

INCIDENTAL THYROID LESIONS DETECTED WITH FDG PET SCANNING

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ABSTRACT

Aims: fluorodeoxyglucose Positron Emission Tomography (FDG PET) scanning has become more popular in recent years, it has also become more frequent means of detecting incidental thyroid lesions. The aim of this study is to investigate the prevalence of incidentally found thyroid lesions in patients undergoing FDG PET and determine the risk for thyroid cancer. FDG PET was performed on 5758 patients for evaluation of suspected or known cancer without any history of thyroid disease between January 2006 and May 2012 in our clinic.

Material and methods: Patients with incidental thyroid abnormalities were identified. Medical records related to the FDG PET findings including standardized uptake value (SUV) and pattern of FDG uptake, fine needle aspiration (FNA) diagnosis and histopathology after thyroid surgery were reviewed retrospectively.

Results: One hundred twenty three patients (2.1%) were identified to have focal incidental thyroid lesions and 52 patients (0.9%) were identified diffuse incidental thyroid lesions on FDG PET. Twenty-four patients with focal and 5 patients with diffuse incidental thyroid lesion underwent FNA. The malignant diagnosis was detected in 41.6% of focal lesions. In diffuse lesions, malignant diagnosis was not observed. There was a significant difference in the SUVmax between the benign and malignant lesions (5.7 ± 2.2 and 10.1 ± 5.3). Malignant diagnosis was noted in 57.1% of male patients and 20% of female patients who underwent FNA.

Conclusion: The results of this study suggest that focal FDG uptake, high SUV and male gender have high risks for thyroid malignancy in incidentally found thyroid lesions by FDG PET. Further diagnostic work-up is needed in patients with these findings.

Key words: FDG PET scan, incidental thyroid lesion, risk of malignancy.

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Introduction

Lesions detected during imaging with no indication of thyroid disease are called incidental thyroid lesions⁽¹⁾. The most common incidental lesion observed during head and neck imaging is thyroid nodules⁽²⁾. The frequency of incidental thyroid lesions is progressively increasing due to extensive use of imaging methods with high resolution. The most frequently used imaging studies in which incidental lesions are found are ultrasonography (US), computerized tomography (CT), and magnetic resonance imaging (MRI). Another important technique of imaging where thyroid lesions are detected is fluorodeoxyglucose positron emission tomography (FDG PET). FDG PET, which is a functional method of imaging, has been recently adopted, especially by oncologists. The incidence of incidental thyroid

lesions are lower by FDG PET imaging compared to other techniques; however, when compared to other methods, the risk of malignancy of the focal incidental thyroid lesions detected by FDG PET is quite high⁽³⁾. The incidental lesions observed in a FDG PET study are divided into two groups: focal and diffuse lesions. Focal thyroid lesions are seen in 1.1-4%⁽³⁻¹²⁾ of cases. The rate of malignancy is quite high in those lesions with an incidence ranging from 14% to 56%⁽³⁻¹²⁾. On the other hand, diffuse incidental thyroid lesions are seen in 0.6-33%^(4,5,13,14). These lesions are generally seen in some benign thyroid diseases such as thyroiditis and Graves' disease^(13,15,16). The aim of this study was to determine the frequency of the incidentally diagnosed thyroid lesions by FDG PET imaging due to causes other than thyroidal reasons, the rate of malignancy in these lesions, and findings that raise suspicion for malignancy.

Materials and methods

After receiving the approval of the Ethics Co A total of 5,758 patients (3,594 males, 2,164 females) with no thyroid disease in their past medical history, who had FDG PET imaging due to various indications at the Department of Nuclear Medicine, School of Medicine, University of Gaziantep, were included in the study. PET-CT imaging of the patients included in the study was performed using Siemens Biograph 2 PET-CT equipment at the Department. Patients with an abnormal uptake in the thyroid gland were identified and these lesions were defined as incidental thyroid lesions. The demographics of these patients, patterns of FDG uptake (focal or diffuse), SUV values of the lesions, and the pathological findings of cases that underwent a histopathological exam were evaluated.

