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# **14 years Radioiodine Therapy in Management of Thyrotoxicosis (Single Institutional Study)**

**Abd El-Kareem, M and Abougabal M.**

*Nuclear Medicine Unit, Kasr Al-Ainy Hospital, Cairo University, Cairo, Egypt.*

## **ABSTRACT:**

**Objective:** Present our 14-year experience in Radioactive iodine-131 (131RAI) therapy in Graves`s disease (GD) and toxic adenoma (TA). **Methods:** 525 patients were included, 445 were having GD and 80 TA. one hundred ninety-nine patients received first dose ranging from 296 - 444 MBq and 326 received dose ranging from 555- 1073 MBq. **Results:** Among 525 patients, 368 (70.1%) recovered, out of them 66.3% patients with GD and 91.3% patients with TA, with a statistically significant difference in cure rate between both groups in favor of the latter ( $P < 0.001$ ). Higher doses had higher cure rate in GD (75.5 % vs. 50.3 %,  $P < 0.001$ ), however no difference in cure rate between higher and lower doses was found TA (93.2 % vs. 88.9 %,  $P = 0.69$ ).

In GD; male gender, presence of ophthalmopathy, moderate & large sized glands, absence of old thyroidectomy, higher Tc99m uptake and lower 131-RAI were less likely to be cured, in TA, less response was

found in higher thyroid uptake & TSH values. In multivariate analysis; medium & large sized glands and higher Tc-99m thyroid uptake values were found to be independent variables that reduce response in GD while only higher thyroid uptake value was found to be an independent variable that adversely affects response in TA.

The second therapy dose controlled the remaining seven patients who had TA with 100 response rate, while achieving 87.3% response rate in GD patients. The remaining uncontrolled nineteen GD patients required two more additional doses.

**Conclusion:** 131-RAI is successful after two doses; however some patients may need up to four doses. Higher first dose is recommended for those who expect to have lower cure rate such as who had medium & large sized glands in GD and higher Tc-99m thyroid uptake in GD & TA, but this is not necessary in the second dose.

**Key Words:** Graves` disease; radioactive iodine; toxic adenoma.

**Corresponding Author:** Abd El-Kareem, M. **E-mail:** [maha\\_abdelkareem@yahoo.com](mailto:maha_abdelkareem@yahoo.com).

## INTRODUCTION:

Hyperthyroidism is treated by anti-thyroid drugs, radioactive iodine-131 (131-RAI), and surgery <sup>(1)</sup>. 131-RAI is the favorable choice for most patients with Graves' diseases (GD) and toxic adenoma (TA) due to its high efficacy with a cure rate 100% after single or multiple doses <sup>(2)</sup>, lower side effects, most reliable therapeutic options, relatively inexpensive, administered simply, targeted tissue specific therapy and it is safe in all age groups <sup>(3)</sup>.

The main goal of radioiodine therapy is to destroy sufficient over functioning thyroid tissue to cure hyperthyroidism <sup>(4)</sup>. Controversy exists regarding the optimal dose of 131-RAI <sup>(3)</sup>. The methods used to determine the 131-RAI dose include fixed dose and calculated dose based on gland size, iodine uptake and turnover <sup>(5)</sup>. However, it is clear that most patients develop hypothyroidism after therapy <sup>(6)</sup>. The low doses are designed to avoid or delay hypothyroidism; however, may fail to cure hyperthyroidism. Most patients who become euthyroid soon after radioiodine therapy eventually develop hypothyroidism at a rate of approximately 5% per year <sup>(7)</sup>. Permanent hypothyroidism seems inevitable in Graves' disease, whereas this risk is much

lower when treating toxic adenoma.

