

Society of Nuclear Medicine Procedure Guideline for Breast Scintigraphy

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I. Purpose

The purpose of this guideline is to assist nuclear medicine practitioners in recommending, performing, interpreting, and reporting the results of ^{99m}Tc -sestamibi breast scintigraphy (mammoscintigraphy, scintimammography).

II. Background Information and Definitions

Breast scintigraphy is performed after intravenous administration of ^{99m}Tc -sestamibi and includes planar and/or single-photon emission computed tomography (SPECT).

III. Examples of Clinical or Research Applications

- A. Evaluate breast cancer in patients in whom mammography is nondiagnostic, equivocal, or difficult to interpret (e.g., the presence of scar tissue, mammographically dense breast tissue, implants, or severe dysplastic disease).
- B. Assist in identifying multicentric and multifocal

carcinomas in patients with tissue diagnosis of breast cancer.

- C. May be useful in the evaluation of the effectiveness of neoadjuvant chemotherapy for breast carcinoma.

IV. Procedure

A. Patient Preparation

1. No special preparation for the test is needed; however, a thorough explanation of the test should be provided by the technologist or physician. Before radiopharmaceutical injection, the technologist may have the patient attempt the prone position with arms extended, to assess the feasibility of the study.
2. The patient should remove all clothing and jewelry above the waist and should wear a hospital gown open in front.

B. Information Pertinent to Performing the Procedure

1. Prior mammograms should be available, as well as prior ultrasound and MRI, if performed.

The Society of Nuclear Medicine (SNM) has written and approved these guidelines as an educational tool designed to promote the cost-effective use of high-quality nuclear medicine procedures or in the conduct of research and to assist practitioners in providing appropriate care for patients. The guidelines should not be deemed inclusive of all proper procedures nor exclusive of other procedures reasonably directed to obtaining the same results. They are neither inflexible rules nor requirements of practice and are not intended nor should they be used to establish a legal standard of care. For these reasons, SNM cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment about the propriety of any specific procedure or course of action must be made by the physician when considering the circumstances presented. Thus, an approach that differs from the guidelines is not necessarily below the standard of care. A conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in his or her reasonable judgment, such course of action is indicated by the condition of the patient, limitations on available resources, or advances in knowledge or technology subsequent to publication of the guidelines.

All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

Advances in medicine occur at a rapid rate. The date of a guideline should always be considered in determining its current applicability.

2. A breast physical examination must be performed by either the nuclear medicine physician or the referring physician. A copy of the physical examination performed by the referring physician should be a part of the nuclear medicine referral jacket.
3. The time of last menses and pregnancy and lactating status of the patient should be determined. If the patient is pregnant or lactating, then determination should be made as to whether to proceed with the examination. If so, appropriate radiation safety recommendations should be provided for the patient.
4. Breast scintigraphy should be delayed at least 2 wk after a cyst aspiration or fine needle aspiration, and 4–6 wk after a core or excisional biopsy. This procedure can produce false-positive results if performed within 4–6 wk after core or excisional biopsy.
5. The nuclear medicine physician should be aware of physical signs and symptoms and prior surgical procedures or therapy.

C. Precautions

Known hypersensitivity to ^{99m}Tc -sestamibi should be noted.

D. Radiopharmaceutical

1. Intravenous injection of 740–1,110 MBq (20–30 mCi) ^{99m}Tc -sestamibi should be administered in an arm vein contralateral to the breast with the suspected abnormality. If the disease is bilateral, the injection is ideally administered in a foot vein.
2. The radiopharmaceutical should be administered using an indwelling catheter or butterfly needle. The radiopharmaceutical should be followed by 10 cc of saline to flush the vein.
3. Normal distribution of the radiopharmaceutical includes the salivary and thyroid glands, myocardium, liver, gallbladder, small and large intestine, kidneys, bladder, and skeletal muscles.

