



Radiofrequency ablation of an intrathyroidal parathyroid adenoma with intraoperative parathyroid hormone monitoring: a case report of a novel technique

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Background: Primary hyperparathyroidism (PHPT) is classically treated by conventional parathyroidectomy, an open neck surgery. Radiofrequency ablation (RFA) has been shown as a safe minimally-invasive alternative to parathyroidectomy for the management of PHPT and has been shown to be effective in 60–90% of cases. Here, we present a patient successfully treated for persistent PHPT by RFA with simultaneous intraoperative parathyroid hormone (IOPTH) monitoring.

Case Description: A 51-year-old female with a past medical history of resistant hypertension, hyperlipidemia, and vitamin D deficiency presented to our endocrine surgery clinic with PHPT. Neck ultrasound (US) localized a 0.79 cm lesion suggestive of a parathyroid adenoma. Parathyroid exploration resulted in the excision of two masses. IOPTH levels dropped from 259.9 to 204.7 pg/mL. No ectopic parathyroid tissue was found. Three-month follow-up demonstrated elevated calcium levels, suggesting persistent disease. A repeat neck US one-year post operation localized a suspicious hypoechoic sub-centimeter thyroid nodule, which was subsequently determined to be an intrathyroidal parathyroid adenoma. The patient elected to proceed with RFA with IOPTH monitoring, citing concern for increased risk of redo open neck surgery. Operation pursued without complication and IOPTH levels dropped from 270 to 39.1 pg/mL. The patient's only three-day post-operative complaints, occasional numbness and tingling, were completely resolved by her three-month follow up. The patient had normal PTH and calcium levels at seven months post-operation visit and was without complaint.

Conclusions: To our best knowledge, this is the first reported case of RFA with IOPTH monitoring used to manage a parathyroid adenoma. Our work adds to the growing literature suggesting minimally-invasive techniques, such as RFA with IOPTH, as a potential management option for treating parathyroid adenomas.

Keywords: Radiofrequency ablation; case report; parathyroid; hyperparathyroidism; intraoperative parathyroid hormone (IOPTH)

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Introduction

Primary hyperparathyroidism (PHPT) is a common neuroendocrine disorder characterized by elevated serum calcium levels secondary to elevated parathyroid hormone (PTH). PHPT is more prevalent in women and the elderly, affecting almost 1% of all patients aged 69 and older (1). Parathyroidectomy is the mainstay management modality of PHPT, though other minimally-invasive techniques been reported with adequate efficacy considering the disease most often (in 80–85% of cases) arises in consequence of a single adenoma.

Radiofrequency ablation (RFA) is a minimally-invasive approach which delivers well-localized heat by means of a percutaneous catheter for thermal ablation of soft tissue (2). The technique induces thermal injury in the tissue and coagulative necrosis, with applications in the fields of cardiology, vascular surgery, and endocrine surgery. RFA has been demonstrated to effectively and safely treat benign (3), toxic (4), and malignant thyroid nodules (5). Recently, RFA has grown as an attractive alternative to parathyroidectomy, given its impressive safety profile, lack of transcervical incisional scar, and obviation of general anesthesia. The first-ever reported RFA of a parathyroid adenoma in the United States was reported by Hussain *et al.* in 2021 (6), though a handful of international works, mostly from Asia, have reported their experience with RFA in small cohort studies (20 to 50 patients) (7,8). Interestingly, the use of intraoperative parathyroid hormone (IOPTH) monitoring to confirm cure immediately post-operation during RFA has never been reported.

Persistent PHPT, defined as hypercalcemia within 6 months following parathyroidectomy/intervention, is often secondary to the presence of residual hyperfunctioning

parathyroid tissue and occurs in about 1% of cases (9). To our knowledge, we report the first case of successful treatment of a parathyroid adenoma by RFA with IOPTH monitoring in a patient with persistent PHPT. We present this article in accordance with the CARE reporting checklist (available at <https://gs.amegroups.com/article/view/10.21037/gS-22-733/rc>).

