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Pathologic Assessment of Lymph Node Involvement in Patients Undergoing Mastectomy

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ABSTRACT

Introduction: Breast cancer remains a major global health burden, and lymph node involvement is a key pathologic indicator of tumor spread, prognosis, and postoperative treatment planning in patients undergoing mastectomy. Accurate nodal assessment also improves disease staging and therapeutic decision-making. This study aims to evaluate the pathologic status of lymph node involvement in patients undergoing mastectomy.

Material and methods: This retrospective descriptive cross-sectional study was conducted at Shahid Madani Hospital in Tabriz on 250 patients selected by convenience sampling, with sample size estimated using Cochran's formula. Data were extracted from archived medical and pathology records, and clinicopathologic variables, particularly lymph node status and related breast tumor characteristics, were systematically collected and analyzed to evaluate the pattern of nodal involvement in mastectomy patients.

Results: Among 250 mastectomy patients, invasive ductal carcinoma was the predominant subtype (79.2%), most tumors were grade II (57.2%), and mean tumor size was 3.41 ± 1.67 cm. Lymph node involvement was present in 58.4%, with macrometastasis in 51.2% and extranodal extension in 15.6%. Nodal positivity was significantly associated with larger tumor size (3.98 ± 1.78 vs. 2.61 ± 1.14 cm, $P<0.001$), higher grade ($P=0.002$), and lymphovascular invasion (60.3% vs. 23.1%, $P<0.001$).

Conclusion: These findings indicate that lymph node metastasis is common in mastectomy specimens and is closely linked to adverse pathologic features. Larger tumors, higher histologic grade, and lymphovascular invasion appear to be the strongest correlates of nodal spread, underscoring the importance of careful pathologic lymph node assessment for accurate staging, prognostic stratification, and postoperative treatment planning in breast cancer patients.

Introduction

Breast cancer remains the most frequently diagnosed malignancy among women worldwide and continues to represent a major cause of cancer-related mortality despite substantial advances in screening, molecular characterization, and systemic therapy. Its clinical behavior is remarkably heterogeneous, ranging from indolent lesions with excellent long-term outcomes to biologically aggressive tumors associated with early recurrence and distant dissemination.

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Within this broad spectrum, accurate staging at the time of diagnosis and surgery remains essential for prognostication, treatment planning, and long-term follow-up. Among the components of staging, the status of regional lymph nodes has retained a central role because it reflects the interaction between primary tumor biology and metastatic potential, and it often determines the need for adjuvant systemic therapy or regional radiotherapy [1].

The axillary lymph nodes are the most common initial site of regional spread in breast carcinoma, and their involvement has long been recognized as one of the strongest predictors of disease outcome. Even in the era of genomic profiling and targeted treatment, lymph node status continues to influence survival estimates, recurrence risk, and the selection of multidisciplinary therapeutic strategies. The number of involved nodes, the size of nodal metastases, extranodal extension, and the distribution of metastatic deposits all carry prognostic implications. For this reason, pathologic assessment of lymph nodes in breast cancer is not merely a descriptive exercise but a crucial diagnostic process that directly shapes clinical decision-making and institutional treatment pathways [2].

Mastectomy remains an important surgical option in the management of breast cancer, particularly in patients with multicentric disease, large tumor burden relative to breast size, contraindications to breast-conserving therapy, recurrent disease, or personal preference. In many of these patients, evaluation of lymph node status accompanies the surgical procedure through sentinel lymph node biopsy, axillary dissection, or both, depending on clinical and radiologic findings as well as current treatment guidelines. The mastectomy specimen, together with the associated nodal tissue, provides a comprehensive pathologic opportunity to examine the extent of local and regional disease. Such evaluation contributes not only to precise staging but also to a better understanding of patterns of spread in specific patient populations undergoing definitive surgery [3].

Pathologic examination of lymph nodes involves more than counting positive and negative nodes. It includes the identification of macro metastases, micro metastases, and isolated tumor cells, assessment of nodal architecture, evaluation for extranodal extension, and correlation with the histopathologic features of the primary tumor. These details have gained added significance because small-volume nodal disease may carry different clinical implications from extensive nodal replacement, and extranodal extension has been associated in several studies with a greater risk of locoregional recurrence and worse prognosis. Standardized pathologic processing, careful gross dissection, and meticulous microscopic review are therefore essential to avoid understating and to ensure consistent reporting across institutions [4].

