

# Lymphoscintigraphy: Breast and Melanoma

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**L**ymphoscintigraphy helps identify the first lymph node (sentinel node) receiving lymphatic drainage from a tumor site and can provide the surgeon with a map to follow during surgery and help stage the disease (1,2).

## CLINICAL INDICATIONS

- Identification of the sentinel lymph node for surgical excision to stage the disease.
- Assistance in planning the incision for sentinel node biopsy.
- Evaluation of intermediate-stage primary melanoma.

## CONTRAINDICATIONS

- Patients who are pregnant or breastfeeding. Pregnancy must be excluded in accordance with local institutional policy. If the patient is breastfeeding, appropriate radiation safety instructions should be provided.
- Patients with known metastases.
- Patients who have recently undergone a radiopharmaceutical-dependent nuclear medicine study.

## PATIENT PREPARATION AND EDUCATION

- Patient may eat and take medications as prescribed (4,5).
- Fasting requirements for same-day surgical procedures should be followed as prescribed by the surgical department.
- A topical numbing agent may be used (lidocaine and prilocaine cream [Emla; AstraZeneca] or cold spray) to minimize pain.
- A focused clinical history should be obtained, including previous biopsy results, the pathologic classification of the tumor (thickness and penetration), and surgical excision, if any, of the primary lesion.

## ACQUISITION INSTRUCTIONS

### Breast

- The total dose is divided into 1–4 aliquots (institution-specific). Adding pH-balanced 1% lidocaine to the radiopharmaceutical may improve patient comfort without compromising sentinel lymph node identification.
- The injections, performed by the physician or a trained individual, are placed around the tumor or biopsy site approximately 1 cm from the edge of the lesion and

may be subdermal, periareolar, subareolar, or intradermal. Ultrasound guidance may be needed to determine the injection location for nonpalpable lesions.

- Imaging is tracer-dependent and is performed in 2 phases (Tables 1 and 2). Early-phase static or dynamic imaging to identify the first draining node begins immediately after injection of  $^{99m}\text{Tc}$ -sulfur colloid or 15 min after injection of  $^{99m}\text{Tc}$ -tilmanocept for 15–30 min. Delayed-phase imaging to identify lymph node retention and to visualize the sentinel nodes is performed for 30 min to 3 h, at the conclusion of the initial early-phase imaging sequence for either isotope, in the anterior, oblique, and lateral views.
- Transmission imaging to delineate the patient's body contour using a  $^{57}\text{Co}$  sheet source may be helpful for localization. Alternatively, a  $^{99m}\text{Tc}$  point source may be used to trace the body contour outline.
- The anterior and lateral locations of the sentinel nodes are marked and labeled on the patient's skin.
- Imaging may not be necessary and is institution-specific (see the "Adjunct Imaging and Interventions" section).

### Melanoma

- The total dose is divided into 4–8 aliquots with a volume of 0.1 mL each. Each aliquot should contain at least 3,700 kBq (100  $\mu\text{Ci}$ ) of activity.
- The intradermal injections, performed by the physician or a trained individual, are placed around the tumor or biopsy site approximately 1 cm from the edge of the lesion.
- Imaging is performed immediately after injection of sulfur colloid or 15 min after injection of  $^{99m}\text{Tc}$ -tilmanocept, with the patient supine or prone and with the field of view centered over the region of interest.
- If the injection is on the trunk, all nodal basins are imaged to rule in or rule out lymphatic involvement. If the injection is on a limb, only nodal basins on that limb and the trunk are imaged (e.g., if injecting an ankle, image the popliteal and inguinal nodes).
- A continuous dynamic acquisition (30 s/frame for 30–60 min) or sequential static images (every 5 min for 1 h) are obtained until the sentinel lymph node is identified.
- The location of the sentinel node or nodes is marked on the skin.

## COMMON OPTIONS

- Gentle massage at the injection site may be performed to promote tracer uptake (3).

**TABLE 1**  
Radiopharmaceuticals (1,2)

Identity	Dose	Administration route
<sup>99m</sup> Tc-sulfur colloid (filtered or nonfiltered)	Mean, 15 MBq (0.5 mCi); range, 15–35 MBq (0.5–1.0 mCi)	Subdermal or intradermal
<sup>99m</sup> Tc-tilmanocept	18.5 MBq (0.5 mCi)	Subdermal or intradermal

- The area of injection may need to be covered with a piece of lead to better evaluate the lymphatic drainage.
- Radioactive markers positioned on known anatomic locations may be helpful.
- Oblique and lateral images of the region of interest may be helpful for localization.

**TABLE 2**

Standard Acquisition Parameters for Dynamic, Static, and Planar Imaging (1,2)

Category	Parameter
Camera type	Large-field-of-view multidetector
Energy peak	140 keV
Energy window	20%
Collimator	Low-energy high-resolution
Patient position	
Breast	Supine
Melanoma	Supine or prone
Camera position, dual-head	
Detector 1	Anterior
Detector 2	Posterior
Camera position, single-head	Anterior
Injection-to-scan time	
Sulfur colloid	Immediate
<sup>99m</sup> Tc-tilmanocept	15-min delay
Acquisition type	Dynamic or planar
Views	
Breast	Immediate anterior images for ~15–30 min; delayed anterior, oblique, or lateral images, as appropriate, for 3 h
Melanoma	Immediate anterior or posterior images for ~30–60 min; additional anterior, oblique, or lateral images, as appropriate, for 1 h
Matrix	128 × 128 or 256 × 256
Acquisition time	
Dynamic: breast	30 s/frame for 2–30 min
Dynamic: melanoma	30 s/frame for 30–60 min
Planar	5–10 min/view
Additional views	5–10 min/view

- For melanoma, imaging of trunk lesions may include axillary and inguinal views; imaging of head and neck lesions may include anterior, posterior, and oblique views, and SPECT/CT may be deemed necessary.

### ADJUNCT IMAGING AND INTERVENTIONS

The use of a  $\gamma$  probe in the operating room may replace imaging in some institutions and can help to identify and pinpoint the region with the highest count rate for incision. Important note: The probe should be directed away from the activity at the injection site.

### PROCESSING

To enhance low-count areas of the image, contrast enhancement should be used or the upper threshold of the computer display should be lowered.

### PRECAUTIONS

- Leakage from the injection site may occur. Cover the injection site with gauze.
- If an intraoperative  $\gamma$ -probe is used to help locate the sentinel node, the tracer must be injected 15 min to 3 h before surgery. If surgery is delayed by 6 or more hours, obtaining another image before surgery to define further migration of the tracer to additional nodes is advised.
- Mapping should not be delayed more than 15 h.

### REFERENCES

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4. Bluemel C, Herrmann K, Giammarile F, et al. EANM practice guidelines for lymphoscintigraphy and sentinel lymph node biopsy in melanoma. *Eur J Nucl Med Mol Imaging*. 2015;42:1750–1766.
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