

ARTICLE TITLE: Incidental findings of the thyroid gland on PET-CT.

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THESIS:

Incidental findings of the thyroid gland are common on the whole-body FDG (18F-fluorodeoxyglucose) positron emission tomography-computed tomography (PET-CT).

Materials and Methods

A retrospective review of 100 patients with breast cancer (AJCC IV) was done. PET-CT studies with incidental focal and diffuse FDG thyroid uptake formed the review basis. These studies were performed within a period of 12 months (January 1, 2016-December 31, 2016). Twenty two (n=22) patients out of 100 (22%) had FDG thyroid uptake and comprised the study group. We excluded patients who had a history of previous thyroid malignancy or predisposing causes (e.g., Cowden syndrome).

Scans were acquired approximately 60 min after the injection of 555MBq (15mCi) FDG with the Gemini TF PET/CT (Philips Medical Systems, Cleveland, Ohio, USA) scanner with a 16-slice Brilliance CT.

Results

This study shows that thyroid FDG uptake, incidentally identified on PET/CT of patients with breast cancer (AJCC - IV), occurred at a frequency of 22%. Focal and diffuse types of uptake were diagnosed with equal frequency.

Conclusion:

However, well-defined criteria for evaluating thyroid incidentalomas on PET examinations aren't developed yet and ultrasound still remains the method of choice for analyzing thyroid changes

KEYWORDS: incidentaloma, PET-CT, thyroid gland, FDG-uptake, petoma

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Introduction

Incidental findings of the thyroid gland are common on the whole-body FDG (18F-fluorodeoxyglucose) positron emission tomography-computed tomography (PET-CT). FDG accumulates slightly in normal thyroid tissue on the whole-body PET-CT with FDG and an increase of uptake is common for pathological changes [1].

Incidental thyroid activity on FDG-PET, performed in patients without thyroid malignancy, referred to as a “PEToma” or incidentaloma. It is suggested, that such lesions are associated with a significant incidence of primary thyroid cancer over the past 20-30 years and the development of new diagnostic techniques such as PET [2].

Different studies shows that thyroid FDG uptake incidentally identified on PET-CT occurred at a frequency of 2-10%. Focal and diffuse types of uptake were diagnosed with equal frequency [1, 2]. The risk of malignancy varies: it is higher in cases with focal thyroid FDG uptake, whereas diffuse thyroid FDG uptake most likely represents chronic thyroiditis.

SUV (standardized uptake value) is usually used for distinguishing between benign and malignant thyroid PETomas. [1, 2] This parameter is considered to be high when the lesion is malignant, however, in practice it is not always the case. For example, a Hürthle adenoma has a SUVmax of 8.9, while a papillary thyroid carcinoma - only 2.8 [4]. However, well-defined criteria for evaluating thyroid incidentalomas on PET examinations aren't developed yet and ultrasound still remains the method of choice for analyzing thyroid changes [3].

Materials and Methods

A retrospective review of 100 patients with breast cancer (AJCC IV) was done. PET-CT studies with incidental focal and diffuse FDG thyroid uptake formed the review basis. These studies were performed within a period of 12 months (January 1, 2016-December 31, 2016).

Twenty two (n=22) patients out of 100 (22%) had FDG thyroid uptake and comprised the study group. We excluded patients who had a history of previous thyroid malignancy or predisposing causes (e.g., Cowden syndrome). These 22 patients were further evaluated to determine the clinical significance of unexpected focal and diffuse FDG uptake in the thyroid gland. All the patients were women in the age group of 70-75 .

18F-fluorodeoxyglucose-PET/CT

Patients fasted for at least 4 hours before PET/CT imaging and had a measured finger stick glucose level less than 11.1 mmol/L (200 mg/dl) before the administration of FDG. Scans were acquired approximately 60 min after the injection of 555MBq (15mCi) FDG with the Gemini TF PET/CT (Philips Medical Systems, Cleveland, Ohio, USA) scanner with a 16-

slice Brilliance CT. Low-dose CT with contrast enhanced in arteriovenous equilibrium phase was performed.

Results

Patients, who had unexpected FDG uptake in the thyroid gland, were divided into two groups: diffuse uptake group (n=15) and focal uptake group (n=11). 4 patients had both diffuse and focal changes. Location of the focal thyroid lesions are given in Table 1.

Table 1. Location of thyroid PETomas

Location of thyroid PEToma	N and %
Left lobe (the largest node)	41%
Right lobe (the largest node)	59%
Isthmus	9%
Bilateral	27.2%

Mean age of the patients was 73, standard deviation was $\pm 1,9$. We correlated SUV values with focal and diffuse types of uptake (Table 2).

Table 2. SUVmax and SUVmean according to the type of uptake

	Focal FDG Uptake - min value	Focal FDG Uptake - max value	Diffuse FDG Uptake - min value	Diffuse FDG Uptake - max value
SUV max	1,8	13,3	1,1	8,7
SUV mean	4,2	7,0	2,2	3,4

Diffusal uptake is associated with the increased volume of the thyroid gland, however, the mean volume of the gland is also increases when uptake is focal (Table3).

