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Thyroid incidentalomas discovered on positron emission tomography CT scanning – Malignancy rate and significance of standardised uptake values

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Abstract

Aims: Increasing use of 18F-Fluorodeoxy glucose (FDG) Positron Emission Tomography Computed Tomography (PET CT) has resulted in an increased frequency of incidentally discovered areas of focally increased FDG uptake within the thyroid gland – thyroid incidentalomas. We aimed to compare radiological characteristics of thyroid incidentalomas with cytology, histology and ultrasound findings.
Materials and methods: We examined all FDG PET CT scan reports for all patients undergoing this investigation over a 6 year period in a single tertiary cancer centre. All PET CT scans followed an agreed proforma allowing reports mentioning "thyroid" to be identified. Reports commenting on a positive finding within the thyroid gland were investigated further manually. Incidental mentions of thyroid with no underlying abnormality were discounted from analysis.
Results: In the study period, 7221 patients underwent FDG PET CT scanning in our unit. Within this group 75 (1%) showed diffuse FDG uptake and 81 (1.1%) showed focal uptake (thyroid incidentalomas). Only 30 patients (37%) with incidentalomas had further investigation and malignancy rate was 23% (7/30). Median Standardised Uptake Values (SUV) in malignant lesions was 9.9 (range 3.5–17.8) whilst in benign lesions and diffuse lesions it was 5.4 (2.8–32) and 4.2 (2.1–25.6) respectively ($p = 0.0013$, Kruskal Wallis).
Conclusion: There remains a need to develop a standardised approach to the investigation and management of thyroid incidentalomas discovered on FDG PET CT scanning. Up to 1 in 4 of these patients will harbour thyroid malignancy.

Keywords: Thyroid incidentaloma; 18F-fluorodeoxy glucose (FDG) positron emission tomography computed tomography; Standardised uptake values; Thyroid cancer

Introduction

The use of 18F-Fluorodeoxy glucose (FDG) Positron Emission Tomography Computed Tomography (PET CT) scanning is increasing in the investigation and staging of malignancy. With its increased use, more incidental findings of increased uptake of FDG either diffusely or as a focal hotspot in the thyroid are being reported, with the associated dilemma of further investigation and management. Diffuse uptake of FDG in the thyroid is usually due to benign inflammatory processes such as thyroiditis,[1,2] while focal uptake can be due to either a benign or a malignant nodule,[3] and is referred to as an incidentaloma. Thyroid incidentalomas are noted on 1–4%[4,5] of PET CTs worldwide. In those which are further investigated, malignancy rates of 26–50%[6,7] are reported. Standardised Uptake Value (SUV) is the accepted measurement of intensity of FDG uptake in tissue on scanning, and is a reflector of the degree of metabolic activity.[8] Some studies have reported a higher SUV in malignant nodules than benign,[4,5,9,10] but this finding is not corroborated by all.[1,11,12] No UK guideline currently exists regarding the

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investigation or management of incidentalomas. We conducted a review of all thyroid incidentalomas identified on PET CT over a 6 year period in a regional oncology centre, examining the SUV, cytology, histology and ultrasound (US) findings. Our primary aims were to determine the rate of malignancy, and evaluate whether SUV has any correlation with malignancy. A secondary aim was to investigate the trends in management of incidentalomas in the absence of clear UK guidelines.

Materials and methods

7221 patients underwent PET-CT in our regional oncology centre between 2007 and 2012. All 7221 PET-CT reports followed an agreed proforma whereby any and all sites of abnormal FDG within the body uptake were mentioned. All reports are stored within an electronic Radiology Information System database. Results from all PET CT reports containing the word 'thyroid' were extracted from the radiology information system by means of a keyword search. Those reports containing mention of the thyroid, but with no underlying thyroid abnormality or uptake, or where the scan had been performed to investigate a known primary thyroid malignancy were excluded from further analysis. All other PET CT scan reports which commented on a positive finding within the thyroid gland were investigated further via a manual trawl. Demographics including age, gender, indication for PET CT, and age at diagnosis were recorded for all patients. The PET CT reports were examined for maximum SUV values within the thyroid lesion, the pattern of uptake of FDG, whether diffuse or focal, unilobar or bilobar and the presence or absence of cervical lymphadenopathy. Where the original report did not give an SUV for the thyroid incidentaloma, the PET scans were examined by a Consultant Radiologist and SUV measured. Electronic records were then searched for evidence of any further investigation or management related to the thyroid findings. This included local and regional radiology systems for US reports, and local pathology systems and clinical notes for fine needle aspiration (FNA) cytology, histology and thyroid function test results. The search was then expanded to base hospitals and community based general practitioners records since many patients had no further investigations other than the PET CT at the regional oncology unit. Clinical outcomes were recorded, including operative intervention on the thyroid and mortality related to primary malignancy.

Results

During the 6 year study period, 7221 PET CTs were performed. 156 of 7221 patients (2.1%) were identified with FDG uptake in the thyroid which was unrelated to the original clinical indication for the PET CT exam. Of these, 75/7221 patients (1%) showed diffuse uptake, with 81 patients (1.1%) demonstrating focal FDG uptake in keeping with a focal incidentaloma. There were proportionally more males with incidentaloma than diffuse uptake, and mean age was similar in the two groups at 68 and 67 years respectively (Table 1). Table 2 summarises the primary indication for scanning. The most common indication in both overall group and the incidentaloma group was for lung cancer staging. Patients who were subsequently diagnosed with thyroid malignancy were initially referred for PET CT following a diagnosis of cervical lymphadenopathy ($n = 3$), oesophageal carcinoma (2), solitary pulmonary nodule (1), lymphoma (1), prostate cancer (1), colorectal carcinoma (1).

Table 1
Demographics of the study population.

Variables	Incidentaloma $n = 81$	Diffuse uptake $n = 75$
Mean age (years)	68	67
Female	47 (58%)	59 (79%)
Male	33 (42%)	16 (21%)
Cervical lymphadenopathy	9	7

Only 2 of 75 patients (3%) with diffuse uptake had further investigation with ultrasound directed FNA confirming one to be benign, and hemithyroidectomy proving one malignant (multifocal papillary carcinoma on a background of lymphocyctic thyroiditis).

Only 30 of 81 patients (37%) discovered to have a thyroid incidentaloma on PET scanning had evidence of further investigation. Four patients had ultrasound only, with no cytological diagnosis. Twenty-six patients had either cytological or histological diagnosis and 7 were proven to have thyroid malignancy (4 papillary carcinomas, 2 follicular carcinomas, 1 thyroid lymphoma). Thus the malignancy rate in patients with thyroid incidentalomas who proceeded to tissue biopsy was 27% (7/26). Thirteen of 26 patients (50%) had benign cytological or histological diagnoses. The remaining patients had atypical ($n = 3$) or

Table 2
Indication for PET CT scans in study population.

Indication for PET CT	Whole group $n = 156$	Incidentaloma group $n = 81$
	n(%)	n(%)
Lung cancer	43(28)	23(28)
Colorectal cancer	22(14)	13(16)
Lymphoma	20(13)	8(11)
Oesophageal cancer	19(12)	9(10)
Solitary pulmonary nodule	10(7)	5(6)
Squamous cell carcinoma of head/neck	5(3)	3(4)
Breast cancer	4(3)	2(2)
Cervical lymphadenopathy	3(2)	2(2)
Neck lymphoma	2(1)	0(0)
Gastric adenocarcinoma	2(1)	0(0)
Anal cancer	2(1)	2(2)
Other	24(15)	15(18)