

Original article

Patient Satisfaction after Radiofrequency Ablation of Benign Thyroid Nodules: A Comparative Analysis Based on Nodule Type and Volume

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Abstract: *Background* — The incidence of thyroid nodules is increasing. Although most are benign and asymptomatic, some require treatment for compressive or cosmetic reasons. Radiofrequency ablation (RFA) is a minimally invasive alternative to surgery. To date, published studies focused on the technical aspects of RFA, while comparative analysis of patient satisfaction depending on nodule volume was limited.

Methods — This prospective cohort study analyzed 101 patients who underwent RFA for benign thyroid nodules (from January 9, 2019, to October 15, 2024). Patients were distributed among two groups depending on nodule volume (<10 ml and ≥10 ml). Post-procedural satisfaction was assessed using questionnaires regarding physical and emotional well-being.

Results — We observed high overall patient satisfaction. Although nodule volume did not significantly affect overall satisfaction, larger nodules were associated with higher rates of a full symptomatic satisfaction. Satisfaction with cosmetic outcome was similar across nodule volume groups. Significant volume reduction was observed at 24 months of follow-up.

Conclusion — RFA results in high patient satisfaction for benign thyroid nodules. Nodule size influences several aspects of the experience, highlighting the need for further research examining factors affecting patient satisfaction beyond nodule volume.

Keywords: thyroid nodules, radiofrequency ablation (RFA), patient satisfaction.

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Introduction

The incidence of thyroid nodules and nodular goiter has been steadily increasing over the past decades [1]. Thyroid nodules are a common endocrine problem. Although most of them are benign and asymptomatic, some benign nodules cause compressive and cosmetic symptoms requiring treatment [2]. Therefore, percutaneous ablative treatments such as ethanol ablation, radiofrequency ablation (RFA), and laser ablation (LA) have been proposed as satisfactory alternatives [3, 4]. Thermal ablation via RFA is a novel, minimally invasive method that can be an alternative to surgery in patients with benign thyroid nodules. RFA has shown efficacy and safety in the treatment of thyroid nodules [5]. RFA has emerged as an effective treatment for benign thyroid nodules, providing a minimally invasive option aimed at reducing nodule size and relieving symptoms. RFA uses thermal energy to induce tissue necrosis. It was found safe and effective in numerous studies showing that RFA can result in significant reduction in nodule volume, with rates often exceeding 80% in carefully selected cases [6]. To date, only a few studies have compared thermal ablation with surgery in patients with benign thyroid nodules [7], highlighting several potential advantages of RFA over surgery. Although these studies have compared the efficacy,

tolerability, cost, and health-related quality of life of RFA with surgery, postoperative patient satisfaction has not been addressed. Patient satisfaction encompasses a variety of factors including procedural comfort, adequacy of information provided, and overall outcomes [8]. Patient satisfaction in the context of thyroid nodule treatment involves multifaceted considerations including symptom relief, improved cosmetic appearance, and overall quality of life. Assessing patient satisfaction after RFA of benign thyroid nodules is relevant given that patients often seek treatment not only for medical indications but also for cosmetic outcomes [9, 10]. Although existing studies have primarily focused on the technical aspects and outcomes of RFA, there remains a gap in comparative studies assessing patient satisfaction based on nodule volume. This gap is significant since larger nodules may present different challenges and outcomes than smaller nodules. The aim of this study was to conduct a comparative analysis of patient satisfaction after RFA of benign thyroid nodules, paying particular attention to the impact of nodule volume [11]. By examining these relationships, we aimed at providing information that can help refine patient selection criteria and clinical practice by providing insights that could improve patient care.

Methods

Study design and sampling procedure

This prospective cohort study included 101 patients who underwent RFA of benign thyroid nodules at the First Central Hospital of Mongolia between January 9, 2019, and October 15, 2024. Each patient had one nodule that met the inclusion criteria (male to female ratio: 9 to 174; mean age ± standard deviation [SD]: 45.67±11.68 years). Participants were distributed among two groups based on nodule volume: Group 1 (node volume >10 ml) and Group 2 (node volume <10 ml). Comparative analysis was performed to evaluate the differences in terms of age (p=0.883), gender (p=0.041), nodule composition (p=0.352), and previous treatment (p=0.182) (Figure 1).

