

Lymph Node Flap Based on the Right Transverse Cervical Artery as a Donor Site for Lymph Node Transfer

Stamatis Sapountzis, MD, Dhruv Singhal, MD, Abid Rashid, MD, Pedro Ciudad, MD, Domenico Meo, MD, and Hung-Chi Chen, MD, MHA, FACS

Abstract: Lymph node transfer is a novel technique in lymphedema surgery. In this study, we present our experience in harvesting lymph nodes flap based on the right transverse cervical artery. In a period of 7 months, we harvested 11 cervical lymph node flaps based on the right transverse cervical artery (TCA). The reliable anatomy of the TCA and the low complication rate of the donor site make this lymph node flap ideal for transfer in the treatment of lymphedema. Knowledge of the regional anatomy and the anatomic variations of the TCA are mandatory for safe dissection of this flap. We also present the preliminary results of our first 2 cases in which we performed cervical lymph node transfer for secondary lower extremity lymphedema.

Key Words: lymph node transfer, lymphedema

(*Ann Plast Surg* 2014;73: 398–401)

Lymphedema is a chronic, progressive, and often debilitating condition. It can be either primary, as the result of lymphatic malformation, or secondary, due to obstruction or disruption of the lymphatic system. Secondary cases can occur as a consequence of tumors, surgery, trauma, infection, inflammation, or radiation therapy.¹ Few surgical options for lymphedema have achieved satisfactory long-term results. Among previously described methods, the microvascular lymph node transfer seems to be the most promising and appears to provide significant improvement especially in early-stage lymphedema. While the most common source of lymph nodes is the inguinal area, alternative harvest sites have been described including the submental lymph nodes or lymph nodes based on the lateral thoracic artery.^{2–7}

In our review of the literature, no prior description of harvesting cervical lymph nodes as a donor site for lymph node transfer in lymphedema was found. Below, we present our experience harvesting a novel lymph node flap based on the right transverse cervical artery (TCA), focusing on technical details. In addition, we present the preliminary results of our first 2 cases in which we performed cervical lymph node transfer for secondary lower extremity lymphedema.

PATIENTS AND METHODS

In a period of 7 months, we harvested 11 lymph node flaps based on the right transverse cervical artery for the treatment of lower extremity lymphedema. The preliminary results of our first 2 cases with early-stage lymphedema are also presented, as their follow-up is 7 and 6 months, respectively, and the postoperative

results are considered reliable. The first patient was a 48-year-old woman with a 7-month history of secondary lymphedema of the right lower limb after ablative surgery for cervical cancer and groin lymph node dissection performed 1.5 years ago. The second patient was a 54-year-old woman with an 8-month history of left lower limb lymphedema following melanoma excision of the right sole and ipsilateral groin lymph node dissection performed 10 months ago. Both patients presented with stage I lymphedema according to the criteria of the International Society of Lymphology.¹¹ Preoperative and postoperative lymphoscintigraphy with technetium 99m was performed in both patients.

Surgical Procedure

In all cases, we harvested the cervical lymph node flap from the right side of the neck in order to avoid potential traumatic injury to the main lymphatic duct on the contralateral side. The anatomical landmarks of the flap are those of the posterior triangle of the neck and include the clavicle inferiorly, the sternocleidomastoid muscle anteriorly, the trapezius muscle posteriorly, and the external jugular vein. A 4-cm “S”-shaped incision is marked 1.5 cm above the clavicle (Fig. 1). Following incision, subplatysmal flaps are raised to the previously described anatomical landmarks. Particular care is taken to identify the external jugular vein (EJV) early in order to avoid injury to the vessel. Once all 4 anatomic landmarks are visible, the dissection progresses at the lateral border of the sternocleidomastoid muscle. A deep dissection is carried out to identify the omohyoid muscle. The omohyoid muscle is isolated and reflected cephalad. The dissection is then continued deep to the muscle until the transverse cervical artery is visualized. The transverse cervical artery can arise from either as a branch of the thyrocervical trunk or directly from the subclavian artery in a minority of cases (17%).⁸ The artery runs posterolateral toward the trapezius muscle, beneath the omohyoid muscle, and superficial to the anterior scalene muscle and the brachial plexus within the fibrofatty tissue of the supraclavicular fossa. After identification of the TCA and its accompanying vein (TCV), the dissection progresses laterally in a plane above the anterior scalene muscle towards the trapezius muscle. A careful dissection will ensure that the artery is not separated from the overlying fibrofatty tissue which includes the lymph nodes. The superficial cervical vein (SCV) is also included with the flap and its location is constant and present posterolateral and superficial to the TCA. The EJV is included in the flap and ligated proximally and distally. The inclusion of the EJV in the flap is important in order to avoid venous congestion. Of note, a prominent cutaneous sensory nerve can traverse the fibrofatty tissue being harvested. Most often, the nerve can be preserved by sacrificing the superficial tissue as the majority of the lymph nodes are deeper. However, in certain cases, a lymph node can be identified in the superficial tissue. While sacrifice of a superficial lymph node is acceptable, the node can be included in the flap by dividing and re-anastomosing the nerve. We believe that primary repair will result in faster recovery of sensation. Suction drain is placed in the donor area and final skin closure is performed.

