Metastatic Pattern of Breast Carcinoma Observed in PET-CT Imaging at INMAS Suhrawardy

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ABSTRACT

Introduction: Metastasis from breast carcinoma accounts for the majority of the death from this disease. Hybrid imaging like PET-CT is an integral part of staging breast carcinoma, selection of therapy, and detection of metastases.

Patients and methods: Histopathologically proven breast carcinoma patients before or after surgery, chemotherapy and radiotherapy who had undergone whole body 18F-FDG PET-CT at Institute of Nuclear Medicine & Allied Sciences, (INMAS) Suhrawardy, between May, 2024 to December, 2024 were retrospectively studied to assess the pattern of metastases.

Results: A total of 33 breast carcinoma patients with a mean age of 51.4 ± 12 years were studied. Among them infiltrating ductal cell carcinoma (IDC) was found in 22 (66.7%), lobular carcinoma in 5 (15.1%), mucinous carcinoma in 2 (6.1%), triple negative breast carcinoma in 2 (6.1%), ductal cell carcinoma in situ in 1(3.03%) and metaplastic carcinoma in 1(3.03%). Out of 22 IDC cases, 15 (68%) were diagnosed with lung metastasis and 3 (60%) out of 5 cases of lobular breast carcinoma metastasized to bones. Other than axillary lymph nodes, breast carcinoma often metastasizes to mediastinal lymph nodes. Two patients presented with rare metastasis in the ovary and adrenal gland.

Conclusions: ^{18}F-FDG PET-CT findings of breast carcinoma have a substantial impact on therapeutic strategies, and stage migration may require a significant change in the management protocol to provide proper treatment.

Keywords: Whole body PET-CT, breast carcinoma, metastasis, staging

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INTRODUCTION

Breast carcinoma (BC) is the most prevalent cancer among women worldwide, and it is the leading cause of cancer-related deaths in women globally (1). Metastatic breast carcinoma (MBC) is considered an incurable disease with a 5-year overall survival of only 25% (2).

BC can metastasize to several organs; the most frequent metastatic sites include bone, lungs, liver, and skin. In the war against BC, metastasis remains a primary clinical challenge as it is unpredictable in onset, and it exponentially increases the clinical impact to the patient (3). An accurate diagnostic workup is paramount for staging and monitoring treatment effects (4).

^{18}F-FDG PET-CT is used in the staging of breast carcinoma, estimation of the therapeutic response, revelation of recurrent disease, and distant metastasis. However, with the increasing use of ^{18}F-FDG PET-CT, physicians can easily detect unexpected locations of metastasis that may not correlate with the patient's clinical history or the expected propagation of the primary malignancy (2).

^{18}F-FDG PET-CT has shown superior accuracy compared with conventional imaging for diagnosing distant metastases (5). Specifically, it has been suggested that ^{18}F-FDG PET-CT has a higher sensitivity when assessing metastatic bone lesions and higher specificity for metastatic liver lesions than CE-CT (6). Consequently, ^{18}F-FDG PET-CT has been added as a potential replacement for conventional imaging in recent international guidelines (2).

PATIENTS AND METHODS

Study design

This single-institution based retrospective study of 33 patients with histologically proven BC done at INMAS from May 2024 to December 2024, with the aim to determine the distribution and metastatic pattern of different type of BC.

Patients

Prior to undergoing examination, all 33 patients were required to complete a written informed consent form, provide the history and relevant investigation reports necessary for evaluation.

The patients were submitted for the study and reviewed against inclusion and exclusion criteria as follows.

Inclusion criteria were all cases of histologically proven breast carcinoma. Some cases were positive operative history (modified radical mastectomy, simple mastectomy, and lumpectomy). The study included patients who received chemotherapy with last cycle for more than 3 weeks and radiotherapy with last session for more than 3 months.

Exclusion criteria were early post-operative cases, uncontrolled diabetic patients, and patients with impaired renal function.

Imaging technique:

Whole body 18F-FDG PET-CT was done to patients after proper preparation and detailed history and low-dose CT was performed first, followed by the contrast enhanced (CE) CT imaging. PET part was acquired from the top of the skull to the mid-thigh approximately 60 min after the intravenous administration of 1 mCi (18F) FDG per 10 kilogram of body weight. Routine monitoring of blood sugar levels was performed, and patients fasted for a minimum of four hours before the (18F) FDG injection. All scans were conducted using PET-CT scanners, namely the Biograph™ mCT PET-CT- Siemens.