All patients provided written informed consent before inclusion in the study. Nodule assessment was performed preoperatively and at 1, 3, 6, 12 and 24 months after treatment. Nodule volume and associated symptoms were systematically recorded at each follow-up visit. Patient satisfaction after the procedure was assessed using structured questionnaires designed to assess physical and emotional well-being, as well as overall satisfaction with the procedure.

For all patients who completed the satisfaction questionnaire, baseline characteristics including age, gender, nodule composition and treatment history were collected. Notably, surgical complications were documented separately and were not classified in the same way as complications after RFA.

All procedures performed in our study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments. This study received approval from the Institutional Review Board of the Mongolian National University of Medical Sciences in 2019 (approval No. 2019/3-05).

Inclusion criteria for the study were as follows: (1) treatment of a solitary benign thyroid nodule classified as Bethesda II/Thy2/TR2, (2) treatment completed at least one year prior to the study, and (3) procedures performed by the same surgeon.

Participants were also required to have normal serum thyrotropin and thyroid hormone levels.

Exclusion criteria for our study were pregnancy, history of neck irradiation, follicular neoplasms, and primary thyroid cancer.

Pre-ablation assessment

All participants underwent a comprehensive clinical examination, laboratory tests, ultrasonography (USG), and USG-guided fine-needle aspiration (FNA). The procedures (USG, USG-guided FNA and RFA) were performed using a real-time USG system and a linear transducer operating at a frequency of 10-16 MHz (Mindray M7, China).

The proportion of solid components and three orthogonal diameters of each nodule (the largest diameter and the other two perpendicular diameters) were measured. The formula for calculating the volume of the nodule is as follows:

$$V = \pi abc/6,$$

where V is volume, a is the largest diameter, and b and c are two perpendicular diameters.

Along with blood coagulation tests and platelet count, thyroid function markers such as free thyroxine, total triiodothyronine, and thyrotropin were measured [12]. In addition, a 10-cm visual scale (0–10 cm) was employed to assess nodule-related symptoms in patients. As for the type of nodes, they were defined as solid (with a solid component content of more than 70%), spongiform (with a solid component content of less than 70% and more than 30%), and cystic (with a solid component content of less than 30%).

Radiofrequency ablation procedure

USG-guided RFA therapy was performed in a hospital setting. We used a modified straight electrode with internal cooling for the RFA system (Cool-Tip RF System, M-1000, RF Medical, Korea). Depending on the size of the nodule and the physician's choice of treatment method, an internally cooled 18-gauge electrode with active tips of 0.3, 0.5, 0.7, or 1 cm was used.

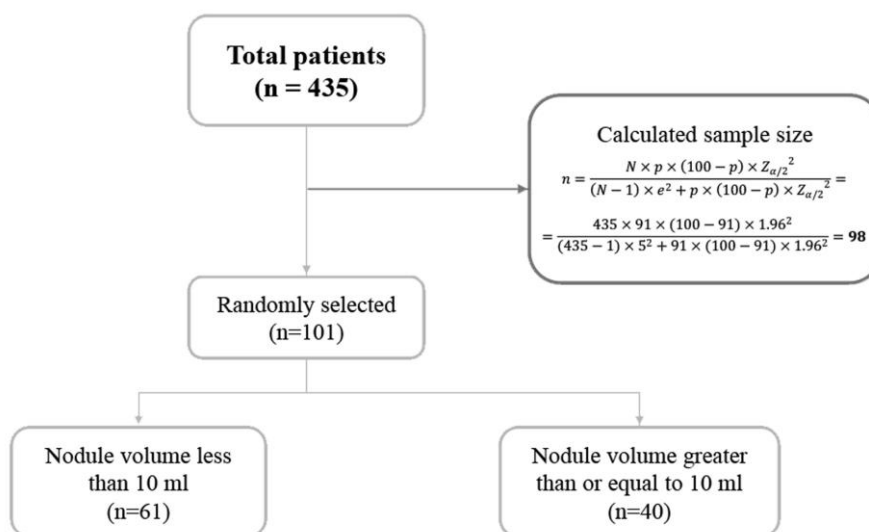


Figure 1. Flow chart depicting patient selection procedure.

