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CASE REPORT
Reconstructive

Modified Dynamic Lymphaticovenular Anastomosis for Surgical Management of Alzheimer Disease

Zhegang Zhou, MD*
Xuhui Chen, MD†
Wei Kou, MD‡
Fanbin Meng, MD*
Longbiao Yu, MD*
Jingjing Wen, MD*
Johnson Boey, MD§
Vitrag Shah, MD¶
Paloma Malagón, MD‖

Summary: Alzheimer disease (AD) is a neurodegenerative disorder that frequently results in progressive cognitive decline. Despite the extensive research conducted on AD, there is presently no solution available due to its increasing prevalence. Recent research has suggested cervical lymphaticovenular anastomosis (LVA) as a therapeutic strategy to improve lymphatic outflow and potentially reduce AD symptoms. We established an amended LVA protocol to mitigate the risk of venous reflux, a prevalent issue associated with the original LVA methodology. A 64-year-old man of Chinese descent exhibited the typical signs and symptoms of AD. The absence of substantial progress with standard medical treatment led to the consideration of LVA. We used a lower limb vein graft for the LVA, anastomosing it to the cervical lymphatic vessels and external jugular vein. The cognitive function of the patient got better after LVA, as shown by higher Mini Mental State Examination and Montreal Cognitive Assessment scores. Fewer β-amyloid and tau protein deposits were observed on positron emission tomography/computed tomography scans. No adverse occurrences or issues were observed. The success in this case demonstrated the potential role of LVA in the management of AD. However, further thorough research is required to evaluate the efficacy of our technique. *(Plast Reconstr Surg Glob Open 2025;13:e7082; doi: 10.1097/GOX.0000000000007082; Published online 2 October 2025.)*

Alzheimer disease (AD) progresses over a continuum, beginning with a preclinical stage, advancing to mild cognitive impairment, and ultimately culminating in dementia. Biomarker derangement can manifest years before the emergence of clinical symptoms.[1] These biomarkers are classified into 3 categories: A (amyloid-β biomarkers), T (tau biomarkers), and N (neurodegeneration or neuronal damage biomarkers), collectively referred to as the "ATN" system.[2] The A and T categories have been reclassified into core 1 and 2 biomarkers, a reflection of our understanding of progression from the preclinical to symptomatic phase.[3] The core 1 biomarkers, which include biomarkers of cerebrospinal fluid and plasma, and amyloid positron emission tomography (PET), are detected in the preclinical stages of AD, whereas core 2 biomarkers are elevated in the later symptomatic stages.[3] Although there is no cure for AD, timely identification of AD is essential for prompt care and for delaying progression of the illness.

Preliminary animal studies suggest that improving the glymphatic system in the central nervous system can facilitate the removal of plaques and neurofibrillary tangles, hence reducing cognitive decline.[4] Studies have investigated lymphaticovenular anastomosis (LVA), indicating its capability to alleviate AD symptoms.[4,5] The potential complications of venous-lymphatic reflux in the traditional LVA have been reported, which may result in suboptimal outcome. Some centers believe that end-side lymph node-to-internal jugular vein (IJV) anastomosis might address this issue. In this study, we modified the LVA by connecting a venous graft from the

*From the *Department of Hand and Microsurgery, Peking University Shenzhen Hospital, Shenzhen, China; †Department of Neurology, Peking University Shenzhen Hospital, Shenzhen, China; ‡Department of Hand and Foot and Reconstructive Microsurgery, Shandong Affiliated Provincial Hospital of Shandong First Medical University, Shandong, China; §Department of Podiatry, Singhealth Polyclinics, Singapore, Singapore; ¶Department of Plastic Surgery, Shah Speciality Hospital, Surat, Gujarat, India; and ‖Department of Plastic Surgery, Hospital Germans Trias i Pujol, Universitat Autònoma de Barcelona, Barcelona, Spain.*

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superficial leg vein to the external jugular vein (EJV) in an end-to-side manner. This lowered the risk of venous-lymphatic reflux, and the anatomical location of the EJV minimized trauma and stress to the underlying soft tissue structures.

