THYROID SCANNING WITH GALLIUM-67 AND CESIUM-131

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The roles of ^{131}Cs and ^{67}Ga in the evaluation of solitary thyroid nodules were investigated. Radionuclide scans were performed with ^{67}Ga and ^{131}I in 27 patients and with ^{131}Cs and ^{131}I in 43 patients. Gallium-67 detected only two of eight malignant nonfunctioning nodules and ^{131}Cs detected one of three such nodules. The contribution of ^{131}Cs and ^{67}Ga to the preoperative identification of malignant thyroid lesions is of doubtful value.

The diagnostic and therapeutic problems presented by the patient with a solitary thyroid nodule are well known and have been emphasized in previous publications from our unit (*1,2*). Modern tests can usually detect thyrotoxicosis, but it is far more difficult, if not impossible, to exclude the presence of a malignant lesion.

With conventional ^{131}I scanning, thyroid nodules may be classed as hot, warm, or cold, depending on whether they concentrate more, equal, or less tracer than the surrounding parenchyma. Use of ^{99m}Tc-pertechnetate has similar diagnostic implications, although a preferential concentration of ^{99m}Tc by some thyroid nodules has been found (*3–5*). Most authors agree that cold thyroid nodules are more likely to harbor a cancer, but the percentage of malignancy varied over 4.8–58% in the various series reviewed by Börner et al (*6*). In our case material the percentage of malignancy was about 13% (*1,2*). In a study by Psarras et al (*2*), both warm and hot nodules were considered: 6.6% of the warm ones were proven malignant. Although no cancer was found in a hot nodule in these series, this can occur. Since our previous publications, we have found cancer in two hot nodules that were autonomous in the T_3 suppression test.

Even if hot and warm nodules are treated conservatively, surgical removal of all cold nodules carries the depressing stigma of about seven unnecessary operations for every malignant nodule removed. For this reason, investigators have sought more accurate preoperative diagnoses or, at least, a better selection of patients with increased risk of malignancy. To this end, various procedures have been used, including fine-needle aspiration and cytology of the thyroid gland (*7–9*); ultrasonography (*10*); thermography; various radiologic procedures, such as lymphography; and, finally, several "tumor seeking" radionuclides. The object is to find a tracer selectively concentrated by malignant lesions and to use it to scan all the thyroid nodules that appear cold with ^{131}I. Nuclides investigated for this purpose include ^{32}P (*11,12*), ^{75}Se-selenomethionine (*13*), ^{131}Cs (*14–16*), and ^{67}Ga (*3,17,18*). The present work was undertaken to define better the possible usefulness of ^{131}Cs and ^{67}Ga scanning in the evaluation of solitary thyroid nodules.

MATERIALS AND METHODS

Twenty-seven patients were studied with ^{67}Ga and 43 with ^{131}Cs. All patients were selected clinically as having a solitary thyroid nodule, without prominent enlargement of the thyroid gland and without clinical evidence of hyperthyroidism. The ^{67}Ga was given intravenously as gallium citrate in a dose of 1.5–1.8 mCi, and thyroid scintigrams were obtained 48 and 72 hr later using a Siemens Scintimat-2 scanner (Iselin, N.J.), equipped with a 5 × 2-in. crystal and a coarse-focus collimator with 55 holes. The spectrometer was set for 0.296 MeV peak, 0.100 MeV window, background cutoff 25–40%, line spacing 2.5 mm, and scanning speed 70 cm/min. The ^{131}Cs was also given intravenously as cesium chloride in

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TABLE 1. COMPARISON OF ^{67}Ga AND ^{131}I SCANNING RESULTS IN 27 CASES

^{131}I scanning		^{67}Ga scanning		Histology	
Hot	1	Hot	1	Benign	1
Warm	1	Warm	1	Benign	1
Cold	25	Hot	3	Benign	1 (33%)
				Malignant	2 (67%)
		Cold	22	Benign	16 (73%)
				Malignant	6 (27%)

