Original Article

Value of the Postablative Thyroglobulin Measurements for Assessment of Disease-Free Status in Patients with Differentiated Thyroid Cancer

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Abstract

Aim: The aim of the study is to evaluate the value of thyroid-stimulating hormone (TSH)-stimulated thyroglobulin (sTg) measurements by the end of the 1st-year postablation in differentiated thyroid cancer (DTC) patients with biochemical non complete response (indeterminate and incomplete response). **Patients and Methods:** One hundred patients with DTC underwent near-total thyroidectomy and radioactive remnant ablation by iodine-131 (I^{131}) with regular follow-up every 6 months during the first 2 years and at 6–12-month intervals thereafter by I^{131} whole-body scan (WBS), neck ultrasound, and sTg measurement in the hypothyroid state (TSH >30 mU/L). Patients were divided according to the imaging findings and sTg level into three groups: excellent response (ER) – no evidence of disease by imaging and sTg <1 ng/mL, indeterminate or acceptable response (AR) – nonspecific findings on imaging studies and sTg < 10 ng/mL, and incomplete response (IR) – patients with incomplete structural and/or incomplete biochemical response (sTg > 10 ng/mL). **Results:** The follow-up at 6-month postablation showed ER in 3 (3%) patients, AR in 29 (29%) patients, and IR in 68 (68%) patients. The second follow-up at 9–12-month postablation showed dramatic biochemical response with ER, indeterminate, and IR in 50 (50%), 34 (34%), and 16 (16%) patients, respectively, and 14 (14%) patient had structural recurrence. This change is highly statistically significant ($P = 0.00$). In the last follow-up (ranges from 3 to 10 years), 53 (55.8%) patients achieved ER, 42 (44.2%) AR and no patient with non complete response. The change in patients with IR between the second and the last follow-up is also statistically significant ($P = 0.001$). **Conclusion:** sTg measurement by the end of the 1st year is more reliable in the follow-up of patients with DTC and biochemical non complete response and considered significant predictor of disease-free status. Patients with biochemical IR still have the chance to achieve ER or AR by the passage of time without additional therapies.

Keywords: *Biochemical incomplete response, differentiated thyroid cancer, I^{131} whole-body scan, thyroid-stimulating hormone-stimulated thyroglobulin*

Introduction

The papillary and follicular differentiated thyroid cancer (DTC) represents more than 90% of all thyroid cancers.[1] An increasing incidence of thyroid cancer has been recognized around the world during the last few decades.[2] The iodine-131 (I^{131}) whole-body scan (WBS) and stimulated thyroglobulin (sTg) are the two key modalities currently in practice for follow-up of patients with DTC. The first is utilized to assess residual or recurrence of disease and the second as the tumor biomarker. The data obtained from both modalities together can modify the management and possibly benefit outcome.[3]

According to the 7th edition of the American Thyroid Association (ATA) management guidelines for adult patients with thyroid nodules and DTC 2015, patients are divided according to their response to treatment into three groups, excellent response (ER), indeterminate or acceptable response (AR), and incomplete response (IR).[4]

An ER was defined as negative imaging results (no evidence of disease [NED]) with very low level of the sTg <1 ng/ml. The indeterminate (acceptable) response was defined as the presence of low serum-sTg level <10 ng/mL or the presence of nonspecific changes in neck ultrasound (US) or nonspecific faint uptake on the whole-body iodine imaging. Finally, the IR may be either structural (local/regional or distal disease evident on imaging examinations) or biochemical (no disease evident) with the presence of elevated sTg ≥10 ng/mL.[5]

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A biochemical IR is seen in 11%–19% of ATA low-risk patients, 21%–22% of ATA intermediate-risk patients, and 16%–18% of ATA high-risk patients.[6]

However, the reported outcomes of individuals with detectable Tg levels in the absence of localizable disease and the benefit from repeating thyroid-stimulating hormone (TSH)-sTg testing in this patient population is uncertain and showed wide variation.[7] It is important to define whether the improvement of the response for these patients from biochemical IR to disease-free status was related to further therapies or simply the passage of time.[8]

Aim of the study

The aim of the study is to evaluate the value of TSH sTg level obtained by the end of the 1st year (9–12 months) after radioactive remnant ablation (RRA) in correlation with I^{131} WBS and neck US for the assessment of disease-free status in patients with DTC and biochemical non complete response.