Incidental thyroid lesions were divided into two main groups: focal and diffuse lesions. The maximum FDG uptake levels were recorded as SUV values. Histopathological diagnoses of the patients who underwent diagnostic FNA were categorized as malignant, benign, or suspicious. In addition, the definite histopathological diagnoses of those patients who were referred for surgery were also obtained. The findings of FDG PET were compared with the histopathological results. Frequency of incidental thyroid lesions, malignancy potential of these lesions and the clinical importance, and the association of SUV values obtained with the FDG uptake patterns with the histopathological results of the patients' were analysed. This retrospective study was approved by the Medical Ethics Committee of the University of Gaziantep, School of Medicine (Date of approval: 25.10.2011, Number of approval: 10-2011/195).

Results

Focal incidental thyroid lesions

A total of 5,758 patients with no thyroid disease in the past medical history had FDG PET imaging due to various indications between January 2006 and May 2012 at our Department. Among these 3,594 were males and 2,164 were females. Mean age in the total series was 51.6 ± 17 years; mean age of males and females were 52.3 ± 17.3 years and 50.6 ± 16.5 years, respectively. Focally increased FDG uptake was observed in the thyroid region in 123 of the patients (2.1%). Forty-nine of these patients were males (39.8%) and 74 were females (60.2%). Focal

incidental thyroid lesions were identified in 1.4% of males and 3.3% of females. Mean age of all patients with a focal incidental lesion identified was 58 ± 13 years (range, 22-90); mean age of males and females were 57.3 ± 12.5 years (range, 22-78) and 58.7 ± 13.5 years (range 25-90). The increase in FDG uptake was unifocal in 105 of the patients with placement of 4 in the isthmus, 5 in the right lobe, and 50 in the left lobe. The uptake was multifocal in 18 patients. FNA of the thyroid lesion was performed in 24 patients. Males and females comprised 14 and 10 of these patients, respectively. The results of FNA were reported as benign in 10 patients (41.6%), malignant in 10 patients (41.6%), and suspicious for malignancy in 4 patients (16.6%). Thyroidectomy was performed in 6 patients with malignant FNA results.

Calculated mean SUV value in the total series was 6.2 ± 4 (range: 1.9-23) and mean SUV values of cases with benign pathology, malignant pathology, and suspicious pathology were 5.7 ± 2.2 (range: 3.6-11.5), 0.1 ± 5.3 (range: 2.9- 18.9), and 8.5 ± 5.1 (range: 4.4-16), respectively. Pathology results were malignant in 8 (57.1%) patients, benign in 5 (35.7%) patients, and suspicious in 1 patient (7.2%) among males who underwent thyroid FNA. On the other hand, pathology results were malignant in 2 (20%), benign in 5 (50%), and suspicious in 3 patients (30%) among females who underwent thyroid FNA. Primary thyroid cancers were detected in 6 patients among the 10 with malignant cytology and 4 patients had metastatic thyroid disease.

Primary thyroid cancers were of the papillary type in 5 patients and squamous cell type in one patient (Figure 1). Among the metastatic thyroid diseases, two were reported as thyroidal metastasis of lung cancer, and one each as metastasis of rectal cancer and Hodgkin's lymphoma. Benign FNA results were reported in 10 patients (Figure 2).

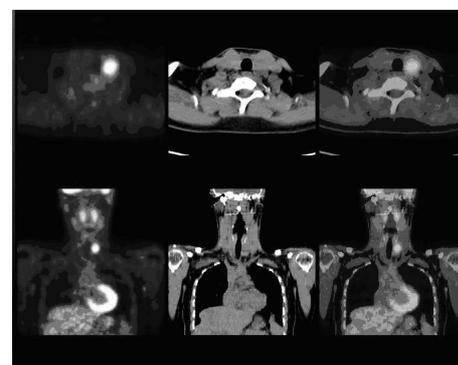


Figure 1: Papillary thyroid cancer incidentally identified by FDG PET imaging in a patient with a brain tumor.

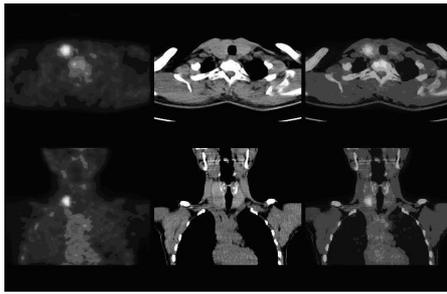


Figure 2: Benign focal incidental thyroid lesion detected by FDG PET imaging in a patient with Non-Hodgkin's lymphoma.

