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Coincident Pelvic Uptake in the F-18 FDG PET/CT Imaging in Patients With the Diagnosis of Breast Carcinoma

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ABSTRACT

Objective: The F-18 FDG PET/CT imaging is a commonly preferred imaging modality for staging breast carcinoma. The gynecological tumors are more frequently present in patients with breast carcinoma compared to the general population. The aim of this study was to investigate the clinical importance of the uterine and adnexal uptake observed incidentally in the F-18 FDG PET/CT imaging of breast carcinoma.

Patients and Methods: The F-18 FDG PET/CT images (performed for staging or treatment response evaluation purposes) of the patients (sixty-six women, the mean age 49,5±12,6 years) with suspicious uterine and/or adnexal uptake were included in the study. The imaging results were compared with pelvic examination data as well as operative and pathology results.

Results: In the imaging studies the increased FDG uptake sites were the primary tumor (mean 27, 3 (24,5) mm, SUVmax=31,3 (20) in 35 patients, and 22 patients additional axillar metastases and distant metastasis in 19 patient were observed. Among the patients involved in the study 29 had unilateral adnexal uptake and/or lesion and/or uterine uptake and others had suspicious findings without increased uptake.

Conclusion: Referral of the patients for gynecological examination with coincident uterine and adnexal abnormal uptake in the F-18 FDG PET/CT would be the appropriate approach for the patients with the diagnosis of breast cancer.

1. Introduction

Breast carcinoma is one of the leading causes of death among women. Patients with breast carcinoma also have secondary cancers, especially gynecologic ones F-18 FDG PET/CT is a successful staging, restaging and treatment response evaluation tool in patients with breast cancer. Additional to these aims, it is well known that F-18 FDG PET/CT might show additional secondary tumors in patients bearing a known primary tumor. (1) The ratio of the unexpected secondary malignancies in patients with or without primary malignancy was found to be 1,7% by FDG PET/CT according to a previous study. (2) In another study including only breast carcinoma patients the ratio of incidental detection of all types of secondary tumors has reported to being 1,2% in PET/CT examinations.

It is already known that the coincidence between gynecological and breast tumors is frequent. The explanation of this association may be the same predisposing factors like dietary habits, hormonal stimulation and genetic factors like BRCA 1 and 2 mutations.

Unfortunately, many pitfalls are associated with the gynecological organs resembling malignancy. (3) Park et al. have shown that physiological uptake in the uterus and ovaries may be observed during menstruation and ovulation phases in the premenopausal women. (5) Although physiological FDG uptake is an expected finding the premenopausal women; FDG accumulation in the ovary region of postmenopausal women is considered suspicious about malignancy. (4)

In this retrospective analysis, the ratio of malignancy associated with coincident abnormal FDG uptake and other findings in the uterus and adnex in the F-18 FDG PET/CT images of breast cancer patients was performed.

2. Patients and Methods:

Patients: The F-18 FDG PET/CT images of the female patients (mean: 49,5±12,6 years old) with pathological diagnosis (Summarized in Table 1) of the breast carcinoma in premenopausal and postmenopausal state (decided by the clinicians report previous to the imaging study) who were referred for staging, restaging, treatment response evaluation between January 2017 and May 2018 were reviewed retrospectively regarding uterine and adnexal abnormalities by an experienced a Nuclear Medicine Physician. The study was conducted according to the Helsinki Declaration. The ethic approval was obtained from the Mersin University Ethics Committee date on 24/5/2018with number 232.

Inclusion criteria were; uterus enlargement (>4 cm), mass in the uterus (>3 cm lesion), and increased FDG uptake (higher than physiological uptake of the mediastinum and/or SUVmax>3) in the uterus or adnexa respectively.

The exclusion criteria were; malignancy other than breast carcinoma, previously known gynecological malignancy, <18 years old and pregnancy.

Table 1. The pathology, menopausal state, PET/CT findings and pathology results of the patients.

