

Radioguided surgery in primary hyperparathyroidism

N.Ö. KUÇUK,* P. ARICAN,* S. KOÇAK** and G. ARAS*

Departments of *Nuclear Medicine and **Surgery, Ankara University Medical Faculty, Ankara, Turkey

Surgical neck exploration is usually made in primary hyperparathyroidism (PHPT). Localization of the adenoma or detection of hyperplasia may reduce the operation period and limit the extent of the surgery. In this study the efficacy of preoperative Tc-99m MIBI scintigraphy and intraoperative gamma probe was evaluated. **Materials and Methods:** Six patients with PHPT had preoperative Tc-99m MIBI parathyroid scintigraphy and intraoperative gamma probe (IGP) was used in surgical neck exploration. **Results:** Parathyroid adenoma was observed in 2/6 patients on scintigraphy in the right retroclavicular region and the left lobe of the thyroid. Both of them were clearly detected by IGP during the surgery and easily removed by the surgeon in a short time (35 min) with a small incision. Pathologic examination confirmed the parathyroid adenoma. No abnormal MIBI uptake was not observed in scintigraphy in 4/6 patients. Subtotal parathyroidectomy was performed in these patients. **Conclusion:** Preoperative Tc-99m MIBI scintigraphy and the use of IGP may limit the exploration and also the operation time and reduce surgical complications.

Key words: Tc-99m MIBI, parathyroid adenoma, intraoperative gamma probe

INTRODUCTION

SOLITARY PARATHYROID ADENOMA is a common cause of primary hyperparathyroidism and up to 20% of parathyroid adenomata can be located in ectopic sites.¹⁻⁴ The traditional treatment for primary hyperparathyroidism usually involves exploratory surgery. But morbidity is quite high and the surgery takes a long time. Prior localization of the adenoma may reduce the duration of the operation and limit the extent of the surgery. Preoperative Tc-99m MIBI is frequently used for this purpose with high sensitivity⁵⁻⁷ and radioguided surgical techniques facilitate parathyroidectomy without invasive neck exploration.⁸⁻¹¹ The results of the recent studies showed that this technique might guide the surgeon to detect an adenoma easily. In this study our aim was to evaluate the efficacy of Tc-99m MIBI parathyroid scintigraphy and the use of an intraoperative gamma probe (IGP) in the

detection of parathyroid adenoma.

MATERIALS AND METHODS

Six patients (3 male, 3 female, 29–57 years old) were included in the study. Informed consent of the patients was obtained. Their PTH and calcium levels were measured just before and 48 hours after the operation.

Preoperative Tc-99m MIBI parathyroid scintigraphy: 545 MBq Tc-99m MIBI was injected intravenously and planar and tomographic images of the neck and the thorax were taken for 5 minutes at 5, 30, 60 and 120 minutes after injection with a single head gamma camera (GE 4000I, 20% window centered at a 140 keV peak, with parallel hole general purpose low energy collimator).

Tomographic sections were taken at 120 minutes with a 64 × 64 matrix, zoom 1, 180° clockwise, 20 sec/64 frames with a Butterworth and Ramp filter for back projection at 0.5 cycle/cm (order 5).

An 11 mm hand held gamma probe (Europrobe, Euro-Medical, France) was used for IGP.

The operation was performed 3–4 hours after the injection. An IGP was used during the operation and when the counts taken with the IGP were at least three times higher than that of the thyroid and background tissue, it was

Received January 7, 2002, revision accepted May 9, 2002.

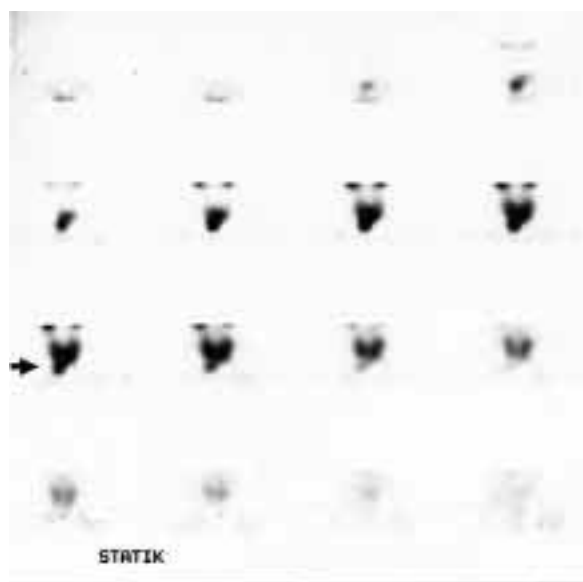
For reprint contact: Yrd.Doç.Dr. N. Özlem Küçük, Ankara Üniversitesi Tıp Fakültesi, Nükleer Tıp Anabilim Dalı, 06100 Cebeci-Ankara/TURKEY.