Interpretation of images:

Different methods were used for assessment of radiotracer uptake by normal and pathologic tissues; analysis of PET images was via visual and semi-quantitative assessment (SUV max measurement). Active lesions were recorded at areas of high FDG uptake. SUV max was measured at each lesion and compared to background activity. The standard background activity was measured at the liver (right lobe). In patients having diseased liver, the background activity was measured at the mediastinal blood pool.

RESULT

The study included, 33 female patients with breast carcinoma. The age distribution of the study patients is shown in Figure 1 reflecting that, majority of patients were above 40 years (20 of 33 patients).

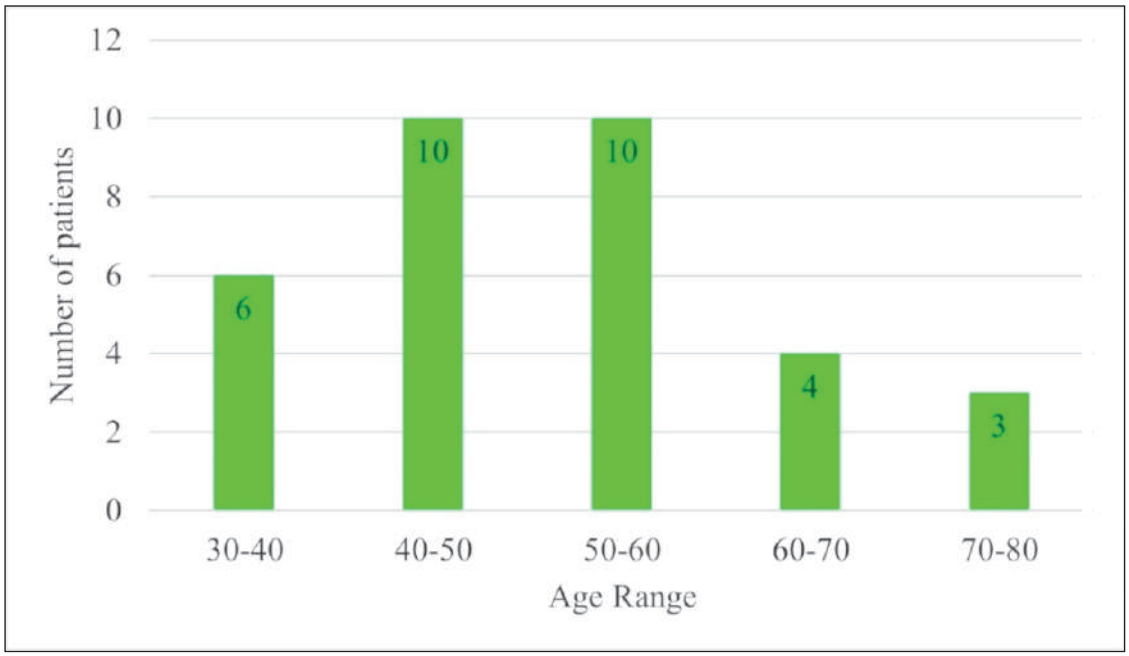

Figure 1: Bar chart showing Total case of breast carcinoma patients referred to INMAS, Suhrawardy according to their age.

Table 1: Demographic characteristics of the breast carcinoma patients studied with whole body FDG PET-CT (n=33)

Parameter	Grouping	Patient number
Age	Age Range	30-80
	Mean Age	51.4
Histological type	Infiltrating ductal cell carcinoma	22
	Lobular carcinoma	5
	Others	6
Tumor size (cm)	<2	14
	>2 and <5	19
Hitological grade	1	8
	2	13
	3	12
Lymph node metastasis	Negative	7
	Positive	26
Distant metastasis	Present	17
	Absent	13
Surgical history	Negative	7
	Positive	26
Estrogen receptor (ER)	Negative	10
	Positive	23
Progesterone receptor (PR)	Negative	8
	Positive	25
Her-2 status	Negative	4
	Positive	29
Chemotherapy	Negative	10
	Positive	23
Radiotherapy	Negative	15
	Positive	18

It was noticed that, Invasive ductal carcinoma (IDC), also known as infiltrating ductal carcinoma, is the most common type of breast cancer, accounting for about 22 patients and second most common type was lobular carcinoma, about 05 patients of all breast carcinoma cases. Among rest of 6 cases, 2 had mucinous carcinoma, 2 were diagnosed with triple negative breast carcinoma, 1 had ductal cell carcinoma in situ and 1 were diagnosed with metaplastic carcinoma (squamous cell type).

