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Journey to the centre of the armpit: Mapping axillary sensory cutaneous nerves for enhanced analgesic approaches in breast surgery

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Introduction

Female breast cancer is the most diagnosed cancer and the fifth leading cause of cancer death worldwide.1 Breast cancer treatments vary, often involving a combination of chemotherapy, radiation, sampling or removal of lymph nodes within the axilla, and surgical resection, thereby targeting the breast, pectoral muscles, axilla, lateral thoracic wall, and medial arm.2 Approximately 60% of patients undergoing breast cancer surgery experience acute postoperative pain (APP) that is primarily localized to the axilla.3 Postoperative analgesia is often managed with intraoperative peripheral nerve blocks (PNBs), a form of regional anesthesia.4,5 The PNBs typically administered in breast surgery target the intercostobrachial nerve (ICBN), which provides sensory innervation to the axilla. Complete analgesia for axillary dissection with peripheral nerve blocks are not consistent or reliable. Therefore, the incomplete coverage could be due to additional, undocumented innervation pathways. The axilla is a pyramidal structure residing between the thorax and upper limb, with a curved and oblong base of axillary fascia and an apex formed from the cervicoaxillary canal and houses many highly significant structures as they pass to the thorax, upper limb, and neck, most notably the brachial plexus and its branches, the axillary artery and vein, and lymph nodes 6,7 The current study aims to expand sensory nerve identification via anatomical dissection.

Materials and Methods

Ethics Board approval of the Western University Office of Human Research Ethics (OHRE) CREB committee, (project id 121117) was obtained. Axilla dissections were undertaken in donors sourced from Western University's body bequeathal program. To maximize the quantity of donors that could be recruited, both soft-embalmed and fresh/frozen specimens were accepted. There was no preference for sex given the general consistency of innervation pathways demonstrated in non-reproductive regions.

Nine axillary dissections (5F, 4M) were performed with donors' supine and upper limbs abducted. Incisions along the anterolateral thorax and superior clavicle created laterally reflecting skin flaps deep to pectoralis minor, allowing visualization of the ICBN and brachial plexus. Scaled photographic images were taken during dissections for documentation.

Results/Case Report

In each dissection, an ICBN (100%, n=9) and a branch of the posterior cord (posterior cord branch: PCB; 100%, n=9) were identified entering axillary subcutaneous tissue. In 55% of dissections (n=5), a branch of the medial cord (medial cord branch: MCB) was identified. The upper & lower subscapular nerves and the thoracodorsal nerve were identified separately on the posterior cord, along with the medial pectoral nerve and medial cutaneous nerves of the arm & forearm on the medial cord, distinguishing the PCB and MCB as separate entities.Table 1

The ICBN remained localized to the anterior axillary base but demonstrated various extrathoracic branching patterns: a single origin, dual origins, and double ICBNs. The ICBN was present in 100% of subjects (n=9), although its branching patterns were highly variable. Subject 1 demonstrated dual ICBN origins from the lateral cutaneous branches of intercostal nerves 2 & 3. Subject 2 possessed a single origin of ICBN from the lateral cutaneous branches of the second intercostal nerve. Subject 3 presented double ICBNs that did not converge; one exited from the second intercostal space while the other exited from the third intercostal space. The ICBNs found in subject 1 and the right side of subject 2 (2R) pierced pectoralis minor. Figure 1 depicts the various patterns of origin observed in the ICBN. Overall, the cutaneous distribution of these nerves remained confined to the anteroinferior portion of the axillary base, along the anterior axillary line.

The PCB was present in 100% of subjects (n=9). While being consistent in its origin and distribution, there was variability in its branching patterns. Arising more proximally than the upper & lower subscapular nerves and the thoracodorsal nerve, the PCB courses inferiorly, deep to the axillary vessels & brachial plexus, before crossing medially beneath the axillary vein and penetrating axillary subcutaneous tissue. This pathway is illustrated in Figure 2. Overall, the cutaneous distribution of these nerves remained confined to the posteroinferior portion of the axillary base, along the posterior axillary line.

Finally, the MCB was identified in 55% of subjects (n=5). Arising from the proximal region of the medial cord, the MCB travelled inferiorly, crossing medially beneath the axillary vein before penetrating axillary subcutaneous tissue. The MCB discovered in subject 2R did not bifurcate, despite bifurcating once in subject 1L and thrice in subject 3R. Overall, the cutaneous distribution of these nerves was localized to the base of the axilla, localized along the midaxillary line.

Discussion

The current anatomical study will contribute to an overarching investigation to develop a novel approach to comprehensive regional analgesia for breast cancer surgery. In addition to the ICBN, which has been previously documented as the source of axillary sensory innervation, two branches of the brachial plexus have been documented as entering the subcutaneous tissue of the axilla. The PCB and MCB were determined to be novel, previously undocumented sensory branches arising from the brachial plexus. Previous studies investigating the brachial plexus positively identify and characterize the variability of the well-documented branches of the cords, namely the upper subscapular, lower subscapular, thoracodorsal, medial pectoral, and medial cutaneous nerves of the arm & forearm. 8,9 However, neither the PCB nor the MCB can be characterized as a variable branch due to their individual origins on the cords and their distal innervation sites. In contrast to the anteriorly-distributed ICBN, the PCB is localized more posteriorly and has been identified in all cases, whereas the MCB is localized more centrally and has only been identified in 4 out of 7 cases.

The identification of these additional nerves supplying the axilla is crucial information when administering local anesthetic for breast & axillary procedures. Determining relevant landmarks for these nerves will help to provide more accurate and targeted nerve block for axillary surgery. This could greatly reduce postoperative pain and eliminate the need for postoperative opioids, both increasing the likelihood of surgical success and reduction of post-surgical morbidity.

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Disclosures

No

Tables / Images