CHAPTER 3

Axillary Lymphadenectomy

CRITICAL ELEMENTS

- Identification of Anatomical Structures for Level I and II Axillary Dissection
- Removal of Level III Nodes
- Removal of Rotter Nodes
- Removal of a Sufficient Number of Lymph Nodes for Axillary Staging
- Identification and Preservation of the Long Thoracic, Thoracodorsal, and Medial Pectoral Nerves
- Identification and Preservation of the Second and Third Intercostobrachial Nerves
- Drain Placement

1A. IDENTIFICATION OF ANATOMICAL STRUCTURES FOR LEVEL I AND II AXILLARY DISSECTION

Recommendation: Identification of the axillary vein and latissimus dorsi, pectoralis major, pectoralis minor, serratus anterior, and subscapularis muscles is essential for the resection of sufficient level I and II axillary nodes for breast cancer staging and adjuvant treatment planning.

Type of Data: Retrospective case series.

Strength of Recommendation: The consensus of the group supports this guideline based on historic evidence.

Rationale

Breast cancer typically spreads to the axillary lymph nodes first, and axillary dissection is important for both local control and treatment planning. The anatomic borders of the axilla must be identified to adequately resect level I and II axillary lymph nodes (see Fig. 3-1). The axilla is a triangular space that is delineated by the axillary vein

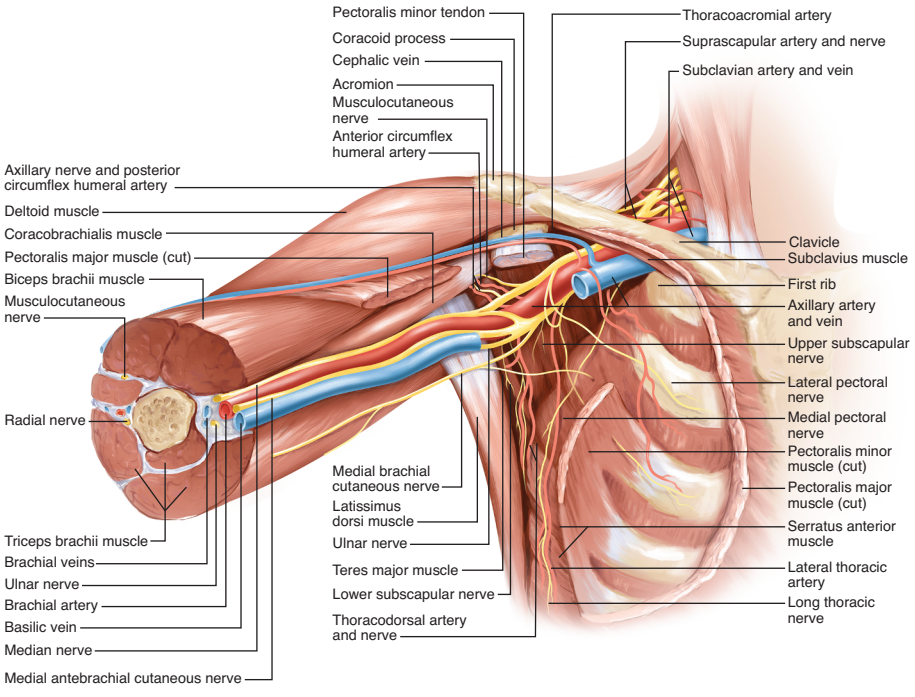

FIGURE 3-1 Anatomy of the axilla.

superiorly, the latissimus dorsi muscle laterally, the serratus anterior muscle medially, the subscapularis muscle posteriorly, and the pectoralis minor and major muscles anteriorly. Lymph nodes in the axilla are identified by their location in one of three anatomical levels. Level I contains the axillary lymph nodes between the latissimus dorsi and the lateral border of the pectoralis minor muscle; level II contains the axillary lymph nodes between the lateral and medial borders of the pectoralis minor muscle; and level III encompasses the lymph nodes between the medial border of the pectoralis minor muscle and Halsted's ligament. Level III axillary nodes can be exposed by resecting or dividing the pectoralis minor muscle. Axillary lymph nodes are located primarily in level I (60% to 70% of nodes), followed by level II (20% to 30%) and level III (10% to 20%).[1–3] Axillary metastases are most often identified in level I nodes followed by level II nodes. Single-node metastasis occurs in level I nodes almost exclusively.[1,2] Metastases that occur in level II or III nodes in the absence of level I metastasis ("skip" metastases) are rare and typically occur in level II nodes.[2,4]