Patients and Methods

We retrospectively studied the medical archives of 100 adult patients treated for DTC and under follow-up at the Oncology and Nuclear Medicine Center, Faculty of Medicine, Cairo and Zagazig University hospitals between January 2009 and December 2017. The enrollment of patients and collection of data were approved by the ethics committee of the board of nuclear medicine at the oncology and Nuclear Medicine Center, Cairo and Zagazig Universities. Informed consent at the time of I^{131} treatment was obtained from all patients or their relatives with a full description of the procedures. All patients submitted to near-total thyroidectomy and followed by I^{131} (80–120 mCi) ablation of the thyroid remnant. The patients then received TSH suppressive therapy and seen every 4–6 months for follow-up.

All patients were subjected to clinical assessment (general and local for evaluation of the health status, assessment of the surgical bed, and cervical lymph nodes [LNs]), neck US, I^{131} WBS 4 weeks after eltroxin withdrawal with TSH level more than 30 mU/ml in the hypothyroid state, and sTg level was also estimated in the hypothyroid state.

Inclusion criteria

Patients more than 18 years old, had DTC, underwent near-total thyroidectomy, and complete ablation of the thyroid residue.

Exclusion criteria

Patients with thyroid carcinoma other than DTC, patients underwent lobectomy or did not undergo surgery before radioactive iodine (RAI) ablation, and patients with unsuccessful ablation (presence of postablative residual thyroid remnant) or metastatic thyroid cancer at presentation.

Staging

Each patient was classified using the seventh edition of the AJCC/UICC staging system 2015 (tumor-node-metastasis [TNM] Stage I, II, III, or IV and risk stratification).[4]

Follow-up procedures

All patients were regularly followed up every 6 months during the first 2 years and at 6–12-month intervals thereafter based on the clinical course of the disease and the risk of the individual patient. Patients were checked clinically for evaluation of the health status, assessment of the surgical bed, and cervical LNs. The follow-up period ranged from 3 to 10 years after RAI ablation. The following tests were done as follows:

- I^{131} WBS and neck US – Hormonal withdrawal (4 weeks) for all patients to elevate TSH serum level above 30 mU/ml at the time of radioactive I^{131} administration. I^{131} WBS was performed 72 h after I^{131} intake for diagnostic scan. The images were evaluated for iodine-avid residual/locoregional recurrence or distant metastases. Images were interpreted by two experienced nuclear medicine physicians. Any iodine activity rather than the normal biodistribution was categorized abnormal. Comparison was done with baseline/previous scans or other radiological data as well as thyroglobulin level
- Neck US – It was also obtained at the time of whole-body iodine imaging for the assessment of thyroid bed and cervical LNs
- Thyroglobulin measurement – The levels of serum markers including sTg, TgAb, and TSH were checked for all patients in hypothyroid state (under high TSH stimulation) postoperatively and during follow-up on a regular basis. sTg was measured at 4–6 weeks after TSH withdrawal. The sTg level was considered abnormal when its value was higher than 1.0 ng/mL in the hypothyroid state. All sTg values were measured using the radioimmunoassay with reference values 0.83–68.0 ng/mL.

Evaluation of postablative response

Patients were classified according to the response to ablative RAI dose as having both structural and biochemical responses (complete and incomplete) through clinical evaluation, radiological imaging (I^{131} WBS and neck US), as well as thyroglobulin measurement. According to the 7th edition of the ATA management guidelines for adult patients with thyroid nodules and DTC 2015,[4] patients were divided according to their response into three groups as follows:

1. ER – It was defined as sTg < 1 ng/mL and NED by imaging
2. AR – Nonspecific findings on imaging studies, faint uptake in thyroid bed on RAI scanning, and sTg more than 1.0 ng/mL and ≤10 ng/mL

3. IR – Patients with incomplete structural and/or incomplete biochemical response
   a. Structural IR – Patients who had findings either local/regional or distal disease evident on the follow-up postablative whole-body iodine scan/neck US
   b. Biochemical IR – Patients with postablative elevated sTg more than 10.0 ng/ml.