The relationship between nodal involvement and primary tumor characteristics has been a persistent area of interest in breast pathology and surgical oncology. Tumor size, histologic grade, lymph vascular invasion, skin or chest wall involvement, molecular subtype, and hormone receptor profile have all been associated to varying degrees with the likelihood of lymph node metastasis. Invasive ductal carcinoma, invasive lobular carcinoma, and other less common histologic subtypes may also demonstrate distinct metastatic behaviors. Understanding these associations is clinically valuable because it may help identify patients at higher risk for nodal disease, refine preoperative assessment, and improve interpretation of pathologic findings in the context of overall tumor biology [5].

In routine practice, the burden of nodal disease found after mastectomy may occasionally differ from preoperative clinical or imaging expectations. Ultrasonography, magnetic resonance imaging, and needle-based axillary sampling can improve preoperative detection of suspicious nodes, yet none of these approaches can fully replace histopathologic confirmation. Occult nodal metastases may still be identified in clinically node-negative patients, whereas some enlarged or radiologically suspicious nodes may ultimately prove reactive rather than metastatic. Consequently, the definitive pathologic evaluation of lymph nodes remains the reference standard for determining actual regional disease involvement, emphasizing the continued relevance of surgical pathology in an increasingly image-driven and biomarker-rich oncologic landscape [6].

The significance of lymph node involvement extends beyond staging because it also intersects with treatment de-escalation and escalation strategies. In selected settings, contemporary breast cancer management has moved toward minimizing axillary surgery to reduce complications such as lymphedema, pain, numbness, and shoulder dysfunction. At the same time, accurate identification of patients with clinically meaningful nodal disease remains essential so that undertreatment does not compromise oncologic outcomes. This balance has intensified the need for reliable pathologic data, particularly in patients undergoing mastectomy, for whom nodal status may influence decisions regarding completion axillary treatment, postmastectomy radiotherapy, and systemic therapeutic intensity. Therefore, careful examination of nodal pathology remains highly relevant even as surgical techniques and treatment algorithms evolve [7].

From a research perspective, evaluating lymph node involvement in mastectomy specimens can also offer insight into disease patterns within a defined clinical population. Variations in nodal positivity may reflect differences in tumor presentation, access to screening, biologic subtype distribution, or referral patterns within a healthcare system. Local institutional studies can therefore provide meaningful data that complement larger international reports, particularly when they characterize the pathologic spectrum of nodal disease in relation to patient and tumor features. Such work can help clinicians better understand the burden of regional metastasis in their own practice environment and may identify trends that support future improvements in diagnosis, treatment planning, and prognostic stratification [8].

Despite notable progress in breast cancer management, the pathologic status of regional lymph nodes continues to be a cornerstone of postoperative evaluation in patients undergoing mastectomy. A systematic assessment of nodal involvement can clarify the extent of disease, strengthen prognostic estimation, and support more individualized postoperative care. It also creates an opportunity to explore how nodal metastasis corresponds with the pathologic characteristics of the primary lesion and the surgical population under study. Accordingly, the objective of this study is to evaluate the pathologic status of lymph node involvement in patients undergoing mastectomy [9].

Material and methods

Study Design:

This retrospective descriptive cross-sectional study was conducted at Shahid Madani Hospital, Tabriz, Iran. The study was designed to evaluate the pathologic status of lymph node involvement in patients who had undergone mastectomy and who's medical and pathology records were available in the hospital archive. Because the study relied on previously documented clinical and histopathologic data, no intervention was performed and no change was made to routine patient management. The retrospective design allowed assessment of the distribution and pattern of lymph node involvement in a defined hospital-based population over the study period using existing records and pathology reports.

