

Is Thyroid Scintigraphy Necessary before I-131 Therapy for Hyperthyroidism?

Concise Communication

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To assess the value of routine thyroid scintigraphy in the differential diagnosis of hyperthyroidism and as a guide to I-131 therapy, we prospectively examined 100 consecutive hyperthyroid patients referred for a 24-hr radiolodine uptake and I-131 therapy. The nuclear medicine physician recorded his preimaging diagnostic impression and therapeutic plan for each patient. After the [^{99m}Tc] pertechnetate image, the patient was reassessed to determine whether the image induced any change in the diagnosis or therapeutic plan. Seventy-nine of 80 patients with diffuse goiter to palpation, had scintigrams demonstrating no discrete focal defects and were diagnosed as Graves' disease; thus the scintigram did not contribute useful information. In 17 of 20 patients with uninodular or multinodular goiters, the image was necessary to clarify the final diagnosis and therapeutic plan. Thus, selective use of thyroid scintigraphy should decrease the number of scintigrams performed before I-131 therapy for hyperthyroidism, without compromising diagnostic accuracy or therapeutic success.

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It is generally agreed that an I-131 uptake is necessary before treatment of hyperthyroidism with I-131. Disparate opinions exist, however, regarding the value of thyroid imaging in diagnosis and treatment of hyperthyroidism. Some authors feel that, in addition to a thorough history and physical examination, thyroid scintigraphy is indicated in the assessment of hyperthyroidism with or without a palpable nodule (1-5). However, others are of the opinion that, in the absence of palpable nodularity, thyroid images need not be done routinely (6,7).

To ascertain whether or not thyroid imaging influences the diagnosis and/or treatment of a hyperthyroid population, we examined in a prospective manner the value of [^{99m}Tc]pertechnetate scintigraphy in 100 con-

secutive patients referred for treatment of hyperthyroidism.

METHODS

The study group consisted of 100 patients with documented hyperthyroidism, referred for I-131 therapy between January, 1980, and March, 1983. We excluded hyperthyroid patients who had had previous radioiodine or surgical therapy, or who now had an I-131 uptake less than 2% associated with painless thyroiditis, or had iodine contamination. There were 76 females and 24 males, with a mean age of 45.0 yr (range 20-85 yr).

The diagnosis of hyperthyroidism was confirmed by one of five experienced nuclear medicine physicians, based upon clinical and laboratory findings. All patients had a history and physical examination, including careful palpation of the thyroid gland, before I-131 therapy. The staff physician then recorded his preimaging diagnostic impression, differentiating Graves' disease from Graves'

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TABLE 1. PATIENTS WITH PALPABLE THYROID NODULES GROUP 2 MULTINODULAR GOITER

Patient No.	Age	Sex	Diagnosis	
			Preimage	Postimage
8	50	F	Plummer's compared with Graves' disease	Graves' superimposed on multinodular goiter
10	76	F	Plummer's compared with Graves' disease	Graves' superimposed on multinodular goiter
41	75	F	Graves' disease compared with Plummer's	Graves' superimposed on multinodular goiter
48	61	F	Thyrotoxicosis, multinodular goiter	Graves' superimposed on multinodular goiter
61	29	F	Thyrotoxicosis, multinodular goiter	Graves' superimposed on multinodular goiter
64	65	M	Thyrotoxicosis, multinodular goiter	Graves' superimposed on multinodular goiter
66	60	F	Thyrotoxicosis, multinodular goiter	Plummer's disease
69	80	F	Thyrotoxicosis, multinodular goiter	Graves' superimposed on multinodular goiter
78	76	M	Thyrotoxicosis, multinodular goiter	Graves' superimposed on multinodular goiter
90	69	F	Graves' disease, multinodular goiter	Graves' superimposed on multinodular goiter
95	53	F	Graves' disease, multinodular goiter	Graves' superimposed on multinodular goiter

disease superimposed on a multinodular goiter or from Plummer's disease (i.e., toxic autonomously functioning thyroid adenoma or toxic multinodular goiter). The dose of I-131 was then chosen, based on μCi per gram of estimated gland weight, for those patients with presumed Graves' disease. If Graves' disease superimposed on a multinodular goiter was suspected, an additional 2-3 mCi was added empirically to the calculated dose because of the relative radioresistance of such glands. If Plummer's disease was suspected, a dose was chosen to deliver a minimum of 10 mCi to the autonomously functioning tissue. After the scintigram was performed, the patient was reassessed to determine whether the image induced any changes in the diagnosis or therapeutic plan.

Thyroid scintigraphy was performed in these 100 patients following intravenous administration of 10 mCi of [$^{99\text{m}}\text{Tc}$]pertechnetate, using a standard-field-of-view gamma camera. A 60-sec image using a parallel-hole collimator was obtained 5 min after injection to compare thyroid against salivary uptake of the tracer and qualitatively assess thyroid size. At 20 min, images of the thyroid were obtained with a pinhole collimator (4 mm insert) in the anterior, RAO, and LAO positions. The pinhole-to-thyroid distance was adjusted so that the thyroid gland filled two thirds of the field of view. Images were interpreted based upon direct localization of the palpatory findings using point-source markers as needed.