Statistical analysis

Complete data collected including history, basic clinical examination, laboratory investigations, and outcome measures were coded, entered, and analyzed using Microsoft Excel software. Data were then imported into the Statistical Package for the Social Sciences (SPSS 20, IBM, Armonk, NY, United States of America). Qualitative data was represented as number and percentage while, quantitative continuous data was represented by mean ± standard deviation. Chi-square test was used to test differences and association of qualitative variables. Differences between quantitative independent groups was done by Mann–Whitney U test. *P* value was set at <0.05 for significant results, and <0.001 for high significant result.

Results

The current study included 100 patients; 76 (76%) females and 24 (24%) males with a mean age of 43.9 ± 11.6 years and range 21–63 years, with more than half of them less than 45 years old (54%). All patients had DTC 79 (79%) papillary, 17 (17%) follicular, and 4 (4%) papillary-follicular type. They underwent near-total thyroidectomy and I^{131} RRA at a dose range of 80–120 mCi under high TSH stimulation >30 micro IU/ml (mean 63.4 ± 25.3 micro IU/ml) in a hypothyroid state. TSH-stimulated baseline sTg was measured as a reference with mean value 48.9 ± 28.2 ng/ml.

On reviewing the surgical and pathology reports, only 8 (8%) patients had LN metastasis and 23 (23%) patients had capsular invasion. All patients were free from vascular invasion, extrathyroidal extension, or distant metastasis; the clinicopathological features of our patients are shown in Table 1.

According to the seventh edition of AJCC TNM Classification System for Differentiated Thyroid Carcinoma 2015, about two-thirds (64%) of patients were Stage I, 15 (15%) patients Stage II, and 21 (21%) patients Stage III. In respect to risk classification, most patients (92/100) were in the low-risk category and 8/100 patients in the intermediate-risk category and no patient in the high-risk group [Table 2].

It is noticed that the mean sTg level was highest at the baseline (48.9 ± 28.2 ng/ml) and the lowest at the last follow-up, years after ablation (1.6 ± 1.8 ng/ml). There was continuous decrease in the mean values of sTg through the serial follow-ups with the most significant decrease between the mean baseline sTg value (48.9 ± 28.2 ng/ml) and the first follow-up sTg mean value (23.3 ± 24.4 ng/ml) (*P* = 0.000), followed by the decrease from the first follow-up mean value to the second follow-up mean value (from 23.3 ± 24.4 ng/ml to 13.2 ± 35.2 ng/ml, *P* = 0.000); however, there is less

Table 1: Patients clinicopathological characteristics

	Total patients number
Age, mean±SD	43.9±11.6
Sex, *n* (%)	
Female	76 (76.0)
Male	24 (24.0)
Tumor size, mean±SD	3.3±2.7
Pathology type, *n* (%)	
Bifocal pap	1 (1.0)
Follicular	17 (17.0)
Papillary-follicular variant	4 (4.0)
Papillary	78 (78.0)
Capsular invasion, *n* (%)	
Yes	23 (23.0)
No	77 (77.0)
LN, *n* (%)	
Yes	8 (8.0)
No	92 (92.0)
Baseline TSH, mean±SD	63.4±25.3
Baseline Tg, mean±SD	48.9±28.2
Follow-up period, mean±SD	6.04±2.2

TSH: Thyroid-stimulating hormone, Tg: Thyroglobulin, SD: Standard deviation, LN: Lymph node

Table 2: Tumor node metastasis staging for patients with differentiated thyroid carcinoma

Stage	*n* (%)
TNM	
T1N0M0	34 (34.0)
T1N1M0	1 (1.0)
T2N0M0	40 (40.0)
T2N1M0	5 (5.0)
T3N0M0	18 (18.0)
T3N1M0	2 (2.0)
Staging	
<45 years	
I	54 (54)
>45 years	
I	10 (10)
II	15 (15)
III	21 (21)
Risk	
Low	92 (92)
Intermediate	8 (8)
High	0.0 (0.0)
Total	100 (100.0)

Staging according to the AJCC TNM classification system for differentiated thyroid carcinoma (7th edition). TNM: Tumor node metastasis, AJCC: American joint committee on cancer

statistically significant difference between the mean value of second sTg and the last sTg follow-up mean value (from 13.2 ± 35.2 ng/ml to 1.6 ± 1.8 ng/ml, $P = 0.009$) [Figure 1].

