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RAI Thyroid Bed Uptake After Total Thyroidectomy: A Novel SPECT-CT Anatomic Classification System

Rebecca Zeuren, MS, RN, ANP-BC, Agnese Biagini, MD, Ravinder K. Grewal, MD, Gregory W. Randolph, MD, FACS, FACE, Dipti Kamani, MD, Mona M. Sabra, MD, Ashok R. Shaha, FACS, and R. Michael Tuttle, MD

Department of Endocrinology Service (R.Z., A.B., M.M.S., A.R.S., M.R.T.); the Department of Nuclear Medicine (R.K.G.); the Department of Head and Neck Surgery (A.R.S.), Memorial Sloan-Kettering Cancer Center, New York, New York; the Division of Thyroid and Parathyroid Surgery, Otolaryngology, Massachusetts Eye and Ear Infirmary (G.W.R., D.K.) and the Department of Surgical Oncology, Massachusetts General Hospital, Harvard Medical School (G.W.R.), Boston, Massachusetts, U.S.A

Abstract

Objective—Recent, more selective use of radioactive iodine (RAI) has led to reevaluation of the clinical importance of achieving complete total thyroidectomy with minimal residual normal thyroid tissue. We utilize the improved localization by post-RAI remnant ablation, single photon emission computerized tomography-computed tomography (SPECT-CT) to define specific anatomic sites of residual RAI-uptake foci after total thyroidectomy for differentiated thyroid cancer (DTC) and to provide a novel classification system relating uptake to thyroid anatomy and preservation of adjacent neural structures.

Study Design—Retrospective.

Method—Radioactive iodine-uptake foci in thyroid bed were localized by SPECT/CT imaging at the time of RAI remnant ablation in 141 DTC patients undergoing total thyroidectomy.

Results—Minimal residual RAI uptake (median 0.32% at 24 hours) in the thyroid bed was detected by diagnostic planar whole body scans in 93% and by posttherapy SPECT/CT imaging in 99% of subjects. Discrete RAI uptake foci were identified on the SPECT/CT imaging at Berry's ligament (87%), at superior thyroid poles (79%), in paratracheal-lobar regions (67%), in isthmus-region (54%), and in pyramidal lobe (46%). Despite the residual foci, the nonstimulated thyroglobulin (Tg) prior to remnant ablation (with a median thyroid-stimulating hormone of 0.36 m IU/L) was <0.6 ng/mL in 53% and <1 ng/mL in 73% of cases.

Conclusion—After extracapsular total thyroidectomy, highly sensitive detection tools identify microscopic residual RAI avid foci in thyroid bed in the majority of patients. These foci can be classified as 1) neural-related and 2) capsule-related. These common residual foci have no

Send correspondence to Gregory W. Randolph, MD FACS FACE, Department of Otolaryngology, Division of Thyroid and Parathyroid Surgery, Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston MA 02114. Gregory_Randolph@meei.harvard.edu.

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relationship to postoperative Tg, suggesting that attempts at radical removal of thyroid tissue in these locations may not be warranted.

Keywords

radioactive iodine; remnant ablation; thyroidectomy; thyroid cancer; RRA; postoperative Tg

INTRODUCTION

For intermediate- and high-risk thyroid cancer patients, total thyroidectomy with therapeutic lymph node dissection remains the primary treatment modality.^{1,2} In fact, completeness of surgical resection of the primary tumor is one of the most important prognostic factor in determining the recurrence risk, likelihood of disease progression, and ultimately the disease-specific mortality.¹⁻⁴

