

Feasibility of portable gamma camera imaging in intraoperative radioguided parathyroid adenoma identification

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ABSTRACT

Novel surgical applications include radioguided procedures in parathyroidectomy operations. In order to investigate the feasibility of usage of the portable gamma camera in parathyroidectomy operations; intraoperative radioguided parathyroidectomy operation was performed in three hyperparathyroidism patients with inconclusive preoperative parathyroid scintigraphy results. Intraoperative portable gamma camera did not reveal additional benefit over gamma probe in the patients with preoperative inconclusive parathyroid scintigraphy results that have parathyroid adenomas in close proximity to the thyroid lobes. However this modality might be evaluated by future studies regarding the ability to replace frozen section analysis or quick PTH analysis in the verification of the excision of the parathyroid adenoma.

Key words: Portable gamma camera; Gamma probe; Radioguided; Parathyroid; Scintigraphy

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INTRODUCTION

The most important additional modality in the parathyroid imaging is intraoperative gamma probe applications which provide self-confidence and guidance for the surgeon during the surgery. In fact, the most of the parathyroid adenomas could be found out by a simple exploration eventually; however radioguided surgery has benefits including time saving and leading minimal invasive surgery.

The difficult parathyroid adenomas include ectopic localizations, adjacent thyroid uptake due to thyroid nodules and multiglandular disease [1]. There are limited number of reports about the new method 'portable gamma camera' and parathyroid applications of this method [2]. We aimed to analyze the efficiency of this new modality in especially scintigraphically inconclusive cases and investigate the feasibility of this modality in primary hyperparathyroidism.

CASE REPORT

The ethic committee approval was obtained from the Local Ethics Committee. Informed consents were obtained from all patients. Patients were included in the study in case of inconclusive parathyroid scintigraphy results. Any of the patients had additional severe illness contributing the operation or were operated from neck region previously. Comparative analysis of the early, late phase planar and SPECT images and additional ultrasonography analysis of the patients by the same Nuclear Medicine Physician were performed in all patients. In the day of operation intravenous administration of 2 mCi Tc-99m sestamibi was performed. The operations were performed approximately one hour after the injection of the radiopharmaceutical. After removal of the lesions, evaluation of the postoperative specimen was performed by both the gamma probe and portable gamma camera in all the patients. Intraoperative

frozen section analyses of the specimens were performed in all the three patients.

Case 1

52 years old female patient with diagnosis of primary hyperparathyroidism (PTH: 78.2 pg/mL, Ca: 10.34 mg/dL, P: 2.71 mg/dL) attended to the hospital for preoperative evaluation. Parathyroid scintigraphy with additional SPECT imaging revealed inconclusive results (Figure 1a). Intraoperative evaluation of the thyroid bed revealed also inconclusive results by both gamma probe and portable gamma camera (Figure 1b). After the incision with the guidance of gamma probe and previous SPECT images the identification of the focus in the upper part of the left thyroid lobe was possible. Either gamma probe or portable gamma camera verified the specimen to be radiolabelled (Figure 1c) and pathology confirmed the diagnosis.

Case 2

56 years old female patient presented with severe hypercalcemia (Ca:12.8 mg/dL, P:2.63 mg/dL) and hyperparathyroidism (180 pg/mL). Preoperative parathyroid scintigraphy pointed out bilateral uptake related to the thyroid nodules which was not relevant for parathyroid adenoma (Figure 2a). Intraoperative investigations including gamma probe and portable gamma camera did not show any uptake pointing the parathyroid adenoma (Figure 2b). During the dissection while the right thyroid lobe was separated and liberalized the surgeon recognized increased uptake by gamma probe and portable gamma camera identified the lesion as a separate activity accumulation (Figure 2c) after excision of the lesion (right lower quadrant) which was verified with both the portable gamma camera and the gamma probe and the pathological analysis (Figure 2d).

