Comparison of 4- and 24-hr Thyroid Scans with ^{123}I: Concise Communication

Stuart L. Rosenthal, Fred D. Hofeldt, and Thomas A. Verdon, Jr.

University of Missouri, Columbia, Missouri

Thyroid scans were performed at 4 and 24 hr after administration of $Na^{123}I$ solution in 124 examinations. The 4-hr and 24-hr scans were found to be of equal diagnostic value. Thus, in individuals with structural thyroid abnormalities, one can effectively reduce the time required for scan evaluation from the standard 24 hr to 4 hr.

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Most of the patients sent to a nuclear medicine clinic for thyroid evaluation are referred for the appraisal of structural abnormalities, and these most frequently include thyroid goiter or nodules. Until recently, the usual method of evaluation was to give an oral dose of ^{131}I and have the patient return the next day for a rectilinear thyroid scan. The 24-hr interval between dosing and scanning is inconvenient for the patient, who must find time for the procedure on two consecutive days. The two widely separated visits are a particular hardship to patients who work and to those who must come to the hospital from a considerable distance.

Technetium-99m as pertechnetate is widely and successfully used as an alternative scanning agent to ^{131}I, but inconsistencies have been reported in the imaging of multinodular goiters and carcinomas (*1,2*).

Iodine-123, which has been proposed as the ideal agent for thyroid scanning (*3*), offers most of the advantages of $^{99m}TcO_4^-$ while eliminating its drawbacks. Iodine-123 has a manageable principal gamma energy of 159 keV, no beta decay, and a short half-life (13 hr), and it can be used with both the rectilinear scanner and the scintillation camera. Per microcurie administered, the dose absorbed by the thyroid gland is about one-hundredth that of ^{131}I, and the whole-body dose is decreased by a factor of more than 10 (*4*). Thus, the microcurie dose of ^{123}I can be increased considerably over that used for ^{131}I without unacceptable radiation exposure to the patient. The increased scanning dose allows for greater image contrast, especially when the uptake is low. Because ^{123}I is both trapped and organified, it should indicate the functional characteristics of the visualized tissue as reliably as ^{131}I, as long as enough time has elapsed for organification. The high-contrast high-resolution images obtainable within a few hours of ^{123}I administration permit scan evaluations of a thyroid nodule or goiter during a single patient visit (*5,6*). We report our experience with ^{123}I thyroid scans in a large group of patients with structural irregularities of the thyroid.

MATERIALS AND METHODS

One-hundred-twenty consecutive patients (124 studies) referred to our nuclear medicine clinic were given 400 μCi of $Na^{123}I$ solution. In six instances, scans of the neck were performed in conjunction with whole-body images in search of residual thyroid tissue or metastases following total thyroidectomy for carcinoma. These patients received 2 mCi of ^{123}I instead of 400 μCi. At the University clinic, the subjects were scanned with a 3-in. fine-focus collimator at 4 and 24 hr after dose administration. Information density was adjusted to 800 and the line spacing to 2 mm. No background subtraction or contrast enhancement was used. Images were recorded on both x-ray film and Teledeltos paper. The thyroid gland was palpated while the patient was still under the scanner, and nodules were localized

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For reprints contact: Fred D. Hofeldt, University of North Dakota, c/o Veterans Administration Hospital, North Elm & 21st Ave., Fargo, ND 58102.

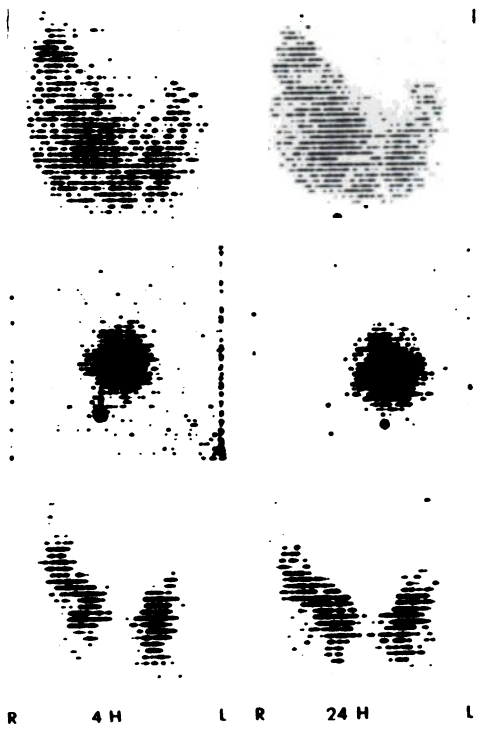

FIG. 1. Iodine-123 scans at 4 and 24 hr in three patients. Top: Multinodular goiter (4-hr uptake, 12%; 12-hr uptake, 15%). Middle: Autonomous nodule on suppression (4-hr uptake, 5%; 24-hr uptake, 9%). Bottom: Solitary cold nodule (4-hr uptake, 7%; 24-hr uptake, 23%).

and outlined on the Teledeltos picture. The procedure at the Veterans Hospital Clinic was essentially the same as at the University, except that the images were obtained using a 3.5-in. focused collimator* and $\frac{1}{16}$-in. line spacing. Instead of Teledeltos paper, thyroid topography was mapped on an oscilloscope image by an electronic marking device.

