Iodine131 doses of 100 Gy (110 µCi/g), 200 Gy (220 µCi/g), and 300 Gy (330 µCi/g) [21]. The protocol of our department was the fixed dose, as recommended by many authors [22,23,27]. A single fixed dose was prescribed for all patients, taking into consideration the thyroid uptake calculated by using Sodium Pertechnetate.

A deep review of the literature revealed a very high remission rate (>95%) with doses >150 µCi/g [16,20,28]. The predictors factors of

treatment failure included the male gender, initial high free thyroxin at diagnosis, a palpable goiter, prior use of ATD, time elapsed before RAI treatment, and exophthalmia [25,29]. This could partly explain the high success rate in the current study, as all the patients were female, with no pre-existing exophthalmia.

Conclusion

The current study and the review of literature re-demonstrate that RAI is safe and effective as a second-line therapy for juvenile patients who fail to respond to ATD treatment. However, high cure rate, exceeding almost 95%, with single dose, less toxicity and less relapse rate, continue to make RAI more and more attractive for initial treatment of hyperthyroidism in this particular population, especially when the appropriate treatment activity is prescribed.

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