RESULTS

We divided the study population into three groups on the basis of clinical evaluation of the thyroid: 1: goiter without nodularity; 2: multinodular goiter; and 3: solitary nodule with associated goiter.

Of the 100 patients studied, 80 had a diffusely enlarged gland without nodularity (Group 1). Gland size, as estimated by palpation, varied from 20-120 g. Of

these patients, 65 (81.25%) had homogeneous uptake, 11 (13.75%) had mildly heterogeneous uptake, and 4 (5%) had markedly heterogeneous uptake. The scintigraphic findings did not change the estimated gland size of any of these 80 patients. Neither did the preimage diagnosis change in any patient with homogeneous or mildly heterogeneous uptake. Of the patients with marked heterogeneity, the preimage diagnosis was changed in one (No. 29). After reviewing the scintigram, this patient's gland was repalpated again and felt to be multinodular rather than diffusely enlarged, as had originally been thought. Additionally, the dosage of I-131 was increased by 35% on the basis of the marked heterogeneity that was shown on the image. Thus, 79 of 80 patients were diagnosed as having Graves' disease, and were treated with I-131 in a dosage varying from 3 mCi to 15 mCi, designed to deliver 100-150 $\mu\text{Ci}/\text{gram}$ of estimated thyroid weight. Thirteen of the 80 patients (16.2%) had Class II or III ophthalmopathy at the time of initial presentation (8).

There were 11 patients with multinodular goiter (Group 2), with gland size ranging from 20-100 g. Three patients (Nos. 48, 90, and 95) had Class II or III ophthalmopathy consistent with Graves' disease superimposed on a previous multinodular goiter, as confirmed by scintigraphy. In the remaining eight patients, the distinction between Plummer's disease and Graves' disease superimposed on a multinodular goiter could not be made by physical examination alone. In Patient 66 (Table 1), the preimage diagnosis was Graves' disease superimposed on a multinodular goiter. Following scintigraphy, the patient was diagnosed as having Plummer's disease and was treated with a much larger dose of I-131 than originally planned. Three years later she remains euthyroid. The remaining seven patients had Graves' disease superimposed on a multinodular goiter, and were treated with I-131 in doses varying from 4.2 mCi to 20 mCi (Table 1). In the eight patients without ophthalmopathy, the scintigram was felt to have been



FIG. 1. [^{99m}Tc]pertechnetate image from patient with Graves' disease and multinodular goiter. Closed arrows correspond to palpable nodule.



FIG. 2. Scintigram with photopenic defect left upper lobe corresponding to palpable 2.5-cm nodule (Patient 96).

necessary to clarify the final diagnosis and to initiate proper therapy.

Group 3 consisted of nine patients, all of whom were felt to have a solitary palpable nodule with a small associated goiter. In one patient (No. 4, Table 2), scintigraphy demonstrated 1-cm focus of decreased activity in the left upper pole (Fig. 1). This patient's gland was palpated again and felt to have bilateral nodularity consistent with Graves' disease superimposed on a multinodular goiter. Following treatment with I-131, there was complete resolution of the palpable abnormalities. Two patients (Nos. 26, and 47) demonstrated no corresponding area of increased or decreased uptake by imaging and were not felt to have a nodule upon repalpation after imaging. Another patient (No. 38) was felt to have Graves' disease superimposed on a multinodular goiter after scintigraphy, and two patients (Nos. 55, and 96) had photopenic defects on scintigram corresponding to 2.0- and 2.5-cm palpable nodules, respectively (Fig. 2). Fine needle aspiration of the nodules revealed cytologic findings of a colloid nodule. The last three patients (Nos. 85, 87, and 97) had Plummer's disease (Fig. 3). None of the patients in Group 3 had ophthalmopathy.

DISCUSSION

Thyroid scintigraphy is commonly performed in the routine evaluation of patients with suspected or confirmed hyperthyroidism. Pretherapy I-131 scintigraphy has been used to assist the physician in gland-size estimation, to differentiate various causes of hyperthyroidism, and to detect concomitant disease such as thyroid carcinoma. Gland-size estimation by pinhole thyroid scintigraphy is unreliable, since this technique does not use a standard pinhole-to-thyroid distance, but instead adjusts this distance to optimize visualization of the gland. Two-dimensional gland size (length and width) can be assessed by parallel-hole scintigraphy or by pin-

hole scintigraphy with a superimposed calibrated marker. In our experience, however, the absence of the depth dimension severely limits such gland quantitation techniques.

In our study, routine scintigraphy did not alter the final diagnosis or treatment in 79 (98.75%) of the hyperthyroid patients with diffuse goiter without nodularity. However, in 17 of 20 individuals with a multinodular goiter, or with solitary palpable nodule with associated goiter, scintigraphy was of value in determining the final diagnosis, the need for further investigation, or a change in therapy.