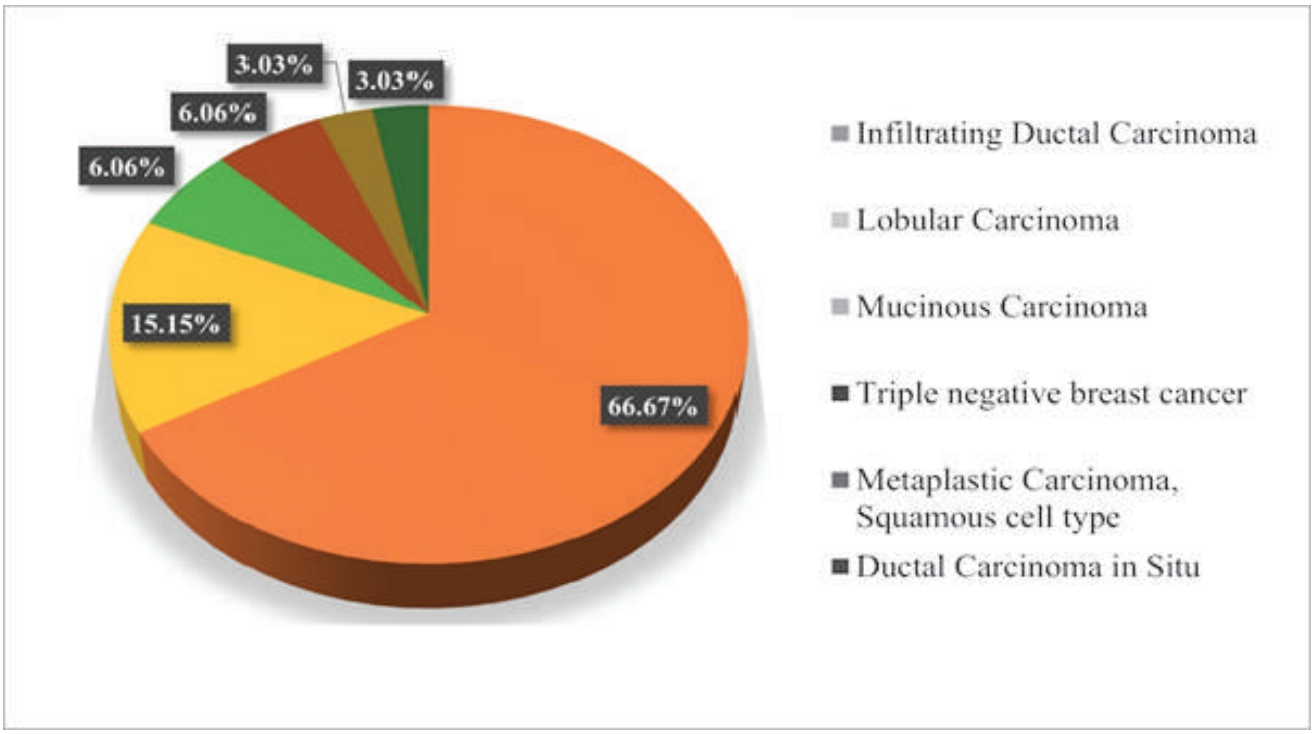

Figure 2: Pie chart showing Percentage variation of histologically different type of breast carcinoma patients referred to INMAS, Suhrawardy.

The focus of this study is mediastinal lymph node metastases are mostly evident, about 14 patients of 33 breast carcinoma, as some of them were came after mastectomy surgery with axillary clearance. Number of patients associated with lymph node metastases, followed by surgery is noted below in Figure 3.

