

Nuclear imaging in primary hyperparathyroidism: a comparison of protocols



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Objectives

To compare the accuracy of the 5 most commonly employed nuclear imaging protocols used as localization studies in primary hyperparathyroidism at our institution.

Introduction

Sestamibi imaging is one of the most commonly used studies for preoperative localization in primary hyperparathyroidism. Currently, there is no standard protocol in place. The true gold standard is surgical and pathological confirmation of the abnormal parathyroid gland.

Methods and Materials

A retrospective chart review was undertaken from January 1, 2010 to December 31, 2011. The five imaging protocols assessed were Technetium (^{99m}Tc) sestamibi, ^{99m}Tc sestamibi with single positron emission CT (SPECT), ^{99m}Tc sestamibi with pertechnetate, ^{99m}Tc sestamibi with pertechnetate and SPECT, and ^{99m}Tc sestamibi with Iodine 123 (¹²³I). Exclusion criteria included lack of pre-operative sestamibi scan, insufficient documentation in the medical records, secondary hyperparathyroidism, parathyroid hyperplasia, or parathyroid carcinoma.

Imaging results were compared to the surgical location and were considered a "match" if the imaging was positive on that side. All statistical analysis was performed using SAS version 9.3 by the Kaiser Division of Research. Pairwise analysis and logistic models were used to compare the accuracy between imaging techniques.

Results

748 patients underwent parathyroid surgery for hyperparathyroidism. 544 patients met inclusion criteria. 509 patients had single adenomas, while 35 had double adenomas. 79% were female, and the mean patient age was 62 years. 67% of patients were white. For single adenomas, the match rate was highest for ^{99m}Tc sestamibi with ¹²³I (97.4%) and lowest for ^{99m}Tc sestamibi alone (81.5%). Pairwise analyses showed a statistically significant difference between ^{99m}Tc sestamibi compared to ^{99m}Tc sestamibi with ¹²³I (p = 0.0290). Patients scanned with ^{99m}Tc sestamibi with ¹²³I were almost 10 times more likely to have a match than with ^{99m}Tc sestamibi alone (OR=9.6 p=0.03). In addition, Hispanics were almost 5 times more likely to have a match than Whites (OR=4.7 p=0.04).

For the 35 patients with double adenomas, the majority were performed with ^{99m}Tc sestamibi/SPECT (n=27), while only 5 were ^{99m}Tc sestamibi alone and 3 were ^{99m}Tc sestamibi with ¹²³I. The highest match rate was for ^{99m}Tc sestamibi/SPECT (74%), which reached statistical significance compared to the other scan types (p = 0.0281). For all patients (single and double adenomas), there was no difference in age or gender with respect to match rates.