Diffuse incidental thyroid lesions

Diffusely increased FDG uptake was present in 52 of 5,758 patients (0.9%) with no history of thyroidal disease who underwent PET-CT with various indications in our Department. Sixteen of these patients were males (30.8%) and 36 were females (69.2%). Diffuse incidental thyroid lesions were present in 1.6% of females and 0.45% of male patients. Mean age of the patients with diffuse incidental thyroid lesions was 54.8±15.5years (range: 25-81), while it was 58.9±14.5 years (range: 32- 81) and 52.9±15.1 years (range 26-79) in males and females, respectively. Diffuse FDG uptake was present in both lobes in 44 patients, in left lobe only in 6 patients, and in the right lobe only in 2 patients. Mean SUV value of all patients was calculated as 6.6±3.5 (range 2.8-17.8). Five patients underwent thyroid FNA with benign histopathological findings in all of them (Figure 3). One of the patients was referred to surgery and the histopathological report after surgical resection was lymphocytic thyroiditis.

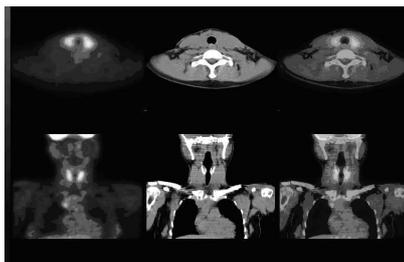


Figure 3: Benign diffuse incidental thyroid lesion identified by FDG PET imaging in a patient with a mediastinal mass.

Discussion

The presence of thyroid nodules is a quite frequently encountered clinical problem. The rate of thyroid diseases is reported as 50-65% in many autopsy series⁽¹⁷⁾. Only a small part of the thyroid nodules are palpable. The rest of the patients are diagnosed incidentally by various imaging studies. The most frequently encountered incidental finding

during head and neck imaging is thyroid nodules⁽²⁾. Incidental thyroid lesions have been diagnosed more often lately due to the extensive use of imaging studies and increased resolutions of them⁽¹⁸⁾. US is the imaging method by which incidental thyroid nodules are most often diagnosed. Ever increasing nonpalpable thyroid nodules have been identified due to the extensive use of US in neck imaging^(18,19). At least one nodule is identified in the thyroid gland by US in clinically asymptomatic patients in 19-46% of the cases^(17,18-21). Malignancy risk in such nodules is around 1.5-10%⁽²²⁾.

Incidental thyroid nodules have been diagnosed in 10-17% of the cases by CT and MR studies performed with indications other than thyroid diseases⁽²³⁻²⁵⁾. Ten percent of these nodules are identified as malignant.

Another technique of identification of incidental thyroid lesions is FDG PET imaging. FDG uptake of a normal thyroid gland is homogeneous and low in intensity, and thus not visualized by FDG PET most of the time^(4,26). Therefore, focal or diffusely increased FDG uptake in the thyroid gland in a case with no past medical history of thyroidal disease is defined as an incidental thyroid lesion. Incidental thyroid lesions observed in FDG PET studies are divided into two groups: focal and diffuse lesions. Focal incidental thyroid lesions have been found in 1.1-4% of the cases in many studies⁽³⁻¹²⁾. This rate is 2.1% in this study, which is compatible with the literature results. Malignancy rates in focal incidental thyroid lesions are quite high and vary between 14% and 56%⁽³⁻¹²⁾. In the present study, 46.6% of the cases had malignant histopathological findings.