Total thyroidectomy for thyroid cancer should be a meticulous extracapsular total thyroidectomy with removal of all normal thyroid tissue. However, resection of all normal thyroid tissue may not be feasible in all patients due to two main factors: 1) The first relates to small amounts of normal thyroid tissue (neural-related [NR]) intentionally left behind to preserve important intimately related neural structures, and thus optimize safety of the procedure. This includes normal thyroid tissue infiltrating Berry's ligament because of the close association between this ligament and the distal-most course of the recurrent laryngeal nerve (RLN), as well as tissue at the anterior and posterior margins of the superior thyroid poles, and due to the close relationship between the upper portion of the superior thyroid poles and the external branch of the superior laryngeal nerve (EBSLN). 2) The second relates to thyroid tissue that the surgeon may be unaware of (capsule-related [CR]). Recognition of all normal thyroid tissue at surgery is problematic for several reasons. Thyroid tissue may be present outside of the normal confines of the typical orthotopic lobar-isthmus thyroid body. In the midline, the pyramidal lobe (and other thyroglossal duct cyst tract elements), especially if diminutive, and laterally and varyingly present elements such as the tubercle of Zuckerkandl in the tracheoesophageal groove and frank extrathyroidal thyroid rests in lateral thyroid region may escape routine surgical detection.⁵ Because thyroid gland capsule is not a well-defined anatomical fibrous capsule but is a pseudocapsule that is derived from midline-deep cervical fascia, it may not be possible to define discrete anatomical boundaries clearly delineating the normal thyroid from surrounding tissue.^{6,7} Hence, scant thyroid tissue on the trachea adjacent to thyroid isthmus may be left behind. These practical anatomic and surgical considerations suggest that small amounts of residual normal thyroid tissue may be left behind at several discrete anatomic locations, even when a surgeon endeavors to perform meticulous extracapsular total thyroidectomy.

Formerly, these small remnants were routinely destroyed with ¹³¹I/radioactive iodine remnant ablation (RRA). However, because RRA utilization is becoming more selective and risk adapted, fewer low- and intermediate-risk patients are receiving RRA.^{2,8} As a result, there is renewed interest in the completeness of surgical resection of both the thyroid gland and the small volume central neck lymph node (prophylactic neck dissections) in an effort to achieve undetectable serum thyroglobulin (Tg) with surgery alone.⁹⁻¹² Studies of potential

Tg benefits of prophylactic central neck dissection may be in fact confounded by residual normal thyroid elements in the thyroid bed after total thyroidectomy with and without prophylactic central neck dissection.^{13–16}

Numerous studies in the past and more recently have demonstrated that most patients have small volume, functional thyroid remnants that can be detected by ¹³¹I scan after total thyroidectomy.^{14,15} In studies from highly specialized surgical centers in the US and Europe, 52% to 93% of total thyroidectomy patients had visibly evident residual thyroid bed uptake postoperatively.^{16,17} Thus far, the literature has limited information on the discreet anatomical localization of residual uptake foci, but on planar imaging, the residual radioactive iodine (RAI) uptake appears to be localized in the pyramidal lobe in some patients, and in other patients it is localized in various regions within the thyroid bed and superior pole.^{15,18} The ability to fuse RAI scans with cross sectional imaging with single photon emission computerized tomography-computed tomography (SPECT-CT) has dramatically improved RAI uptake localization to specific anatomical locations, both within the thyroid bed and lymph node metastases, and provides the anatomic substrate of our study.^{14,19–24}

In addition to the expected uptake often seen in the pyramidal lobe, we hypothesized that the discrete areas of residual RAI avid thyroid tissue in the thyroid bed would correspond to specific anatomical sites, including:

1. Neural-related areas where excessive dissection would be more likely to lead to injury to the RLN (Berry's ligament) or the SLN.
2. Capsule-related areas where thyroid tissue may not be entirely recognized at surgery, partly because of midline and lateral ectopic normal thyroid tissue (relative to the orthotopic main body of the gland) and in areas of reduced integrity of thyroid capsule such as the posterior surface of the isthmus.

Because postsurgical thyroid bed uptake is of significant interest to surgeons (who leave it behind) and endocrinologists/nuclear medicine physicians (who subsequently become responsible to treat residual normal and malignant remaining thyroid tissue), it is critical to accurately assess the frequency, causes, sites, and clinical significance of this residual thyroid tissue. Our study aims to leverage the greater acuity of post-RAI ablation SPECT-CT to 1) accurately define specific anatomic sites of residual RAI uptake after total thyroidectomy for differentiated thyroid cancer (DTC); 2) provide a classification-scheme of their distribution relative to the central neck landmark, the larynx; and 3) relate this anatomic classification scheme to surgical conduct during total thyroidectomy as it relates to the thyroid surgical capsule and adjacent neural structures.