The response to 131-RAI therapy is to some extent related to the radiation dose. Inaccurate measurement of 131-I biokinetics and improper estimation of the internal dosimetric factors, such as the thyroid follicle size and the individual radio sensitivity interfere with the accurate calculation of the exact 131-RAI dose. Moreover, many factors interfere with the efficacy of 131-I treatment, and they may even mutually interact together & counteracting each other. Several studies have evaluated the efficiency of 131-I therapy and their results have been conflicting, probably due to differences in sample size, patient selection and dose calculation, however it is clear that no single factor reliably predicts the 131-RAI therapy outcome <sup>(8)</sup>.

## MATERIAL AND METHODS:

525 hyperthyroid patients over 18 years referred for 131-RAI therapy to nuclear medicine unit at Kasr Al aini, Cairo University in last 14 years for Graves' disease and toxic adenoma confirmed clinically & laboratory as well as by thyroid scan.

Patients less than 18 years, patients with thyrotoxic symptoms due to thyroiditis, patients who had an associated cold nodule on thyroid scan, pregnant and breast feeding patients and patients with toxic multinodular goiter (Plummer's disease) were excluded from this study.

The institutional medical ethics committee approved the protocol.

In our center we adapted fixed dose method with considerable cost saving advantages, based on size of thyroid gland and Tc-99m pertechnetate uptake ranging from (8-25 mCi). The data from our database; including age, gender, symptoms, type and response to initial treatment if present, presence of eye signs, thyroid function test including FT3, TT3, FT4, TT4 and TSH levels $\pm$  Neck ultrasound as well as if any palpable nodules was recorded. Tc99m pertechnetate thyroid scan was done using gamma camera fitted with low energy high resolution parallel-hole collimator, with the window width at  $\pm$  15% centered on 140 keV in a 128 x 128 matrix for 500.000 counts per view on anterior view projection while the patients in a supine position with neck

extension. Quantitative evaluation of thyroid uptake was done using on-line computer system. All counts were corrected for the acquisition time and decay of 99m-Tc pertechnetate. Normal thyroid uptake value determined within the range (0.5 - 4%).

The size of the gland /toxic adenoma was divided in to either average size (impalpable) & mildly enlarged (palpable but not visible) or moderate & markedly enlarged (palpable and visible). Patients were categorized into two groups: Graves' disease and toxic adenoma. Each group is then divided according to given dose in to two groups: who receive lower dose of RAI ranging from 8-12 and who receive higher doses ranging from 15-25 mCi.

Anti-thyroid drugs were withdrawn a week before therapy if given before therapy, and for another 1 week after therapy to avoid any drug influence on the therapeutic effectiveness. Iodine-containing medications were also discontinued several weeks before therapy; moreover, the patients were advised to be on low-iodine diet for 10 days before therapy, fasted 2 hours before and after given the dose to achieve higher absorption.

Clinical and laboratory follow-up to classified according to the outcome in to euthyroid with absence of signs or symptoms of hyperthyroidism or hypothyroidism and normal serum TSH values (0.5-4 mcIU/ml) without levothyroxin therapy for 6 months, resistant to therapy: with persistent thyrotoxic manifestation & suppressed TSH value ( $< 0.5$  mcIU/ml) or hypothyroid: if symptoms or signs of hypothyroidism develop with elevated TSH value ( $> 4$ mcIU/ml) on two occasions four weeks apart and require permanent treatment with levothyroxine. Treatment was considered to be successful if the patient was either euthyroid or hypothyroid. For patients with persistent disease, further fixed therapy doses were done with minimum 3 months after every dose until complete recovery.

Statistical analysis: Data was analyzed using statistical package of social science software program, version 15 (SPSS). Data was summarized using: Mean, SD, percentile, minimum, maximum and range for quantitative variables and number and percent for qualitative variable. Comparisons between variables were done using chi square test for qualitative variables and independent t-test for quantitative variables. Binary logistic regression analysis was done to test for significant predictors of the response to treatment.

Odds ratio (OR) with it 95% confidence interval (CI) were used for risk estimation. P-value  $< 0.05$  was considered significant.

