Lymphedema is a type of swelling that is caused by damage to the lymph transport system. Lymphedema can co-exist alongside other causes of swelling, such as cardiac disease (congestive heart failure), venous disease (valve damage or deep blood clots), fat disorders (lipedema), endocrine disease (hypothyroidism), and protein abnormalities (liver disease). These forms of edema can also mimic lymphedema. It is important to diagnose the cause of swelling as some non-lymphedema forms of swelling can be reversed by medical or surgical means. Radionuclide lymphoscintigraphy (RNL) is an important tool in sorting out the cause of edema. In patients with lymphedema, RNL can also be useful in guiding treatment decisions.

Radionuclide lymphoscintigraphy is a procedure that images lymph vessels and lymph nodes. RNL provides evaluation of the pathways by which the body clears proteins via lymphatic transport from the interstitial space and returns them to the central venous circulation. It also provides information on the efficiency and timing of this lymph transport.

Typical abnormalities of the lymph system seen on RNL are: delayed lymph flow, collateral lymph vessels, dilated lymph vessels, dermal backflow, delayed or poor uptake in expected regional lymph nodes, fewer lymph nodes in the expected area, increased uptake in accessory lymph nodes, or no visualization of lymph vessels and nodes. RNL can demonstrate both the efficiency and elapsed time for protein to be cleared from the interstitium; how and if it is cleared by the lymphatic vessels, reaches the lymph nodes, and ultimately is returned to the central venous circulation. The impact of lymph node or lymph vessel surgery on patterns of RNL is not yet established. However, RNL can predict the severity of lymphedema and the success of Complete Decongestive Therapy (CDT) [1,4]. In certain lymphatic disorders as noted by RNL imaging, treatment by standard CDT may not be as effective. In these situations the goal of lymphedema management can be directed to accepting a less than optimal volume reduction if the patient is functioning well without complications such as cellulitis. In such cases alternative means of treatment, such as pneumatic compression, may be considered earlier.

An abnormal RNL prior to lymphedema treatment indicates that lymph vessels and or nodes are damaged and not functioning properly. Research has shown that abnormal RNL images do not typically change after successful lymphedema treatment, regardless of the type of treatment rendered. [Lymphovenous surgery to correct lymphedema (Vaqueiro), IPC (intermittent pneumatic compression), MLD (manual lymph drainage) (Miranda, Kafejian-Haddad)]. Therefore, RNL is not a good way to follow the effectiveness of lymphedema treatment. Volume measurements, functional limb use scales, and improvement in skin texture are better ways to follow the success of lymphedema treatment.

Hwang showed that physical examination is not a good predictor of successful CDT. In another study, Pecking demonstrated that RNL was superior to physical examination in predicting the severity of lymphatic abnormalities and response to CDT. The presence of a main lymphatic channel without collaterals, as visualized with RNL, was a very good predictor of successful CDT. A normal RNL does not necessarily exclude early lymphedema, but indicates that there are good, functioning lymphatic vessels present. Conversely, an abnormal RNL, demonstrating the presence of collateral lymphatics, with or without a functioning main channel, or dermal backflow, indicates that significant damage has already occurred to the lymphatic vessels, predicting a poor response to CDT.

RNL requires that an experienced nuclear medicine radiologist perform the procedure. The radiologist must be familiar with the patterns of RNL abnormality. Attention must be paid to the location of the injection, the size of the colloid, temperature and muscle contraction.

The following case study provides an illustration: A 42 year old woman presented to our clinic with swelling in her dominant right hand 6 years after undergoing right lumpectomy and axillary node dissection for breast cancer. Nine of twenty lymph nodes were positive. She underwent chemotherapy and radiation therapy. She had early onset lymphedema managed by a certified lymphedema therapist. She was fitted with a compression sleeve and glove worn for about a year. The lymphedema resolved and she was free of swelling without garments for 5 years during which time she was cancer free.