The transisthmic approach and the moving shot technique were employed, which are described in more detail below [13]. To avoid blood loss, the access route and adjacent vessels were carefully assessed under USG control. Local anesthesia at the puncture site was achieved by injecting 10 ml of 1-2% lidocaine around the thyroid gland. With the transisthmic approach, the electrode is inserted along the short axis of the thyroid nodule being treated, which allows passing through a sufficient volume of thyroid parenchyma. The transisthmic approach under USG control helps minimizing the risk of injury to the esophagus and recurrent laryngeal nerve by the electrode tip, since the interstitial space is well controlled throughout the procedure. In addition, needle movement is limited during swallowing or talking of the patient, which helps avoiding leakage of fluid out of the thyroid from the cystic nodule [14].

First, the electrode was inserted into the nodule using the mid-lateral approach through the isthmus, into the deepest part. Depending on the size of the electrode tip, ablation started with a power of 20 to 50 W: 15-30 W for the active tip of 0.7 cm and 30-70 W for the active tip of 1 cm. In less than 10 seconds, a transient hyperechoic zone should form. If this did not happen, the RFA power was increased stepwise (in increments of 5-10 W) in accordance with the electrode tip. When a transient hyperechoic zone appeared, the electrode tip was moved back from the periphery of the nodule to avoid heat transfer to adjacent tissues. When the hyperechoic zone expanded, the electrode was moved back into the central parts of the nodule using the moving shot technique [15]. The ablation units were determined before RFA and ideally should be larger in the central part of the nodule but smaller at the periphery to prevent damage to other important anatomical structures. Subsequently, the nodule was treated unit by unit using the moving shot technique. If the patient experienced low pain tolerance during the treatment, more anesthetic was injected into the thyroid capsule or the current procedure was interrupted for a while. If the nodule was completely hyperechoic, the procedure was completely terminated.

In accordance with the recommendations of the Society of Interventional Radiology, side effects and complications were continuously monitored and assessed during and after the procedure, and a multicenter complication assessment was performed beforehand [16]. Patients remained in hospital for one day after RFA therapy.

Follow-Up

At 1, 3, 6, 12 and 24 months, the outcomes of RFA therapy and any associated complications were monitored using USG and clinical examinations. Compressive symptoms and nodule volume were assessed using the above-mentioned methods.

Volume reduction ratio was calculated using the following formula [17]:

$$\text{Volume reduction ratio} = \frac{([\text{initial volume} - \text{final volume}] \times 100)}{\text{initial volume}}$$

Table 1. General demography. Patients clustered into two study groups exhibited a statistically significant gender-based difference in nodule size (p=0.041).

| | Total, n (%) | Volume | | P-value* |
|--------------------|--------------|------------------------|------------------------|----------|
| | | Less than 10 ml, n (%) | More than 10 ml, n (%) | |
| Age, years | | | | 0.883 |
| Under 39 | 29 (28.7) | 16 (26.2) | 13 (32.5) | |
| 40-49 | 34 (33.7) | 22 (36.1) | 12 (30.0) | |
| 50-59 | 27 (26.7) | 16 (26.2) | 11 (27.5) | |
| Above 60 | 11 (10.9) | 7 (11.5) | 4 (10.0) | |
| Gender | | | | 0.041 |
| Male | 12 (11.9) | 4 (6.6) | 8 (20.0) | |
| Female | 89 (88.1) | 57 (93.4) | 32 (80.0) | |
| Nodule composition | | | | 0.352 |
| Cystic | 37 (36.6) | 19 (31.1) | 18 (45.0) | |
| Solid | 51 (50.5) | 33 (54.1) | 18 (45.0) | |
| Spongiform | 13 (12.9) | 9 (14.8) | 4 (10.0) | |
| Medical treatment | | | | 0.182 |
| Yes | 10 (9.9) | 8 (13.1) | 2 (5.0) | |
| No | 91 (90.1) | 53 (86.9) | 38 (95.0) | |
| Total | 101 (100.0) | 61 (100.0) | 40 (100.0) | |

* Pearson's chi-squared test.