## RESULTS:

Patient characteristics, early complications and delayed outcome are listed in **Table (1 and 2)**. Of the 525 patients, 445 (84.8%) were having Graves' disease and 80 (15.2%) toxic adenoma. 199 patients (37.9%) were treated with a first dose ranging from 296-444 MBq and 326 (62.1%) received a dose ranging from 555- 1073 MBq . The overall response rate to the first therapy dose was 70% (368 patients) with development of euthyroidism in 222 patients (60.3%) and hypothyroidism in 146 patients (39.7%). Regarding the whole population , there was a significantly higher cure rate for patients treated with a high doses compared with those given lower doses (77.9% vs. 57.3%,  $P < 0.0001$ ) and in patients who had toxic adenoma compared to who had Graves` disease (91.3% vs. 66.3%,  $P < 0.001$ ) , Graves' patients had a higher incidence of hypothyroidism (31.5% vs. 7.5%,  $P < 0.0001$ ). Males had a lower cure rate than females (61.4% vs. 73.8%,  $P = 0.005$ ). Patients with history of thyroidectomy ( $P = 0.022$ ) were more likely to be cured after a single dose of RAI, whereas those who had medium or large sized goiters ( $P < 0.0001$ ).

Higher Tc99m thyroid uptake value (P< 0.0001) and history of previous medical treatment (P= 0.001) were less likely to be

cured after a single dose of I-131.

The other factors were not significantly associated with cure rate (*Table 3*).

**Table (1):** Patients characteristics, clinical data, laboratory results, thyroid uptake level and RAI doses.

	Graves' disease N= 445	Toxic adenoma N = 80	P value
<b>Gender</b>			
Female	301 (67.6%)	66 (82.5%)	P= 0.008
Male	144 (32.4%)	14 (17.5%)	
<b>Mean age and SD (year)</b>	40.98±11.880	52.81± 9.682	P< 0.001
<b>Ophthalmopathy</b>			
Yes	109 (24.5%)	0 (0%)	P< 0.001
No	336 (75.5%)	80 (100%)	
<b>Previous medical treatment</b>			
Positive	327 (73.5%)	22 (27.5%)	P< 0.001
Negative	118 (26.5%)	58 (72.5%)	
<b>Mean Duration of medical treatment and SD</b>	21.21± 32.9	26.19± 57.9	P< 0.001
<b>Previous surgical treatment</b>			
Yes	63 (14.2%)	4 (5%)	0.574
No	382 (85.8%)	76 (95%)	
<b>Size of the thyroid gland</b>			
Average and mildly enlarged	224 (50.3%)	33 (41.3%)	P=0.027
Moderate and markedly enlarged	221 (49.7%)	47 (58.9%)	
<b>Suppression of the rest of the gland in toxic nodular disease</b>			
Partial suppression		14 (25.9%)	
Complete suppression		40 (74.1%)	
<b>Dose of RAI 131 given</b>			
Low dose	163 (36.6%)	36 (45%)	P= 0.169
High dose	282 (63.4%)	44 (55%)	
<b>Mean Base TSH and SD</b>	0.08 ± .26	0.1± 0.32	P= 0.313
<b>Mean Tc 99 m Uptake and SD</b>	14.7±10	7.1± 8.4	P< 0.001
<b>Mean pre-therapy Free T 3 level and SD</b>	10.8 ± 9.5	5.7± 3.3	P= 0.008
<b>Mean pre-therapy Free T 4 and SD</b>	13.9±19.4	12.4±14.5	P= 0.715
<b>Mean pre-therapy total T 3 and SD</b>	334.3±157.5	278.6±131.5	P= 0.256
<b>Mean pre-therapy total T 4 and SD</b>	23.7± 28.4	22.4± 13.4	P= 0.848

