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Role of PET/CT Versus Conventional Ct in Post-Operative Follow up of Breast Cancer Patients

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Abstract

Cancer breast is one of the leading causes of death and it is the commonest cause of women death by cancer, its prevention remains a challenge, thus early and accurate diagnosis are mandatory to achieve this target. This work is aiming for a comparison between sensitivity and specificity of CT alone versus those of PET/CT in post-surgical follow up of patients with breast cancer. This study was conducted on (31) female patients from 2015 to 2019. Their ages ranged from 25 to73 years with mean age of 51 years All patients have positive history of breast cancer surgery. Those patients were referred to Misr Radiology Center, Cairo for post-operative follow up by PET/CT. FDG-PET-CT is very useful in evaluating the response after therapy. The technique also can detect response to therapy very early before any other available imaging modality. PET-CT is helpful in evaluating regions treated with chemotherapy or radiotherapy and differentiating between recurrence and post treatment changes.

Keywords: Cancer, Breast, FDG-PET-CT, Radiology, post-operative, Surgery and interventions.

1. Introduction

Cancer breast is one of the leading causes of death and it is the commonest cause of women death by cancer. Thus careful patient evaluation and accurate staging are crucial for detecting the proper therapeutic plan and to improve patient survival [1].

PET-CT can easily detect sites of metastasis as well as sites of recurrence because it gives an idea about the metabolic activity of these lesions and differentiating between recurrent lesions and normal changes seen in operative bed. This information couldn't be assessed by CT alone which shows only anatomic changes [2].

In case of elevated tumor markers like CEA or CA 15-3 antigen, PET-CT plays very important role as it depicts FDG avid lesions that cannot be detected using CT alone [3].

PET-CT performed with FDG utilizes the known information that tumor cells consume more glucose than normal cells, thus tumor cells will uptake tracer avidly [4].

Patient with locally advanced breast cancer, elevated tumor markers and patients on follow up post chemo or radiotherapy are sent by clinicians to perform PET-CT [5].

Commonest site of metastasis is bone accounting for 90% of cases with metastasis and then lymph nodes comes next [6].

Combined PET-CT examination can detect both lytic and sclerotic lesions as the former one appears hot in PET and the latter one is easily detected in C.T. It also shows very good ability to detect millimetric lymph nodes with tiny metastatic lesions as they appear avid in PET scan [7].

2. Patients and methods

This study was conducted on (31) female patients from 2015 to 2019. Their ages ranged from 25 to73 years with mean age of 51 years all patients have positive history of breast cancer surgery. Those patients were referred to Misr Radiology Center, Cairo for post-operative follow up by PET/CT.

2.1 Inclusion criteria of the study

Positive operative history (modified radical mastectomy, simple mastectomy, total mastectomy and lumpectomy), Histological proven breast cancer and Blood urea nitrogen and serum creatinine within normal range.

2.2 Exclusion criteria

Women in childbearing age, inquiry about pregnancy was done for fear of the risk of radioactive material upon the fetus and in case of suspicion, a pregnancy test was done and Women with renal impairment.

The following was done to all patients: Clinical evaluation by complete past and present history and Laboratory studies including: Blood glucose level, Blood urea nitrogen and creatinine and Tumor marker (CA 15-3) when indicated.

2.3 FDG PET/CT examination

The machine used was Siemens Bio-graph true point PET/CT scanner. The images were taken from the skull to the mid-thigh during suspended respiration.

2.4 Patient Preparation

After demonstrating the exam to patients they fast for 6 hrs, remove any metallic objects, void, and measure blood glucose, levels between 80 to 210 ng/dl.

A cannula placed intravenously for 18F-FDG administration. Patients prevented from vigorous movement before examination and after administration of the tracer to minimize uptake by muscles.

A 1000cc of mannitol 5% taken orally 1 hour prior to exam as well as administration of 3-7 MBq/Kg of 18F-FDG 45–90 mins prior to scanning. That duration is mandatory as the tracer is distributed and gathered by cells. The patient sits calmly in dark room avoiding movement and talking. On PET-CT scanner patient lies on his back with arms on top of his head.

2.5 CT Technique

Administration of 125ml Low osmolar iodinated contrast media through the cannula was done then patent ordered to breath quietly and CT images were taken from head to mid-thigh. Parameters of the scan

are collimation width 5.0 mm, pitch 1.5, gantry rotation time 0.8 sec and FOV 50 cm. The final data reconstruction was at 1mm interval.

2.6 PET Technique

PET examination done after CT at the same table. 6 to 7 sectors planned from head to mid-thigh for 3D acquisition modes with time of scan 3-5mins for each sector.

2.7 PET/CT Fusion

The final images of PET and CT examinations were fused in different planes to combine the anatomic and biological data at the same image. The time for the whole scan reaches about 25-30mins. By the provided machine software PET images reconstructed with the CT images for attenuation correction. For each site the Sensitivity, specificity, PPV, NPV and Accuracy were calculated.

