Cervical Lymph Node Metastasis of Thyroid Papillary Carcinoma Imaged with Fluorine-18-FDG, Technetium-99m-Pertechnetate and Iodine-131-Sodium Iodide

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A 49-yr-old white woman with diffuse sclerosing variant of papillary carcinoma of the thyroid revealed abnormal [^{18}F]FDG accumulation within cervical lymph node metastases prior to thyroidectomy. The abnormal cervical foci of glucose metabolism corresponded to similar areas of abnormal [^{99m}Tc]pertechnetate and radioiodine accumulation on presurgical scans. The primary thyroid tumor within the thyroid gland was not delineated as a focal defect on any of the three imaging studies. The relative thyroid-to-background soft-tissue ratio in the [^{18}F]FDG study, however, appeared higher than usual. As with ^{131}I and [^{99m}Tc]pertechnetate, this case demonstrates that [^{18}F]FDG PET can detect cervical lymph node metastases in the preoperative thyroid cancer patient.

Key Words: fluorodeoxyglucose; thyroid cancer; lymph node metastasis

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When using the radionuclides [^{131}I]sodium iodide (NaI) and [^{99m}Tc]pertechnetate, successful detection of thyroid cancer lymph node metastases often depends on the absence of the native thyroid gland (i.e., post-thyroidectomy) and the histology of the primary tumor (i.e., well-differentiated follicular and papillary carcinoma). When identified, preoperative thyroid cancer lymph node metastases may present as [^{99m}Tc]pertechnetate-positive and radioiodine-negative foci (*1–3*). There have been, however, several reported cases of preoperative [^{99m}Tc]pertechnetate and radioiodine accumulation in lymph node metastases secondary to follicular (*2,4*) and papillary thyroid carcinoma (*5*).

The increasing availability of PET has provided an additional modality to facilitate tumor detection. Fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG) has been shown to accumulate in thyroid cancer and its metastases (*6–10*). The degree of accumulation is usually a reflection of increased glucose metabolic demand in tissues with a high glycolytic rate. Both Joensuu et al. (*7*) and Adler et al. (*9*) have reported FDG accumulation within both malignant and benign primary thyroid tumors in preoperative patients. It is interesting, however, that in Joensuu et al.'s study, all three patients with papillary carcinoma showed none to slight accumulation of FDG based on a visual scale. In the Adler study, all three patients with papillary carcinoma showed mild to intense accumulation of FDG on a subjective scale.

We present an unusual case of metastatic cervical lymph node accumulation of FDG secondary to diffuse sclerosing variant of papillary thyroid carcinoma in a prethyroidectomy patient. The demonstrated abnormal lymph node metastases correspond to concordant [^{131}I]NaI and [^{99m}Tc]pertechnetate lymph node accumulation.

CASE REPORT

A 49-yr-old woman was referred for evaluation of abnormal thyroid function laboratory tests and symptoms of nausea, palpitation and increased shortness of breath for 2 yr. Her laboratory tests indicated primary hypothyroidism and were as follows: TSH 58.12 μIU/ml (nl = 0.35–5.50), free T4 0.44 ng/dl (nl = 0.68–1.76), free T3 = 2.0 pg/ml (nl = 1.90–5.0). On physical examination, she had a diffusely enlarged thyroid gland with an estimated weight of 35–40 g (nl = 15–20 g). No palpable thyroid nodules were noted. There was, however, an approximate 1.5-cm palpable, nontender cervical mass superficially in the distribution of the left jugular lymph node chain.

An image obtained 20 min following intravenous injection of 400 MBq (10.8 mCi) [^{99m}Tc]pertechnetate revealed mild inhomogeneous tracer distribution within the thyroid. No discrete or focal defects were identified. There was abnormal extrathyroidal accumulation of radiotracer within several foci in the left lateral neck (Fig. 1). The largest focus of radiotracer accumulation corresponded to the clinically palpable left cervical mass.

To determine if the mass uptake represented a discordant [^{99m}Tc]pertechnetate-radioiodine finding, 24-hr [^{131}I]NaI imaging

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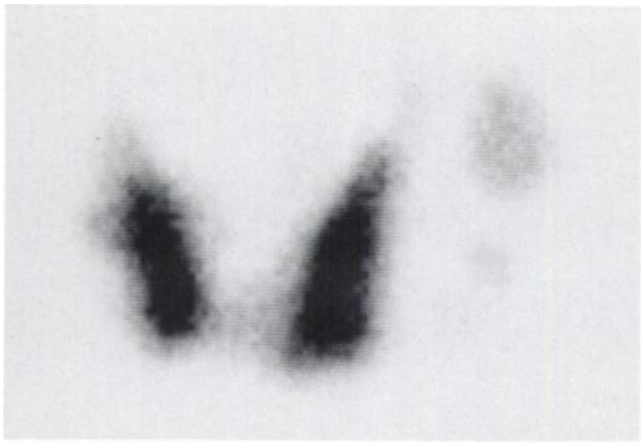

FIGURE 1. Anterior [^{99}Tc]pertechnetate pinhole image shows several foci of extrathyroidal accumulation of radiotracer in the lymph nodes lateral to the left lobe of the thyroid.

following oral administration of 2.7 MBq (73 μCi) was performed 8 days after the [^{99m}Tc]pertechnetate scan. Iodine-131, rather than ^{123}I, was used because of the high clinical suspicion for malignancy. The radioiodine scan showed similar distribution of radiotracer within the thyroid gland and several left cervical lymph nodes (Fig. 2). All of the images were obtained using gamma camera with pinhole collimation (Picker Intl., Bedford Heights, OH).

