Role of ⁹⁹mTc-MIBI Scintimammography and X-ray mammography in the diagnosis of locoregional recurrence of breast cancer

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Abstract

Objective: To evaluate the utility of Tc- MIBI scintimammography in the loco-regional recurrence of breast cancer and its comparison with mammography.

Methods: The study population comprised of 33 subjects (mean age, 44.9 ± 14.1 years); evaluated for suspected loco-regional recurrence of breast cancer on clinical examination. All subjects received a 740-1000 MBq bolus IV injection of ⁹⁹mTc-MIBI preferably in pedal vein. At 5-10 min and 60-90 min post injection planar images were obtained in prone lateral and supine anterior position using double head gamma camera. MIBI uptake was scored as follows: 1: as normal uptake (compared with contralateral side); 2: focal low intense uptake (equivocal); 3: focal high intense uptake (positive). Mammography was performed by two standard views of cranio-caudal and mediolateral oblique in 26 patients. All patients had either excision biopsy or fine needle aspiration cytology (FNAC) for tissue diagnosis.

Results: Out of 33 patients, 21 had confirmed as recurrence on histopathology/cytology. Scintimammography was found true positive in 18 and true negative in 11 patients. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 85.7%, 91.7%, 94.7%, 78.6% and 87.8% respectively. In comparison, mammography was true positive in 9 and true negative in 6 patients with sensitivity of 52.9%, specificity, 66.7%, PPV 75%, NPV 42.9% and accuracy 57.7%.

Conclusion: Scintimammography has better diagnostic accuracy than mammography in the detection of loco-regional recurrence of breast cancer (JPMA 57:172;2007).

Introduction

Breast cancer is the most common cancer among women and the second leading cause of death in women after lung cancer. Approximately 178000 new cases are detected every year in the USA, and in the European Union the number is more than 135000.¹ Approximately 1 out of 9 women will develop breast cancer during her lifetime.²

Actual cancer incidence data has never been available for any population in Pakistan except for Cancer Registry in Karachi³ and some sporadic data reported by few radiotherapy centers and multi-institutional basis.⁴ In Pakistani females, breast cancer is the commonest cancer observed representing more than one third of female cancers and about one fourth of all malignancies. The age-standardized rate (ASR) is the highest in Asia, except the Jews in Israel.⁵

Patients who have been treated for breast cancer may develop recurrence of primary cancer. In a large Italian cohort study local recurrence rate was 1-2% per year.⁶ Most recurrences appear within first two or three years after treatment, but breast cancer can occur many years later.⁷ The rate of loco-regional recurrence at 10 years is 12% with mastectomy and 20% with breast-conserving surgery.⁸

Recent studies found that one third of recurrence were manifested by history, one third detected by physical examination and one sixth by mammogram.⁷ After breast conserving treatment, there are significant changes in the sensitivity and specificity of mammography and physical examination. In 25-50% cases recurrence is often missed on mammography.⁹ Dershaw¹⁰ describe that mammography can be expected to detect 30-40% of breast cancer recurrence. Traditionally X-ray mammography was used to assess the post surgical breast, but post surgery and radiotherapy changes to the breast reduce the accuracy. Interpretation of X-ray mammography relies on anatomical features of breast cancer and thus its positive predictive value may be as low as 15-30%.¹¹

It is therefore important to find a sensitive and accurate diagnostic method for detecting early loco-regional breast cancer recurrence. Tc-⁹⁹m MIBI, is a potential tumour imaging agent, which can be used for visualization of different tumors such as breast¹², parathyroid¹³, thyroid and bone tumours.¹⁴,¹⁵ The exact mechanism of MIBI uptake by tumour is not very clear. It is reported that MIBI is accumulated within mitochondria (90% of tracer activity) and cytoplasm of cells on the basis of transmembrane electrical potentials. Malignant tumors show increased transmembrane potentials due to the increased metabolic requirements, which induce, increased accumulation of MIBI in tumours.¹⁶ The principle aim is to study the role of Tc-⁹⁹m MIBI scintimammography in evaluation of loco-regional recurrence of breast cancer in comparison with mammography.
Patients and Methods

A total of 33 diagnosed breast cancer patients (mean age, 44.9 ± 14.1 years; median age 40 years; age range, 22-77 years) were studied, 15 patients had undergone lumpectomy and 18 had mastectomy. Patients were selected for this study if there was a clinical suspicion of loco-regional recurrence of breast cancer.