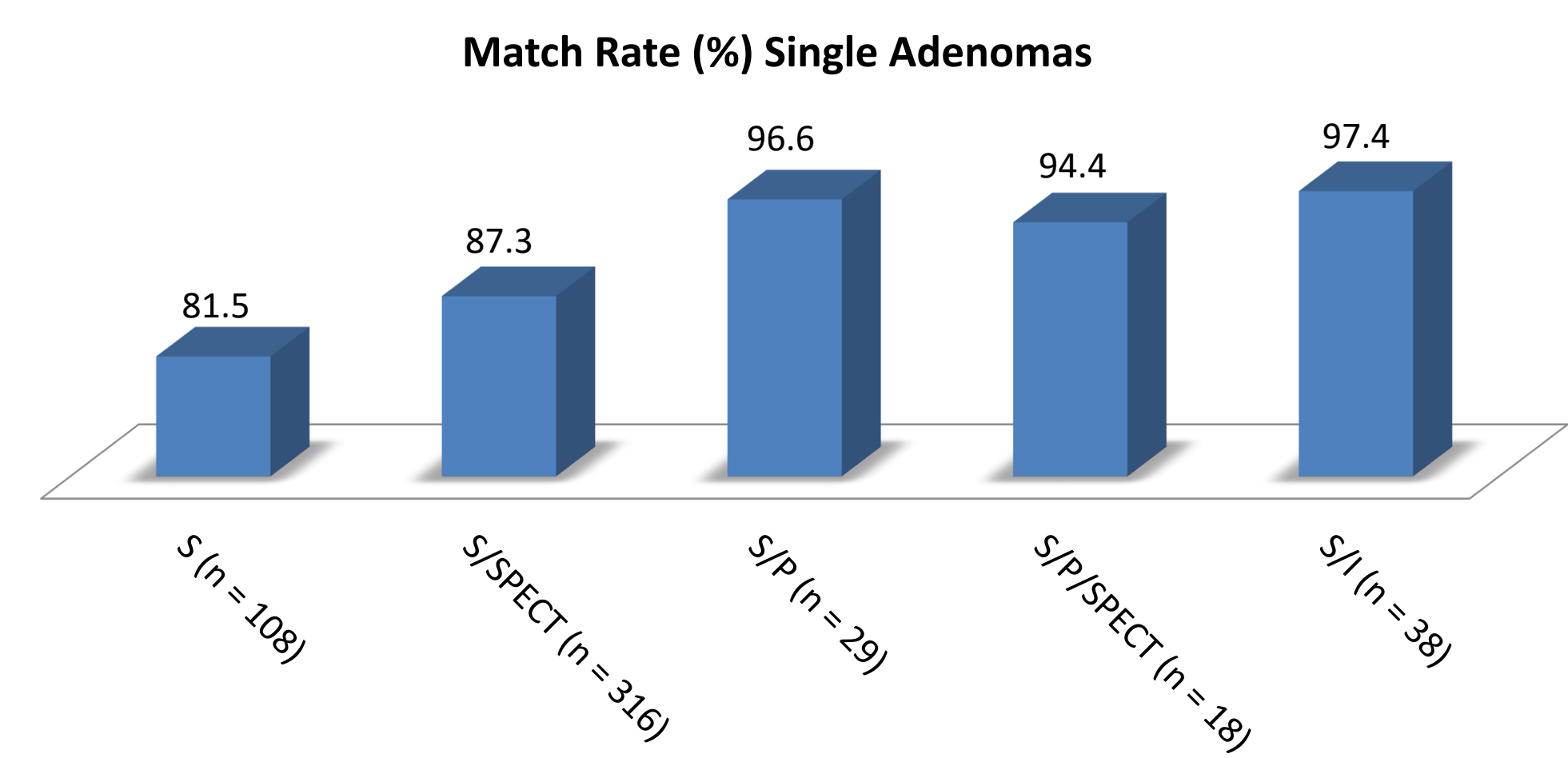


Chart 1. Match rates for single adenomas. S = ^{99m}Tc sestamibi; SPECT = single positron emission CT; P = pertechnetate; I = ¹²³I

