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Recent Advances in Management of Lymphedema

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ABSTRACT

Lymphedema is a chronic condition characterized by swelling, typically in the arms or legs, caused by a compromised lymphatic system. It commonly occurs after lymph node removal or damage due to cancer treatment, trauma, or genetic disorders. The impaired lymphatic drainage leads to the accumulation of fluid, causing discomfort, decreased mobility, and an increased risk of infection. Although lymphedema is incurable, it can be managed through various approaches, including compression therapy, manual lymphatic drainage, exercise, and skin care. These strategies aim to reduce swelling, improve lymphatic flow, and enhance overall quality of life for individuals living with lymphedema. Early diagnosis and comprehensive treatment play a crucial role in effectively managing this condition.

Keywords: Recent; Management; Lymphedema.

INTRODUCTION

Lymphedema is a condition characterized by accumulation of protein rich fluid in the interstitial space and consequent tissue swelling. Early stages may have physical findings and symptoms of painless pitting edema, discomfort, and heaviness of the limb, especially after continued use.[1] However, as time passes without treatment, the condition progresses to fibrosis, thickening of the skin, and irreversible non pitting edema. The etiology of lymphedema is classified as either primary or secondary. Primary lymphedema occurs due to a congenital anomaly or absence of the lymphatic system in certain populations. Secondary lymphedema occurs due to an acquired impairment in lymphatic flow. Common etiologies include trauma, chronic infection, and malignancy.[3] The most common cause, in westernized countries, is treatment of malignancy, particularly breast cancer.

First line intervention of lymphedema includes conservative measures, such as complete decongestive therapy (CDT). CDT is a multidisciplinary treatment approach involving exercise, daily bandaging, manual drainage therapy and skin care. The intervention occurs as a 2 phase approach, with phase 1 focusing on reduction of lymphedema volume, and phase 2

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focusing on maintenance of the reduced volume. Surgical treatment of lymphedema is suggested when conservative management fails, particularly early following the onset of the swelling. The field of lymphedema surgery is a constantly evolving field. Early techniques in management of lymphedema include ablative procedures such as the Homans or Charles procedures, which involve excision of the subcutaneous tissue beneath the affected skin and covering the defect with skin flaps or a full or split thickness grafts.[13,14] Advances in microsurgical techniques have allowed the advent of more physiologic and effective methods such as vascularized lymph node transplant (VLNT) or lymphovenous anastomosis (LVA).

PHYSIOLOGIC THERAPY

Surgical techniques of lymphedema management can broadly be divided into physiologic therapy and ablative therapy. Physiologic surgical techniques are microsurgical procedures that foster the physiologic drainage of lymphatic fluid through anastomosis of lymphatic vessels with the venous system, or the incorporation of a functional lymph node in the region of ablative treatment.

LVA

LVA was first described in the 1960s by Nielubowicz and Olszewski. Artificial connection between a patent lymphatic vessel and adjacent venules to redirect lymphatic flow, allowing the lymphatic fluid to bypass obstructed lymphatic vessels. The anastomosed vessels have diameters ranging from 0.1 to 0.8 mm, requiring super microsurgical technique. LVA is more effective in early stages of lymphedema, rather than at later stages when irreversible tissue fibrosis has occurred and lymphatic smooth muscle is dysfunctional. Results not as good for lower extremity lymphedema becase large size and constantly dependent nature of lower extremities may make them less likely to improve in symptoms in comparison to the upper extremity. In a meta-analysis Jorgensen *et al.* (2018) found that prophylactic LVA at the time lymphadenectomy reduced the risk of lymphedema by 77% compared to no prophylactic procedure ($P<0.0001$)

VLNT

VLNT is a relatively new technique in the treatment of lymphedema. It was first clinically described by Clodius *et al.* (1982), who transferred a pedicled groin flap with vascularized inguinal lymph nodes to the left lower extremity with partial success in reducing lymphedema. The technique involves transfer of a vascularized lymph node and surrounding tissue to a region where a lymph node has been removed or lymph flow is impaired. A microsurgical anastomosis is created between recipient site blood supply and the flap, thereby maintaining vascularization of the lymph node. Common donor sites for the lymph nodes include omental, inguinal, mesenteric, lateral thoracic, axillary, gastroepiploic, and submental nodes.[32,33] Common recipient sites include the axilla, elbow, wrist, groin, and ankle.

Although the exact mechanism through which VLNT works is unclear, there are 2 main theories. The first is that lymph node transfer induces lymph angiogenesis at the recipient site, leading to improved lymphatic flow and alleviation of lymphedema. Lymphoscintigraphy show formation of new lymphatic channels at the recipient site following VLNT. The second proposed mechanism is that the transferred lymph node acts as a "pump", wicking lymph fluid from the surrounding interstitial space, and projecting it into the efferent venous circulation. This is based on the observation that ICG dye injected in the tissue surrounding a transferred lymph node can be found in the afferent donor and recipient venules. Lin *et al.* (2009) reasoned that the high pressure afferent arterial flow to the lymph node flap creates a local pressure gradient that transports adjacent lymphatic fluid towards the transplanted node. An advantage that VLNT has over LVA is that it can be performed in the absence of patent lymphatic vessels at the recipient site. Although the volume reduction cannot be attributed to VLNT alone, the findings suggest that VLNT can be an effective treatment in advanced lymphedema, when performed with adjunct ablative procedures. A limitation of VLNT is the risk of donor site lymphedema. Reverse lymphatic mapping prior to surgery has been proposed as a technique to prevent donor site lymphedema following VLNT.[41] This method allows the surgeon to visualize the donor site lymph nodes intra-operatively and actively avoid lymph nodes that drain the extremities, thereby lowering the risk of iatrogenic donor site lymphedema.

