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Visualization of a Hyperfunctioning Parathyroid Adenoma Using Se^{75} Selenomethionine and the Photoscanner[1]

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The detection and localization of hyperfunctioning parathyroid adenomas has been the subject of investigation in nuclear medicine during the past several years. Sisson and Beierwaltes (1) demonstrated that Co^{57} B_{12} concentrated in the dog parathyroid gland and Potchen (2, 3) found concentration of tritiated methionine in rat parathyroid. Both of these studies employed thyroid administration to suppress uptake of radioactivity in the thyroid gland. Potchen also used a hi protein lo calcium diet to stimulate uptake of activity in parathyroid tissue. DiGiulio, Sisson and Beierwaltes (4,5) have reported preliminary clinical results using both Co^{57} B^{12} and Se^{75} Methionine. With tissue counting techniques, they found 2–3 fold concentration of radioactivity in parathyroid tissue over that found in thyroid, muscle or blood and were successful in locating an adenoma pre-operatively in one of three patients studied. We have encountered a patient with a hyperfunctioning parathyroid adenoma in whom the scan with Se^{75} selenomethionine was positive. We are presenting this case because the technique in this patient differed slightly from that reported by others and because of the strikingly positive results.

CASE REPORT

O.B., Uh. No. 23097P—A 50 year old white female was admitted to the John Sealy Hospital with a complaint of weight loss, anorexia, nausea and vomiting of two months duration. On physical examination the patient appeared acutely and chronically ill with a thin sallow complexion. A 3 cm firm nodule could be vaguely outlined near the left lower lobe of the thyroid gland. Significant laboratory data included serum calcium 15.3 mg per cent, phosphorus 3.4 mg per cent and alkaline phosphatase 2.9 Sigma units.

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Because of the patient's condition, it was decided to attempt a parathyroid scan immediately rather than attempt preparation with special diets or other procedures. The patient was given 200 μc of Se^{75} selenomethionine[1] and a scan of the neck performed two hours thereafter employing a photoscanner[2] with a 3″ D X 2″ Na I crystal and a 19 hole collimator with the spectrometer set from 230–300 kev. The maximum count rate over the left lower neck was found to be

[1]Sethotope, E. R. Squibb & Sons, New Brunswick, New Jersey
[2]Picker Magnascanner, Picker X-ray Corporation, White Plains, New York