1B. REMOVAL OF LEVEL III NODES

Recommendation: The removal of level III axillary nodes is not typically indicated for patients with stage I or II breast cancer but should be considered to facilitate local disease control in patients with locally advanced breast cancer or N2 disease and patients in whom the nodes are identified by palpation intraoperatively.

performed before chemotherapy and axillary dissections performed after chemotherapy yield similar numbers of lymph nodes.[15,16] Therefore, adequate axillary node dissection after chemotherapy should include level I and II lymph nodes within the previously outlined boundaries rather than the absolute node count.

3A. IDENTIFICATION AND PRESERVATION OF THE LONG THORACIC, THORACODORSAL, AND MEDIAL PECTORAL NERVES

Recommendation: Complete axillary dissection should include the identification and preservation of the long thoracic, thoracodorsal, and medial pectoral nerves. The nodal tissue should be dissected from these nerves with minimal nerve manipulation and without skeletonization to ensure adequate oncologic resection with minimal nerve morbidity. The nodal contents between the long thoracic and thoracodorsal nerves should be dissected to achieve optimal axillary nodal clearance.

Type of Data: Retrospective case series.

Strength of Recommendation: Although the data is retrospective, there is strong consensus of the panel to follow this recommendation based on historical evidence and to limit patient morbidity.

Rationale

A major detraction from routine use of ALND is the increased morbidity and sequelae from nerve injury, which is a major complaint of breast cancer survivors. Nerve injury can cause muscle weakness or pain, limit movement, and result in anatomical abnormalities. Thus, the preservation of the main nerves in the axilla is necessary to help ensure optimal physical outcomes. The long thoracic nerve, which innervates the serratus anterior muscle, originates from the cervical nerve roots and travels within a fatty layer along the muscle surface. However, its exact anatomy varies among patients. Intentional or inadvertent transection of the nerve results in serratus muscle palsy that manifests as pain, weakness, limited shoulder elevation, and scapular winging.[17] Additional surgery and/or years of therapy may be necessary to recover function that is lost as a result of transecting the nerve.[18,19]

The thoracodorsal nerve, which innervates the latissimus dorsi muscle, arises primarily from the C7 and C8 cervical nerve roots and descends behind the axillary vein before joining with the thoracodorsal artery and vein to form the thoracodorsal neurovascular bundle. Although contemporary practice favors preserving the thoracodorsal nerve, this nerve can be resected if the nerve is encased by tumor. However, resecting the nerve is rarely necessary given the widespread use of systemic neoadjuvant chemotherapy. Transection of the thoracodorsal nerve results in weakness or atrophy of the latissimus dorsi muscle.

A complete ALND should include resection of the tissue between the long thoracic and thoracodorsal nerves. Retrospective studies have reported that nodal tissue anterior to the subscapularis muscle in this area is present in 56% to 67% of patients and that 10% of these nodes are positive.[20,21]

The medial pectoral nerve, which innervates the lower parts of the pectoralis major and pectoralis minor muscles, arises from the medial cord of the brachial plexus and is located lateral to the lateral pectoral nerve.[22] Transection of this nerve causes weakness and atrophy of the pectoralis minor muscle and the lateral and inferior portions of the pectoralis major muscle and results in muscle fibrosis. The nerve can be divided in cases of dense tumor involvement.