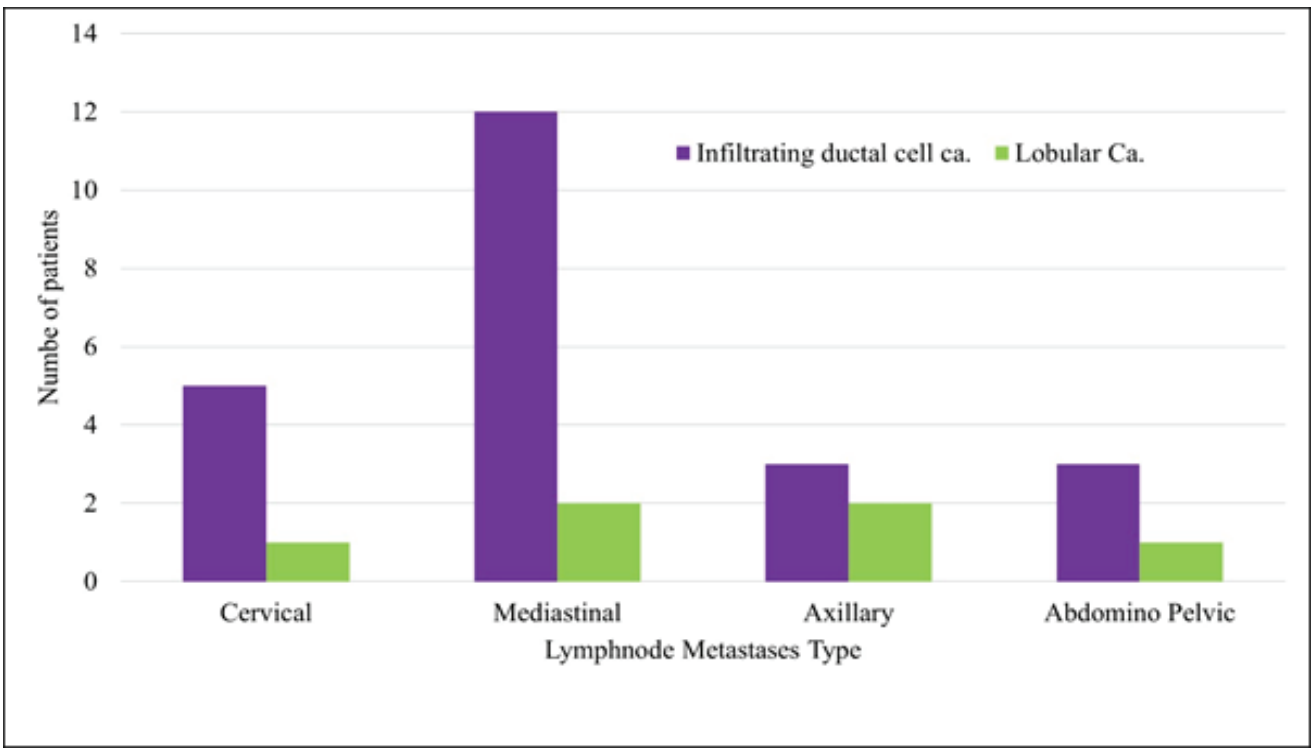

Figure 3: Bar chart showing Metastatic lymph node involvement of breast carcinoma patients in INMAS, Suhrawardy

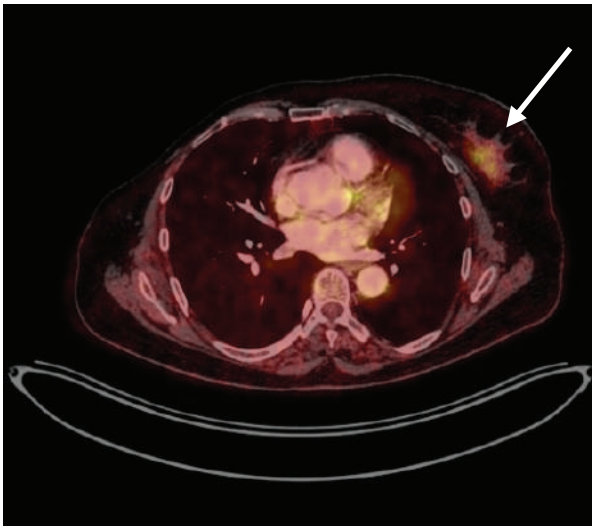

Figure 4: PET-CT image of a 43-year-old woman with right breast carcinoma, following surgery, showed a heterogeneously enhancing FDG avid (SUVmax: 4.2), lobulated, soft tissue density, and an outer margin mass lesion (3.6 X 2.6 X 1.8 cm) possibly due to disease recurrence.

