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# Lymphoscintigraphy as the standard of imaging for lymphatic mapping in melanoma and breast cancer

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A renewed interest has been posed on lymphoscintigraphy since its widespread use in the sentinel node (SN) localization technique. Its main indications are melanoma and breast cancer, although it is used in other type of tumours.

An essential prerequisite for a successful SN biopsy is an accurate map of the lymphatic drainage pattern from the tumour site. The role of lymphoscintigraphy is to provide such a map in every patient. Lymphoscintigraphy indicates not only the location of sentinel nodes but also the number of SNs at each location. This mapping is especially important in malignant melanoma, since lymphoscintigraphy can identify the lymphatic vessels draining to the SNs.

Reliable clinical prediction of lymphatic drainage from the skin or breast is not possible. Patterns of lymphatic drainage from the skin are highly variable from patient to patient, even from the same area of the skin.

In breast cancer, lymphoscintigraphy permits accurately detection of SNs outside the axilla, which occurs in about 40 % of cases. These nodes can be visualized in the internal mammary chain, the supraclavicular region, the intrapectoral region as well as intrammarian location. The location of the breast tumour is not a reliable guide to lymphatic drainage, since lymph flow often crosses the center line of the breast.

There are some aspects to take in account in order to reach the best quality in lymphoscintigraphic images. In summary, radiopharmaceutical, site and route of administration and gammacamera positioning and imaging are important issues.

**Radiopharmaceuticals**

There are numerous radipharmaceuticals for SN imaging (suitably labelled with 99mTc). These include dextran, human serum albumin and colloids. Antimony colloid is largely used in Australia, sulfur colloid (filtered or unfiltered) is mostly used in North America an nanocolloidal albumin is widely used in Europe. Their main differences are based on particle size (ranging from 3 to 600 nm), the speed of migration from injection site and the visualization of lymphatic channels and one or more lymphatic nodes. Then, the lesser particle size the faster radiotracer migration to lymph nodes. The particle concentration and the dosage of radiopharmaceutical are important too.

**Tracer administration**

The injection of the tracer has evolved since the beginning of SN procedure. In the first procedures (melanoma, palpable breast) the injection was performed by the nuclear medicine physician. However, as the technique evolved the injection site can be guided by ultrasound and sterotaxis in non-palbale breast cancers.

In melanoma patients the tracer is injected intradermally, raising a wheal on the skin, around the primary lesion or biopsy scar. The best approach is performing the injection with a 5 mm distance from the lesion in order to gain the best drainage reproducibility.

In breast cancer there is no consensus about the best way to inject the radiotracer. Thus, intradermal, subdermal, periareolar, peritumoral, subtumoral and intratumoral routes have been described. We can categorize them in to groups, skin-related (intradermal, subdermal, periareolar) injections and tumor-related (all the others) injections. All of them get a suitable SN identification and localization in the axilla. However, there is a remarkable variability between them as skin-related injections almost always

depict an axillary node and on the other hand, the tumor-related injections show a significant percentage of extraaxillary drainage.

**Gammacamera positioning**

Lymphoscintigraphy is mandatory in SN procedure for many reasons:

- To ascertain the lymph node basins at risk for metastatic spread
- To indicate the location and number of sentinel nodes
- To distinguish the sentinel nodes and non-sentinel nodes
- To localize the sentinel nodes in aberrant, in transit or unpredictable locations
- To mark the sentinel node position on the skin

Lymphoscintigraphy has to be performed sequentially.

Dynamic scintigraphy: Normally we use a 30 sec images during the first 10-15 min after injection. This approach facilitates the identification of lymphatic ducts from a lesion with a rapid drainage expected.

Static images: They last at least 180 s in both anterior and lateral projections. Oblique and other special views can be performed in order to clarify the SN location. The time scheduled to obtain these images are 20-30 min, and 2 hours for cutaneous lymphoscintigraphy and until 4 hour or more when a slow migration of tracer is expected.

The body contour can be outlined with a 57Co or 99mTc marker or, preferably, with a flood source of 57Co or 99mTc. The aim of these procedures is to mark the SN location on the skin in the same manner that patient will be subsequently operated.