MATERIALS AND METHODS

Subjects

With institutional review board approval, we retrospectively identified 141 consecutive DTC patients with SPECT/CT images at Memorial Sloan-Kettering Cancer Center, New York,

New York, as part of RRA following total thyroidectomy between September 2009 and December 2010. Patients with total thyroidectomy as a single procedure or as a completion thyroidectomy after lobectomy were included. Patients were risk stratified using both the American Joint Committee on Cancer/tumor-node-metastasis (AJCC/TNM) staging system (7th edition) and the American Thyroid Association (ATA) risk of recurrence staging system.^{2,25}

Radioactive Iodine Remnant Ablation

Remnant ablations were performed using recombinant human thyroid-stimulating hormone (rhTSH) stimulation 1 to 3 months after total thyroidectomy.²⁶ In brief, after following a low iodine diet for 1 to 2 weeks, 0.9 mg of rhTSH was given on days 1 and 2. About 2 hours after administering rhTSH on day 2, a tracer dose of 55.5 MBq (1.5 mCi) of I^{123} was administered orally. On day 3, a diagnostic planar whole body scan with spot views was obtained, subsequently giving a therapeutic dose of I^{131} . Similar to previous studies, the need for RAI remnant ablation and the administered RRA activity were based on recurrence-risk assessment of each patient.

Serum TSH, Tg, and anti-Tg antibodies were measured in levothyroxine suppression therapy on the day 1 prior to the first rhTSH injection. Serum Tg values were measured with an immunoradiometric recovery assay (Brahms Inc., Berlin, Germany) (functional sensitivity 0.6 ng/mL normalized to CRM 457).

SPECT/CT

Post-RRA imaging was performed at 4 to 7 days after I^{131} therapy.²² In brief, SPECT/CT images of the neck were recorded using a Philips Precedence system, Royal Phillips N.V., Amsterdam, Netherlands.), which consists of a dual-detector G-camera with dual 1.6 cm (5/8") detectors equipped with high-energy general-purpose collimators and an integrated 16-slice helical CT scanner. Computed tomography scans were acquired with a tube voltage of 120 kV; the tube current was adjusted for body weight (e.g., 37.5 mA for 70 kg of body weight). Reconstructed slice width and spacing was 3 mm. Computed tomography data were used for attenuation correction and anatomic information. Single photon emission computerized tomography data were obtained on a dual-head camera in step-and-shoot mode using a noncircular orbit, 128 · 128 · 16 matrix, and 32 angles over a total of 180 degrees (per detector). The acquisition time varied from 30 to 60 seconds per stop, depending on the counting rate. Reconstruction was performed on a Philips JET Stream system using the Philips Astonish algorithm.

Anatomic Localization of SPECT/CT Findings

The thyroid bed region was divided into a *superior and inferior compartments* based on an imaginary horizontal line that approximated the inferior border of the thyroid cartilage (Fig. 1). The inferior border of the thyroid cartilage provided a consistent and reliable landmark on axially CT that allowed specific RAI avid sites to be compared between subjects.

The *superior compartment* was subdivided into three anatomical locations: 1) The pyramidal lobe or other thyroglossal duct cyst tract elements, with uptake near the midline and anterior

to the larynx (such pyramidal lobe elements may be present in over half of normal patients)²⁷; 2) the superior pole (anterior region) anterolateral to the thyroid cartilage; and 3) the superior pole (posterior region) posterior to the thyroid cartilage. Aggressive upper superior pole dissection places EBSLN at risk, especially if the superior pole is developed extensively upward.^{28,29}