4. Radiation dosimetry

E. Image Acquisition

1. Instrumentation
 - a. A standard scintillation camera is equipped with a low-energy, high-resolution collimator.
 - b. A symmetric 10% energy window should be centered over the 140-keV photopeak of ^{99m}Tc .
2. Patient Position
 - a. The patient lies prone with the breast to be imaged dependent from the imaging table. The contralateral breast should be compressed against the table to prevent cross-talk of activity. A breast-positioning device (table adapter, foam pad, etc.) should be used to minimize patient motion. The arms should be raised to expose the axillae. The head should be turned away from the detector to minimize shine-through of normal head and neck activity.
 - b. The detector should touch the patient's side for improved resolution.
 - c. The anterior image may be acquired with the patient supine or upright.
3. Images
 - a. Imaging begins 5–10 min after administration of the radiopharmaceutical.
 - b. Planar images are acquired for 10 min each, using a 128×128 or larger matrix to allow for pixel overload that may come from the liver, heart, etc.
 - c. The following planar images should be acquired:
 - i. Prone lateral image of the breast with the suspected abnormality. The field of view should include the breast, axilla, and anterior chest wall, excluding any internal organ activity. Electronic magnification should be used as needed to optimize pixel size.

Radiation Dosimetry: Adults*

Radiopharmaceutical	Administered activity MBq (mCi)	Organ receiving the largest radiation dose mGy/MBq (rad/mCi)	Effective dose mSv/MBq (rem/mCi)
^{99m}Tc -sestamibi	740–1,110 iv (20–30)	0.039 Gallbladder (0.14)	0.0085 (0.031)

*International Commission on Radiological Protection. *Radiation Protection in Biomedical Research*. ICRP Publication 62. New York, NY: Pergamon Press; 1993:23.

- ii. If needed, prone posterior oblique image of the ipsilateral breast. The detector is moved 30° posterior of lateral.
- iii. Prone lateral and, if needed, posterior oblique images of the contralateral breast.
- iv. Anterior supine or upright chest image. The anterior upright or supine image should include both breasts and both axillae in the field of view. Arms should be raised (for upright anterior view) or extended (for prone anterior view) to expose the axillary regions. Do not use zoom in anterior position if the camera system does not allow breasts and both axillae in the image.
- d. The use of radioactive markers over palpable abnormalities is optional. A set of anterior planar images of the thorax can be made to provide more accurate anatomical location using radioactive markers placed at the nipples. If markers are placed, they must be placed after patient is positioned in prone position. The location of the breast lesion in relation to the marker may change significantly if the markers are placed in supine or upright position and then the breast is positioned in prone lateral.
- e. No consensus has been reached regarding the utility of SPECT imaging; therefore, no parameters for SPECT imaging or processing are included here.

F. Interventions

None.

G. Processing

1. Masking of the high-activity chest and abdominal organs, such as the myocardium and liver, from the final images will improve visualization of breast tissue. This masking may be performed using regions of interest generated on the computer or by count subtraction. Both the masked and original images should be included in the final display.
2. Interpretation of the images should be done from the computer monitor whenever possible, because adjustment of the image contrast by the interpreting physician may be necessary.
3. A logarithmic scale to enhance low-count areas instead of a linear scale is preferable for image display.
4. Grayscale is preferable to color for interpretation.

H. Interpretation Criteria

1. Focal increased uptake of the radiopharmaceutical in the breast or axilla (in the absence of radiopharmaceutical infiltration) is suspicious for malignancy.
2. Mild homogeneous uptake of the radiopharmaceutical in the breast or axilla is consistent with a normal study.
3. Patchy or diffuse increased radiopharmaceutical uptake in the breasts is probably not consistent with malignancy.
4. There is a great variability of intensity of focal uptake. The following image features are more suspicious of breast malignancy: focal increased uptake, relatively well-delineated contours, with mild-to-intense radiotracer uptake; focal increased uptake (1 or more foci) in the ipsilateral axilla, in the presence of a primary lesion in the breast is strongly suggestive of axillary lymph node metastatic involvement. Note that a linear and superficial axillary uptake on the lateral thoracic views usually corresponds to uptake in skin folds. The following image features are more suggestive of a benign disease of the breast: diffuse or patchy radiotracer uptake of mild to moderate intensity, often bilateral, edges are not visually well defined.

