

## The Mechanism of Vascularized Lymph Node Transfer for Lymphedema: Natural Lymphaticovenous Drainage

Ming-Huei Cheng, M.D.,  
M.B.A.

Jung-Ju Huang, M.D.

Chih-Wei Wu, M.D.

Chin-Yu Yang, M.Sc.

Chia-Yu Lin, M.Sc.

Steven L. Henry, M.D.

Leila Kolios, M.D.

Taoyuan, Taiwan; Austin, Texas;  
and Ludwigshafen, and Heidelberg,  
Germany



**Background:** Vascularized lymph node flap transfer for the treatment of upper and lower limb lymphedema has had promising results. This study was performed to investigate the mechanism of lymph drainage of a vascularized lymph node flap both experimentally and clinically.

**Methods:** In the experimental study, 18 Sprague-Dawley rats were used to create 36 flaps, either a groin lymph node flap or an abdominal cutaneous flap that did not contain lymph nodes. Indocyanine green dye was injected into the edge of 12 lymph node flaps, directly into a lymph node of 12 lymph node flaps, and into the edge of 12 cutaneous flaps. In the clinical study, an identical study design was used, with 24 vascularized lymph node flaps and 12 cutaneous flaps not containing lymph nodes.

**Results:** Experimentally, fluorescence was detected in the pedicle vein after a mean latency period of  $153 \pm 129$  seconds when the edge of the lymph node flap was injected and  $12.8 \pm 8.1$  seconds when the lymph node was directly injected. Fluorescence was not detected in the pedicle vein of the cutaneous flaps ( $p < 0.01$ ). Clinically, fluorescence was detected in the pedicle vein after a mean latency period of  $346 \pm 249$  seconds when the edge of the lymph node flap was injected and  $23.5 \pm 27.1$  seconds when the lymph node was directly injected. Fluorescence was not detected in the pedicle vein of the cutaneous flaps ( $p < 0.01$ ).

**Conclusion:** The vascularized lymph node flap drains lymph into the pedicle vein, both experimentally and clinically. (*Plast. Reconstr. Surg.* 133: 192e, 2014.)

**CLINICAL QUESTION/LEVEL OF EVIDENCE:** Therapeutic, V.

Lymphedema of the upper extremity is mostly a sequela of breast cancer treatment with mastectomy and radiation,<sup>1,2</sup> and thus is often referred to as breast cancer–related lymphedema. It is a morbidity that affects an estimated 6 to 30 percent of survivors<sup>3,4</sup> and has a severe impact on quality of life, as it interferes with most activities of daily living.<sup>5</sup> Risk factors include greater number of lymph nodes removed, larger size of primary tumor, exposure to multifield radiation, higher body mass index, and upper outer quadrant tumor

site.<sup>6</sup> Lower extremity lymphedema is a side effect of pelvic surgery and radiotherapy for patients with uterine corpus and endometrial malignancies, and the incidence increases with the number of regional lymph nodes removed.<sup>7–9</sup>

As survivorship of these cancers increases, more clinicians are committed to awareness of these associated sequelae. Several surgical approaches have been introduced, including lymphaticovenous bypass<sup>10–20</sup>; attempts to reduce soft-tissue volume, such as liposuction,<sup>21–23</sup> partial excision, and the Charles procedure<sup>24–27</sup>; local latissimus dorsi myocutaneous flap transfer to the axilla<sup>5,28,29</sup>; free omental flap or abdominal flap transfer with or without lymph nodes to the axilla<sup>26,29–32</sup>; and vascularized groin lymph node transfer.<sup>33–36</sup> In 2009, Cheng et al.'s group reported

From the Division of Reconstructive Microsurgery, Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Chang Gung University, College of Medicine; Seton Institute of Reconstructive Plastic Surgery; Department of Hand and Plastic and Reconstructive Surgery, Burn Center, BG Trauma Center; and Department of Plastic Surgery, University of Heidelberg.

Received for publication June 27, 2013; accepted August 23, 2013.

Copyright © 2014 by the American Society of Plastic Surgeons

DOI: 10.1097/01.prs.0000437257.78327.5b

**Disclosure:** The authors have no financial interest in the products or procedures mentioned in this article.