

Early Stage Breast Cancer Diagnosed with ^{99m}Tc-MIBI Parathyroid Scintigraphy in a Patient with Hyperparathyroidism

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Background	Standard modalities for breast imaging include mammogram, ultrasound, and MRI. However, there are many other imaging modalities that have been studied or are in development. ^{99m} Tc-MIBI Parathyroid Scintigraphy (sestamibi scan) is commonly used for localization of hyperfunctioning parathyroid gland(s). There are some reports of sestamibi scanning detecting occult tumors in other organs. Additionally, sestamibi scan has been described as a means of breast imaging and tumor surveillance. We present a case of a patient with a breast cancer detected by sestamibi scan during workup for primary hyperparathyroidism.
Summary	<p>A 59-year-old patient presented biochemical diagnosis of mild primary hyperparathyroidism. Neck ultrasound and sestamibi scan with SPECT CT were used utilized for localization of the parathyroid gland(s). Ultrasound imaging was nonlocalizing for a parathyroid lesion; however, sestamibi scan revealed an enlarged retroesophageal parathyroid lesion on the right side and suspicious tracer uptake in the right breast.</p> <p>Clinical examination revealed a 2 cm irregular, indistinct area of thickening in the right breast. Right diagnostic mammogram and ultrasound confirmed the presence of a hypoechoic mass measuring 20 x 16 x 18 mm. Core biopsy of the mass demonstrated invasive mammary carcinoma, no special type, intermediate grade, estrogen and progesterone receptor positive, Her2 not amplified.</p> <p>The patient underwent partial mastectomy and sentinel node biopsy with final anatomic and pathologic stage of IIA and IA respectively (AJCC8). She completed adjuvant radiation therapy and is currently taking adjuvant endocrine therapy for a prescribed duration of five years. Surgical planning for cure of the hyperparathyroidism was deferred during her treatment.</p>
Conclusion	We present the case of 59-year-old female diagnosed with invasive breast cancer diagnosed on sestamibi scan during workup for primary hyperparathyroidism. This case demonstrates potential use of ^{99m} Tc-MIBI scintigraphy in diagnosing occult breast cancer and the need for careful assessment of such abnormalities outside of the thyroid bed. Additionally, the case illustrates the potential utility of this modality in breast cancer imaging.
Keywords	Breast imaging; breast cancer; sestamibi

DISCLOSURE STATEMENT:

The authors have no conflicts of interest to disclose.

MEETING PRESENTATION:

Tennessee Chapter of the American College of Surgeons, Nashville, TN, August 2018

To Cite: Grisham CJ, Sanders M, Langdon W, Baregamian N, Sweeting RS. Early Stage Breast Cancer Diagnosed with ^{99m}Tc-MIBI Parathyroid Scintigraphy in a Patient with Hyperparathyroidism. *ACS Case Reviews in Surgery*. 2020;3(1):12-15.

Case Description

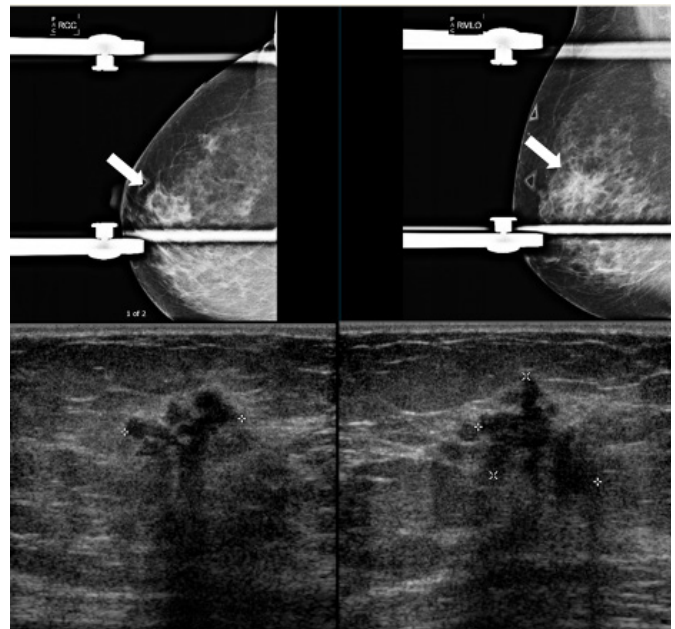
Breast cancer is one of the most common cancers diagnosed in women.¹ Early diagnosis and detection is the key goal of breast cancer screening, and the current gold standard for screening is mammography.² There has been a recent push towards new imaging modalities. Standard modalities for breast imaging include mammogram, ultrasound, and MRI. ^{99m}Tc-MIBI parathyroid scintigraphy (sestamibi scan) is commonly used for localization of hyperfunctioning parathyroid gland(s). There are some reports of sestamibi scanning detecting occult tumors in other organs. Additionally, sestamibi scan has been described as a means of breast imaging and tumor surveillance. The authors present the case of a patient with breast cancer detected by sestamibi scan during Workup for primary hyperparathyroidism.

A 59-year-old female presented initially with vague symptomatology of hyperparathyroidism. She had a history of type 2 diabetes and hypothyroidism, and her medical workup confirmed a biochemical diagnosis of mild primary hyperparathyroidism. She was referred for surgical evaluation. Localization studies to identify her hyperfunctioning parathyroid included neck ultrasound and sestamibi scan with SPECT CT. Ultrasound imaging was nonlocalizing for a parathyroid lesion; however, sestamibi scan revealed suspicious tracer uptake in the right breast (Figure 1).



