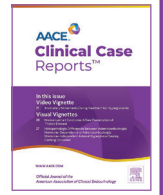




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Interpretation of Endocrine Testing

The Right Hand Must Know What the Left Hand is Doing: A False-Positive Hotspot on the Sestamibi Scan

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ABSTRACT

Objective: Imaging studies in the setting of primary hyperparathyroidism are performed to rule out an ectopic parathyroid adenoma. Although rare, false-positive scans can cause confusion and possibly more extensive procedures.

Method: A 68-year-old woman with parathyroid hormone–dependent hypercalcemia was found to have uptake in the left midclavicular area on the parathyroid scan with sestamibi. Retention of the isotope was considered a possibility, and the sestamibi scan was repeated after injecting the isotope in the right hand and this did not show uptake in the left midclavicular area.

Results: Sestamibi is taken up by the mitochondrial-rich adenoma cells and can help identify an ectopic location of the adenoma. Sestamibi scans are commonly performed before neck exploration to rule out an ectopic adenoma and to localize the parathyroid adenoma. Thyroid adenoma and thyroid cancer can also cause retention of isotopes. Retention of the isotope in the vein can also give an illusion of an ectopic parathyroid adenoma. Injecting the isotope in the contralateral hand can overcome this retention issue.

Conclusion: Uptake on parathyroid scan outside of normal embryologic descent of the parathyroid gland should raise the possibility of a false-positive uptake.

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Case Presentation

A 68-year-old woman was referred to the clinic after calcium levels were noted to be elevated. She reported nonspecific muscle aches and pains. The examination was unremarkable. She was not taking calcium supplements, antacids, or hydrochlorothiazide. She had never taken lithium or aromatase enzyme inhibitors.

Biochemical evaluation revealed elevated ionized and corrected calcium along with elevated parathyroid hormone levels. Thyroid ultrasound and sestamibi parathyroid scans were performed. the

ultrasound showed a simple cyst measuring 3 mm in the upper right thyroid lobe without obvious parathyroid adenoma.

Rationale and Test Characteristics

Most parathyroid adenomas contain mitochondrial-rich oxyphil cells; these cells cause retention of 99mTc-MIBI and help localize the adenoma. However, not all parathyroid adenomas have many oxyphil cells, and 99mTc-MIBI is only helpful in around 75% of the cases.¹ A negative sestamibi scan does not refute the diagnosis of primary hyperparathyroidism, the sensitivity of MIBI scanning ranges from 74% to 100%. The sestamibi scans are helpful in identifying primary hyperparathyroidism from multiple adenomas and identifying an ectopic adenoma.²

Sestamibi is a nonspecific tracer that is taken up by mitochondria; therefore, sestamibi will be taken up by any mitochondrial-rich tissue, including some thyroid adenomas and

Abbreviations: mCi, millicuri; SPECT, single-photon emission computed tomography; Tc, technetium.

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abnormal lymph nodes. False-positive scans will occur only when structures other than a parathyroid adenoma take up and concentrate Tc 99m-labeled radiopharmaceutical to a higher degree than surrounding tissues.

Her parathyroid scintigraphy protocol was to obtain planar imaging at 20 minutes and 2 hours following administration of Tc-99m sestamibi. Additionally, single-photon emission computed tomography (SPECT) and computed tomography (CT) imaging of the head/neck and thorax were obtained at the 2-hour time point. Fused SPECT-CT images were then produced. In this instance, the radiopharmaceutical dose was 21.6 mCi.

Results Interpretation and Patient Application

A parathyroid scan (with left-arm radionuclide administration) showed residual tracer accumulation involving a nodular density inferior to the left midclavicular line adjacent to the subclavian vein (Fig.). This finding may represent an ectopic parathyroid adenoma. In addition, residual tracer accumulation along the posterior and inferior right thyroid lobe, raising the possibility of a right parathyroid adenoma, was also noted.

After discussing the scan with radiology and endocrine surgery colleagues, the retention of the sestamibi isotope in the vein was discussed as a possibility, and a repeat scan was performed—this time, injecting the 21.3 mCi dose of Tc 99m sestamibi isotope in the right arm to overcome the possible retention of the isotope. Axial CT, SPECT, and fused SPECT-CT images on the subsequent parathyroid scintigraphy were interpreted as negative for parathyroid adenoma at the level of the inferior thyroid gland, and no focal radiotracer retention was noted at the subclavian vein, therefore, was interpreted as negative for ectopic parathyroid adenoma.

Parathyroid glands start to develop at the base of the brain at 2 months of gestation and migrate from the origin and finally settle in the neck around (para) the thyroid gland. Ectopic parathyroid glands either do not descend or are too far down in the neck or stop the descent anywhere away from the thyroid gland. The 2 superior parathyroid glands originate from the fourth pharyngeal pouch, whereas the third pharyngeal pouch develops into 2 inferior parathyroid glands and the thymus.³ This common embryonic origin of the thymus and inferior parathyroid explains why the

Highlights

- Vascular retention of injected isotope should be considered in the differential in situations where the retention of the isotope is seen outside of normal embryologic descent of the parathyroid gland.
- Considering the possibility of false positive uptake on the scan can help avoid unnecessary delay and, most importantly, risky procedures.

