# EARLY VISUALIZATION OF $^{99m}$Tc-PERTECHNETATE IN METASTATIC THYROID CANCER IN A PATIENT WITH GRAVES' DISEASE

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The use of $^{99m}$Tc-pertechnetate to detect metastatic thyroid carcinoma has appeared in only one case report (*1*). Sodee demonstrated visualization of metastatic deposits in the lungs of a 65-year-old woman with papillary carcinoma of the thyroid (*1*).

This report describes another case of metastatic papillary thyroid carcinoma localized to the neck and mediastinum and complicated by the presence of Graves' disease. Multiple studies confirmed early uptake and visualization with rapid turnover of the pertechnetate in the metastatic tumor tissue.

## CASE REPORT

EL, a 20-year-old white female, developed symptoms of hyperthyroidism in January 1968. Proptosis appeared and the diagnosis was made by her physician in March 1968; it was confirmed by a PBI of 17 μg/100 ml. Oral antithyroid medication was administered, and in July 1968 a subtotal thyroidectomy was performed which revealed carcinoma of the thyroid. Several weeks postoperatively an $^{131}$I scan revealed metastatic deposits outside the remaining thyroid in the right cervical area.

On referral to Vanderbilt University Hospital, physical examination revealed a 2 × 2 cm, firm, nonmovable mass in the right cervical area. The chest radiograph showed no abnormalities. All laboratory data were normal except for those related to thyroid function as outlined below. Surgical extirpation of the remaining thyroid gland and all of the identifiable metastatic deposits was decided upon. Pre- and postoperatively a number of radionuclide studies were performed.

## METHOD

A commercial 3 × 2-in. crystal scanner with a 31-hole focusing collimator for medium energy was used for the rectilinear scans. The count rate range differential varied from 20 to 60. The density setting was 100. Line spacing was 3 mm.

A commercial 13 × ½-in. crystal Anger scintillation camera with a straight-bore low-energy collimator was used for the dynamic studies.

## RADIONUCLIDE STUDIES

A series of pertechnetate and iodide thyroid examinations were performed. The isotope and dose used, date scanned and other data are given in Table 1. Pertinent scans are reproduced in the composite Fig. 1.

At the time of referral a rectilinear scan was done using 5 mCi of $^{99m}$Tc-pertechnetate. Three areas of uptake outside the thyroid were seen (A in Table 1 and Fig. 1A). These findings were essentially the same as those on $^{131}$I scans performed after the subtotal thyroidectomy at another hospital. A total thyroidectomy and right radical neck dissection was attempted. At surgery, numerous nodes extending into the right and left tracheo-esophageal groove, and deeper extensions into the mediastinum were found. Incomplete resection of all the tumor was reported by the surgeon. Tissue submitted to histologic examination revealed papillary thyroid carcinoma and a portion of the resected residual thyroid, free of tumor, demonstrated findings consistent with Graves' disease.

Three weeks after surgery a scan with $^{131}$I (B in Table 1 and Fig. 1B) showed residual activity in the upper cervical area but no uptake in the thoracic inlet area. One hundred millicuries of $^{131}$I was administered as a therapy dose. At the time of discharge she was placed on triiodothyronine 50 μg b.i.d., vitamin D—25,000 units q.d. and calcium lactate 4 gm t.i.d. At outpatient visit 6 weeks after therapeutic $^{131}$I, a scan with 1.0 mCi of $^{131}$I (C in Table 1) showed no accumulation in the neck or lung. The scan for this study is not included in Fig. 1.

Five months after $^{131}$I therapy, a repeat pertechnetate scan was performed using 2.1 mCi. This was the first use of this isotope since the preoperative study, and the scan was done after discontinuation

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of triiodothyronine for a week. Scanning on the rectilinear instrument at 30 min after radionuclide injection revealed an area of substernal uptake in the right sternoclavicular area visible only on the anterior scan (D in Table 1 and Fig. 1, D1) and not on the obliques. Repeat anterior scan 1½ hr postdose failed to show this uptake (Fig. 1, D2).

Because of this unexplained uptake on a 30-min film, which failed to appear on subsequent scans, 2 mCi of pertechnetate was reinjected, and serial studies using the Anger camera were obtained. Serial studies were 2 min each and spanned 1 hr. Areas of uptake were present in the right sternoclavicular area and superiorly below the left submandibular region of the neck. Most impressive was the observation that the uptake peaked at 24–26 min postinjection (E in Table 1 and Fig. 1, E1) and was significantly less apparent on the 52–54-min film (Fig. 1, E2). During a dynamic study, the patient was kept in the same position in relationship to the camera. The intensity settings and time of collection remained constant. At 47–50 min postinjection a 3-min camera study was obtained in the hope of improving resolution of the lesions. There was a comparable increase in background counts as well as in counts from the lesions. The delineation of the metastatic regions was best at 24–26 min. The findings on both the rectilinear and camera study showed early visualization of the lesions with pertechnetate.

Six months after $^{131}I$ therapy and 24 hr after a 1-mCi dose of $^{131}I$, the patient was rescanned (F in Table 1). The lesion beneath the right sternoclavicular area was again found, and this confirmed the Anger camera pertechnetate findings. The area below the left submandibular region was not visualized with $^{131}I$.

