THE AMERICAN SOCIETY OF Breast Surgeons

Resource Guide

Technical Considerations for Axillary Surgery in Breast Cancer Patients

Purpose

To outline the techniques of sentinel lymph node (SLN) surgery and axillary lymph node dissection (ALND), discuss special populations and circumstances, and review complications of these procedures. For a discussion of the clinical indications for axillary surgery, please refer to the ASBrS Clinical Consensus Statement on "Axillary Management for Patients With In-Situ and Invasive Breast Cancer" (#3 below).

Associated ASBrS Guidelines or Quality Measures

1. Resource Guide for Sentinel Lymph Node Biopsy in Breast Cancer Patients: Original Guidelines (November 1998), First Revision (August 2000), Second Revision (November 2002), Third Revision (October 2003), Fourth Revision (December 2005), Fifth Revision (November 2010), and Sixth Revision (November 2014).

2. Resource Guide for Axillary Lymph Node Dissection in Breast Cancer Patients (November 2014).

3. Clinical Consensus Statement on Axillary Management for Patients with In-Situ and Invasive Breast Cancer: A Concise Overview (Sept 2025- pending publication).

4. Considerations for Clinicians in the Diagnosis, Prevention, and Treatment of Breast Cancer-Related Lymphedema: Recommendations from a Multidisciplinary Expert ASBrS Panel, Parts I and II (August 2017).

5. Resource Guide on Oncolactation (May 2024).

6. Resource Guide for Neoadjuvant Systemic Therapy in the Management of Breast Cancer (March 2017).

Methods

This is a clinical guide informed by current guidelines, recommendations, and a literature review, inclusive of randomized controlled trials, retrospective series, and database studies. The ASBrS Critical Writing, Editing and Review Committee (CWERC) reviewed and updated this resource guide, combining the previous documents "Axillary Lymph Node Dissection in Breast Cancer Patients" and "Sentinel Lymph Node Biopsy in Breast Cancer Patients" written in 2014. The new document was further revised after membership comment and approved for publication by the ASBrS Board of Directors.

Summary of Data Reviewed

A. Sentinel Lymph Node (SLN) Surgery

SLN surgery (also known as SLN biopsy) is a surgical axillary staging procedure which begins with lymphatic mapping. This can be performed with radioactive isotope (Tc-99 as ^{99m}Tc-sulfur colloid,

^{99m}Tc-albumin nanocolloid, ^{99m}Tc-antimony trisulfide, or ^{99m}Tc-Tilmanocept aka Lymphoseek) and/or colored dye, most commonly isosulfan blue, though methylene blue, patent V blue, and indocyanine green (ICG) can also be used.[1-3] Isotope may be injected the day before or day of surgery with similar efficacy, though the dose will need to be adjusted.[4] Blue dye or ICG is injected at the start of surgery. Some surgeons prefer to also administer isotope once the patient is under anesthesia to avoid injection site pain.[5] Lymphoscintigraphy is performed at the discretion of the surgeon and nuclear medicine physician and may be useful to identify atypical drainage patterns, especially in situations with prior surgery or mapping to the contralateral axilla.[4,6,7] The success and accuracy of SLN surgery are comparable with a variety of injection sites (peritumoral, intratumoral, intradermal, subdermal, subareolar), injection volumes, isotope preparations, and blue dyes.[8-11] It is general practice to massage the breast for up to 5 minutes after injection to encourage migration of the tracers through the lymphatics to the proximal lymph nodes.[12] In one retrospective study of 643 women undergoing SLN surgery for primary breast cancer, massage significantly improved the uptake of blue dye (94.3% vs 59.8%, $p = 0.001$) but not isotope.[13] Regardless of technique, the SLN identification rate is higher and false negative rate (FNR) is lower when both isotope and blue dye are used (i.e. dual tracer mapping), compared with either method alone, particularly in the post-neoadjuvant therapy setting.[4,14-17] Selection between single or dual-tracer mapping should be individualized to the clinical scenario, and may consider resource availability and potential complications (see relevant section below), particularly in up-front surgery when likelihood of mapping failure is low.

SLN surgery is performed under local or general anesthesia, in the supine position, with the patient's arm abducted at 80-90 degrees; the arm may be sterilely draped into the operative field at the surgeon's preference. It can be helpful to check the transcutaneous gamma probe signal in the axilla to confirm isotope uptake and guide initial dissection. SLN surgery is most often performed through an axillary incision made at the base of the hair-bearing skin. However, the axilla can be reached through many mastectomy incisions and often via a single well-placed lumpectomy incision for an upper-outer quadrant tumor (i.e. hidden scar technique).