TABLE 2. COMPARISON OF ^{131}Cs AND ^{131}I SCANNING RESULTS IN 43 CASES

^{131}I scanning		^{131}Cs scanning		Histology	
Hot	7	Hot	7	Benign	7
Warm	3	Hot	1	Benign	1
		Warm	2	Benign	2
Cold	33	Hot	8	Benign	7 (87%)
				Malignant	1 (13%)
		Warm	1	Benign	1
		Cold	24	Benign	22 (92%)
				Malignant	2 (8%)

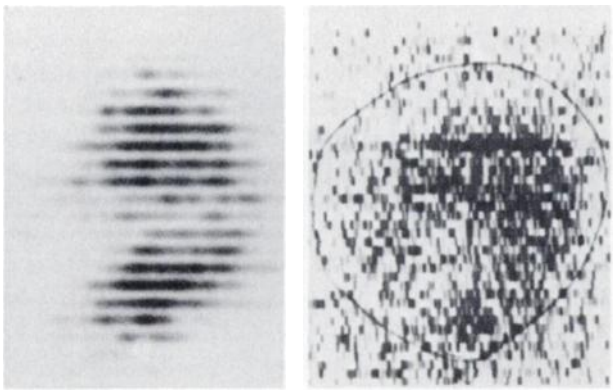

FIG. 1. Anaplastic thyroid carcinoma appearing as ^{131}I-cold (left) and ^{67}Ga-hot (right) nodule.

a dose of 0.5–0.7 mCi, and thyroid scintigrams were obtained 1 hr later using a Picker Magnascanner (Mentor, Ohio), equipped with a 3 × 2-in. crystal and a 1045-hole collimator appropriate for the low energies of ^{131}Cs. The spectrometer was set for lower level 15 keV, upper level 50 keV, background cutoff 70%, and scanning speed 50–70 cm/min.

After the ^{67}Ga or ^{131}Cs scintigrams, conventional ^{131}I tests were performed as described by Malamos et al (*19*). These included at least two thyroid uptake measurements at 4 and 24 hr, a protein-bound iodine determination at 48 hr, and a ^{131}I thyroid scintigram at 24 hr using a Siemens Scintimat-2 scanner with a 5 × 2-in. crystal and a fine-focus collimator with 163 holes. The spectrometer was set for 0.364 MeV peak, 0.100 MeV window, background cutoff 10%, line spacing 2.5 mm, and scanning speed 55 cm/min. Additional tests were performed as necessary, including serum protein-bound iodine and thyroxine measurements, T_3-resin uptake determination, and T_3 suppression or TSH stimulation tests. Ideally, it would have been preferable to study only patients with ^{131}I-cold nodules, but since the ^{131}I activity interfered with scanning by other agents, the ^{131}I studies were performed after the ^{67}Ga and ^{131}Cs ones. This resulted in the inclusion of some ^{131}I-hot nodules.

RESULTS

The results are summarized in Tables 1 and 2. Table 1 shows that of the 27 cases studied with ^{67}Ga, 25 had ^{131}I-cold thyroid nodules. Of these, three were hot with ^{67}Ga; and of these three, two were malignant. One of them, however, was a clinically obvious anaplastic carcinoma (Fig. 1). Six malignant nodules were cold with both ^{131}I and ^{67}Ga and so could not be differentiated from benign nodules (Fig. 2). Thus, of the eight malignant neoplasms, only two were correctly detected with ^{67}Ga. The only toxic adenoma in this series of 27 cases was hot with both ^{131}I and ^{67}Ga.

The results obtained with ^{131}Cs are summarized in Table 2. Of the 43 cases, ten were hot (mostly toxic adenomas) or warm to ^{131}I, and scanning with ^{131}Cs

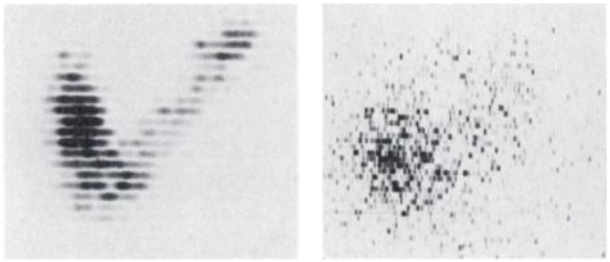

FIG. 2. Follicular thyroid carcinoma appearing as cold nodule with both ^{131}I (left) and ^{67}Ga (right).