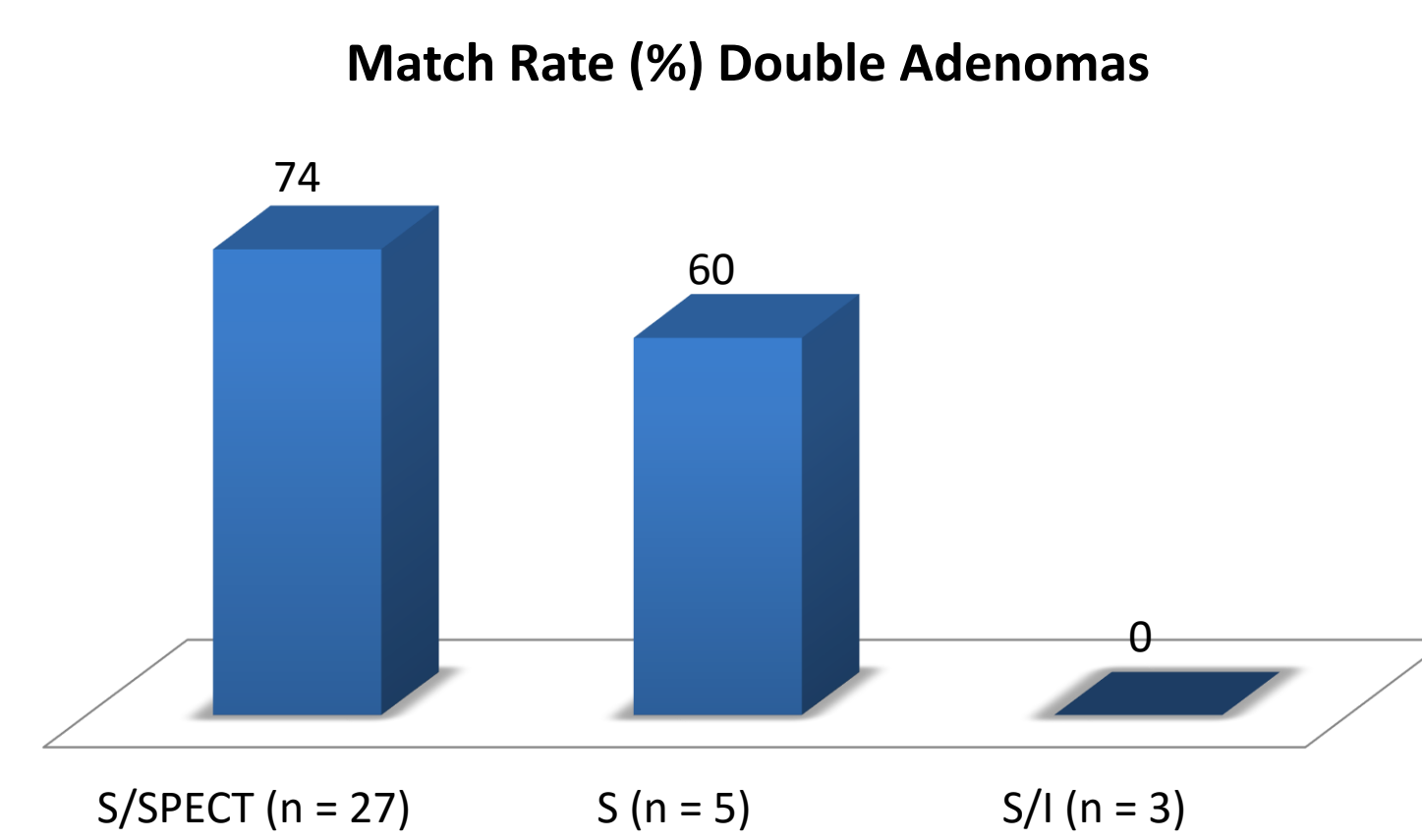


Chart 2. Match rates for double adenomas (p=0.0281 for S/SPECT). S = ^{99m}Tc sestamibi; SPECT = single positron emission CT; I = ¹²³I