CASE PRESENTATION

A 64-year-old Chinese man presented at the neurology department with worsening amnesia that had developed over the previous year. He had comorbid type 2 diabetes mellitus and hypertension. The patient scored 14 points on the Mini Mental State Examination (MMSE) and 11 points on the Montreal Cognitive Assessment (MoCA). The cerebrospinal fluid examination revealed that red blood cells (3×10^6/L), glucose (5.12 mmol/L), and phosphorylated tau (48.38) were within normal limits. No anti-aquaporin-4 antibodies were detected, and the levels of Aβ-42 were diminished (553.44 pg/mL), with an Aβ42:Aβ40 ratio of 0.04. PET/computed tomography (CT) scans revealed aberrant amyloid PET and heightened tau PET uptake in neocortical areas. (**See figure, Supplementary Digital Content 1**, which displays a preoperative amyloid PET/CT scan showing an increased uptake of amyvid-45 in the areas of cingulate and occipitoparietal lobules. An amyloid PET/CT scan taken 1 month perioperatively showed an overall reduction in amyloid plaques, **https://links.lww.com/PRSGO/E287**.) The patient was diagnosed with stage 6D of AD according to the diagnostic criteria established by the Alzheimer Association. He underwent treatment with various medications for AD, including donepezil, idebenone, and citicoline, for a period of 10 weeks, but there was no observed clinical improvement. Meanwhile, anti-Aβ immunotherapy is not suitable in advanced AD. Thereafter, LVA was recommended as an adjunct treatment after the medical management had failed to improve the symptoms. During the 1-month follow-up appointment after LVA, the MMSE and MoCA scores improved to 18 and 13, respectively. PET/CT scans revealed less accumulation of Aβ and tau proteins, whereas a venous ultrasound indicated no abnormalities in the EJV. During the most recent 3-month follow-up session, we noted an additional enhancement in the MMSE score to 19, although the MoCA score persisted at 13 (**Supplementary Digital Content 1, https://links.lww.com/PRSGO/E287**).

SURGICAL PROTOCOL

The procedure was performed under general anesthesia with the patient in a supine position and the neck hyperextended. We injected 4 mL of 0.5% indocyanine green (ICG) solution (Dandong Yichuang Pharmaceutical, Co., Ltd., China) at 2 sites using an 18G needle: the anterior border of the sternocleidomastoid (SCM) muscle at the mandibular angle and the posterior border of the SCM muscle at the lower edge of the mastoid process. We performed ICG lymphography 30 minutes after ICG administration to identify enlarged lymphatics vessels measuring between 0.3 and 0.7 mm. At the same time, a vein finder device was used to identify a superficial vein measuring 1 mm in diameter and 10 cm in length, after which the vein graft was cut into 2 segments, each measuring about 3–5 cm in length (Fig. 1).

A 4-cm transverse incision was made along the midline of the neck, over the SCM muscle. The EJV that lay superior over the SCM muscle was identified and carefully dissected under the surgical microscope Kinevo 900 (Carl Zeiss Meditec, Oberkochen, Germany) (Fig. 2). The SCM muscle was transected in the middle to create a tunnel for the vein graft to pass through. After locating the IJV, it was dissected and retracted. The posterior fascia was resected, and deep lymphatic vessel (LV) and lymph nodes were examined using fluorescence-assisted microscopy. The distance between the LV and the EJV was measured to be about 4 cm.

We placed the vein graft superomedially through the SCM muscle. The proximal aspect of the vein graft was anastomosed with the EJV in an end-to-side manner, whereas its distal part connected to deep LVs in an end-to-end anastomosis (Fig. 3). This technique was replicated on the contralateral side. No drains were placed in the neck. All incisions were closed directly. The patency was confirmed with intraoperative ICG lymphography. (**See Video [online]**, which demonstrates the routing of the donor graft through the SCM muscle, aiming to enhance the dynamism of our LVA approach.)

DISCUSSION

The principle of lymphatic reconstruction has been established as an effective treatment for lymphedema.[6] Following the discovery of the glymphatic drainage system, Lu et al[7] were the first to use the LVA technique in managing patients with cognitive impairment. Several studies investigated this hypothesis and found symptomatic improvements in cognitive deficits.[5,7,8] Commonly used techniques include lymph node-to-vein anastomosis,

Fig. 1. A 10-cm superficial vein with 3 tributary branches was harvested from the medial calf.