Sampling

The sample size was estimated as 250 patients using the Cochran sample size formula, which is commonly applied in descriptive studies to determine the minimum number of subjects required for reliable estimation of study variables. After sample size estimation, patients were selected by convenience sampling from eligible cases registered in the medical record and pathology archive of Shahid Madani Hospital. All accessible records meeting the study criteria during the defined study period were reviewed until the required sample size was reached. This sampling approach was considered appropriate given the retrospective nature of the study and the dependence on available hospital records.

Inclusion and Exclusion Criteria

The study included patients who had undergone mastectomy at Shahid Madani Hospital with a definitive histopathologic diagnosis and a documented pathology report containing information on lymph node evaluation. Eligible cases were required to have complete or sufficiently detailed records regarding demographic characteristics, surgical procedure, and pathologic findings related to the breast specimen and axillary or regional lymph nodes. Patients were included regardless of age if their records clearly documented the presence or absence of lymph node involvement and provided interpretable pathology data. Exclusion criteria comprised incomplete medical files, missing or illegible pathology reports, absence of lymph node assessment in the surgical specimen, duplicate records, uncertain final diagnosis, history of another concurrent primary malignancy affecting interpretation of nodal status, and records lacking essential clinicopathologic variables required for analysis. Cases with insufficient information for confirmation of mastectomy status or nodal pathology were also excluded from the study.

Procedure

After identification of eligible patients, the required data were extracted from hospital records, operative documents, and pathology reports using a structured data collection form. Demographic and baseline variables included age at surgery and available clinical information relevant to the mastectomy case. Pathologic variables related to the primary breast lesion were recorded in detail, including tumor type, histopathologic subtype, tumor size, laterality, histologic grade, and other documented morphologic characteristics reported by the pathologist. Information concerning the surgical specimen was reviewed to ensure consistency between operative records and pathology documentation. The principal outcome variable was lymph node involvement, recorded according to the pathology report as present or absent. In addition, nodal and related pathologic characteristics were documented comprehensively. These variables included the total number of examined lymph nodes, number of involved lymph nodes, extent of nodal involvement, and any available description of metastatic burden in the lymph nodes. Other extracted variables included lymph vascular invasion, margin status where documented, and any additional pathologic features considered relevant to regional disease spread in the pathology report. Data were entered into the study database after verification of consistency and completeness, and all variables were coded in a standardized manner to permit accurate statistical analysis.

Statistical Analysis

Because the data were normally distributed, parametric statistical methods were used for analysis. Descriptive statistics were applied to summarize the study variables, with quantitative data presented as mean and standard deviation and qualitative data reported as frequency and percentage. For comparison of quantitative variables between groups, the independent samples t-test was used when two groups were analyzed and one-way analysis of variance was used for comparisons involving more than two groups. Associations between categorical variables were assessed using the chi-square test, and Fisher’s exact test was applied when expected cell counts were limited. Correlations between continuous variables were evaluated using Pearson’s correlation coefficient. A p-value of less than 0.05 was considered statistically significant. Statistical analysis was performed using the relevant statistical software package.

Ethical Considerations

This study was approved by the Ethics Committee of Tabriz University of Medical Sciences under the ethics code IR.TBZMED.REC.1397.648. All data were collected from archived hospital records and pathology documents in accordance with institutional ethical standards. Patient confidentiality was preserved throughout the study by removing personal identifiers and using the data solely for research purposes. Access to records was limited to the research team, and all procedures were conducted in compliance with ethical principles governing retrospective medical research.

Results

Table 1 shows that the mean age of the patients was 52.34 ± 11.28 years, with the highest proportion belonging to the 50-59-year age group (31.6%). Tumor laterality was nearly evenly distributed between the right breast (48.4%) and the left breast (51.6%). Invasive ductal carcinoma was the predominant histopathologic subtype, accounting for 79.2% of cases, followed by invasive lobular carcinoma in 10.8%. Most tumors were classified as grade II (57.2%), and the mean tumor size was 3.41 ± 1.67 cm, with the majority of patients falling within the 2-5 cm category (61.6%). Lymph vascular invasion was present in 44.8% of patients, while negative surgical margins were observed in 92.4%. In addition, the mean number of examined lymph nodes was 11.72 ± 5.43. Overall, Table 1 indicates that the study population was predominantly characterized by intermediate-grade, moderate-sized tumors, with invasive ductal carcinoma as the most common pathologic type.