2.8 Histopathological examination

Histopathological analysis was performed on formalin fixed paraffin embedded tissue biopsies for all patients.

Twenty-six candidates with infiltrating ductal carcinoma and five candidates with infiltrating lobular carcinoma.

2.9 Statistical analysis

Data have been tabulated and analyzed by IBM SPSS ver. 25.

Sensitivity and specificity were calculated for the overall number of cases in all anatomical locations of neoplastic growth.

Calculation of sensitivity and specificity was not performed on each anatomical site separately due to the relatively low number of cases in each group.

3. Results

Table (3) Positive and negative findings in lymph nodes metastases.

	Malignant LN			
	TP	**TN**	**FP**	**FN**
CT	11	15	2	3
PET/ CT	14	17	0	0

Table (4) sensitivity, specificity, PPV, NPV and Accuracy in lymph nodes metastases.

	CT	**PET/CT**
Sensitivity	78%	100%
Specificity	89%	100%
PPV	84%	100%
NPV	83%	100%
Accuracy	83.8%	100%

Table (5) Positive and negative findings in bone metastases

	Bone metastases			
	TP	**TN**	**FP**	**FN**
CT	5	21	2	3
PET/ CT	8	23	0	0

Table (6) Sensitivity, specificity, PPV, NPV and Accuracy in bone metastases.

	CT	**PET/CT**
Sensitivity	87%	100%
Specificity	71%	100%
PPV	91%	100%
NPV	62%	100%
Accuracy	83%	100%

Table (7) Positive and negative findings in other visceral sites of metastases.

	Other visceral metastases			
	TP	**TN**	**FP**	**FN**
CT	5	25	0	1
PET/CT	6	25	0	0

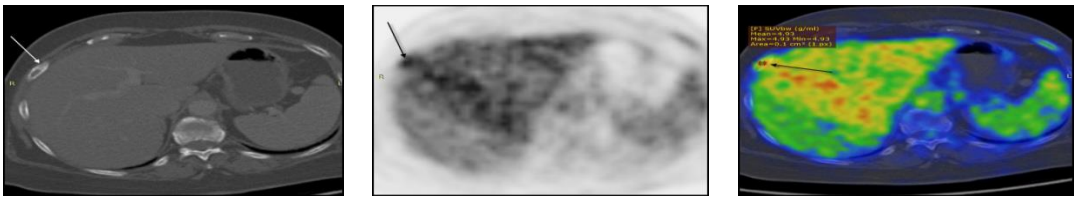
Table (8) Sensitivity, specificity, PPV, NPV and Accuracy in other visceral sites of metastases.

	CT	PET/CT
Sensitivity	83%	100%
Specificity	100%	100%
PPV	100%	100%
NPV	96%	100%
Accuracy	96.7%	100%

Table (9) Overall Sensitivity, specificity , PPV, NPV and Accuracy for CT and PET/CT.

	CT	PET/CT
Sensitivity	74.6%	91.3%
Specificity	89%	98.5%
PPV	80.1	94.6
NPV	87	97.8
Accuracy	88.3	97.3

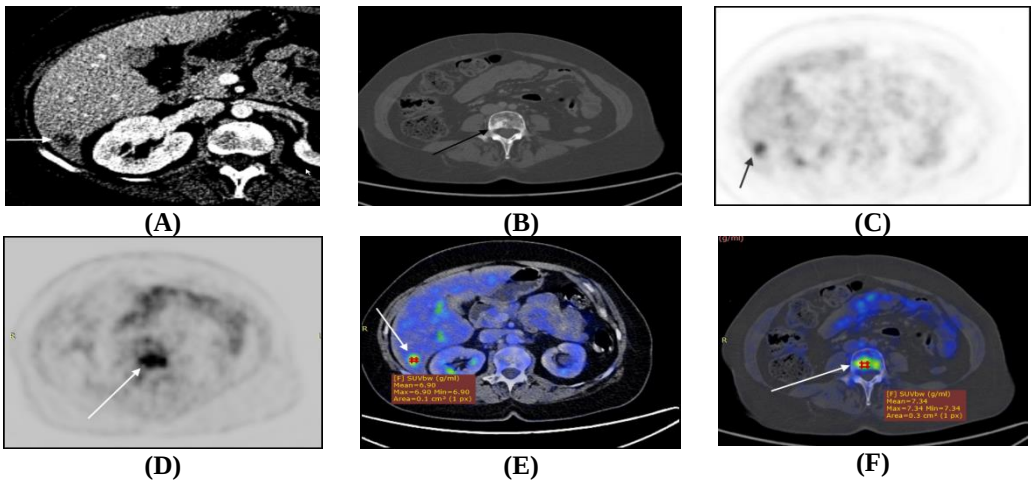
Case (1)



(A) **(B)** **(C)**

Fig (1) Patient aged 66y underwent bilateral total mastectomy, presented with a CT-base small sclerotic rib lesion. A- Axial CECT (bone window): revealed a tiny mixed lytic/sclerotic lesion at the lateral aspect of the right 8th rib (arrow). B- Axial PET: showed an abnormal area of increased uptake (arrow), yet no definite anatomical correlation with the CT-based lesion could be obtained. C- Axial Fusion PET/CT: revealed anatomic correlation of the CT-based lesion with SUVmax of 5 in the lesion denoting malignant activity.
Final diagnosis: Metastatic rib lesion.

