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Reconstructive

A Novel Technique for Preventive Lymphovenous Anastomosis: Anastomosing a Ligated Lymphatic Vessel

Bernard Depypere, MD
Tom Vyncke, MD
Nicolas Dhooghe, MD
Karel Claes, MD
Phillip Blondeel, MD, PhD
Koenraad Van Landuyt, MD, PhD

Background: Lymphedema is defined as a chronic condition, caused by lymphostasis. A major part in the Western world consists of iatrogenic lymphedema caused by surgery to the lymph nodes of the axilla or groin. Prophylactic lymphovenous anastomosis (LVA) could be beneficial in the prevention of lymphedema of the extremities. These procedures require experienced supramicrosurgeons and can be time consuming, which might be the reasons why prophylactic LVA has not yet been widely implemented in the treatment of cancer. Due to the small diameter of lymphatic vessels, it remains challenging to identify the lumen, and therefore, anastomoses are prone to back wall stitching. Different inventive procedures have been described making use of stents or monofilament sutures.

Methods: In this article, we describe a newly developed and straightforward technique for LVA in 4 patients who underwent an axilla dissection and 1 patient who underwent a dissection of the groin lymph nodes. This latter approach makes use of clipping of the lymphatic vessel during lymph node dissection, and remains ligated during anastomosis. The candidate vein was the V. thoracodorsalis for the axilla and the V. circumflexa superficialis for the groin. We describe the feasibility, average duration, and complications.

Results: Performing an end-to-side anastomosis on a clipped lymphatic vessel minimizes the problem of back wall stitching as well as the trouble of finding the lumen due to collapsing of the vessel. The turgor of the lymphatic vessel is maintained and makes anastomosing easy. Average time for LVA was 33.4 minutes and 1 minor complication was seen.

Conclusion: We believe that this approach might be of value in popularizing LVA in the treatment or prevention of different conditions such as breast cancer-related lymphedema. *(Plast Reconstr Surg Glob Open 2021;9:e3509; doi: 10.1097/GOX.0000000000003509; Published online 22 March 2021.)*

INTRODUCTION

Lymphedema is defined as a chronic condition, caused by lymphostasis due to dysfunction of the lymphatic system. Two major categories exist: primary or congenital lymphedema and secondary lymphedema (trauma, surgery, infection, etc.). A major part of the latter group in the Western world consists of iatrogenic lymphedema due to cancer treatment. In the cancer-related group, the breast cancer-related lymphedema (BCRL) accounts for the biggest part. The incidence of BCRL is estimated between 33% and 52%, 2 years after breast cancer treatment on average.[1] In recent years, more consideration has been given to the lymphatic system when performing surgery to the lymph nodes or lymphatic system (ie, sentinel procedure or axilla dissection for breast cancer). Surgical outcomes reported in the literature vary due to a lack of standardization of measurement methods and surgical techniques.[2] Even though only a few clinical studies are performed, prophylactic lymphovenous anastomosis (LVA) could be beneficial in the prevention of BCRL and shows a significant reduction of lymphedema (relative risk: 0.33, confidence interval 95%).[3–5] These procedures

From the Department of Plastic, Reconstructive and Aesthetic Surgery, Gent University Hospital, Gent, Belgium.

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require experienced supramicrosurgeons and are time consuming, which might be the reasons why prophylactic LVA has not yet been widely implemented. Due to the small diameters (0.3–1.0 mm), it is often challenging to identify the lumen of lymphatic vessels, and therefore, anastomoses are prone to back wall stitching. Different inventive procedures have been described, making use of stents and monofilament sutures.[6,7] In this article, we describe a new and straightforward technique for LVA.

MATERIAL AND METHODS

A single surgeon experience with the new LVA technique was reviewed for patients undergoing either axilla or groin dissection between May 2020 and September 2020 for oncological reasons (breast cancer or vulvar cancer) (Table 1). Demographic data were collected, such as procedural parameters and postoperative complications.

