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

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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 ^{99m}Tc-pertechnetate on planar scintigraphy. We present an incidental primary intrathoracic goiter found in a patient undergoing evaluation with multimodal scintigraphy and early ^{99m}Tc-sestamibi single-photon emission computed tomography/computed tomography (SPECT/CT) for localization of parathyroid adenomas. The mass was inconspicuous on TcO^{4-} scintigraphy but methoxyisobutylisonitrile-avid on early planar and SPECT/CT.

Keywords

- primary intrathoracic goiter
- scintigraphy
- MIBI
- SPECT/CT
- hyperparathyroidism

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 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 thyroid goiter is 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 ^{99m}Tc-pertechnetate (TcO^{4-}) 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 ^{99m}Tc-sestamibi (methoxyisobutylisonitrile, MIBI), TcO^{4-}, and early-MIBI single-photon emission computed tomography/computed tomography (SPECT/CT). Our institutional protocol, including early MIBI SPECT/CT and subsequent TcO^{4-} evaluation, is based on a higher reported accuracy for the

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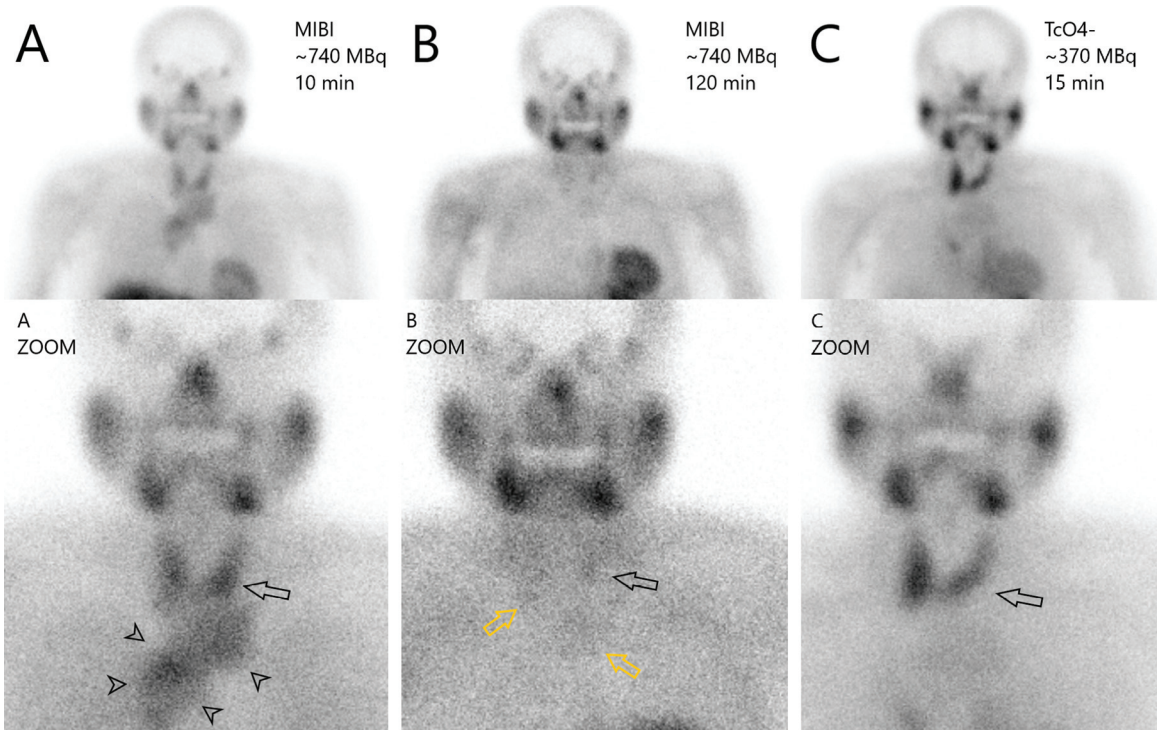

