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# SNM Practice Guideline for Breast Scintigraphy with Breast-Specific $\gamma$ -Cameras 1.0\*

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## PREAMBLE

The Society of Nuclear Medicine (SNM) is an international scientific and professional organization founded in 1954 to promote the science, technology, and practical application of nuclear medicine. Its 16,000 members are physicians, technologists, and scientists specializing in the research and practice of nuclear medicine. In addition to publishing journals, newsletters, and books, the SNM also sponsors international meetings and workshops designed to increase the competencies of nuclear medicine practitioners and to promote new advances in the science of nuclear medicine.

The SNM will periodically define new guidelines for nuclear medicine practice to help advance the science of nuclear medicine and to improve the quality of service to patients throughout the United States. Existing Practice Guidelines will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each Practice Guideline, representing a policy statement by the SNM, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Committee on SNM Guidelines, Health Policy and Practice Commission, and SNM Board of Directors. The Practice Guidelines recognize that the safe and effective use of diagnostic nuclear medicine

imaging requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published Practice Guideline by those entities not providing these services is not authorized.

These Practice Guidelines are an educational tool designed to assist practitioners in providing appropriate care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the SNM cautions against the use of these Practice Guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the Practice Guidelines, standing alone, is not necessarily below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the Practice Guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of the Practice Guidelines.

The practice of medicine involves not only the science, but also the art, of preventing, diagnosing, alleviating, and treating disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to these Practice Guidelines will not ensure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current

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knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these Practice Guidelines is to assist practitioners in achieving this objective.

## I. INTRODUCTION

The intention of this guideline is to assist breast imaging practitioners in selecting patients for, performing, interpreting, and reporting  $^{99m}\text{Tc}$ -sestamibi breast-specific  $\gamma$ -imaging.

## II. GOALS

The goal of breast-specific  $\gamma$ -imaging performed with a high-resolution, small-field-of-view, breast-optimized  $\gamma$ -camera after intravenous administration of  $^{99m}\text{Tc}$ -sestamibi is to detect breast malignancies and is therefore classified under the current procedural terminology codes 78800–78804, Radiopharmaceutical Localization of Tumor or Distribution of Radiopharmaceutical Agent(s).

## III. DEFINITIONS

See the SNM Procedure Guideline for General Imaging.

## IV. COMMON CLINICAL INDICATIONS

- A. Breast scintigraphy was addressed by the American College of Radiology Appropriateness Criteria Panel on Breast Imaging, the American College of Surgeons Consensus Conference III (1,2), and the Institute for Clinical Systems Improvement in its guideline on diagnosis of breast disease.
- B. In patients with recently detected breast malignancy (3–5), breast scintigraphy is used to:
  1. Evaluate the extent of disease (initial staging)
  2. Detect multicentric, multifocal, or bilateral disease
  3. Assess response to neoadjuvant chemotherapy
- C. In patients at high risk for breast malignancy (6–8), breast scintigraphy is used when:
  1. Recurrence is suspected
  2. Only a limited mammogram was obtained or previous malignancy was occult on mammography
- D. In patients with indeterminate breast abnormalities and remaining diagnostic concerns (3,4,9,10), breast scintigraphy is used to:
  1. Evaluate nipple discharge in patients with abnormal mammography or sonographic findings, with or without contrast ductography
  2. Evaluate bloody nipple discharge in patients with normal mammography or ductography findings
  3. Evaluate significant nipple discharge in patients who underwent ductography unsuccessfully
  4. Evaluate lesions when patient reassurance is warranted (Breast Imaging Reporting and Data System [BIRADS] 3)
  5. Evaluate lesions—whether palpable or nonpalpable—identified by other breast imaging techniques