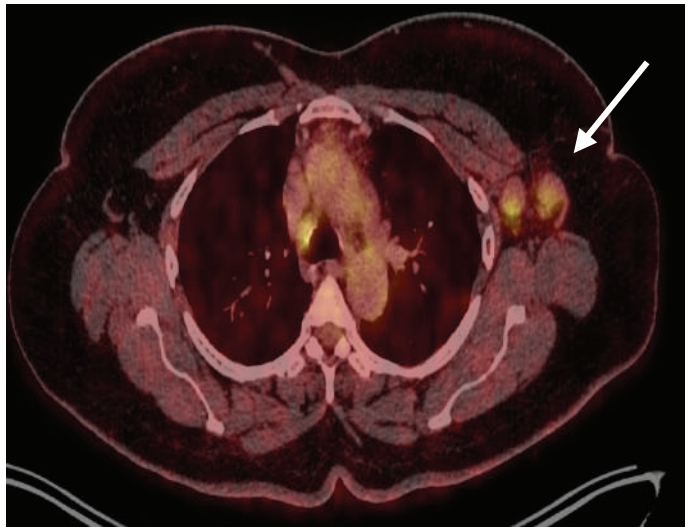

Figure 5: Coronal PET-CT image of a 55 Y/O, woman diagnosed with left breast carcinoma, showing multiple, FDG avid (SUV max: 3.5), enhancing, necrotic left axillary lymph nodes with loss of architecture

The distribution of metastatic organ of breast carcinoma patients scanned in INMAS, Suhrawardy is shown in Figure 6. Most of the infiltrating ductal cell carcinoma is metastasized into the lung and bone metastases mostly found in lobular breast carcinoma.