The *inferior compartment* was also subdivided into three anatomical locations: 1) the isthmus region, anterior to the trachea tissue, which may be inadvertently left behind on the ventral midline and paramidline tracheal surface due to less distinct thyroid capsule in this region. 2) The ligament of Berry region, with discrete foci of uptake on the right/left anterolateral trachea corresponding to the anatomical region, where the ligament of Berry anchors the thyroid gland to the trachea. The ligament of Berry may be variably infiltrated with thyroid tissue that can be preserved in order to reduce the dissection of distal RLN, the most common area of surgical injury^{30,31} (Fig. 2). 3) The lobar regions, with uptake in the tracheoesophageal grooves and posterolateral tracheal region on either side. The variably present posterolateral lobar elements may derive from the tubercle of Zuckerkandl or thyroid rests, which are embryological perithyroidal elements and are relatively common^{5,32,33} (Fig. 1).

Foci of uptake, clearly outside the thyroid bed or with corresponding structural evidence of metastatic disease, were not included in the analysis.

Review of Operative Reports

To determine whether the operative reports could provide explanation for the presence of persistent RAI avid uptake in the thyroid bed, each operative report was independently reviewed by an endocrinologist and a surgeon blinded to the results of the SPECT/CT imaging and information regarding normal thyroid tissue intentionally left behind at the time of thyroidectomy was recorded. These results were compared with the SPECT/CT findings.

RESULTS

The demographics, clinical and pathological features, and risk stratification of the 141 subjects are presented in Table I. As expected, the subjects were predominantly female (65%), with a median age at diagnosis being 47 years (21–85 years). The thyroidectomy was performed as single procedure in 91.5% of the patients and as a two-stage procedure (completion thyroidectomy) in 8.5%. Classic papillary thyroid cancer (PTC) was the most common histology (48.9%). Consistent with our risk-adapted approach to the use of RAI remnant ablation, the majority of patients were classified as ATA intermediate (84.4%) or high (9.2%) risk of recurrence. In fact, 10/11 T1a patients who received RAI ablation were classified as ATA intermediate risk on the basis of metastatic lymph node involvement or minor extrathyroidal extension. Gross extrathyroidal extension was documented in four patients (2.8%), but in each case the tumor was invading overlying strap muscle that was resected, leaving no gross residual disease.

The serum Tg, just prior to the first (day 1) rhTSH injection (with a corresponding median TSH of 0.36 mIU/L), was less than 0.6 ng/mL in 53% and less than 1 ng/mL in 73%. A

nonstimulated serum Tg <0.6 ng/mL at the time of remnant ablation was associated with a smaller primary tumor and a lower percent uptake in the thyroid bed (see Table II). Furthermore, an undetectable Tg prior to ablation (< 0.6 ng/mL) was statistically more likely to be seen in ATA low-risk tumors, T1a tumors, M0 tumors, and AJCC stage I disease (see Table II). Conversely, no association was seen between an undetectable preablation Tg and the age at diagnosis, presence or absence of visible uptake in the thyroid bed on diagnostic scanning, tumor histology, SPECT/CT localization of remaining RAI foci in the neck, or the finding in the operative note (data not shown). However, analysis of patients who had nonstimulated Tg values >1 ng/mL at the time of ablation demonstrated that these patients had higher risk disease as being more likely to have AJCC stage IVC disease ($P=0.01$), ATA high risk ($P=0.001$), aggressive histology ($P=0.03$), and M1 disease at diagnosis ($P=0.001$), suggesting that metastatic disease may be contributing to the serum Tg levels at the time of ablation.

On the basis of the operative note (available in 95%), the presence of residual normal thyroid tissue on SPECT/CT imaging was predicted in 2.8% of the subjects by an endocrinologist and in 1.4% with surgeon review. A comparison of findings on retrospective operative report review (by endocrinologist or surgeon) with the SPECT/CT revealed no correlation with either the presence or absence of thyroid bed uptake or the specific uptake site.

As would be expected, the 24-hour RAI uptake was only 0.32% in patients having total thyroidectomy, consistent with a meticulous extracapsular total thyroidectomy. However, because of the remarkable sensitivity of RAI scanning, we were able to identify areas of RAI uptake in the region of the thyroid bed in 93% of patients on diagnostic planar imaging and 99% of subjects on posttherapy SPECT/CT imaging (Table III). The mass of residual tissue in these RAI avid areas was too small to quantify with SPECT/CT. The likelihood, percent uptake, and uptake sites were not significantly different between initial total thyroidectomy and two-stage total thyroidectomy patients.