The goal of SLN surgery is to remove sufficient "hot" and/or blue nodes and/or palpably suspicious nodes to accurately stage the axilla. A typical number of SLNs resected is 1-4 with a median of 2 in most series.[13,18,19] Removing more than 3-4 SLN does not improve staging accuracy and can lead to higher complication rates, particularly lymphedema.[20-22] Regarding isotope, one should aim to remove the "hottest" SLN, and if using the "10% rule", to remove all nodes whose counts are 10% or more of the hottest node.[19,23] One should aim to remove all blue nodes or nodes contiguous with blue-stained lymphatics.[4,24] The axilla should be palpated and any suspicious nodes removed even if they are neither blue nor hot; these are still SLNs. Per surgeon preference and when required for ACS Commission on Cancer synoptic reporting for Operative Standard 5.3 (SLNB for Breast Cancer), the total number and mapping characteristics of each SLN should be noted i.e. hot, and/or blue, and/or palpable, along with the results of intraoperative assessment, if completed.

The axilla can be irrigated; hemostasis and lymphatic control should be ensured prior to incision closure, with or without re-approximation of the clavipectoral fascia. Drain placement is not necessary or recommended.

I. Targeted Axillary Dissection

Targeted Axillary Dissection (TAD) is a procedure which combines SLN surgery and selective removal of previously biopsied and clipped lymph node(s) with intraoperative localization. It was initially used to improve the accuracy of axillary staging following neoadjuvant systemic therapy for clinically node-positive disease, but can also be used during primary surgery to ensure the removal of biopsied node(s).[25] In a 2016 prospective trial of TAD after neoadjuvant chemotherapy in the U.S., SLN surgery followed by ALND yielded a FNR of 10.1% compared with 2.0% for TAD followed by ALND.[26] A multicenter trial from the Netherlands evaluating the MARI procedure (marking the axillary lymph node with radioactive

seed) plus SLN surgery reported an overall identification rate of 99.3% using the combined technique, which was also superior to SLN surgery or MARI alone for the identification of residual axillary disease (63.3% vs. 48.9% and 56.1% respectively, $p<0.01$).[27] In an analysis of patients from the prospective ACOSOG Z1071 trial who had a clip placed at initial lymph node biopsy and confirmation of clipped node retrieval during SLN surgery, the FNR was 6.8%, compared with 19.0% in patients for whom the clipped node was in the ALND specimen instead of the SLNs; the FNR was 13.4% in patients without a clip placed.[28]

TAD is facilitated by pre-operative placement of a localization marker within the clipped node, similar to localization of non-palpable breast lesions. A variety of methods can be used, including radioactive and magnetic seeds, wires, needles, and radar reflectors. Once removed, the clipped node can be imaged intraoperatively to confirm retrieval of the intended specimen and sent for frozen section if the results will determine the need for further concomitant axillary surgery.[25] Documentation of clipped node retrieval should be included in the operative note, specimen radiograph (if performed), and pathology report; the surgeon should also note whether the clipped node was a SLN (i.e. whether it was radioactive, blue or palpably abnormal).

B. Axillary Lymph Node Dissection

ALND is performed with the same patient positioning and incision placement described above for SLN surgery. If needed to maximize exposure, a lazy "S" or "U" incision can be used starting posterior to the lateral border of the pectoralis major and ending anterior to the lateral border of the latissimus dorsi. Surgeons may elect to sterilely drape the arm and/or circumferentially apply skin preparation since abducting the arm with a bent elbow can enable access to level II nodes. To facilitate nerve dissection, the surgeon and anesthesiologist may avoid paralytic agents or allow them to be metabolized or reversed prior to the axillary portion of the procedure.[29,30]

ALND is considered an anatomic dissection, ideally performed within the following boundaries: the axillary vein superiorly, the serratus medially, the latissimus laterally, the clavipectoral fascia anteriorly and the subscapularis posteriorly. The inferior boundary of the axilla is less well-defined but should reach the axillary tail of the breast.