Table 2. Nodule volume reduction after radiofrequency ablation (RFA)

| | Nodule volume after RFA | | | P-value |
|-------------------|-------------------------|-------------|-------------|---------|
| | Median | 95% CI | IQR | |
| Repeated measures | | | | 0.0001 |
| Before | 0.371 | 0.289-0.513 | 0.078-2.322 | |
| 1 month after | 0.263 | 0.205-0.325 | 0.057-1.217 | |
| 3 months after | 0.158 | 0.124-0.218 | 0.031-0.912 | |
| 6 months after | 0.142 | 0.074-0.194 | 0.023-0.839 | |
| 12 months after | 0.070 | 0.046-0.150 | 0.006-0.721 | |
| 24 months after | 0.055 | 0.006-0.111 | 0.001-0.291 | |

The mean nodule size before treatment was 0.371 (0.289-0.513), and after 24 months of follow-up it was 0.055 (0.006-0.111), indicating statistically significant reduction.

Table 3. Satisfaction results for symptomatic relief, cosmetic outcome and outcome of radiofrequency ablation therapy

| | A1 | | | | P-value | A2 | | | | P-value | A3 | | | P-value |
|-------------------|--------------|------------------|-----------|---------------------|---------|--------------|------------------|-----------|---------------------|---------|--------------|------------------|-----------|---------|
| | Fully, n (%) | Partially, n (%) | No, n (%) | Asymptomatic, n (%) | | Fully, n (%) | Partially, n (%) | No, n (%) | Asymptomatic, n (%) | | Fully, n (%) | Partially, n (%) | No, n (%) | |
| Age, years | | | | | 0.045 | | | | | 0.845 | | | | 0.844 |
| Under 39 | 18 (62.1) | 2 (6.9) | 1 (3.4) | 8 (27.6) | | 26 (89.7) | 1 (3.4) | 1 (3.4) | 1 (3.4) | | 25 (86.2) | 3 (10.3) | 1 (3.4) | |
| 40-49 | 19 (55.9) | 4 (11.8) | 1 (2.9) | 10 (29.4) | | 31 (91.2) | 2 (5.9) | 1 (2.9) | 0 (0) | | 27 (79.4) | 5 (14.7) | 2 (5.9) | |
| 50-59 | 7 (25.9) | 3 (11.1) | 1 (3.7) | 16 (59.3) | | 25 (92.6) | 2 (7.4) | 0 (0) | 0 (0) | | 24 (88.9) | 3 (11.1) | 0 (0) | |
| Above 60 | 2 (18.2) | 0 (0) | 0 (0) | 9 (81.8) | | 11 (100) | 0 (0) | 0 (0) | 0 (0) | | 10 (90.9) | 1 (9.1) | 0 (0) | |
| Gender | | | | | 0.13 | | | | | 0.31 | | | | 0.223 |
| Male | 3 (25) | 0 (0) | 1 (8.3) | 8 (66.7) | | 11 (91.7) | 0 (0) | 1 (8.3) | 0 (0) | | 11 (91.7) | 0 (0) | 1 (8.3) | |
| Female | 43 (48.3) | 9 (10.1) | 2 (2.2) | 35 (39.3) | | 82 (92.1) | 5 (5.6) | 1 (1.1) | 1 (1.1) | | 75 (84.3) | 12 (13.5) | 2 (2.2) | |
| Medical treatment | | | | | 0.905 | | | | | 0.824 | | | | 0.158 |
| Yes | 4 (40) | 1 (10) | 0 (0) | 5 (50) | | 9 (90) | 1 (10) | 0 (0) | 0 (0) | | 7 (70) | 3 (30) | 0 (0) | |
| No | 42 (46.2) | 8 (8.8) | 3 (3.3) | 38 (41.8) | | 84 (92.3) | 4 (4.4) | 2 (2.2) | 1 (1.1) | | 79 (86.8) | 9 (9.9) | 3 (3.3) | |
| Total | 46 (45.5) | 9 (8.9) | 3 (3) | 43 (42.6) | | 93 (92.1) | 5 (5) | 2 (2) | 1 (1) | | 86 (85.1) | 12 (11.9) | 3 (3) | |

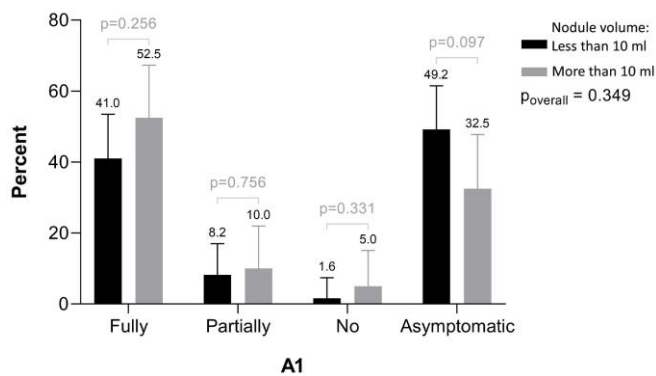


Figure 2. Satisfaction with symptomatic relief depending on the volume of the nodule (A1).