The posttherapy scan (done 5 to 7 days after I^{131} ablative doses) showed small residual active thyroid tissue in the surgical bed in 99 (99%) patients and bulky residual thyroid tissue in only 1 (1%) patient. Evidence of LN activity was seen in 3 (3%) patients.

All patients displayed complete structural response on the first follow-up I^{131} WBS and neck US done 6 months after receiving ablative dose of I^{131}, while measurement of TSH-stimulated serum Tg level at the same time revealed ER in 3 patients, AR in 29 (29%) patients, and unfortunately 68 (68%) patients still have biochemical IR (high sTg level >10 ng/ml). Patients with indeterminate and biochemical IR received no treatment and subjected to follow-up for variable period ranges from 3 to 10 years with mean value 6.04 ± 2.2 years.

A second I^{131} WBS, neck US, and TSH sTg level assessment after 9–12-month postablation were done for all patients and showed dramatic biochemical response with ER, indeterminate, and IR in 50 (50%), 34 (34%), and 16 (16%) patients versus 3 (3%), 29 (29%), and 68 patients (68%) in the 1st follow-up, respectively. This change is highly statistically significant ($P = 0.00$).

I^{131} WBS/neck US and TSH sTg were repeated at 6–12-month intervals for years thereafter based on the clinical course of the disease and the risk of the individual patient. During the last follow-up, all patients showed ER and indeterminate response (53 [55.8%] patients and 42 [44.2%] patients, respectively) and no body with biochemical IR noted, as all of them (11 patients after subtraction of the lost 5 patients with de-DTC) achieved significant improvement to ER and indeterminate response. The change in patients with IR between the second and the last follow-up is statistically significant ($P = 0.001$) [Figure 2].

Concordance between I^{131} WBS and sTg was seen in 59 patients (59%) (50 patients had negative I^{131} WBS with excellent biochemical response and 9 patients had positive I^{131} WBS and indeterminate or incomplete biochemical response). Discordance was seen in 41 (41%) patients that had negative I^{131} WBS and indeterminate or biochemical IR; these figures had statistically significant difference ($P = 0.001$) [Table 3].

Structural recurrence was seen in 14 (14%) patients, all of them had indeterminate and incomplete biochemical response. Out of them, five patients had false-negative I^{131} WBS and showed local recurrence by neck US and high sTg level. Positron emission tomography-computed tomography study and histopathological examination were also done for these patients and confirmed the development of dedifferentiation of their tumors. They were referred to oncology department and lost from our follow-up. The remaining nine patients with structural and biochemical IR achieved complete structural response during the third follow-up several years after receiving therapeutic dose of I^{131} ranged from 80 to 150 mCi.

On reviewing the sTg level of the 14 patients with structural recurrence compared to the rest of patients, it was found that they had higher baseline, first, and second follow-up serum levels with statistically significant difference for the baseline and second Tg follow-up values ($P = 0.00$**). The mean value of the last follow-up done years later at the time they achieved complete structural response was comparable to that of the rest of patients, and no patient had incomplete biochemical response ($P = 0.322$) [Table 4].

By the end of the 1st year, it was found that the highest percentage of ER was in Stage I 41 (41%) patients, particularly those with age <45 years old (33/50) and the highest percentage of indeterminate and IR was in Stage II (9%) and III (7%), respectively, and this difference in patients distribution is statistically significant ($P = 0.0018$) Table 5. The mean baseline sTg value was highest in patients who had biochemical IR and lowest in those who had ER. Patients with biochemical IR showed marked decrease of their mean sTg value and most of them was shifted to indeterminate (acceptable) response also, patients with indeterminate response