The extent of ALND within the above boundaries is defined as level I (lateral to the pectoralis minor), level I-II (extending behind the pectoralis minor), or level I-III (extending medial to the pectoralis minor and to the apex of the axilla, "Halsted's ligament"), and should be based on pre-operative imaging, extent of nodal disease, patient anatomy, and intraoperative findings. ALND should be sufficient to excise all gross evidence of disease, and the nodes along with intervening lymphatic tissue are removed. A standard ALND should include level I-II dissection and contain at least 10 nodes per NCCN guidelines.[25] In population-based cancer registries such as the NCDB and SEER, the median number of nodes retrieved during ALND is 11-12, with a range of 6-40 in recent series.[31,32] Palpably suspicious Rotter's (interpectoral) and level III nodes should be removed if present. The pectoralis minor may be divided or excised to facilitate exposure and removal of gross disease at levels II and III. However, overly aggressive dissection could lead to a higher risk of complications, particularly lymphedema, and should be avoided. The long thoracic, thoracodorsal, and medial pectoral nerves should be identified and, unless grossly involved by tumor, preserved. If anatomically suitable, the T2 (intercostobrachial) and T3 sensory nerves may be preserved at the discretion of the surgeon. A combination of blunt and sharp dissection with suture and clips for hemostasis may be preferable to avoid thermal injury from electrocautery, though bipolar devices can be useful. Unresectable residual disease should be clipped to facilitate radiation treatment planning and documented in the operative note.

Surgical techniques to prevent or mitigate lymphedema following ALND include axillary reverse mapping, in which blue dye is injected into the proximal arm to differentiate arm vs. breast lymphatics; and LYMPHA (Lymphatic microsurgical preventive healing approach) using prophylactic bypass of transected lymphatics to nearby veins to reconstruct outflow channels. Please see the ASBrS documents on "Diagnosis, Prevention, and Treatment of Breast Cancer-Related Lymphedema" for additional details.

One or more surgical drains should be placed and blub suction applied after skin closure. Instructions for wound care, drain management, and arm exercises should be part of routine post-operative care.

C. Special Considerations

I. Special Populations

Pregnant/Breastfeeding women

Single tracer localization with radioactive colloid is preferred for SLN surgery during pregnancy.[33] Administration of radioactive colloid results in levels lower than the average daily background radiation to the uterus and studies have demonstrated safety in pregnancy and neonatal outcomes.[34-38] Consideration should be taken for timing of injection to minimize radioactive dose, with 1-day protocols (eg. Injection performed on the day of surgery) that require lower dose of radioactive colloid preferred over 2-day protocols (eg. Injection performed the day before surgery).[39,40]

Localization with blue dye should be avoided as methylene blue is potentially teratogenic and should not be used during pregnancy.[41] While isosulfan blue is a Category C teratogen without formal testing[42], given the risk of associated anaphylaxis it should also be avoided in pregnancy.

For special considerations in patients who are breastfeeding, please reference the ASBrS Oncolactation Resource Guide.

Male breast cancer

SLN surgery in individuals who are male sex assigned at birth has a similar level of accuracy as patients who are female sex assigned at birth; therefore, management of the axilla in the setting of male breast cancer should be as detailed above. In a recent meta-analysis of 12 studies that included 153 male breast cancer patients, axillary surgery was successfully performed in 99% of cases in a pooled estimate.[43] Further, the SLN FNR was 0% in the subset for which this data was available (5 studies with 50 patients). In the male patients in whom an ALND was performed, the mean number of lymph nodes removed was 15-25, similar to expected numbers for female patients.

Following neoadjuvant systemic therapy

Multiple special considerations around management of the axilla following neoadjuvant systemic therapy (NST) exist, including additional strategies to improve FNR such as dual tracer mapping (blue dye and radioisotope), removing a minimum of 3 SLN, and identification of an originally biopsied positive lymph node (or targeted axillary dissection).[16,28,44,45] Lymph node yield in ALND following NST may be lower than in primary surgery due to treatment effect.[46] For additional discussion of these considerations, please reference the ASBrS Neoadjuvant Systemic Therapy in the Management of Breast Cancer Resource Guide.

II. Clinical Challenges

Repeat axillary surgery

Repeat axillary surgery for breast cancer recurrence can be considered.[25] Successful identification of a SLN in the re-operative setting is reported at 64-75%, with higher success rates in patients with prior SLN surgery only, or fewer than 10 lymph nodes removed during prior surgeries.[6,7,47] A meta-analysis of 18 articles and 585 patients who underwent lymphatic mapping in the re-operative setting identified 63 patients with a negative SLN surgery but a confirmatory ipsilateral ALND, and in these patients the FNR for SLN surgery was 0.2% (95% CI 0.0-1.5).[7] In a series of 536 patients undergoing repeat SLN surgery for recurrent breast cancer, on multivariable analysis there was no significant impact of prior breast surgery (i.e. BCT vs. mastectomy) on SLN identification rate, likely attributable to the effect of radiation in BCT patients[48]; other studies have found greater success with repeat SLN surgery after mastectomy (67.7%) than BCT (59.7%, p=0.05).[6]

