

## CASE REPORT

# Rare Intensely Fluorine-18-fluorodeoxyglucose Avid Large Retropharyngeal Goiter in a Patient with Invasive Breast Carcinoma

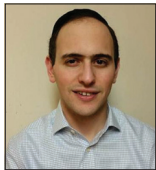
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## ABSTRACT

Diffuse increased fluorine-18-fluorodeoxyglucose (<sup>18</sup>F-FDG) avidity on positron emission tomography (PET) scans has been demonstrated in patients with chronic thyroiditis, likely secondary to increased inflammatory cell glucose uptake. A complex association has been demonstrated between breast cancer and thyroid disease, although the mechanism remains elusive. Development of chronic thyroiditis and/or goiter in breast cancer patients has been suggested to convey a more favorable prognosis. Goiter extension is almost exclusively into retrosternal space, with only a handful of cases reported with superior extension into retropharyngeal space. We present a rare case of a diffusely enlarged goiter extending superior and posterior into the retropharyngeal space with an associated intense <sup>18</sup>F-FDG avidity standardized uptake value maximum (SUV<sub>max</sub>) of 16.1 in a patient with invasive ductal breast cancer. To our knowledge, this represents the first published case of diffusely <sup>18</sup>F-FDG avid goiter with retropharyngeal extension.

**Key words:** Breast cancer, fluorine-18-fluorodeoxyglucose, goiter, positron emission tomography, retropharyngeal

## INTRODUCTION

Goiters usually present with a painless enlarging neck mass. Typically goiter extension is into the retrosternal space, as described back in 1934 by Lahey and Swinton, for several reasons.<sup>[1]</sup> These include the lack of thyroid gland anatomic restraint inferiorly, downward traction caused by the swallowing mechanism, and negative intrathoracic

pressure due to respiration. The finding of retropharyngeal extension via pretracheal and retroesophageal spaces is very rare, only described in a handful of case reports.<sup>[2]</sup>

In routine clinical practice, background thyroid gland fluorine-18-fluorodeoxyglucose (<sup>18</sup>F-FDG) uptake on positron emission tomography (PET) is routinely encountered. Diffuse increased <sup>18</sup>F-FDG uptake throughout

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the gland has been shown to correlate with chronic thyroiditis and nodular goiter among other etiologies.<sup>[3]</sup> Observational studies have found an association between invasive breast cancer and chronic thyroiditis, although the mechanism has not been elucidated.<sup>[4]</sup> Some suggest that development of thyroiditis in patients with invasive breast cancer may convey a more favorable prognosis.<sup>[5]</sup> We present a case of an intensely <sup>18</sup>F-FDG avid large goiter with a standardized uptake value maximum (SUV<sub>max</sub>) of 16.1 with superior extension into the retropharyngeal/prevertebral compartment found incidentally in a patient with invasive ductal breast cancer.

## CASE REPORT

A 68-year-old female patient was found to have a new left breast mass on screening mammogram. Subsequent diagnostic mammography revealed a 2 cm, highly suspicious mass in the left breast at 1 o'clock along with morphologically abnormal lymph nodes in the left axilla. Ultrasound-guided core biopsies of the left breast mass, and one axillary lymph node were performed, consistent with infiltrating, well-differentiated ductal carcinoma with focal lobular features (tubulolobular carcinoma). The lymph node was positive for disease as well, with extranodal involvement. The tumor was estrogen receptor 50% positive, progesterone receptor 20% positive, and HER-2/neu was negative by fluorescence *in situ* hybridization (FISH). The patient underwent bilateral breast gadolinium-enhanced magnetic resonance imaging which revealed another suspicious area in the left breast, at 10 o'clock position, for which ultrasound-guided biopsy revealed similar pathological features.