The scans at 4 and 24 hr were read at the time they were performed. In addition, each pair of scans was reviewed at the conclusion of the entire project. The criteria used in comparing the 4- and 24-hr scans were (A) whether or not the diagnostic conclusions suggested by the pair of scans were identical, and (B) whether or not one scan contained diagnostic information not found on the other.

RESULTS

Of the 124 pairs of scans reviewed, every set met both of our standards for concordance. In each case, the diagnosis derived from the 24-hr scan was made just as easily using only the 4-hr scan (Fig. 1). The quality of the early images seemed uniformly as high as those of the 24-hr scans.

When classified purely on the basis of morphologic characteristics without regard to thyroid functional state, our material included 32 glands that were normal in size and structure, 12 isoresponsive nodules, 20 solitary or dominant cold nodules, 23 diffuse goiters, 14 multinodular goiters, and 8 cases of thyroiditis without discrete nodularity. Three of five patients with isolated functional nodules were later rescanned with the patient on suppression doses of L-triiodothyronine. All three suppression tests resulted in the diagnosis of an autonomous nodule. Two scans were nondiagnostic at both 4 and 24 hr due to iodine from recent radiologic contrast studies. This interference came to light only after the completion of the studies. Of the six postthyroidectomy examinations, five revealed small foci of iodine-concentrating tissue in the neck. We did not obtain 4-hr whole-body scans.

A majority of patients had 4- and 24-hr uptakes recorded as part of their clinical workups. At the end of this study, these values were broken down in order to ascertain whether our scans were obtained over a broad range of thyroid functional states, including a number of patients with very low uptakes. The range of 24-hr uptakes extended from 1 to 82% and included ten cases with uptakes below 5%. When the two cases of iodine residual are excluded, 8 of our 124 patients (6.6%) are classified as having low uptake at 24 hr. The 4-hr uptakes were distributed between 1 and 30%, with 23 instances of less than 5% uptake.

DISCUSSION

These results indicate no discernible difference in diagnostic quality between ^{123}I thyroid scans performed at 4 hr and at 24 hr after dose administration. Because of the very favorable counting statistics from the increased dose possible with ^{123}I, this observation holds even at very low levels of ^{123}I uptake, as found in 6.6% of our patients. In a few cases, scintillation-camera views were used to delineate better a nodule that was equivocal on the rectilinear study. The early camera images were just as helpful and satisfactory as their 24-hr counterparts. Assuming the general availability of ^{123}I, it is now feasible to reduce the time required for thyroid-imaging studies from 24 to 4 hr. With conventional procedures, this conclusion applies only to cases in which there is a question of a structural thyroid abnormality in a euthyroid individual. The extension of the concept to the evaluation of thyroid *dysfunction* must await analysis of 4-hr ^{123}I uptake data.

The implications of a shortened thyroid-study period with ^{123}I are great for both the patient and the examiner. However, there are instances when the longer half-life of ^{131}I is needed for later scans at 48, 72, or 96 hr. This happens, for example, during

a search for functioning metastases in thyroid cancer patients.

At present, the only drawbacks to full-scale utilization of ^{123}I for thyroid evaluation are its high cost and the necessity of having it flown by air freight because of its short half-life. In nearly 2 years of continuous ^{123}I scanning, we have found the delivery system for the radionuclides to be generally reliable. As use of ^{123}I becomes more widespread, its price should decrease.

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FOOTNOTE

* Ohio-Nuclear Model No. 53524L (Solon, Ohio).

REFERENCES

1. ATKINS HL, KLOPPER JF, LAMBRECHT RM, et al.: A comparison of technetium-99m and iodine-123 for thyroid imaging. *Am J Roentgenol Radium Ther Nucl Med* 117: 195–201, 1973

2. KRISHNAMURTHY GT, SHOOP L, WALSH CF, et al.: Comparison of 99m technetium pertechnetate and radioiodine (I-131) as thyroid scanning agents. *Nucl Med (Stuttg)* 12: 97–106, 1973

3. MYERS W: Radioisotopes of iodine. In *Radioactive Pharmaceuticals, Proceedings of an Oak Ridge Institute of Nuclear Studies Symposium, November 1–4, 1965.* USAEC, Division of Technical Information, 1966, p 217

4. WELLMAN HN, ANGER RT: Radioiodine dosimetry and the use of radioiodines other than ^{131}I in thyroid diagnosis. *Semin Nucl Med* 1: 356–378, 1971

5. WELLMAN HN, MACK JF: Study of preliminary experience with the use of ^{123}I for thyroid function and scanning compared to ^{131}I. *J Nucl Med* 9: 359–363, 1968

6. NISHIYAMA H, SODD VJ, BERKE RA, et al.: Evaluation of clinical value of ^{123}I and ^{131}I in thyroid disease. *J Nucl Med* 15: 261–265, 1974