3B. IDENTIFICATION AND PRESERVATION OF THE SECOND AND THIRD INTERCOSTOBRACHIAL NERVES

Recommendation: The axilla should be carefully dissected to identify and preserve the intercostobrachial nerves (ICBNs). In the level I axilla, these nerves exit the chest wall through the intercostal and serratus anterior muscles and cross the axilla parallel to the axillary vessels. The second ICBN, which provides sensation to the skin of the medial and posterior upper arm, is generally the largest and most superior of the ICBNs. Unless the nerve is encased by tumor, this nerve should be spared by dissecting it from the axillary fat. Once released, the nerve is positioned inferior to the axillary vein.

Type of Data: Small prospective trials and a larger retrospective dataset.

Strength of Recommendation: There is moderate evidence to support this recommendation.

Rationale

Four small prospective trials with follow-up durations ranging from 3 to 38 months have investigated the value of ICBN preservation by randomizing patients to ALND with ICBN preservation or ALND without ICBN preservation. These trials, each of which enrolled fewer than 130 patients, revealed no significant difference in the rates of survival or axillary disease recurrence between patients who did and patients who did not have ICBN preservation. However, whereas Freeman et al,[23] Abdullah et al,[24] and Torresan et al[25] found that patients with ICBN preservation had significantly fewer sensory deficits and symptoms than patients with no ICBN preservation, Salmon et al[26] found that ICBN preservation provided no functional advantage. Findings from a retrospective study with a larger patient cohort and longer follow-up suggest that ligating or damaging the ICBNs during axillary surgery exacerbates sensory changes in the arm that may persist for years.[27]

4. DRAIN PLACEMENT

Recommendation: Optimal drain placement following standard level I, II, and/or III ALND is essential to preventing seroma in order to avoid delays to adjuvant treatment.

Type of Data: Multiple randomized trials and two meta-analyses.

Strength of Recommendation: There is strong evidence to support this recommendation.

CHAPTER 4

Sentinel Lymphadenectomy

CRITICAL ELEMENTS

- Identification of All Sentinel Nodes
- Technique for Injecting Localizing Tracer or Dye
- Preincision Evaluation of Drainage Pattern
- Node Removal Technique to Limit Seroma Formation

1. IDENTIFICATION OF ALL SENTINEL NODES

Recommendation: All sentinel nodes must be identified, removed, and subjected to pathologic analysis to ensure that sentinel lymph node mapping and sentinel lymphadenectomy provide accurate information for breast cancer staging. Sentinel nodes are defined by the presence of a tracer (radioactive tracer and/or colored dye) that has been previously injected into the affected breast or by the presence of a dominant palpable lymph node identified by the operating surgeon.

Type of Data: Randomized multicenter prospective trials.

Strength of Recommendation: The group strongly endorses this recommendation based on strong evidence.

Rationale

The original definition of a sentinel lymph node was "the first draining lymph node on the direct pathway from the primary tumor site."[1] According to the sentinel node hypothesis, tumor cells migrate from a primary tumor focus to the first draining lymph node(s) before involving distal lymph nodes. Sentinel lymph nodes are variably located but are usually within the level I or II axilla near the lateral thoracic vein.[2,3] The median number of sentinel nodes removed during a sentinel lymphadenectomy is between two and three; in the two largest randomized clinical trials comparing sentinel

lymphadenectomy to axillary node dissection, the mean numbers of sentinel nodes removed per procedure were 2.8 in the National Surgical Adjuvant Breast and Bowel Project B32 trial[3] and 2.2 in the ALMANAC (Axillary Lymphatic Mapping Against Nodal Axillary Clearance) trial.[4] For cases in which only one sentinel lymph node is removed, the reported false negative rate of the procedure is greater than 10%, potentially leading to the assignment of lower than actual disease stages to some breast cancers.[5]