Patient	Menopausal state	Breast pathology	stage	Gynecology-PET/CT findings	SUVmax	Size (mm)	Pathology results
1	Prem.	IDC	4	Right ovary	6,5	14	Endometrium proliferation
2	Postm.	IDC	4	Bilateral ovary	3,5	10	
3	Postm.	IDC	2	Bilateral ovary, uterus	8,7	23	Endometrium polyp
4	Postm.	MC	1	Uterus enlargement	-	-	-
5	Prem.	DCI	1	Right ovary lesion	-	30	-
6	Postm.	SIP	1	Uterus enlargement	-	-	-
7	Prem.	IDC	1	Right ovary lesion	-	40	-
8	Postm.	IDC	1	Uterus, ovary uptake	7,7	-	-
9	Prem.	IDC	I	Uterus enlargement	-	-	Operation: Leiomyoma
10	Postm	IDC	1	Uterus enlargement	-	-	Endometrium: polyp
11	Postm.	IDC	1	Uterus enlargement, uptake	9,1	-	-
12	Postm.	ILC	4	Left ovary lesion	-	10	-
13	Postm.	IDC	1	Uterus enlargement	-	-	-
14	Prem.	ADH	1	Uterus enlargement	-	60	-
15	Postm.	DCI	2	Left ovary lesion	-	40	-
16	Prem.	IDP	1	Left ovary lesion	8,3	20	
17	Postm.	IDC	1	Uterus enlargement	-	-	Operation: Endometrium atrophy
18	Prem.	DCI	1	Uterus enlargement	-	-	Operation: Leiomyoma
19	Prem.	MIC	1	Uterus enlargement	-	90	-
20	Post	MeIC	1	Uterus, ovary uptake	6,2	-	-
21	Postm.	IDC	1	Left ovary lesion	7	25	-
22	Postm.	ILC	1	Left ovary lesion	2,5	60	-
23	Postm.	IDC	1	Uterus enlargement	-	-	-
24	Postm.	IDC	1	Uterus enlargement	-	65	-
25	Postm.	IDC	1	Left ovary lesion	2,5	35	-
26	Prem.	ILC	4	Bilateral ovary	-	31	-
27	Postm.	EPC	1	Uterus uptake	2,7	-	Operation: Endometrium atrophy
28	Prem.	IDC	2	Left ovary	11,9	17	-
29	Postm.	DCI	1	Uterus enlargement		68	-

30	Postm.	IDC	2	Uterus enlargement	-	-	Operation: Endometrium adenocarcinoma
31	Prem.	ADH	4	Left ovary	6,4	10	-
32	Postm.	IDC	4	Left ovary	3,5	50	-
33	Postm.	ILC	4	Uterus lesion	5,8	16	-
34	Prem.	IDC	1	Uterus Enlargement	-	65	-
35	Postm.	IDC	2	Uterus uptake	5,9	92	Endometrium: N
36	Postm.	IDC	1	Left ovary lesion-lymph node	5,8	-	Operation: Squamous metaplasia
37	Postm.	IDC	1	Uterus uptake	3,1	-	-
38	Postm.		2	Uterus myom, uptake	2,8	45	-
39	Prem.	IDC	1	Bilateral ovary lesion	8,6	10	-
40	Prem.	IDC	1	Uterus uptake	4,2	-	Operation: cervicitis
41	Prem.	IDC	1	Uterus enlargement, uptake	4,6	82	-
42	Postm.	IDC	4	Uterus enlargement, lesion	-	92	-
43	Postm.	ILC	1	Uterus, left ovary lesions	6,6	48	-
44	Prem.	IDC	1	Right ovary lesion, uterus uptake	5,6	18	Endometrium: polyp
45	Prem.	IDC	1	Left ovary lesion	5,4	20	-
46	Prem.	IDC	3	Pelvic lymph nodes	3,7	10	-
47	Postm.	ILC	1	Uterus enlargement, uptake	3,1	98	Operation: Anembryonic pregnancy
48	Prem.	ADH	1	Uterus enlargement, uptake	2	60	-
49	Prem.	IDC	1	Uterus enlargement, right ovary lesion	4	28	Endometrium: adenocarcinoma
50	Prem.	IDC	2	Uterus lesion, uptake	31,1	54	
51	Postm.	IDC	4	Uterus lesion, uptake	19,3	68	Sitology follow up: N
52	Postm.	IDC	1	Left ovary lesion, uptake	2,5	24	Operation: Leiomyoma
53	Prem.	IDC	1	Left ovary lesion, uptake	23,7	66	
54	Postm.	IDC	1	Left ovary lesion	-	66	Operation: Breast metastasis
55	Postm.	IDC	4	Left pelvic lymph node	4,7	35	-
56	Postm.	IDC	3	Uterus myom, uptake	7,7	10	-
57	Postm.	IDC	4	Uterus enlargement, uptake	2,6	79	-
58	Prem.	IDC	4	Uterus uptake	7,5	-	-
59	Prem.	IDC	4	Bilateral ovary uptake	5,2	10	Endometrium: atrophy
60	Postm.	ILC	1	Uterus enlargement	6	52	Endometrium atrophy
61	Prem.	IDC	4	Left ovary lesion, lymph node	4,4	10	-
62	Prem.	IDC	2	Bilateral ovary lesion, uptake	3	30	-
63	Prem.	IDC	1	Right ovary uptake	4,8	10	-
64	Prem.	ILC	4	Bilateral ovary lesions, uptake	12,5	60	-
65	Prem.	IDC	1	Uterus lesion, uptake	15,8	17	Operation: leiomyoma
66	Prem.	IDC	1	Uterus lesion, uptake	10,4	10	Operation: adenocarcinoma of uterus