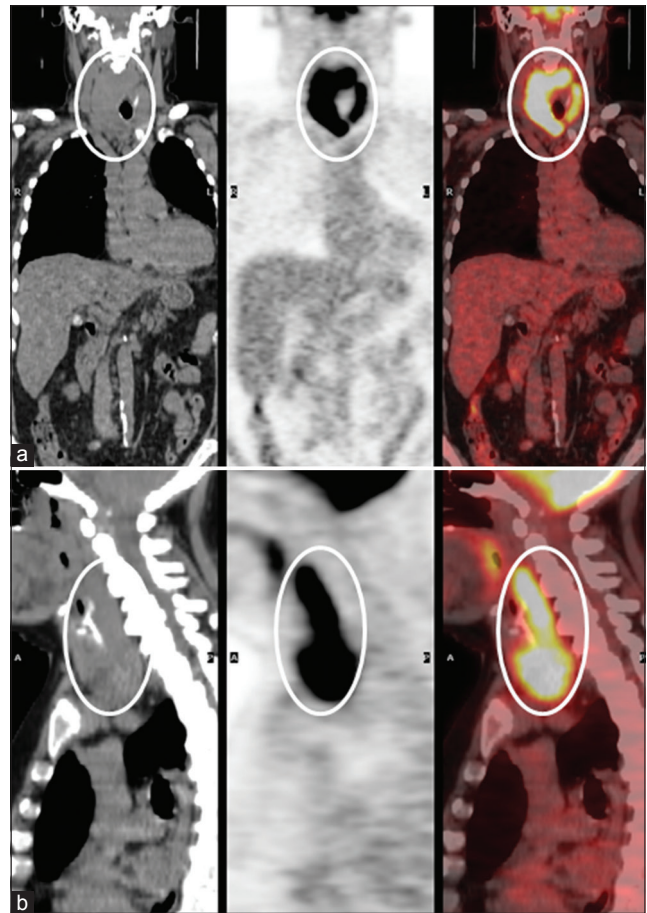
The patient has a history of hypothyroidism and has been on 50 mcg levothyroxine daily for greater than a year. Physical examination revealed firm diffuse bilateral thyroid enlargement, with both lobes partially underlying the sternocleidomastoid muscles. Pemberton's sign was not present. She was asymptomatic with no difficulty swallowing, and had normal pulmonary function tests.

The patient underwent a left breast modified radical mastectomy. Final pathology revealed multicentric tumors with left axillary metastasis and foci of extranodal extension. Her breast cancer was staged as pT2N2a by AJCC seventh edition.

A staging <sup>18</sup>F-FDG PET-computed tomography (CT) scan performed prior to chemotherapy revealed diffuse postsurgical changes in the left breast and axilla. In addition, a diffusely <sup>18</sup>F-FDG avid goiter was present (SUV<sub>ma</sub> × 16.1) with superior extension into the retropharyngeal and

prevertebral space [Figures 1-3]. Correlating noncontrast CT scan of the neck demonstrated a large goiter with bilateral thyroid lobe enlargement. The right thyroid lobe measured 3.3 cm × 4.0 cm × 10 cm with extensive sub-sternal, superior and posterior extension, resulting in mild leftward tracheal deviation [Figure 4].

Blood work showed normal total T3, free T4, and thyroid-stimulating hormone with high titers of anti-thyroglobulin antibody (998 IU/ml) and thyroid peroxidase antibody (2337 IU/ml). An ultrasound-guided fine needle aspiration was performed and pathology was consistent with chronic thyroiditis. The patient received adjuvant chemotherapy with docetaxel and cyclophosphamide for six cycles, followed by adjuvant chest wall radiation.



**Figure 1:** 68-year-old female with newly diagnosed breast cancer found to have markedly enlarged fluorodeoxyglucose avid goiter with retropharyngeal extension. (a) Fluorine-18-fluorodeoxyglucose positron emission tomography/computed tomography coronal reformatted images of the neck and mediastinum including noncontrast computed tomography, fluorine-18-fluorodeoxyglucose positron emission tomography, and fused images demonstrate enlarged bilobar goiter with diffuse fluorodeoxyglucose avidity (white circles). (b) Fluorine-18-fluorodeoxyglucose positron emission tomography/computed tomography sagittal reformatted images of the neck including noncontrast computed tomography, fluorine-18-fluorodeoxyglucose positron emission tomography, and fused images demonstrate superior extension of the goiter into the retropharyngeal and prevertebral space (white circles).