E-mail: kucukozlem68@yahoo.com

okucuk@medicine.ankara.edu.tr



A



B

Fig. 1 A: Retroclavicular adenoma was observed in parathyroid scintigraphy in planar images at 60 minutes. B: Retroclavicular adenoma was observed in parathyroid scintigraphy in 120 minute tomographic section.

evaluated as a “parathyroid adenoma” and histopathological examination of this tissue was made in frozen sections.

RESULTS

Parathyroid adenomas were observed in scintigraphy in 2/6 patients.

Case I: A 29-year-old man. A parathyroid adenoma was observed in the retroclavicular region preoperatively with Tc-99m MIBI scintigraphy planar and SPECT study and neck ultrasonography (USG: GE RT-X200, 7.5 MHz



Fig. 2 Parathyroid adenoma was clearly identified with Tc-99m MIBI in the left lobe of the thyroid

Table 1 The parathormone and calcium levels before and after surgery

patients	PTH 1 (pg/ml)	PTH 2 (pg/ml)	Ca 1 (mg/dl)	Ca 2 (mg/dl)
1	60	42	10	9.4
2	180	54	12	10.1
3	200	58	15	10.4
4	80	16	11	8.5
5	96	22	11.4	8.1
6	154	26	13.6	9.2

PTH 1: Parathormone levels before the operation.

PTH 2: Parathormone levels after the operation.

Ca 1: Calcium levels before the operation.

Ca 2: Calcium levels after the operation.

transducer). The adenoma was clearly detected with the IGP during the surgery and excised with a small collar incision. The duration of the operation was 35 minutes (Fig. 1A, B).

Case II: A 57-year-old woman. She had multiple recurrent urinary stones. Parathyroid adenoma was observed in the area of the left lower parathyroid with high resolution neck USG (GE RT-X200, 7.5 MHz transducer) and Tc-99m MIBI scintigraphy. The adenoma was not found in surgical exploration. A high count was detected with the IGP in the left thyroid lobe. Left thyroid lobectomy was performed and parathyroid adenoma was confirmed in a frozen section of this lobe (Fig. 2).

Four out of six patients had a normal Tc-99m MIBI scintigraphy result. Subtotal parathyroidectomy was performed in these patients. The counts of parathyroid tissue and thyroid were not different with the IGP. All parathy-

roid tissues were explored and "parathyroid hyperplasia" was observed on pathological examination.

The PTH values were 60–200 pg/ml (normal range 14.2–60.8 measured by radioimmunoassay) before the operation and were within normal limits 48 hours after surgery. The calcium levels were slightly higher than normal (10–15 mg/dl) and fell to the normal range after the operation (8.1–10.5 mg/dl determined by photometric color test) (Table 1).

The weight of each resected adenoma was about 1.5 grams and the hyperplastic parathyroid glands were 0.3 grams or less.

DISCUSSION

Accurate preoperative localization of parathyroid adenoma results not only in improving the outcome of these patients but also in shortening the duration of the operation and lowering the morbidity. Localization studies are particularly valuable in these patients. Tc-99m MIBI is commonly used to detect parathyroid adenoma especially when it is located in ectopic sites.^{5–7} But there are some limitations when it is coexisting with nodularly goiter and/or located in the thyroid lobe. For these limitations the use of IGP is also debated. Recent studies have shown that the rates of success in the detection of parathyroid adenoma preoperatively with scintigraphy and during the operation with all IGP are quite high and helpful in performing minimal excision.^{8–11} Casara et al. evaluated 21 patients with parathyroid adenoma and they could detect adenomas with scintigraphy and neck USG preoperatively and with an IGP during the operation in 20/21 (95.2%) and limited neck exploration was enough for these patients.⁹ The same workers also evaluated one hundred and forty three patients with primary hyperparathyroidism and concluded that parathyroid scintigraphy and neck USG might guide minimal invasive surgery and SPECT could enable the surgeon to detect the ectopic parathyroid adenoma easily when it was located in the mediastinum or deep in the neck.¹¹

Rubello et al. also investigated ectopic parathyroid adenoma with preoperative scintigraphy and with an IGP during the operation.¹⁰ The ectopic parathyroid adenomas were located at the carotid bifurcation and easily excised with minimal incision using an IGP during the operation.

