RAPID EVALUATION OF THYROID NODULES USING ^{99m}Tc-PERTECHNETATE SCANNING

Evaluation of thyroid nodules by scintiscanning has become an accepted procedure and permits a classification according to uptake. This communication deals principally with the advantages of ^{99m}Tc over radioiodine in the evaluation of "hot" nodules (uptake greater than adjacent tissue). "Hot" nodules require function tests to establish whether or not they are autonomous or remain under the control of thyrotropin. It has been customary to perform base-line scans followed by scans after thyrotropin stimulation and triiodothyronine suppression to establish dependence or autonomy.

Conventional techniques, employing ^{131}I or ^{125}I for these evaluations, have several disadvantages when compared with the use of ^{99m}Tc-pertechnetate. When iodine is used, the scan is usually performed 24 hr after administration of the dose, requiring two laboratory visits per scan. The relatively long half-lives of ^{125}I and ^{131}I require a substantial interval between the initial base-line scan and the scans following thyrotropin stimulation and triiodothyronine suppression to prevent interference by the residual radioactivity from the previous dose. Complete evaluation requires a number of visits and inconvenient delays to patient and physician which are considerably reduced by using ^{99m}Tc. In addition, radiation exposure to the thyroid from ^{131}I beta irradiation and the long half-life of ^{125}I are significant disadvantages when compared to ^{99m}Tc.

To overcome these difficulties, ^{99m}Tc-pertechnetate scans were adopted for the evaluation of thyroid nodules. A number of reports have indicated the usefulness of pertechnetate in thyroid studies (*1–3*). The pertechnetate is concentrated by the thyroid in a manner similar to iodine but, unlike iodine, it is not organified. Concentrations of ^{131}I, ^{125}I and ^{99m}Tc in the thyroid are enhanced by thyrotropin and depressed by triiodothyronine (*2*).

In practice, 1 mCi of ^{99m}Tc is administered intravenously to the subject who presents for evaluation of a thyroid nodule. The thyroid scan is begun 15 min after injection at which time uptake is normally 1–2% of the administered dose. The high level of activity permits a rapid scan. Using a Picker Magnascanner V equipped with a 5 × 2-in. NaI(Tl) crystal and a 3-in. fine focus collimator, a scan speed of 60 cm/min was used. The uptake and scan can be completed within 30 min of ^{99m}Tc administration. Individuals with "cold" nodules are not subjected to stimulation or suppression testing. Patients with "hot" nodules are given 10 units of thyrotropin* by intramuscular injection immediately after completion of base-line scans, and they return in 24 hr for the stimulation scan and uptake. The patient is then given Cytomel tablets, 25 μg four times a day for 7 days, commencing immediately after the stimulation scan. On completion of the 7-day suppression period, the patient returns for suppression uptake and scan. The entire evaluation is completed within 8 days and requires only three visits.

Radiation dose to a 70-kg patient with a 20-gm thyroid given 1 mCi of ^{99m}Tc is shown below. Assuming a biologic half-life of 53 hr (*1*), a calculated effective half-life of 5.2 hr (whole body) and a

* Thytropar, Armour.

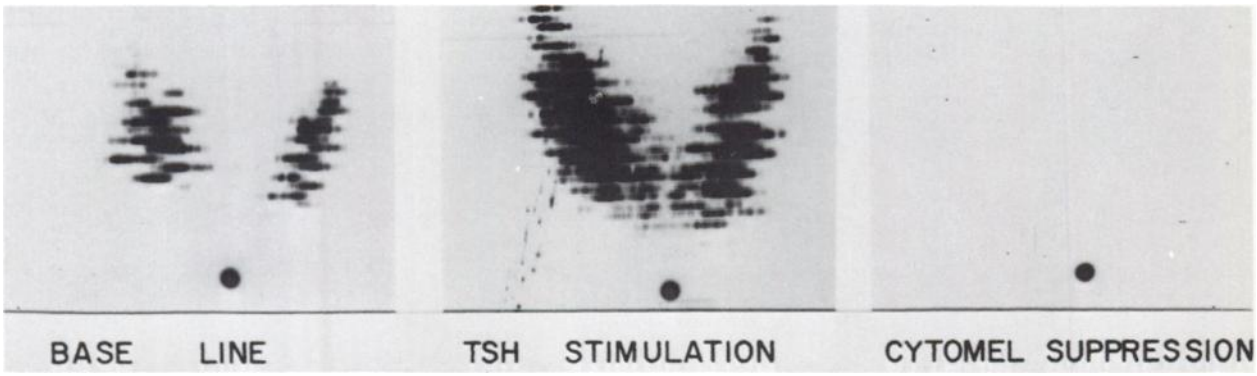

FIG. 1. ^{99m}Tc scans in subject with normal thyroid.

