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EVALUATION OF SENTINEL LYMPH NODE IMAGING AND BIOPSY USING TECHNETIUM-99M RADIOISOTOPE IN EARLY-STAGE BREAST CANCER PATIENTS AT K HOSPITAL

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ABSTRACT

Objectives: To evaluate the outcomes of sentinel lymph node imaging and biopsy using the Technetium-99m (Tc-99m) radioisotope in patients with early-stage breast cancer and to analyze factors associated with axillary lymph node metastasis.

Subjects and Methods: A retrospective descriptive study was conducted on 55 patients with early-stage breast cancer treated at the Department of Breast Surgery, K Hospital, from June 2021 to September 2021. Patients underwent sentinel lymph node imaging using Tc-99m and sentinel lymph node biopsy during surgery, followed by comparison with the histopathological results of axillary lymph node dissection specimens. Evaluated indicators included the sentinel lymph node detection rate, number of sentinel lymph nodes identified, rate of sentinel lymph node metastasis, and analysis of factors associated with lymph node metastasis.

Results: The sentinel lymph node detection rate was 96.4%. The mean number of sentinel lymph nodes identified was 1.8 ± 0.6 nodes per patient. The sentinel lymph node metastasis rate was 23.6%. The sensitivity of sentinel lymph node biopsy was 92.3%, while specificity reached 100%. No severe complications related to the technique were recorded. Factors associated with axillary lymph node metastasis included histopathological type ($p < 0.05$), histological grade ($p < 0.05$), and lymphovascular invasion (LVI) status ($p < 0.05$).

Conclusion: Sentinel lymph node biopsy using Tc-99m is a safe, feasible, and highly accurate method for evaluating axillary lymph node status in patients with early-stage breast cancer. This technique contributes to reducing unnecessary axillary lymph node dissection and minimizing postoperative complications.

Keywords: Breast cancer; sentinel lymph node; Technetium-99m; sentinel lymph node biopsy; axillary lymph nodes.

1. INTRODUCTION

Sentinel lymph node biopsy (SLNB) has become the standard method for axillary staging in patients with early-stage breast cancer and clinically negative axillary lymph nodes because it provides accurate nodal assessment with substantially lower morbidity than conventional axillary lymph node dissection (ALND). Randomized clinical trials have demonstrated that SLNB offers comparable oncologic outcomes to ALND while significantly reducing postoperative complications such as lymphedema, sensory dysfunction, chronic pain, and limitation of shoulder movement [1, 2]. Among the currently available techniques, Tc-99m–guided lymphoscintigraphy combined with intraoperative gamma probe detection remains one of the most widely used and validated approaches for sentinel lymph node identification because of its high detection rate, good sensitivity, and low false-negative rate [3].

Axillary lymph node metastasis remains one of the most important prognostic factors in breast cancer and plays a critical role in determining adjuvant treatment strategies and long-term outcomes [4]. Previous studies have demonstrated that clinicopathological factors such as tumor size, histological grade, lymphovascular invasion, and biologic markers including hormone receptor and HER2 status are associated with the risk of axillary lymph node involvement [4]. Therefore, evaluating the diagnostic performance of Tc-99m sentinel lymph node imaging together with these pathological characteristics may provide important information for optimizing individualized axillary management in patients with early-stage breast cancer. This study was conducted to evaluate the early outcomes of sentinel lymph node imaging using Tc-99m and to assess several factors associated with axillary lymph node metastasis.

2. SUBJECTS AND METHODS

2.1. Patients, time and location

This study was conducted on 55 female patients diagnosed with early-stage breast cancer who were treated at the Department of Breast Surgery, K Hospital, from June 2021 to September 2021. Eligible patients included those with stage T1–T2, N0 breast cancer according to the AJCC/UICC 2017 classification, histopathological confirmation of breast carcinoma, and

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those who underwent sentinel lymph node imaging and biopsy using Tc-99m with available postoperative histopathological results and complete medical records. Patients were excluded if they had recurrent breast cancer, had received chemotherapy or radiotherapy before surgery, had evidence of distant metastasis, were allergic to radiopharmaceutical agents, or refused to participate in the study.