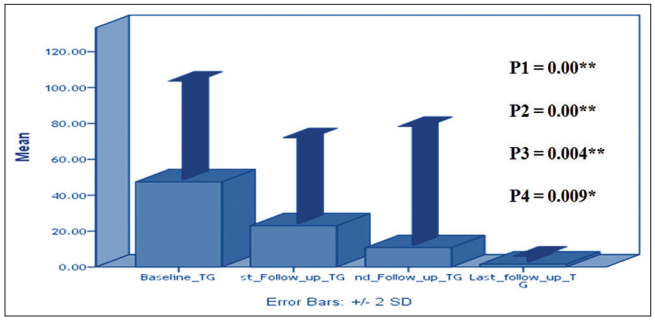

Figure 1: Mean values of the baseline and postablation follow-up thyroglobulin measurements, P1 – baseline and 1st thyroglobulin, P2 – 1st and 2nd thyroglobulin, P3 – 1st and last thyroglobulin, and P4 – 2nd and last thyroglobulin, *: Significant, **: Highly significant

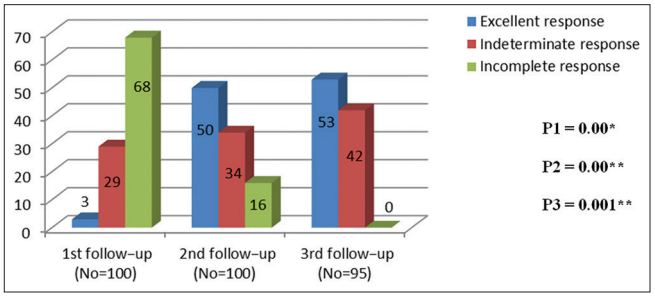

Figure 2: Number of patients with excellent, indeterminate, and incomplete biochemical response during postablation follow-up. P1 – 1st and 2nd follow-up, P2 – 1st and 3rd follow-up, and P3 – 2nd and 3rd follow-up, *: Significant, **: Highly significant

Table 3: Agreement between radiological and biochemical follow-up results for patients with differentiated thyroid cancer

Scan result	Thyroglobulin result (%)		Total, *n* (%)	χ^2	κ	*P*
	ER	Indeterminate response and IR				
First I^{131} WBS and US	First Tg					
Negative	3 (3)	97 (97)	100 (100)			
Positive	0 (0.0)	0 (0.0)	0.0 (0.0)			
Second I^{131} WBS and US	Second Tg					
Negative	50 (100%)	41 (82)	91 (91)	54.6	0.79	0.001**
Positive	0 (0.0%)	9 (18)	9 (9)			
Last I^{131} WBS and US	Last Tg					
Negative	53 (55.8%)	42 (44.2)	95 (100)			
Positive	0.0 (0.0%)	0.0 (0.0)	0.0 (0.0)			

**: Highly significant, I^{131} WBS: Whole-body iodine-131 scan, US: Ultrasound, Tg: Thyroglobulin, ER: Excellent response, IR: Incomplete response

Table 4: Comparison between the mean values of the baseline and serial follow-up thyroglobulin measurements for patients with and without structural recurrence by the end of the 1st year

	n	Baseline Tg (*n*=100)	*n*	1st Tg (*n*=100)	*n*	2nd Tg (*n*=100)	*n*	Last Tg (*n*=95)
Recurrence	14	87.1±24.7	14	35.1±45.3	14	81.5±59.5	9	1.0±0.6
No recurrence	86	42.6±23.6	86	21.4±18.9	86	2.1±3.1	86	1.7±1.9
P		0.00**		0.282		0.00**		0.322

**: Highly significant, Tg: Thyroglobulin

Table 5: Relation between staging and biochemical response during the postablation second thyroglobulin follow-up by the end of the 1st year

Age	Stage	(*n* = 100), *n* (%)	Response			χ^2	*P*
			Excellent (*n* = 50), *n* (%)	Indeterminate (*n* = 34), *n* (%)	Incomplete (*n* = 16), *n* (%)		
<45	I	54 (54)	33 (66)	15 (44.1)	6 (37.5)		
>45	I	10 (10)	8 (16)	2 (5.9)	0 (0.0)	17.13	0.0018*
	II	15 (15)	3 (6.0)	9 (26.5)	3 (18.8)		
	III	21 (21)	6 (12)	8 (23.5)	7 (43.7)		

*: Significant

revealed more reduction of their mean sTg value at the last follow-up. This refers to that patients with biochemical IR still have the chance to achieve excellent or AR by passage of time without additional therapies. There was statistically significant differences among the three groups, namely, the excellent, the indeterminate, and IR (P = 0.00) in the mean baseline and second follow-up sTg but no statistically significant difference in the first and the last follow-up mean sTg values (P = 0.054 and 0.541) [Figure 3].