**Figure 2:** 68-year-old female with newly diagnosed breast cancer found to have markedly enlarged fluorodeoxyglucose avid goiter. Serial fused computed tomography/fluorine-18-fluorodeoxyglucose positron emission tomography coronal reformatted images of the neck from fluorine-18-fluorodeoxyglucose positron emission tomography/computed tomography scan demonstrate diffusely intense fluorine-18-fluorodeoxyglucose avidity throughout the bilobar goiter,  $SUV_{max} \times 16.1$  (white circles).

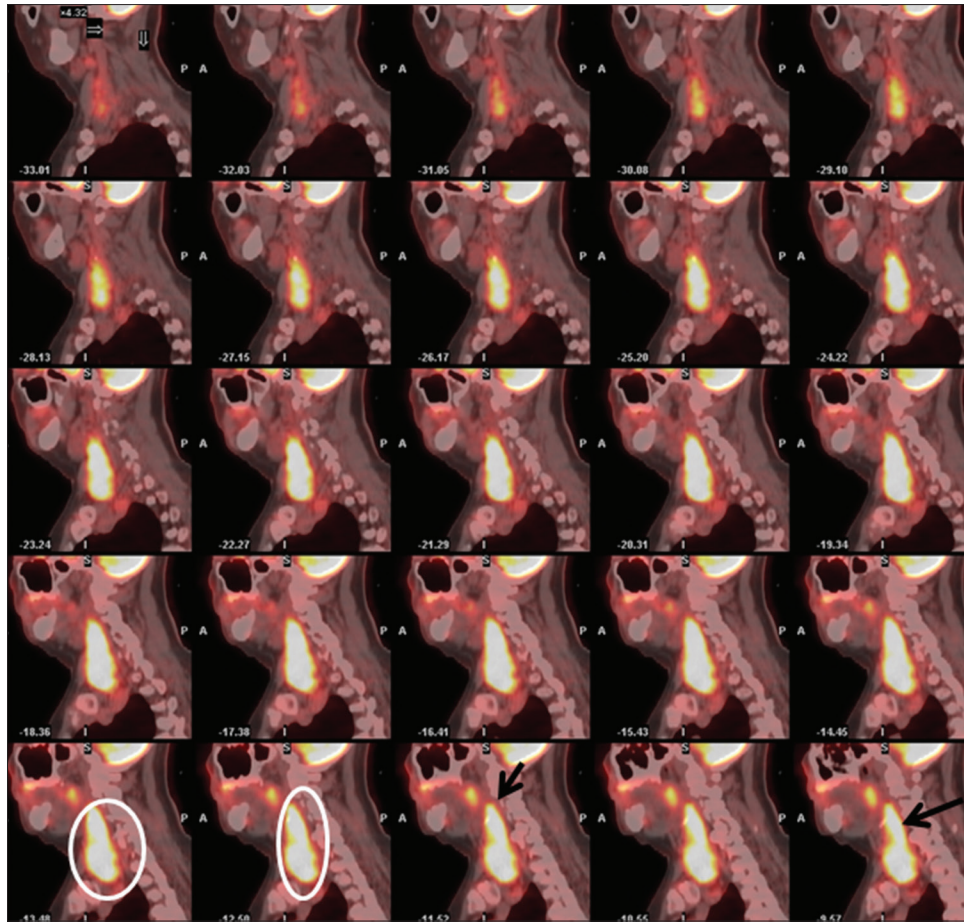
## DISCUSSION

The role of  $^{18}\text{F}$ -FDG PET/CT in cancer imaging has increased exponentially over the past decade for diagnosis, staging, and evaluation of treatment response. This has subsequently resulted in increased detection of incidental lesions, including thyroid disease. Under normal circumstances, the thyroid gland should not be visualized by PET due to free fatty acids being the preferred substrate for the thyroid gland.<sup>[5]</sup> In 2006, Choi et al., found incidental focal  $^{18}\text{F}$ -FDG avid thyroid nodules in 4% of cases, with associated risk of thyroid malignancy of 36.7%.<sup>[6]</sup>

