Journal of Plastic, Reconstructive & Aesthetic Surgery (2015) 68, 419—427

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Lymphatic anatomy of the inguinal region in aid of vascularized lymph node flap harvesting☆

Mario F. Scaglioni, Hiroo Suami*

Department of Plastic and Reconstructive Surgery, The University of Texas MD Anderson Cancer Center, Houston, TX, USA

Received 27 June 2014; accepted 31 October 2014

KEYWORDS
Vascularized lymph node transfer;
Lymphatic system;
Lymphedema;
Sentinel lymph node;
Indocyanine green fluorescence lymphography;
Inguinal lymph nodes

Summary *Background:* Vascularized lymph node transfer (VLNT) has shown promise as a treatment for breast cancer—related lymphedema, a common and debilitating condition among breast cancer survivors. In VLNT, the most popular lymph node flap donor site is the inguinal region; however, concerns about the possibility of iatrogenic lymphedema hamper the widespread adoption of VLNT. A better understanding of the anatomy of the lymphatic system in the inguinal region is essential to preserving lymph drainage in the leg and avoiding iatrogenic lymphedema.
Methods: Five human cadaver hind-quarter specimens were used for this study. First, the specimens were scanned with indocyanine green fluorescence lymphography to map the lymphatic vessels. A dual injection technique using different radiocontrast media was then applied to delineate arteries and lymphatic vessels on radiographs. Finally, radiological analysis and meticulous dissection were used to investigate relationships between the arteries and lymphatic vessels.
Results: By chasing the lymphatic vessels retrogradely from their corresponding lymph nodes, we were able to divide the superficial inguinal lymph nodes into three subgroups: the abdominal, medial thigh, and lateral thigh nodes. We found no connections between the superficial and deep lymphatic system in the inguinal region. The dominant lymph nodes draining the leg were in the lower part of the inguinal triangle, and their efferent lymphatic vessels ran medial to the common femoral artery.

☆ Presented in part at the 3rd International Symposium on Lymphedema Surgical Treatment, Barcelona, Spain, March 5, 2014; Presented in part at the 10th Australasian Lymphology Association Conference, Auckland, New Zealand, from April 3—5, 2014.

* Corresponding author. Department of Plastic Surgery, Unit 1488, The University of Texas MD Anderson Cancer Center, 1515 Holcombe Blvd. Houston, TX 77030, USA. Tel.: +1 713 794 1247; fax: +1 713 794 5492.
E-mail address: HSuami@mdanderson.org (H. Suami).

http://dx.doi.org/10.1016/j.bjps.2014.10.047

Conclusions: Preserving the sentinel nodes of the lower leg in the medial thigh and their efferent lymphatic vessels is crucial to avoid iatrogenic lymphedema in limbs with donor sites for VLNT.

Introduction

Lymphedema is a chronic, progressive, debilitating condition, affecting up to 250 million people worldwide. In developed countries, cancer treatments are the major cause of lymphedema.[1–4] Breast cancer–related lymphedema (BCRL) is a well-known common issue among breast cancer survivors; axillary lymph node dissection (Odds ratio (OR) 1.3–6.7), chemotherapy (OR 1.6–2.0), and irradiation (OR 1.7–3.8) increase its risk.[5] The standard treatment for lymphedema is decongestive therapy consisting of exercise, compression garment use, skin care, and manual lymph drainage. However, lymphedema that is resistant to the standard treatment requires surgery, which is a challenging task. Although several surgical modalities for addressing lymphedema have been introduced, none offers a definitive cure.

Vascularized lymph node transfer (VLNT) has been gaining popularity as a prospective promising option for the surgical treatment of lymphedema since Becker et al. reported its outcomes for patients with BCRL.[6] In VLNT, free flaps that includes lymph nodes are transferred to the regions where lymph nodes have been removed for cancer treatment[7,8] or to the distal parts of lymphedematous limbs[9,10] to restore lymphatic drainage. Donor sites for VLNT have included the inguinal,[6–10] lateral thoracic,[11] submental,[12] and supraclavicular regions.[13] The most popular VLNT donor site in patients with BCRL is the inguinal region because its lymph node flap can be combined with abdominal flaps to simultaneously accomplish delayed autologous breast reconstruction and VLNT.[6,7]

One major concern regarding the harvest of inguinal lymph nodes for VLNT is the possibility of causing iatrogenic lymphedema in the donor limb. Becker et al. stressed that the superficial inguinal lymph nodes located along the superficial circumflex iliac vein drain lymph fluid mainly from the abdominal wall and that their procurement did not impair lymph drainage of the lower limb.[11] Viitanen et al. used circumferential measurement and quantitative lymphoscintigraphy to assess lymphatic function in the donor lower extremities and found that although no patients developed symptoms of postoperative lymphedema, lymphatic transport function was often impaired in the donor limb.[14] Pons et al. reported a case of irreversible iatrogenic lymphedema associated with VLNT and advised surgeons to take precautions to prevent iatrogenic lymphedema.[15]

Current knowledge about the anatomy of the lymphatic system is largely based on anatomy atlases depicting lymphatic vessels that were detected using mercury injection method.[16–18] Detailed anatomic knowledge of the lymphatic system is crucial to avoid donor site lymphedema following flap harvest for VLNT. Some studies have already provided useful anatomic information about the inguinal lymph nodes targeted for VLNT: Dayan et al. used magnetic resonance angiography to identify the number of inguinal lymph nodes and their location relative to anatomical landmarks,[19] and Zhang et al. performed a similar study using computed tomography angiography.[20] However, no studies have described the lymphatic vessels that connect nodes or the direction of lymphatic drainage, two important factors that must be considered to preserve lower extremity lymph drainage. To demonstrate the lymphatic system radiographically, Kinmonth developed a lymphangiography technique that included cannulation directly into the lymphatic vessel at the dorsal foot and injection of contrast medium into the vessel to demonstrate

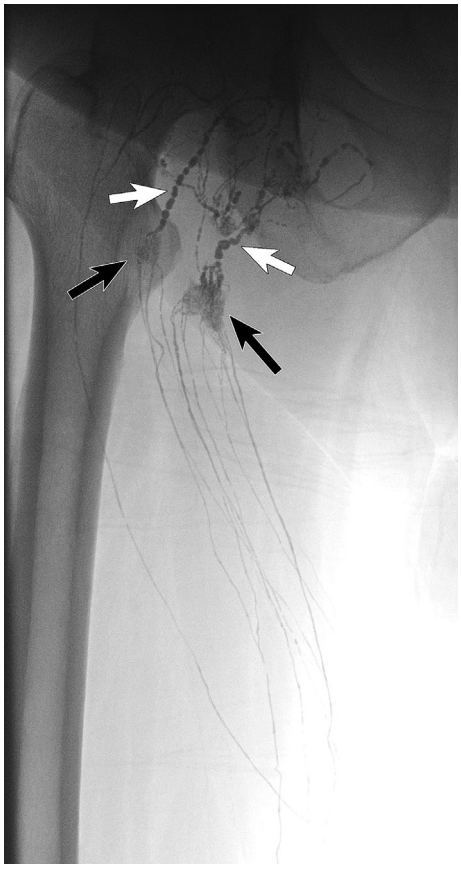

Figure 1 Lymphangiogram of the normal right lower extremity. Sentinel lymph nodes of the lower leg (black arrows) and their efferent lymphatic vessels (white arrows) are shown.