In all our cases, 1 arterial and 2 venous anastomoses were performed. The arterial anastomosis was uniformly performed to the

Received September 29, 2012, and accepted for publication, after revision, November 25, 2012.

From the Department of Plastic Surgery, China Medical University Hospital, Taichung, Taiwan.

Conflicts of interest and sources of funding: none declared.

Reprints: Hung-Chi Chen, MD, MHA, FACS, Department of Plastic Surgery, China Medical University Hospital/China Medical University, 2, Yuh-der Road, Taichung, Taiwan. E-mail: D19722@mail.cmuh.org.tw.

Copyright © 2013 by Lippincott Williams & Wilkins

ISSN: 0148-7043/14/7304-0398

DOI: 10.1097/SAP.0b013e31827fb39e



FIGURE 1. The anatomical landmarks of the flap are the clavicle inferiorly, the sternocleidomastoid muscle anteriorly, the trapezius muscle posteriorly, and the external jugular vein. A 4-cm “S”-shaped incision is also marked 1.5 cm above the clavicle.

TCA. For the venous anastomosis, the EJV was always utilized. The second venous anastomosis was performed to the SCV or TCV (Figs. 2 and 3).

In the presented 2 clinical cases, the lymph node flap was grafted to the dorsum of the foot. The arterial anastomosis was performed to the dorsalis pedis artery. The 2 venous anastomosis were performed to the concomitant vein and to a superficial vein of the dorsum of the foot. A local flap was raised in order to cover part of the flap and the remaining defect was covered by split-thickness skin graft. Wet dressing was applied to avoid pressure to the flap and the anastomosis.

RESULTS

In 11 cases where we harvested cervical lymph node flap, the postoperative course was uneventful apart from 1 case in which lymphorrhea occurred. However, this was self-limited and resolved after 3 days. During the follow-up period, no donor-site complication was noted including hematoma, infection, or seroma formation. The suction drain was removed on average the seventh postoperative day (ranged from 5 to 9 days).

In our presented 2 clinical cases, reduction of the circumference of the affected limb was noted. The reduction for the first

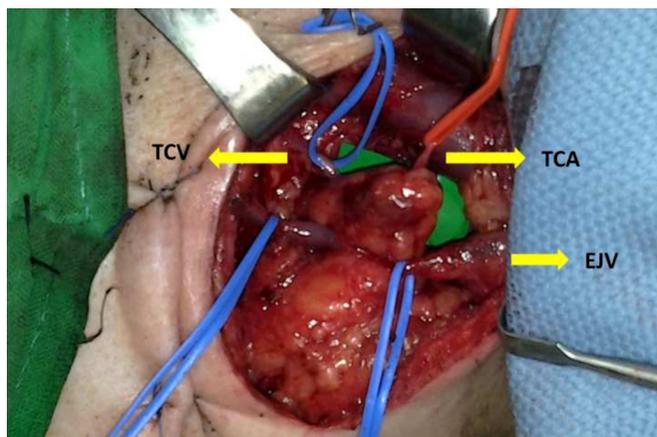


FIGURE 2. Intraoperative photo of harvesting the cervical lymph node flap. The yellow arrows indicate the external jugular vein (EJV), the transverse cervical artery (TCA), and the transverse cervical vein (TCV).