Table 3. Volumes of the thyroid gland according to the type of uptake

	Focal FDG Uptake	Percentage of normal value (upper limit)	Diffuse FDG Uptake	Percentage of normal value (upper limit)
Mean volume of the right lobe	18,1	243%	26,6	354,7%

Mean volume of the left lobe (ml)	16,9	225,3%	20,9	278,7%
Mean total thyroid volume (ml)	34,9	232,6%	46,1	325,4%

The results of the audit demonstrate how often radiologists missed incidental findings of the thyroid gland and forgot to recommend ultrasound evaluation (Table 4).

Table 4. Results of the audit

Radiologists' mistakes	Frequency
Missed focal changes of the thyroid gland	30,30%
Missed diffuse changes of the thyroid gland	45,45%
Forgot to recommend ultrasound evaluation	60,60%
The thyroid gland volume is not mentioned	100%

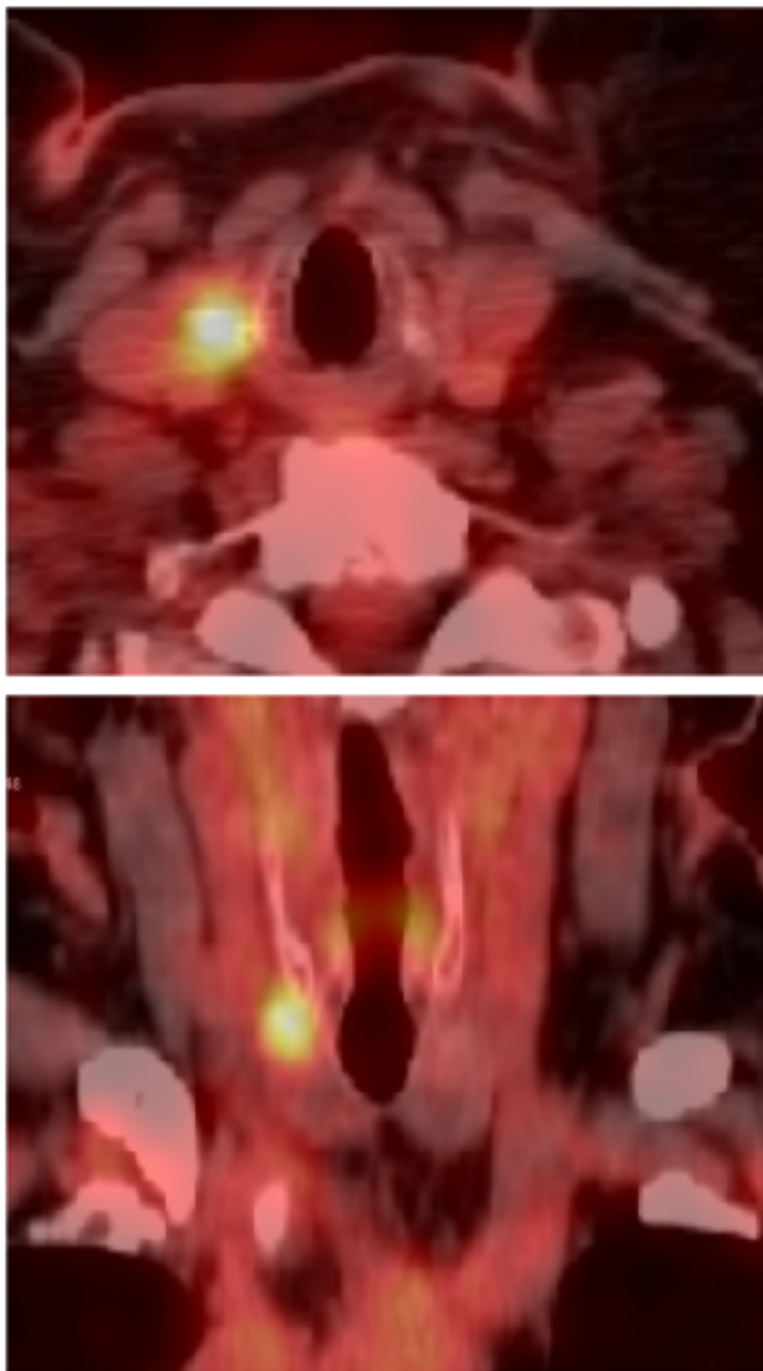


Figure 1 (a, b). The thyroid gland (axial - a, and coronal - b) with focal FDG uptake on PET-CT of the neck region