In 26 individuals mammography (XMM) was performed using a standard two-view protocol of craniocaudal and mediolateral oblique projections was performed with 26 to 28 KeV X-rays with automatic exposure control (Metal Tronica). A senior radiologist having knowledge of the patient's history, clinical presentation and previous mammogram, interpreted the images. The results are reported using three point system of positive for cancer, negative and equivocal.

All patients had scintimammography (SMM) using TOSHIBA GCA 7200A/PI (double head camera) with low-energy high resolution parallel hole collimator. The energy peak was centered at 140keV with a 20% window. At 5-10 min and 60-90 min post injection planar images were obtained in prone lateral and supine anterior position. MIBI uptake was scored as follows: 1) as normal uptake (compared with contralateral side); 2) focal low intense uptake (equivocal); 3: focal high intense uptake. Two experienced nuclear physicians, who were blind to the clinical information of the patient, analyzed the scintimammograms. Only focal uptake was interpreted as positive.

All patients with suspicious breast cancer recurrence had either fine needle aspiration cytology (FNAC) or core biopsy or definite wide local excision biopsy to confirm the final diagnosis. If there was a suspicion of axillary lymph node disease either clinically or by any imaging modality, then lymph node sampling was also performed.

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of scintimammography, mammography were calculated.

Results

Out of 33 patients 21 had evidence of recurrence on histopathology/cytology. Scintimammography was positive in 19 out of 33 patients. It was equivocal in two patients and in remaining 12 patients scan was negative for abnormal tracer uptake. Mammography was done in twenty six patients (79%), it was positive in 12 patients, equivocal in 4 and negative in remaining 10 patients (Table 1).

The overall sensitivity of planar Tc-99m MIBI scintimammography in detecting recurrent breast cancer was 85.7%, the specificity 91.7%, positive predictive value 94.7%, negative predictive value 78.6%, and the accuracy was 87.8%.

The overall sensitivity, specificity, PPV, NPV and accuracy of mammography were found to be 52.9%, 66.7%, 75%, 42.9% and 57.7%.

Discussion

In this study, sensitivity of scintimammography is in close proximity to those reported by Buscombe et al17, which was 85%. Regarding 3 false negative scans in this study; in one patient abnormal tracer uptake was superimposed by left ventricular myocardial uptake while in remaining lesions were smaller in size <2cm. Scintimammography has low sensitivity for detecting small cancers, usually in the range 1±1.5 cm and smaller.18

The specificity of scintimammography in this study was high. A false positive result was noted in one patient on planar images, while cytology revealed local inflammation, similar results had been reported by Cwikla et al.19 Local inflammation, fibroadenomas and fibrocystic changes represent the major source of false positive images on scintimammography.18

![Figure 1](image1.png)  
Figure 1: A 65 year old woman with a 9 month history of left side breast cancer treated by lumpectomy only. She presented with a lump in left upper outer quadrant & left axilla. (a) Medio-lateral oblique view of left breast mammography is highly suspicious for recurrence. (b) Scintimammography shows focal increased tracer uptake in left breast and axilla. Atypical cells were found on FNAC.

![Figure 2](image2.png)  
Figure 2: A 38 year old woman with 12 month history of left sided breast cancer treated by lumpectomy & chemotherapy. She presented with a lump in left upper outer quadrant. (a) Mammography was highly suspicious for breast cancer. (b) Scintimammography revealed no abnormality. Scar tissue was found at biopsy.
Table 2. Results of Scintimammography and Mammography.

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<th>Sensitivity</th>
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<td>91.7%</td>
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<tr>
<td>Mammography</td>
<td>52.9%</td>
<td>66.7%</td>
<td>75%</td>
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TP = true positive; FN = false negative; TN = true negative; FP = false positive.

Scintimammography is a simple noninvasive and reliable diagnostic tool for the diagnosis of loco-regional breast cancer recurrence. Compared with mammography, scintimammography has a better diagnostic accuracy in the detection of loco-regional breast cancer recurrence. Scintimammography can be used with conviction for discrimination of post surgical and post radiation changes and scar tissue tumour from recurrence.

References