SPECT/CT most commonly localized the specific uptake areas within the thyroid bed to the ligament of Berry (87%). However, 79% of subjects had uptake in the anterior superior regions, and 67% had uptake in the lobar regions (Table IV) (Fig. 3).

DISCUSSION

In this consecutive series of 141 DTC patients selected for RRA after total thyroidectomy, the median 24-hour uptake was only 0.32%. It is clear that these patients had a meticulous extracapsular total thyroidectomy, with every effort taken to remove all visible thyroid tissue. This is our goal in thyroidectomies for malignancy: a true total thyroidectomy. However, uptake in the thyroid bed was visible on diagnostic planar imaging in 93% of the patients and on posttherapy scanning with SPECT/CT in 99%. These data confirm the findings of numerous previous studies that demonstrate total thyroidectomy seldom results in removal of all thyroid tissue.^{14,15,19,21} In fact, our work and the literature suggest that the term *total thyroidectomy* must be used relative to the method applied to identify thyroid tissue postoperatively. Although this uptake probably represents residual normal thyroid

tissue, in some cases the uptake could also be caused by persistent thyroid cancer in the thyroid bed.

As expected, we found RAI uptake in the region of the pyramidal lobe in 46% of the patients. This is consistent with previous postmortem studies that demonstrate a discrete identifiable pyramidal lobe in 55% of patients.^{34,35} Uptake in the region of Berry's ligament, a dense fibrous tissue that tightly attaches the thyroid to the anterolateral aspect of the trachea, was detected even more commonly in 87% of patients. Autopsy studies demonstrate that normal thyroid tissue is often found in the ligament of Berry.^{36,37} Furthermore, the close approximation of the RLN to Berry's ligament may also result in a less than complete thyroidectomy due to limited dissection in this area to avoid RLN injury. The third most common persistent RAI uptake site was in the regions of the superior poles of the thyroid. This is another area where the capsule of the thyroid gland gradually tends to attenuate as one precedes cranially. Furthermore, the close approximation of the EBSLN to the superior pole may also lead to limited dissection in this area.³⁸ It is interesting to note that 67% of patients had uptake in the lobar regions, which often extended posterior to the trachea. It is unclear whether this residual thyroid tissue remained because of the incomplete nature of the thyroid capsule or lack of appreciation of the tissue at surgery. Operative reports are unhelpful in terms of prediction of postoperative bed uptake because both surgeons and endocrinologists reviewing the operative reports were unable to predict patients with radiographic remnant uptakes. It is interesting to note that total thyroidectomy done in one or two stages did not show any difference in observable postsurgery uptake; completion thyroidectomy appears to be equivalent to primary total thyroidectomy in obtaining complete thyroid resection.

Thus, discrete areas of RAI uptake are found in anatomically identifiable thyroid bed area and can be classified as: 1) NR areas where thyroid dissection may be intentionally limited to avoid important neural structures (ligament of Berry-recurrent laryngeal nerve, superior thyroid poles-external branch of the superior laryngeal nerve); and 2) CR areas where thyroid tissue may be less apparent during routine surgical inspection of the orthotopic thyroid capsule (including posterior surface of the isthmus, tracheoesophageal groove/lateral thyroid region, and pyramidal lobe). NR-uptake areas occurred in up to 87% of patients, whereas CR-uptake areas occurred in up to 67% of patients. Armed with this information, a surgeon who is offering a more complete total thyroidectomy will better understand the areas that more commonly frustrate the completeness of the surgery, both as it relates to specific areas that we have discussed above (the areas related to the capsule) and to areas where tissue is left in an effort to avoid extensive neural dissection. Although improved understanding of postsurgical thyroid bed uptake might impact how a given surgeon performs surgery and may impact how an endocrinologist interprets thyroid bed uptake postoperatively, we appreciate that this information may not necessarily impact directly on changes in clinical behavior. Again, our surgical goal in patients with thyroid malignancy is a meticulous extracapsular total thyroidectomy.