Clinical Relevance

This case reinforces a critical learning point, which is often forgotten in the modern era of high-tech imaging, that surgical exploration remains the “gold standard” when localization scans are negative or have false-positive findings in patients with primary hyperparathyroidism.

mediastinum is the most common location of ectopic inferior parathyroid adenoma.³ If the superior parathyroid gland fails to descend, it can be found in the base of the neck. Lack of capsular fixation of the parathyroid glands can sometimes cause a heavy parathyroid adenoma to slide to a new anatomic position, such as the tracheoesophageal groove.

The true incidence of the ectopic parathyroid gland is unknown. The ectopic location of the parathyroid glands only becomes pertinent when the ectopic gland develops an adenoma. The incidence of ectopic parathyroid adenoma is 5% to 20% of patients with primary hyperparathyroidism.⁴

False-positive sestamibi scans, although not very common, have been reported. In most cases, they are due to concomitant thyroid nodules, reactive lymph nodes, and thyroid cancer.⁵ Case reports were published documenting “false-positive” parathyroid localization due to uptake in follicular, Hurthle cell, and papillary thyroid carcinomas. Tc 99m sestamibi uptake in the brown adipose tissue can also cause a false-positive sestamibi scan, and since brown adipose tissue can be present in the neck and shoulders, it can cause the illusion of ectopic parathyroid glands.⁶

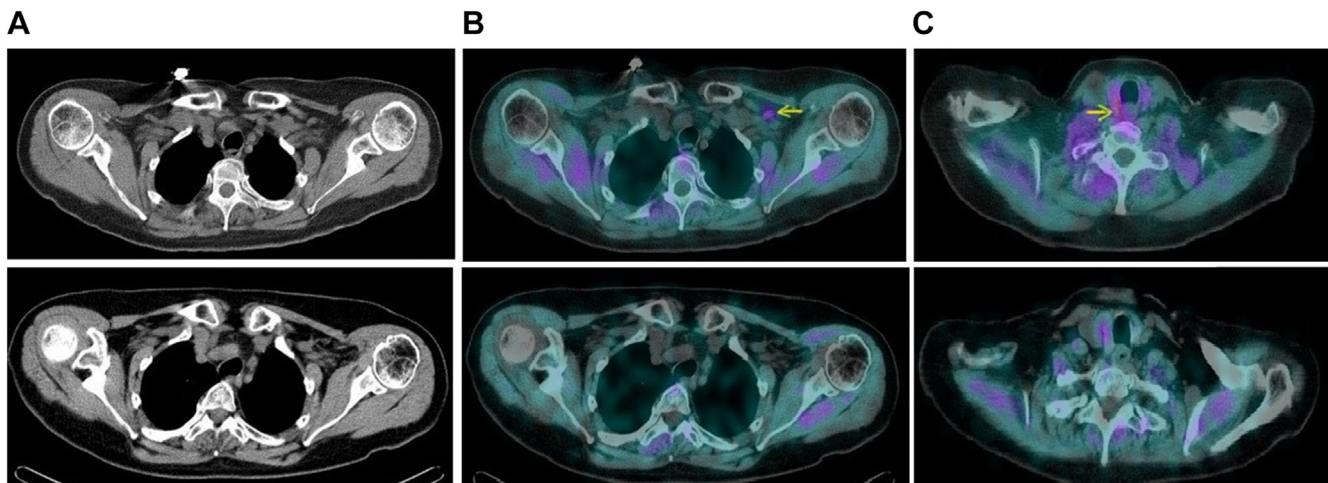


Fig. Line 1: Initial parathyroid scintigraphy [A] Axial CT [B] SPECT, images at the level of the *Left* midclavicular region with nodular uptake adjacent to *Left* subclavian vein was interpreted as concerning for parathyroid adenoma. Yellow arrow pointing to the area of interest. [C] SPECT images on the initial parathyroid scintigraphy at the level of the inferior thyroid gland. Nodular uptake along the posterior inferior *Right* thyroid gland was interpreted as concerning parathyroid adenoma. Yellow arrow sign pointing to the area of interest. Line 2: Subsequent parathyroid scintigraphy [A] Axial CT [B] SPECT image at the level of the *Left* subclavian vein This was interpreted as negative for ectopic parathyroid adenoma. [C] SPECT images on the subsequent parathyroid scintigraphy at the level of the inferior thyroid gland. This was interpreted as negative for parathyroid adenoma. CT = computed tomography; SPECT = single-photon emission computed tomography.

Patient Outcome

In our patient, an isolated persistent uptake in the left infraclavicular area after 2 hours and a corresponding hot spot in the SPECT scan led to a possibility of this being an ectopic parathyroid adenoma. This location, however, is not in the usual anatomic pathway of descent of parathyroid glands and made us wonder if this was a false-positive scan. A literature review indicates a similar reported case, where the patient was taken to the operating room based on similar findings on the sestamibi scan and required infraclavicular neck exploration, which showed a collapsible saccular varix of the left SCV at the site of imaging hot spot.⁷ The second 99mTc-MIBI scan with the administration of Tc 99 in the right hand in our patient did not show the presence of uptake in the infraclavicular area, indicating that the uptake on the first scan was likely due to sestamibi retention. The patient underwent 4 gland parathyroid exploration. The right superior parathyroid gland was abnormal and grossly consistent with an adenoma. Calcium post-resection dropped from 11.1 mg/dl to 10.1 mg/dl within a few hours after surgery. The final pathology showed a hypercellular right superior parathyroid gland weighing 200, and 56 milligrams parathyroid gland consistent with parathyroid adenoma. On a 3-month follow-up, she was found to have normal corrected calcium levels.

Consent

Patient consent was obtained.

Disclosure

The authors have no multiplicity of interest to disclose.

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