Identification Using a Radioactive Tracer

Most commonly technetium sulfur colloid is injected in the breast an hour prior to the planned sentinel node biopsy, but the tracer can be injected the day before if more convenient. After the patient is under general anesthesia, a handheld gamma detection probe is held over the axilla to identify the area of greatest radioactivity. A 3- to 6-cm incision is then made near the area of greatest radioactivity within the region at the base of the axillary hairline. The clavipectoral fascia is opened to the level I axilla, and the area around the lateral thoracic vein and second intercostobrachial nerve is evaluated using the gamma detection probe. The first sentinel node is the node with the highest absolute radioactivity count. The nodes are excised using clip, tie, or sealing device closure of the indwelling lymphatics and vessels, and blunt dissection of the surrounding fat is performed to prevent the removal of multiple nonsentinel nodes. After the first sentinel node is excised, its ex vivo highest or 10-second radioactive count is obtained and recorded, and the radioactivity of the axillary basin is reassessed. All nodes whose radioactive count is at least 10% that of the most radioactive node are considered sentinel nodes and are removed in a similar fashion, and ex vivo radioactive counts are recorded for each node. Confirmation of an elevated ex vivo count of the node ensures that it is indeed a hot node and not that the count was falsely elevated in vivo due to scatter from the primary injection in the breast.

Identification Using Vital Blue (or Colored) Dye

For sentinel node identification with a blue dye, isosulfan or methylene blue are most commonly used. The dye is injected in the breast and massaged; subsequently, the axilla is incised and opened as described for sentinel node identification with a radioactive tracer. Blunt dissection is performed to identify the dye-filled lymphatic tract. This tract is then followed proximally and distally until a blue-stained sentinel node is identified (Fig. 4-1). If more than one dye-filled lymphatic tract is identified, each is followed until a blue node is identified. Blue-stained sentinel nodes are removed in a fashion similar to that used to remove sentinel nodes identified using a radioactive tracer. Another colored tracer in current use is indocyanine green; in cases in which this tracer is used, all nodes with fluorescent tracer uptake must be identified.

Identification Using a Dual-Tracer Approach

The majority of sentinel lymphadenectomy procedures utilize a dual-tracer technique.[6] If both a radioactive tracer and blue dye have been injected, nodes that are

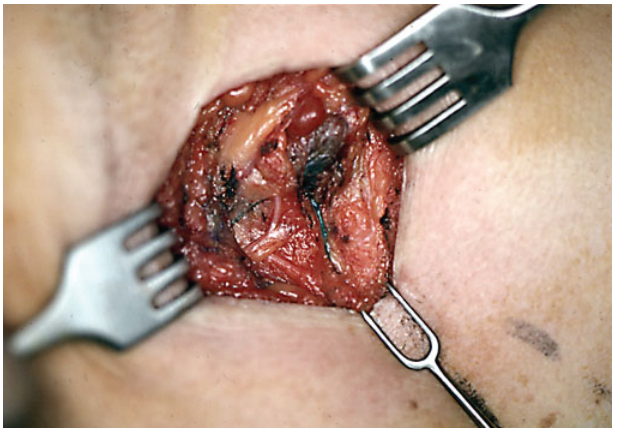

FIGURE 4-1 Sentinel node procedure demonstrating blue lymphatic leading to blue sentinel node. (Photo courtesy of Sarah Blair, MD, and Marek Dobke, MD.)

radioactive and/or stained blue are considered sentinel nodes. All blue-stained nodes should be assessed with a gamma detection probe for radioactivity, and all radioactive nodes that are removed should be assessed for the presence of blue dye. Some nodes may only be identified by one modality, as studies show that the procedure is the most accurate when dual tracer technique is utilized.[6]

Identification Using Palpation of the Axilla

As a component of sentinel lymphadenectomy, careful palpation of the level I and II axilla is essential to guiding the complete removal of all sentinel nodes. Nodes that feel abnormal on palpation should be categorized as sentinel nodes and removed regardless of whether they are radioactive or stained blue.[7]

2. TECHNIQUE FOR INJECTING LOCALIZING TRACER OR DYE

Recommendation: The site of localizing tracer or dye injection within the affected breast and/or subareolar plexus does not influence the identification of the axillary sentinel node(s).

Type of Data: Multiple single institutional series, small prospective randomized study, and systematic review.

Strength of Recommendation: Consensus of the group is that the evidence is strong.

Rationale

Over the past 15 years, several different techniques and combinations of techniques have been employed for the injection of radioactive tracer and/or dye for sentinel node identification. Pesek et al[5] published the most comprehensive and systematic