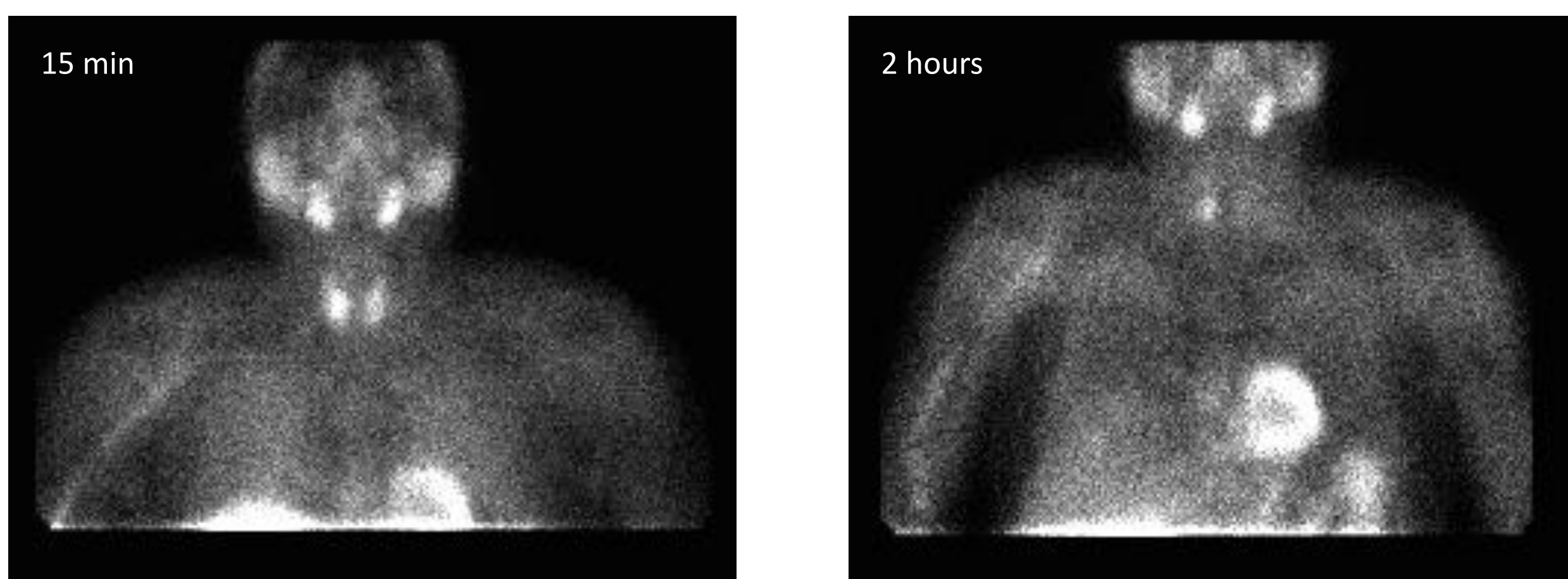


Figure 1. Single agent, dual phase imaging with ^{99m}Tc sestamibi alone. It shows an abnormal right inferior gland on the delayed 2 hour image

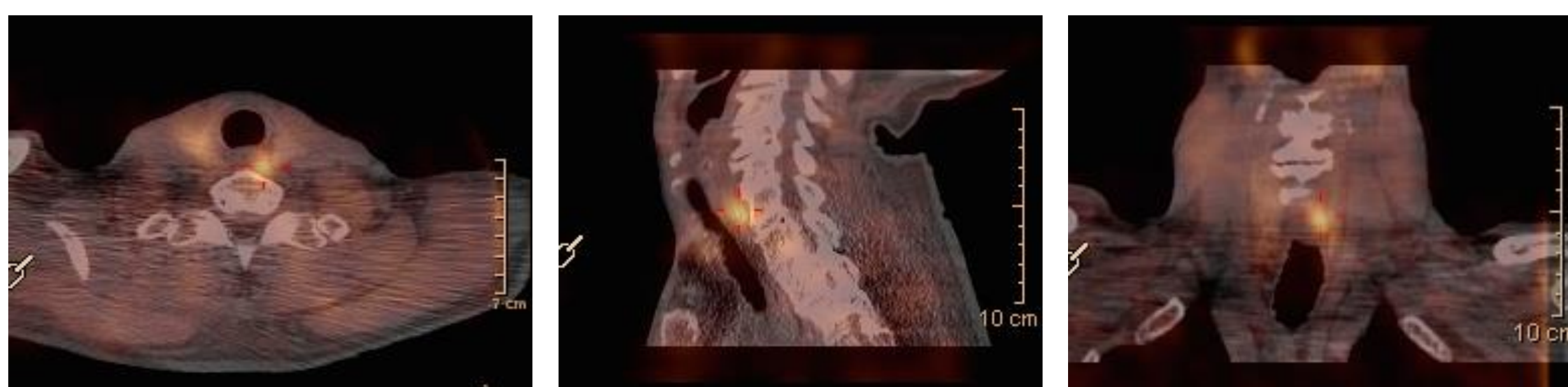


Figure 2. Sagittal, and coronal views that SPECT gives to help localize the abnormal left inferior parathyroid gland in multiple dimensions