FIGURE 3. The cervical lymph node flap.

patient 7 months after the LNT was 3.6% above the knee, 11.1% below the knee, 16.7% at the level of the ankle, and 9.9% at the foot (Fig. 4). The improvement for the second patient 6 months after the LNT was 5.2% above the knee, 9.5% below the knee, 14.7% at the level of the ankle, and 8.2% at the foot. Postoperative lymphoscintigraphy showed improvement of the lymph flow in both patients (Fig. 5).

We should notice that the patients were mobilized on the seventh postoperative day and any conservative treatment for lymphedema was discontinued after the second postoperative month.

DISCUSSION

Surgeons performing this procedure must be aware of the anatomical variations of the transverse cervical artery. In anatomical studies, the TCA most often takes its origin from the thyrocervical trunk (80%) or directly from the subclavian artery (20%). There are also reports that the TCA may arise as a branch of the internal mammary artery.^{9,10}

The mean operating time for the flap harvests was 115 minutes. However, in those cases where the TCA arose from the subclavian artery, the harvest time was 30 to 45 minutes longer. In our series, the TCA was a branch of the thyrocervical trunk in 9 patients and arose directly from the subclavian artery in 2 patients. Of note, when the TCA arises directly from the subclavian artery, the dissection of the pedicle is more tedious as it must be performed deeper and adjacent to the clavicle and subclavian artery. In 2 cases, a lymph node was identified above the cutaneous sensory nerve. In both cases, the nerve was preserved by dividing and re-anastomosing the free ends. Overlying sensation was noted to be intact in both patients at 3 months' follow-up.

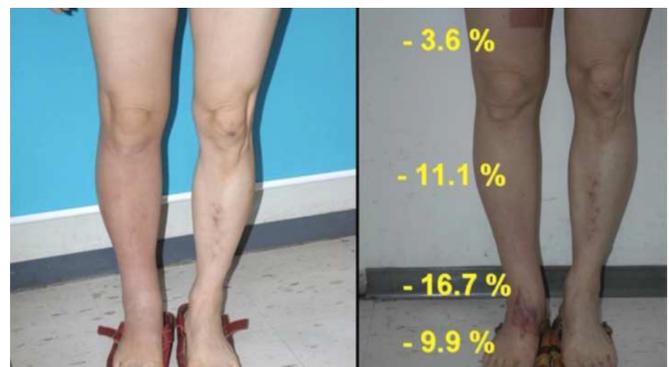


FIGURE 4. Preoperative and 7 months postoperative picture of the first patient who received cervical lymph node transfer.

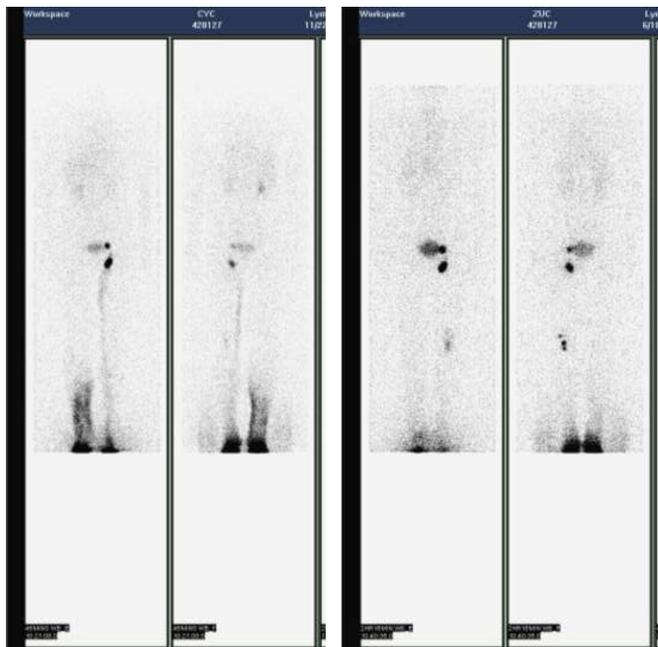


FIGURE 5. Preoperative and postoperative picture of the first patient's lymphoscintigraphy. Improvement of the lymph flow on the right affected limb is noted.

In 1990, Chen et al¹² investigated the efficacy of transferring vascularized lymph nodes into lymphoedematous limbs. Experimental studies showed that 3 to 6 months after vascularized lymph node transfer, the grafted lymph nodes have normal architecture. Furthermore, the circumference of the limb was reduced after transplantation, and postoperative lymphangiography demonstrated regeneration of the lymphatic system. In addition, the authors noticed that lymphaticolymphatic anastomosis to vascularized node transfer is neither necessary nor beneficial.