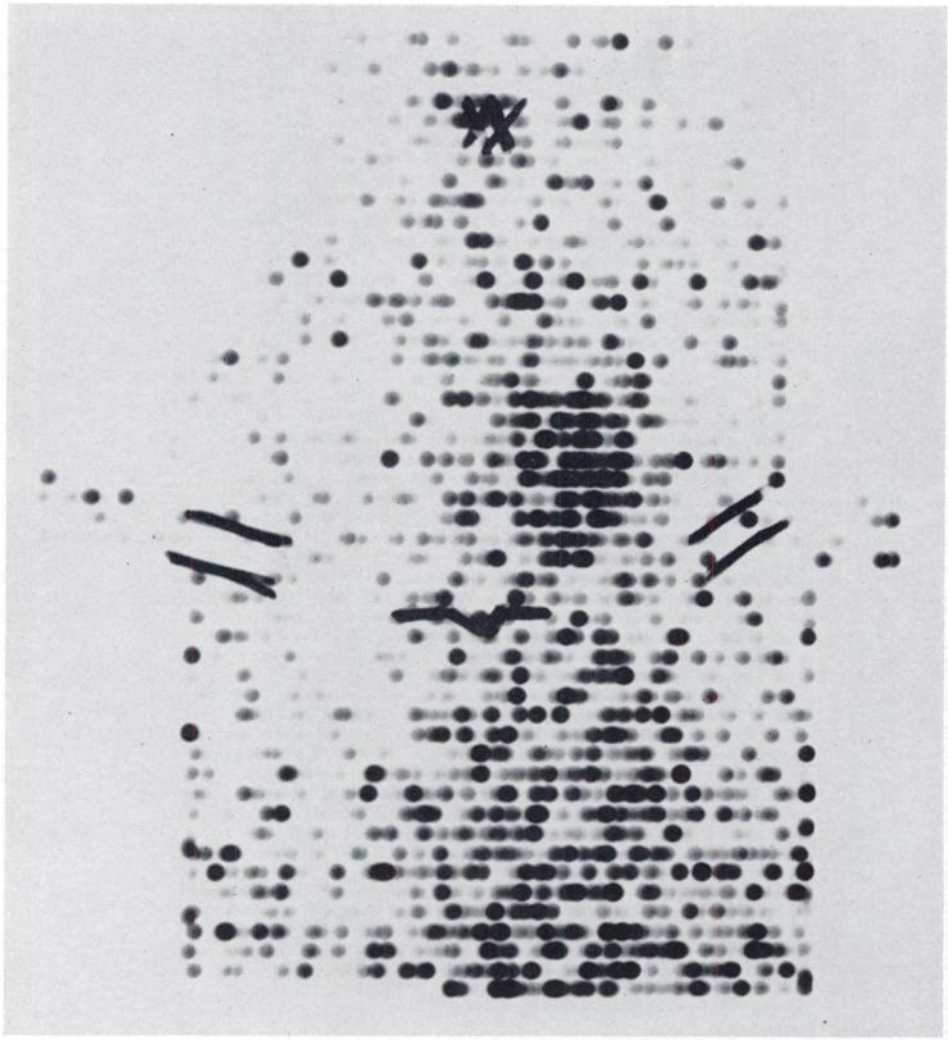

Fig. 1A. Scan of the neck and upper mediastinum in Patient O. B. performed two hours following intravenous injection of 200 μc of Se^{75} Selenomethionine. The concentration of radioactivity within the parathyroid adenoma is apparent in the left lower neck.

600–700 cts/min. Background count was 200–300 cpm. A photoscan was performed with a speed of 16 cm/min, ⅛ time constant, at a spacing of 0.4 cm between passes of the probe. The scan revealed marked increase in concentration in the area of the questionable nodule in the left lower neck (Fig. 1A). As thyroid tissue had also been reported to concentrate radioactive methionine, a tracer dose of 100 μc of I^{131} was given and a thyroid scan was performed revealing a normal gland with no concentration in the area which had previously showed good concentration of Se^{75} (Fig. 1B). After these studies, the patient's condition worsened. A serum calcium was repeated and found to be 17.8 mg per cent. The patient was taken to the operating suite on April 1, 1964. At the time of induction of anesthesia, a second 200 μc dose of Se^{75} selenomethionine was given. An explora-