Dual tracer mapping can be used to improve SLN identification and accuracy in the re-operative setting.[49] It may be advisable to inject the tracers peritumoral or periareaolar in the quadrant of the tumor rather than subareolar to improve success rates.[48] Additionally, imaging the pattern of lymphatic uptake (i.e. lymphoscintigraphy) after injection of the radioactive isotope is recommended, as systematic reviews and meta-analyses report aberrant drainage in 40-43% of patients who have had a prior axillary procedure.[6,7]

Failure to map

In the event that no axillary lymph nodes are localized during SLN surgery and axillary staging cannot be omitted, the National Comprehensive Cancer Network recommends level I-II ALND of the ipsilateral axilla.[25] However, in an axilla with low or no pre-incision "hot spot" using a gamma probe, it is reasonable to trouble shoot prior to immediately proceeding with ALND. First, dual tracer mapping should be performed by injecting subareolar or peritumoral blue dye with proper technique, at least 5 minutes of breast massage, and meticulous inspection of the axilla for blue lymphatic channels. The axilla should also be inspected with the gamma probe after making an incision, as often a weak signal can be identified in this setting. Additional techniques that can be considered include manual exam of the axilla for any palpably present nodes and/or utilizing an intra-operative ultrasound to identify lymph nodes within the axillary fat pad.[49] Once such lymph nodes are identified, they can be inspected for radiotracer or blue dye uptake. An additional technique for improving uptake includes injecting 10-40 mL of sterile saline at the site of radiotracer injection, which will increase interstitial pressures and thereby increase flow within the lymphatic channels.[49] If despite these techniques, a SLN is still not able to be identified, ALND can be considered; however the decision to proceed with ALND may also be delayed to allow time for multidisciplinary discussion, consideration of risks and benefits on a case-by-case basis, and an opportunity for shared decision making with the patient following failure to map.

It may be prudent to consent patients for "SLN surgery, possible ALND" when lymphatic mapping and/or SLN identification is expected to be challenging (i.e. repeat axillary surgery, prior radiation) and proceeding with ALND in the same operation would be clinically indicated if SLNs are not identified.

III. Complications

The rate of complications after axillary staging varies and is related to extent of axillary surgery. An understanding of these complications allows for prevention, early recognition, and proper management.

Anaphylaxis secondary to blue dye is rare, reported in 0.1-2.0% of cases for isosulfan blue, 0.05-1.1% for patent V blue, and 0.0006% for methylene blue, though there is a significant risk of skin and soft tissue necrosis at the injection site with methylene blue.[20,50-53] Diluted methylene blue dye has been shown to be associated with successful mapping and fewer complications compared with the undiluted form.[54] Other minor complications after axillary surgery include infection (~1%), hematoma (1-2%), seroma (5-19% after SLN surgery and 20-50% after ALND) and axillary cording (6-32% with SLN surgery and 28-72% after ALND).[20,21,55-63] The management of recurrent seroma can be challenging and can often require multiple aspirations, placement of a percutaneous catheter, or surgical intervention.[56] Nerve injury with sensory disturbance occurs in ~5-25% after SLN surgery and 30-77% after ALND, but is often transient.[1,18,20,21] Shoulder dysfunction is more prevalent after ALND and often necessitates rehabilitation. Lymphedema can lead to significant morbidity and is reported in 3-8% after SLN surgery and 13-60% after ALND.[14,16,64-67]

Surgical strategies to reduce lymphedema risk include axillary reverse mapping, which can be performed at time of SLN surgery and/or ALND; and immediate lymphatic reconstruction or LYMPHA, a microsurgical approach that combines lymphovenous anastomosis with ALND. Please see the ASBrS documents on "Diagnosis, Prevention, and Treatment of Breast Cancer-Related Lymphedema" for additional details.

Recommendations

- Sentinel lymph node (SLN) surgery to stage the axilla is performed with radiotracer isotope (Tc-99) and/or blue dye administered at an appropriate injection site, followed by 5 minutes of breast massage and removal of abnormally palpable, "hot" and/or blue lymph nodes.
- Following neoadjuvant chemotherapy, targeted axillary dissection (TAD), i.e. SLN surgery along with removal of the index biopsy-proven positive node, can be considered to improve the false-negative rate of SLN surgery alone in patients with a previously biopsied positive lymph node.
- Axillary lymph node dissection (ALND) is considered an anatomic dissection of level I-II of the axilla with at least 10 lymph nodes removed.
- When performing ALND, incorporation of lymphedema prevention techniques should be considered, including axillary reverse mapping and immediate lymphatic reconstruction.
- Indications for SLN surgery, TAD, and ALND are further discussed in the ASBrS Clinical Consensus Statement "Axillary Management for Patients with In-Situ and Invasive Breast Cancer: A Concise Overview".

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