**Table (2):** Early complications and delayed outcome.

		Graves' disease	Toxic adenoma	P value
<b>No complications</b>		407 (91.5%)	80 (100%)	P= 0.002
<b>Early complications</b>	<b>Neck pain</b>	2 (0.4%)	0 (0%)	
	<b>Exacerbation of hyperthyroidism symptoms</b>	23 (5.2%)	0 (0%)	
	<b>Transient hypothyroidism</b>	13 (2.9%)	0 (0%)	
<b>Late outcome</b>	<b>Euthyroidism</b>	189 (42.5%)	73 (91.3%)	< 0.0001
	<b>Hypothyroidism</b>	256 (57.5%)	7 (8.8%)	

**Table (3):** Relationship between clinical factors with outcome of RAI therapy.

	Cure with 1 dose of radioiodine N= 368	Cure with > 1 dose of radioiodine N = 157	P value
<b>Type of thyrotoxicosis</b>			
<b>Graves` disease</b>	295 (66.3%)	150 (33.7%)	P< 0.001
<b>Toxic adenoma</b>	73 (91.3%)	7 (8.7%)	
<b>Gender</b>			
<b>Female</b>	271 (73.8%)	96 (36.2%)	P= 0.005
<b>Male</b>	97 (61.4%)	61 (38.6%)	
<b>Mean age and SD (year)</b>	43.0±12.5	42.3± 12.0	P= 0.520
<b>Previous medical treatment</b>			
<b>Positive</b>	228 (65.3%)	121 (34.7%)	P< 0.001
<b>Negative</b>	140 (79.5%)	36 (20.5%)	
<b>Previous surgical treatment</b>			
<b>Yes</b>	55 (82.1%)	12 (17.9%)	P= 0.022
<b>No</b>	313 (68.3%)	145 (31.7%)	
<b>Size of the thyroid gland</b>			
<b>Average and mildly enlarged</b>	200 (77.8%)	57 (22.2%)	P< 0.0001
<b>Moderate and markedly enlarged</b>	168 (62.7%)	100 (37.3%)	
<b>Dose of RAI 131 givens</b>			
<b>Low dose</b>	114 (57.3%)	85 (42.7%)	P< 0.0001
<b>High dose</b>	254 (77.9%)	72 (22.1%)	
<b>Mean Base TSH and SD</b>	0.08 ± 0.3	0.08± 0.2	P= 0.879
<b>Mean Tc 99 m Uptake and SD( N 0.5 to 5.0 mIU/L)</b>	12.6±9.5	18.0±11.7	P< 0.0001
<b>Mean pre-therapy Free T 3 level and SD(N0.2 to 0.5 ng/dl)</b>	9.4 ± 8.6	10.0± 10.0	P= 0 .806
<b>Mean pre-therapy Free T 4 and SD(N0.8 to 1.8ng/dL).</b>	12.1±15.8	20.8±27.5	P= 0.069
<b>Mean pre-therapy total T 3 and SD(N100 to 200 ng/dl)</b>	316.0±154.9	340.4±146.2	P= 0.653
<b>Mean pre-therapy total T 4 and SD(N4.5 to 11.2 mcg/Dl)</b>	23.4± 25.0	22.8±24.0	P= 0.937

In Graves' disease, there was no significant statistical difference in response rate regarding sex, presence of ophthalmopathy, previous thyroidectomy, size of the gland, <sup>131</sup>RAI and <sup>99m</sup>Tc uptake (P values 0.01, P =0.01, P=0.001, P<0.001, P<0.001 and P =0.003 respectively), where male gender,

presence of opthalmopathy, moderate & large sized glands, absence of old thyroidectomy, higher <sup>99m</sup>Tc uptake and lower <sup>131</sup>-RAI were less likely to be cured and no significant statistical difference in response rate regarding the other factors (*Table 4*).

**Table (4):** Outcome of a single fixed dose of radioiodine for patients with Graves' disease in relation to clinical factors.