A literature review of the focal incidental thyroid lesions identified by FDG PET is shown in Table 1. Diffuse incidental thyroid lesions are diag-

Study	Number of Patients	Number/Percent of Focal lesions	Number of patients with histopathological evaluation	Number/Percent of Malign lesions
Cohen7	4525	71/1.6	15	7/47
Choi9	1763	70/4.0	44	17/38.6
Chen8	4803	60/1.2	50	7/14
Nishimori18	4726	103/2.2	30	9/30
Kim4	4136	45/1.1	32	18/56
Are6	8800	101/1.1	57	24/42
Bogsrud10	7347	79/1.1	48	15/31.3
Chu11	6241	76 /1.2	14	4/28.6
This study	5758	123/2.1	24	10/41.6

Table 1: Literature review of focal incidental thyroid lesions identified by FDG PET imaging.

nosed in 0.6-3.3% of the cases in the studies performed^(4,5,13,14). Diffuse incidental thyroid lesions were found in 0.9% in this study, which is compatible with the literature results. Diffuse incidental thyroid lesions are generally seen in thyroidal diseases that are benign in nature, such as thyroiditis and Graves' disease^(13,15,16). On the other hand, some researchers suggest that diffusely increased FDG uptake in the thyroid gland is a reflection of a variation of the normal state^(27,28). Benign histopathological findings were found in all of the 5 diffuse incidental thyroid lesions by FNA in our study.

The use of SUV values of the lesions in the differentiation of benign and malignant focal incidental thyroid lesions is controversial. SUV values of malignant lesions were markedly high in some studies compared to the benign lesions^(7-9,12,14), whereas some other studies reported no significant difference^(4,5,10,17). Kang et al. found a mean SUV value of 16.5 in malignant lesions in their study, while this value was 6.5 in benign lesions⁽¹⁴⁾. Choi et al. on the other hand, identified a mean SUV value of 6.7 and 10.7 in benign and malignant lesions, respectively⁽⁹⁾. However, Are et al. found a mean SUV value of 9.2 and 8.2 in benign and malignant lesions, respectively⁽⁸⁾. Nishimori et al. found these values to be 5.2 and 5.8, respectively⁽¹⁷⁾. Mean SUV values were found to be significantly high in malignant lesions compared to benign lesions in our study (mean SUV value in benign and malignant lesions were 5.7 ± 2.2 and 10.1 ± 5.3 , respectively). Although we found a higher mean SUV value in malignant lesions compared to benign ones, this parameter by itself is not sufficient to differentiate malignant and benign lesions. Hurthle cell adenomas have a tendency of high FDG uptake, although they are benign lesions⁽²⁹⁾. In addition, small diameter papillary thyroid carcinomas are known to have a low tendency of FDG uptake and/or the SUV values are suggested to be lower than their actual values in those cancers due to the volume effect⁽²⁹⁾. Kim et al. identified a direct correlation between the SUV values and tumor diameter in patients with malignant pathological lesions, although they found no differences in mean SUV values between benign and malignant lesions⁽⁴⁾. No relation was found between the tumor diameter and maximal SUV value in our study.

Both types of incidental thyroid lesions were encountered more frequently in female patients in our study. Focal and diffuse incidental thyroidal lesions in female patients were seen in 3.3% and 1.6%, respectively, and in male patients in 1.4% and

0.45%, respectively. Of the focal incidental and diffuse incidental thyroid lesions, 60.2% and 69.2% were seen in female patients, respectively. These rates are compatible with the reality of higher frequency of thyroidal diseases in women. However, malignant incidental thyroid lesions were seen in higher rates in women compared to men in this study. Fourteen of 24 patients were males and 10 were females among cases with a histopathological evaluation in our study with an incidence of malignant pathology in 57.1% of males and 20% of females. This finding suggests that the male gender might be one of the possible criteria for suspicion of malignancy in incidental thyroid lesions diagnosed by FDG PET studies.

Although incidental thyroid lesions are not frequently observed in FDG PET imaging studies, the high rate of malignancy in focal lesions render this finding valuable. Diffuse incidental thyroid lesions are almost always seen in benign thyroid diseases, such as thyroiditis and Graves' disease. Therefore, a histopathological examination in the diagnostic evaluation of diffuse incidental thyroid lesions identified by FDG PET imaging generally are not necessary. Focal incidental thyroid lesions, on the other hand, have a high rate of malignancy. The focal nature of the FDG uptake in thyroid gland, high FDG uptake by the lesion (high SUV value) and male gender are the main findings that increase the malignancy risk in the incidental thyroid lesions in this study. Nevertheless, presence of these findings alone is not adequate to make a diagnosis of malignancy. Therefore, taking into account the high malignancy rates, focal incidental thyroid lesions identified by FDG PET imaging should always be taken seriously and advanced diagnostic evaluation of these lesions should be performed.

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