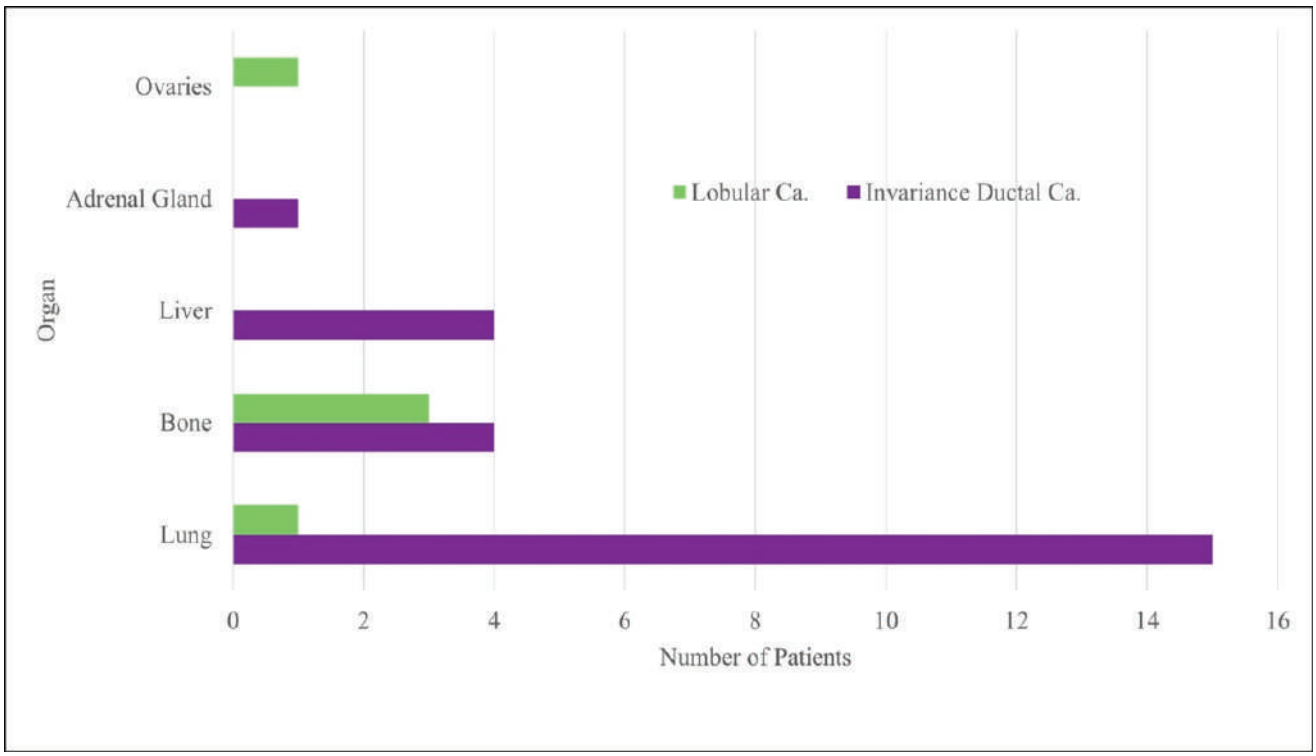

Figure 6: Bar chart reflecting metastatic organ involvement by breast carcinoma patient at INMAS, Suhrawardy.

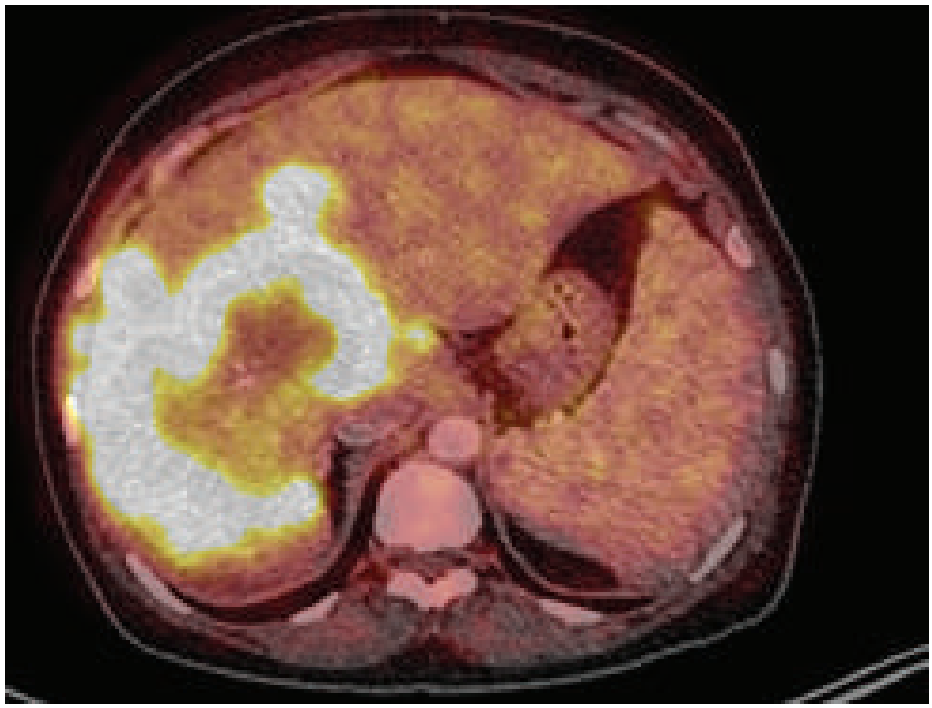

Figure 7: PET-CT image of a 57 years old woman with left breast carcinoma patient shows, huge FDG avid (SUV max :12.5) rim enhancing, necrotic, intra hepatic, hyper vascular mass (measuring about CC- 9.9, TD- 9.8 & AP- 10.9 cm), compression over right branch of portal vein, involving segment V, VI, VII & VIII; possibly metastases.