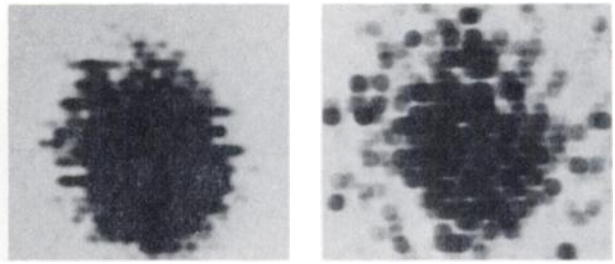

FIG. 3. Toxic thyroid adenoma appearing as hot nodule with both ^{131}I (left) and ^{131}Cs (right).

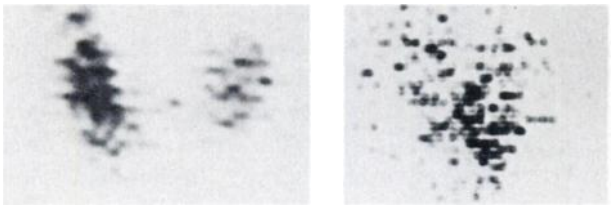

FIG. 4. Mixed papillary–follicular thyroid carcinoma appearing as ^{131}I-cold (left) and ^{131}Cs-hot (right) nodule.

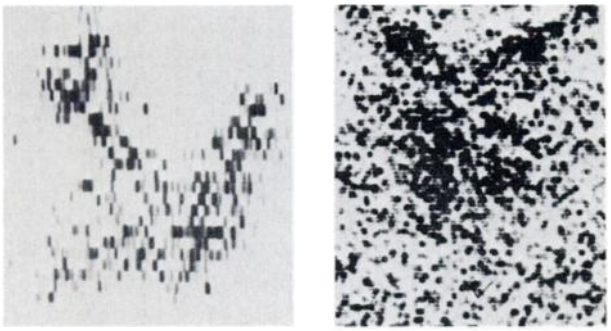

FIG. 5. Benign thyroid adenoma appearing as ^{131}I-cold (left) and ^{131}Cs-hot (right) nodule.

gave generally parallel results (Fig. 3). Of the 33 ^{131}I-cold nodules, eight were hot with ^{131}Cs and 24 were cold (only one was warm). One of the former and two of the latter were malignant. In addition, one case in each of the two subgroups was classified as histologically doubtful: there was a suggestion of malignancy, but no definite pathologic diagnosis could be made. Hence, of the eight nodules scanning cold with ^{131}I and hot with ^{131}Cs, only one (Fig. 4) was definitely malignant and another possibly so, whereas the other six were definitely benign histologically (Fig. 5). Of the 24 nodules scanning cold with both tracers, two (or perhaps three) were malignant (Fig. 6); the remaining cases were benign (Fig. 7).

DISCUSSION

Cesium-131. Previous investigators have reported more favorable results with these two "tumor seeking" nuclides. Uchiyama et al (*14*) found 16 out of 19 cases of ^{131}Cs-hot nodules to be malignant, whereas only 4 out of 23 ^{131}Cs-cold ones were. Murray et al (*15*) found five out of seven ^{131}Cs-hot nodules to be malignant, as opposed to one out of 15 ^{131}Cs-cold ones, these being submitted to operation. In a more recent work, Alevizaki et al (*16*) investigated 40 patients with ^{131}I-cold nodular goiters and found that 12 of them were hot with ^{131}Cs (ten malignant and two benign), with the remaining 28 being cold and all benign.

