Incidental Primary Intrathoracic Goiter: Dual-Isotope Scintigraphy and Early-MIBI SPECT/CT

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Introduction

Primary intrathoracic goiter is a rare congenital entity arising from accessory and/or ectopic thyroid tissue that is discrete from an orthotopic thyroid gland and may lead to complications such as respiratory obstruction and malignancy.¹ These entities are typically managed surgically due to an increased risk for respiratory complications and malignancy.²⁻⁴ On the contrary, secondary thyroglossal duct cysts are a more common entity that arises from orthotopic thyroid tissue.⁵ Differential diagnoses that should be considered when encountering incidental mediastinal masses in adult patients include thymoma and lymphoma.⁶

Intrathoracic thyroid goiter may be inconspicuous on planar ⁹⁹mTc-pertechnetate (TcO⁴⁻) scintigraphy, relative to normal thyroid tissue,⁷ although it may demonstrate early blood pool activity.⁸

Case Report

An elderly woman was referred to our institution for evaluation of primary hyperparathyroidism with a parathyroid hormone (PTH) level of 105 pg/mL (upper limit of normal [ULN]: 65), and hypercalcemia with calcium 10.1 mg/dL (ULN: 10.5). Initial diagnostic imaging evaluation with high-resolution ultrasound was unremarkable for localization of parathyroid adenomas.

Nuclear medicine was consulted for the localization of parathyroid adenoma, and the patient was prepared for evaluation with dual-isotope scintigraphy with ⁹⁹mTc-sestamibi (methoxyisobutylisonitrile, MIBI), TcO⁴⁻, and early-MIBI single-photon emission computed tomography/computed tomography (SPECT/CT) for localization of parathyroid adenomas. The mass was inconspicuous on TcO⁴⁻ scintigraphy but methoxyisobutylisonitrile-avid on early planar and SPECT/CT.

Keywords
► primary intrathoracic goiter
► scintigraphy
► MIBI
► SPECT/CT
► hyperparathyroidism

Abstract

Primary intrathoracic goiter is an uncommon congenital entity resulting from over decent ectopic thyroid tissue. As compared with secondary intrathoracic goiter, primary entities are discrete from orthotopic thyroid tissue and may lead to potentially serious complications such as malignancy and shortness of breath. Intrathoracic goiters have been described as showing mild or absent uptake of ⁹⁹mTc-pertechnetate on planar scintigraphy. We present an incidental primary intrathoracic goiter found in a patient undergoing evaluation with multimodal scintigraphy and early ⁹⁹mTc-sestamibi single-photon emission computed tomography/computed tomography (SPECT/CT) for localization of parathyroid adenomas. The mass was inconspicuous on TcO⁴⁻ scintigraphy but methoxyisobutylisonitrile-avid on early planar and SPECT/CT.

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evaluation of parathyroid adenomas, and increased value of MIBI-SPECT/CT for anatomic localization and surgical planning. The patient received approximately 740 MBq of $^{99m}$Tc-sestamibi followed by 10 and 120 minutes planar scanning in anterior projection, in addition to early-MIBI SPECT/CT at 15 minutes following administration of radiotracer. Three hours following administration of MIBI, the patient received approximately 370 MBq of $^{99m}$Tc-pertechnetate followed by 15 minutes delayed planar scanning in anterior projection. The protocol for the study was based on Society of Nuclear Medicine practice guidelines.

Early-MIBI planar scintigraphy ($\text{Fig. 1}$) showed a large moderately-avid mediastinal lesion inseparable from the thyroid. On delayed imaging, the mediastinal mass revealed equivocal areas of minimal retention. Differential diagnoses included lymphoma, thymoma, and primary intrathoracic goiter. Additionally seen was a relatively thicker left lower thyroid pole that was discordant with TcO$_4^-$ images ($\text{Fig. 3}$) and demonstrated minimal retention on delayed-MIBI ($\text{Fig. 2}$), suggestive of a left lower thyroid pole localized parathyroid adenoma.

The patient underwent surgical resection of the left lower thyroid and mediastinal mass ($\text{Fig. 3}$), PTH levels decreased to 53 pg/mL (ULN: 65). Histopathologic evaluation of the mediastinal mass revealed thyroid parenchyma with smaller areas of thymic and parathyroid tissue, and evaluation of the left lower parathyroid nodule revealed hypercellular parathyroid tissue.

**Discussion**

This patient was clinically diagnosed with primary hyperparathyroidism and referred to our nuclear medicine department for the localization of parathyroid adenoma(s). During our imaging evaluation, the patient was found to have an incidental MIBI-avid mediastinal mass with minimal equivocal retention that was nonavid on TcO$_4^-$. Prior case reports have described primary intrathoracic thyroid with minimal or absent uptake of TcO$_4^-$, although we found no cases comparing their appearance with early and delayed MIBI and SPECT/CT, as shown in this case. The nearly-absent uptake of TcO$_4^-$ is likely secondary to a poor expression of sodium iodide symporters in the congenital neoplasm, as compared with normal thyroid tissue.

Primary intrathoracic thyroid goiter results from enlargement of ectopic thyroid tissue within the thoracic cavity. Unlike secondary thyroid goiter, primary entities derive their
Fig. 2  Early-methoxyisobutylisonitrile single-photon emission computed tomography/computed tomography (MIBI SPECT/CT) performed as part of the protocol for localizing parathyroid adenoma(s). Early-MIBI SPECT maximum intensity projection (A), and transcoronal fused SPECT/CT (B1) and contrast-enhanced CT images (B2) showed a large mediastinal mass discrete from the thyroid gland with heterogeneous uptake of MIBI (arrowheads). Additionally, there was relatively more intense activity in the left lower thyroid pole (arrows) that corresponded to the discordant uptake seen on TcO₄⁻ planar images.

Fig. 3  Transaxial fused and CT images at the level of the lower thyroid gland show an MIBG-avid nodule posterior to the left thyroid lobe (A1-A2; arrows). Transaxial fused and CT images of the chest showed a heterogeneously MIBG-avid mediastinal mass (B1, arrowheads) with heterogeneous contrast enhancement (B2, arrowheads). Post surgical changes are shown with removal of the left thyroid nodule (A3) and mediastinal mass (B3).
blood supply from intrathoracic vessels and are associated with potentially serious complications.

Requirements for Authorship
Requirements for authorship included prior experience in diagnostic imaging of thyroid and parathyroid pathology. Every author is either a diagnostic imaging specialist (radiologist or nuclear medicine specialist) with experience on nuclear medicine and/or parathyroid/thyroid imaging, or a trainee in nuclear medicine.

Statement of Authorship
The manuscript has been read and approved by all the authors. The aforementioned requirements for authorship have been met and each author believes that the manuscript represents honest work.

Conflict of Interest
None declared.

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