Case presentation

A 51-year-old female with a past medical history of resistant hypertension, hyperlipidemia, vitamin D deficiency, psoriasis, carpal tunnel syndrome, and hysterectomy presented to the endocrine surgery clinic for evaluation of PHPT with complaints of headache, fatigue, and bilateral elbow and leg bone pain. The patient was diagnosed with PHPT consistent with hypercalcemia (11.7 mg/dL), elevated PTH (92 pg/mL), and hypophosphatemia (2.3 mg/dL). Vitamin D levels were normal. 24-hour urine calcium levels were elevated (460 mmol). The patient was not on calcium or Vitamin D supplements and had no history of nephrolithiasis or gallstones. A bone density scan noted osteoporosis.

Nuclear medicine Sestamibi scan (NM Sestamibi) could not localize a parathyroid adenoma. For financial concerns, the patient refused a neck computerized tomography (CT) scan. A comprehensive neck ultrasound (US) identified a 0.79 centimeter (cm) left central compartment lesion.

Parathyroid exploration led to the excision of the left central compartment lesion related to the upper pole. Following excision, IOPTH dropped from 259.9 to 217.9 pg/mL. Since Miami criterion was not met, which posits that a drop in IOPTH >50% from baseline within 10 minutes confirms procedural cure, neck exploration commenced (10). The left central compartment lesion related to the lower pole was explored but not identified. Right central compartment lesions related to the right upper pole and right inferior pole were identified. Following excision of the larger right superior parathyroid gland, IOPTH dropped to 204.7 pg/mL. Neither extensive neck dissection nor gamma probe scanning could elicit ectopic parathyroid tissue. The surgical pathology noted hypercellular left (60 mg) and normal right upper parathyroid glands. At the time, the lesion discovered on preoperative ultrasound was not suspected to be a parathyroid gland. Three months post operation, the patient's calcium level was 10.6 mg/dL.

The patient returned one-year post operation with labs as follows: serum calcium 10.9 mg/dL, Vitamin D 37 ng/mL,

Highlight box

Key findings

- This is the first report of successful treatment of persistent PHPT by RFA with IOPTH monitoring.

What is known and what is new?

- RFA has been used to manage PHPT.
- RFA with IOPTH can be used to manage patients with PHPT.

What is the implication, and what should change now?

- Our work adds to the growing literature suggesting minimally-invasive techniques, such as RFA with IOPTH, as a potential management option for treating parathyroid adenomas.

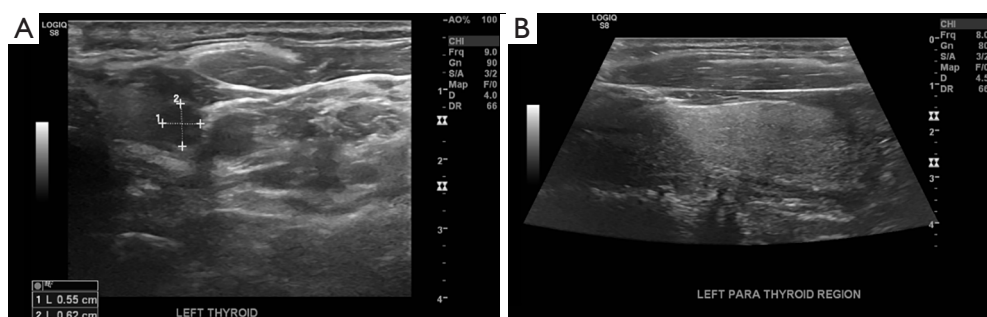


Figure 1 Ultrasound of the left thyroid (A) before RFA and (B) following radiofrequency ablation. (B) was taken 7 months post-operation. RFA, radiofrequency ablation.

and PTH 79 pg/mL. The patient was diagnosed with persistent PHPT. Neither a repeat NM Sestamibi scan nor neck 4D CT with contrast could identify a parathyroid adenoma. A neck US localized a suspicious hypoechoic sub-cm left thyroid nodule which measured 0.62 cm × 0.55 cm (*Figure 1*). Fine needle aspiration of the sub-cm nodule noted a follicular lesion of undetermined significance and PTH-washout revealed an elevated PTH level (2,108 pg/mL), suggestive of an intrathyroidal parathyroid adenoma.