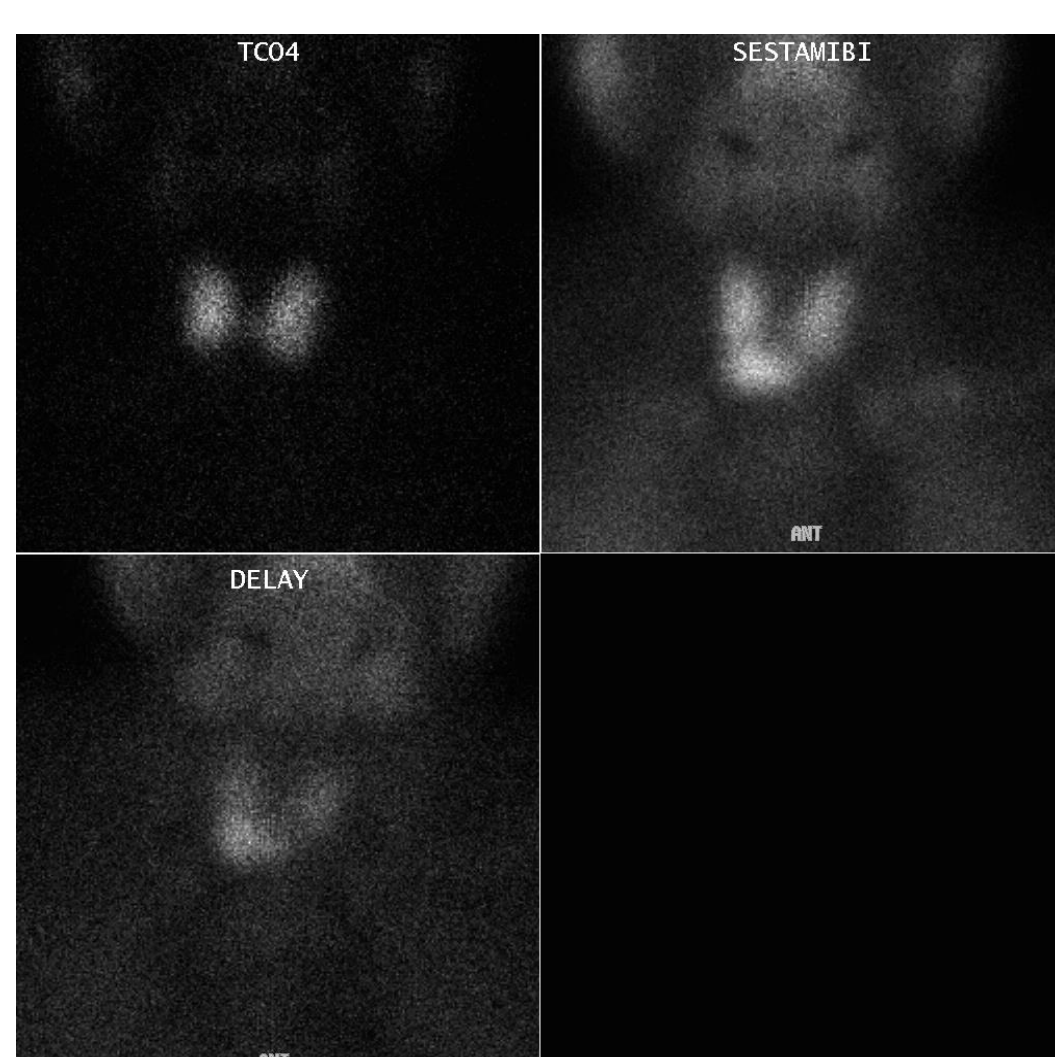


Figure 3. ^{99m}Tc sestamibi with pertechnetate

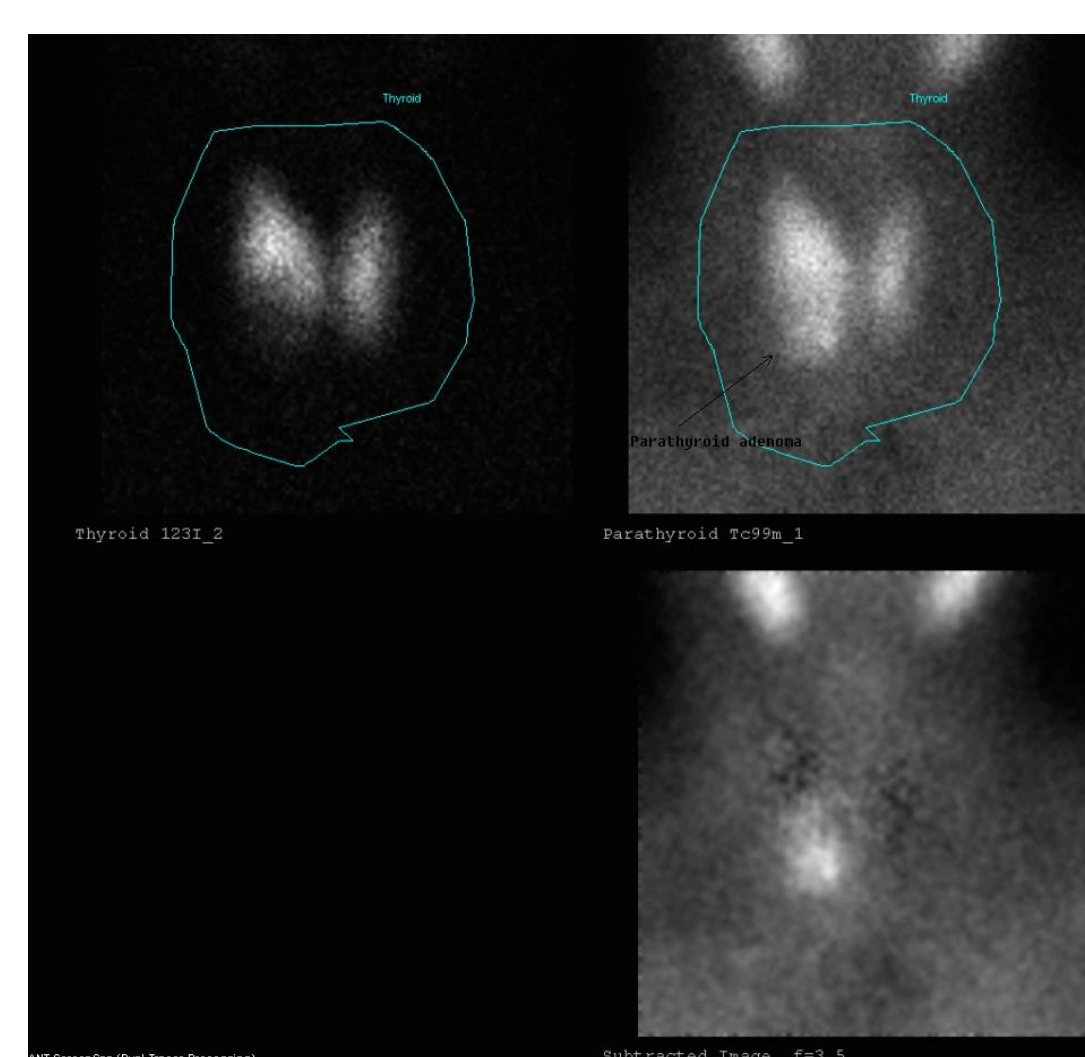


Figure 4. ^{99m}Tc sestamibi with ¹²³I

Discussion

There are several limitations that warrant discussion. Our exclusion criteria included patients with primary hyperparathyroidism from hyperplasia in order to standardize the pathology in our study population. While there were only 13 patients in this group, their exclusion introduces potential verification bias.

For the patients with double adenomas, it should be noted that the overall power is low. There was also an uneven distribution among the scan types with zero matches for the 3 performed with ¹²³I. If more scans had been performed with ¹²³I, we may see higher accuracy using this technique.

Conclusions

In our study population, ^{99m}Tc sestamibi with ¹²³I appears to be superior with a higher accuracy in localization of abnormal parathyroid glands. This information may be helpful as standardization of imaging protocols occurs.

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