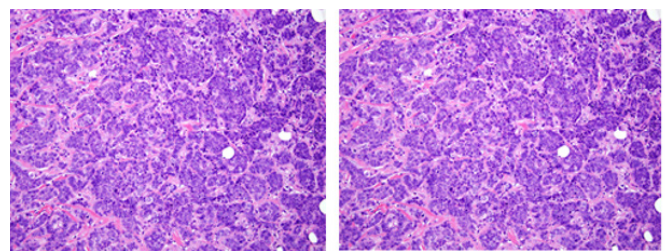
Figures 1. Sestamibi scan: Sestamibi imaging demonstrating uptake in the right breast.

After concluding the unknown mass was not due to a possible artifact such as clothing, physical exam was performed to determine if there were any palpable findings in the area of increased uptake. A thickened area approximately 2 cm was palpated on the right breast. The patient was referred to the breast oncology department for further workup. Her last mammogram had been exactly 12 months prior to her referral to breast oncology. Right diagnostic mammogram and ultrasound confirmed the presence of a hypoechoic mass measuring 20 x 16 x 18 mm (Figure 2).



Figures 2. Diagnostic imaging of the breast: Diagnostic mammogram and ultrasound images of the palpable area identified on sestamibi imaging.

Ultrasound-guided core biopsy of the mass demonstrated invasive mammary carcinoma, no special type, intermediate grade, estrogen and progesterone receptor positive, Her2 not amplified (Figure 3).



Figures 3. Pathology: Hematoxylin and eosin stained slides of surgical pathology from partial mastectomy at 20X and 40X.

The patient subsequently underwent partial mastectomy and sentinel node biopsy with final anatomic and pathologic stage of IIA and IA, respectively (AJCC8). She completed adjuvant radiation therapy and is currently taking adjuvant endocrine therapy for a prescribed time of five years. Workup of the hyperparathyroidism was placed on hold during her treatment. She is experiencing some hot flashes on endocrine therapy but otherwise feels asymptomatic from her hyperparathyroidism and has elected to delay surgery at this time.

Discussion

The current screening and diagnostic imaging methods for breast cancer include mammography, ultrasound, and MRI. Mammography and MRI in particular have demonstrated relatively high sensitivity and specificity across the general patient population; however, there have been specific limitations reported with both.

Mammography sensitivity can have wide variations depending on breast density, ranging from 48 percent sensitivity for women with very dense breast compared to 78 percent sensitivity for all women.³ With breast density being one potential factor for imaging occult breast cancers, it is important for imaging methods to not be restricted by this factor. Breast density is now incorporated into risk calculators for breast cancer, and low-cost imaging modalities are constantly under evaluation to aid in detection of breast cancer in dense breasts.

MRI scans can compensate for some of the limitations exhibited with mammography, such as breast density. However, there have been varying sensitivity results reported with MRI. Although sensitivity for cancer detection with breast MRI is high (over 90 percent), specificity is low to moderate (72 percent). The relatively low specificity of MRI can make differentiating between benign and malignant findings challenging, leading to a high number of biopsy recommendations.⁴ Furthermore, MRI is more expensive than both CT and mammographic imaging.

This case study demonstrates the ability of gamma imaging with technetium-99m-sestamibi to detect breast lesions. Sestamibi scans are traditionally used for localization of parathyroid adenomas in a 3-dimensional field.⁵ The abnormal parathyroid gland readily uptakes ^{99m}Tc-sestamibi due to the increased number of mitochondria in the environment.^{6,7} This allows surgeons to localize and assess the size of the gland for surgical excision.

However, in the case of this patient, the authors were able to identify an incidental malignant mass in the right breast. A number of studies have explored the diagnostic potential of ^{99m}Tc-sestamibi in breast cancer using scintimammography. In a study by Maublant et al., the authors analyze 198 tumors and demonstrate markedly increased ^{99m}Tc-sestamibi concentrations in the breast tumor in addition to some affected lymph nodes.⁸ The amount of uptake in tumors appears to be dependent of tumor size, as quantified in the study by Tan et al.⁹ A large meta-analysis by Xu et al. demonstrated that for patients who exhibited a palpable mass, the sensitivity and specificity of ^{99m}Tc-sestamibi scintimammography were 87 percent and 86 percent, respectively. Patients without palpable masses had a sensitivity and specificity of 59 percent and 89 percent, respectively. The overall findings indicated ^{99m}Tc-sestamibi scintimammography nuclear imaging as a viable option for breast cancer diagnosis.¹⁰ With the evidence thus far, ^{99m}Tc-sestamibi scintimammography imaging may be a viable adjunctive imaging modality to be used with mammography, particularly in patients with dense breasts who exhibit lower sensitivity and specificity with standard mammography. There are now commercially available, breast specific ^{99m}Tc-sestamibi gamma imaging machines available.

Conclusion

Numerous breast cancer imaging modalities exist; however, there are limitations to each method. The authors present a case that demonstrates the ability of sestamibi scan for hyperparathyroidism to detect incidental breast lesions. It highlights the need to further explore the value and limitations of sestamibi scans in relation to other common imaging technique such as mammography and MRI.

Lessons Learned

The imaging modality ^{99m}Tc-MIBI parathyroid scintigraphy can detect breast cancer lesions. Additionally, it may accurately detect breast cancers, especially when used in conjunction with other imaging modalities.

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