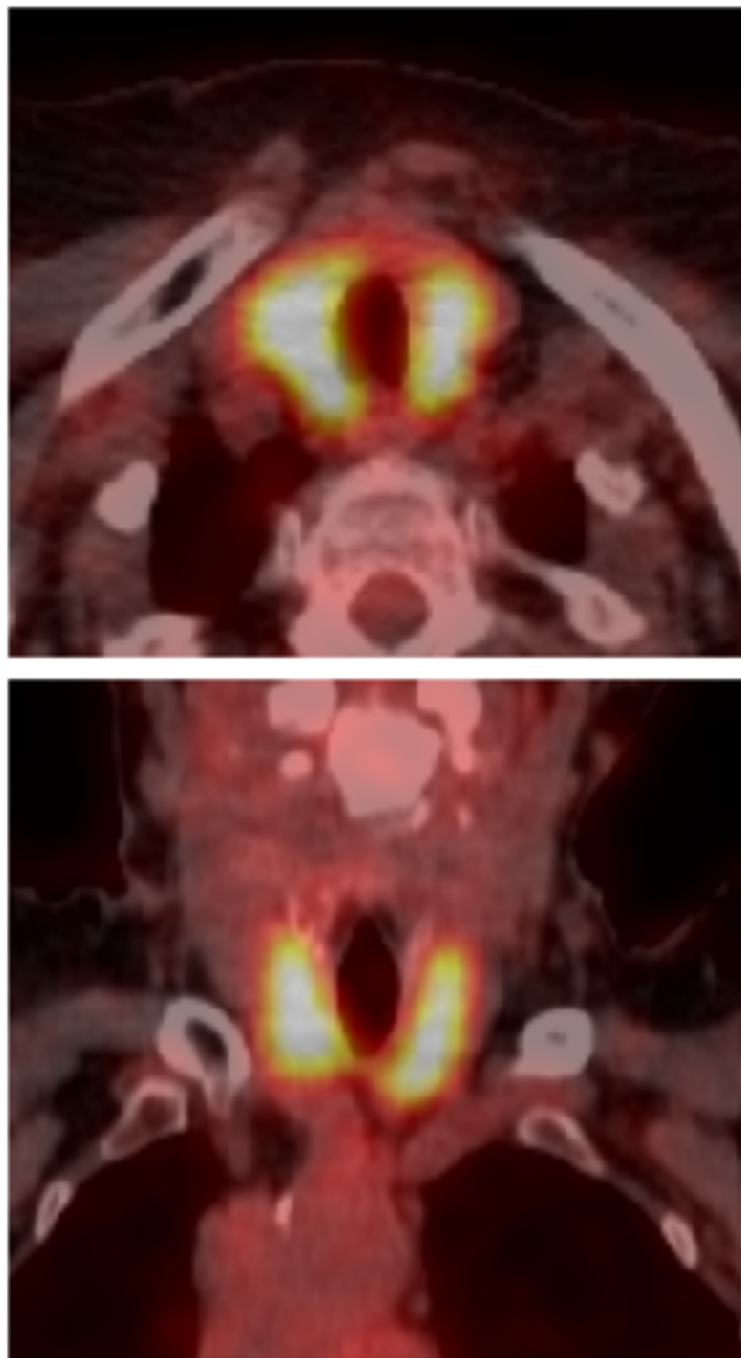


Figure 2 (a, b). The thyroid gland (axial - a, and coronal - b) with diffuse FDG uptake on PET-CT of the neck region

Discussion

In our study we retrospectively reviewed all the 100 whole-body FDG PET-CT studies performed with the aim to evaluate the prevalence of incidental FDG uptake in the thyroid gland.

Our data showed a 22% prevalence of incidental thyroid FDG uptake on FDG PET-CT and this data correlate with the literature [5, 6]. Lesions had both diffuse (15 of 22, 68%) and focal (11 of 22, 50%) uptake and more often focal uptake was in the right lobe.

Considering that the study group was small, more findings are needed to evaluate the role of SUV in the differentiation between benign and malignant lesions of the thyroid gland, that were accidentally found on PET and verified with ultrasound and biopsy. Benign lesions sometimes have much higher SUV value than malignant lesions, so quantitative evaluation of metabolic activity is not accurate thus far [4]. Ultrasound still remains the method of choice for evaluation of a thyroid incidentalomas. This method is available and cheap thuswise the evaluation of the role of SUV is not the task of prime importance.

Volume of the thyroid gland was measured in order to compare with normal female thyroid gland volume, which is ~ 10-15 ml [7]. Enlargement of the thyroid gland is nearly always seen in patients with diffuse diseases, cases with autoimmune hypothyroidism are sometimes the exception [8]. In our study, diffuse FDG uptake is seen in the enlarged thyroid gland, however, the mean volume of the gland was also increased in approximately two times, when uptake was focal.

The audit, mentioned in this study, showed weak awareness of radiologists about thyroid pathology defined on PET-CT. The results of the audit revealed that even in cases, when the changes of the thyroid gland was protocolled, thyroid volume was not mentioned and ultrasound evaluation was not recommended.

Conclusion

This study shows that thyroid FDG uptake, incidentally identified on PET/CT of patients with breast cancer (AJCC - IV), occurred at a frequency of 22%. Focal and diffuse types of uptake were diagnosed with equal frequency.

The risk of malignancy is high in lesions with focal thyroid FDG uptake, but radiologists didn't always pay due attention to these important incidental findings and didn't recommend ultrasound evaluation.

Diffuse thyroid FDG uptake most likely represents chronic thyroiditis and other diffuse pathologies of the thyroid gland, clinically presented with a goiter. It is important to measure the thyroid volume, because focal changes also result in gland enlargement.

Conflict of Interests.

The authors state that they have no conflict of interests.

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