	Response N= 295 (66.3%)	Non response N= 150 (33.7%)	P value
<b>Gender</b>			
Female	212 (70.4%)	89 (29.6%)	P= 0.01
Male	83 (57.6%)	61 (42.4%)	
<b>Mean age and SD (year)</b>	40.56±11.832	41.82± 11.969	P= 0.289
<b>Ophthalmopathy</b>	61 (56%)	48 (44%)	P= 0.01
Yes	234 (69.6%)	102 (30.4%)	
No			
<b>Previous medical treatment</b>			
Positive	209 (63.9%)	118 (36.1%)	P= 0.088
Negative	86 (72.9%)	32 (27.1%)	
<b>Duration of medical treatment</b>			
Less than 1 year	113 (62.4%)	68 (37.6%)	P= 0.903
More than 1 year	71 (61.2%)	45 (38.8%)	
<b>Previous surgical treatment</b>			
Yes	53 (84.1%)	10 (15.9%)	P= 0.001
No	242 (63.4%)	140 (36.6%)	
<b>Size of the thyroid gland</b>			
Average and mildly enlarged	169 (75.4%)	55 (24.6%)	P< 0.001
Moderate and markedly enlarged	126 (57%)	95 (43%)	
<b>Dose of RAI <sup>131</sup> givens</b>			
Low dose	82 (50.3%)	81 (49.7%)	P< 0.001
High dose	213 (75.5%)	69 (24.5%)	
<b>Mean Base TSH and SD</b>	0.1±0.3	0.1±0.2	P= 0.488
<b>Mean Tc 99 m Uptake and SD</b>	13.8±9.6	17.9± 11.0	P=0.003
<b>Mean pre-therapy Free T 3 level and SD(N0.2 to 0.5 ng/dl)</b>	10.7 ±10.0	11.2± 10.5	P= 0.868
<b>Mean pre-therapy Free T 4 and SD(N0.8 to 1.8ng/dL).</b>	12.0±16.1	22.9±29.8	P= 0.204
<b>Mean pre-therapy total T 3 and SD(N100 to 200 ng/dl)</b>	331.1±158.3	349.4±165.0	P= 0.783

Logistic regression analysis showed medium & large goiters, higher thyroid uptake and TA were found to be an independent variable that adversely affects response with OR of 2 (95%CI: 1.2-3.6), 1 (95% CI: 1-1.1) and 4.3 (95%CI: 1.3-14.7) respectively (**Table 6**).

Logistic regression analysis showed gland size and Tc99m thyroid uptake were found to be an independent variable that affects response with OR of 2.2 (95% CI: 1.2-3.8) and 1 (95% CI: 1-1.1) respectively (**Table 6**).

In patients with toxic adenoma significant difference was found regarding Tc-99m thyroid uptake and TSH level (P values 0.019 and 0.014 respectively) with more response in lower thyroid uptake & TSH values (**Table 5**). Logistic regression analysis showed thyroid uptake value to be an independent variable that affects response with OR of 1 (95% CI: 0.9-1.1) (**Table 6**).

**Second dose of RAI:** All remaining seven patients who had toxic adenoma had achieved cure after second dose (range 444 - 555 MBq) with development of euthyroidism in 6 patients and hypothyroidism in the remaining one. The second dose was given to uncontrolled 150 Graves's disease patients ranging from 296 -740 MBq with higher response rate (87.3%) compared to the first dose (66.3%) with development of euthyroidism in 33 (25.4%) out of 131 responding patients to the second dose and hypothyroidism in 98 patients (74.8%). There was no significant statistical difference in response rate regarding any of the factors to the second dose of RAI (**Table 7**). Among the remaining 19 (12.7%) Graves's disease patients, 16 patients (84.2%) achieved response after third dose and the remaining three patients achieved response after 4<sup>th</sup> dose.

**Table (5):** Outcome of a single fixed dose of radioiodine for patients with toxic adenoma in relation to clinical factors.

