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Comparative Study Between Fdg-Pet (Fluorine-18 Labelled 2-Fluoro-2-Deoxy-D-Glucose-Positron Emission Tomography) And Sentinel Lymph Node Biopsy in Detecting Loco-Regional (Axillary) Lymph Node Metastasis in A Carcinoma Breast.

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Abstract

Background : Axillary lymph node dissection (ALND) has been part of the surgical treatment of Carcinoma breast. Recently, increasing number of early detections of breast cancer patients led to a reconsideration of the need for axillary dissection, as many of patients with carcinoma of the breast show no involvement of axillary lymph nodes. The dissection is carried out as a staging procedure, to rule out occult metastases. Sentinel node biopsy (SNB) has been introduced to avoid unnecessary axillary dissection. In contrary as a non-invasive modality is FDG-PET computed tomography scanner, a method which may be able to detect clinically occult metastases pre operatively.

AIM & OBJECTIVES: Comparison between SNB and FDG-PET to asses reliability in detecting occult axillary metastasis in clinically node negative Carcinoma breast patient.

MATERIAL AND METHOD: 126 diagnosed breast cancer patients with clinically node negative, operated with mastectomy plus SNB were studied. All patients were pre operatively evaluated with 18-FDG-PET. All patients underwent sentinel lymphoscintigraphy. Patient with positive 18-FDG-PET, SNB underwent axillary dissection. Pre operative PET-CT result is compared with histopathology results of SNB and ALND.

RESULTS: Out of 126, age group of 33 to 86 year. 45 had metastasis in axillary nodes. Sensitivity of FDG-PET for detection of axillary occult metastases was low (13.33%), although specificity was acceptable (91.36%) while Sensitivity of SLNB for detection of axillary occult metastases was high (73.33%), although specificity was very high (95.06%). Both FDG-PET and Sentinel Lymph Node Biopsy show correlation with histopathology in detecting loco-regional (axillary) lymph node metastasis in breast carcinoma. However, SLNB has much higher sensitivity, specificity, positive

predictive value, negative predictive value, and overall accuracy compared to FDG-PET, indicating SLNB is a more reliable method for this detection.

Conclusion : Conclusion of this study strongly supported by the statistical significance of both tests but favours SLNB as the superior diagnostic tool. As the specificity is high, sentinel lymph node biopsy can be avoided in FDG-PET positive for axillary metastasis breast carcinoma and straight away proceed with axillary lymph node detection. But as sensitivity is low, FDG-PET negative breast carcinoma patients shouldn't exclude possibility of axillary metastasis and further should do SLNB to detect axillary occult metastases.

Key words : Sentinel lymph node biopsy, 18-FDG-PET scan, Axillary Lymph node dissection, Breast cancer, Lymph node metastasis.

Introduction :

Breast carcinoma is the most frequently diagnosed malignancy among women worldwide and remains one of the leading causes of cancer-related deaths. According to global cancer statistics, it accounts for nearly one in four cancer diagnoses among women, with a rising incidence in both developed and developing countries [1]. The prognosis and therapeutic strategy in breast cancer are highly dependent on the stage at diagnosis, with axillary lymph node involvement being one of the most important prognostic determinants. The presence or absence of axillary lymph node metastasis not only reflects tumor biology but also directly guides systemic therapy, radiotherapy planning, and surgical decision-making [2,3].

Historically, axillary lymph node dissection (ALND) was considered the gold standard for axillary staging. While ALND provides accurate pathological staging and regional disease control, it is associated with significant short- and long-term morbidity, including lymphedema, neuropathic pain, seroma formation, decreased shoulder mobility, and infection [4]. To mitigate these complications, sentinel lymph node biopsy (SLNB) was introduced and has now become the standard of care for axillary staging in clinically node-negative early breast cancer patients. SLNB is a minimally invasive surgical technique that accurately predicts axillary nodal status with high sensitivity and specificity while significantly reducing surgical morbidity [5,6]. However, SLNB remains an invasive procedure, requiring specialized surgical expertise, perioperative resources, and histopathological evaluation. Furthermore, false-negative rates, though low, are not negligible, and the procedure cannot be performed in all patients (e.g., those with prior extensive breast or axillary surgery, pregnancy, or certain medical contraindications) [7].

