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Review Article

Significance of intramammary lymph node in multimodality imaging

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ABSTRACT

The internal mammary lymphatic system, alongside the axillary lymphatic system, is a key pathway for lymphatic drainage from the breast and a significant route for metastatic spread in breast cancer. Internal mammary lymph node (IMLN) involvement is associated with poor prognosis, regardless of axillary lymph node status. Intramammary lymph nodes (IMLNs), often benign incidental findings, require accurate differentiation between normal and abnormal features to guide appropriate diagnostic and therapeutic measures. Multimodality imaging, including mammography, ultrasound, MRI, and PET-CT, is essential for characterizing IMLNs, offering complementary insights into morphology and function. Accurate evaluation of IMLNs aids in breast cancer staging, with the American Joint Committee on Cancer (AJCC) incorporating their status into staging systems, reflecting their prognostic importance. Emerging technologies, such as radiomics and artificial intelligence (AI), promise to enhance diagnostic precision, potentially reducing invasive procedures. This review highlights the clinical significance of IMLNs and the pivotal role of imaging in their evaluation.

Keywords: Intra mammary lymph node, Interval imaging, Clinical correlation

INTRODUCTION

Together with the axillary lymphatic system, the internal mammary lymphatic system constitutes a critical route for lymphatic drainage from the breast, playing a significant role in the metastatic spread of breast cancer. The involvement of internal mammary lymph nodes (IMLNs) in metastatic breast cancer is associated with a notably poor prognosis, irrespective of axillary lymph node status.[1] Therefore, thorough evaluation of IMLNs is essential to accurately stage the disease and guide treatment strategies. Although intramammary lymph nodes (IMLNs) are frequently benign incidental findings, distinguishing between normal and abnormal characteristics is vital. This differentiation facilitates appropriate diagnostic and therapeutic decisions, particularly in cases presenting atypical or suspicious features. IMLNs are integral components of the breast's lymphatic network and are predominantly situated in the upper outer quadrant. Their prevalence varies widely, depending on the population studied and the imaging modality employed. For example, some studies suggest a prevalence ranging from 0.7% to 48% in mammographic examinations.[2,3] Despite their benign nature in most cases, IMLNs can become involved in the metastatic spread of breast carcinoma, emphasizing the importance of their accurate characterization through imaging.

Multimodality imaging plays a pivotal role in identifying and assessing IMLNs. Techniques such as mammography, ultrasound, magnetic resonance imaging (MRI), and positron emission tomography-computed tomography (PET-CT) offer complementary insights into the morphology and functional status of these nodes. For instance, mammography and ultrasound are widely used for initial detection and characterization, whereas MRI and PET-CT provide superior soft-tissue contrast and functional imaging capabilities, respectively.[4,5] Leveraging these imaging modalities aids in distinguishing benign reactive changes from malignant involvement, thereby avoiding unnecessary interventions.

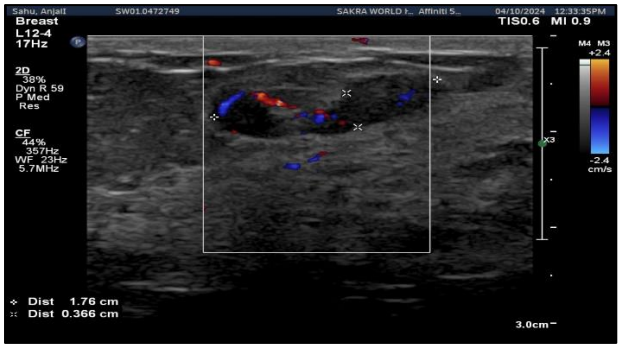

Figure 1: Typical appearance of IMLN: ovoid shaped with central fatty hilum being maintained. No focal lobulation/calcification.

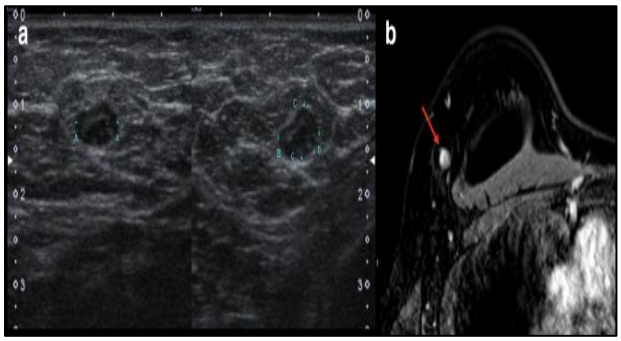

Figure 2: Patient with previous right breast cancer submitted to nipple-sparing mastectomy presented an atypical IMLN in the upper outer quadrant of the same breast at ultrasound (A) and MRI (B), with round shape, eccentric hilum and thickened heterogeneous cortex. Percutaneous ultrasound-guided fine needle aspiration was negative for malignancy and surgical resection confirmed a reactive inflammatory IMLN. IMLN, intramammary lymph nodes.