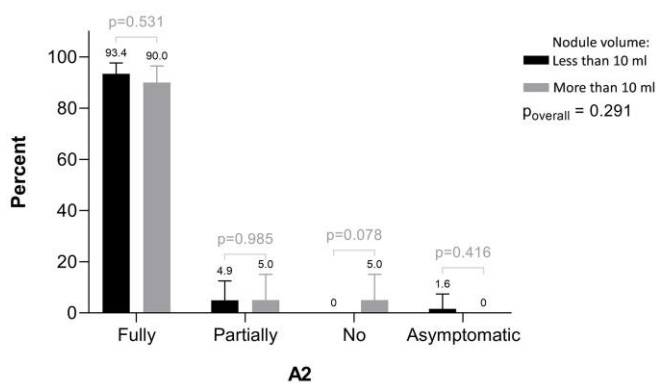


Figure 3. Cosmetic outcome satisfaction depending on the volume of the nodule (A2).

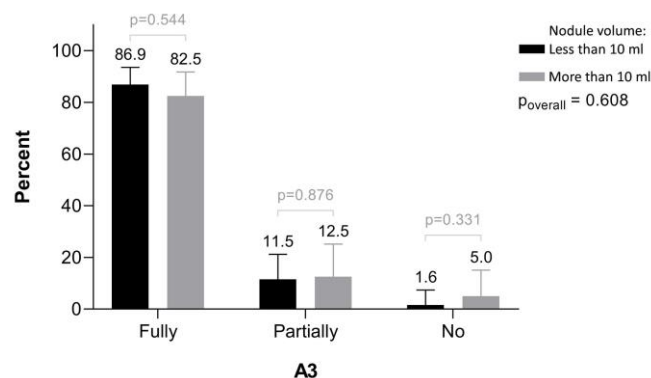


Figure 4. Satisfaction with radiofrequency ablation therapy depending on the volume of the nodule (A3).

The procedure could be repeated if symptoms or cosmetic concerns were not resolved to the patient's satisfaction or if a visible nodule was detected by USG. Therapeutic success was defined as a volume reduction of more than 50%.

Telephone survey

Telephone surveys are widely used in public health research worldwide [18]; given this broad application, we used this method in our study to assess patient satisfaction after thyroid nodule treatment. Between January 9, 2019, and October 15, 2024, all eligible patients were contacted by telephone by the same interviewer, who was a resident. According to the script, patients

were informed about the nature of the interview and the organization conducting it, and they were asked the same four questions:

- (1) Are you satisfied with the resolution of your nodule-related symptoms?
- (2) Are you satisfied with the cosmetic outcomes?
- (3) Are you overall satisfied with the procedure?
- (4) Are you taking any thyroid medications?

After each of the first three questions, patients were offered three possible response options: yes, partially, and no.

When asked about resolution of nodule-related symptoms, they could also answer that they never had symptoms (i.e. were asymptomatic). Regarding thyroid medications, they were asked an open-ended question and their responses were coded as levothyroxine, antithyroid medications, or no medications.

The script of this questionnaire was developed taking into account the following factors: (1) telephone surveys should be concise, otherwise the answers may be affected by consumer fatigue, and (2) the questions should be appropriate for patients who have undergone treatment with two completely different methods.

Statistical processing of collected data

Statistical analysis was performed using SPSS 25.0. Pearson's chi-squared test was used to assess the association between two categorical variables in [Tables 1](#) and [3](#), and [Figures 2](#), [3](#) and [4](#). Friedman test was used to compare medians of repeated measures in [Table 2](#). Statistical significance was set at $p < 0.05$.

