



## Interesting Images

# Role of $^{11}\text{C}$ -Methionine PET/CT in $^{99\text{m}}\text{Tc}$ -Sestamibi-Negative Parathyroid Adenoma: A Case Report

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**Abstract:** We report a case of 16-year-old female primary hyperparathyroidism patient who underwent cervical ultrasonography and  $^{99\text{m}}\text{Tc}$ -sestamibi single photon emission computed tomography/computed tomography, both of which were negative for parathyroid adenoma. Subsequent  $^{11}\text{C}$ -methionine positron emission tomography/CT showed positive focal uptake suggesting parathyroid adenoma, which then was confirmed pathologically.

**Keywords:** primary hyperparathyroidism; ultrasonography;  $^{99\text{m}}\text{Tc}$ -sestamibi SPECT/CT;  $^{11}\text{C}$ -methionine PET/CT



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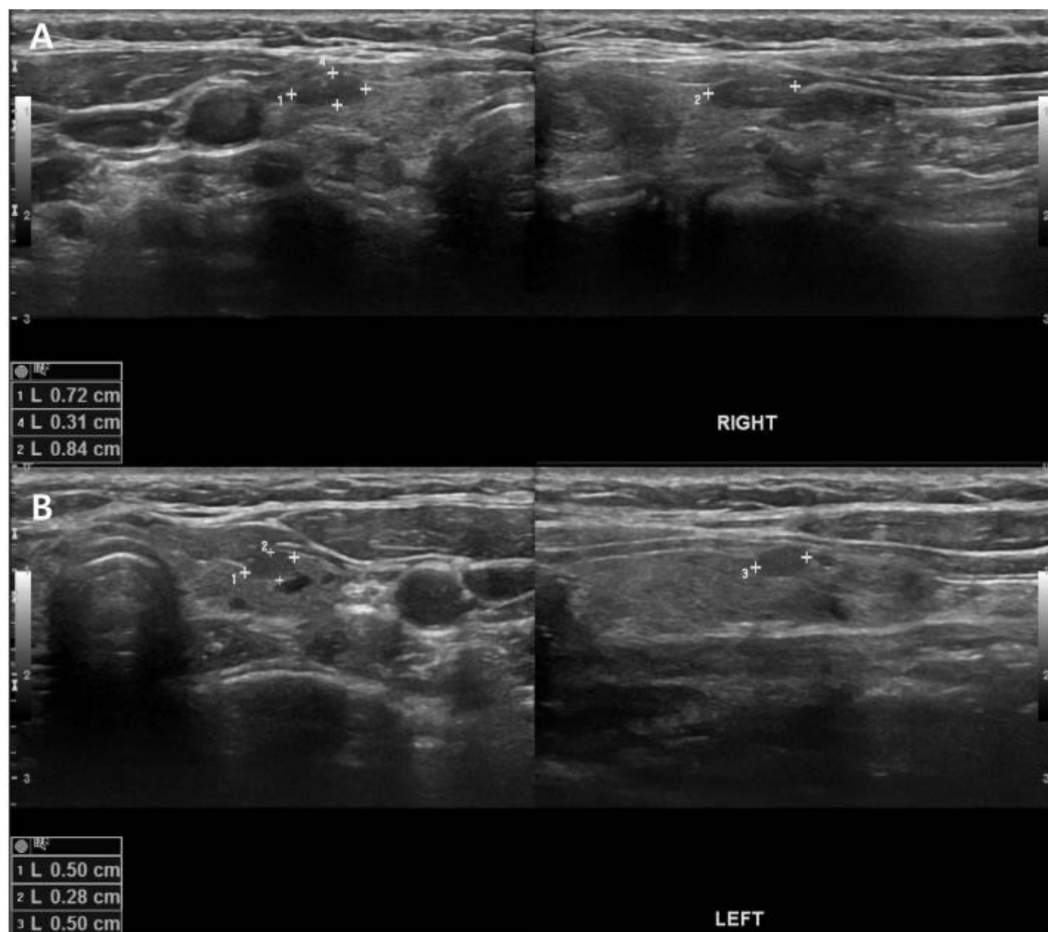
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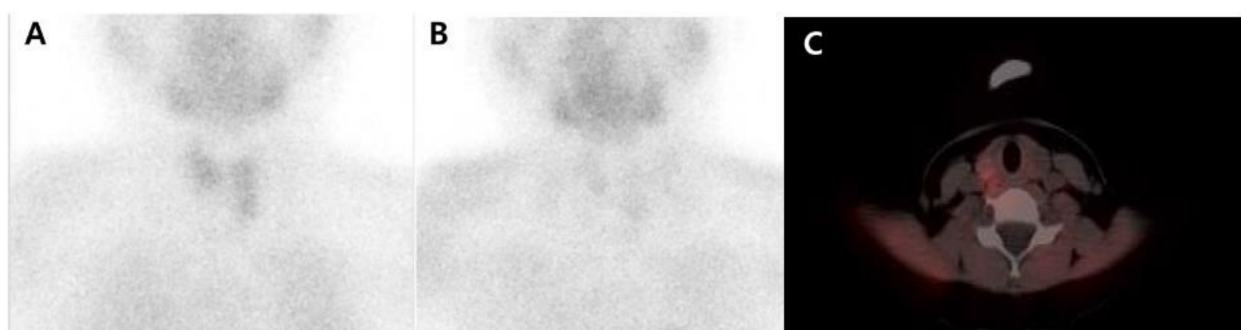
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Primary hyperparathyroidism (pHPT) is a common endocrine disorder characterized by elevated parathyroid hormone and serum calcium level caused by one or more parathyroid adenomas, parathyroid hyperplasia, or in rare cases, by parathyroid carcinoma [1] (Figure 1). Surgical resection of parathyroid adenoma or hyperplastic parathyroid glands is the curative treatment for pHPT patients. Various imaging modalities are required to avoid extensive surgery and establish a more targeted surgical approach. Preoperative imaging modalities include cervical ultrasonography (US);  $^{99\text{m}}\text{Tc}$ -sestamibi scintigraphy, which has been recently combined with single photon emission computed tomography/computed tomography (SPECT/CT) (Figure 2); and  $^{11}\text{C}$ -methionine positron emission tomography/CT ( $^{11}\text{C}$ -MET PET/CT) (Figure 3) [2–7].

