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VIDEO

Reconstructive

Prophylactic Lymphedema Surgery During Soft Tissue Sarcoma Resection: Surgical Technique Step by Step

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INTRODUCTION

Lymphedema results from the accumulation of lymphatic fluid in the extracellular space, causing soft tissue swelling and, eventually, fibrosis. It can be primary or secondary, with oncological resection being the most common cause in developed countries. Its incidence after cancer surgery ranges from 30% to 56%,[1] leading to mobility impairments, recurrent infections, and reduced quality of life.

Anatomical studies show that all lymphatic channels in the leg converge at a single point in the thigh,[2] explaining the high risk of lymphedema in tumors of this region. (**See Video 1 [online]**, which demonstrates the main indications and patient presentation.)

Prophylactic management of lymphedema is being explored in patients with sarcoma,[4] who often have intact lymphatic systems, making LVA relatively straightforward. Similar to approaches in breast cancer,[5] prophylactic lymphatic surgery may reduce long-term lymphedema in patients with lower limb sarcoma.[4]

PREOPERATIVE MARKINGS

The indications for LVAs correspond to the main risk factors[6] for lower limb lymphedema: tumor size greater than 5 cm, involvement of the medial thigh, and adjuvant radiotherapy. (**See Video 2 [online]**, which demonstrates preoperative markings.)

Preoperative lymphatic mapping is performed under general anesthesia using intradermal injections of indocyanine green (ICG) at the first and fourth web spaces, and the medial and lateral retromalleolar grooves. ICG is diluted in 5 mL of 10% glucose serum, with 0.2 mL injected into the first interdigital space and 0.1 mL into the other points. Care is taken to ensure intradermal injection while avoiding superficial veins, and gloves are changed before lymphatic pathway marking on the skin to prevent skin contamination with ICG.

Once lymphatic channels are identified, they are marked and traced proximally until an interruption or the tumor site is reached. Reconstruction is generally considered when most of the superficial ascending lymphatic channels to the inguinal region are interrupted; in practice, this typically corresponds to involvement of 2 or more of the 3 main channels. Preoperative mapping also guides surgical planning to minimize postoperative sequelae without compromising oncological safety. Channels near the planned resection margin may be preserved or reconstructed if unavoidable.

For identification of superficial veins, ultra-high frequency ultrasound was not available; conventional ultrasound (10–15 MHz) was used instead. If suitable tributary veins were not initially found, the incision was oriented or extended to ensure adequate exposure. The incision is placed at least 5 cm distal to the planned tumor resection to protect reconstructed lymphatic channels from disruption during postoperative radiotherapy.

SURGICAL TECHNIQUE

After tumor resection, we performed intraoperative mapping of the surgical bed to identify lymphatic channels that had been transected during excision. (**See Video 3 [online]**, which demonstrates lymphatic dissection and LVA step by step.) Selective clipping of these

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lymphatic channels was carried out to minimize the risk of postoperative lymphatic leakage. Before making the incisions for LVAs, we infiltrated Patent Blue vital dye at 3 points, 3–5 cm from the incision sites, injecting 0.2 mL per point. This facilitated the visualization of lymphatic channels if the ICG mode was not activated on the microscope.

A 1.5-cm incision was made at least 5 cm distal to the tumor resection bed, and dissection was performed under a microscope using supramicrosurgical instruments. A horizontal incision was preferred because skin markings may be imprecise, and a perpendicular approach facilitated the identification of multiple longitudinal veins and lymphatic channels through a single incision. During the initial dissection, we identified superficial veins and aimed to preserve 1 or 2 of them, ensuring anatomical concordance with the lymphatic vessels that will be dissected later. First, the superficial vein was dissected and transected to confirm the absence of venous backflow. Whenever possible, we sought distal branches of superficial veins, as they offered better size congruence with lymphatic channels and were less likely to present backflow. If significant backflow was encountered after transection, an alternative vein was sought.

Lymphatic dissection was typically performed after vein transection. For the purposes of LVA, the channels selected were usually those situated in the subcutaneous tissue below Scarpa fascia but above the muscular fascia, as opposed to the finer dermal lymphatics or lymphatic capillaries[7] that were not suitable for anastomosis. At each incision site, the largest lymphatic vessel was selected for LVA. Meticulous dissection was performed using monopolar electrocautery set at 15 W. Bipolar was used at 7 W. The lymphatic vessel was carefully separated from surrounding adipose tissue, extending proximally up to 1.5 cm.

We typically performed end-to-end anastomoses, as the lymphatic vessel was already interrupted proximally. When conditions in the surgical field allowed, the anastomosis was initiated from the lymphatic vessel to the vein, which facilitated lumen identification and suture placement.

Green backgrounds provided contrast and helped guide vessel sizing. Conventional clamps were often too large and can damage the vessels. To avoid this, small incisions were made in the green background and used as a clamp to secure the vessels and prevent displacement during the procedure. Finally, the patency of the anastomosis was verified.

CONCLUSIONS

Some tips and tricks are as follows:

- Identify lymphatic vessels with larger diameters that match superficial veins for optimal anastomosis. (**See Video 4 [online]**, which displays key messages and take-home points.)
- Preserve 1 or 2 superficial veins during initial dissection.
- Prefer end-to-end anastomoses and selectively clip lymphatic vessels during tumor resection to prevent lymphorrhea.
- Preoperative lymphatic mapping is essential for accurate planning.

To conclude, positioning the incision 5 cm distal to the tumor resection site allows us to mitigate the adverse effects of radiotherapy while reducing potential local complications, such as hematomas, flap anastomosis failure requiring revision, and infections.

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DISCLOSURE

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