A second pertechnetate dynamic study was performed 7 months after $^{131}I$ therapy (G in Table 1). The patient was maintained on triiodothyronine until the day of the study. Early uptake of the pertechnetate in the metastatic areas peaking at 19–23 min was observed on the dynamic camera study. A 2 hr postinjection rectilinear scan failed to detect the lesions. The second dynamic study confirmed the first and also showed that the continuation of triiodothyronine to the day of the study did not affect pertechnetate uptake in the metastatic tissue. Following this study the patient was given a second therapy dose of 100 mCi of $^{131}I$. She is doing well and is being followed as an outpatient.

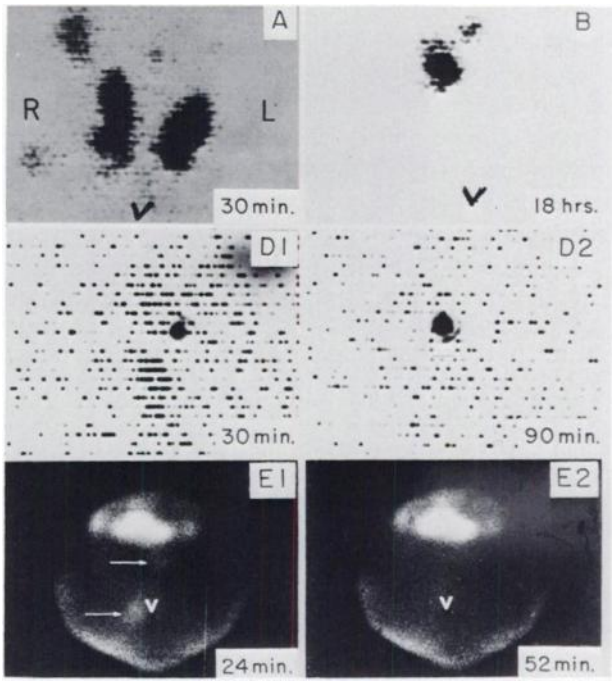


**FIG. 1.** Selected reproductions of isotope studies performed. Letters refer to specific study and correspond to letters in Table 1. Arabic numeral follows letter if more than one reproduction from same study is represented. Time of study following administration of radionuclide is given. V in studies A and B and dots in D1 and D2 represent suprasternal notch. In Anger camera study E1 and E2 V indicates suprasternal notch, arrows metastatic deposits.

**TABLE 1. COMPLETE LISTING OF ISOTOPE STUDIES PERFORMED**

| Study letter | Date | Radionuclide | Dose | Time of study | Status of patient |
|---|---|---|---|---|---|
| A | 9/18/68 | $^{99m}Tc$ | 5.0 mCi i.v. | 30 min | Post biopsy local hospital; no medications |
| B | 10/10/68 | $^{131}I$ | 1.5 mCi p.o. | 18 hr | Post total thyroidectomy and right radical neck |
| C | 12/4/68 | $^{131}I$ | 1.0 mCi p.o. | 24 hr | Post therapy 100 mCi $^{131}I$; off medications 1 week before scan |
| D | 3/12/69 | $^{99m}Tc$ | 2.1 mCi i.v. | 30–90 min | Off medications 1 week before scan |
| E | 3/12/69 | $^{99m}Tc$ | 2.0 mCi i.v. | Dynamic | Reinjected after D as repeat study |
| F | 4/10/69 | $^{131}I$ | 2.0 mCi p.o. | 1–5 days | Off medications 1 week before scan |
| G | 4/30/69 | $^{99m}Tc$ | 2.0 mCi i.v. | Dynamic | On triiodothyronine to evaluate suppressibility |

## DISCUSSION

Two separate dynamic Anger camera studies with pertechnetate showed metastatic thyroid carcinoma in a patient with Graves' disease. On both occasions the best visualization of the metastatic deposits was at 19–24 min. A rectilinear scan performed at 30 min also demonstrated a metastatic deposit. Rectilinear scans performed at 1½ and 2 hr postinjection of pertechnetate failed to show any uptake in metastatic tissue. Iodide showed similar abnormal areas when scanning was performed at 24 hr and up to 5 days post-dose.

Sodee reported increased accumulation of pertechnetate up to 6 hr postinjection in a 65-year-old Negro female with metastatic papillary carcinoma of the lung (*1*). The complicating presence of Graves' disease and its associated hormonal abnormalities may explain the difference in rate of accumulation and loss of pertechnetate in the metastatic disease of this patient.

Atkins and Richards found a maximum counting rate at 15–20 min postinjection of pertechnetate and also an increased trapping index in hyperthyroid patients (*2*). Other factors that may influence turnover rate of pertechnetate in metastatic thyroid cancer are the predominant cell type, blood supply and renal function. The renal status in Sodee's case was not included in the report. The patient in this case report has normal renal function.

## CONCLUSIONS

Small areas of papillary thyroid carcinoma will concentrate pertechnetate. Until further information becomes available, when imaging for metastatic thyroid carcinoma with pertechnetate, both early and late studies should be obtained. The dynamic serial studies of the Anger camera were superior to the static rectilinear scans in both delineation and resolution of this metastatic thyroid lesion with pertechnetate.

## ACKNOWLEDGMENT

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