

Radiofrequency Ablation as a Reliable Option for Treating Autonomous Thyroid Nodules - Case Report and Literature Review

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Abstract

Radiofrequency Ablation (RFA) has been a valuable alternative to treat many benign thyroid nodules in the past ten years. This minimally invasive procedure is specially indicated in large goiters or patients who reject or are unsuitable for surgery. RFA is a technique where an alternating electric current agitates tissue ions, which creates frictional force within proximity to the electrode and heats the targeted nodule to a temperature range capable of causing coagulative necrosis. This treatment is performed under local anesthesia and light sedation and no need for hospitalization. Complications such as hypothyroidism, recurrent nerve damage and unaesthetic scar are much less common in patients submitted to RFA than in other procedures. This case report shows a patient with a sizeable autonomous thyroid nodule (10.8 cc plus a cyst with 6.7 cc) with hyperthyroidism that refuses the surgery or iodine therapy due to a high risk of developing hypothyroidism. She underwent a cyst aspiration and RFA of the nodule and cyst wall and quickly recovered the thyroid gland's normal function, which remains stable and a marked reduction of the nodule volume. Data on toxic adenomas do not support RFA for Hyperfunctioning nodules as strongly as it does for Benign diseases. Still, based on this case, the authors discuss the pros and cons of this treatment for autonomous thyroid nodules and other indications for RFA.

Keywords: Radiofrequency Ablation (RFA); Autonomous Thyroid Nodules; Benign Diseases

Introduction

In the past ten years, Radiofrequency Ablation (RFA) has been employed in the treatment of thyroid nodules. This minimally invasive technique is largely beneficial to patients who reject or are unsuitable for surgery due to clinical or cosmetic reasons. Literature has already established RFA's efficacy on large benign nodules or papillary micro carcinomas, establishing its role as a feasible alternative to thyroidectomy or radioiodine therapy [1,2]. Moreover, complications such as hypothyroidism, voice changes and scar are significantly milder or less common in patients submitted to RFA [3]. On the other hand, ablated hyper functioning nodules have shown conflicting results in the literature and are still a subject of debate [4,5]. This case report aims to exemplify the use of RFA for a specific subset of patients who developed hyper functioning nodules but reject surgery.

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Case Report

A 34-year-old female patient presented at the office complaining of a growing neck mass for the past 2 years. Her endocrinologist had referred her to a head and neck surgeon due to a right-lobe thyroid nodule seen on routine neck ultrasound. No cervical lymphadenopathies were identified. Upon questioning, she confirmed moderate anxiety, mild intolerance to heat and tachycardia, which are compatible with hyperthyroidism. Upon physical examination, the patient showed an asymmetrical and macroscopically enlarged thyroid gland (Figure 1), which was not tender and well-defined on palpation. Laboratory workup showed a TSH < 0.1 mU/L (NR 0.4 - 4.5 mU/L) and FT4 1.8 ng/dL (NR 0.9 - 1.3 ng/dL). Thyroid scintigraphy was ordered, which showed a toxic nodule compatible with the right nodule seen on neck ultrasound.

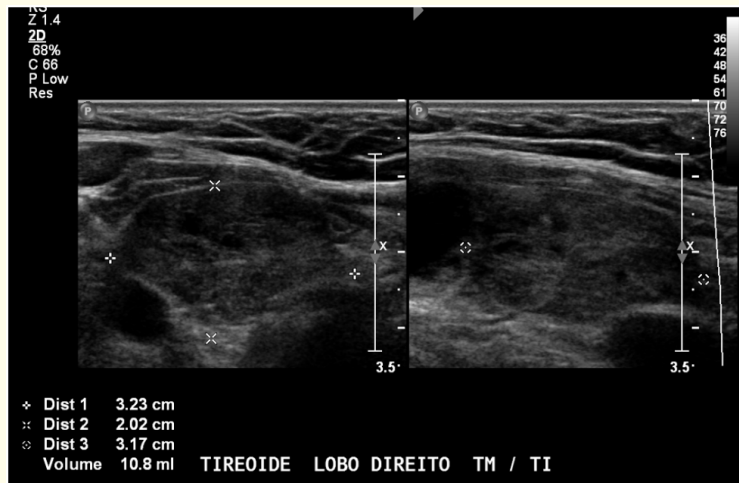


Figure 1: Preoperative aspect of the patient's neck showing an asymmetrically enlarged thyroid gland.