6. Evaluate palpable abnormalities not demonstrated on mammography or ultrasound
  7. Evaluate multiple masses demonstrated on breast imaging
  8. Aid in biopsy targeting
  9. Evaluate diffuse or multiple clusters of microcalcifications
  10. Evaluate breasts for occult disease in cases of axillary lymph node metastases with an unknown primary
  11. Evaluate unexplained architectural distortion
  12. Evaluate a suggestive mammographic finding seen on 1 view only
  13. Increase specificity by evaluating enhancing areas seen on MRI
- E. In patients with technically difficult breast imaging (4,7–9,11,12), breast scintigraphy is used in cases of:
    1. Radiodense breast tissue
    2. Implants, free silicone, or paraffin injections compromising the mammogram
  - F. In patients for whom breast MRI would be indicated (1,13–15), breast scintigraphy is used if:
    1. MRI is diagnostically indicated but not possible:
      - a. Implanted pacemakers or pumps
      - b. Ferromagnetic surgical implants
      - c. Risk of a nephrogenic systemic fibrotic response to gadolinium
      - d. Body habitus exceeding the inside diameter of the MRI bore
      - e. Patients with breasts too large to be evaluated within the breast coil
      - f. Patients with acute claustrophobia
      - g. Other factors limiting compliance with a prescribed MRI study
    2. An alternative is needed for patients who meet MRI screening criteria: breast cancer susceptibility gene 1 or 2; parent, sibling, or child with breast cancer; lifetime risk of 20%–25%; chest radiation performed between ages of 10 and 30 y
  - G. In patients undergoing preoperative chemotherapy who require monitoring of neoadjuvant tumor response (16–18), breast scintigraphy is used to:
    1. Determine the impact of therapy
    2. Plan surgery for residual disease

## V. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

See Section V of the SNM Procedure Guideline for General Imaging.

## VI. THE PROCEDURE/SPECIFICATION OF THE EXAMINATION

- A. Nuclear medicine request
  1. Correlation should be made with other relevant imaging, if available.
  2. The interpreting physician should be aware of physical findings, symptoms, and clinical history.