Results

Patient characteristics

In our study, 101 patients were distributed among two groups depending on the volume of nodules: less than 10 ml and more than 10 ml. According to the composition, the nodules were categorized into cystic ($n=37$, 36.6%), solid ($n=51$, 50.5%) and spongiform ($n=13$, 12.9%), while statistically significant differences were not observed between the groups ($p=0.352$). In addition, 10 patients were prescribed hormonal therapy ($p=0.182$). Most of the nodules were solid ([Table 1](#)).

Reduction in the volume of nodules after radiofrequency ablation

In this study, patients who underwent RFA were observed for 24 months. The median volume reduction at follow-up is illustrated in [Table 2](#). Before ablation, the median volume was 0.371 ml (95% CI 0.289-0.513). At 1, 3, 6, 12 and 24 months after treatment, the median volume reduction was 0.263 (95% CI; 0.205–0.325, $P < 0.0001$), 0.158 (95% CI; 0.124-0.218, $P < 0.0001$), 0.142 (95% CI; 0.074-0.194, $P < 0.0001$), 0.070 (95% CI; 0.046-0.150, $P < 0.0001$), 0.055 (95% CI; 0.006-0.111, $P < 0.0001$), respectively. The median volume reduction was statistically significant ($p=0.0001$) ([Table 2](#)).

Patient satisfaction

Satisfaction with symptomatic relief vs. nodule volume. From the first series of bar graphs ([Figure 2](#)), it follows that full satisfaction with symptomatic relief was 41% in patients with

nodules smaller than 10 ml and 52.5% in patients with nodules larger than 10 ml ($p=0.256$). Partial satisfaction was 8.2% in patients with nodules smaller than 10 ml and 10.0% in patients with nodules larger than 10 ml ($p=0.756$). Among patients with nodules smaller than 10 ml, satisfaction with symptomatic relief was 1.6%, while among patients with nodules larger than 10 ml, it was 5.0% ($p=0.331$). In asymptomatic patients, the satisfaction rate was 49.2% in patients with nodules less than 10 ml and 32.5% in patients with nodules greater than 10 ml ($p=0.097$).

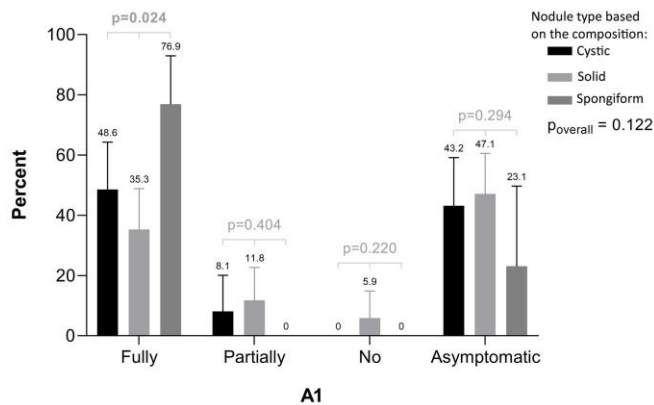


Figure 5. Symptomatic satisfaction depending on the type of the nodule (A1).

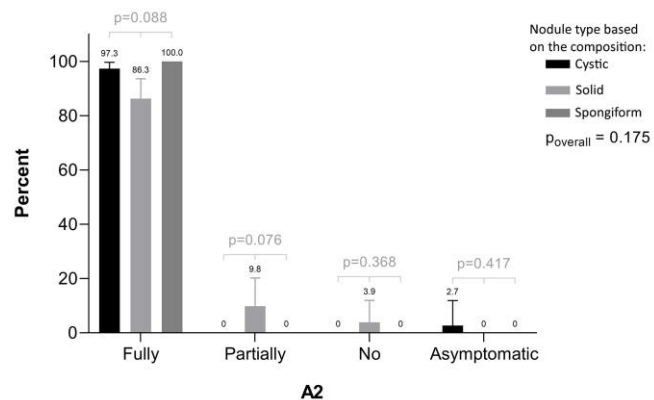


Figure 6. Cosmetic outcome satisfaction depending on the type of the nodule (A2).