The spontaneous regeneration of lymphatic channels between the grafted lymph nodes and the surrounding tissues is the basic mechanism of lymph node transfer. The lymph is absorbed by the vascularized lymph nodes and drained to the venous system through the lymphaticovenous connections inside the flap. Cheng et al⁴ proved the lymph drainage via the transferred lymph nodes, injecting subdermally indocyanine green at the edge of the lymph node flap after the completion of the pedicle anastomosis. Ten minutes after the injection, the indocyanine green was visualized into the recipient vein, providing evidence of lymph drainage from the transferred lymph nodes inside the flap, through the donor vein, and into the recipient vein. In our cases performing 2 venous anastomoses, we attempted to maximize the drainage of the lymph into the deep and the superficial venous system.

Furthermore, the grafted lymph nodes contain macrophages and lymphocytes, which have the ability to capture, phagocytose, and destroy pathogens draining from sites of infection. This immunological mechanism of the lymph nodes can explain the reduction of the infection rate of the affected limb after lymph node transfer.

Becker et al³ analyzed the long-term results following microsurgical lymph node transplantation in postmastectomy upper extremity lymphedema. Upper limb perimeter returned to normal in 10 cases, decreased in 12 cases, and remained unchanged in 2 cases. Five of 16 (31%) isotopic lymphoscintigraphies demonstrated activity of the transplanted nodes. Physiotherapy was discontinued in 15 patients (62.5%). Ten patients were considered as cured,

important improvement was noted in 12 patients, and only 2 patients did not improve.

Lin et al⁶ evaluated the outcome of vascularized groin lymph node transfer using the wrist as a recipient site in patients with post-mastectomy upper extremity lymphedema. In 13 patients, the mean reduction rate ($50.55 \pm 19.26\%$) of the lymphoedematous limb was statistically significant between the preoperative and postoperative groups ($P < 0.01$). The incidence of cellulitis was decreased in 11 patients. Postoperative lymphoscintigraphy indicated improved lymph drainage of the affected arm, revealing decreased lymph stasis and rapid lymphatic clearance.

Gharb et al⁵ reported the outcome between vascularized lymph node transfer with hilar perforators compared with the conventional technique and concluded that the transfer of vascularized inguinal lymph nodes based on the hilar perforators improves the outcomes in the treatment of early lymphedema of the upper extremity.

Saaristo et al¹³ combined breast reconstruction with lymph node transfer in patients suffering from upper extremity lymphedema. Postoperative lymphoscintigraphy demonstrated at least some improvement in lymphatic vessel function in 5 of 6 patients with lymphedema. The upper limb perimeter decreased in 7 of 9 patients. Physiotherapy and compression was no longer needed in 3 of 9 patients.

Cheng et al⁴ reported also reduction of the leg circumference after transferring vascularized submental lymph nodes to the ankle.

While the most common source of lymph nodes is the inguinal area, the disadvantages of the groin lymph node flap are the small size of the vessels and the significant anatomic variations of the regional vascular anatomy. In addition, there is a potential risk of developing lymphedema on the donor site. Viltanen et al¹⁴ evaluated the long-term donor-site morbidity after inguinal lymph node transfer. Even though none of the patients developed lymphedema, in 6/10 patients postoperative lymphoscintigraphy revealed minor changes in lymphatic flow on the donor-site limbs and in 2/10 patients the semiquantitative evaluation of lymphatic drainage was considered slightly abnormal.

The advantages of the cervical lymph node flap are the following: (1) constant vascular anatomy and adequate size of the vessels making the dissection and the anastomosis not so tedious compared to the inguinal lymph node flap; (2) there is no potential risk of development lymphedema on the donor site; (3) of note, most of the times during the flap harvesting lymph nodes can be visualized due to their size, making the dissection more precise.

The main disadvantage of the cervical lymph node flap is the donor-site scar, which is not well hidden compared to the groin flap.

In the presented cases, the lymph nodes were transplanted on the dorsum of the foot. The advantages of this recipient site compared to the groin area and the popliteal fossa are as follows: (1) the area is not as scarred and fibrotic as the groin area after inguinal dissection and radiation; (2) 2 surgical teams can work simultaneously because additional change of patient's position is not required as it happens when the popliteal fossa is selected for recipient site; and (3) due to gravity the lymph is pooled in the lower part of leg, hence the grafted lymph nodes drain the lymph from the area with the most severe lymph stasis.