While focal thyroid lesions have been found to be associated with malignancy, diffuse thyroid gland uptake has been shown to correlate more with chronic thyroiditis and hypothyroidism.<sup>[5]</sup> As lymphocytes become attracted to the thyroid gland, many believe that these activated lymphocytes display greater glucose metabolism and thus play a key role in the uptake process.<sup>[3]</sup> Additional mechanisms suggested for the increased  $^{18}\text{F}$ -FDG uptake include cell apoptosis and active formation of fibrosis.<sup>[7]</sup>

A complex association has been demonstrated between thyroid disease and breast cancer dating back to 1896 where breast cancer patients were treated with oophorectomy and thyroid extract.<sup>[8]</sup> Studies have shown that patients with thyroid dysfunction have a higher prevalence of breast cancer.<sup>[4]</sup> Furthermore, a higher prevalence of antithyroid antibodies has been found in women with breast cancer compared with healthy controls.<sup>[5]</sup> The presence of thyroid autoimmunity in a patient with breast cancer has even been associated with a favorable prognosis.<sup>[9]</sup> In addition, diffuse thyroid gland  $^{18}\text{F}$ -FDG uptake in patients with advanced breast cancer (mean  $SUV_{max}$  of  $\geq 3.2$ ) related to autoimmune thyroiditis has also been demonstrated to be an independently favorable prognostic factor.<sup>[5]</sup>

A significantly increased prevalence of goiter has also been demonstrated in patients with breast cancer compared to control group Smyth et al., were able to show that thyroid gland volume had prognostic implications for breast cancer patients.<sup>[10]</sup> Regarding  $^{18}\text{F}$ -FDG uptake, a positive linear correlation has been shown between  $SUV_{max}$  and thyroid gland volume in patients with breast cancer.<sup>[7]</sup>



**Figure 3:** 68-year-old female with newly diagnosed breast cancer found to have markedly enlarged fluorodeoxyglucose avid goiter with retropharyngeal extension. Serial fused computed tomography/fluorine-18-fluorodeoxyglucose positron emission tomography sagittal reformatted images of the neck from fluorine-18-fluorodeoxyglucose positron emission tomography/computed tomography scan demonstrate extent of retropharyngeal and prevertebral space involvement (white circles and black arrows).



**Figure 4:** 68-year-old female with newly diagnosed breast cancer found to have markedly enlarged bilobed goiter with retropharyngeal extension. Coronal noncontrast enhanced computed tomography with coned down view of the neck shows bilobar thyroid gland enlargement resulting in mild leftward tracheal deviation (white circle).

Our patient with breast cancer had a diffuse goiter visualized on  $^{18}\text{F}$ -FDG-PET scan with  $\text{SUV}_{\text{max}}$  of 16.1, which is much higher

than previously reported. The increased  $\text{SUV}_{\text{max}}$  may be explained by the extensive bilobar enlargement, correlating with positive linear correlation described previously. In addition, a superior extension to the retropharyngeal space via pretracheal and retrosophageal spaces are very rare.<sup>[2]</sup> Finally, intense diffuse FDG uptake in a goiter that extends superiorly, as in our case, has never been previously reported to our knowledge.

## CONCLUSION

As discussed previously, our patient with breast carcinoma and a history of chronic thyroiditis was found to have a rare, FDG avid large bilobed goiter with a retropharyngeal extension on staging  $^{18}\text{F}$ -FDG PET/CT examination. Studies have suggested patients with concomitant breast carcinoma and chronic thyroiditis have a more favorable prognosis. To this date, our patient remains cancer-free which may be partially attributable to the inflamed thyroid gland providing additional immunity.

## Acknowledgments

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## Conflicts of interest

There are no conflicts of interest.

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