Fig. 1 Dual-isotope planar scintigraphy with early (**A**) and delayed (**B**) ^{99m}Tc-sestamibi (methoxyisobutylisonitrile, MIBI), and ^{99m}Tc-pertechnetate (TcO^{4-}) (**B**) of an elderly woman undergoing evaluation for hyperparathyroidism. Early-MIBI planar scintigraphy (**A**) showed a large moderately-avid mediastinal lesion (*arrowheads*) adjacent to the thyroid gland (*arrow*). Delayed images (**B**) showed equivocal areas of minimal retention in the mediastinal mass (*yellow arrows*); differential diagnoses included lymphoma, thymoma, and primary intrathoracic goiter. Early-MIBI planar scintigraphy (**A**) also showed a relatively thicker left lower thyroid pole that was discordant with TcO^{4-} images (**C**) and demonstrated minimal retention on delayed-MIBI (**B**), suggestive of a left lower thyroid pole localized parathyroid adenoma.

evaluation of parathyroid adenomas,[9] and increased value of MIBI-SPECT/CT for anatomic localization and surgical planning.[9–11] 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.[12]

Early-MIBI planar scintigraphy (►**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 more prominent left lower thyroid on MIBI, as compared with TcO^{4-}, with near-complete washout on delayed MIBI, suggestive of a parathyroid adenoma localized in this area.

Early-MIBI SPECT/CT (►**Fig. 2**) localized the previously seen lesion on planar MIBI to a mediastinal mass, which now appeared discrete from the thyroid gland. Also revealed was a parathyroid nodule (►**Fig. 3**—*arrows* at A1 and A2) posterior to the lower portion of the left thyroid pole corresponding to the area of increased activity in the left lower thyroid seen on planar scan.

The patient underwent surgical resection of the left lower thyroid and mediastinal mass (►**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 TcO4-.

Prior case reports have described primary intrathoracic thyroid with minimal or absent uptake of TcO4-, 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 TcO4- 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

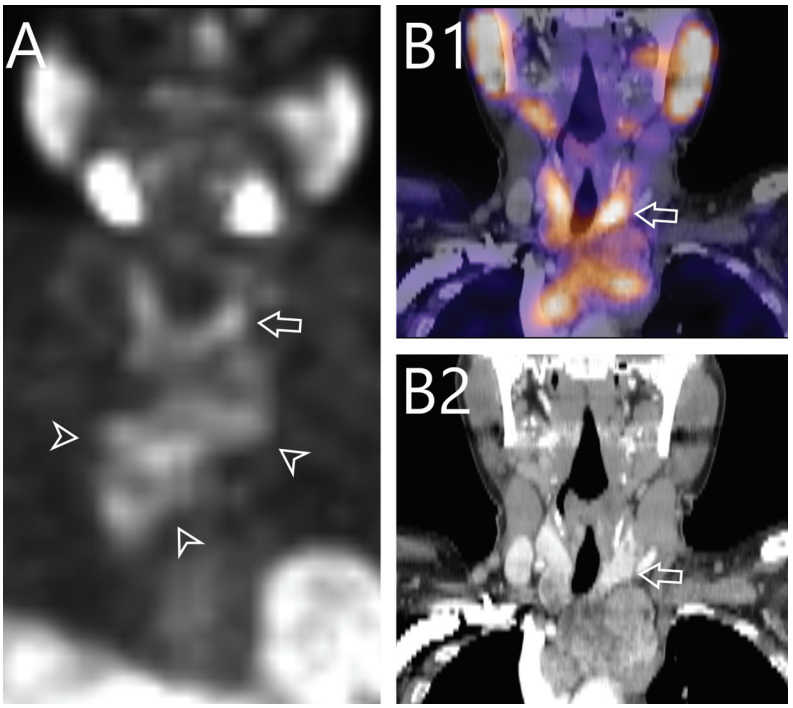

Fig. 2 Early-methoxyisobutylisonitrile single-photon emission computed tomography/computed tomography (MIBI SPECT/CT) performed as part of the protocol for localizing parathyroid adenoma(s). Early-MIBI SPECT maximum intensity projection (**A**), and transcoronal fused SPECT/CT (B1) and contrast-enhanced 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 TcO^{4-} planar images.