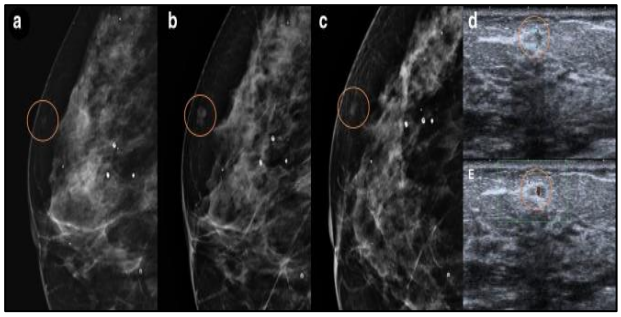

Figure 3: Patient with a typical IMLN in the upper outer quadrant of the right breast at screening mammography (A). After 1 year, the new screening exam (B) showed an increase in the IMLN and a biopsy was suggested. However, after 2 months, when the patient returned to perform the biopsy, the IMLN showed spontaneous regression to normal size (C), suggesting a reactive inflammatory IMLN and the procedure was suspended. IMLN, intramammary lymph nodes.

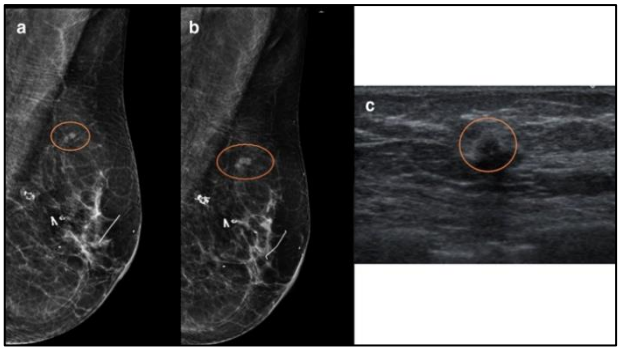

Figure 4: Patient with previous left breast cancer submitted to conservative surgery presented a small circumscribed mass on the left upper outer quadrant at follow-up mammography, mimicking an IMLN (A). Prior exams were not available. At 6-month follow-up, there was an increase in the mass (B), which corresponded to an irregular hypoechoic mass at ultrasound (C) and was confirmed as a recurrent invasive carcinoma after biopsy. IMLN, intramammary lymph nodes.

Understanding the clinical significance of IMLNs also extends to their role in breast cancer staging. The American Joint Committee on Cancer (AJCC) includes IMLN status in its staging system, underscoring its impact on prognostication and treatment planning.[6] Metastatic involvement of IMLNs often necessitates systemic therapy and may alter decisions regarding locoregional radiation therapy. Emerging technologies, such as radiomics and artificial intelligence (AI), hold promise for further refining the evaluation of IMLNs. Advanced imaging algorithms can analyze subtle textural features and morphological patterns, enhancing diagnostic accuracy and potentially reducing reliance on invasive procedures.[7]

Table 1: Normal and abnormal IMLN imaging features.[10]

IMLN features	Normal	Abnormal
Shape	Ovoid or reniform	Round or lobulated
Margins	Circumscribed	Not circumscribed
Size	Less than 1 cm	More than 1 cm
Calcifications	Absent	Present
Hilar fat	Present, may be pronounced	Absent or eccentric
Particularities	Usually adjacent to a vein	Significant alteration in size or morphology at follow-up

DISCUSSION

Intramammary lymph nodes can be present anywhere in the breast, but commonly found in upper outer quadrant.

The prevalence of IMLN ranges between 0.7 and 48% on current studies, depending on the method used for identification, radiological or pathologic examination.[8] Benign intramammary lymph node with typical features includes circumscribed, ovoid shape, central fatty hilum being maintained, size is usually less than 1 cm and interval stable size or interval reduction is size of the lymph node. Abnormal appearance of intramammary lymph node includes round in shape, focal lobulation, fatty hilum being absent or barely maintained and eccentric, size being more than 1 cm, interval increase in size and presence of calcification within. Intramammary lymph nodes (IMLNs) are frequently encountered during breast imaging and have significant clinical implications. Their identification, characterization, and appropriate management require a nuanced understanding of normal and abnormal imaging features across modalities. This discussion synthesizes findings from key studies to explore the relevance of IMLNs, focusing on their role in breast cancer diagnosis and management.

Prevalence and anatomical considerations

IMLNs can occur anywhere within the breast parenchyma but are predominantly located in the upper outer quadrant. Abdullgaffar et al, highlight that the prevalence of IMLNs ranges widely, from incidental findings on imaging to significant markers of malignancy, depending on the patient population and diagnostic modality employed.[9] Their systematic review emphasizes that IMLNs can act as pathways for metastatic spread, underscoring the importance of accurate imaging and interpretation in cancer staging and treatment planning.

Imaging features of normal and abnormal IMLNs

Benign IMLNs generally appear as small, well-circumscribed, ovoid, or reniform structures on imaging. They maintain a central fatty hilum and exhibit stability over time. Bitencourt et al.10 provide a comprehensive overview of multimodality imaging characteristics of normal IMLNs.

Mammography

Benign IMLNs are often visible as circumscribed, oval opacities with a radiolucent hilum.

Ultrasound

Typical features include a hypoechoic cortex and echogenic hilum. Normal nodes exhibit thin, uniform cortical thickness (<3 mm).

