Case Report

Absent radiotracer uptake in thyroid gland in parathyroid scintigraphy with ^{99m}Tc-MIBI: A case report

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ABSTRACT

Localization of ^{99m}Tc- hexakis-2-methoxyisobutylisonitrile (^{99m}Tc-MIBI) by parathyroid adenomas is well known, and this warrants MIBI scan to evaluate suspected parathyroid adenoma in primary hyperparathyroidism. Typically, the radionuclide concentrates in both the thyroid gland and parathyroid adenoma in early images, and later on delayed images washes out slowly from the parathyroid adenomas located in the neck or mediastinum, in comparison with more rapid wash out from the thyroid gland. We report a 71-year old woman with history of hypothyroidism, who has been on levothyroxine therapy for 5 years, and primary hyperparathyroidism, for which a double phase ^{99m}Tc-MIBI parathyroid scintigraphy was performed. Although the planar views demonstrated no evidence of radiotracer uptake in thyroid gland, single photon emission computed tomography/computed tomography (SPECT-CT) images revealed the presence of thyroid gland with a multinodular pattern on CT component of the study. Also planar images showed no focal uptake, but in SPECT-CT evaluation a MIBI-avid nodule was depicted in the posteromedial aspect of lower portion of left thyroid lobe, representing a parathyroid adenoma, later confirmed by pathology after surgical resection. The possible explanation for non-visualization of thyroid gland could be thyroid suppression with levothyroxine.

Key words: ^{99m}Tc-MIBI; Primary hyperparathyroidism; Multinodular goiter; Levothyroxine; Thyroid non-visualization

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INTRODUCTION

Primary hyperparathyroidism (PHPT), characterized by the autonomous secretion of parathyroid hormone (PTH) by parathyroid glands, is caused by a benign solitary parathyroid adenoma in 80–90% of patients [1]. Surgery, as the sole definitive cure for PHPT is indicated in both symptomatic patients and selected subgroup of asymptomatic patients [2], aims to remove all hyperfunctioning tissue and to preserve normal parathyroid glands. The main purpose of imaging modalities is to precisely localize all autonomic tissue, which is the essential prerequisite for focused parathyroidectomy. Among the imaging modalities, cervical ultrasound, with a reported sensitivity of 64-89% [3, 4] and operator dependent detection rate that is lower in patients with multinodular goiters [5, 6], as well as parathyroid scintigraphy with ^{99m}Tc-MIBI often in combination with single photon emission computed tomography/computed tomography (SPECT/CT), with a sensitivity of 70–88% is considered as the reference method for preoperative parathyroid imaging [3, 4, 6], are most commonly used in this milieu [7, 8]. Decreased sensitivity is seen in ultrasound study, parathyroid scintigraphy as well as ^{99m}Tc-MIBI in the presence of multinodular goiter. Successful parathyroidectomy in a considerable percentage of patients with PHPT who are left with negative or equivocal localization studies prior to surgery, even after the combination of imaging with ultrasound and ^{99m}Tc-MIBI scintigraphy/SPECT/CT, depends solely on the expertise of the surgeon.

The purpose of this case report is to show the absence of ^{99m}Tc-MIBI uptake by thyroid tissue in a patient with concomitant primary hyperparathyroidism and multinodular goiter, which might be attributed to levothyroxine consumption, and to demonstrate the usefulness of SPECT-CT performance in the diagnosis.

CASE PRESENTATION

The patient is a 71-year-old female with history of nephrolithiasis, osteoporosis and hypothyroidism, who has been on levothyroxine 0.1 mg daily since 5 years ago, presented with elevated serum calcium (11.1 mg/dL, normal range: 8.5-10.2 mg/dL) and intact parathyroid hormone (PTH) (92 and 106 pg/mL, normal range: 15-65 pg/mL), but decreased serum level of phosphorus (2.4 mg/dL, normal range: 2.5-4.5 mg/dL). Primary hyperparathyroidism was clinically suspected and ultrasonographic examination was requested. A 26*17 mm nodule with heterogenic echo pattern was found in the middle portion of the left thyroid lobe, and a 5.5*3 mm hyperechoic nodule was detected on the left side of the thyroid isthmus. In addition, two hypoechoic nodules measuring 9.5*8 mm were depicted in the middle portion of the left thyroid lobe as well as one heterogenic 9.5*5 mm nodule in the anterior medial portion of the same lobe. Subsequently, ^{99m}Tc-MIBI study was carried out according to the following protocol: After intravenous injection of 20 mCi ^{99m}Tc-MIBI, sequential scan from neck and mediastinum was carried out in anterior projection. Delayed images were also obtained after 120 minutes. Single photon emission computed tomography/computed tomography (SPECT/CT) imaging was also performed 120 min after radiotracer injection. The early and delayed planar MIBI study performed demonstrated no evidence of radiotracer uptake in thyroid gland. However, CT component of the SPECT-CT images confirmed the presence of thyroid gland showing a multinodular pattern. In addition, although planar images showed no focal uptake in favor of parathyroid adenoma, SPECT-CT images revealed a MIBI-avid hypodense nodule in the posteromedial aspect of the lower portion of the left thyroid lobe (Figure 1). Patient underwent surgery and parathyroid adenoma at the above mentioned site was pathologically confirmed.