The partial coverage of the flap with split-thickness skin graft has also potential advantages and disadvantages. The flap without skin paddle is less bulky and the patients after short period of time are able to wear shoes without any effect on the grafted lymph nodes. On the other hand, using skin graft less surface of the flap gets in contact with the surrounding edematous tissue. Even though this seems to have no influence on the grafted lymph nodes, further investigations and long-term follow-up are needed.

The described lymph node flap is buried flap, as skin island is not included. However, the monitoring of the flap is not tedious, as its observation can be done through the skin graft. Furthermore,

the successful harvest of the skin graft ensures the survival of the underlying lymph node flap.

In conclusion, this study proposes a novel source for vascularized lymph nodes based on the transverse cervical artery. The reliable anatomy of the TCA and the low complication rate of the donor site make this lymph node flap ideal for transfer in the treatment of lymphedema. Especially in cases of bilateral lower limb lymphedema where the inguinal lymph nodes cannot be used, the cervical lymph nodes provide an excellent alternative. Knowledge of the regional anatomy and the anatomic variations of the TCA are mandatory for safe dissection of this flap. According to the preliminary results of our first 2 cases, the cervical lymph node transfer is able to improve the early-stage lymphedema.

REFERENCES

1. Murdaca G, Cagnati P, Gulli R, et al. Current views on diagnostic approach and treatment of lymphedema. *Am J Med.* 2012;125:134–140.
2. Becker C, Pham DN, Assouad J, et al. Postmastectomy neuropathic pain: results of microsurgical lymph nodes transplantation. *Breast.* 2008;17:472–476.
3. Becker C, Assouad J, Riquet M, et al. Postmastectomy lymphedema: long-term results following microsurgical lymph node transplantation. *Ann Surg.* 2006;243:313–315.
4. Cheng MH, Huang JJ, Nguyen DH, et al. A novel approach to the treatment of lower extremity lymphedema by transferring a vascularized submental lymph node flap to the ankle. *Gynecol Oncol.* 2012;126:93–98.
5. Gharb BB, Rampazzo A, Spanio di Spilimbergo S, et al. Vascularized lymph node transfer based on the hilar perforators improves the outcome in upper limb lymphedema. *Ann Plast Surg.* 2011;67:589–593.
6. Lin CH, Ali R, Chen SC, et al. Vascularized groin lymph node transfer using the wrist as a recipient site for management of postmastectomy upper extremity lymphedema. *Plast Reconstr Surg.* 2009;123:1265–1275.
7. Fanzio PM, Singhal D, Becker C. Combined radical excision and free microsurgical lymph node transfer for treatment of lower extremity lymphedema. *Eur J Plast Surg.* 2012;35:565–568.
8. Cordova A, D'Arpa S, Pirrello R, et al. Anatomic study on the transverse cervical vessels perforators in the lateral triangle of the neck and harvest of a new flap: the free supraclavicular transverse cervical artery perforator flap. *Surg Radiol Anat.* 2009;31:93–100.
9. Read WT, Trotter M. The origins of transverse cervical and of transverse scapular arteries in American Whites and Negroes. *Am J Phys Anthropol.* 1941;28:239–247.
10. Huelke DF. A study of the transverse cervical and dorsal scapular arteries. *Anat Rec.* 1958;132:233–245.
11. International Society of Lymphology. The diagnosis and treatment of peripheral lymphedema. 2009 Consensus Document of the International Society of Lymphology. *Lymphology.* 2009;42:51–60.
12. Chen HC, O'Brien BM, Rogers IW, et al. Lymph node transfer for the treatment of obstructive lymphoedema in the canine model. *Br J Plast Surg.* 1990;43:578–586.
13. Saaristo AM, Niemi TS, Viitanen TP, et al. Microvascular breast reconstruction and lymph node transfer for postmastectomy lymphedema patients. *Ann Surg.* 2012;255:468–473.
14. Viitanen TP, Mäki MT, Seppänen MP, et al. Donor-site lymphatic function after microvascular lymph node transfer. *Plast Reconstr Surg.* 2012;130:1246–1253.