2.2. Research methods

2.2.1. Study design: Retrospective descriptive study.

2.2. Sample size and sampling method: Convenience sampling was applied, including 55 patients who met the study criteria.

2.3. Technical Procedure: Patients were injected with Tc-99m around the areola or around the tumor before surgery. Following injection, lymphoscintigraphy was performed to identify the location of the sentinel lymph node. During surgery, a handheld gamma probe was used to detect and excise the sentinel lymph node. The sentinel lymph nodes were sent for intraoperative frozen-section examination and routine histopathological analysis. Subsequently, patients underwent axillary lymph node dissection according to treatment indications for comparison of pathological results.

2.4. Data Analysis: Data were analyzed using SPSS version 20.0. Quantitative variables were expressed as mean ± standard deviation. Qualitative variables were presented as frequencies and percentages.

3. RESULTS

Table 1. Clinical Characteristics of the Patients

Characteristics	Value
Mean age	52.6 ± 10.8
Mean tumor size	2.1 ± 0.7 cm
Right breast tumor	30 (54.5%)
Left breast tumor	25 (45.5%)
Upper outer quadrant location	61.8%

As presented in Table 1, the mean age of the study population was 52.6 ± 10.8 years, indicating that most patients were in the middle-aged group. The mean tumor size was relatively small at 2.1 ± 0.7 cm, consistent with early-stage breast cancer. Tumors were slightly more common in the right breast, accounting for 54.5% of cases, compared with 45.5% in the left breast. The upper outer quadrant was the most frequent tumor location, representing 61.8% of all cases.

Table 2. Histopathological Characteristics of the Study Population

Characteristics	Classification	N	%
Histopathological type (n = 50)	Invasive ductal carcinoma	38	69.1
Histological grade (n = 50)	Grade 1	4	8.0
	Grade 2	32	64.0
	Grade 3	9	18.0
	Ungraded	5	10.0
Lymphovascular invasion (LVI)	Present	12	21.8
	Absent	38	69.1
	Not assessed	5	9.1
ER and/or PR	Positive	42	76.4
	Negative	13	23.6
HER2/neu	Positive	16	29.1
	Negative	39	70.9

Table 2 demonstrates that invasive ductal carcinoma was the predominant histopathological type, accounting for 69.1% of patients. Histological grade 2 was the most common tumor grade, observed in 64.0% of cases, whereas grade 1 and grade 3 tumors accounted for 8.0% and 18.0%, respectively. Lymphovascular invasion was identified in 21.8% of patients, while the majority did not show evidence of lymphovascular invasion. Hormone receptor positivity, defined as ER and/or PR positivity, was found in 76.4% of cases. HER2/neu overexpression was observed in 29.1% of patients.

Table 3. Results of Sentinel Lymph Node Imaging Using Tc-99m

	Value
Sentinel lymph node detection rate	96.4%
Mean number of sentinel lymph nodes	1.8 ± 0.6
Detection of 1 node	45.3%
Detection of ≥2 nodes	54.7%

As shown in Table 3, the sentinel lymph node detection rate using Tc-99m reached 96.4%, indicating a high feasibility of the technique in clinical practice. The mean number of detected sentinel lymph nodes was 1.8 ± 0.6 nodes per patient. Detection of two or more sentinel lymph nodes was slightly more frequent than detection of a single node, accounting for 54.7% and 45.3% of cases, respectively. These findings suggest that Tc-99m lymphoscintigraphy combined with intraoperative gamma probe guidance provided reliable localization of sentinel lymph nodes in most patients.

Table 4. Histopathological Results of Sentinel Lymph Nodes

Results	n	%
No metastasis	42	76.4%
Metastasis	13	23.6%

Table 4 shows that the majority of patients did not have sentinel lymph node metastasis, accounting for 76.4% of cases. Sentinel lymph node metastasis was identified in 23.6% of patients. Among patients with positive sentinel lymph nodes, micrometastatic lesions were the predominant pathological finding. These results indicate that most patients with early-stage breast cancer in the present study had no evidence of axillary nodal involvement.