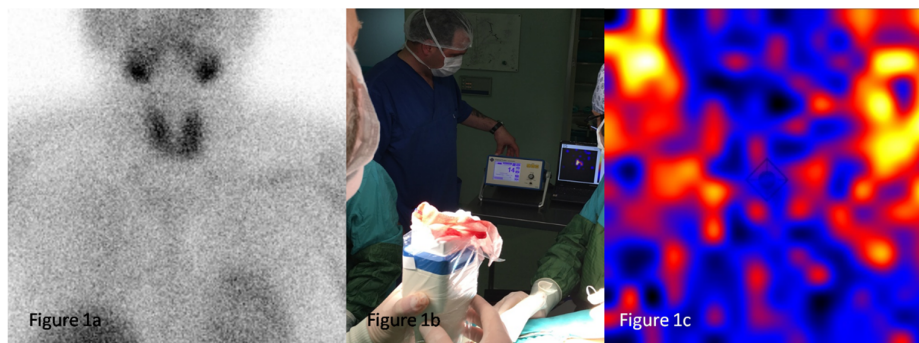


Fig 1. Scintigraphy images of the first patient with inconclusive results for parathyroid adenoma (a). Portable gamma camera images inconclusive for parathyroid adenoma (b). Portable gamma camera image of the excised tissue verifying parathyroid adenoma (c).

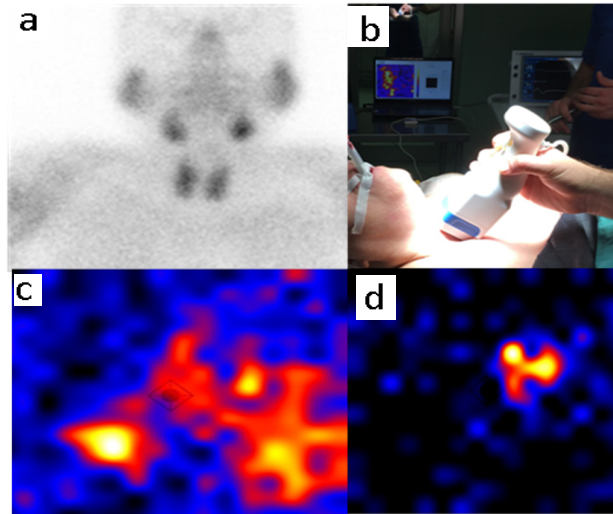


Fig 2. Scintigraphy images of the second patient with bilateral thyroid nodule uptake but not parathyroid adenoma (a). Portable gamma camera images without parathyroid adenoma (b). A discrete activity and separate thyroid activity in front of the parathyroid uptake (c). Parathyroid adenoma after excision (d).

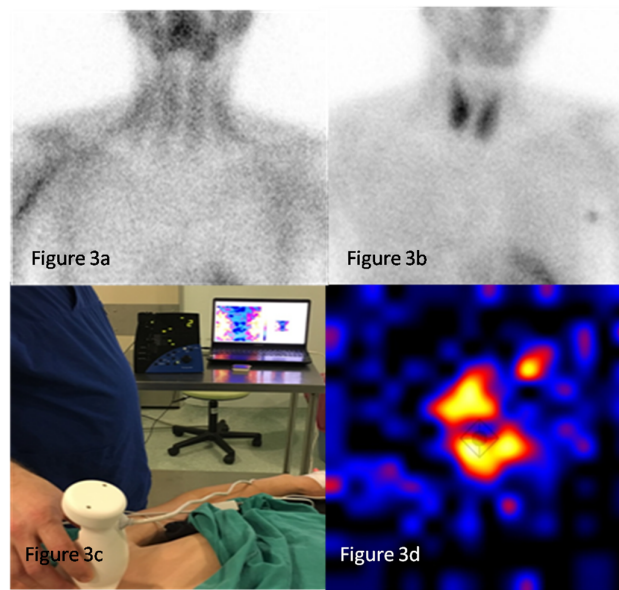


Fig 3. Scintigraphy image of the third patient without any focus of parathyroid adenoma (a). Repeat scintigraphy images without certain identification of parathyroid adenoma (b). Portable gamma camera image without parathyroid uptake (c). Excised parathyroid adenoma (d).

Table 1: Summary of the results of previous studies about portable gamma imaging in radioguided surgery for parathyroid adenoma.

Study	Year	No. of subjects	Added value of PGC
Casella et al.	2015	20	Localization of PA
Hall et al.	2015	20	Confirmation of removal
Estrems et al.	2012	29	Radioguided surgery with minimal parathyroid invasion

PGC: Portable gamma camera, PA: Parathyroid adenoma

Case 3

56 years old female patient with previous diagnosis of hyperparathyroidism (PTH: 120.5 pg/mL, Ca: 10.83 mg/dL, P: 2.94 mg/dL) whose operation could not be planned because of inconclusive parathyroid scintigraphy (Figure 3a) previously. Although repeat parathyroid scintigraphy did not reveal a single focus of parathyroid adenoma also (Figure 3b) the patient underwent parathyroid surgery. Intraoperative portable gamma camera images showed bilateral physiological thyroid uptake only (Figure 3c). However after excision of the lesion from the posterior compartment of right thyroid lobe the lesion was verified by portable gamma probe (Figure 3d).