PET/CT: Positron emission tomography
Postm.: Postmenopausal

3. Imaging protocol

The F-18 FDG PET/CT examination was performed on all the patients after at least 6 hours of fasting and restriction of the physical effort for at least 24 hours. The imaging was performed by PET/CT scanner (GE, Discovery PET/CT 610, US) with an additional low dose CT scan (130 kV, 50 mAs, a pitch of 1.5, a thickness of 5 mm, in 70 cm field of view) for attenuation correction with oral contrast administration from the skull base to the upper thigh with the acquisition time of 1 min per bed position after the radiopharmaceutical injection (mean 370 MBq (10 mCi) according to the body weight) and 60 minutes waiting period.

The gynecological examination and ultrasonography were performed on the patients with suspicious findings listed as inclusion criteria. In case of positive findings in the exam further diagnostic and therapeutic approaches (biopsy, smear and surgery) were performed.

The results of the imaging findings were compared with gynecological examination and biopsy or surgery (pathology results).

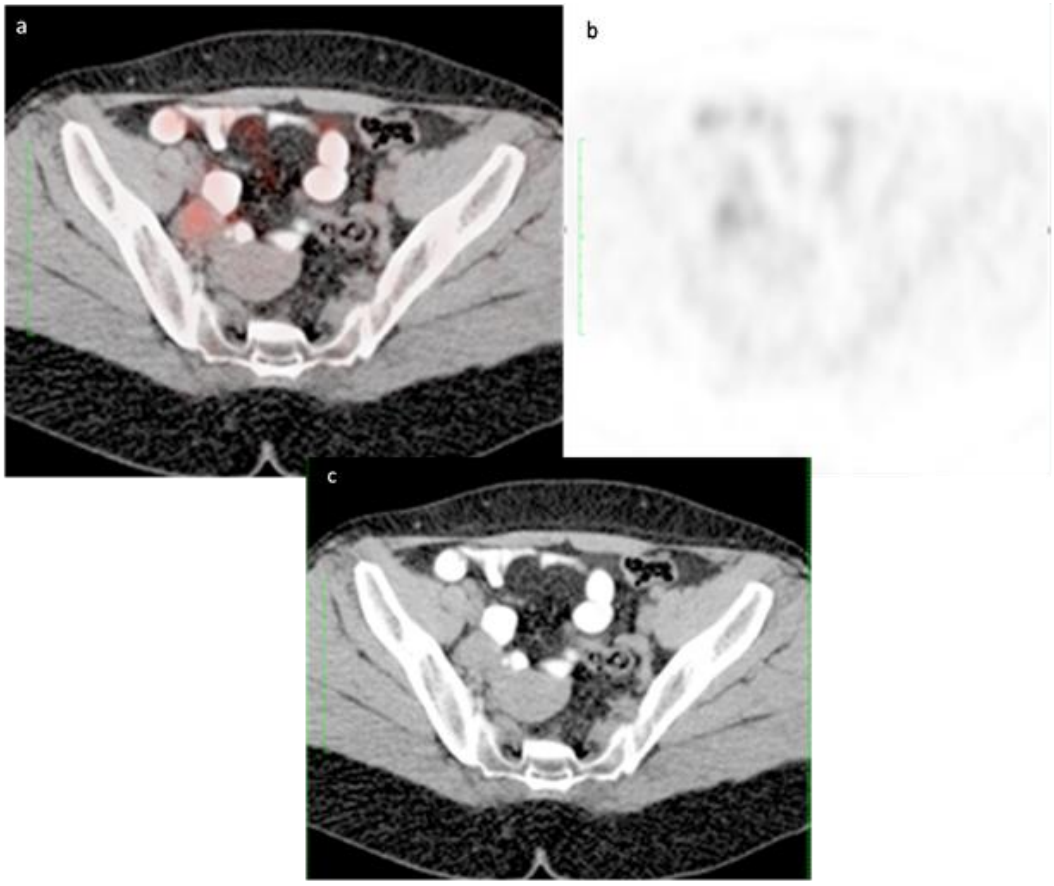

Figure 1. The computed tomography, positron emission tomography and transaxial fusion images of a patients with coincident uterus-adnexa uptake in a solid lesion (SUVmax=10.4) in the imaging performed for restaging due to known breast carcinoma who underwent hysterectomy operation and pathology results showed adenocarcinoma of the uterus.