Case (2)

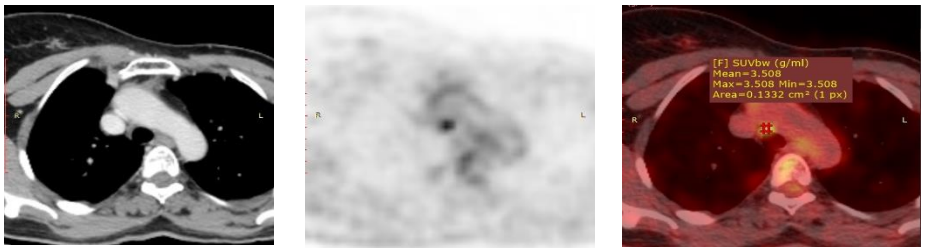


(A) **(B)** **(C)**

(D) **(E)** **(F)**

Fig(2) Patient aged 65y underwent right modified radical mastectomy, came with positive CT-based hepatic & vertebral lesions.
1- Axial CECT: (A) A small non-enhancing hepatic focal lesion measuring about 1.5 X 1 cm, located at segment VI (arrow). (B) An ill-defined mixed lytic/sclerotic L3 vertebral body lesion(arrow).
2- Axial PET: (C) An abnormal area of increased FDG uptake in the area of hepatic segment VI (arrow). (D) An abnormal area of increased FDG uptake in the site of L3 vertebral body (arrow).
3- Fusion PET/CT: (E) SUVmax 6.9 in the fore-mentioned hepatic focal lesion (arrow).
(F) SUVmax of 7.4 in the L3 vertebral body lesion (arrow).
Final diagnosis: Metastatic hepatic & L3 vertebral body lesions.

Case (3)



(A) **(B)** **(C)**

Fig (3) Patient aged 66y arrived for follow up after left mastectomy followed by chemotherapy. (A) Axial CT (Mediastinal window): showed small 5mm retrocaval lymph node. (B) Axial PET: revealed hypermetabolic areas at the same location of the retrocaval lymph node seen in CT images. (C) Fusion PET/CT: showed SUVmax 3.5 in the above mentioned node.

Final diagnosis: Metastatic retrocaval lymph node.

4.Discussion

PET was found more sensitive in depiction of recurrence more than tumor markers in breast cancer patients with clinical doubts of recurrence [8].

Thirty-one patients were eligible to this study, they underwent contrast enhanced CT and combined PET/CT examinations.

PET/CT revealed better sensitivity and specificity reaching 91.3% and 98.5% with PPV 94.6%, NPV 97.8% and Accuracy 97.3% compared to CT alone, which showed only 74.6% sensitivity and 89% specificity, PPV 80.1%, NPV 87% and Accuracy 88.3 %.

Our study agrees with the study [9], PET-CT sensitivity was 97.5% and the overall specificity was 98.8%.

Our results agrees with [10]. Their results showed, FDG-PET/CT with sensitivity of 94.5%, and a specificity of 91% with PPV, NPV and Accuracy 96.7%, 74.5%, and 92.1% respectively. PET/CT showed better sensitivity and accuracy. Treatment plans changed in half of the patients and PET/CT had a significant role in restaging of patients.

Our study agrees with [11] that revealed the important role of PET/CT in detecting distant metastasis and therefore changing the management strategy of their patients.

Again, our study agrees with [12] showing PET/CT had higher sensitivity in depicting millimetric lesions (5–10 mm), especially lymph nodes. In our study, PET/CT showed markedly higher ability to detect neoplastic growth in extra-axillary nodal metastases as shown by 100% sensitivity and 100% specificity.

This agrees with [13] who discussed PET/CT in staging and restaging of breast cancer showing very high ability of PET/CT to evaluate extra-axillary nodal metastases reaching 100% sensitivity and 98% specificity.

And also agrees with the study done [14] who studied role of PET/CT in breast cancer and showed its high ability to detect extra-axillary lymph nodes metastases with sensitivity and specificity exceeding 90%,.

5. Conclusion

PET-CT proved to be more useful in evaluation of distant metastasis than conventional imaging and highly useful in monitoring response to therapy as it can identify response earlier than any other imaging modality.

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