Technique and Treatment Protocol

The lymphatic vessels are identified by preoperative Indocyanine Green (ICG) fluoroscopy and patent blue for intraoperative visualization. The technique makes use of clipping of the lymphatic vessels by the oncologic surgeon during (axilla or groin) lymph node dissection, so the vessels maintain their turgor. Afterward, clips on the lymphatic vessels are replaced by ligature with 9/0 monofilament and the distal part of the lymphatic vessel is cleaned up to the adventitia. The V. thoracodorsalis for axilla and V. circumflexa superficialis for groin are dissected, rerouted, and cut a few millimeters distal of a well-functioning valve. In the millimeters between the cut end and the valve, an additional venotomy is performed and the ligated end of the lymphatic vessel is passed through this venotomy hole (Fig. 1A). With the lymphatic vessel in position and still ligated, several 10/0 or 11/0 monofilament sutures are placed to fixate the lymphatic vessel to the edges of the venotomy (Fig. 1B). Afterward, the ligated lymphatic vessel is cut short, leaving a small part of the lymphatic vessel free floating intraluminal (Fig. 1C). Finally, the vein is clipped distally (Fig. 1D). Because the lymphatic vessel remained ligated up until the end of the anastomosis, there was no pooling of ICG and you can see the ICG running slowly into the vein and past the valve after cutting the lymphatic vessel short and clipping the vein (Fig. 2). (**See Video [online]**, in which LVA with 2 lymph vessels is displayed. Clips on the lymphatic vessels are replaced by ligature with 9/0 monofilament. With the lymphatic vessel in position and still ligated, several 10/0 or 11/0 monofilament sutures are placed to fixate the lymphatic vessel to the edges of the venotomy. Afterward, the ligated lymphatic vessel is cut short and the vein is clipped distal.)

RESULTS

Five consecutive patients were treated with this technique. Mean age was 61 (51–78 y). Mean BMI 25.83 (20.89–33.91). The average time to perform anastomosis was 33.4 minutes (28–42 min). Wound drainage gave average of 192.50 ml (130–280) and could be removed after 2.5 days (2–4 d). One patient developed seroma, which needed to be punctured 2 times. Other patients recovered without complications. Mean FU time is 4 months (3–7 mo). Up until now, no patients developed lymphedema

Table 1. Demographics of the Patients with Age, Type of Cancer, TNM Classification, Adjuvant Therapies and BMI

Age (y)	Type Cancer	Positive Nodes	TNM	Chemotherapy	Radiotherapy	BMI
51	Ductal invasive	1/4	pT1c pN2a	No	Axilla	22.89
51	Lobular invasive	1/8	pT3N1a	12× Paclitaxel	Thorax + axilla	20.89
54	Ductal invasive	1/9	pT1c pN1a(sn)	12× Paclitaxel	Thorax + axilla	26.35
71	Lobular invasive	2/4	pT3n1a	4× Epirubicin-cyclophosphamide	Axilla	33.91
78	Vulva carcinoma	3/10	pT3pN2b	Cisplatin	Vulva	25.10

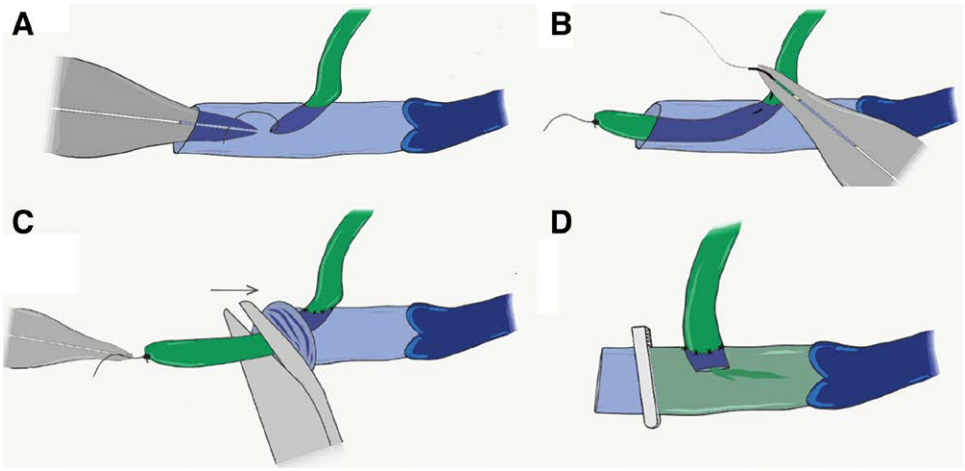

Fig. 1. Graphic representation. A, Sutured lymphatic vessel is pulled through a new cut opening in the vein. B, Sutures are placed. C, Lymphatic vessel is opened after anastomosis. D, Distal vein is clipped.