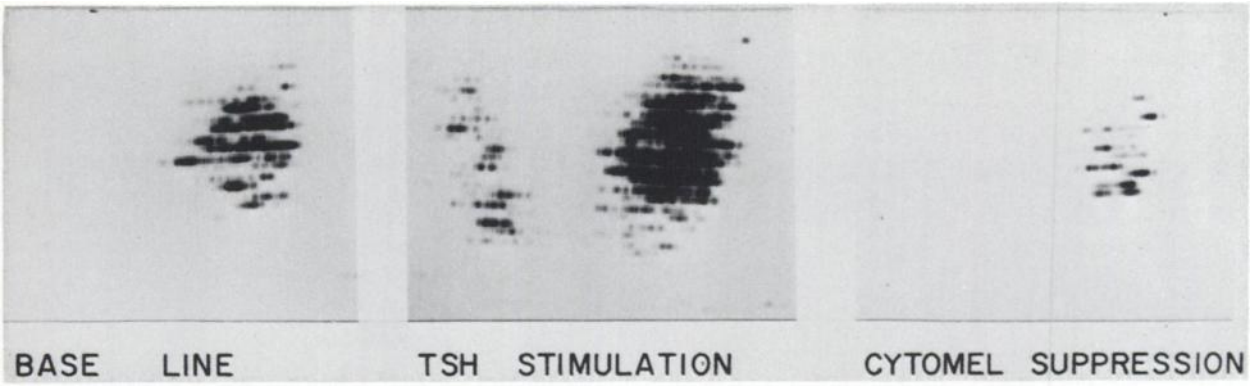

FIG. 2. ^{99m}Tc scans in subject with "hot" nodule.

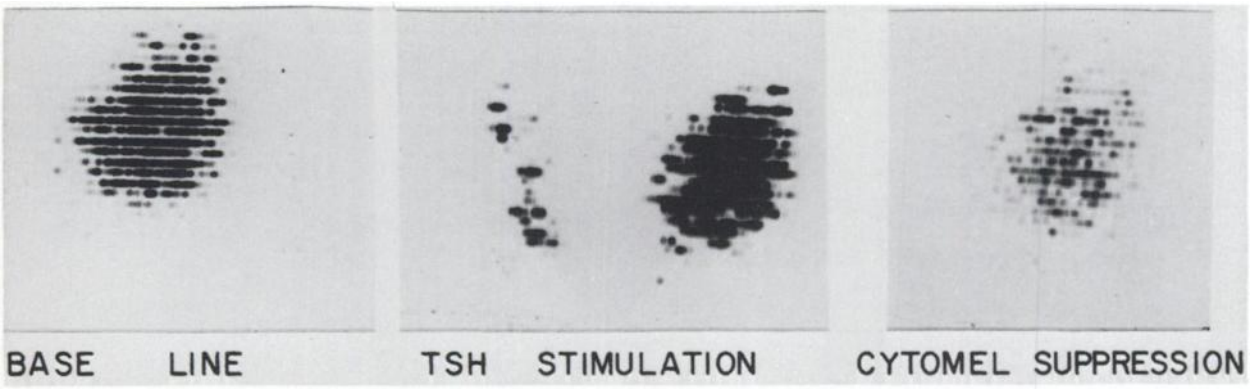

FIG. 3. Comparable ^{131}I scan for subject with "hot" nodule.

maximum thyroid uptake of 3.8%, radiation dose to the thyroid would be 2.6 rad/scan. Actual radiation dose is less than this since uptake is usually about 2% and effective half-life for thyroid should be less than 5.2 hr. This may be compared with 65 rads for ^{131}I and 41 rads for ^{125}I for an uptake of 20%. The calculated whole-body dose for ^{99m}Tc is 20 mrads/scan.

Scans using ^{99m}Tc are reasonably similar to the iodide scans. Figure 1 shows the ^{99m}Tc scans carried out on a euthyroid subject who had a normal thyroid on palpation. Figure 2 shows ^{99m}Tc scans for a patient with a "hot" nodule. The thyrotropin study demonstrates that the extra nodular portion of thyroid has been suppressed. Administration of Cytomel failed to completely diminish uptake over the nodule, indicating some independence from thyrotropin control. Figure 3 shows the corresponding ^{131}I scans for the patient. Similar results were obtained, but greater time and radiation exposure were required. Uptake of ^{99m}Tc by the thyroid has been shown to reasonably reflect thyroid function in a manner similar to the ^{131}I uptake (*2*).

The ^{99m}Tc scan or uptake has a place in the study of thyroid function when several repeat scans are required, a quick uptake or scan is desired, low radiation exposure (as in infants) is desirable or when the uptake is too low to obtain a satisfactory scan with the usual dose of ^{131}I.

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