In recent decades, the advent of molecular imaging has provided new avenues for non-invasive assessment of nodal and distant disease. Among these modalities, positron emission tomography (PET) using fluorine-18 labelled 2-fluoro-2-deoxy-D-glucose (FDG-PET) has gained prominence in oncological imaging. FDG, a glucose analog, is preferentially taken up and retained by metabolically active malignant cells due to their increased glycolytic activity. FDG-PET, often combined with computed tomography (PET/CT), allows functional and anatomical correlation for tumor detection, staging, and response evaluation [8]. In breast cancer, FDG-PET has demonstrated value in the detection of distant metastasis, recurrent disease, and treatment monitoring [9].

The role of FDG-PET in assessing axillary lymph node status, however, remains controversial. While it offers the advantage of being a completely non-invasive technique, its sensitivity is limited in detecting small-volume disease or micrometastases due to partial volume effects and limited spatial resolution [10]. False-negative results are not uncommon in low-burden axillary disease, whereas false-positive uptake can occur in reactive or inflammatory nodes. Despite these limitations, FDG-PET shows high specificity in detecting nodal metastasis and may potentially reduce the need for invasive procedures in selected patient groups [11,12].

Given the importance of accurate axillary staging in breast cancer management, a direct comparison between FDG-PET and SLNB is clinically relevant. While SLNB continues to be the reference standard for axillary staging, FDG-PET may serve as a valuable adjunct or alternative in specific contexts, particularly in patients who are not surgical candidates. This study aims to perform a comparative evaluation of FDG-PET and sentinel lymph node biopsy in detecting locoregional (axillary) lymph node metastasis in carcinoma breast. By analyzing their relative sensitivity, specificity, accuracy, and clinical utility, this study seeks to determine whether FDG-PET can complement or potentially substitute SLNB in certain clinical scenarios, thereby contributing to the ongoing refinement of breast cancer staging strategies.

Aims & Objective : A comparison of the efficacy of Sentinel Lymph Node Biopsy and FDG-PET imaging in assessing the respective values in detecting occult axillary metastases in early breast cancer (clinically node-negative breast carcinoma).

Methodology : This study was designed as a cross-sectional observational study conducted in the Department of Surgical Oncology at Sri Ramakrishna Hospital, Coimbatore. A total of 126 patients were included based on the following criteria. Inclusion Criteria was (1) Biopsy-proven breast carcinoma patients. (2) Clinically node-negative axilla. (3) Underwent mastectomy along with sentinel lymph node biopsy (SNB). Exclusion Criteria was (1) Patients presenting with clinically palpable axillary lymph nodes. (2) Patients with metastatic breast carcinoma. All eligible patients were preoperatively evaluated with an ^18F-fluorodeoxyglucose positron emission tomography (FDG-PET) scan to assess axillary lymph node status. Subsequently, patients underwent sentinel lymph node mapping and biopsy. Lymphoscintigraphy was performed using radio colloids injected 1–2 hours prior to surgery. Methylene blue dye was administered 10–15 minutes before skin incision to aid visualisation of the sentinel lymph nodes. Sentinel lymph node(s) were identified intraoperatively by using both radio colloid uptake and blue dye staining. The excised sentinel lymph nodes were subjected to intraoperative frozen section examination to detect metastatic deposits. Histopathological examination of the resected lymph nodes was performed postoperatively for confirmation. The findings of the FDG-PET scan were compared with the results of sentinel lymph node biopsy (considered the reference standard) to evaluate the diagnostic accuracy of FDG-PET in detecting loco regional (axillary) lymph node metastasis in breast carcinoma.