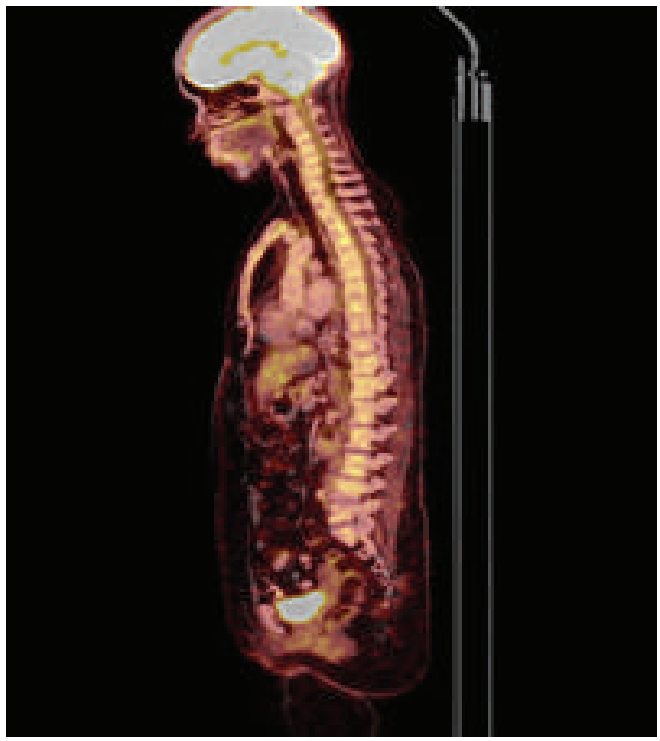

Figure 8: A 35 years woman of left breast carcinoma followed by chemotherapy 2 months ago, came for follow-up PET-CT and sagittal image shows bone marrow hyperplasia due to chemotherapeutic agent.

DISCUSSION

The sample number is 33, which is not sufficient. So, it was the limitation of the study. With the more sample the study will be more accurate in future.

In this study, we observed majority of breast carcinoma patients were, infiltrating ductal cell carcinoma (66.67 %) and second most common type were lobular carcinoma (15.15 %). A study showed that, histologically, approximately 70% of breast cancers are classified as invasive ductal carcinoma and second most common histologic type, and most common special type of breast carcinoma is invasive lobular carcinoma, comprising 10-15% of all breast carcinoma (8). Our findings align with those of the previous study.

In this study, infiltrating ductal cell carcinoma is metastasized mostly into the lung and bone metastases mostly found in lobular breast carcinoma. This study shows, breast carcinoma patient commonly present with metastasis into lung, bone and liver, with some rare site of metastases like- adrenal gland and ovary. The common sites of distant metastasis in breast carcinoma are the bones, lungs, liver, and brain (7). Our analysis revealed that the lungs were the most frequent site of metastasis in patients with breast cancer. This finding differs from several prior studies that predominantly identified the liver and bones as the primary metastatic sites. The underlying reasons for the discrepancy warrant further investigation. As FDG PET-CT is not suitable for detecting brain metastases because of its high FDG activity in the brain, that's why we couldn't confirm any metastases in brain.

In this study, more bone and lymph node metastases were detected by whole body PET-CT than CE-CT alone. In contrast, more metastases to the lung and liver were detected by CE-CT, resulting in only a fair overall agreement between the two modalities (2).

The sensitivity of PET-CT examinations in detected bone lesion deposits was 91.6%, specificity was 100%, while the sensitivity of CT alone was 75%, specificity was 94.4%. The sensitivity of PET-CT examinations in detected pulmonary nodules metastasis was 100% and specificity was 100% while the sensitivity of CT alone was 72.2% and specificity was 73.6%. The sensitivity of PET-CT examinations in detected hepatic deposits was 80%, specificity was 100%, while the sensitivity of CT alone was 40%, specificity was 84% (7). Bone is the most frequent site of distant metastases in BC, accounting for about 65% of patients with distant metastases (7). In a meta-analysis of seven studies, compared bone scans and PET-CT (668 patients in total), FDG PET-CT outperformed bone scintigraphy with a sensitivity of 93% and specificity of 99%, whereas bone scintigraphy had a sensitivity of 81% and specificity of 96% (9).

One study showed, PET-CT outperformed, certainly compared to conventional imaging, in detecting distant metastases, with sensitivity and specificity of 100% and 98%, respectively, compared to 60% and 83%, respectively, for conventional imaging (10).

18F-FDG has limitations due to its low specificity and potential false positives. High physiological uptake in certain organs may mimic tumor deposits. Bone marrow hyperplasia and heterogeneous liver uptake patterns can complicate diagnosis and clinical decision-making, potentially mimicking metastatic disease or obscure existing lesions (7).

FDG PET-CT is a hybrid state-of-the-art imaging technique that can detect distant, unsuspected, and various types of advanced breast cancer metastases in distant nodes as well as pleural, hepatic, splenic, adrenal, and pelvic metastases (8)

CONCLUSION

FDG-PET-CT has potential to serve as an excellent imaging modality because both FDG and CT data can be obtained in a single study, and each imaging modality compensates for the other's weak points. PET-CT imaging with 18F-FDG has superior diagnostic efficacy compared to conventional morphological imaging for detecting regional and distant metastasis in breast cancer.

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