Table 1. Baseline demographic and clinicopathologic characteristics of the studied patients

Variable	Value
Age (years), mean ± SD	52.34 ± 11.28
Age group, n (%)	-
<40	38 (15.2)
40-49	64 (25.6)
50-59	79 (31.6)
≥60	69 (27.6)
Tumor laterality, n (%)	-
Right	121 (48.4)
Left	129 (51.6)
Histopathologic type, n (%)	-
Invasive ductal carcinoma	198 (79.2)
Invasive lobular carcinoma	27 (10.8)
Mixed/other types	25 (10.0)
Tumor grade, n (%)	-
Grade I	29 (11.6)
Grade II	143 (57.2)
Grade III	78 (31.2)
Tumor size (cm), mean ± SD	3.41 ± 1.67
Tumor size category, n (%)	
<2 cm	46 (18.4)
2-5 cm	154 (61.6)

>5 cm	50 (20.0)
Lymphovascular invasion, n (%)	-
Present	112 (44.8)
Absent	138 (55.2)
Surgical margin status, n (%)	-
Negative	231 (92.4)
Positive	19 (7.6)
Number of examined lymph nodes, mean ± SD	11.72 ± 5.43

Table 2 demonstrates that lymph node involvement was identified in 58.4% of the studied patients, whereas 41.6% had no nodal metastasis. The mean number of examined lymph nodes was 11.72 ± 5.43, and the mean number of positive lymph nodes was 3.26 ± 2.91. Regarding the extent of nodal disease, 28.8% of patients had 1-3 involved nodes, 19.6% had 4-9 involved nodes, and 10.0% had involvement of 10 or more nodes. In terms of metastatic burden, macro metastasis was far more frequent than micro metastasis, accounting for 51.2% and 7.2% of cases, respectively. Extranodal extension was observed in 15.6% of patients. Overall, Table 2 indicates that more than half of the patients had pathologically confirmed nodal involvement, most commonly in the form of macro metastatic disease with limited to moderate nodal burden.

Table 2. Pathologic characteristics of lymph node involvement in the studied patients

Variable	Value
Lymph node involvement, n (%)	-
Negative	104 (41.6)
Positive	146 (58.4)
Number of examined lymph nodes, mean ± SD	11.72 ± 5.43
Number of positive lymph nodes, mean ± SD	3.26 ± 2.91
Category of involved lymph nodes, n (%)	-
0	104 (41.6)
1-3	72 (28.8)
4-9	49 (19.6)
≥10	25 (10.0)
Extent of nodal metastasis, n (%)	-
Micro metastasis	18 (7.2)
Macro metastasis	128 (51.2)
Extranodal extension, n (%)	
Present	39 (15.6)
Absent	211 (84.4)

Table 3 shows that lymph node-positive patients had a significantly larger mean tumor size than node-negative patients (3.98 ± 1.78 cm vs. 2.61 ± 1.14 cm, P<0.001). Tumor grade was also significantly associated with nodal involvement, with grade III tumors being more frequent in the node-positive group (38.4% vs. 21.1%, P=0.002). Likewise, tumor size category demonstrated a significant relationship with lymph node status, as tumors larger than 5 cm were more common among node-positive patients (26.7% vs. 10.6%, P<0.001). Lymph vascular invasion was markedly more prevalent in patients with nodal metastasis than in those without nodal involvement (60.3% vs. 23.1%, P<0.001). In contrast, age (P=0.312), histopathologic type (P=0.084), and surgical margin status (P=0.118) were not significantly associated with lymph node involvement. Overall, Table 3 indicates that greater tumor burden and the presence of lymph vascular invasion were the variables most strongly associated with pathologic lymph node metastasis.