3. The date of last menses or the pregnancy and lactation status of the patient should be determined.
    - a. Breast-specific  $\gamma$ -imaging should be performed between days 2 and 12 of the menstrual cycle if possible.
    - b. If pregnancy is possible, the study should be delayed until the onset of menses or until a negative pregnancy test is obtained.
  4. Ideally, breast-specific  $\gamma$ -imaging should be performed before interventional procedures. Breast scintigraphy is commonly used in presurgical planning and can effectively evaluate the remainder of the breast tissue in such cases. If performed within 2 wk after a cyst aspiration or fine-needle aspiration, or 3–4 wk after a core or excisional biopsy, breast scintigraphy can produce false-positive results at the interventional site. This effect is less likely if imaging is conducted within the first 72 h after needle procedures.
- B. Patient preparation and precautions**  
See Section VI of the SNM Guideline on General Imaging.
1. No special preparation for the test is needed. A thorough explanation of the test should be provided by the technologist or physician.
  2. The patient should remove all clothing and jewelry above the waist and should wear a mammography cape or gown.
  3. Known hypersensitivity to  $^{99m}\text{Tc}$ -sestamibi is a contraindication.
  4. Pregnancy is a contraindication.
- C. Radiopharmaceutical**
1. Approximately 925 MBq (25 mCi) of the radiopharmaceutical should be administered using an indwelling venous catheter or butterfly needle followed by 10 mL of saline to flush the vein.
  2. When possible, the tracer should be administered via an upper-extremity vein on the opposite side of the suspected abnormality.
- D. Protocol/image acquisition**
1. The patient is seated for the entire scan. Views should duplicate standard mammographic views according to the most recent mammogram.
  2. Imaging
    - a. Imaging begins 5–10 min after administration of the radiopharmaceutical.
    - b. Planar images are acquired for 10 min each or 175,000 counts (7 min minimum).
    - c. Planar images should be acquired for each breast beginning with the side of the suspected abnormality if appropriate: right craniocaudal, left craniocaudal, right mediolateral oblique, left mediolateral oblique. If needed, additional images may be acquired according to the interpreting physician: 90° lateral (lateromedial or mediolateral), axillary tail, cleavage view, exaggerated craniocaudal view, implant displacement view, right anteroposterior view (axilla), left anteroposterior view (axilla). For lesions close to the chest wall, an extra craniocaudal image with minimal immobilization can help ensure inclusion of posterior tissues, especially in women with breast tissue that resists compression.
  3. Interventions. For biopsy, both a needle localization technique and an intraoperative lumpectomy technique using a  $\gamma$ -probe for guidance have been described in the medical literature (19,20).
  4. Processing
    - a. The image should be interpreted on a computer workstation, because adjustment of the image contrast by the interpreting physician may be necessary.
    - b. Various display parameters, including a gray-scale linear display and color and logarithmic displays, may be considered in order to optimize interpretation.
    - c. If color scales are used, linear monochromatic (hot metal) is preferable to multicolor (rainbow).
- E. Interpretation criteria**
1. Homogeneous uptake of the radiopharmaceutical in the breast or axilla is consistent with a normal study (BIRADS 1).
  2. Patchy or diffusely increased radiopharmaceutical uptake in the breasts is usually a normal variant, especially when the distribution correlates with mammographic anatomy (BIRADS 2).
  3. Features suggestive of benign disease of the breast are diffuse or patchy uptake of mild to moderate intensity, often bilateral, with ill-defined boundaries.
  4. Patchy areas of uptake, mild to moderate in intensity (BIRADS 3) are suggestive of benign processes such as mastitis. If bilateral and symmetric, matching the distribution of glandular tissue as seen on the mammogram, patchy areas suggest a glandular response to hormonal influences.
  5. Small focal areas of increased uptake in the breast or axilla (in the absence of radiopharmaceutical infiltration) represent an equivocal result, consistent with malignancy, inflammation, atypia, or fat necrosis (BIRADS 4).
  6. The intensity of focal uptake in malignant lesions is highly variable. Moderate to intense focal uptake with well-delineated contours is consistent with malignancy (BIRADS 5).
  7. Focally increased uptake (1 or more foci) in the ipsilateral axilla, in the presence of a primary lesion, is strongly suggestive of axillary lymph node metastatic involvement (in the absence of radiopharmaceutical infiltration).
  8. Masking of high-activity lesions in the breast can improve visualization of adjacent breast tissues. Masking can be performed by placing appropriately sized pieces of lead between the lesion and the detec-

tor. Both the masked and the original images should be included in the final display.

9. Sources of error

- a. Infiltration of the radiopharmaceutical administered in an arm vein may cause false-positive uptake in the axillary lymph nodes. Imaging of the injection site is helpful in evaluating the presence and extent of dose infiltration, particularly if an unsuspected breast lesion is discovered on the same side as the injection. Motion of the breast relative to the detector will decrease the accuracy of the test.
- b. The sensitivity, specificity, and accuracy of this test depend on several factors, including the size of the breast neoplasm being imaged. Although the sensitivity of this test for subcentimeter tumors is high at around 95%, as with all radiologic examinations sensitivity decreases with lesion size.

**VII. DOCUMENTATION/REPORTING**

A. Goals of a report

See Section VII.A of the SNM Procedure Guideline for General Imaging.

B. Direct communication

See the American College of Radiology Practice Guideline for Communication of Diagnostic Imaging Findings and section VII.B of the SNM Procedure Guideline for General Imaging.

C. Written communication

See the American College of Radiology Practice Guideline for Communication of Diagnostic Imaging Findings and section VII.C of the SNM Procedure Guideline for General Imaging.

D. Contents of the report

See Section VII.D of the SNM Procedure Guideline for General Imaging for the content of each section.

- 1. Study identification
- 2. Clinical information
- 3. Procedure description
- 4. Description of findings

See the previous section on interpretation.