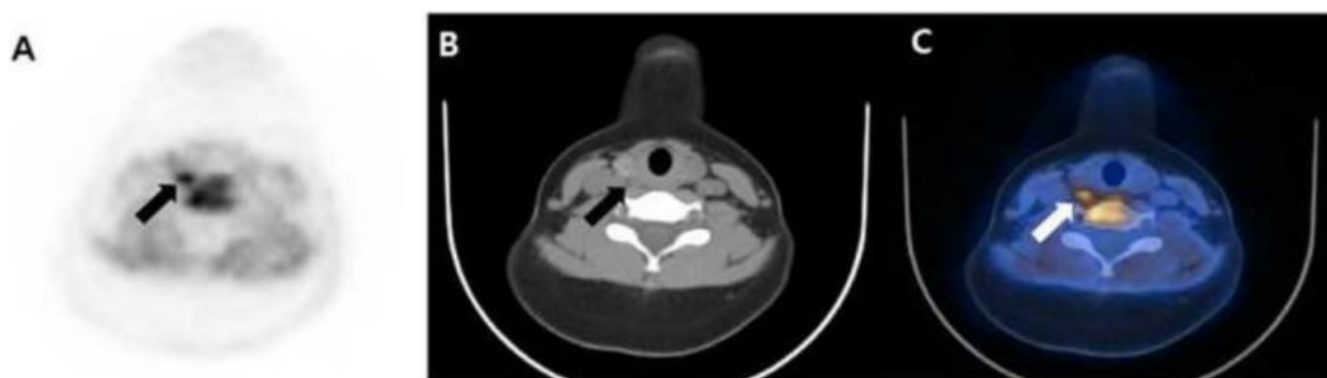
False negative findings of  $^{99\text{m}}\text{Tc}$ -sestamibi scintigraphy can occur due to various reasons. The most common is parathyroid adenoma of small size, which allows limited spatial resolution of conventional scintigraphic techniques [8]. Other reasons for false negative findings are lack of oxyphil cells, parathyroid hyperplasia, multiglandular disease, and high expression of P-glycoprotein [9,10]. In our institute, subsequent  $^{11}\text{C}$ -MET PET/CT is performed in patients with laboratory findings highly suggestive of pHPT and negative or inconclusive results of US and  $^{99\text{m}}\text{Tc}$ -sestamibi SPECT/CT because the higher resolution of PET/CT could improve localization of small lesions.  $^{11}\text{C}$ -MET is a PET radiopharmaceutical agent that is trapped in the hyperfunctioning parathyroid gland during synthesis of the PTH precursor [11]. The major limitation of this agent is the short physical half-life of  $^{11}\text{C}$  (20.3 min). To overcome this limitation, an on-site cyclotron is necessary, an instrument that is not available in most clinics.



**Figure 1.** A 16-year-old female patient with elevated parathyroid hormone and serum calcium levels (89.6 pg/mL and 12.8 mg/dL, respectively) underwent initial neck ultrasonography (US) ((A) right; (B) left) for parathyroid gland evaluation. The images showed heterogeneous echotexture thyroid parenchyme and multiple hypoechoic nodules in both glands but no demonstrable evidence of parathyroid adenoma.



**Figure 2.** Subsequently, a  $^{99m}\text{Tc}$ -sestamibi scan was performed at 20 min (A) and 150 min (B) after radiopharmaceutical injection. There was no abnormal remaining radiotracer uptake lesion suggestive of parathyroid adenoma. Subsequent single photon emission computed tomography/computed tomography (SPECT/CT) (C) did not provide additional evidence of parathyroid adenoma.



**Figure 3.**  $^{11}\text{C}$ -Methionine positron emission tomography/CT ( $^{11}\text{C}$ -MET PET/CT) (A) PET image; (B) CT image; (C) fusion PET/CT image) was performed for primary site localization of primary hyperparathyroidism (pHPT) and showed a small lesion in the posterior aspect of the right thyroid gland (arrow). Right parathyroidectomy was performed and pathologically indicated a 0.8-cm-sized parathyroid adenoma. Since the operation, both parathyroid hormone and serum calcium levels have normalized (31.4 pg/mL and 9.8 mg/dL, respectively).

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**Institutional Review Board Statement:** This study was conducted according to the guidelines of the Declaration of Helsinki, and ethical review and approval were waived for the single case report.

**Informed Consent Statement:** Written informed consent for publication was obtained from the parents of the patient involved in the study.

**Conflicts of Interest:** The authors declare no conflict of interest.

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