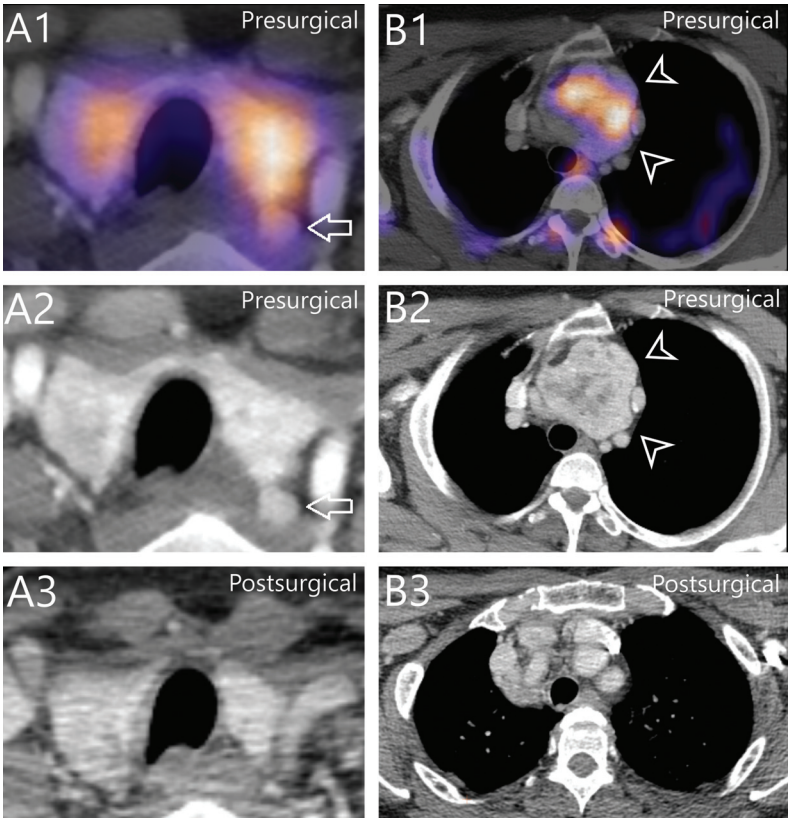

Fig. 3 Transaxial fused and CTimages at the level of the lower thyroid gland show an MIBG-avid nodule posterior to the left thyroid lobe (A1-A2; *arrows*). Transaxial fused and CT images of the chest showed a heterogeneously MIBG-avid mediastinal mass (B1, *arrowheads*) with heterogeneous contrast enhancement (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.

References

1 Foroulis CN, Rammos KS, Sileli MN, Papakonstantinou C. Primary intrathoracic goiter: a rare and potentially serious entity. Thyroid 2009;19(03):213–218

2 Vaiman M, Bekerman I. Anatomical approach to surgery for intrathoracic goiter. Eur Arch Otorhinolaryngol 2017;274(02):1029–1034

3 Kaya S, Tastepe I, Kaptanoglu M, Yuksel M, Topcu S, Cetin G. Management of intrathoracic goitre. Scand J Thorac Cardiovasc Surg 1994;28(02):85–89

4 Allo MD, Thompson NW. Rationale for the operative management of substernal goiters. Surgery 1983;94(06):969–977

5 McCORT JJ. Intrathoracic goiter; its incidence, symptomatology, and roentgen diagnosis. Radiology 1949;53(02):227–237

6 Laurent F, Latrabe V, Lecesne R, et al. Mediastinal masses: diagnostic approach. Eur Radiol 1998;8(07):1148–1159

7 Ahn B-C. Retrosternal goiter visualized on 99mTc pertechnetate SPECT/CT, but not on planar scintigraphy. Clin Nucl Med 2016;41 (03):e169–e170

8 Mahajan MS, Digamber NS, Rajkumar S. Primary intrathoracic goiter: Incidental diagnosis on 99m-Tc pertechnetate radioisotope thyroid scan. Indian J Endocrinol Metab 2012;16(06): 1063–1066

9 Huang Z, Lou C. $^{99m}TcO_4^-$/^{99m}Tc-MIBI dual-tracer scintigraphy for preoperative localization of parathyroid adenomas. J Int Med Res 2019;47(02):836–845

10 Sager S, Shafipour H, Asa S, Yılmaz S, Teksöz S, Önsel C. Comparison of Tc-99m pertechnetate images with dual-phase Tc 99m MIBI and SPECT images in primary hyperparathyroidism. Indian J Endocrinol Metab 2014;18(04): 531–536

11 Eslamy HK, Ziessman HA. Parathyroid scintigraphy in patients with primary hyperparathyroidism: 99mTc sestamibi SPECT and SPECT/CT. Radiographics 2008;28(05):1461–1476

12 Greenspan BS, Dillehay G, Intenzo C, et al. SNM practice guideline for parathyroid scintigraphy 4.0. J Nucl Med Technol 2012;40(02): 111–118