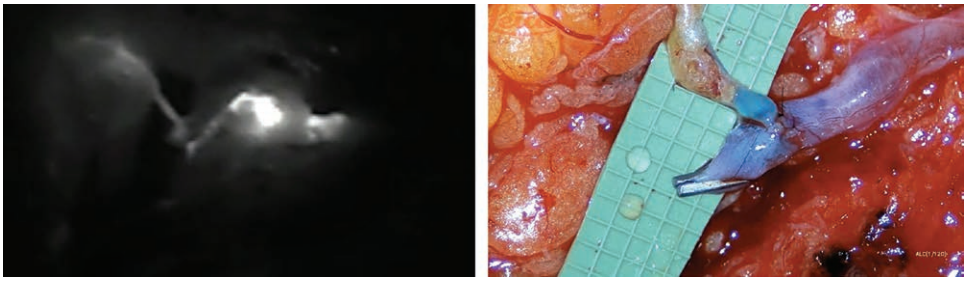

Fig. 2. Intraoperative images. ICG control after anastomosis shows filling of the vein and coloring of the venous valve.

(0/5). The patient with vulvar carcinoma had a bilateral groin dissection but only an LVA on the left side, and she developed lymphedema of the right leg. One patient had a small wound on the forearm which showed slower healing but no lymphedema.

DISCUSSION

The technique makes use of clipping the lymphatic vessels during lymph node dissection, so the vessel maintains its turgor. The lymphatic vessel is sutured end-to-side and is not pulled in the vein through the distal opening as described by Campisi et al[8] but individually through a new opening by venotomy several millimeters proximal from the distal end. Performing an end-to-side anastomosis on a clipped lymphatic vessel minimizes the problem of back wall stitching and the trouble of finding the lumen due to collapsing of the vessel. This allows the surgeon to take a safe bite with every suture. All previously described methods require cutting open the lymphatic vessel to carry out the anastomosis. This often causes the walls of the lymphatic vessel to collapse which makes the procedure even more challenging.

We believe that this technique might be able to popularize LVA. It is easy, has a short learning curve, and is fast. Initial results are substantiating the added value and safety, but further research is required to investigate the long-term outcomes. The effectiveness of the anastomoses is tested using ICG intraoperatively, but long-term results are currently not yet available due to a lack of patient numbers and follow-up time. No clear data are available on the possible increased risk for thrombosis in this type of LVA. Although theoretically the venous valve should inhibit the blood from flowing backward, no blood and thus no clotting factors should come in contact with the edge of the lymphatic vessel. Yamaguchi et al[9] used a similar technique for secondary lymphedema without increasing the lymphatic vessel diameter by clipping it. Second, the use of this technique is mostly limited to regions such as the axilla or groin, where a vein is almost always present and can be rerouted. The approach requires midsize veins with valves, which results in a low intraluminal pressure and, when clipped distally, an absence of backflow. On more distal parts of an extremity or over joints, a big vein might not always be present and an end-to-end or side-to-end technique might be more suited. The use of a donor vein is an option that should be explored (v. saphna or deep epigastric pedicle including lymph nodes). Nevertheless, we believe this approach might be of value in popularizing LVA in the treatment or prevention of different conditions such as BCRL.

CONCLUSIONS

This new technique for LVA is quick and easy for trained microsurgeons. Because it only takes on average 33.4 minutes, we hope more reconstructive surgeons will start performing preventive LVAs. Furthermore, we hope that it might be beneficial in the standardization of LVA in lymph node dissection, and that more high-quality studies might follow.

Bernard Depypere, MD
Gent Academy for Plastic Surgery (GAPS)
C. Heymanslaan 10
9000 Ghent Belgium
E-mail: Bernard.Depypere@Ugent.be

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