I. Reporting

The report to the referring physician should recommend correlation with clinical findings, as well as the results of other imaging studies.

J. Quality Control

1. Routine scintillation camera quality control should be performed as described in the Society of Nuclear Medicine Procedure Guideline for General Imaging.
2. Quality control measures and radiation safety precautions should be followed as described in the Society of Nuclear Medicine Procedure Guideline for Use of Radiopharmaceuticals.

K. Sources of Error

1. Infiltration of the radiopharmaceutical administered in an arm vein may cause false-positive uptake in the axillary lymph nodes. Inclusion of an injection site may be helpful in evaluating the presence and extent of dose infiltration, which may be particularly important if an unsuspected contralateral breast lesion is discovered.
2. Patient positioning that does not allow the breast to be fully dependent will decrease the accuracy of the test.
3. Patient motion will decrease the accuracy of the test.

4. If both breasts are dependent, cross-talk of activity may result in a false-positive result in the contralateral breast.
5. The sensitivity, specificity, and accuracy of this test depend upon several factors, including the size of the breast tumor being imaged. The sensitivity of this test for tumors smaller than 1 cm in diameter is very low with nuclear medicine cameras in current use.

nosis of breast lesions. *J Nucl Med.* 1997;38:58–62.

- I. Villanueva-Meyer J, Leonard MH, Briscoe E, et al. Mammoscintigraphy with technetium-99m-sestamibi in suspected breast cancer. *J Nucl Med.* 1996;37:926–930.

V. Issues Requiring Further Clarification

- A. Further study is needed to determine the characteristics of the population most likely to benefit from breast scintigraphy.
- B. No consensus has been reached as to the efficacy of routine SPECT imaging.
- C. The usefulness of other radiopharmaceuticals for breast scintigraphy has not been established.
- D. The usefulness of breast scintigraphy for all indications included here requires further study.

VI. Concise Bibliography

- A. Cutrone J, Shane-Yospur L, Khalkhali I, et al. Immunohistologic assessment of Tc-99m sestamibi uptake in benign and malignant breast lesions. *J Nucl Med.* 1998;39:449–453.
- B. Del Vecchio S, Ciarmiello A, Pace L, et al. Fractional retention of technetium-99m-sestamibi as an index of p-glycoprotein expression in untreated breast cancer patients. *J Nucl Med* 1997;38:1348–1351.
- C. Diggles L, Mena I, Khalkhali I. Technical aspects of prone dependent-breast scintimammography. *J Nucl Med Technol.* 1994;22:165–170.
- D. Khalkhali I, Mena I, Jouanne E, et al. Prone scintimammography in patients with suspicion of breast cancer. *J Am Coll Surg.* 1994;178:491–497.
- E. Palmedo H, Schomburg A, Grunwald F, et al. Scintimammography with Tc-99m MIBI in patients with suspicion of primary breast cancer. *Nucl Med Biol.* 1996;23:681–684.
- F. Peller P, Khedkar N, Martinez C. Breast tumor scintigraphy. *J Nucl Med Technol.* 1996;24:198–203.
- G. Taillefer R, Robidoux A, Lambert R, et al. Technetium-99m-sestamibi prone scintimammography to detect primary breast cancer and axillary lymph node involvement. *J Nucl Med.* 1995; 36:1758–1765.
- H. Tiling R, Sommer H, Pechmann M, et al. Comparison of technetium-99m-sestamibi scintimammography with contrast-enhanced MRI for diag-