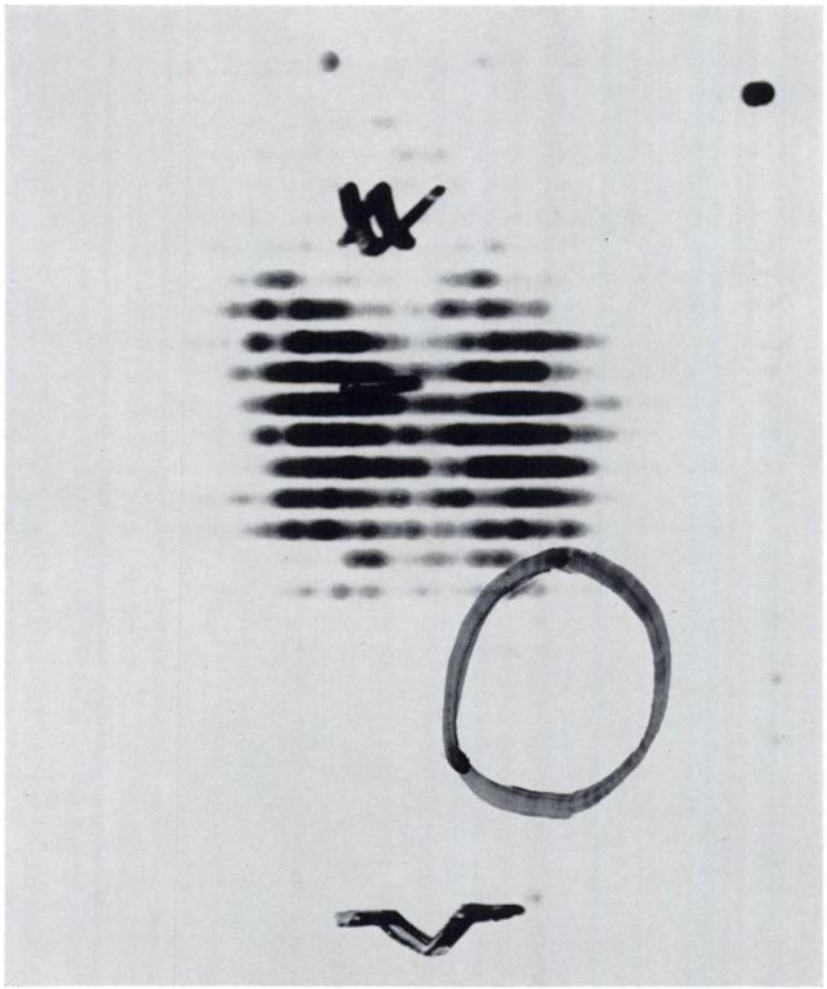

Fig. 1B. Thyroid scan in the same patient performed 24 hours after a 100 μc tracer dose of I^{131} showing a normal thyroid silhouette with no evidence of concentration of I^{131} in the area previously showing good concentration of Se^{75} (Circle).

tion of the neck[1] revealed a 3 × 2 cm parathyroid adenoma in the left lower neck in the area indicated by the palpatory findings and the scan. Following the removal of the adenoma, the patient gradually improved and was essentially well on follow-up visit three months later.

Pathological examination revealed a benign well-encapsulated tumor weighing 5.5 gms. Microscopically, the adenoma was composed of normal-sized to slightly enlarged uniform chief cells. Specimens of thyroid gland and muscle were within normal limits. Specimens of tissue from the adenoma, the thyroid, muscle and blood removed at the time of operation were counted in a well counter ten weeks after removal (to permit decay of I^{131}) and the concentration of Se^{75} selenomethionine in these tissues on the day of operation was calculated in $\mu\mu$c/mg. (Table I). There was a fivefold increase in concentration of radioactivity in parathyroid over thyroid, three fold increase over muscle and sixfold increase over blood. This was six days after the first and two hours after the second injection of 200 μc of Se^{75} selenomethionine. The total amount of radioactivity within the adenoma at the time of removal was calculated to be .34 μc.

DISCUSSION

This case demonstrates that sufficient concentration of Se^{75} selenomethionine may be achieved in a parathyroid adenoma to permit localization of the tumor through the use of the photoscanner. In addition, this was done without preparation of the patient with special diets or drugs. It does not prove that the test will detect all or even many of the parathyroid adenomas encountered in clinical practice or that special dietary or drug manipulation might not be helpful. More research into the problem will be necessary before conclusion regarding these details of technique will be warranted. Our experience to date has demonstrated no problem with thyroid concentration of this material.

Because of the relative rarity of parathyroid adenomas, it may be some time before sufficient clinical experience can be accumulated to indicate a definitive place for this procedure in clinical practice. This might suggest the need for a cooperative study to more rapidly collect data. In any case the technique as illustrated by this case report shows promise of lending valuable information in a very difficult area of diagnosis and deserves further application.

TABLE I

CONCENTRATION OF Se^{75} SELENOMETHIONINE IN TISSUES

Sample	*$\mu\mu$c/mg*	*Parathyroid/Tissue Ratio*
Parathyroid A	61.8	
Parathyroid B	65.3	
Thyroid	13.4	4.7
Muscle	18.3	3.4
Blood	10.2	6.2

[1]Performed by Dr. Fred J. Wolma

ADDENDUM

Since the submission of this report for publication, we have had the opportunity of scanning two additional patients in whom parathyroid adenomas were subsequently found at operation. In one of these patients localization of a small tumor was possible on a scan four hours after injection of 200 μc of Se 75 selenomethionine. However, a larger tumor in the same patient was missed. In the other patient a scan performed two hours after a 100 second μc dose of material was negative.

REFERENCES

1. SISSON, J. C. AND BEIERWALTES, W. H.: Radiocyanocobalamine (Co^{57} B_{12}) Concentration in the Parathyroid Glands. *Journal of Nuclear Medicine* 3:160, 1962.
2. POTCHEN, E. J. AND DEALY, J. B., JR.: Selective Isotope Labeling of the Parathyroid Gland. *Journal of Nuclear Medicine* 4:203, 1963.
3. POTCHEN, E. J.: Isotopic Labeling of the Rat Parathyroid as Demonstrated by Autoradiography. *Journal of Nuclear Medicine* 4:480, 1963.
4. DIGUILIO, W., SISSON, J. C. AND BEIERWALTES, W. H.: Photoscanning the Hyperfunctioning Parathyroid Gland. *Clinical Research* 11:297, 1963.
5. DIGUILIO, W., AND BEIERWALTES, W. H.: Parathyroid Scanning with Selenium 75 Labeled Methionine. *Journal of Nuclear Medicine* 5:47, 1964.