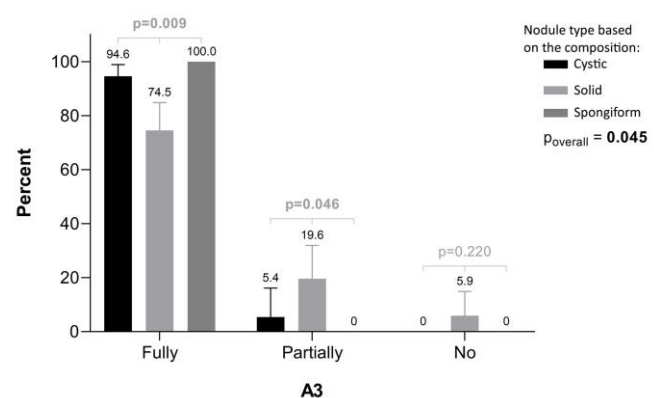


Figure 7. Satisfaction with radiofrequency ablation therapy depending on the volume of the nodule (A3).

Cosmetic outcomes. Full satisfaction with the cosmetic outcome was 93.4% in patients with lymph nodules less than 10 ml, while in patients with lymph nodes greater than 10 ml it was 90.0% ($p=0.531$). Partially satisfied patients were 4.9% in the group with lymph nodules less than 10 ml and 5.0% in the group with lymph nodules greater than 10 ml ($p=0.985$). Among patients with lymph nodules smaller than 10 ml, none were completely satisfied with the cosmetic outcome, while among patients with lymph nodules larger than 10 ml, it was 5.0% ($p=0.416$). In asymptomatic patients, the satisfaction rate was 1.6% in patients with lymph nodules smaller than 10 ml and 0% in patients with lymph nodules larger than 10 ml ($p=0.097$), as shown in (Figure 3).

Satisfaction with radiofrequency ablation outcomes. Full satisfaction with RFA therapy was 86.9% in patients with lymph nodules smaller than 10 ml, while it was 82.5% in patients with lymph nodules larger than 10 ml ($p=0.544$). Partial satisfaction was 11.5% in patients with lymph nodules smaller than 10 ml and 12.5% in patients with lymph nodules larger than 10 ml ($p=0.876$). Among patients with lymph nodules smaller than 10 ml, 1.6% did not report symptomatic relief vs. 5.0% among patients with lymph nodules larger than 10 ml ($p=0.331$) (Figure 4).

Symptomatic satisfaction by the nodule type. Full symptomatic relief satisfaction was 48.6% in patients with cystic nodules, 35.3% in patients with solid nodules, and 76.9% in patients with spongiform nodules ($p=0.024$). Partially satisfied patients constituted 8.1% among patients with cystic nodules, 11.8% among patients with solid nodules, and 0% among patients with spongiform nodules ($p=0.404$). Dissatisfaction was revealed in 5.92% of patients with solid nodules ($p=0.220$). Satisfaction rate was 43.2% in patients with asymptomatic cystic nodules, 47.1% in patients with solid nodules, and 23.1% in patients with spongiform nodules ($p=0.294$) (Figure 5).

Satisfaction with cosmetic outcome vs. nodule type. Full satisfaction with symptomatic relief was observed in 97.3% of patients with cystic nodules, 86.3% of patients with solid nodules, and all patients with spongiform nodules ($p=0.088$). Partially satisfied patients constituted 0% among patients with cystic nodules, 9.8% among patients with solid nodules, and 0% among patients with spongiform nodules ($p=0.076$). Dissatisfaction was established in 3.9% of patients with solid nodules ($p=0.417$), while 2.7% of patients with cystic nodules were asymptomatic ($p=0.417$) (Figure 6).

Satisfaction with radiofrequency ablation therapy depending on the type of nodules. Full satisfaction with RFA therapy was detected in 94.6% of patients with cystic nodules, 74.5% of patients with solid nodules, and all patients with spongiform nodules ($p=0.009$). Partially satisfied patients constituted 5.4% among those with cystic nodules, 19.6% among those with solid nodules, and 0% among patients with spongiform nodules ($p=0.046$), whereas 5.9% of patients with solid nodes were dissatisfied ($p=0.220$) (Figure 7).

Overall satisfaction. There were no differences in overall satisfaction between the groups. Surgery was associated with a trend towards an increased proportion of patients who were fully satisfied as shown in (Figure 2), but this finding was not statistically significant ($p=0.26$). There was a statistically significant age-based difference in pain satisfaction among all patients in the study ($p=0.045$) (Table 2).