Table 3. Association between clinicopathologic characteristics and lymph node involvement in the studied patients

Variable	Node-negative n = 104	Node-positive n = 146	P-value
Age (years), mean ± SD	51.48 ± 10.96	52.95 ± 11.51	0.312
Tumor size (cm), mean ± SD	2.61 ± 1.14	3.98 ± 1.78	<0.001
Histopathologic type, n (%)	-	-	0.084

Invasive ductal carcinoma	77 (74.0)	121 (82.9)	-
Invasive lobular carcinoma	15 (14.4)	12 (8.2)	-
Mixed/other types	12 (11.6)	13 (8.9)	-
Tumor grade, n (%)	-	-	0.002
Grade I	19 (18.3)	10 (6.8)	-
Grade II	63 (60.6)	80 (54.8)	-
Grade III	22 (21.1)	56 (38.4)	-
Tumor size category, n (%)	-	-	<0.001
<2 cm	31 (29.8)	15 (10.3)	-
2-5 cm	62 (59.6)	92 (63.0)	-
>5 cm	11 (10.6)	39 (26.7)	-
Lymph vascular invasion, n (%)	-	-	<0.001
Present	24 (23.1)	88 (60.3)	-
Absent	80 (76.9)	58 (39.7)	-
Surgical margin status, n (%)	-	-	0.118
Negative	99 (95.2)	132 (90.4)	-
Positive	5 (4.8)	14 (9.6)	-

Figure 1 demonstrates a clear relationship between tumor size and lymph node status. Node-negative cases were more common among patients with tumors smaller than 2 cm, whereas node-positive cases increased progressively with larger tumor size categories. The highest proportion of nodal involvement was observed in tumors larger than 5 cm, indicating that increasing tumor size was associated with a greater likelihood of pathologically confirmed lymph node metastasis. Overall, the figure highlights tumor size as an important indicator of regional nodal spread in patients undergoing mastectomy.

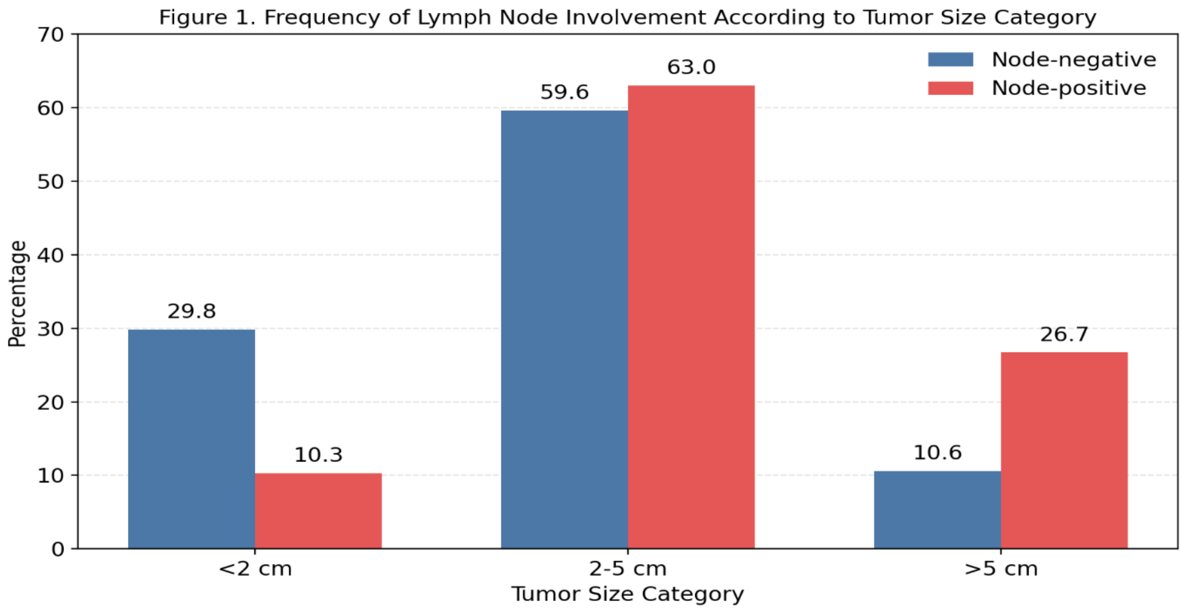

Figure 1. Distribution of Lymph Node Status According to Tumor Size Category

Discussion

In this retrospective cross-sectional study of 250 patients undergoing mastectomy, lymph node involvement was identified in more than half of the cohort, with macro metastasis representing the dominant pattern of nodal disease. The study population was largely characterized by invasive ductal carcinoma, intermediate tumor grade, and moderate tumor size. Most importantly, pathologic nodal positivity showed significant associations with larger tumor size, higher histologic grade, and the presence of lymph vascular invasion, whereas age, histopathologic subtype, and surgical margin status were not significantly related to nodal status. In addition, the distribution shown in Figure 1 reinforced a stepwise increase in nodal metastasis with increasing tumor size, emphasizing the close relationship between primary tumor burden and regional lymphatic spread [10,11].