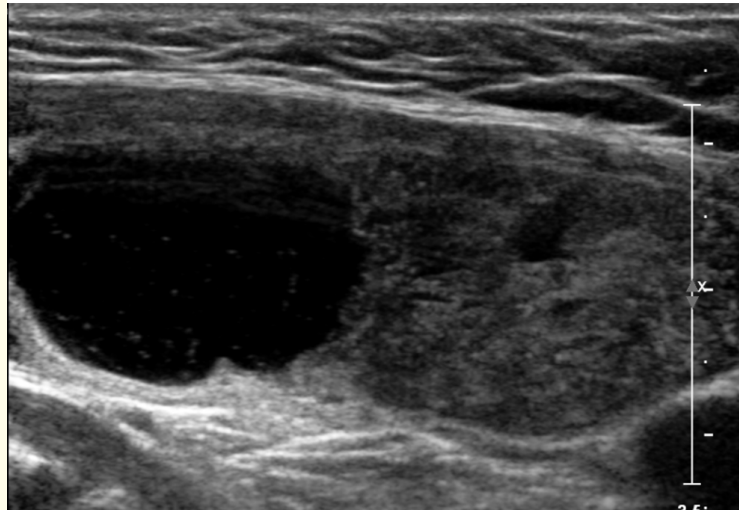
Upon discussion, the patient showed forceful refusal of suggested partial thyroidectomy or iodine therapy for a number of reasons. Her main concern was taking thyroid replacement medications for the rest of her life. Secondly, the patient was recently married and did not want to postpone pregnancy due to radioiodine therapy. Additionally, the patient showed great surgery anxiety and would rather not undergo the procedure due to the potential risks of thyroidectomy. Finally, there was significant cosmetic concern of a neck scar early on in life.

RFA was offered and promptly accepted as an alternative therapeutic option. The procedure was performed under local anesthesia and light sedation. A neck ultrasonography was performed right before the procedure, revealing a 10.8 cc, taller than wide, isoechoic nodule with no microcalcifications, in the mid-inferior aspect of right lobe of thyroid. Adjacent to its superior margin was a cystic image with approximately 6.7cc (Figure 2a and 2b), which was aspirated right before the ablation (Figure 3a). RFA was carried out using an internally

cooled electrode (1.2 mm diameter, with 1-cm active chip) and an RF generator (Mygen V-1000, RF Medical, South Korea). Both dextrose isolation technique and a trans-isthmic approach were used to prevent adjacent tissue overheating. 50 W of power were used for about 8 minutes under ultrasonographic (US) guidance to ablate both the solid component and the cystic wall. Posterior ultrasonographic confirmation revealed a completely ablated nodule with no apparent remnant tissue lesion (Figure 3b-3e).

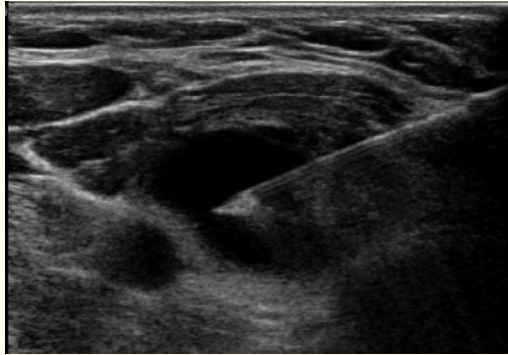


(a)