Ablative therapy

In advanced stages of lymphedema, where extensive interstitial tissue fibrosis has occurred,

physiologic therapies may not provide sufficient volume reduction. "Rescue" procedures such as ablative surgical procedures can be used at this stage to improve aesthetic outcome, although they do not address the root cause of lymphedema. Commonly used ablative procedures include subcutaneous excisional procedures and suction assisted lipectomy.

Excisional Procedures

One of the well known procedures today is the Charles procedure, which involves radical circumferential excision of subcutaneous tissue followed by full thickness skin grafting. Modified Charles procedure negative pressure wound therapy and delayed skin grafting, in an effort to improve graft take and wound recovery.[42] Subcutaneous excisional procedures are generally preserved only for advanced lymphedema due to its poor aesthetic outcome, risk of lymphedema recurrence, infection, wound break down, and in severe cases amputation.

All Excisional Procedures produce the following Advantages:

1. Decrease limb size
2. Reduce episodes of cellulitis, and therefore improve the quality of life of the patients. Although these surgical procedures can be immediately effective to reduce the lymphedema volume, they can carry some risks including wound complications, swelling recurrence, and the need for the patient to wear compression garments lifelong to prevent recurrence.

LIPOSUCTION

Liposuction is a minimally invasive, yet effective method of lymphedema treatment. The technique involves removal of subcutaneous adipose tissue from the lymphedematous limb using a suction assisted lipectomy cannula. The target population are patients with chronic lymphedema whose pitting edema has been replaced by fatty deposits.[43] Patient satisfaction with the technique is high, as patients are encouraged to return to their daily routine with a short recovery time.[44,45] Furthermore, it can be performed as an adjunctive procedure to physiologic treatments such as LVA or VLNT to improve outcomes. Decreased infection risk following combined therapy has been reported as well.[46,47] The primary limitation of liposuction therapy is that patients must wear compressive garments indefinitely to maintain the reduced limb volume. Cosmetic and functional benefits of liposuction outweight the burden caused by lifelong compression therapy.

Combined Surgical Therapy

Recent reports of combined surgical therapy have demonstrated that performing physiological and ablative procedures together may have benefits beyond improved volume reduction (Table 1). Performing a physiological procedure such as VLNT or LVA in addition to liposuction has been shown to reduce the need for continuous compressive therapy following liposuction. While physiological procedures are most effective in early stages of lymphedema, the addition of ablative therapy can render them effective therapeutic options for late stage lymphedema as well.

Table 1: Advantages of combined therapies

Technique	Advantages over isolated procedure
LVA/LNT + Liposuction	• Improved volume reduction
	• Improved aesthetic cutcome
	• Reduced requirement of compressive garment therapy
LNT + Subcutaneous Excision (e.g., Charles, Homan Procedures)	• Improved volume reduction
	• Improved utility in end-stage lymphedema
	• Reduced requirement of compressive garment therapy

Preventive Procedure

Immediate lymphatic reconstruction Lymphedema is a refractory disease that is challenging to treat. Immediate lymphatic reconstruction has drawn attention as a novel preventive technique.[17,18] After reverse mapping with ICG lymphography, surgeons connect lymphatic vessels of the upper and lower extremities to the surrounding vein. This can

improve lymphatic fluid drainage and reduce the lymphedema rate. The advantages and disadvantages of each procedure described in table (Table 2).

Table 2: Advantages and disadvantages of various methods

Technique	Advantages	Disadvantages	Comments
Lymphovenous anastomosis	• Minimally invasive surgery with the use of ICG • Can be performed prophylactically at time of lymph node dissection	• Less effective for iover extremity lymphedema • Requires a patent lymphatic vessel for anastomosis	• Performed in early stage lymphedema
Lymph node transfer	• Procedure not limited by recipient site lymphatic patency • Variety of donor sites sites available • Simultaneous breast reconstruction possible	• Risk of donor site complications (e.g., seroma, lymphedema)	• Can be performed at all stages, but most efficacious in early stage lymphedema
Liposuction	• Removes fibrofatty tissue unresolved by physiotherapy • High patient statisfaction	• Requires continuous use of compressive gament therapy if performed alone.	• Performed in all stages of lymphedema
Subcutaneous excision (e.g., Charles, Homans)	• Remove fibrofattry tissue unresolved by physiotherapy • Effective for severe lower extremity lymphedema (e.g, elephantiasis)	• Risk of surgical site complications (e.g., infection, wound dehiscence) • Poor aesthetic outcome	• Performed at end stage lymphedema

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