The high rate of lymph node involvement observed in the present series is clinically plausible and consistent with the biologic behavior of breast carcinoma in patients selected for mastectomy. In many practice settings, mastectomy is more frequently performed for patients with larger tumors, multifocal disease, locally advanced presentation, contraindications to breast-conserving surgery, or patient preference in the context of a substantial tumor burden. As a result, mastectomy-based cohorts may contain a greater proportion of patients with aggressive pathologic features than screening-detected or breast-conserving surgery populations. This selection pattern can partly explain why nodal positivity and macro metastatic disease were common in our patients. Moreover, the predominance of invasive ductal carcinoma and grade II lesions suggests a cohort with the typical histopathologic profile of operable breast cancer, but with enough adverse features to sustain a considerable risk of regional dissemination through axillary lymphatics [12,13].

The strong association between larger tumor size and nodal metastasis is one of the most biologically coherent findings of this study. As tumor size increases, the probability of stromal invasion, lymphatic permeation, and prolonged tumor-host interaction also rises, creating more opportunities for malignant cells to enter regional lymphatic channels. Larger tumors may additionally reflect a longer duration of subclinical growth, during which metastatic subclones acquire the capacity for migration, immune evasion, and implantation in axillary lymph nodes. The significant difference in mean tumor size between node-positive and node-negative patients, together with the excess of nodal involvement among tumors larger than 5 cm, strongly supports this mechanism. The figure-based trend further illustrates that tumor size is not merely a descriptive variable but a practical marker of metastatic potential and disease advancement at the time of surgery [14,15].

The observed relationship between higher tumor grade and nodal positivity is also pathobiologically reasonable. Histologic grade reflects the degree of tumor differentiation, mitotic activity, and nuclear atypia, all of which are linked to proliferation rate and invasive behavior. Grade III tumors are generally associated with genomic instability, accelerated growth, and a greater ability to breach tissue barriers, which may explain their higher frequency among node-positive patients in this study. By contrast, well-differentiated tumors often grow more slowly and may remain localized for longer periods. The present findings therefore support the concept that nodal spread is not determined solely by tumor size, but also by intrinsic tumor aggressiveness. In routine pathology practice, this reinforces the value of integrating nodal evaluation with grade-based risk stratification when estimating prognosis and considering adjuvant systemic treatment after mastectomy [16,17].

Lymph vascular invasion emerged as one of the strongest correlates of nodal metastasis, and this finding deserves particular emphasis. From a mechanistic perspective, lymph vascular invasion is direct morphologic evidence that tumor cells have penetrated endothelial-lined spaces and gained access to the pathways required for regional and distant dissemination. It is therefore unsurprising that patients with lymph vascular invasion had a markedly higher prevalence of nodal positivity than those without it. In practical terms, lymph vascular invasion may serve as an intermediate link between local tumor biology and established metastasis in axillary nodes. Its presence likely reflects both mechanical access to lymphatic channels and an inherently invasive phenotype. For clinicians and pathologists, this means that careful documentation of lymph vascular invasion is essential, because even when other variables are borderline, its presence may identify patients at increased risk for occult or overt regional spread [18,19].