Discussion

Minimally invasive techniques, including thyroid RFA, represent a promising therapeutic alternative to surgery, avoiding its disadvantages [19]. The efficacy and safety of thyroid RFA have been demonstrated in several studies [2]. In particular, in a recent randomized controlled trial comparing RFA with observation, RFA significantly reduced the volume of benign thyroid nodules, resulting in significant improvement in cosmetic and compressive symptoms after the procedure without major side effects [20].

Although we are entering the era of interventional radiology [2, 5, 21], surgery remains the first-line treatment for most patients with symptomatic benign thyroid nodules [22]. In this study, we compared RFA with nodules less than 10 ml, more than 10 ml, and nodule types in terms of patient satisfaction. Overall, all our patients who underwent RFA were highly satisfied with the outcome. It represents a definitive solution to the problem of symptomatic thyroid nodules. Moreover, it not only alleviates local symptoms and/or removes the autonomous functioning thyroid nodule (AFTN), but also allows to exclude malignancy.

Published data show good results in both countries, but with differences in patient selection and device use. In Italy, the authors working with Dr. Spiezia's group initially treated patients using a 14-gauge biopsy needle with four or nine expandable hooks to treat large solid or predominantly solid nodules (cystic component <30%), both toxic and nontoxic [23]. In Korea, Baek et al. and other thyroidectomy radiologists used a single 18-gauge needle with internal cooling to treat smaller nodules with a larger cystic component than those studied in the Italian published series [24-27].

RFA does not cause hypothyroidism, has a low complication rate, post-procedural pain is rare, and patients are satisfied [28]. In this study, satisfaction was higher after RFA than after surgery. Also, RFA is an outpatient procedure that does not require general anesthesia or hospitalization.

As for questionnaires, their advantage is that they allow for the collection of confidential data, since respondents are given perceived anonymity. On the other hand, such questionnaires have some limitations. First, they must be brief and therefore less detailed than other questionnaires. Second, an increasing share of patients declines to participate due to the recent phenomenon of consumer fatigue [29]. These reasons underlie the choice of this questionnaire. However, given that this survey was not validated prior to its use, further larger studies with validated surveys are needed to confirm our findings and examine patient satisfaction postoperatively.

Patients responded gradually to the treatment, which is consistent with the progressive reduction in nodule volume induced by RFA over time. Specifically, RFA reduced nodule volume by 51, 63, 69, and 75% at 1, 3, 6, and 12 months, respectively. This is consistent with published sources, which has demonstrated that RFA can reduce AFTN volume by 33–54% at one month [30, 31], 51-75% at six months [32, 33], and 79% at two years after the procedure [34, 35]. The different percentages of volume reduction may be related to the number of sessions performed. Based on this gradual response to RFA, we believe it is reasonable to inform the patient that euthyroidism (or withdrawal of antithyroid drugs) will not usually be achieved for several months after the procedure [36, 37].

Conclusion

This study investigated patient satisfaction after RFA of benign thyroid nodules, with an emphasis on the impact of nodule type and volume. The results showed high overall patient satisfaction with RFA. Although larger nodule volume did not significantly impact overall satisfaction, it did affect individual aspects of the experience. For instance, complete symptomatic relief was more common with larger nodules, and satisfaction with the cosmetic outcome was slightly higher with smaller nodules. Our study highlighted the efficacy and safety of RFA as a minimally invasive alternative to surgery for benign thyroid nodules, emphasizing the need for further studies using validated questionnaires to confirm these findings and explore patient experience. Future studies should also examine other factors (besides nodule volume) influencing patient satisfaction.

Limitations

This study has a number of limitations. First, the sample size was relatively small and sample was drawn from a single center, which may have limited the generalizability of the results to larger and more diverse populations. Second, although structured questionnaires were employed to assess patient satisfaction, they were not validated instruments, potentially affecting the reliability and comparability of satisfaction outcomes. Third, although the study controlled for several baseline factors such as age, gender, nodule composition, and treatment history, other potentially influencing variables such as patient expectations, psychological factors, and socioeconomic status were not assessed. Further research addressing these limitations, ideally through multicenter randomized controlled trials and the use of validated patient-reported outcome measures, is needed to confirm and extend these findings.

Conflict of interest

The authors declare no conflicts of interest.

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