In this study we observed parathyroid adenomas located in retroclavicular regions and in the thyroid lobe. They were clearly detected preoperatively with Tc-99m MIBI scintigraphy. The parathyroid adenoma located in the retroclavicular region was excised with minimal incision and in a short time using an IGP. But a parathyroid adenoma located in the thyroid lobe was not easily discriminated from nodularly goiter. Intrathyroidal parathyroid gland is found in 2–5% of ectopic parathyroid adenomata usually within the lower third part of the thyroid.^{12,13} In our patient the adenoma was located with

scintigraphy but it could not be seen by the surgeon. But a high count was obtained in the left lower lobe of the thyroid with an IGP. A frozen section and histopathological examination of this excised tissue confirmed "parathyroid adenoma."

Casara et al.¹¹ reported that the mean counts of parathyroid adenomas were as high as 2.5 times the background. Others had similar findings. In our study the counts were either too close to the background (1–1.2 times) or too high (at least three times). We have therefore chosen a cut off level three times higher than the background.

Radioguided surgical techniques facilitate parathyroidectomy by discriminating parathyroid adenoma from thyroid nodules, lymph nodes and other normal neck structure.

As a conclusion, preoperative Tc-99m MIBI scintigraphy and the use of an IGP may limit the extent of surgery and shorten the operation time. Surgical complications may also be minimized.

REFERENCES

1. Consensus Development Conference Panel. Diagnosis and management of asymptomatic primary hyperparathyroidism: Consensus Development Conference statement. *Ann Intern Med* 1991; 114: 593–597.
2. Rodriguez JM, Tezelman S, Siperstein AE, Duh OY, Higgins C, Morita E, et al. Localization procedures in patients with persistent or recurrent hyperparathyroidism. *Arch Surg* 1994; 129: 870–875.
3. Jarhult J, Nordenstrom J, Perbeck L. Re-operation for suspect primary hyperparathyroidism. *Br J Surg* 1993; 80: 453–456.
4. Rothmund M, Diethelm I, Brunner C, Kummerle F. Diagnosis and surgical treatment of mediastinal parathyroid tumors. *Ann Surg* 1976; 183: 139–145.
5. Carter WB, Sarfati MR, Fox KA, Patton DA. Preoperative detection of sporadic parathyroid adenomas using technetium-99m-sestamibi: what role in clinical practice? *Am Surg* 1997; 63 (4): 317–321.
6. Borley NR, Collins REC, O'Doerthy M, Coakley A. Technetium-99m sestamibi parathyroid localization is accurate enough for scan-direct unilateral neck exploration. *Br J Surg* 1996; 83: 989–991.
7. Gupta VK, Karen AY, Burke GJ, Wei JP. 99m-technetium sestamibi localized solitary parathyroid adenoma as an indication for limited unilateral surgical exploration. *Am J Surg* 1998; 176: 409–412.
8. Norman J, Chleda H. Minimally invasive parathyroidectomy facilitated by intraoperative nuclear mapping. *Surgery* 1997; 122: 998–1004.
9. Casara D, Rubello D, Piotta A, Pelizzo MR. ^{99m}Tc-MIBI radio-guided minimally invasive parathyroid surgery planned on the basis of a preoperative combined ^{99m}Tc-pertechnetate/^{99m}Tc-MIBI and ultrasound imaging protocol. *Eur J Nucl Med* 2000; 27 (9): 1300–1304.
10. Rubello D, Piotta A, Pagetta C, Pelizzo M, Casara D. Ectopic parathyroid adenomas located at the carotid bifurcation. The role of preoperative Tc-99m MIBI scintigraphy

- and the intraoperative gamma probe procedure in surgical treatment planning. *Clin Nucl Med* 2001; 26 (9), 774–776.
11. Casara D, Rubello D, Pelizzo MR, Shapino B. Clinical role of Tc-99m O⁴/MIBI scan, ultrasound and intraoperative gamma probe in the performance of unilateral and minimally invasive surgery in primary hyperparathyroidism. *Eur J Nucl Med* 2001; 28 (9): 1351–1359.
 12. Spiegel AM, Marx SJ, Doppman JL. Intrathyroidal parathyroid adenoma or hyperplasia. An occasional overlooked cause of surgical failure in primary hyperparathyroidism. *JAMA* 1975; 234: 1029–1033.
 13. Thomson NW, Edchansen FE, Harness JK. The anatomy of primary hyperparathyroidism. *Surgery* 1982; 92: 814–821.