Intradermal Lymphoscintigraphy: Technical Improvement and an Interpretation of the Pathological Patterns on Clinical Management of Severe Stage Lymphoedema.

Girolamo Tartaglione, MD
Department of Nuclear Medicine, Cristo Re Hospital, Rome, Italy

21st International Congress of Lymphology
September 26-29, 2007 Shanghai, China

The Lymphatic System - The Skin

• The skin’s lymphatic system consists of complex Lymphatic capillary networks; they are abundant in the dermis
• The lymphatic capillaries are without valves.
• The epidermis and subcutaneous tissue are without lymph capillaries.

Background

• The validation of the sentinel node concept in oncology has led to the rediscovery of lymphoscintigraphy.
• The new interest has led to a discussion about methodological aspects such as tracer characteristic or administration routes.
• Both Subcutaneous (SC) and Intradermal (ID) injections are used in lymphoscintigraphic routine studies of superficial lymphatics of the extremity.

The Lymphatic System - The Skin

• The Lymphatic Capillaries form in the dermis superficial and deep plexuses. The superficial are of smaller caliber than the deep ones. The caliber varies greatly in a given plexus from a few micromillimeters to one millimeter.
• The lymphatic capillary plexuses vary greatly in form; the anastomoses are usually numerous; blind ends are especially common in the dermal papillae.
Purpose and Hypothesis

- **Injecting ID**, normally we can observe the lymph drainage pathways of the epifascial lymphatic compartment until the first lymph node basin in less than 10 minutes.
- In patients with lymphedema a delayed lymph drainage and a wide variety of lymphatic abnormalities can be displayed.
- We identified 4 different scintigraphic patterns related to lymphedema from Clinical Stages 1-3 and we propose their impact on clinical management.

Radiocolloids Injection Technique . 1

- We advise *superficial parallel injections at the first interdigital area, on the top of the feet.*

Radiocolloids Injection Technique . 2

- The needle was introduced ID at an angle about 1-2 mm under the skin’s surface, where the lymphatic capillary networks provide a large surface area for uptake and a faster visualization of the lymphatic pathways.

Radiocolloids Injection Technique . 3

- If *deeper* injections are performed, the timing of the lymphoscintigraphy will be longer, whereas the blood accumulation rate, the background, the bladder and liver uptake will increase.
Lymph Transport Concept

- Interstitial fluid pressure in the skin is **slightly negative**, whereas lymphatic capillary pressure in the skin is **positive**, thus suggesting the lymph transport into the initial lymphatics occurs **against a low pressure gradient**.
- A current theory proposes the presence of a **suction force** that is generated through the contraction of collecting lymphatics, coupled with increases in interstitial fluid pressure created through muscle contraction and arterial pulsation.
- An increase in pressure applied to an enclosed fluid is transmitted undiminished to every part of the fluid, as well as to the walls of the container (**Pascal's Law**).


Material and Methods

- **63 patients** affected by **lymphoedema on clinical stages 1-3** were enrolled.
- Radiopharmaceutical: **99mTc-Nanocoll** (*human serum albumin colloidal, the particles have an optimal diameter <80 nm*)
- Dose: **74-100 MBq, diluted in 0.3 mL**
- **Advice**: Elastic and tight clothes should be removed before injections!

Image Acquisition Protocol

- **Imaging**: starts **immediately** after injections.
- **Collimator**: LEGP
- **Energy Window**: **20%** window centered at 140 KeV
- **Pixel Matrix Acquisition**: **128x128**
- **View**: **Anterior**
- **Acquisition**: **Dynamic and Static** images were acquired until first lymph node appearance.
- **Time of Arrival**: **TA** is defined as the time in mins. from the injections to appearance of the first lymph node basin.
- If lymph drainage was delayed we recommended that the patient **walked or exercised** for a few minutes.

**Normal Pattern**

- Normally we can observe the lymph drainage pathways of epifascial compartment (along the great saphena) until the groin’s lymph nodes in **less than 10 mins**.
Legs Lymphedema on Clinical Stage 1

Pattern 1: Delayed lymph drainage

Left Upper Limb Lymphedema on Clinical Stage 2

Pattern 2: Diversion and Obstruction of lymph way

Left Leg Lymphedema on Clinical Stage 2

Pattern 2: Diversion and/or Obstruction of lymph way

Right Leg Lymphedema on Clinical Stage 2

Pattern 2: Diversion and/or Obstruction of lymph way
Left Leg Lymphedema on Clinical Stage 2

Pattern 2: Diversion and/or Obstruction of lymph way

Right Leg Lymphedema Secondary to Groin's Lymphadenectomy on Clinical Stage 2. Prostate Cancer

Pattern 2: Diversion and/or Obstruction of lymph way

Right Leg Lymphedema on Clinical Stage 3

Pattern 3: Dermal Backflow

Legs Lymphedema on Clinical Stage 2

6 MONTHS LATER
The same Patient after pressotherapy, vascular rehabilitation and manual lymph drainage

Pattern 3: Dermal Backflow
Right Leg Lymphedema Secondary to Groin’s Lymphadenectomy on Clinical Stage 3. Cervical Cancer

Pattern 3: Dermal Backflow

- In the presence of a severe obstruction of deep lymph way, probably the pressure gradient increases over a threshold value, causing an incompetence of the valves and an inversion of lymph flow toward the superficial lymphatic networks.

Right Upper Leg Congenital Precox Lymphedema on Clinical Stage 3

Pattern 4: Failure of lymph drainage

Results

- **Pattern 1**: a normal lymph pathway, with a delayed drainage, in 8 pts. TA: 10-30 mins.
- **Pattern 2**: a diversion of lymph path and/or an incomplete obstruction with spontaneous collaterals, in 38 pts. TA: <30 mins.
- **Pattern 3**: a lack of a tract of deep lymph way with an inversion of lymph flow toward superficial lymphatic networks, Dermal Backflow, in 15 pts. TA: 30-60 mins.
- **Pattern 4**: a failure of lymph drainage, in 2 pts. with congenital lymphedema, TA: not applicable.
Conclusions

• In our experience, Intradermal Injections provide a clear image of lymphatic flow and of its pathways.
• The patients with delayed lymph drainage or with spontaneous collaterals gave best results after pressoterapy, vascular rehabilitation and manual lymph drainage.
• The patients with a lymph way obstruction without suitable collaterals, should be treated with a microsurgical approach.

Case Report

• The patient with a Right Upper Leg Congenital Precox Lymphedema reported an interesting anamnesis, that could open new fields of research:

Female, 22 ys., She said: ...when I was a child, I had the chickenpox disease. I was very happy because, during all the disease, about 1 month, my right arm was completely normal!...

Chickenpox is the common name for Varicella Zoster, classically one of the childhood infectious diseases caught and survived by almost every child.

Thank you for your attention!

E-mail: nmcrh@hotmail.com