She was seen in our clinic 5 days after awakening with dramatic right hand edema that progressed to the forearm. There was no trauma, cellulitis or obvious cause. She tried wearing her old garments. She rested, elevated the arm and had...
slight improvement. As she used her arm more, the edema worsened and she experienced pain. On examination the right arm was dramatically swollen with a positive Stemmer sign at the MCP joints (knuckles). The hand and forearm had 2+ dough-like pitting. She had difficulty making a fist or using her fingers. Color, pulse, sensation and strength were normal. There was no chest edema, mass or axillary node enlargement. Doppler US was negative for DVT. PET-CT was negative for cancer. The patient’s job required repetitive hand use. Therefore, she was taken off work on temporary disability and referred to a certified lymphedema therapist.

Initial evaluation by the certified lymphedema therapist showed right upper extremity (RUE) volume 2356 ml and left upper extremity (LUE) volume 2197 ml by tape measurements every 5 cm, using the truncated cone calculation, representing a 7% inter-limb volume difference. The patient completed 4 weeks of CDT. She returned to the MD Lymphedema Clinic having completed Phase I CDT, with minimal to no improvement in her symptoms or function. Measurements at the completion of CDT showed a loss of approximately 150 ml in the right arm. She was following Phase II home maintenance program with self MLD twice daily bid, Lymphatic exercises bid, wearing compression class 2 custom sleeve and glove during the day, and short stretch bandaging with standard technique at night. She was attempting to work part-time but was unable to adequately perform the duties of her job due to persistent pain, stiffness in the MCP joints, and impaired fine motor function.

Examination revealed a tearful woman with significant persistent lymphedema of the right arm and hand. There was negligible visual size reduction in the hand compared to previous examination. She still had a positive Stemmer sign, induration and pitting in the hand and forearm. Six weeks of intensive CDT and home management had not provided resolution. She was unable to perform her job duties so temporary disability from work was continued and long term disability was considered. She was referred to a psychologist for counseling. A RNL study was ordered for evaluation of severity of lymphatic injury and prognostication.

The RNL study was performed with technetium filtered sulfur colloid, injected intradermally and subcutaneously in the dorsum of both hands. The left upper extremity showed rapid clearance with immediate visualization of a normal, single, large deep lymphatic channel and normal lymph node uptake in the left axilla. The right upper extremity had no visualization of the deep lymphatics or axillary nodes at 6 hours of elapsed time.

The patient was informed of the severity of lymphatic injury to the right arm. She was counseled regarding the requirement for permanent job modifications and more intensive long term self management, with expectation that the lymphedema was unlikely to return to prior latent status. She was informed that further CDT could not be expected to produce more volume reduction. Lifelong diligent home management would be necessary. She was referred back to her certified lymphedema therapist for a short course of treatment with goals now directed to a more manageable home and work regimen and prevention of progression. She started using elastic taping on the hand at work, wore a glove at home, and was fitted for a padded night garment to eliminate bandaging. She was placed on a gradually increasing fitness program in garments and lost 15 pounds. Permanent restrictions for her job were given including periodic breaks from repetitive arm and hand tasks, and the rotation of job duties as needed. The employer was informed of the scan results and was able to better understand and comply with the restrictions.

At follow up 2 years later, she continued a home regimen of sleeve daily, glove as needed, night garment, self MLD and exercise regimen of Pilates, running and light weights. Right UE volume remained at 2200 ml (unchanged from one year earlier in spite of her weight loss). Left UE volume was 2075 ml with 6% inter-limb volume difference (no significant change from initial presentation at onset). She was working full time with modifications. She had had no episodes of cellulitis. Examination showed persistent hand lymphedema unchanged visually with positive Stemmer sign and tension on the MCPs when making a fist. The patient reported satisfaction with the outcome as she is able to pursue her job without discomfort with current modifications. She was able to manage her home activities and enjoy avocational activities. She was not interested in any additional management tools or therapy having no significant limitations imposed on her function and ability to work.

Summary RNL Pros and Cons:

Lymphoscintigraphy Pros:
• Predicts response to treatment;
• Predicts severity of lymphatic injury to assist in determining goals of treatment, as opposed to the inaccuracy of clinical assessment alone;
• Cost effective in directing treatment to effective and timely courses of treatment;
• Assists patients in making vocational and life adjustment decisions.

Lymphoscintigraphy Cons:
• Availability limited to major medical centers;
• Accuracy of technique and reading of scans is variable;
• Few radiologists are experts in performing and reading RNL;
• Does not show changes after effective treatment, so is not an optimal way to follow effectiveness of treatment.

References: