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Posttherapy I-131 Thymic Uptake Demonstrated with SPECT/CT in a Young Girl with Papillary Thyroid Carcinoma

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Dear Editor:

We present the images of a young patient with well-differentiated thyroid carcinoma who had mediastinal I-131 uptake on first posttherapy radioiodine scintigraphy, diagnosed as thymus gland activity on hybrid single photon emission computed tomography (SPECT/CT) imaging. This relatively new technology allows rapid and precise localization of I-131 activity to anatomic structures, which in this patient confirmed a known physiologic mimic of disease, allowing conservative management.

An 11-year-old girl was diagnosed with papillary thyroid carcinoma on fine-needle aspiration biopsy, after presenting with a left-sided neck mass. Thyroid ultrasound revealed a 4 cm left thyroid lobe mass and several nearby cervical lymph nodes with microcalcifications suspicious for nodal metastases. She underwent total thyroidectomy and lymph node dissection of the central neck compartment (pTNM stage 1). She was referred to our Nuclear Medicine Therapy Clinic 2 months later for assessment for radioiodine therapy. Her biochemical markers at the time were thyroid-stimulating hormone 355 mU/L, thyroglobulin (Tg) < 0.5 ng/mL, and anti-Tg antibodies present. Histopathology reported evidence for capsular invasion of the thyroid cancer with extrathyroidal extension and 14/24 lymph nodes in the central compartment positive for metastases. The patient was otherwise healthy with no intercurrent illness and a normal chest radiograph.

Diagnostic scintigraphy with 37 MBq (1 mCi) I-131 demonstrated intense radioiodine uptake in the central neck compartment with no abnormal uptake in the thorax. An oral dose of 5.7 GBq (155 mCi) I-131 was administered. On the posttherapy images 4 days later there was thoracic radioiodine uptake in an inverted V-shape suggestive of thymic uptake (Fig. 1). Intense radioiodine uptake in the central neck was consistent with local cervical nodal metastases. Also present was diffuse hepatic radioiodine uptake, due to residual functioning thyroid tissue incorporating I-131 into thyroxine, which was subsequently metabolized in the liver.

Thoracic SPECT/CT imaging was performed on a gamma camera with inline CT capability (Symbia T6; Siemens Medical Solutions, Illinois) to further evaluate the mediastinal I-131 activity (Fig. 2). Fusion axial and coronal images localized thoracic radioiodine activity to a bilobed anterior mediastinal soft tissue density consistent with the thymus in this young patient. SPECT/CT technology allowed a rapid clinical answer, with greater confidence than planar images, and obviated the need for diagnostic thoracic CT. The patient was staged as T_4, N_1, and M_0 due to histopathologic evidence of capsular extension and central compartment lymph nodes positive for disease. The presence of anti-Tg antibodies in serum invalidated the undetectable Tg levels; however, based on SPECT/CT appearance, mediastinal nodal or thymic metastases were considered unlikely and biopsy was not performed. The patient had no identifiable clinical reason for thymic hyperplasia.

Radioiodine uptake in the thymus of young patients with differentiated thyroid cancer is a known physiologic mimic of disease, which can be managed conservatively (1). Recently, identification of sodium–iodine symporter gene expression in extrathyroidal tissue, including thymus, provides indirect evidence for the mechanism of uptake (2). The incidence of thymus visualization on I-131 scintigraphy has been reported between 3.4% and 26.3% in four series, the largest with 489 patients by Haveman *et al*. (3). They suggested a flow chart to assist management of patients with mediastinal activity. I-131 SPECT/CT imaging has been shown to provide superior lesion localization and more accurate staging of thyroid cancer (4). Certainly, SPECT/CT could aid work-up of mediastinal activity by characterizing uptake as physiologic (including esophageal secretions, gastro-esophageal reflux, hiatus hernia, thymus, and tracheo-bronchial aspiration) or pathologic (mediastinal nodal, pulmonary, or osseus metastases) and guide management.

Gamma cameras with integrated CT have the advantages of rapid, efficient, fusion of functional and anatomic data, with minimal patient motion between acquisitions. The CT portion of the study is typically low dose and nondiagnostic, performed for localization and attenuation correction purposes only. Therefore, the radiation dose is lower than diagnostic CT. Hybrid SPECT/CT imaging is a new tool at the nuclear physician's disposal that improves staging of thyroid cancer, although its use should be judicious in the pediatric population (5). An alternative to evaluate suspected thymic tissue is to perform MR imaging, which has the significant advantage of avoiding ionizing

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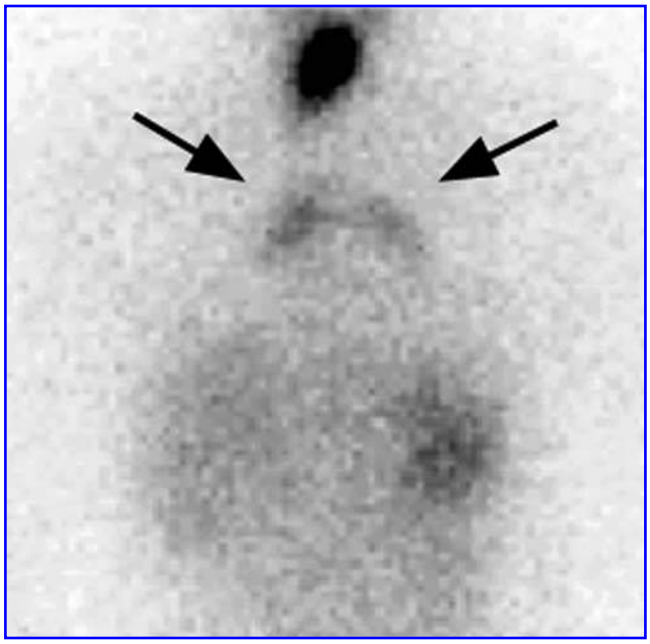

FIG. 1. Posttherapy I-131 anterior static image of the neck and thorax demonstrates mild radioiodine uptake in the anterior thorax with an inverted V-shape suggestive of thymic gland activity (arrows). Central neck radioiodine uptake is consistent with cervical nodal metastases.

radiation exposure in younger patients. The normal thymus gland characteristically will have a homogenous T2 or short TI inversion recovery (STIR) signal, although if the thymic mass contains fat, chemical-shift MR sequences have been found useful in early adulthood populations, in differentiating thymic hyperplasia from tumors of the thymus gland (6).

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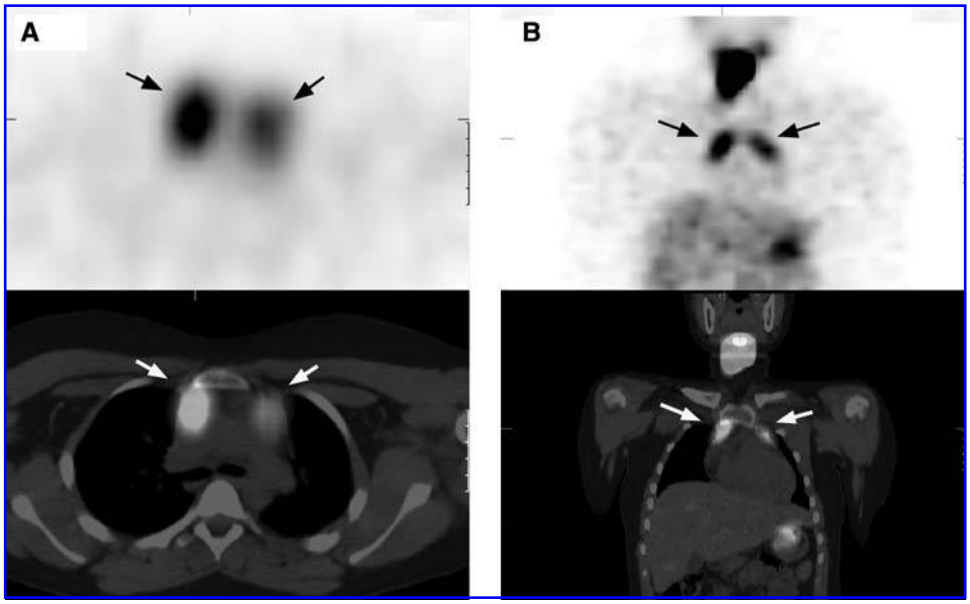

FIG. 2. Posttherapy I-131 fusion SPECT/CT (**A**) axial and (**B**) coronal images localize thoracic radioiodine activity to a bilobed anterior mediastinal soft tissue density consistent with thymus in this young girl (arrows).

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