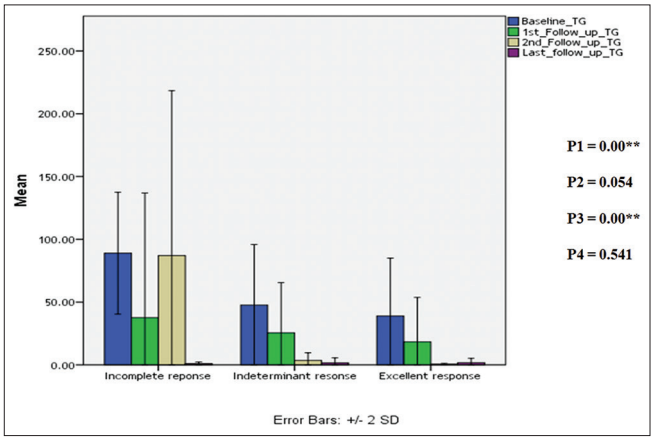

Figure 3: Comparison between the mean values of the excellent, indeterminate, and biochemical responses of the second thyroglobulin follow-up by the end of the 1st year in relation to the baseline and serial follow-up thyroglobulin measurements. P1 – baseline, P2 – 1st, P3 – 2nd, and P4 – last thyroglobulin

Discussion

DTC is related with a good prognosis, especially in patients <45 years old who have no evidence of distant metastasis and have no aggressive histology. In patients who had total thyroidectomy and ablation therapy sTg measurements can be used as an indicator of residual or metastatic cancer. Postoperative RAI ablation is routinely used at some institutions to destroy thyroid remnant and occult foci of neoplastic cells.[9] Low serum sTg level at the time of ablation has negative predictive value for the absence of residual disease and the risk of persistent disease increases with increased sTg levels.[10] In this retrospective study, we investigated the natural course of DTC in 100 patients