Thyroid scintigraphy following TSH stimulation was not performed in any of the 20 patients with suspected nodular goiter, since, after the initial scintigram, repeat thyroid palpation, and clinical assessment, the diagnosis was considered sufficiently established. None of the patients treated for Graves' disease superimposed on multinodular goiter demonstrated a failure to respond to the prescribed dose of I-131. In the two patients with Graves' disease and a photopenic nodule (Nos. 55, and

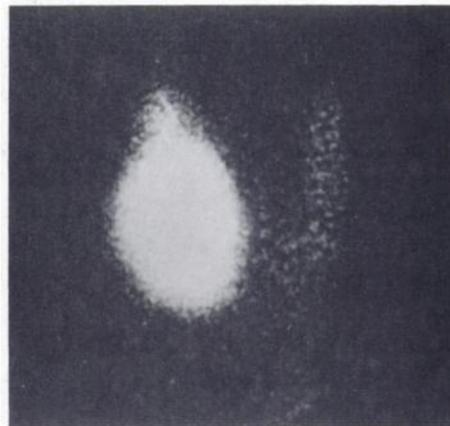


FIG. 3. Thyroid image in Patient 87, demonstrating 3.5-cm focus of increased activity in right lobe, with suppression of left lobe. Note that pertechnetate gives faint image of suppressed thyroid issue.

TABLE 2. PATIENTS WITH PALPABLE THYROID NODULES GROUP 3 SINGLE PALPABLE NODULE AND GOITER

Patient No.	Age	Sex	Preimage	Diagnosis	Postimage
4	56	F	Graves' disease, nodule, left lobe	Graves' disease superimposed on multinodular goiter with photopenic nodule	
26	26	F	Thyrotoxicosis, nodule, right lobe	Graves' disease, no nodule	
38	71	F	Thyrotoxicosis, nodule, left lobe	Graves' disease superimposed on multinodular goiter	
47	40	F	Graves' disease, nodule, left lobe	Graves' disease, no nodule	
55	58	F	Graves' disease, nodule, left lobe	Graves' disease with photopenic nodule	
85	76	F	Plummer's disease	Plummer's disease	
87	58	F	Plummer's disease	Plummer's disease	
96	33	F	Plummer's disease compared with Graves' with nodule	Graves' disease with photopenic nodule	
97	85	F	Plummer's disease	Plummer's disease	

96, Table 2), the possibility of the Marine-Lenhart syndrome was not excluded, since TSH stimulation imaging was not performed (9). Our major concern was to exclude malignancy, as accomplished by the needle biopsy, and the patient was rendered euthyroid by a single dose of I-131.

Based on this study, thyroid scintigraphy has little value in the evaluation of hyperthyroid patients with a diffuse goiter and a normal or elevated RAIU, but imaging should be done in those hyperthyroid patients with nodular goiters to confirm the diagnostic impression and therapeutic plan. Whether this conclusion will be applicable to other nuclear medicine practices depends on several factors. For one, the physicians involved in this study are experienced in thyroid palpation. A less experienced physician may wish to err on the side of performing thyroid scintigraphy in those patients in whom his or her palpatory findings are uncertain. Again the prevalence of nodular goiter in our population was 20%. In a population with a far greater prevalence of nodular goiter, i.e., in an endemic goiter area, the value of performing scintigraphy in our selective manner may be limited. Thus, in this similar setting, the selective use of thyroid scintigraphy should decrease the number of thyroid scintigrams required before I-131 therapy for

hyperthyroidism, without compromising diagnostic accuracy or therapeutic success.

REFERENCES

1. PINSKY S, RYO UY: *Nuclear Medicine Annual 1981*. New York, Raven Press, 1981, pp 157-194
2. HOFFER PB, GOTTSCHALK A, QUINN J: Thyroid in vivo studies. In *Diagnostic Nuclear Medicine*. Baltimore, The Williams and Wilkins Co., 1976, pp 255-277
3. TJOE SL, LEVINE B, WIELAND RG, CHEN JC: Relationship of the thyroid scintiscan to the therapeutic effects of ¹³¹I in hyperthyroidism with diffuse goiter. *J Nucl Med* 12:804-807, 1971
4. DELAND FH, WAGNER HN JR: *Atlas of Nuclear Medicine*, Vol. 3, Philadelphia, W. B. Saunders Co., 1972, p 237
5. JOHNSON PM: Thyroid and whole body scanning. In *The Thyroid*. Werner SC, Ingbar SH, eds. New York Harper and Row Publishers, 1978, p 300
6. KAPLAN MM, UTIGER RP: Diagnosis of hyperthyroidism. *Clinics in Endocrin & Metab* 7(1):97-113, 1978
7. HAMBURGER J: *Hyperthyroidism Concept and Controversy*. Springfield, IL, Charles C Thomas Publisher, 1972, p 23
8. WERNER SC: Modification of the classification of the eye changes of Graves' disease: Recommendations of the Ad Hoc Committee of the American Thyroid Association. *J Clin Endocrinol & Metab* 44:203-204, 1977
9. CHARKES ND: Graves' disease with functioning nodules (Marine-Lenhart Syndrome). *J Nucl Med* 13:885-892, 1972