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F-18 FDG PET/CT FINDINGS IN DIFFERENTIATED PAPILLARY CARCINOMA OF THYROID AND DETERMINATION OF METABOLIC ACTIVITY

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ABSTRACT

Aims: In well differentiated thyroid cancers, FDG PET has a relatively low sensitivity. F-18 FDG PET/CT is an imaging method which is used before the treatment and in high risk patient groups with suspected recurrent disease. In this study we aim to determine the character of metabolic activity in differentiated thyroid cancer and in case of metastasis and to evaluate the findings of F-18-FDG PET/CT images in high risk patient group of differentiated thyroid cancer.

Methods: The data of 79 patients who underwent imaging for staging or restaging and followed at Trakya Univer¬sity Faculty of Medicine from 2010 to 2015, were included in this study. Patient reports were analyzed retrospectively. Age, gender, size of thyroid lesion, presence of lymphadenopathy, other organ metastases (lung, liver, brain, bone) were included in the study.

Results: The findings of 79 patients (29 male, 50 female) with papillary differentiated thyroid cancer were included in the analyses. The mean age of participants was 51±15 years. 14 patients (18%) were evaluated as normally. Recur¬rent disease was detected in the thyroid gland of 10 patients (13%) (SUVmax: 6.2±5.1; 2.3-19.3). In 54 patients (68%) lymph node metastasis was detected (SUVmax; 5.8±5.1; 2.1-24.2). 12 patients had liver metastasis (SUVmax: 5.7±3.9; 2.0-11.7), 12 patients had bone metastasis (SUVmax: 6.1±2.9; 2.2-13.9), 8 patients had lung metastasis (SUVmax: 4.3±4.5; 1.0-4.9) and one patient had brain metastasis (SUVmax: 10.2).

Conclusion: Papillary differentiated thyroid cancer is associated with a tumor showing low glucose affinity, but it is understood that the tumor changes its behavior and gets metabolically active in the patients within the high risk group and in those with systemic metastasis.

Keywords: Thyroid cancer, F-18 FDG, PET/CT

INTRODUCTION

Thyroid gland an important, butterfly-shaped endocrine gland located in front of the neck, under the throat. Thyroid cancer is one of the most common forms of malignancies. It constitutes about 1% of all cancers (1). At the same time, it is the most common endocrine malignancy (1). Generally, patients do not have any complaints.

According to the National Cancer Institute, there are about 56.000 new cases of thyroid cancer each year in the US, with papillary thyroid cancer being the most common type (2). Women are more likely to have thyroid cancer with a male to female ratio of 1:3 (2).

Thyroid cancer is classified according to its clinical and histopathological behavior. One of them is well differentiated thyroid carcinoma (DTC) and the other one is poorly DTC. With a percentage of 70 to 80%, most common type of thyroid cancer is papillary thyroid cancer. Papillary thyroid cancer can occur at any age (3).

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A definitive diagnosis of thyroid cancer is made by biopsy. This is used to detect whether nodules detected by ultrasonography (USG) or routine examination are cancerous. However, less than 10% of all thyroid nodules are cancerous (4). Also, one of the most diagnostic important examinations is scintigraphy which is done to detect the function status of the nodule.

In well DTC's, F-18 FDG PET/CT is an imaging method which is used before the treatment and high risk patient groups with suspected recurrent disease. In this study, we intended to determine the character of metabolic activity of DTC and metastasis and to evaluate the findings of F-18-FDG PET/CT images in high risk patient group of DTC.

MATERIAL AND METHODS

This study is designed to retrospectively evaluate the data of the patients with high risk and determine the risk of thyroid cancer. For this object, data of 79 patients who underwent staging and restaging with FDG PET/CT imaging from 2010 to 2015 at the Trakya University Department of Nuclear Medicine were included in the study using hospital's Picture Archiving and Communication System (PACS). Age, gender, pathology examination and clinical data were noted. Metabolic activity data was evaluated. Patients with missing data were excluded.

In this study, 241 patients with the age range of 18 to 81, who were examined at Trakya University Faculty of Medicine, Department of Nuclear Medicine from 2010 to 2015, were screened.

The study group consists of 79 patients who underwent F-18 FDG PET/CT imaging for follow-up or re-staging at Trakya University Faculty of Medicine in between 2010 and 2015. The reports of the patients in the hospital archives were evaluated retrospectively. Age, gender, size of thyroid lesion, presence of lymphadenopathy, other organ metastases (lung, liver, brain, bone) were included in the study.

The assessment with 18F-FDG PET is performed as follows: Firstly, patients should fast at least for 4 hours and have a blood glucose level of <170 mg/dL at the time of 18F-FDG injection. 18F-FDG is administered through the antecubital vein. The first scan is performed as a whole-body image. The second set of images of the pancreatic area was acquired about 1 hour after the whole-body scan. Secondly, static FDG PET/CT imaging starts in 3D covering the upper torso after the injection.