whose initial assessment after primary treatment (near-total thyroidectomy and RRA) revealed TSH-stimulated serum Tg levels between 0.4–170 ng/mL with complete structural response. This Tg level included patients whose biochemical response to therapy would currently be classified as incomplete (sTg levels >10 ng/mL), indeterminate (sTg levels >1 <10 ng/mL), and complete (sTg <1 ng/mL). The initial sTg level at 6-month posttherapy was high (mean value 23.3 ± 24.4 ng/ml) and only 3 (3%) patients had ER denoting the delay in normalization of Tg compared to the I^{131} WBS as all patients had negative scan by that time, and in 50% of the cases, repetition of the sTg assay at some point during follow-up (median: 1 year after the initial assay) revealed levels below 1 ng/ml, while imaging findings remained negative, thereby allowing these patients to be reclassified as disease-free, as defined by the ATA Guidelines, 2015. In the remaining 50% of patients, the stimulated serum Tg level was still above 1 ng/ml with 34 patient with AR and 16 patients with IR, 14 of these patients had developed structural evidence of the disease. These outcomes were changed, but not to a large extent as before (P = 0.001), at the final follow-up visit (mean period 6.04 + 2.2 years after the initial assessment, range: 3–10 years), more ER has been achieved 55.8% (three more patients became disease-free) and no IR was seen and no evidence of structural disease had emerged in any of the patients reclassified as disease-free or in the 42 whose sTg levels remained >1 ng/mL. This is in agreement with Lamartina *et al*. in their study on 86 patients who found in 80% of cases the delayed stimulated assay (median 5.2 years) revealed sTg levels 1 ng/ml and in the remaining 20% with sTg level >1 ng/ml, only 1 patient had structural recurrence.[11] Yim *et al*. retrospectively analyzed 186 cases of DTC with sTg levels ≥2 ng/mL roughly 1 year after thyroidectomy and RRA. Repeat sTg assays during follow-up (i.e., 1–2 years after the first assay) allowed 45 (24%) of these patients to be reclassified as disease free.[12] A similar picture emerged from the retrospective study by Pitoia *et al*. They examined a smaller cohort of 32 patients whose only anomaly at the first follow-up visit was a sTg level of >1 ng/ml. Six (19%) were subsequently reclassified as disease-free on the basis of negative results in the repeat sTg assay. In all 6 cases, the initial sTg level had been ≤1.9 ng/ml, and assay negativization occurred within 2.5 years.[7] In the current study, the highest rate of patient's normalization (achieving ER) occurred early by the end of the 1st year in particular in 9–12-month postablation which is considered early compared to other studies. The rate of normalization after the 1st year is low; however, the rate of achieving AR is high and on long-term follow-up, the IR completely disappears. The rate of normalization in the present study is far less than the rate in Lamartina *et al*. study in which 68/86 (80%) of the patients achieved sTg (and basal) levels <1 ng/ml together with persistently negative findings on physical examination, neck US, and any other imaging studies. In our cohort, negativization of the sTg assay during follow-up displayed no significant association with the initial ATA risk class which is consistent with Lamartina *et al*., this is because 92% of patients were low risk. However, it was significantly more common in the subgroup whose initial sTg value was >10 ng/mL ng/ml (i.e., within the so-called IR) than that in the subgroup with initial values that met the criteria for an indeterminate biochemical response. This finding is inconsistent with the results reported by Pitoia *et al*.[7] In their study, all cases of assay negativization occurred in patients whose initial levels were between 1.5 and 1.9 ng/mL and Lamartina *et al*., in their study, the highest rare was in the subgroup of patients in the indeterminate range. Yim *et al*. also observed that rates of negativization declined as the initial sTg level rose.[12] In contrast to the study by Yim *et al*. to observe the natural history of patients with detectable Tg levels but no imaging evidence of disease, we chose not to exclude the 14 patients that received additional course of radioiodine treatment. Our data showed that even patients with detectable serum thyroglobulin levels (>10 ng/ml) without structural evidence of disease during the 1st year of follow-up (biochemical IR) have a high probability to have NED or AR without any additional therapy when followed up for a long period of time this happened in 100 of patients with IR. Vaisman *et al*. in 72.1% of the patients in the acceptable group and 33.7% of those in the biochemical IR group had NED after long-term follow-up. This was mostly in young patients with low levels of suppressed serum Tg but with no identifiable structural disease.[6] This same pattern of a slow decline in serum thyroglobulin values over time in patients that have no structural evidence of disease has been previously reported in several series.[8,13-16] Biko *et al*.[8] recently described a continuing spontaneous decline of Tg levels in children treated previously with RAI 10 years before. These data suggest that patients with a biochemical IR to therapy can often be followed without additional interventions beyond continued levothyroxine suppression to determine whether they are in the 33% of patients that have spontaneous decline in serum Tg over time.[6] This is in agreement with our study that recommends no further treatment unless there is evidence of structural recurrence. Postoperative sTg level is primarily related to the success of surgeon and the presence of persistent disease or normal thyroid remnant. Even after successful total thyroidectomy by applied experienced surgeons, absence of residual thyroid tissue is extremely rare. Low serum Tg levels (<2 ng/ml) predict successful ablation and remaining no residual tumor tissue after ablation;[9] however, the current study revealed that the postoperative Tg level is not related to ablation success as all patients with low and high levels achieved successful ablation that could be explained by 92% of patients are in the ATA low-risk category. Regarding the AJCC staging system, it was accurate to predict recurrence or persistence of disease in our population. This is clear in the incomplete/indeterminate disease seen in Stage II and III patients combined (62.5 and 50%, respectively) which is not consistent with Vaisman *et al*., who stated that it is not

surprising as this system was developed to predict mortality, not recurrence, and other studies previously showed similar results concerning recurrence rates in different populations and age groups.[8,17,18]

Conclusion

sTg measurement by the end of the 1st year is a more reliable test in the follow-up of patients with DTC and biochemical non complete response and considered significant predictor of disease-free status in these patients. Patients with biochemical IR (Tg >10 ng/ml) without structural evidence of disease have a high probability of having disease-free status without any additional therapy.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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