**Clinical results in melanoma and breast cancer**

After an adequate lymphoscintigraphic adquisition and skin marking, the surgical SN retrieval is successfully accomplished in the majority of cases. However there are different aspects depending on the tumour to be treated.

Thus, in melanoma patients lymphoscintigraphic SN visualization and surgical harvesting reaches almost 100 % of cases. Important aspects in melanoma are the aberrant or intransit SNs, the unpredictability of some anatomical regions (trunk, head & neck) and, specially, the false negative rate (i. e. the presence of a positive lymph node in a patient with a negative SN).

In breast cancer patients, the identification of SN in lymphoscintigraphy ranges from 85-97 % depending on the way of administration. Important aspects in this clinical scenario are the extraaxillary SN identification (inner mammary chain, supraclavicular, intrammamry nodes) that represents as much as 35 % of cases (with intratumoral injection). The false negative rate is currently below 5 % in the majority of studies.

**References**

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Lymphoscintigraphy (LS) allows the surgeon to easily identify and biopsy a SLN.Ä  Differences in study volumes and in lymphatic mapping techniques are two of the factors contributing to variations in the proportions of suc-cessful mappings [15]. The ranges of rates for false-negative findings and for SLN identifications emphasize the variability of this procedure.Â  SLN localization and biopsy are now the â€œstandard of careâ€ for staging the axillary lymph nodes in breast cancer patients.Â  In the nuclear medicine department, in preparation for imaging, the patient should remove all clothing and jewellery above the waist. In all patients, a physical examination of the breast should be performed by the nuclear medicine physician before injec-tion of the radiopharmaceutical. Results of the studies and comparison to other similar procedures for lymph node mapping (LNM) is made. Sentinel lymph node (SLN) involvement and stage of the disease is characterized as variable and is explained, in detail, throughout this paper. There are varying opinions on the best route of administration, length of delay images and radiopharmaceutical to use. All of the discrepancies between protocols are supported with evidence such as positive results or false positive results.Â  The series of images that are taken in lymphoscintigraphy must be sensitive enough to pick up on the SLN yet quickly clear from healthy lymph channels in order to distinguish the SLN from lymph channels. This creates a debate around which radiopharmaceutical is best for this study. Lymphoscintigraphy in melanoma has proven to be a reliable method to identify regional lymph nodes at risk for metastases. The first lymph node to drain a cutaneous lesion, the sentinel lymph node (SLN), is predictive of the metastatic status of the regional lymph node group. Lymphatic mapping allows for the identification of the SLN and for selective lymph node sampling.Â  The purpose of this study was to assess the clinical benefit of fused SPECT/CT images to planar images for SN mapping. Thirty-four consecutive patients with cutaneous malignant melanoma (n = 28) and squamous cell carcinoma (n = 6) and scheduled for SN biopsy were enrolled. Special considerations for sentinel node mapping in breast cancer, melanoma, and uterine cervix, endometrial, vulvar, penile, colorectal, and head and neck cancers were also discussed. Download chapter PDF. 11.1 Brief Introduction and Historical Perspective. The first nodes receiving lymphatic drainage of a tumor are known as the sentinel or guarding nodes.Â  Planar lymphoscintigraphy images of a breast cancer patient with two visible sentinel nodes in the axilla (blue arrows). Injection site is shown by a red arrow. Open image in new window. Fig. 11.5. Early (a) and delayed (b) lymphoscintigraphy of the patient with forehead melanoma.Â  Axillary lymph node dissection is still the standard of care. History of neoadjuvant chemotherapy. No contraindication. Lymphoscintigraphy using dynamic and static imaging better defines the sequence of lymphatic flow from the tumor site to draining lymph nodes, especially the sentinel node. There are two important parameters to measure the utility of the SLN, namely, identification rate and the false-negative rate.Â  Axillary lymph node dissection has long been the standard practice in breast surgery for staging, chemotherapy recommendation, and local disease control. A typical dissection consists of removal of both level I and level II lymph nodes for pathological evaluation (Fig.Â  Lentigo maligna melanoma arises from melanoma in situ (lentigo maligna) mainly in sun-damaged skin of elderly patients and is characterized by presence of atypical melanocytes at dermoepidermal junction.