Final decision of successful removal of the parathyroid adenoma was confirmed by both frozen section analysis and by the significant decrease in the plasma Ca levels after the operation.

DISCUSSION

Preoperative interventions including parathyroid scintigraphy and ultrasonography were inconclusive in this study. In this kind of cases SPECT and SPECT/CT has important diagnostic value by increasing the sensitivity over 90% according to the previous literature [3]. SPECT imaging showed the lesions however the results were still inconclusive because of the lack of verification of the lesions with ultrasonography except for one of the cases (upper left lobe; Case 1).

The clinical applications about the portable gamma camera were started in 2007's [2]. Previous studies about parathyroid imaging with these devices concluded that this method might be important for patients with negative preoperative imaging studies and patients with the multinodular thyroid diseases [2, 4]. Esteems et al. compared this devices diagnostic accuracy with the preoperative imaging modalities and according to their analysis the sensitivity increased to 86% from 79% and specificity 92% from 91% by addition of this modality [4]. Although, it was considered that portable gamma camera would be helpful in discordant cases, it was not the case in this study. Casella et al. achieved a localization rate of 100%, and a sensitivity and specificity of 90% in identification of parathyroid adenoma and the diagnostic accuracy according to quadrant analysis was 98% in the same study [2]. They also emphasized that the method may replace the quick PTH analysis as previous literature [2]. We confirmed that postoperative analysis of the specimen by portable gamma camera may obviate the need for the postoperative verification methods after a learning curve and prospective studies.

Casella et al. claimed that portable gamma camera imaging may obviate the need for preoperative imaging methods and other intraoperative guidance methods however it is not possible to decide these conclusions without side by side comparative analysis in the same patients [2]. In this study we could not observe a clear superiority of this modality over the existing methods at least in difficult cases. Estrems et al. observed some benefit for their three patients with negative parathyroid scintigraphy from portable gamma camera however they also did not compare these cases with gamma probe which is a standard procedure in most of the centers [4].

Besides these studies, Hall et al. showed that portable gamma probe imaging is a useful adjunct for parathyroid imaging in MIBI avid disease which is an expected result and which was achieved by gamma probe imaging previously [5]. They also reported that the operation time would be shorter in case of obviating the need to perform intraoperative PTH and frozen section analysis [5]. There are limited number of previous studies about parathyroid adenoma surgery by portable gamma camera imaging (Table 1).

CONCLUSION

According to the results of this study portable gamma camera imaging cannot replace gamma probe in radioguided surgery of parathyroid lesions which are in close proximity to the thyroid tissue whose parathyroid scintigraphy did not reveal a clear focus of uptake. This modality might replace other verification methods (frozen section, quick PTH) with capability of confirmation of the excision of parathyroid adenoma.

REFERENCES

1. Phillips CD, Shatzkes DR. Imaging of the parathyroid glands. *Semin Ultrasound CT MR*. 2012 Apr;33(2):123-9.
2. Casella C, Rossini P, Cappelli C, Nessi C, Nascimbeni R, Portolani N. Radioguided Parathyroidectomy with Portable Mini Gamma-Camera for the Treatment of Primary Hyperparathyroidism. *Int J Endocrinol*. 2015;2015:134731.
3. Hassler S, Ben-Sellem D, Hubele F, Constantinesco A, Goetz C. Dual-isotope ^{99m}Tc-MIBI/¹²³I parathyroid scintigraphy in primary hyperparathyroidism: comparison of subtraction SPECT/CT and pinhole planar scan. *Clin Nucl Med*. 2014 Jan;39(1):32-6.
4. Estrems P, Guallart F, Abreu P, Sopena P, Dalmau J, Sopena R. The intraoperative mini gamma camera in primary hyperparathyroidism surgery. *Acta Otorrinolaringol Esp*. 2012 Nov-Dec;63(6):450-7.
5. Hall NC, Plews RL, Agrawal A, Povoski SP, Wright CL, Zhang J, Martin EW Jr, Phay J. Intraoperative scintigraphy using a large field-of-view portable gamma camera for primary hyperparathyroidism: initial experience. *Biomed Res Int*. 2015;2015:930575.