Enhanced Localization of Recurrent Parathyroid Carcinoma Using ^{99m}Tc-MIBI SPECT/CT: A Case Report

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ABSTRACT

Parathyroid carcinoma (PC) is a rare endocrine malignancy, representing less than 1% of primary hyperparathyroidism cases. Its management is particularly challenging due to the high incidence of local recurrence. Detailed mapping of tumor location requires imaging modalities. Hybrid imaging SPECT/CT is widely regarded as the preferred imaging technique for localizing both primary and recurrent parathyroid tumors prior to surgical intervention. Here, we report the case of a 24 year old male with hyperparathyroidism due to recurrent parathyroid carcinoma. Patient had history of radical neck surgery four times. Each time, preoperative localization of the recurrent mass was successfully achieved using 99mTc-MIBI SPECT/CT.

Keywords: Endocrine malignancy, parathyroid adenoma, parathyroid carcinoma, primary hyperparathyroidism, hypercalcemia, SPECT/CT.

Bangladesh J. Nucl. Med. Vol. 28 No. 2 July 2025
DOI: https://doi.org/10.3329/bjnm.v28i2.89159

INTRODUCTION

Parathyroid carcinoma (PC) is a rare endocrine malignancy, representing only <1% of primary hyperparathyroidism (PHPT) cases (1, 2). First described by Sainton and Millot in 1933, it remains the least common endocrine cancer globally. Although the exact etiology is unclear, both genetic and environmental factors play a role. Somatic mutations are identified in over 75% of sporadic cases, while 50%–75% of familial cases have a genetic basis (3). Unlike benign parathyroid adenomas (PA), PC is usually associated with severe hypercalcemia, markedly elevated serum calcium and parathyroid hormone (PTH) levels. The disease typically demonstrates local invasion with recurrences most often occurring within 2–4 years after initial surgery (1, 2). Distinguishing PC from PA is challenging because of the lack of distinctive histological or biochemical markers. Histopathological confirmation is usually based on vascular or capsular invasion. 99m Tc-MIBI SPECT/CT is most widely used for accurate preoperative localization (4, 5).

CASE REPORT

A 24 year old man was requested 99mTc-MIBI parathyroid scan by endocrinologist and referred to Institute of Nuclear Medicine & Allied Sciences (INMAS), Mitford in July 2025. History revealed that the patient had noticed multiple swellings in the right cheek, jaw, and right leg for the last six years. Initial clinical symptoms included severe frequent vomiting, generalized bodyache, severe anorexia, and significant weight loss. Biochemical tests revealed severe hypercalcemia (S. calcium-18.1 mg/dL) and hypokalemia (S. potassium-2.8 mmol/L) with ST-T changes on ECG. FNAC from the right maxillary swelling found a fibro-osseous lesion. Provisional diagnosis of primary hyperparathyroidism was made during evaluation of severe hypercalcemia, revealing intact PTH levels at 4594 pg/mL. A 99mTc-MIBI SPECT/CT scan indicated the presence of a parathyroid adenoma / hyperplasia at the lower pole of the left thyroid bed at the C7 vertebral level. Subsequently, a focused parathyroidectomy on the left side was performed, with histopathology confirming the diagnosis as parathyroid adenoma in 2019.

When hyperparathyroidism (IPTH-561 pg/mL) returned in 2022, a recurrent parathyroid adenoma in the lower pole of the left thyroid bed was discovered by a MIBI parathyroid scan. At that time, neck exploration and left parathyroid adenectomy followed a histopathology report

of parathyroid adenoma. Due to a persistently raised parathyroid hormone (PTH) level (IPTH-209 pg/ml) after two and a half months of the second surgery, 99Tc-MIBI SPECT/CT was repeated. Scan revealed a suspected lesion at the lower pole of the left thyroid bed (level of C6-C7). This time, left hemithyroidectomy and left superior and inferior parathyroid glands were excised. Surprisingly, parathyroid carcinoma was reported histologically. The patient was advised to have oral chemotherapy (sorafenib 200 mg) and regular follow-up.