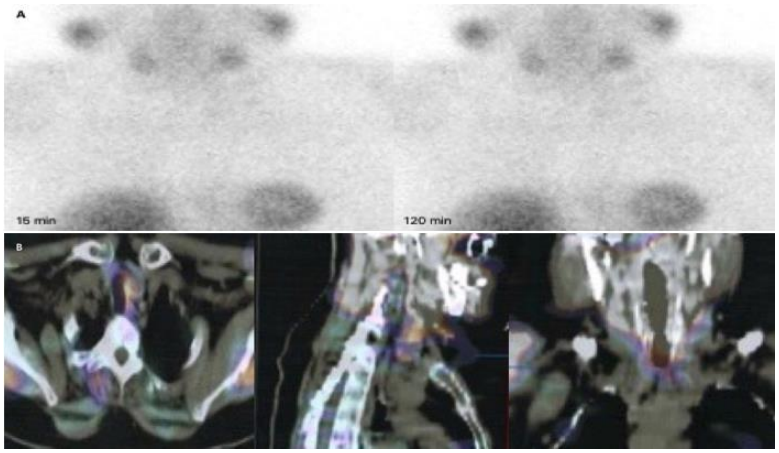

Figure 1. ^{99m}Tc sestamibi scintigraphy in a 71-year-old woman with primary hyperparathyroidism. (A) Planar imaging demonstrates no evidence of thyroid uptake. (B) Single-photon emission computed tomography/computed tomography confirms multinodular goiter with a MIBI-avid nodule in the lower portion of the left thyroid lobe.

DISCUSSION

With the advent of ^{99m}Tc-MIBI scintigraphy, which is currently the most common radiotracer used for parathyroid imaging, our ability to localize parathyroid adenomas has markedly improved [9]. ^{99m}Tc-MIBI is concentrated in mitochondria in a variety of metabolically active tissues comprising thyroid gland, salivary glands, heart, liver, and autonomous parathyroid glands [10]. Depending on institutional experience, two strategies can be utilized for parathyroid imaging: 1) dual-tracer subtraction, based on the different uptake patterns produced in the thyroid and parathyroid glands using either ^{123}I or ^{99m}Tc- pertechnetate as the thyroid agent; and 2) single tracer dual-phase scintigraphy based on the differential washout of MIBI from thyroid and parathyroid tissue. It is widely accepted that SPECT scanning could enhance parathyroid lesion localization [11], and that with the cost of increased radiation dose, coregistration of SPECT imaging to CT images (SPECT/CT) provides further anatomic information. On the other hand, investigations have not reached a consensus with regard to the increased sensitivity of SPECT and SPECT-CT scans over planar imaging alone for the detection of abnormal parathyroid glands [11-13]. In present case, first non-visualization of thyroid gland which is an unexpected finding in MIBI imaging is discussed, and second the usefulness of SPECT/CT images in resolving diagnostic dilemmas such as negative planar imaging in a patient with high clinical suspicion for parathyroid adenoma is reemphasized.

It is currently widely accepted that the complex interplay of size, site, and the presence of thyroid nodules, and other factors yet unknown affect the accuracy of MIBI scintigraphy; however, to the best of our knowledge, the absence of ^{99m}Tc-MIBI uptake by normal thyroid gland in such scintigraphic study has not been reported thus far. It has been previously speculated that histologic structure, with the presence of mitochondria-rich oxyphil cells, is important [14, 15] as Bénard et al. revealed a small number of oxyphil cells accounting for rapid washout of MIBI from the parathyroid adenoma [16]. Notwithstanding the fact that other investigators showed no correlation between lesion detection and the predominant cell type [17], the histologic structure and mitochondria density could stand as the possible reason for the lack of thyroidal ^{99m}Tc-MIBI uptake, discussed in the present case. The other possible explanation for the lack of ^{99m}Tc-MIBI uptake by thyroid tissue in the present case is consumption of levothyroxine, which may have led to thyroid suppression, and this has been previously speculated as the reason for decreased MIBI uptake by the thyroid gland [18].

To sum up, as tissues with a low mitochondrial content are incapable of significantly retaining the tracer, different histologic subtypes of the thyroid tissue could probably explain the reason of the absence thyroid radiotracer uptake in the present case. As in this case, we believe that SPECT/CT imaging could help increase diagnostic accuracy in such dilemmas.

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