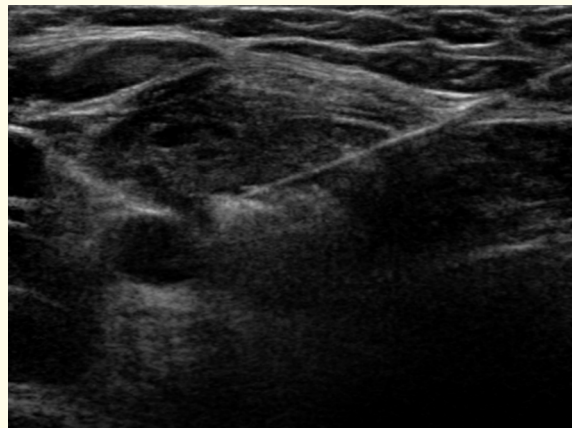


(b)

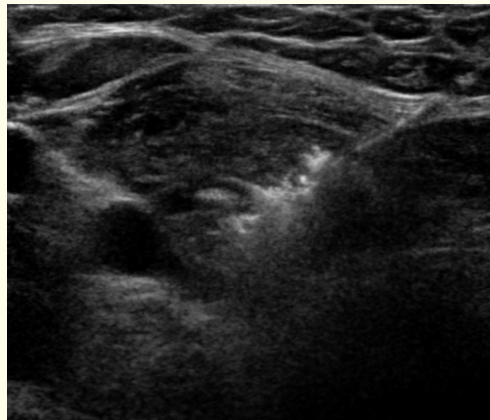
Figure 2a and 2b: Preoperative ultrasonographic aspect of the right-sided thyroid nodule. The image shows a taller than wide, isoechoic solid component measuring 10.8cc (shown as mL in the figure) with no microcalcifications, in the mid-inferior aspect of right lobe of thyroid. There was an accompanying cystic component measuring 6.7cc.



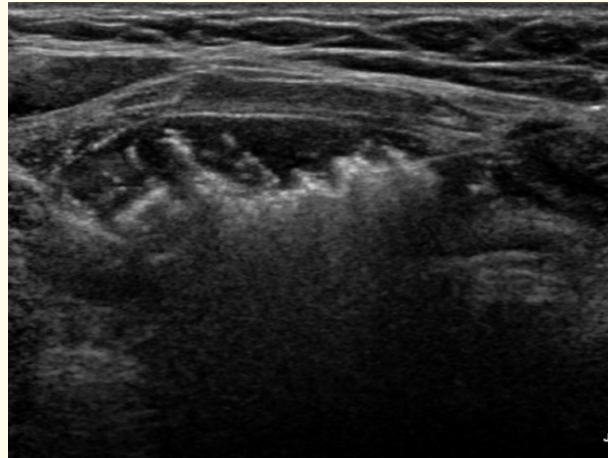
(a)



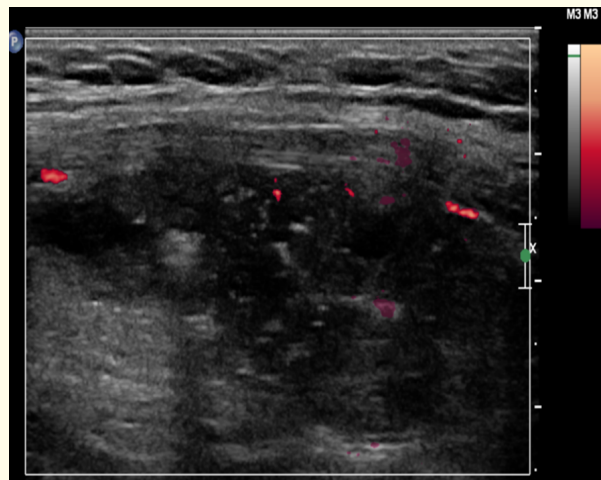
(b) Ablation of solid and cyst wall



(c)



(d)



(e)

Figure 3: Perioperative ultrasonographic images of the nodule. Firstly, aspiration of cystic component was performed out to prevent heat dispersion (a), followed by the trans-isthmic ablation of solid component and cyst wall (b). Ablation was carried with utilizing the moving shot technique, in which posterior-inferior regions (c) are ablated anterior-superior regions (d). During ablation, hyperechoic microbubbles are identified in ultrasound, which helps demarcate which areas are being heated. A final ultrasound confirms no vascular lesion and altered echogenicity from initial aspect (e).

