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HOW I DO IT

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Axillary lymph node dissection in the era of immediate lymphatic reconstruction: Considerations for the breast surgeon

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1 | INTRODUCTION

Axillary lymph node dissection (ALND) had traditionally played a fundamental role in breast cancer staging and management.[1] As breast surgery techniques have continued to evolve throughout the years, less invasive approaches have been established to manage the axilla. Sentinel lymph node biopsy (SLNB) is now the initial staging procedure for patients with breast cancer and clinically negative lymph nodes. SLNB was demonstrated to be equivalent to ALND in terms of regional control, disease-free survival, and overall survival.[2,3] Furthermore, results from the American College of Surgeons Oncology Group Z0011 Randomized Trial demonstrated no survival benefit of ALND over SLNB for selected patients with early-stage breast cancer with metastasis in up to two lymph nodes.[4]

Despite the widespread implementation of SLNB in the staging of early breast cancer, ALND remains the mainstay of treatment for patients with three or more involved nodes identified by SLNB or patients with clinically positive nodes that do not exhibit a complete pathologic response after neoadjuvant chemotherapy.

Axillary lymph node dissection is associated with the risk of nerve and vascular injury as well as lymphedema. Those risks are significantly reduced during SLNB.[5-7] Lymphedema is a debilitating, chronic condition that has no cure. It is characterized by arm swelling secondary to abnormal accumulation of interstitial fluid in the initial stages, followed by the deposition of fibroadipose tissue in the chronic phase. It is associated with a variety of symptoms, including arm pain, heaviness, and decreased range of motion that can have a profound impact on the individual's ability to perform daily and work-related tasks, quality of life, and healthcare costs.[8] Several systematic reviews have estimated the risk of lymphedema as highly variable because of differing criteria and modalities used for diagnosis and assessment. Usually they report rates of approximately 20% in patients undergoing ALND.[8] The rate of lymphedema is reduced to approximately 6% in patients undergoing SLNB.[9]

To address the concern of lymphedema, the concept of immediate lymphatic reconstruction (ILR) with the lymphatic microsurgical preventing healing approach technique has been evolving in recent years. This technique was pioneered by a group at the University of Genoa, Italy, led by Dr. Campisi. It involves the identification of transected lymphatic vessels and subsequent bypass into a tributary of the axillary vein at the time of ALND. The reported rate of lymphedema following this procedure by Dr. Campisi's team was less than 5%,[10,11] which is far lower than the incidence reported in the literature after ALND.[9,12,13] A recent literature review and meta-analysis conducted by Johnson et al. showed a drastic reduction in lymphedema rate when ILR is performed after ALND compared to ALND alone (2.1% vs. 14.1%), or after ALND and regional radiation to the axillary nodes compared to ALND and radiation alone (10.3% vs 33.4%).[14]

The Beth Israel Deaconess Medical Center (BIDMC) is one of a few centers in the United States offering routine ILR to patients with breast cancer undergoing ALND. The approach is multidisciplinary and involves careful coordination between the breast surgical oncology team performing the ALND and the plastic surgery team performing the lymphatic reconstruction. Preservation of the superficial veins during ALND is critical to the success of lymphatic reconstruction.

The purpose of this manuscript is to describe our initial experience combining ALND with ILR and discuss modifications in the operative technique during ALND that we believe are necessary for successful lymphatic bypass.

2 | METHODS

We retrospectively reviewed our prospectively collected institutional Research Electronic Data Capture (REDCap) database for lymphatic surgery. From this review, we extracted data between 9/2016 and 4/2019 on patients with breast cancer undergoing ALND who elected to have ILR at BIDMC (IRB Protocol #: 2020P000237).

Operative data were collected on the completion rate of ALND and ILR, the number of lymphatic channels bypassed, and veins used for lymphatic reconstruction. In cases where the ILR procedure was not feasible, the reason for the inability to perform the procedure was extracted from the clinical record.

3 | RESULTS

Ninety-seven patients were brought to the operating room for planned ILR immediately following ALND. The mean age was 54 years (range: 28–85). Of the patients, 60% were white, 21% were African American, 7% were Asian, and 12% had ethnicity not reported.

Of these patients, 81% (79/97) successfully underwent ILR. The median number of channels bypassed was 1 (interquartile range: 1–2). The most commonly used vein was the accessory vein in 59.5% (47/79) of the cases, followed by the thoracodorsal vein in 14% (11/79). Less frequently used veins included the pectoral, lateral thoracic, and tributaries of the thoracodorsal (Table 1). Of note, the primary thoracodorsal vein is not commonly used so as not to preclude subsequent latissimus dorsi flap reconstruction.

The primary reason for aborting the lymphatic bypass was the presence of venous backflow in seven cases, absence of divided lymphatic channels in eight cases, absence of an adequate donor vein in two cases, and insufficient vein length (less than 5 cm) in two cases. Of note, in cases where no transected lymphatic channels were seen, fewer nodes on average were retrieved compared to other cases aborted for a different reason (10 vs. 12.3). Prior SLNB did not appear to independently increase the risk of failure to complete the lymphovenous bypass.