5. Impression

The report to the referring physician should indicate the most likely diagnosis and should recommend appropriate follow-up as with any breast imaging study, using BIR-ADS classification.

6. Comments, when appropriate

**VIII. EQUIPMENT SPECIFICATIONS**

A. High-resolution small-field-of-view  $\gamma$ -camera

B. A symmetric energy window should be centered over the 140-keV photo peak of  $^{99m}\text{Tc}$  unless otherwise specified by the manufacturer.

**IX. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION CONCERNS**

A. Routine quality control procedures should be performed for the scintillation camera as described in the SNM Procedure Guideline for General Imaging. Some of the devices developed for this procedure are based on a pixilated design (both digital and scintillator element types) and not a single crystal design. The quality control and quality assurance of these devices may require additional or modified testing to maintain proper operation. The manufacturer's manuals should be reviewed in addition to these guidelines.

B. Quality control measures and radiation safety precautions should be followed as described in the SNM Procedure Guidelines for Use of Radiopharmaceuticals.

**X. RADIATION SAFETY IN IMAGING**

See Section X of the SNM Procedure Guideline for General Imaging. Dose estimates to adults, children, and the fetus are presented in Tables 1–4. Regarding dose estimates to breastfeeding patients, ICRP Publication 106 (Appendix D) suggests that no interruption is needed for breastfeeding patients administered  $^{99m}\text{Tc}$ -sestamibi or  $^{99m}\text{Tc}$ -tetrofosmin (21).

**TABLE 1**  
Radiation Dosimetry in Adults

Radiopharmaceutical	Administered activity		Largest radiation dose			Effective dose	
	MBq	mCi	Organ	mGy/MBq	rad/mCi	mSv/MBq	rem/mCi
$^{99m}\text{Tc}$ -sestamibi*	925	25	Gallbladder	0.039	0.14	0.009	0.033
$^{99m}\text{Tc}$ -tetrofosmin†	925	25	Gallbladder	0.027	0.10	0.0069	0.026
$^{18}\text{F}$ -FDG*	370	10	Urinary bladder	0.13	0.48	0.019	0.070

\*Data are from (22).

†Data are from (21).

**TABLE 2**  
Fetal Dose: <sup>99m</sup>Tc-Sestamibi Rest Studies

Stage of gestation	Fetal dose	
	mGy/MBq	rad/mCi
Early	0.015	0.055
3 mo	0.012	0.044
6 mo	0.0084	0.031
9 mo	0.0054	0.020

<sup>99m</sup>Tc-sestamibi dose estimates to fetus are from Russell et al. (24). No information about possible placental crossover of this compound was available for use in estimating fetal doses.

**TABLE 3**  
Fetal Dose: <sup>99m</sup>Tc-Sestamibi

Stage of gestation	Fetal dose	
	mGy/MBq	rad/mCi
Early	0.012	0.044
3 mo	0.0095	0.035
6 mo	0.0069	0.026
9 mo	0.0044	0.016

<sup>99m</sup>Tc-sestamibi dose estimates to fetus are from Russell et al. (24). No information about possible placental crossover of this compound was available for use in estimating fetal doses.

**TABLE 4**  
Fetal Dose: <sup>99m</sup>Tc-Tetrofosmin Studies

Stage of gestation	Fetal dose	
	mGy/MBq	rad/mCi
Early	0.0096	0.036
3 mo	0.0070	0.026
6 months	0.0054	0.020
9 mo	0.0036	0.013

<sup>99m</sup>Tc-tetrofosmin dose estimates to fetus are from Russell et al. (24). No information about possible placental crossover of this compound was available for use in estimating fetal doses. Separate estimates were not given for rest and exercise subjects.

## XI. ACKNOWLEDGMENTS

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### XIII. APPROVAL

This Practice Guideline was approved by the Board of Directors of the SNM on June 4, 2010.