After surgical counseling, the patient refused left thyroid lobectomy, citing concern for post-operative hypothyroidism and the increased risk of complication with redo neck surgery. RFA with IOPTH monitoring was subsequently proposed, to which the patient consented.

Two years following initial parathyroid exploration, the patient underwent IOPTH monitored RFA of the intrathyroidal parathyroid adenoma. Peripheral venous draw determined baseline IOPTH to be 270 pg/mL. US-guided (15-megahertz linear transducer) RFA with a short axis approach proceeded using a 5 mm STARmed probe. The energy level was 15 watts and impedance went up to 300 ohms. Two sessions were conducted in the same operating-room setting. The total ablation time was 3 minutes. Repeat peripheral venous draw ten minutes after final ablation determined IOPTH to be 39.1 pg/mL. The total procedure time lasted 21 minutes. The patient was observed for 30 minutes post-procedure. Post-operative bilateral mobile vocal cords were confirmed via laryngoscope. The patient tolerated the procedure well.

The patient's only third-day post-operative complaints were of occasional numbness and tingling of her hands and feet. Serum calcium was 9.3 mg/dL. Three months post operation, the patient had normal PTH (49 pg/mL) and calcium (9.5 mg/dL) levels as well as a complete resolution

of symptoms. Ultrasound could not detect the adenoma. At 7 months post operation, the patient had no complaints with normal PTH (35 pg/mL) and serum calcium (8.9 mg/dL) levels.

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

Discussion

PHPT is a common endocrine disorder commonly treated by parathyroidectomy. In patients with persistent PHPT following parathyroidectomy/intervention, minimally-invasive techniques such as RFA might be an acceptable and encouraged alternative considering the increased risk of complication in redo surgery. Here, we describe for the first time the successful treatment of persistent PHPT by RFA with IOPTH monitoring.

Parathyroidectomy was first introduced in 1926 by Felix Mandl, and has been the classic method of treating PHPT and persistent hyperparathyroidism. Since then, improved parathyroid imaging studies and intraoperative localization techniques have considerably enhanced the outcomes of modern-day parathyroidectomy. Importantly, the use of IOPTH monitoring has significantly improved success rates of parathyroidectomy, allowing surgeons an intraoperative method of predicting success with >95% accuracy. Patients who achieved a >50% drop from highest baseline IOPTH level at 10 minutes and final IOPTH level within the

Table 1 Literature search of non-case report studies reporting RFA for the treatment of primary hyperparathyroidism

Study	Year	Country	Patients (N)	Mean age (years)	Cure rate (%)	Complication
Ebrahminik <i>et al.</i> (12)	2022	Iran	27	63.2	NR	None
*Peng <i>et al.</i> (13)	2022	China	51	58.0	98.00	Transient dysphonia [3]
*Chai <i>et al.</i> (14)	2022	China	39	59.5	82.10	Transient dysphonia [2]
*Wei <i>et al.</i> (15)	2021	China	27	58.9	92.59	Dysphonia [1]
*Wei <i>et al.</i> (7)	2021	China	23	59.1	87.00	Dysphonia [1]
Li <i>et al.</i> (16)	2021	China	25	53.9	100.00	None
Ha <i>et al.</i> (8)	2020	Korea	11	64.8	63.64	None
Korkusuz <i>et al.</i> (17)	2018	Germany	9	NR	NR	None
Sormaz <i>et al.</i> (18)	2017	Turkey	5	60.3	60.00	None
Xu <i>et al.</i> (19)	2013	China	2	52	NR	Transient dysphonia [1]

*, Wei *et al.* 2021 (23 patients) and Wei *et al.* (27 patients) report on similar patient cohorts. Chai *et al.* (39 patients) and Peng *et al.* (51 patients) report on similar patient cohorts. NR, not reported; RFA, radiofrequency ablation.

reference range had a 97% positive predictive value of cure (11). Interestingly however, our literature search of studies utilizing RFA for the treatment of PHPT found no studies which reported the use of IOPTH monitoring (Table 1). Our case demonstrates that the use of IOPTH in minimally-invasive techniques such as RFA is safe and may be encouraged.