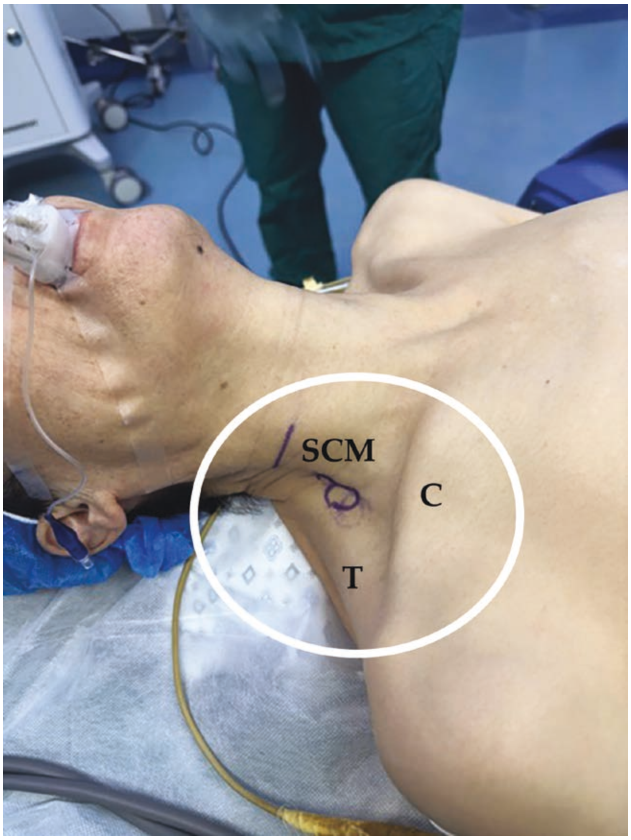

Fig. 2. A transverse incision is made over the SCM, and the location of the EJV is approximated using ICG lymphography. C, clavicle; T, trapezius.

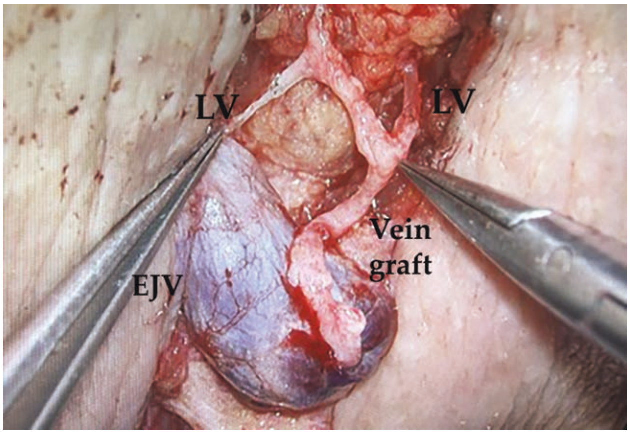

Fig. 3. End-to-side anastomosis of the proximal part of the vein graft to the EJV and end-to-end anastomosis of the distal aspect of the vein graft to 3 adjacent LVs.

lymphaticovenous end-to-end anastomosis, and octopus anastomosis.[6–8] Common complications encountered in LVA are reflux and edema caused by lymphatic fluid congestion. These are caused by differential pressure between the lymphatic and veins, along with diminished capability of the muscular pump, exacerbated by deteriorated smooth muscle due to sclerosis.

The choice of a small-caliber, superficial calf vein graft diminishes the danger of reflux, resulting from a pressure differential between lymphatic and venous veins. Valves facilitate unidirectional flow into lymphatics, whereas smaller conduit tubes improve dynamic blood flow through the Venturi effect. Second, we selected the EJV over IJV due to its decreased intraluminal pressure and diminished risk of trauma or stress to the underlying deep tissue structures. Third, the presence of tributaries facilitates additional connections for lymphatics, hence enhancing the overall efficacy of LVA, as demonstrated by Yamamoto et al.[9] Furthermore, the concept of dynamic LVA presented by Seki et al[10] to tackle issues of lymphatic edema leads us to our modification of previous works by Lu et al[7] and Li et al.[8] As described in the protocol, the vein graft is routed through a slit created in the SCM muscle. The active head movement accentuates the effect of dynamic LVA and further venous backflow.

The underlying mechanism by which the LVA influences the pathophysiology of AD remains uncertain. The observation presented in this case report is inconclusive and will require longer follow-up and larger sample size to draw any relationship between lymphatic reconstruction and symptomatic improvement of AD. Nonetheless, the clinical findings serve as a foundation for investigating promising surgical intervention for AD.

Zhegang Zhou
Department of Hand and Microsurgery
Peking University Shenzhen Hospital
Lianhua Road 1120
Shenzhen 518036, China
E-mail: sumszzg@163.com

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

PATIENT CONSENT

Written informed consent was obtained from the patient for the publication of this case report and the use of their images.

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ETHICAL APPROVAL

This study received approval from the ethics committee of the Peking University Shenzhen Hospital.

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