The patient's PTH level was normal for two successive years but started rising gradually in 2025. Raised PTH level was up to 1136 pg/ml and high-resolution neck ultrasound revealed a small hypoechoic lesion of about 8 X 8 mm at the left thyroid bed (white arrow, Figure 1A). This time 99mTc-MIBI SPECT/CT was requested at the scintigraphy division of INMAS, Mitford. Scan found active parathyroid tissue in the left thyroid bed at the level of the D1 vertebra (white arrow, Figure 1D) and the reported case appeared to be quite challenging as localization of the parathyroid mass was successfully achieved using 99mTc-MIBI SPECT/CT and diagnosing the case as recurrent parathyroid carcinoma (black arrow, Figure 1C and white arrow, Figure 1D).

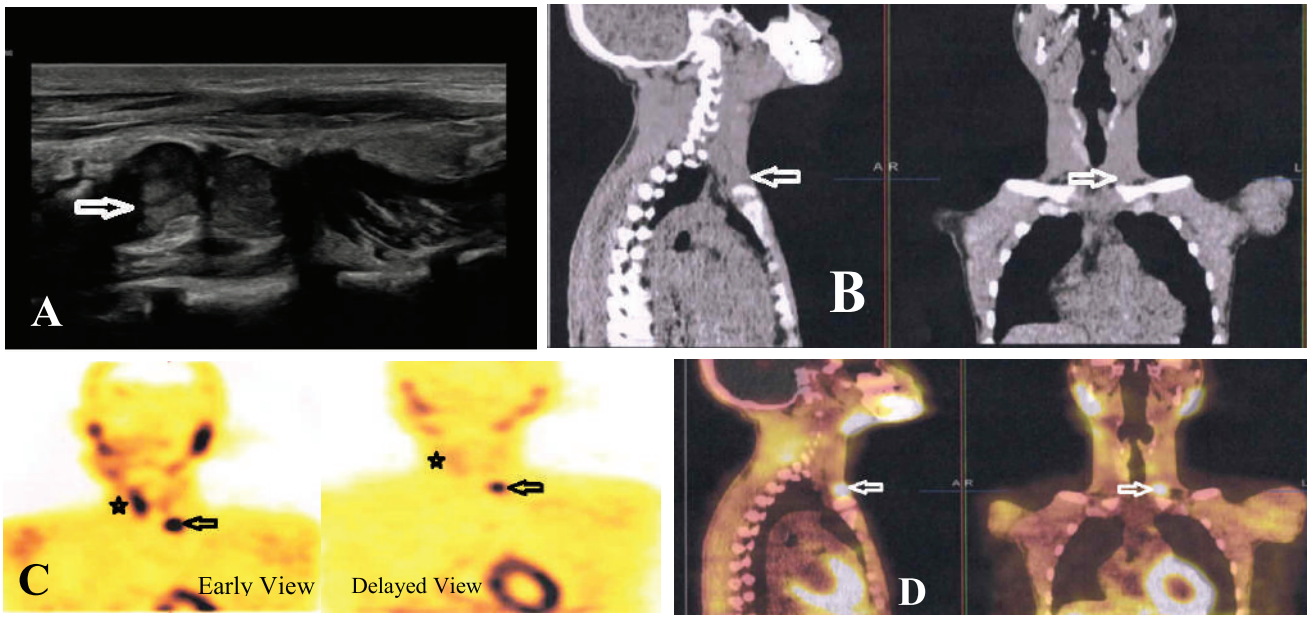

Figure 1: (A) HRUS of neck revealed hypoechoic hyper vascular lesion (white arrow) in the left lower neck, (B) CT Neck showed soft tissue density lesion (white arrow) in the left lower neck, (C) MIBI SPECT early and delayed image: early uptake with rapid washout of right thyroid (black asterisk), while persistently increased tracer uptake in the left lower neck indicates hyperfunctioning parathyroid (black arrow) (D) MIBI SPECT/CT: recurrent PC (white arrow) at left lower neck at D1 vertebral level.

DISCUSSION

Hyperparathyroidism (HPT) is defined by increased secretion of PTH. Humans typically have four parathyroid glands, two superior and two inferior, but some individuals have as few as two or as many as eleven glands. Primary hyperparathyroidism (PHPT) results from autonomous PTH overproduction, leading to elevated serum calcium levels. The most common cause is parathyroid adenoma (~85%), followed by multiple adenomas (15–20%), parathyroid hyperplasia (<15%), and the rarest cause—parathyroid carcinoma (~1%). PC is a rare malignancy that may occur sporadically or in association with hereditary syndromes such as familial hyperparathyroidism and multiple endocrine neoplasia (MEN) types 1 and 2A (6).