In comparison to conventional parathyroidectomy, RFA has several advantages (20). Foremost, RFA is typically a short procedure that requires only local anesthetic. Obviating the need for general anesthesia, RFA is an attractive option for elderly patients or those with significant comorbidities. Furthermore, RFA is a scarless procedure. Considering the typical PHPT patient who is female and middle-aged (similar to our patient), a 2–6 cm transcervical permanent scar is an appreciable cosmetic concern for a significant portion of patients (21). In a study of 120 patients who underwent thyroid or parathyroid surgery, Arora *et al.* found that 75% of the patients would have chosen to have undergone a scarless procedure had they been given the option (22). RFA can also be done as an outpatient procedure and is only minimally discomforting, especially when compared to conventional parathyroidectomy. In addition, unlike parathyroidectomy, RFA can be re-done with minimal to no increase in complication rate. RFA, however, does have important drawbacks. For example, considering the nature of the procedure, patients with parathyroid adenomas which cannot be localized by preoperative ultrasound should not be managed by RFA. In

addition, patients who do not experience a drop in IOPTH during RFA are not automatically subject to bilateral neck exploration as in the case of case surgery.

A literature search of non-case report articles which describe the treatment of PHPT by RFA elicited 10 studies (7,8,12-19) (Table 1). All studies were conducted beyond the United States, with 6 works from China. A wide range of cure rates was reported across the studies, ranging from 60% to greater than 90% (15,18). The variability in cure rates could be due to the lack of formally adopted guidelines, which would assist clinicians and surgeons in providing standardized care. The use of IOPTH, as our study demonstrates, may improve this rate as well. Conceivably, the principal concern with the use of RFA for the parathyroid glands are their close proximity to the recurrent laryngeal nerve and the risk of injury due to thermal spread. For this reason, works utilized hydrodissection to mobilize the parathyroid gland to a safer location (6,8,15). Dysphonia was the only complication reported in the studies elicited from our literature search. Consistent with RFA of thyroid nodules, the studies reported consistently low rates of complication. There were no reports of permanent complication. Considering our study specifically, intrathyroidal parathyroid adenomas may be ideal targets for RFA given their location within the thyroid parenchyma which may provide a barrier to thermal spread. Of note, Li *et al.* reported the treatment of four patients with multiglandular disease. The authors reported that operative failure (defined as both PTH and

serum calcium levels within normal limits at 6 months) was more frequent in patients with multiglandular disease (50% cure, N=2/4) as compared to single adenomas (90% cure, N=19/21, P=0.043) (16). Since RFA is a localized treatment and multiglandular disease would suggest multiple ablation attempts, patients with localized PHPT may be more suitable candidates for RFA.

Considering the novelty of parathyroid adenoma management by RFA, future investigations are warranted. For example, persistent or recurrent disease subsequently managed by parathyroidectomy may be more difficult given the potential for increased scar tissue, though this has been shown to be minimal and inconsequential with respect to thyroid nodules (23). In addition, a robust long-term study investigating the risk of long-term recurrence is warranted to better counsel patients.

Conclusions

To our knowledge, this is the first report of successful treatment of persistent PHPT by RFA with IOPTH monitoring. Our work adds to the growing literature suggesting minimally-invasive techniques, such as RFA with IOPTH, as a potential management option for treating parathyroid adenomas.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at <https://gs.amegroups.com/article/view/10.21037/gS-22-733/rc>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://gs.amegroups.com/article/view/10.21037/gS-22-733/coif>). EK serves as an Editor-in-Chief of *Gland Surgery* from May 2017 to April 2024. EK also serves as a consultant of STARmed. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical

standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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