Another notable feature of our results is the predominance of macro metastasis over micro metastasis and the presence of extranodal extension in a meaningful subset of cases. This pattern suggests that many patients in the cohort had not merely early nodal colonization but established regional disease with a substantial metastatic burden. Macro metastatic deposits usually indicate sustained survival and proliferation of tumor cells within the nodal microenvironment, while extranodal extension implies penetration beyond the nodal capsule and is often regarded as a marker of more aggressive disease biology. Together, these findings may reflect delayed presentation, limited screening uptake, or referral of more advanced cases to tertiary surgical care. They also underscore the importance of comprehensive pathologic examination of axillary specimens, because the extent of nodal disease carries implications for final staging, locoregional control strategies, and decisions regarding adjuvant chemotherapy and radiotherapy [20,21].

The lack of a significant association between age and lymph node involvement in this study is also informative. Although age influences breast cancer phenotype at the population level, its relationship with nodal metastasis is often indirect and may be confounded by tumor subtype, screening behavior, and treatment pathways. Younger patients sometimes present with more aggressive biology, whereas older patients may have delays in diagnosis or different hormonal profiles; however, these age-related tendencies do not always translate into a uniform difference in nodal status within a surgically selected cohort. Our findings suggest that once patients proceed to mastectomy, pathologic variables such as tumor size, grade, and lymph vascular invasion may be more decisive than chronological age in determining axillary involvement. This interpretation is compatible with the principle that nodal spread is driven primarily by local invasion dynamics and tumor biology rather than age alone [22,23].

Similarly, the absence of significant associations for histopathologic subtype and surgical margin status can be interpreted in a clinically sensible way. Although invasive lobular carcinoma differs from invasive ductal carcinoma in growth pattern and detectability, both major subtypes are capable of nodal dissemination, and the relatively small number of non-ductal cases in this cohort may have limited the ability to detect subtype-specific differences. Regarding margin status, positive or negative margins reflect the completeness of local excision rather than the metastatic capacity of the primary tumor. A tumor may be completely excised yet already have spread to regional lymph nodes, while a margin-positive lesion may still remain node-negative. Therefore, the lack of correlation between surgical margins and nodal status does not weaken the biologic significance of nodal involvement; instead, it highlights that local residual disease and regional metastasis, although related to tumor behavior, are not identical processes [24,25].

From a broader clinical perspective, the present findings support the continued central role of pathologic lymph node assessment in patients undergoing mastectomy. Even in the era of molecular profiling and increasingly personalized oncology, nodal status remains a cornerstone of staging and prognostic estimation. The data suggest that patients with larger tumors, higher-grade lesions, and lymph vascular invasion deserve particularly meticulous nodal evaluation because they are more likely to harbor metastasis and potentially greater nodal burden. This has practical implications for pathology reporting, multidisciplinary case discussion, and postoperative treatment planning. At the same time, the findings may help inform preoperative counseling by clarifying which tumor characteristics are most strongly linked to regional spread. In resource-limited settings especially, these conventional pathologic factors remain highly valuable because they are accessible, reproducible, and immediately relevant to management decisions [26,27].

Several limitations should be considered when interpreting this study. Its retrospective cross-sectional design limits causal inference, and the findings reflect associations rather than temporal proof of metastatic progression. Because all patients were treated at a single center, referral patterns and local surgical practice may have influenced the case mix, particularly the proportion of advanced tumors managed by mastectomy. In addition, the absence of molecular subtype data, survival outcomes, and treatment response information restricts the ability to explore how biologic subtype and systemic therapy interact with nodal disease. Nonetheless, the study provides a coherent pathologic picture of lymph node involvement in a well-defined mastectomy cohort and identifies clinicopathologic variables that align strongly with established mechanisms of regional spread. Future multicenter studies incorporating receptor status, molecular classification, and long-term outcomes would further refine the prognostic value of these observations [28,29].

Conclusion

Overall, the present study indicates that pathologic lymph node involvement in mastectomy specimens is frequent and is most strongly associated with larger tumor size, higher histologic grade, and lymph vascular invasion. These findings are biologically plausible and clinically relevant, because they reflect the interaction between tumor burden, invasive potential, and access to lymphatic channels. The predominance of macro metastasis further suggests that a substantial proportion of patients present with established regional disease. Taken together, the results reinforce the importance of detailed axillary pathologic assessment and careful interpretation of adverse tumor features in order to improve staging accuracy, prognostic stratification, and postoperative therapeutic planning for patients with breast cancer undergoing mastectomy.

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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