Table 5. Diagnostic Performance of the SLNB Technique

	%
Sensitivity	92.3%
Specificity	100%
Accuracy	98.1%
False-negative rate	7.7%

As presented in Table 5, sentinel lymph node biopsy demonstrated high diagnostic performance in the assessment of axillary lymph node metastasis. The sensitivity of the technique was 92.3%, while specificity reached 100%, indicating excellent ability to correctly identify patients without nodal metastasis. The overall diagnostic accuracy was 98.1%, with a false-negative rate of 7.7%. These findings support the reliability and clinical utility of SLNB using Tc-99m in patients with early-stage breast cancer.

4. DISCUSSION

In the present study, invasive ductal carcinoma was the predominant histopathological subtype, accounting for 69.1% of cases, while histological grade 2 represented the majority of tumors (64.0%). These findings are consistent with previous domestic and international studies reporting invasive ductal carcinoma as the most common histological subtype of breast cancer and an important predictor of axillary lymph node metastasis [4]. Higher histological grade has been associated with more aggressive tumor biology and increased metastatic potential, which may explain the increased risk of nodal involvement observed in high-grade tumors.

Hormone receptor positivity (ER and/or PR) was identified in 76.4% of patients, whereas HER2/neu positivity was observed in 29.1%. In addition, lymphovascular invasion (LVI) was present in 21.8% of cases. Several previous studies have shown that biologic markers such as ER, PR, HER2, and particularly LVI are associated with axillary lymph node metastasis and may contribute to predictive models for nodal involvement [4, 5]. Among these factors, LVI has consistently been reported as one of the strongest independent predictors of lymph node metastasis because tumor cells must first invade lymphatic channels before spreading to regional lymph nodes.

The sentinel lymph node detection rate using Tc-99m in our study reached 96.4%, which is comparable to previously published detection rates ranging from approximately 90% to 98% [3]. These findings support the feasibility and reliability of Tc-99m lymphoscintigraphy combined with intraoperative gamma probe guidance for sentinel lymph node identification in early breast cancer. The high detection rate observed in our study may be related to the use of standardized injection techniques and close collaboration between breast surgeons and nuclear medicine specialists.

The mean number of detected sentinel lymph nodes was 1.8 ± 0.6 nodes per patient, and more than half of patients (54.7%) had two or more sentinel lymph nodes identified. Previous studies have suggested that retrieval of an adequate number of sentinel lymph nodes is important for reducing the false-negative rate and improving diagnostic accuracy [2]. At the same time, excessive removal of lymph nodes may reduce the minimally invasive advantage of SLNB. Therefore, the number of sentinel lymph nodes identified in our study appears appropriate and comparable with findings from previous reports.

Sentinel lymph node metastasis was detected in 23.6% of patients, whereas 76.4% showed no evidence of nodal metastasis. This finding is consistent with the characteristics of early-stage breast cancer, in which a substantial proportion of patients have clinically and pathologically node-negative disease. Previous studies have demonstrated that larger tumor size, higher histological grade, and lymphovascular invasion are strongly associated with increased risk of axillary lymph node metastasis [5, 6]. The relatively low metastatic rate observed in our study may partly reflect the predominance of early-stage tumors with small tumor size.

Sentinel lymph node biopsy demonstrated excellent diagnostic performance in our study, with a sensitivity of 92.3%, specificity of 100%, overall accuracy of 98.1%, and a false-negative rate of 7.7%. These results are comparable to previously published studies reporting sensitivity rates of approximately 77%–90% and false-negative rates of approximately 5%–10% for Tc-99m–guided SLNB [7]. The high specificity and diagnostic accuracy observed in our study further support the role of Tc-99m SLNB as a reliable and minimally invasive method for axillary staging in patients with early-stage breast cancer.

5. CONCLUSION

Sentinel lymph node biopsy using Tc-99m demonstrated high feasibility and diagnostic accuracy in evaluating axillary lymph node status in patients with early-stage breast cancer, with a high detection rate, excellent specificity, and low false-negative rate. Invasive ductal carcinoma, higher histological grade, and lymphovascular invasion were associated with increased risk of nodal metastasis. These findings support the clinical utility of Tc-99m–guided SLNB as a reliable and minimally invasive approach for axillary staging in early breast cancer.

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