Lymphoscintigraphy: Its Role In Lymphedema Management

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This issue of LymphLink focuses on the benefits and challenges of imaging in the diagnosis and treatment of lymphedema. The focus of this article is on the specialized examination called Lymphoscintigraphy.

Lymphoscintigraphy (lim-fo-sin-tigg’rah-fee) uses the injection of radioactive tracer to assess lymphatic structure and function. Similar to many nuclear medicine techniques, lymphoscintigraphy requires a special camera to create images based on the distribution and density of radioactive tracer that has accumulated in the tissues. Structures appear dark where tracer molecules have been densely absorbed and generated lots of counts. Images can be repeated at intervals ranging from minutes to hours to study the movement of tracer over time. Evaluation of repeated images permits us to make inferences about the function and structure of the lymphatic system.

Lymphoscintigraphy begins with the injection of radio-labeled tracer molecules into or just below the skin using a fine gauge needle. Controversy persists over where the tracer should be injected. Some diagnostic centers inject into the skin and other just below the skin. Sulfur colloid is a tracer molecule utilized widely for lymphoscintigraphy. The relatively large size of sulfur colloid molecules (<100 m) limits their absorption by blood capillaries. Their distribution on lymphoscintigraphic images is, therefore, specific to lymphatic structures; collectors, nodes and ducts.

Tracer is usually injected into the dorsal (top) surface of the hands or feet. However, it can be deposited anywhere within the body including breast, scalp, genitals, or internal organs, depending on the area of suspected lymphatic insufficiency. Tracer movement depends on the integrity of local lymph capillaries and vessels. Functioning lymphatics take up the tracer and transport it to regional lymph nodes. Tracer concentrates in the lymph nodes which appear as clusters of dark spots on lymphoscintigraphic images. Lymph drainage pathways may or may not be visible, depending on the rate of tracer transport, its concentration in the vessels, and frequency with which images are obtained. Generally, only large lymphatics contain enough tracer to appear clearly on images. If the lymphatic system is sufficiently intact, the injected tracer will eventually enter the blood stream and appear in the liver, spleen, bladder and heart.

Lymphoscintigraphy reports typically offer qualitative information. They describe tracer movement through the regional and systemic lymphatics and may identify sites of diminished or absent movement. Locations of low count density presumably correspond to areas of functional insufficiency. Images with tracer present 2 to 24 hours after injection may suggest retrograde flow through lymph vessels, as well as diffusion of the tracer throughout the limb. In such cases, the silhouette of the affected body parts often becomes visible.

Although it is less commonly and consistently reported, considerable quantitative information can also be gained. (Quantitative information is in numerical form and can be analyzed by statistical procedures.) Values that can be quantitatively measured include count reduction at the injection site, transit time to the lymph nodes, and time required for 50% of the tracer to be concentrated in the nodes. Repeated measurement allows calculation of tracer clearance rates. Clearance rates have been reported for unaffected individuals as well as patients with different stages of lymphedema. The clinical significance of this quantitative data is still unknown. As of now, they do not allow prediction of important clinical events such as LE progression or cellulitic infection.

Lymphedema therapists may question whether lymphoscintigraphic images can...
reveal drainage pathways for use in mobilizing stagnant lymph. Several limitations of lymphoscintigraphy should be considered when addressing this very reasonable question. First, only large lymph collectors that contain significant amounts of tracer will appear on the images. Small networks of collateral lymph vessels may never acquire sufficient count density to be seen. Second, it is important to remember that lymphoscintigraphy only displays tracer counts. If vessels, organs, bones, and other tissues do not absorb tracer, they will not be seen. Even when lymph drainage pathways are well visualized, the failure of lymphoscintigraphy to image surrounding anatomy makes it difficult to orient the pathways in anatomic planes. If more precise anatomic location is required, it is necessary to use radio-emitting external markers to identify the body landmarks.

The following case study shows how lymphoscintigraphy can refine diagnoses and improve lymphedema treatment. It illustrates how the functional information gained from lymphoscintigraphy can alter the relevance of findings on conventional imaging. Structures that appear intact on imaging, like MRI, may prove to be functionally incompetent. Physiological tests, like lymphoscintigraphy, may provide little information about structure. That is not their purpose. Rather, they allow us to make inferences about how systems function and to identify where functional integrity breaks down.

The patient was a 54-year-old woman with a history of bilateral breast cancer who presented with a two-month history of increasing right neck pain and arm swelling. She had undergone bilateral mastectomies and Level I & II axillary lymph node dissections, but was felt only to require radiation to her right axillary and supraclavicular lymph nodes. Despite persistent use of a Class I compression sleeve, her right arm volume steadily increased. Physical examination revealed trigger points and taut bands throughout the right cervical musculature, fullness at the right neck base, no neurological deficits, and a 36% limb volume increase. The patient was tentatively diagnosed with a muscle strain/sprain attributed to the increasing weight of her arm. Treatment consisted of analgesics, myofascial release and the initiation of phase I complete decongestive therapy (CDT).

The patient’s neck pain worsened, despite a 21% reduction in arm volume over the following two weeks. Her therapist noted a steady increase in right supraclavicular swelling that appeared correlated with the degree of volume reduction. Given her history and persistent neck pain, an MRI was obtained to evaluate her right neck. The study was read as normal. Therefore, therapy was continued with slight technical modifications and the initiation of opioid analgesics.

Despite a greater than 55% volume reduction, her pain and supraclavicular swelling worsened. Two months after starting CDT, lymphoscintigraphy of the right arm was performed to assess her pain and neck swelling. Images (Figure 1) showed normal tracer movement without appreciable abnormalities. Therefore, a second lymphoscintigraphy was performed with tracer injected into her scalp to evaluate her cervical and supraclavicular lymphocele. A discrete blockage was apparent at the right neck base with overflow of lymph from the head and scalp into the supraclavicular soft tissue and upper extremity (Figure 2).

The patient’s cervical MRI was then carefully reviewed. A previously noted focus of mild enhancement at the neck base gained greater significance. It was thought to represent a discrete area of radiation fibrosis. After non-invasive measures failed to reduce the patient’s fibrosis, she elected to undergo surgical exploration. Several supraclavicular fibrotic bands were identified and lysed. Post-operatively, the patient reported a 60% decrement in her pain and reduced neck swelling.

This case illustrates how findings initially dismissed as insignificant on high-resolution images can acquire greater significance in light of the information provided by clinical evaluation and functional testing.


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