MRI

Normal IMLNs display low T1 and high T2 signal intensity with homogeneous contrast enhancement in the hilum. Stability in size and appearance over sequential imaging supports benignity.

Abnormal and malignant IMLNs

Malignant IMLNs, as noted by Dialani et al.11, often demonstrate loss of the fatty hilum, irregular margins, cortical thickening, and increased vascularity. These findings warrant further evaluation through biopsy or advanced imaging techniques. The study stresses that imaging features alone are insufficient; clinical correlation and histopathological confirmation are imperative.

Key features of malignancy

Loss of hilum

The absence of the fatty hilum is a strong predictor of malignancy.

Irregular margins

Malignant nodes often present with spiculated or indistinct borders.

Cortical thickening

A cortex thicker than 3 mm is suspicious, especially when asymmetrical or eccentric.

Contrast enhancement

Dynamic contrast-enhanced MRI can highlight irregular and rapid enhancement patterns associated with malignancy.

Diagnostic and prognostic implications

IMLNs' role in breast cancer is dual: diagnostic marker and prognostic indicator. Solorzano et al, report on a case where metastatic involvement of an IMLN mimicked a benign breast nodule, underscoring the challenge of distinguishing benign from malignant nodes.[12] Their findings demonstrate the necessity of maintaining a high index of suspicion for patients with known malignancy. Abdullgaffar et al, emphasize that the identification of metastatic IMLNs correlates with poorer outcomes and may influence the staging and treatment approach, including the need for systemic therapy or more extensive surgical intervention.[9]

Multimodality imaging approach

Multimodality imaging enhances diagnostic accuracy by leveraging the strengths of different modalities.

Mammography

Ideal for initial screening, especially in identifying calcifications or suspicious opacities. However, its sensitivity for IMLNs may be limited, particularly in dense breasts.

Ultrasound

Adds specificity by allowing real-time evaluation of morphological details, vascularity, and elasticity.

MRI

Offers superior soft-tissue contrast, functional imaging capabilities (e.g., DWI), and sensitivity for detecting subtle abnormalities. Bitencourt et al, advocate for MRI in ambiguous cases or high-risk patients.[10]

Indications for biopsy

Dialani et al, propose clear criteria for biopsy in the absence of concurrent breast cancer.[10] Loss of fatty hilum. Eccentric cortical thickening >3 mm. Progressive increase in size on follow-up imaging. Suspicious enhancement on MRI.

Chen et al, highlight the prevalence and clinical relevance of IMNs, suggesting tailored interventions such as radiation therapy or surgical excision for cases with advanced or metastatic disease.[13] Westra et al, focus on imaging-detected intramammary and axillary lymph nodes (IMLNs), outlining specific biopsy indications, including loss of fatty hilum, irregular margins, and cortical thickening. The study underscores the importance of multimodality imaging for accurate assessment, reducing unnecessary biopsies while ensuring timely intervention for suspicious nodes.[13]

Lam et al, discuss mucinous carcinoma, a rare breast cancer subtype, noting its distinct sonographic appearance, such as hypoechoic, well-defined masses that may mimic benign lesions. High suspicion, coupled with biopsy, is essential for accurate differentiation and diagnosis.[15]

Clinical management

The detection of IMLNs should prompt careful clinical correlation. For benign-appearing IMLNs, surveillance and interval imaging are typically sufficient. Abnormal nodes, particularly those with high suspicion for malignancy, require tissue sampling for definitive diagnosis.

The causes for benign atypical intramammary lymph node are inflammatory condition, patients submitted to breast cancer treatment, including mastectomy or breast conservative surgery and radiation therapy may present atypical reactive IMLN with enlargement and cortical thickening (Figure 2). Sometimes, reactive IMLN may show spontaneous regression on follow-up studies (Figure 3), which confirm its benign aetiology.

Metastatic LN

IMLN are a potential site of locoregional spread for ipsilateral breast carcinoma. The incidence of metastases in these node ranges between 1 and 34% and they are found in the same quadrant as the primary tumour in almost 50% of cases.[8] The evaluation of IMLN should be meticulous in patients with breast cancer. only “high suspicion” features, such as eccentric/diffuse cortical thickness equal to or greater than 5 mm or loss of fatty hilum, should be used for threshold to biopsy in this population.[10] Metastatic IMLN may mimic a synchronous benign mass in a patient with breast cancer; however, its location and proximity of an artery or vein should alert the radiologist to the possibility of a metastatic IMLN (Figures 5 and 6).[11]

CONCLUSION

Intramammary lymph nodes (IMLNs) are frequently observed in breast imaging and have diagnostic implications ranging from benign conditions to metastatic disease. Radiologists must distinguish between typical and atypical benign features and those indicative of malignancy to ensure timely biopsy and treatment of malignant conditions while avoiding unwarranted interventions for benign findings. A comprehensive imaging assessment, incorporating clinical context and follow-up studies, is essential for accurate diagnosis and effective management. Multimodality imaging serves a complementary role, enabling precise differentiation and informed decision-making, ultimately improving patient outcomes by balancing prompt intervention with the prevention of unnecessary procedures.

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