Palpable neck mass may present about 65% of PC cases. Biochemically, patients exhibit markedly elevated calcium and PTH levels. According to Sharrette et al., PC should be suspected when PTH exceeds five times higher than normal value (7). Symptoms of hypercalcemia may vary from mild fatigue, nausea, and weakness to severe manifestations such as polyuria, renal failure, bone pain,

fractures, etc. Distinguishing PC from PA is difficult due to overlapping clinical and biochemical findings. Unlike PA, which is more common in postmenopausal women. PC affects both sexes equally and tends to occur at a younger age with more severe hypercalcemia and a higher PTH level (8). Disease severity is driven primarily by hypercalcemia rather than tumor size. PC is more aggressive and frequently shows local invasion or metastasis to the bones, lungs, or liver even after radical surgery (1).

Diagnosing and managing PC is troublesome due to its nonspecific clinical and imaging features (3). The main goal of imaging is to localize all sources of excess PTH secretion before surgery. Commonly used non-invasive imaging modalities include ultrasound (US), 99mTc-MIBI SPECT/CT, CT scan, MRI, etc. The US is a widely available, non-invasive, radiation-free tool, but its accuracy depends on operator skill and is limited in detecting deep or ectopic glands. Features such as size > 2 cm, hypoechogenicity, irregular margins, or local invasion may suggest malignancy, but none are specific for PC. CT and MRI offer better assessment of mediastinal lesions but struggle to distinguish lymph nodes from enlarged parathyroid glands in the neck due to similar soft tissue density. However, these modalities are useful to determine the local extent, invasion, and distant spread (9, 10). 99mTc-MIBI scintigraphy remains the preferred technique for accurate preoperative localization of hypersecreting parathyroid tumors. The basis of the 99mTc-MIBI scan is the slower washout of the radiotracer from abnormal parathyroid tissue compared to the thyroid, allowing better visualization of hyperfunctioning parathyroid tumors. SPECT alone is limited by lack of anatomical details, but SPECT/CT is a hybrid modality provides both anatomical and functional information, achieving sensitivities up to 91% (11). In cases of recurrence or metastasis, advanced imaging such as 18F-FDG or 11C-choline PET/CT may be used (8). This case demonstrated that diagnosis of Parathyroid carcinoma requires integration of biochemical, imaging, intraoperative, and histopathological findings as preoperative distinction from benign parathyroid lesions is challenging.

Definitive diagnosis of PC is confirmed postoperatively through histopathology. Larger tumors with significant capsular and vascular invasion are linked to poorer prognosis and higher recurrence rates. Definitive treatment of PC is removal of the affected parathyroid gland along with the ipsilateral thyroid lobe, adjacent adipose tissue, and any involved lymph node. Chemotherapy is largely ineffective for PC. Recurrence typically appears 2–4 years after surgery but can appear even decades later. Management of recurrent or metastatic disease involves repeat surgery and controlling hypercalcemia. Reported case had the first recurrence within 3 years of initial treatment and there were at least four episodes vof recurrences within 6 years, reflecting the highly aggressive pattern of this disease. Although no metastases were noted. Lifelong surveillance with monitoring of calcium and PTH levels is the key to improving outcomes and detecting late recurrence or metastasis (1, 2).

PC can be misdiagnosed as adenoma due to similar histology. Microscopic features of carcinoma can be very similar to those of an atypical PA in the absence of capsular or vascular invasion (12). Reported case presented with typical symptoms of PHPT, and the initial histopathology was consistent with PA. However, PTH concentration remained high, and PC was confirmed after the second surgery. However, the PC in this case may have evolved after the initial surgery or it may have existed from the beginning. Although 99mTc-sestamibi SPECT/CT successfully localized recurrent lesions at each stage, it could not reliably differentiate carcinoma from adenoma, emphasizing that the primary role of imaging is accurate localization of hyperfunctioning tissue prior to surgery rather than definitive cellular characterization.

CONCLUSION

Parathyroid carcinoma is a rare neoplasm that poses significant diagnostic challenges, even when clinical, biochemical and histological findings are suggestive.

This case report highlights the critical role of 99mTc-MIBI SPECT/CT in precise anatomical localization of hyperfunctioning parathyroid tissue.

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