Diagnosis of a Case of Ectopic Parathyroid Adenoma on the Early Image of $^{99m}$Tc-MIBI Scintigram

TAKAKO MORIYAMA*,***, KAZUNORI KAGEYAMA*, TAKESHI NIGAWARA*, MASASHI KOYANAGI**, IKUO FUKUDA**, HITOSHI YASHIRO*** AND TOSHIHIRO SUDA*

*Department of Endocrinology and Metabolism, Hirosaki University School of Medicine, 5 Zaifu-cho, Hirosaki, Aomori 036-8562, Japan
**First Department of Surgery, Hirosaki University School of Medicine, Aomori 036-8562, Japan
***Third Department of Internal Medicine, Odate Municipal Hospital, 3-1 Yutaka-cho, Odate, Akita 017-8550, Japan

Abstract. We report the case of a 64-year-old woman who had a severe hypercalcemia. Serum calcium, intact parathyroid hormone (PTH), 1α, 25 (OH)2 vitamin D3 levels were all elevated, and serum phosphorus level was decreased, which were all consistent with primary hyperparathyroidism (PHPT). $^{201}$TI/$^{99m}$Tc subtraction scintigraphy failed to detect any abnormal accumulation in the neck and chest, while $^{99m}$Tc-MIBI scintigraphy demonstrated the focal accumulation of increased radiotracer uptake in the mediastinum only on the early image, but not on the delayed image. Neck and chest computerized tomography scanning showed a small nodule at the retrosternal region, and a selective venous sampling study of the intact PTH suggested PTH production from the nodule. Together with the observation of the early image of $^{99m}$Tc-MIBI scintigraphy, it was diagnosed that the patient had an ectopic parathyroid adenoma. Video-assisted thoracic surgery was performed. A 15-mm diameter mass, visualized by an intravenous infusion of methylene blue, was excited. The histopathology was consistent with the parathyroid adenoma. The adenoma was composed of mainly chief cells and rarely oxyphil cells. The absence of oxyphil cells would explain the lack of $^{99m}$Tc-MIBI retention on late-phase imaging in our case. Even without uptake on the delayed image of $^{99m}$Tc-MIBI scintigram, the early image was available for the localization of an ectopic parathyroid adenoma.

Key words: Primary hyperparathyroidism, Intact PTH, Calcium, $^{99m}$Tc-MIBI scintigram, Venous sampling

might induce a false negative or positive case [8–10], because of certain factors that influence the uptake and clearance of $^{99m}$Tc-MIBI [11–13].

An ectopic parathyroid adenoma is also caused PHPT. However, it is too difficult to detect by various imaging modalities, because ectopic parathyroid adenomas are usually small [14]. Therefore, ectopic parathyroid adenomas are often detected either in the preoperative work up of patients who present with hypercalcemia or in post-parathyroidectomy patient with persistent hypercalcemia [15]. A few reports demonstrate that an early imaging of dual-phase $^{99m}$Tc-MIBI scintigraphy is a pitfall to diagnose abnormal parathyroid adenomas located in the neck [11, 12], while only one paper reported the usefulness of early imaging in an ectopic adenoma [15].

We report here another case of PHPT due to an ectopic parathyroid adenoma, detected only on the early image of dual-phase $^{99m}$Tc-MIBI scintigraphy, but not on the delayed image.

**Clinical Summary**

A 64-year-old woman with a severe hypercalcemia was referred to our department for further evaluation of PHPT. Her serum calcium (12.3 mg/dl), intact PTH (226 pg/ml), 1α, 25 (OH)$_2$ vitamin D$_3$ (85 pg/ml) concentrations were all elevated, serum phosphorus level (2.1 mg/dl) was decreased, and PTH-related protein level (0.3 pmol/ml) was within normal limits. T-score of her femoral bone mineral density was −1.5. $^{201}$Tl/$^{99m}$Tc subtraction scintigraphy failed to detect any abnormal accumulation in the neck and chest. $^{99m}$Tc-MIBI scintigraphy demonstrated the focal accumulation of increased radiotracer uptake in the mediastinum.

![Fig. 1. $^{99m}$Tc-MIBI scintigram of the patient. (A) The scintigram on the early image reveals an increased focal accumulation of the radioisotope in the mediastinum (a white arrow). (B) The scintigram on the delayed image (2 h) does not clearly show the focal accumulation.](image)

![Fig. 2. CT scannings of the chest. The scanning shows a small nodule (15 mm transverse diameter) at the retrosternal region and in the anterior left of the brachiocephalic artery (a white arrow).](image)
only on the early image, but not on the delayed image (Fig. 1). The enhanced CT scanning of the chest showed a small nodule (15 mm transverse diameter) at the retrosternal region (Fig. 2). To further examine the existence of an ectopic parathyroid adenoma, a selective venous sampling study of intact PTH was performed. As shown in Fig. 3, intact PTH levels were increased in the left brachiocephalic vein. Video-assisted thoracic surgery was performed. A 15-mm diameter mass, visualized by an intravenous infusion of methylene blue, was found and excited. Histopathology was consistent with parathyroid adenoma. The adenoma was composed mainly of chief cells and a few oxyphil cells, covered with a fibrous capsule (Fig. 4). Soon after the operation, the patient’s elevated calcium and intact PTH levels were transiently decreased, and then normalized.

**Discussion**

$^{99m}$Tc-MIBI scintigraphy is accurate, and produces images of higher quality [6]. The typical pattern in the parathyroid adenoma demonstrates a prolonged retention of $^{99m}$Tc-MIBI in the adenoma with a rapid washout of the tracer from the normal thyroid tissue. The size of tumor, oxyphil cell contents, cell cycle phases, serum calcium levels, and P-glycoprotein expression levels have been discussed as contributing factors [13]. Mitochondrial density in the adenoma is also a major factor to cause a prolonged retention of $^{99m}$Tc, because the number of mitochondria is significantly higher in lesions detected by scintigraphy than in those that were missed, and the highest ratio of mitochondria per cell has been found in oxyphil cells [16].

Benard et al. reported a case of rapid $^{99m}$Tc-MIBI clearance from a parathyroid adenoma [11]. They hypothesize that mitochondria-rich oxyphil cells make a logical target for the prolonged retention of $^{99m}$Tc-MIBI usually observed in abnormal parathyroids. This concept is consistent with our case, because the histopathology in our case showed hardly any oxyphil cells. Although we have no idea whether most ectopic parathyroid adenomas have few oxyphil cells, it is at least possible that the absence of these cells would explain the lack of $^{99m}$Tc-MIBI retention on late-phase imaging in our case.

In summary, we report a case of ectopic parathyroid adenoma detected on early image of $^{99m}$Tc-MIBI scintigram, but not on delayed image. The absence of oxyphil cells would explain the lack of $^{99m}$Tc-MIBI retention on late-phase imaging in our case. Even without uptake on the delayed image of $^{99m}$Tc-MIBI scintigram, the early image was available for the localization of the ectopic parathyroid adenoma.
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