Additionally, delayed PET emission images of the upper abdomen were acquired at approximately 110 minutes. Transaxial, coronal, and sagittal images for visual and semi-quantitative analysis of the data was corrected for dead time, decay and photon attenuation and reconstructed in a 128×128 matrix. Images were reconstructed using 2 iterations and 28 subsets with a 6.0 mm FWHM post filter and a fully 3D maximum likelihood ordered subset expectation maximization reconstruction algorithm. The 18F-FDG PET images were evaluated with regard to the presence and nature of focal lesions with increased 18F-FDG uptake.

As for statistical analysis, descriptive statistics as arithmetic mean± standard deviation, numbers, percentages and minimum-maximum values were used.

This study was approved by Trakya University Faculty of Medicine Scientific Research Ethics Committee.

RESULTS

Seventy nine patients were included in the retrospective study. 29 of them were male, 50 of them female. The mean age of the patients was 51 ± 15 years. The youngest patient was 18 years old; the oldest patient was 81 years old. 14 of them (18%) had no pathological metabolic foci, as so were evaluated in normal limits.

Recurrent disease was detected in the thyroid of 10 patients (13%) (Maximum Standardized Uptake Value (SUV max): 6.2±5.1; 2.3-19.3). In 54 patients (68%) lymph node metastasis was detected (SUV max: 5.8±5.1; 2.1-24.2). 12 patients had liver metastasis (SUV max: 5.7±3.9; 2.0-11.7), 12 patients had bone metastasis (SUV max: 6.1±2.9; 2.2-13.9), 8 patients had lung metastasis (SUV max: 4.3±4.5; 1.0-4.9) and one patient had brain metastasis (SUV max: 10.2). The mean values of local recurrent and metastatic foci of thyroid cancer The mean SUVmax values of local recurrent and metastatic foci of thyroid cancer were presented tabe 1. Figure 1 showed that 18F-FDG PET/CT -fusion images of a 58-year old male patient with thyroid carcinoma with lymph node, lung and brain metastases.

Table1. The mean values of local recurrent and metastatic foci of thyroid cancer.

Location lesions with increased 18F-FDG uptake	N	SUVmax value Mean± SD (range)
Thyroid- local recurrence disease	10	6.2±5.1 (2.3-19.3)
Lymph node metastasis	54	5.8±5.1 (2.1-24.2)
Bone metastasis	12	6.1±2.9 (2.2-13.9)
Lung metastasis	8	4.3±4.5 (1.0-4.9)
Liver metastasis	12	5.7±3.9 (2.0-11.7)

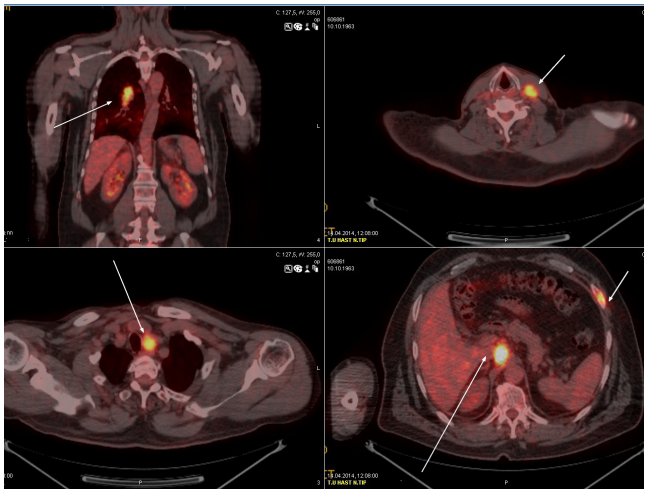

Figure 1. 18F-FDG PET/CT -fusion images of a 58-year old male patient with thyroid carcinoma with lymph node, lung and bone metastases.

DISCUSSION

In the PET imaging of high-risk differentiated thyroid cancer, we found high glucose uptake in metastatic lesions despite the iodine uptake.

We found that of the 79 patients who underwent 18F-FDG PET/CT imaging for follow-up or re-staging at Trakya University Faculty of Medicine between the years 2010-2015, 50 were male (63.3%) and 29 were female (36.7%). In a different retrospective analysis which was done in between 2009-2010, the data of 241 patients was evaluated and 222 of them (92.1%) were female and 19 (7.9%) were male (5).

According to study of Schlüter et al. (6) FDG PET has been accepted as a valuable imaging method for patients with differentiated thyroid cancer who present with elevated hTg levels and negative 131I scans. A great number of studies showed the ability of FDG PET in the detection of 131I-negative lesions seen in DTC. FDG PET/CT imaging is the only indicated in one negative case of in differentiated disease. If the FDG affinity is low in differentiated tumors, I131 imaging and Tg follow-up are preferred. In the study of Grünwald et al. (7) it was found that in most types of high-DTC's, 131I is advantageous with its high uptake values.

As a conclusion, papillary differentiated thyroid cancer is associated with a tumor showing low glucose (FDG) affinity. It is understood that the tumor changes its behavior and gets metabolically active in the patients within the high risk group and in those with systemic metastasis.

Ethics Committee Approval: This study was approved by Scientific Researches Committee of Trakya University School of Medicine.
Informed Consent: Written informed consent was obtained from the participants of this study.
Conflict of Interest: The authors declared no conflict of interest.
Financial disclosure: The authors declared that this study received no financial support.

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