Shortly after procedure, the patient complained of mild neck discomfort and heat sensation, both of which quickly subsided with two 15-minute rounds of cold therapy. She returned to work on the 3rd day after procedure. Upon 20-day follow-up, the patient did not complain of pain or other adverse effects and had early perception of reduction of neck swelling. At this moment, neck ultrasound showed a 47% volume reduction (from 10.8 to 5.8 cc) and TSH increase to 0.8 mU/L. 2 and 6 moth follow-up after RFA showed an increase of TSH to 1.6 and 1.5 mU/L and a volume reduction of 70% and 91%, respectively. Overall, the patient was highly satisfied with the recovery process, as well as the final cosmetic results (Figure 4).



(a)



(b)

Figure 4a and 4b: Anterior (a) and lateral (b) aspects of patient's neck 6 months after RFA. It can be noted that the gland's volume has decrease substantially and no scarring was left, which allows for satisfactory cosmetic results. altered echogenicity from initial aspect (e).

	Pre-op	20d	2mo	6mo
VRR (Thyroid gland Volume)	N/A (10.8)	47% (5.8)	70% (3.2)	91% (9.7)
TSH	< 0.1	0.8	1.6	1.5

Table 1: Table representing volume reduction rates in % (and corresponding glandular volume in milliliters) and TSH before RFA, at 20 days, 2 months and 6 months follow-up in mg/dL.

Discussion

Until recently, the classic treatment for most thyroid nodules was restricted to partial or total thyroidectomy, radioiodine therapy or anti-thyroidal therapy, all of which have potential drawbacks [6]. On the other side of the spectrum stands observational follow-up, which despite avoiding procedural complications, may lead to compressive symptoms or cosmetic concerns [7]. In this context, RFA and other thermal therapies have emerged to fill in the gap of less invasive and yet similarly effective therapeutic options.

RFA is a technique where an alternating electric current agitates tissue ions, which creates frictional force within close proximity to the electrode and heats the targeted nodule to a temperature range capable of causing coagulative necrosis in a short period of time. While RFA was originally described for the treatment of liver nodules, it has been successfully adapted to the thyroid gland. In view of the ellipsoid shape of nodules and relatively large size when compared to the healthy surrounding tissue, ablation techniques vary from those used in the liver. Most operator access the gland through the oblique trans-isthmus approach, which provides more stability during swallowing or coughing, reduces damage to the danger triangle and helps with the visualization of the entire length of the electrode. Ablation from deeper and inferior to more superficial portions of the nodule is called the moving-shot technique, which improves safety and completeness of ablation of the nodule due to its non-spherical shape [8].

RFA has proven effective for different types of thyroid nodules. Studies from the United States, Korea and Italy on RFA effectiveness for benign nodule showed a significant decrease in volume and compressive symptoms, while preserving thyroid function and avoiding a neck scar [9-13]. A more recent systematic review and meta-analysis indicates a mean volume reduction rate after single or multiple sessions of RFA of 80.3% at 36-month follow-up and up to 92.2% thereafter [1]. For a single-session treatment, a 12-month follow-up 71% volume reduction [3]. Joungh, *et al.* [14], achieved a greater than 50% nodule volume reduction ratio in 91.06% of patients with benign thyroid nodules and a 27.81% disappearance in up to 41 months follow up.

Similarly, a meta-analysis of RFA and other thermal ablation techniques in the treatment of papillary microcarcinomas by Choi, *et al.* found a 99.3% volume reduction after RFA, which was higher than microwave and laser ablation (95.3% and 88.6%) [2]. The same study reported a 0.4% recurrence rate in overall thermal ablation techniques, which was confirmed by Cho, *et al.*'s finding of no recurrence of 84 low-grade papillary microcarcinomas after 5 years [15]. A previous systematic review by the same group, showed no recurrence or distant metastasis and only two patients out of 503 showed loco regional recurrences after thermal ablation of low-risk papillary microcarcinomas [16]. In comparison, Ahn, *et al.* reported 18 recurrences in 433 patients treated with hemi-thyroidectomy for low-risk papillary microcarcinomas, which corresponds to a 0.4% recurrence rate [17].