Our findings are consistent with the work of other researchers, including Salvatori et al., who found that planar imaging revealed thyroid remnant in 93% of patients after total thyroidectomy, anatomical distribution of the remnant being 16% in the right mid-upper

pole, 18% in the right mid-lower pole, 13% in the left mid-upper pole, 15% in the left mid-lower pole, and 20% in the pyramidal lobe and/or thyroglossal duct region.¹⁵ The use of SPECT/CT in our study allowed for more precise anatomical localization of the RAI.

The relationship between postoperative bed uptake and postoperative Tg is complex. Interestingly, we observed that at the time of ablation, the nonstimulated serum Tg was undetectable in most patients, less than 0.6 ng/ml in 53% and less than 1 ng/ml in 73% of cases. Furthermore, undetectable preablation Tg values were seen in patients who had the lower percent uptake in the thyroid bed prior to ablation and who were least likely to have the disease outside the thyroid gland at the time of ablation (ATA low risk, T1, M0, AJCC stage 1 disease). Because we do not obtain stimulated Tg values at the time of rhTSH-stimulated RAI ablation, we cannot know whether the stimulated Tg values would have been correlated with thyroid bed uptake. We acknowledge this is a potential weakness of our study, and clinicians may use stimulated Tg levels in postoperative thyroid cancer decision making. However, nonstimulated Tg values are often undetectable postoperatively after total thyroidectomy. It is unclear whether more aggressive attempts to remove the small amounts of normal thyroid tissue remaining after a “total thyroidectomy” would have a significant impact on suppressed Tg.

CONCLUSION

Our study demonstrates that very small volume RAI avid thyroid tissue can be detected with sensitive diagnostic and posttherapy scanning in the majority of patients after meticulous extracapsular total thyroidectomy. Furthermore, residual uptake foci consistently correlate with anatomical sites related to less discrete thyroid capsule or important neural structures. The clinical significance of these residual uptake foci after a meticulous extracapsular total thyroidectomy appears to be minimal, with little relationship to postoperative Tg levels, suggesting that attempts at a more radical thyroid tissue excision may not be warranted. Nonetheless, we believe that the knowledge of remnant thyroid bed foci after surgery empowers both surgeons as well as endocrinologists/nuclear medicine physicians managing patients with postsurgical remnants during thyroid cancer surveillance follow-up, especially in an era where surgical remnant ablation is less common.

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Fig. 1.

Three-quarter view of thyroid and larynx with cross-sectional levels indicated. Red line indicates division between the upper versus lower thyroid bed uptake regions. Upper cross-section depicts superior pole remnants from the anterior and the posterior margin of the superior pole (yellow circles) as well as midline/paramidline pyramidal lobe remnants (blue circle). Middle cross-section depicts Berry's ligament (green circle) and isthmus-related remnants (purple circles). Lower cross-section depicts tracheoesophageal (TE) groove remnants (red circles).

Fig. 2.

Examples thyroid tissue infiltration of ligament of Berry. The degree of dissection of distal segment of RLN (which is commonly prone to injury) can be titrated based on the nerve caliber and the extent of thyroid tissue infiltration. (Panel A) Small caliber nerve. (Panel B) Large caliber nerve. RLN = recurrent laryngeal nerve.

Fig. 3. SPECT/CT most commonly localized the specific uptake areas within the thyroid bed in the regions of Berry's ligament, lobar region, pyramidal lobe, and superior poles. CT = computerized tomography; SPECT = single photon emission computerized tomography.

