Clinical Correlation of Maximum Standardised Uptake Value (SUVmax) in Positron Emission Tomography-Computed Tomography (PET-CT) with Initial Disease Staging of Carcinoma Breast- An Observational Study at Indian Tertiary Care Centre

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ABSTRACT

BACKGROUND
The most common primary malignant disease in the world amongst women is carcinoma breast. Metabolic activity of a lesion (SUVmax) has strong clinical correlation with various prognostic factors according to numerous literature reviews. The main aim of this study is to assess the correlation between maximum Standardized Uptake Value [SUVmax] and initial disease staging (as per AJCC TNM-8th edition). We wanted to study the correlation between metabolic activity [SUVmax] of the primary tumour in breast carcinoma, and size of the primary, nodal and distant metastatic status.

METHODS
This is an observational study conducted over a period of two years in breast cancer patients [n=139] undergoing PET-CT as a part of initial staging. PET-CT was done using Siemens Horizon True-V PET according to institutional protocols.

RESULTS
Significantly higher SUVmax values were observed in tumours with larger size [>2 cms]. However, there was no significant correlation between SUVmax of primary tumours and the status of axillary nodal involvement and distant metastases [p = 0.125 and 0.847 respectively].

CONCLUSIONS
Metabolic activity of primary breast cancer has strong clinical correlation with size; however, there is no such correlation found in nodal and metastatic spread of the disease.

KEY WORDS
Carcinoma Breast, PET-CT, Tumour Size, Axillary Nodes, Distant Metastasis

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Various diagnostic and screening modalities and protocols are being formulated and constantly revised to help in the evaluation of breast carcinoma to help in the early diagnosis and accurate staging of the tumour, so as to initiate appropriate therapy at the earliest. Before initiating therapy, it is highly recommended to perform a staging/metastatic workup,[1-3] and obtain the histopathological characteristics of the tumour.[1-3] Multiple new treatment modalities are available, which are tailored to the grade and stage of the tumour.[2-4] Newer drugs targeted at the molecular level are also available which are selected according to the hormonal receptor expression by the tumour cells.[5] The prognosis of the patients significantly improves when the pre-treatment staging is accurate and the stage-appropriate therapy guidelines are followed.[6]

Previously, metastatic workup used to consist of a chest X-ray, ultrasonography screening of abdomen and Bone scintigraphy. As these consist of multiple individual tests and diagnostic yield of the above modalities in detecting early metastatic disease is quite low, the use of PET-CT as a single modality for screening the whole body for metastases is quite beneficial,[7] as the patient compliance and diagnostic sensitivity is better as compared to conventional modalities.[8-12]

Previous imaging modalities like USG, Mammogram and CT/MRI are designed to provide anatomical information with good resolution, but they lack any functional information. Nuclear scintigraphy, PET and other nuclear imaging studies are capable of providing information about the metabolic activity of the tumour under evaluation. However, their major drawbacks include poor anatomical localisation and low spatial resolution. With the advent of PET-CT fusion imaging those drawbacks has been rectified and the resultant imaging data provides combined anatomical and functional information with excellent spatial resolution and precise anatomical localisation.

PET-CT is performed by injecting the patient with radioactive isotope [18F-Fluro Deoxy Glucose in our case] and scanning the patient. The radioisotope accumulates within the tissues with high metabolic activity i.e., tumour cells and these tissues show up as areas of increased uptake [hot-spots]. The PET metabolic data is fused with CT anatomical/morphologic data, which help us localise the tumour better.[13] PET-CT also plays a significant role in detecting and localising metastases.[13]

BACKGROUND

Inclusion Criteria
- Patients undergoing primary staging evaluation for breast carcinoma.
- Patients with complete histopathological data, i.e., histological type, Nottingham grading and immunohistochemistry panel including Oestrogen receptor status [ER], Progesterone receptor status [PR], HER-2 receptor status [HR] and ki-67 labelling index.

Exclusion Criteria
- Patients who have general contraindications for undergoing PET-CT such as pregnancy and breastfeeding.
- Patients who have undergone any form of treatment before PET-CT such as chemotherapy, radiotherapy or any form of allopatic/homeopathic medications targeted for breast carcinoma.
- Patients without the required histopathological data/immunohistochemistry markers.

Materials and Methods
- Equipment used: Siemens Biograph Horizon TRUE V PET/CT.
- Software: syngo.via version VB30A.
- Radiotracer Used: 18F-Flurideoxyglucose [Dose: 5-10 mCi].
- Contrast Media Used: Iohexol [Trade name - Omnipaque 350 mg/dL] [dose - 1.5 mg/kg]

Statistical Analysis
Statistical analysis is done by independent sample-t test with significance set at p<0.05.

METHODS

An observational study was conducted in radiology department of Sri Ramachandra Institute of Higher Education and Research from November 2017 to October 2019 in 139 consecutive eligible patients who were referred for whole body PET-CT for diagnosis and staging of Primary breast carcinoma. Institutional Ethics committee approval was obtained for the study. Informed consent was obtained from all the patients.

RESULTS

Difference in SUVmax Value of Primary Tumour in Relation to Tumour Size
In keeping with the previous literature, we divided the patients into two groups, with the first group [n = 33] consisting of patients with primary tumours ≤ 2 cm in size [greatest dimension] and the second group [n = 106] consisting of patients with tumours > 2 cm. The mean ± SD value of SUVmax of primary tumours ≤ 2 cm was 6.0 ± 4.6 and that of tumours > 2 cm was 10.83 ± 8.46. The difference between the two groups was found to be statistically significant [p = 0.002] as shown in table 1.

| Size ≤ 2 cm | Size > 2 cm |
|-------------|-------------|
| 33          | 106         |
| Mean SUVmax | 6.0         |
| SD          | 4.6         |

Table 1. Independent Sample t-test for Difference in the SUVmax and Size of the Primary Tumour

Correlation of SUVmax Value of Primary Tumour with Axillary Nodal Involvement
In our study of 139 patients, 100 patients had axillary nodal involvement at the time of initial scan and 39 patients did not...
have axillary nodal involvement. The mean ± SD of SUVmax values of cases with axillary nodal involvement and without axillary nodal involvement were 10.37 ± 7.73 and 7.93 ± 8.5 respectively. Even though the mean SUVmax of tumours with axillary nodal involvement was higher [10.37 vs. 7.93], the difference between the groups was not statistically significant \( [p = 0.125] \) as shown in table 2.

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### CONCLUSIONS

SUVmax of tumours >2 cms size was significantly higher than that of tumours ≤2 cms \([p=0.002]\). No significant correlation was observed between SUVmax of primary tumours and the status of axillary nodal involvement and distant metastases \([p = 0.125\) and 0.847 respectively].

### Data Availability

The data can be made available to the readers upon request to corresponding author of this article.

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