In contrast, the present work does not confirm the claims for ^{131}Cs and suggests that this nuclide is not suitable for the preoperative detection of thyroid cancer. This conclusion is not based on the finding that toxic adenomas are depicted as hot with ^{131}Cs, since these are easily detected with a ^{131}I scintigram. What is more disturbing is the fact that of the eight nodules that were cold with ^{131}I and hot with ^{131}Cs, only one or possibly two were malignant. If this alone were the case, ^{131}Cs could still be useful, since of the 33 ^{131}I-cold nodules only eight were ^{131}Cs-hot, thus sparing the remaining 25 patients an unnecessary operation. However, of the 24 ^{131}Cs-cold nodules, two, or possibly three, were also malignant. Hence, ^{131}Cs scanning neither confirms nor excludes thyroid malignancy. To be sure, ^{131}Cs-hot nodules had a 12.5% incidence of malignancy (or 25% if the doubtful case is included), whereas the ^{131}Cs-cold nodules scored 8.3% (or 12.5%). Study of a larger group of patients would probably find a significant difference, but if this cannot be shown in 33 cases, it can hardly be important enough to be of clinical use. The fact that most thyroid units do not use ^{131}Cs scanning extensively seems to reflect the conclusions drawn from the present work.

It is not clear why our findings differ from those of Uchiyama et al (*14*), Murray et al (*15*), and Alevizaki et al (*16*). Differences in the scanning procedure may have contributed to the discrepancy, but more likely the selection of cases is the principal factor. If clinically obvious thyroid carcinomas were considered, possibly better results would be obtained.

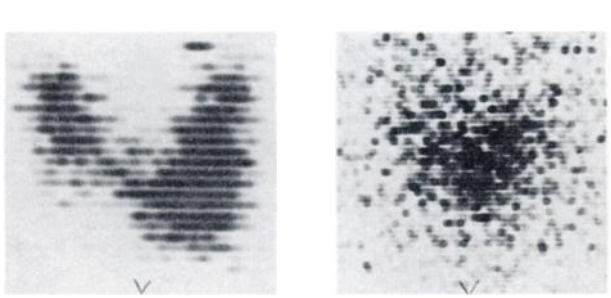

FIG. 6. Mixed papillary–follicular thyroid carcinoma appearing as cold nodule with both ^{131}I (left) and ^{131}Cs (right).

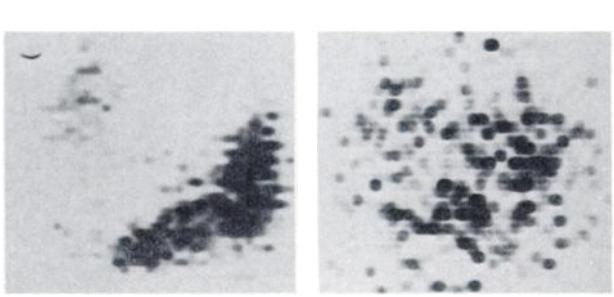

FIG. 7. Benign thyroid adenoma appearing as cold nodule with both ^{131}I (left) and ^{131}Cs (right).

But the usefulness of any laboratory procedure lies in the detection of lesions that are not clinically obvious, and in this ^{131}Cs scanning seems ineffective.

Gallium-67. Radiogallium has also been used with apparent success for the detection of various malignancies (*20,21*). Higashi et al (*17*) found that 7 out of 11 thyroid malignancies showed hot when scanned with ^{67}Ga and the remaining four were cold. Roos and Schoot (*18*) used ^{67}Ga-citrate for scanning multinodular goiters and found four out of five hot lesions to be malignant, compared with two out of six ^{67}Ga-cold ones. Furthermore, in the series of Hör et al (*3*) of 19 thyroid carcinomas of various histologic types, 17 were hot and 2 cold with ^{67}Ga, whereas 12 benign nodular goiters were all cold.

Again, the present work does not agree with these results and at best does not generate much optimism. Out of eight malignant thyroid nodules only two were positively identified with ^{67}Ga, one of them being a clinically obvious anaplastic carcinoma. Thus, in our series, ^{67}Ga has proved to be useless in the preoperative detection of thyroid carcinoma. As for ^{131}Cs, we differ from others and can only wonder about the selection of the cases included. Any difference in the scanning technique is small and could not account for such contradictory results.

In summary, although ^{131}Cs and ^{67}Ga scanning may contribute to the preoperative identification of malignant thyroid lesions, their contribution is a small one. It is therefore doubtful whether these procedures should be recommended for the routine workup of patients with solitary thyroid nodules.

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