	Response N=295 (66.3%)	Non response N=150 (33.7%)	P value
<b>Gender</b>			
Female	59 (89.4%)	7 (10.6%)	P= 0.344
Male	14 (100%)	0 (0%)	
Mean age and SD (year)	52.9±9.8	51.6± 8.5	P= 0.725
<b>Size of the thyroid gland</b>			
Average and mildly enlarged	31 (93.9%)	2 (6.1%)	
Moderate and markedly enlarged	42 (89.4%)	5 (10.63%)	P= 0.694
<b>Suppression of the rest of the gland</b>			
Partial suppression	13 (92.9%)	1 (7.1%)	P=1.0
Complete suppression	38 (95%)	2 (5%)	
<b>Dose of RAI 131 givens</b>			
Low dose	32 (88.9%)	4 (11.1%)	P= 0.695
High dose	41 (93.2%)	3 (6.8%)	P= 0.344
Mean Base TSH and SD	0.1±0.2	0.4±0.7	P= 0.014
Mean Tc 99 m Uptake and SD	6.5±6.2	18.1± 27.7	P= 0.019
Mean pre-therapy Free T 3 level and SD(N0.2 to 0.5 ng/dl)	5.7±3.4	5.5± 2.9	P= 0.905
Mean pre-therapy Free T 4 and SD(N0.8 to 1.8ng/dL).	12.5±15.0	11.4±12.0	P= 0.908
Mean pre-therapy total T 3 and SD(N100 to 200 ng/dl)	266.4±139	319.3±116.7	P= 0.564
Mean pre-therapy total T 4 and SD(N4.5 to 11.2 mcg/Dl)	23.2± 14.1	17.6± 9.7	P= 0.513

**Table (6):** Logistic Regression for factors affecting response rate.

Whole study population						
	B	S.E.	P value	OR	95% C.I. for OR	
					Upper	Lower
Gland size	0.724	0.283	0.010	2.062	1.185	3.588
Tc99m Uptake	0.033	0.013	0.009	1.034	1.009	1.060
Type of thyrotoxicosis	1.467	0.643	0.019	4.334	1.276	14.725
Graves` Disease						
Gland size	0.768	0.289	0.008	2.156	1.225	3.796
Tc99m Uptake	0.029	0.013	0.025	1.030	1.004	1.057
Toxic adenoma						
Tc99m Uptake	0.077	0.042	0.066	1.080	0.995	1.172

B: regression coefficient, SE: standard error, OR: odds ratio, CI: confidence interval.

**Table (7):** Outcome of a second dose of RAI in Graves's disease patients and its relation to different clinical factors.

	<b>Response N=131 (87.3%)</b>	<b>Non response N=19 (12.7%)</b>	<b>P value</b>
<b>Gender</b>			
Female	77 (86.5%)	12(13.5%)	P = 0.806
Male	54 (88.5%)	7 (11.5%)	
<b>Mean age and SD (year)</b>	41.73±11.64	42.42± 14.34	P= 0.816
<b>Previous medical treatment</b>			
Positive	100 (84.7%)	18 (15.3%)	P= 0.077
Negative	31 (96.9%)	1 (3.1%)	
<b>Duration of medical treatment</b>			
Less than 1 year	59 (86.8%)	9 (13.2%)	P= 0.432
More than 1 year	36 (80%)	9 (20%)	
<b>Previous surgical treatment</b>			
Yes	10 (100%)	0 (0%)	P=0.363
No	121 (86.4%)	19 (13.6%)	
<b>Size of the thyroid gland</b>			
Average and mildly enlarged	50 (90.9%)	5 (9.1%)	P=0.446
Moderate and markedly enlarged	81 (85.3%)	14 (14.7%)	
<b>Dose of RAI 131 given</b>			
8-10 mCi	57 (87.7%)	8 (12.3%)	
12-15mCi	51 (89.5%)	6 (10.5%)	P= 0.630
> 15 mCi	23 (82.1%)	5 (17.9%)	
<b>Mean Base TSH and SD</b>	0.1±0.2	0.1±0.03	P= 0.315
<b>Mean Tc 99 m Uptake and SD</b>	17.4±10.76	21.5± 13.2	P= 0.322
<b>Mean pre-therapy Free T3 level and SD</b>	24.3±30.5	4.1	P= 0.535
<b>Mean pre-therapy total T3 and SD</b>	332.2±159.6	392.5±236.9	P= 0.702
<b>Mean pre-therapy total T4 and SD</b>	25.4± 30.7	20.2± 3.8	P= 0.822