4. Results

In the retrospective analysis of F-18 FDG PET/CT results, the patients were diagnosed with right breast carcinoma in 21, left in 36, and bilateral in 2; others were already operated on in the examination. According to imaging results, eleven patients with primary tumors (n=35) were multifocal. The mean size of the primary tumor was 27,3 (24,5) mm, and the mean uptake value (SUVmax) was 31,3 (20). Axillary involvement (right n=6, left n=13 and bilateral n=3) was observed in 22 patients (mean 17,5 (9,2) mm/SUVmax=9,8 (7,1). Distant metastatic sites of the patients were; internal mammarian lymph nodes (n=4), mediastinal (n=7), abdominal (n=2) lymph nodes, bone (n=13), liver (n=4), lung (n=4) and adrenal gland (n=1) according to frequency respectively.

The coincident gynecological findings of the patients were; enlargement of the uterus (n=22, mean:72,8±19,5 mm), lesion in the uterus (n=13, mean=38,6±24,8 mm), lesion in the adnexa (n=25, mean=41,2±25,8 mm), increased FDG accumulation in the adnexa (n=29, mean SUVmax=3,9±3), in the uterus (n=23, mean SUVmax=20,6 ±4,2) respectively according to frequency. Additionally, pathologic FDG accumulating pelvic lymph nodes were determined in three patients (left SUVmax=5,8 and right SUVmax=3,7 in one patient and left mass 35 mm, SUVmax=4,74 in another). The findings in the pelvic region the findings (SUVmax levels and enlargement of the uterus) were determined with caution, especially in the premenopausal state; the cyclic physiological changes were considered.

The gynecological examination and ultrasonography findings of the patient's revealed abnormal results; and had an endometrial biopsy and thirteen patients underwent hysterectomy operation whose pathology results revealed benign lesions and malignancy in four patients (Figure 1) (Table 1).

5. Discussion

The rate of secondary malignancy in the study group was 4/66 (6,1%), according to the results. This study showed a higher frequency of secondary gynecologic malignancy in breast carcinoma patients than in other malignancy types. These findings pointed out the importance of routine pelvic examination in this special group of patients prone to pelvic malignancies. Besides benign malignancy, conditions associated with increased FDG uptake in pelvic region might be observed in the endometrium and ovaries, which were endometrial atrophy, hyperplasia, polyp, thickening and myoma uterus and serous cyst adenoma in this series. The mean SUVmax levels of the patients with FDG accumulation in the endometrium and ovaries were significantly higher than the SUVmax levels associated with physiological FDG uptake, according to previous literature. (4) Park et al. have also demonstrated that oral contraceptives or hormonal therapy do not affect these uptake values significantly. They also have shown that the SUVmax level of 7.9 might discriminate physiological FDG accumulation for the ovaries.

There are plenty of causes of false positive interpretation in FDG PET/CT thus, careful evaluation of abnormal FDG uptake in the pelvic region has to be performed in patients with breast carcinoma.(5) In this study group, there was one patient with metastasis there are previous case reports that were also presenting breast carcinoma metastasis of the uterus. (6,7) Abrams et al. reported metastatic involvement of the endometrial polyps and in this study group, we also observed adenocarcinoma in an endometrial polyp. (8)

In a recent study, the diagnostic performance of the contrast-enhanced F-18 FDG PET/CT was investigated and, incidental FDG accumulation due to benign ovarian lesions was reported. (9) Additionally, previous reports included other benign ovarian FDG accumulating lesions like endometriosis, hemorrhagic corpus luteum cysts, and thecoma in the literature. (10-12) These observations lead the Nuclear Medicine physicians to underestimate the gynecologic uptake as benign variation and physiologic changes. Most of the patients in this series also revealed insignificant findings in the pelvic examination however four patients with concomitant malignancy could be underestimated in ignorance. In this case series, we observed a single patient with FDG uptake with benign ovarian pathology; serous cyst adenoma.

In a previous study including 1000 patients, it was demonstrated that in patients with gynecologic cancers the breast cancer is the most common secondary malignancy (13) and another study has also shown that the most common coexisting cancers are breast and gynecological cancers. (14) In the study of Plotcha et al., the patient's cervix cancer usually has synchronous breast carcinoma. They have shown that PET/CT is an effective modality in determining secondary cancers. (15)

The critical of this study was the small number of patients included and the pathology results. The retrospective structure of the study was another limitation; however, the diagnostic workup of the gynecological malignancies would not change; thus, this limitation may not be problematic.

6. Conclusion

According to the results of this study the coincident abnormalities of pelvic organs might be important thus careful evaluation must be performed in the patients with breast carcinoma in FDG PET/CT studies and pelvic examination and ultrasonography might be included in the workup of the patients with breast cancer.

Conflict of Interests

No conflict of interest was declared by the authors.

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