To further search for metastatic foci, FDG-PET imaging was performed 1 hr after injection of 381 MBq (10.3 mCi) [^{18}F]FDG on a camera that provides 5–6-mm resolution. Attenuation correction was performed by transmission imaging using a ^{68}Ga ring source before the injection of the FDG. PET imaging also demonstrated radiotracer accumulation corresponding to the prior ^{131}I and [^{99m}Tc]pertechnetate studies within the thyroid and the left cervical lymph nodes (Fig. 3). Standardized uptake values (SUVs) (*11*) were 2.82 in the lymph nodes and 1.8 in the thyroid gland. Lymph node uptake was significantly elevated, and the thyroid gland value was higher than that in the adjacent soft tissue or thyroids of other patients without known thyroid problems.

At thyroidectomy, a diffuse sclerosing variant of papillary carcinoma was found, which involved the entire thyroid gland and five left lateral cervical lymph nodes. The normal thyroid parenchyma was virtually replaced by tumor.

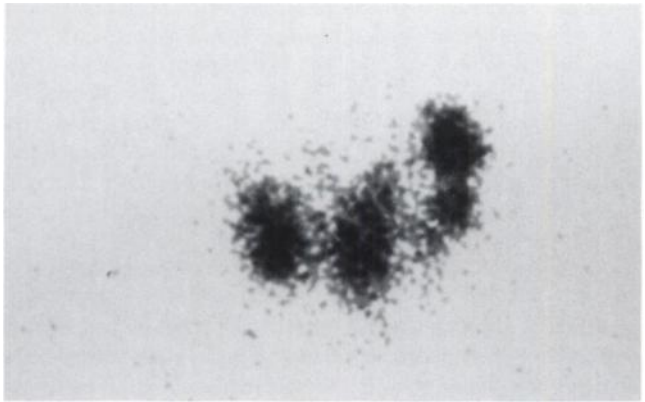

FIGURE 2. Anterior pinhole image with [^{131}I]NaI demonstrates abnormal lymph node accumulation in the left cervical lymph nodes. Note the lack of discrete hypofunctional areas within the thyroid gland.

FIGURE 3. Coronal [^{18}F]FDG PET image confirms abnormal metabolic foci within the left cervical lymph nodes, which corresponds to the [^{99}Tc]pertechnetate and [^{131}I]NaI scans. Relative increased thyroid-to-background, soft-tissue ratio is observed.

DISCUSSION

In the presence of native thyroid tissue, radioisotopic imaging and detection of thyroid cancer lymph node metastases has been quite uncommon (*12,13*). Many authors have shown, however, that preoperative accumulation of radioiodine, [^{99m}Tc]pertechnetate or both within cervical lymph nodes generally portends a diagnosis of thyroid carcinoma with metastatic spread (*1–5*). We used PET to show a related case of abnormal preoperative FDG metabolism within proven thyroid carcinoma cervical lymph node metastases, which also corresponded to matching abnormal [^{131}I]NaI and [^{99m}Tc]pertechnetate accumulation. In addition to visualizing FDG, [^{99m}Tc]pertechnetate and [^{131}I]NaI accumulation within the cervical lymph node metastases, a particularly interesting feature of this case was the relative lack of any focal scan abnormalities within the thyroid gland.

Since the papillary cancer diffusely involved the entire thyroid gland with virtual complete replacement of the normal parenchyma, it is likely that, under elevated TSH stimulation, the tumor possessed enough trapping and organification function to account for the ^{131}I and ^{99m}Tc images obtained. Also, based on our own anecdotal experiences and the 1.8 SUV, we believe that the degree of FDG accumulation within the thyroid gland of our patient exceeds that expected in the population without thyroid disease. This observation is likely supported by Joensuu et al. (*7*) who suggest that the identification of more than very slight accumulation of FDG in the thyroid gland reflects significant entrapment of FDG. Additionally, several authors (*14,15*) have shown that glucose accumulation by thyroid cells is stimulated by TSH. Sisson et al. (*10*) have shown reduced accumulation of FDG in tumor metastases, when the serum TSH concentration was reduced to the low normal range. Thus, in our patient, it is reasonable to

assume that the elevated TSH level also facilitated tumor detection.

CONCLUSION

FDG accumulation within cervical lymph node metastases can be identified in the preoperative patient with thyroid cancer. The abnormal foci of FDG metabolism also may be concordant with both [^{99m}Tc]pertechnetate and radioiodine.

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