

Thyroid Imaging with ^{123}I

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One of the most extensively studied organs in nuclear medicine has been the thyroid gland. The thyroid is an endocrine organ and produces hormones which are directly involved with the metabolism of the body. More and more elaborate procedures are being designed to record and evaluate the physiological actions of the thyroid. However, one of the most important aspects of thyroid evaluation is still the thyroid "scan". The importance of knowing the size, shape, and location of the gland and whether or not a thyroid nodule is functioning or nonfunctioning is a prime concern of the clinician.

There have been a large variety of iodine nuclides used in the evaluation of the thyroid. A few of them are ^{125}I , ^{130}I , ^{131}I , and ^{132}I . For many years, ^{131}I has been the standard nuclide used for several reasons: (A) it has a reasonable half-life of 8.08 days which means storage is pos-

sible; and (B) its 364-keV gamma ray is suitable, although not ideal, for most imaging devices. It is more ideal for the rectilinear scanner than the gamma camera with its relative thin sodium iodide crystal.

But ^{131}I also has drawbacks. One of the major ones is the beta radiation that increases the radiation dose to the patient significantly. This also prevents one from performing several or serial images in a short period of time.

Iodine-125 has also been used for imaging, but the long half-life of 60 days is considered a hindrance in most cases. The low energy of ^{125}I is not suitable when one is looking for a substernal thyroid or metastatic thyroid disease.

Recently, ^{123}I with a short 13.3-hr half-life has been introduced. This nuclide has a low 159-keV gamma energy that is ideally suited for imaging with the gamma camera and is free from beta radiation since it decays by electron capture. This reduces the total radiation dose to the patient significantly and makes this a particularly good nuclide for examining babies and young children. The 13.3-hr half-life is short enough to allow repeated images to be performed within 3 or 4 days without any significant amount of ^{123}I remaining from previous examinations. Henry Wagner has stated, "In all respects, then, ^{123}I fulfills our criteria for ideal gamma isotopes for in situ and in vivo diagnostic procedures more closely than any other radionuclide of iodine" (1).

Method

When we use ^{123}I , a dose of 100-400 μCi is given orally and imaging is done from 2 to 24 hr later*. Usually a 6-hr and a 24-hr uptake are performed, and images are obtained at the 6-hr interval although images at 24-hr are possible.

We visualize the thyroid using the following techniques with 100-400 μCi of ^{123}I administered

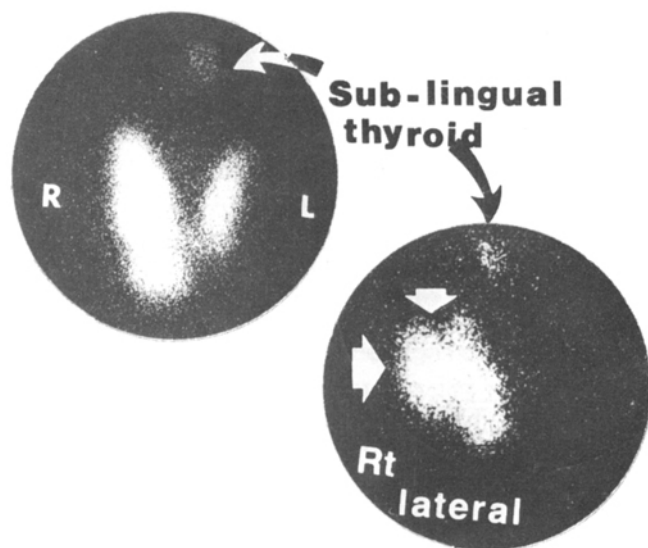


FIG. 1. Case 1. Patient is white 54-year-old woman who complained of fullness in her neck with some slight trouble swallowing. On physical examination right lobe was somewhat larger than left.

Summary: Thyroid image indicated functioning nodule on right lobe of gland, extending posteriorly. Nodule has not yet begun to function autonomously as indicated by failure of suppression of rest of gland.