Data on toxic adenomas does not support RFA for Hyperfunctioning nodules as strongly as it does for Benign diseases. An earlier study by Baek, *et al.* [12], achieved volume reduction and normalization of T3 and fT4 in all 9 patients, while three of them remained with lower TSH level at last follow-up (from 6 to 17 months). However, results are still significantly heterogeneous, with TSH normalization ranging from 21.7% to 87.5% [4]. The correlation between pre-treatment nodule size and restoration of normal TSH levels [18] led both studies to speculate that ablation area is an important factor for predicting the efficacy of RFA treatment. Despite conflicting evidence, in a more recent study by Cervelli, *et al.* [19], 5 out of 25 patients treated with RI developed clinical hypothyroidism and 2 of them developed sub-clinical hypothyroidism after a 1 month follow-up. Conversely, 2 out of the 22 RFA-treated patients developed sub-clinical hypothyroidism and no subject developed overt hypothyroidism. In summary, they found no statistical difference between radioiodine therapy and RFA in the treatment of Hyperfunctioning thyroid nodules. The heterogeneity of studies may be a consequence of the need for longer studies, differences in material or techniques used or team experience. Therefore, in the treatment of Hyperfunctioning Nodules, RFA may be reserved for patients who refuse or unsuitable for surgery [5].

Possibly the main concern of both patient and doctor when selecting the best therapy for thyroid nodules relies on the adverse effects. The risk of recurrent laryngeal nerve injury after hemi-thyroidectomies have been reported to happen in 1 to 2% of patients [20]. Total thyroidectomies lead to 100% hypothyroidism, while hemi-thyroidectomies lead to it in 29.9% of cases and radioiodine therapy can cause up to 73% of clinical hypothyroidism [21,22].

RFA, on the other hand, has proven to be a tolerable and a safe therapeutic option. Post-procedure complications are classified as either major or minor complications. Hypothyroidism or longer than 1-month voice changes, neck discomfort and other complaints are usually defined as major complications. Minor adverse effects include other conditions that do not lead to significant morbidity to the patient. The previously cited meta-analysis reported a pooled 4.6% risk of overall complications and a 1.3% risk of major complications [1], which are similar to that reported by Choi, *et al.* [2] for papillary microcarcinomas. While voice changes due to laryngeal nerve injury are the main major complications, most are transient. No transient or persistent hypothyroidism after RFA were reported. Other reported complications included nodule rupture with fasciitis, pseudocyst formation, pseudocysts with fasciitis, local infection, hyperthyroidism, massive colligative necrosis, brachial plexus injury, tracheal injury and laryngeal dysfunctions. All of which have been reported in few patients and are therefore fairly rare [1,3].

As expected, there was statically significant improvement in symptom and cosmetic scores after RFA. The mean symptom score reported by Baek, *et al.* [12], was reduced from 2.4 to 0.6 out of 10.0, while the mean cosmetic score fell from 3.1 to 1.4 out of 10.0. Interestingly, upon applying quality of life questionnaires, RFA showed slightly better results than surgery [23]. Five of the 10 domains of SF-36, a general purpose short form assessing quality of life, suggested better tolerability of RFA. Similarly, THYCA-QOL, a directed questionnaire for measuring the impact of thyroid surgery on quality of life, showed a higher rate of impact on sexual life and problems with scarring in surgery when compared to RFA [23].

Conclusion

Current literature suggests that RFA is a well-tolerable and effective therapy for benign and small malignant thyroid tumors. Despite being subject to debate, this case report strengthens the role of RFA in the treatment of Hyperfunctioning thyroid nodules.

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