TABLE I

Patient Characteristics.

		n = 141
Age at diagnosis (yrs)	Mean $\pm$ SD	47.26 $\pm$ 14.12
	Median	47
	Range	21–85
Gender	Male	49 (34.8%)
	Female	92 (65.2%)
Total thyroidectomy	Single procedure	129 (91.5%)
	Two-stage procedure	12 (8.5%)
TNM classification	T1a	11 (7.8%)
	T1b	20 (14.1%)
	T2	18 (12.8%)
	T3	84 (59.6%)
	T4a	7 (5.0%)
	T4b	1 (0.7%)
	N0	47 (33.4%)
	N1a	37 (26.2%)
	N1b	57 (40.4%)
	M0	135 (95.7%)
	M1	6 (4.3%)
Gross extrathyroidal extension	Yes	4 (2.8%)
	No	137 (97.2%)
Histotype	Classical variant PTC	69 (48.9%)
	Tall cell variant PTC	27 (19.1%)
	Follicular variant PTC	17 (12.1%)
	Follicular thyroid cancer	6 (4.3%)
	Poorly differentiated	6 (4.3%)
	Others	16 (11.3%)
AJCC stage	I	68 (48.2%)
	II	4 (2.8%)
	III	34 (24.2%)
	IVa	30 (21.3%)
	IVc	5 (3.5%)
ATA initial classification risk	High	13 (9.2%)
	Intermediate	119 (84.4%)
	Low	9 (6.4%)
TSH (IU/L) prior to RRA	Mean + SD	1.77 + 3.34
	Median	0.36
	Range	0.0–23.5
Suppressed Tg at RRA	< 0.6 ng/ml	53%
	< 1.0 ng/ml	73%

		n = 141
Operative note available	Yes	134 (95.0%)
	No	7 (5.0%)

ATA = American Thyroid Association; IU/L = international units/liter; PTC = papillary thyroid cancer; RRA = radioactive iodine remnant ablation; SD = standard deviation; Tg = thyroglobulin; TNM = tumor-node- metastasis; TSH = thyroid-stimulating hormone.

TABLE II

Characteristics Stratified Based on Preablation Tg Levels (Detectable Tg vs. Undetectable Tg)

	Tg <0.6 ng/mL (prior to ablation)	Tg ≥ 0.6 ng/mL (prior to ablation)	P Value
Tumor size	2.3 ±1.5	2.8 ±1.8	0.04
Preablation nonstimulated TSH	0.7 ±1	0.98 ±1.4	0.17
Percent uptake in thyroid bed	0.5 ±0.7%	1.2 ±1.7%	0.005
ATA Risk			0.001
Low	78%	22%	
Intermediate	52%	48%	
High	8%	92%	
T			0.004
1a	91%	9%	
1b	55%	45%	
2	67%	33%	
3	44%	56%	
4	14%	86%	
N			0.06
N0/x	65%	35%	
1a	44%	56%	
1b	43%	57%	
M			0.03
0	52%	48%	
1	0%	100%	
AJCC			0.03
1	56%	44%	
2	75%	25%	
3	53%	47%	
4a	39%	61%	
4c	0%	100%	

AJCC = American Joint Committee on Cancer; ATA = American Thyroid Association; Tg = thyroglobulin; TSH = thyroid-stimulating hormone.

TABLE III

RAI Uptake Within the Thyroid Bed on Diagnostic and Posttherapy Imaging.

Visible uptake on diagnostic scan (^{123}I)	Yes No	93% 7%
Uptake (%)	Mean + SD	0.77 + 0.11
	Median	0.32
	Range	0.01–8.24
Administered activity ^{131}I (mCi)	Mean +SD	123 +35
	Median	144
	Range	49–214
Visible uptake on SPECT/CT	Yes	99%
	No	1%

CT = computed tomography; RAI = radioactive iodine; SD = standard deviation; SPECT = single photon emission computerized tomography.

TABLE IV

Localizing the Site of RAI Uptake Within the Thyroid Bed.

Anatomical Sites	¹³¹ I Uptake SPECT/CT
Superior regions	
Anterior	79.4%
Posterior	34.8%
Pyramidal lobe	46.1%
Isthmus	53.9%
Berry's ligament region	87.2%
TE groove/lateral thyroid region	67.4%

CT = computed tomography; RAI = radioactive iodine; SPECT = single photon emission computerized tomography; TE = tracheoesophageal.