## DUSCUSSIONS:

Early neck pain & mild exacerbation of hyperthyroid symptoms observed in 0.4 and 5.2 respectively in the patients who had Graves`s disease, while no early complication reported in patients who had toxic adenoma received 131-RAI in our study. Thyroid storm did not encountered in any patient in the current study and this matched *Levy et al.*, study who did not documented this complication among 7000 patients treated with RAI <sup>(9)</sup>, however *McDermott et al.*, reported thyroid storm in a small number of patients in the first two weeks of therapy <sup>(10)</sup>.

Our results matched the previous studies that have been investigated the predictive factors associated with 131-RAI success rate, most demonstrated lower success rates in young males, more severe hyperthyroidism <sup>(11,12)</sup> larger goiters <sup>(12,13)</sup> and in cases with high pretreatment thyroid uptake <sup>(14)</sup>. Regarding influence of pretreatment with anti-thyroid drugs on the 131-RAI efficacy, some studies reported that they have a radio-resistance effect <sup>(15, 16 and 17)</sup> and others believe that such effect confined to PTU only in our study no significant difference in response rate was

found <sup>(18)</sup>.

Several studies have demonstrated that patients with larger size thyroid glands are more likely to fail to respond to a single dose of RAI <sup>(19, 20, 21, 22, 23, and 24)</sup>.

In the current study this was found in patients who had Graves`s disease, but no significant correlation could be drawn in patients who had toxic adenoma.

The impact of Tc-99m sodium pertechnetate thyroid uptake on the RAI response rate has been investigated by *Zantut-Wittmann et al.*, they reported that Tc99m thyroid uptake lower than 12% can predict treatment success in patients who treated with 10-mCi fixed-dose approach <sup>(21)</sup>.

In contrast, no statistically significant association was found between thyroid Tc99m uptake and outcome to a 15 mCi fixed dose approach in Graves` disease patients in *Moura-Neto et al.*, Study <sup>(22)</sup>.

In the current study there`s is statistically significant difference between Tc-99m thyroid uptake and response rate in patients who had Graves`s disease and toxic adenoma with more success rate in patients who had lower uptake values.

As regards the impact of different doses of RAI on the response rate, there is no statistically significant difference in response rate in patients who had toxic adenoma (P value  $P=0.7$ ), while the difference exists in Graves` disease patients with more success rate in high dose group (75.5%) rather than low dose group (50.3%) P value  $< 0.001$ . This means that higher dose of RAI increase response rate by approximately 25.2 %. *Nordyke and Gilbert*, stated that the 131-RAI optimal doses needed to achieve cure starting with 10mCi and increasing for those who had large glands or who had other predictor factors for treatment failure <sup>(19)</sup>.

## CONCLUSION:

Radioiodine is successful in curing hyperthyroidism in GD & TA patients after two doses; however some patients may need up to four doses. It is preferable be used as a first standard line in treatment. Higher first

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In this study this difference was only detected in the first given dose and not found in the 2<sup>nd</sup> dose that treat the majority of the uncontrolled Graves` disease patients and only few require further doses with a maximum of 4 doses to achieve complete cure rate.

Also *Sanyal et al.*, and *Franklyn et al.*, reported high cure rate to the second dose of RAI (82.4% and 74.5% respectively) with only few require other doses.

The 2<sup>nd</sup> therapy dose treat the rest of the uncontrolled patients who had autonomous adenoma with none needed more doses <sup>(25, 26)</sup>.

dose is recommended for those who expect to have lower cure rate such as who had medium & large sized glands in GD and higher Tc-99m thyroid uptake in GD & TA, but this is not necessary in the second dose.

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