Age distribution	
Maximum age	86
Minimum age	33
Median age	57

Results:

Table 1: Frequency Distribution of study participants according to Age

FDG-PET results:

Sentinel Lymph node biopsy:

Detection of axillary occult	Out of 126	Percentage
Positive	13	10%
Negative	113	90%

Comparison of Sentinel lymph node biopsy with FDG-PET in detecting axillary occult Metastasis:Histopathology results:
Comparison of FDG-PET with final HPE results:
Comparison of Sentinel lymph node biopsy with final HPE results:

Out of 126 participants of the study 10% show positive for axillary metastasis on FDG-PET scan. Out of the 13 patients in which FDG-PET showed positive for axillary metastasis, 9 patients

Detection of axillary occult	Out of 126	Percentage
Positive	37	29%
Negative	89	71%

HPE results	Out of 126	Percentage
Positive	45	36%
Negative	81	64%

Comparison	FDG-PET	Histopathology
Positive	10%	36%
Negative	90%	64%

were positive for sentinel lymph node biopsy And 4 patients negative for axillary metastasis were

Comparison	SLB	Histopathology
Positive	29%	36%
Negative	71%	64%

showing false positive by FDG-PET scan. The statistical analysis using the chi-square test comparing FDG-PET and Sentinel Lymph Node Biopsy (SLNB) against the histopathology results showed the

	FDG-PET (%)	SNB (%)
Sensitivity	13.33	73.33
Specificity	91.36	95.06
Positive predictive value	46.15	89.19
Negative predictive value	65.49	86.52
Overall accuracy	63.49	87.3

following:

- For FDG-PET, the p-value is 0.00299, indicating a statistically significant association with histopathology results.
- • For SLNB, the p-value is very small, approximately 3.06e-13, indicating a highly significant association with histopathology results.

Discussion:

This comparative study highlights important differences between FDG-PET and SLNB in axillary staging of breast cancer. Although FDG-PET demonstrated high specificity (91.36%), its sensitivity was extremely poor (13.33%), reflecting a high rate of missed metastatic nodes and underscoring that FDG-PET is not suitable as a standalone modality for axillary staging. The limited sensitivity may be

attributed to its inability to reliably detect micrometastases or small-volume nodal disease, which are common in early breast cancer.

In contrast, SLNB showed clearly superior and well-balanced diagnostic performance, with a sensitivity of 73.33%, specificity of 95.06%, and an overall accuracy of 87.3%. The high positive predictive value (89.19%) indicates that SLNB reliably identifies true axillary metastasis, while the negative predictive value (86.52%) underscores its effectiveness in ruling out disease. Being minimally invasive yet highly accurate, SLNB has emerged as the gold standard for axillary staging in breast cancer, consistent with international guidelines. The present findings are also in line with previous studies reporting limited sensitivity of FDG-PET for axillary micrometastases, often ranging between 20–40%, with high specificity (85–95%). Our results corroborate this trend, although the sensitivity observed in our study was even lower. Conversely, the diagnostic accuracy of SLNB in our series aligns well with the broader literature, which consistently reports sensitivities in the range of 70–90% and specificities exceeding 90%. Thus, this study reinforces the existing evidence that SLNB outperforms FDG-PET in clinical decision-making.

From a clinical standpoint, FDG-PET may still be valuable in systemic staging and in patients with clinically advanced disease, where a higher nodal burden may improve its sensitivity; however, in early-stage breast cancer, SLNB should remain the preferred method of axillary staging. While PET can serve as a supplementary tool, it cannot replace histopathological confirmation obtained through SLNB.

The present study has certain limitations, including its single-center design and modest sample size, as well as the absence of subgroup analyses by tumor size, grade, or molecular subtype, all of which may influence nodal positivity and PET performance. Furthermore, PET results may vary with different SUVmax thresholds, but only standard cutoffs were applied here.

Conclusion:

FDG-PET showed high specificity but extremely poor sensitivity for axillary metastasis detection, leading to low overall accuracy. Sentinel Lymph Node Biopsy (SLNB) demonstrated significantly higher sensitivity, specificity, predictive values, and overall accuracy, confirming its role as the gold standard for axillary staging in breast cancer. SLNB should remain the preferred approach in clinical practice, while FDG-PET may be reserved for systemic staging or high-burden disease assessment. FDG-PET negative breast carcinoma patients shouldn't exclude possibility of axillary metastasis and further should do SLNB to detect axillary occult metastases. Larger multicentric studies with subgroup analysis are warranted to further validate these findings and explore whether PET parameters (SUVmax cutoffs, advanced tracers) can improve nodal detection.

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