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*Data supplied by Medi-Physics.



FIG. 2. Case 2: 30-year-old white man with small movable mass on right side of neck with question as to whether it was related to thyroid gland.

Summary: Scintigram shows normal thyroid gland with no evidence of thyroid nodule or cyst.

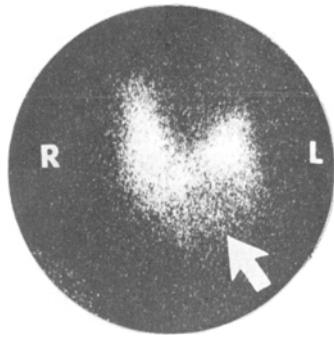


FIG. 3. Case 3: Patient was white, 41-year-old woman with history of thyroid mass for past 1½ years. Patient had been receiving Synthroid (0.3 mg) daily for approximately 1 year with no change in size of mass.

Summary: Thyroid scintigram showed 5-cm nonfunctioning or poorly-functioning nodule on lower pole of left lobe.

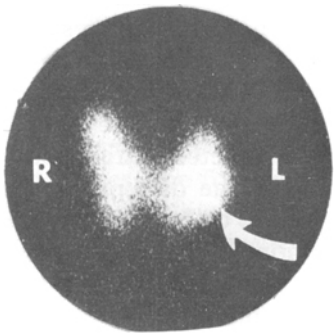


FIG. 4. Case 4: White, 57-year-old woman who had had complaints of swallowing for 6 months. Previous thyroid scan indicated small functioning nodule on left lobe.

Summary: Scintigram shows that nodule has increased in size and continued to function but not autonomously.

orally and a Pho/Gamma scintillation camera using the following:

1. A pinhole collimator.
2. Distance of 3 in. from gland to collimator and a formed positioning device to insure minimal patient movement.

3. Peak the camera to the 159 keV gamma energy.
4. Use a 10-15 percent window (depending on uptake).
5. Accumulate 50,000-100,000 counts per image.
6. Intensity settings will vary depending on the number of counts obtained. Use the lowest possible intensity with the corresponding counts to insure the best resolution.

Results

Some of the patients we have examined with ^{123}I using these techniques are shown in Figs. 1-6. A short history and a summary of the final diagnosis are given in the captions. In all cases, a dose of 300-400 μCi was given, and the thyroid scintigrams were performed at 6 hr.

Reference

1. Wagner HW: *Principles of Nuclear Medicine*, Philadelphia, Saunders, 1968, p 279

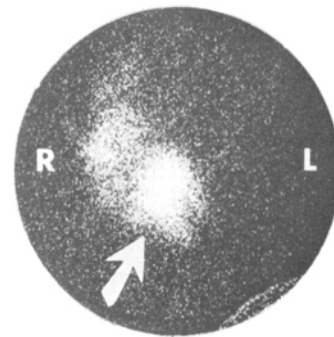


FIG. 5. Case 5: 64-year-old white woman who had thyroidectomy of left lobe approximately 9 months before. Diagnosis of Hashimoto's disease was reported.

Summary: Scintigram shows that progression of Hashimoto's disease is occurring. Most of thyroid gland has been destroyed, and only area near isthmus is functioning adequately.

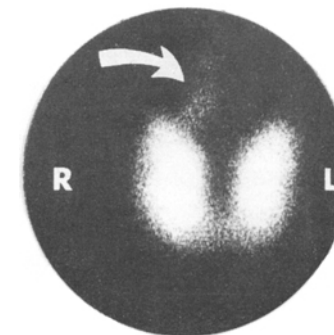


FIG. 6. Case 6: 50-year-old white woman with complaints of tachycardia, extreme nervousness, and slight tremors of hands. Clinically patient was hyperthyroid and thyroid seemed large. Six-hour and 24-hour uptake revealed 40 and 53% uptake, respectively.

Summary: Scintigram showed that thyroid was large and hyperfunctioning. Pyramidal lobe extending from right lobe was identified. There were no nodules present.