TABLE 1 Veins used for immediate lymphatic reconstruction

Vein used	Number of cases (%), N = 79
Accessory	48 (60%)
Thoracodorsal	11 (13.8%)
Pectoral	9 (11.2%)
Lateral thoracic	4 (5%)
Tributary of thoracodorsal	3 (3.8%)
Accessory + Lateral	1 (1.2%)
Other (unnamed veins)	4 (5%)

The total time required to complete the axillary dissection and the lymphovenous bypass ranged between 3 and 5 h. The time required for the axillary dissection portion of the case was typically 1–3 h, depending on the complexity of the anatomy in any individual case.

4 | DISCUSSION

Implementing ILR with ALND has the potential to significantly reduce the long-term morbidity from ALND.[14,15] Performing ALND in this context requires modification to facilitate ILR, specifically, preserving superficial veins to allow subsequent bypass. Our early findings demonstrate that the majority of our patients undergo successful ILR using the preserved accessory vein.

When performing ALND with ILR, there are additional challenges posed by the need to preserve suitable venous conduits while accomplishing an oncological sound lymph node dissection. A thorough understanding of the anatomy of the axillary region and meticulous surgical technique is of paramount importance to achieve these goals. As lymphatic tissue is removed, suitable veins are identified, isolated, followed distally from the axillary vein to achieve a minimum length of 5 cm, and preserved whenever possible. Preferably, we protect the veins at the lateral aspect of the dissection field to facilitate ILR (Figure 1). If the target vein is located medially, greater length is required to reach the more lateral lymphatic channels. The presence of visible valves is one of the other criteria that we use for selecting veins. When necessary, a vein will be sacrificed as not to compromise the dissection.

As we started our lymphatic reconstruction program and recognized the importance of vein preservation in the axilla, we initially approached these ALND/ILR cases as a "dual team" effort. The plastic surgeon was present during the dissection phase to help preserve identified vessels in a favorable anatomic position with microsurgical techniques. As we progressed in our experience, the technique for identifying and maintaining suitable veins is now performed exclusively by the breast surgeon. The time required for the axillary lymph node dissection component has decreased from approximately 3–1 h.

In our center, all patients requiring ALND have the option to consult with our plastic surgery team regarding ILR. While there are known factors that increase the risk of developing lymphedema, such as obesity or postmastectomy radiation therapy,[9] it is clear that even patients who do not fall into these categories are at risk of developing lymphedema after ALND. We make every effort to expedite referrals to the plastic surgeon when patients express interest in undergoing ILR.

Our approach to ALND with ILR has implications for the operating room workflow and protocols pertaining to lymph node

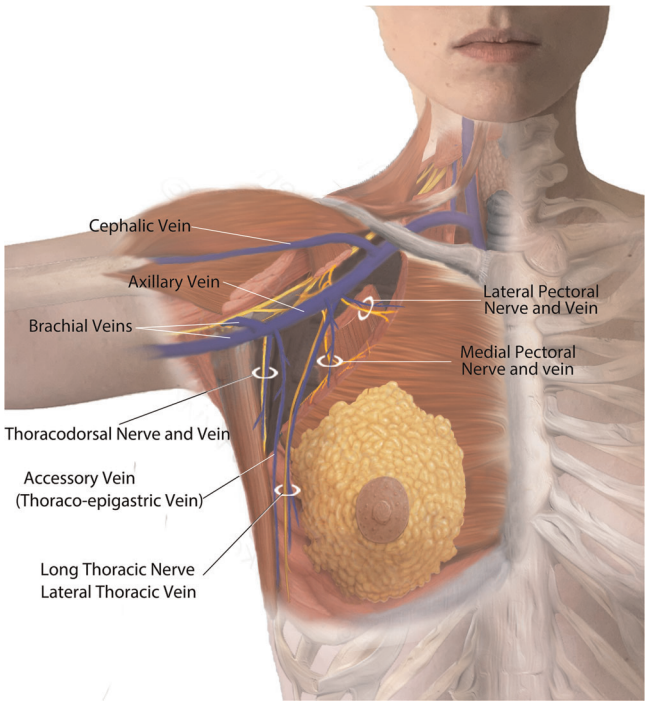

FIGURE 1 Anatomic location of the veins typically used for bypass during immediate lymphatic reconstruction and their respective neuro-vascular bundles [Color figure can be viewed at wileyonlinelibrary.com]

management. We do not routinely perform frozen sections on sentinel nodes. In the event of a positive node in a patient not meeting the Z0011 criteria, an ALND would be performed as a subsequent delayed procedure to allow for coordination with the plastic surgery team performing ILR. Prior axillary procedures that disrupt the venous anatomy (such as SLNB) may render the dissection more challenging. However, in our experience, performing the ALND at a later time is not detrimental to the bypass success rate as a suitable vein can still be found in the majority of cases.

5 | CONCLUSION

Successful implementation of an ILR program requires close collaboration between breast surgeons and plastic surgeons. There are important considerations regarding surgical technique and clinical logistics. A discussion regarding lymphatic reconstruction options should be included in the multidisciplinary care of patients with breast cancer to streamline the referral process. Furthermore, partnership in the operating room will maximize the chances for a successful bypass by modifying the operative technique for ALND, including preserving and isolating suitable veins.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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