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Efficacy and Safety of Radiofrequency Ablation Performed by an Endocrinologist for Benign Thyroid Nodules

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Background and Objectives: Radiofrequency ablation has recently been used for the treatment of benign thyroid nodules, with outstanding results. However, in most studies, the procedure was usually performed by a radiologist or surgeon. This study aimed to evaluate the efficacy and safety of radiofrequency ablation for nodules >2 cm performed by an endocrinologist with several years of experience performing fine-needle aspiration cytology. **Materials and Methods:** This study was a cross-sectional analysis of 111 patients who received radiofrequency ablation between April 2010 and July 2013. A total of 73 patients with 75 nodules >2 cm in diameter with at least 6 months of follow-up examinations were included. **Results:** The mean follow-up period was 11.5 months. The mean nodule volume decreased from 17.0±15.3 mL preoperatively to 6.0±8.5 mL postoperatively, with a mean volume reduction of 69.7%. There were no major complications, and only 1 patient (1.3%) presented with a minor complication (hemorrhaging of the thyroid parenchyma). **Conclusion:** Radiofrequency ablation is a safe method for reducing benign thyroid nodules, and is not associated with any major complications.

Key Words: Radiofrequency ablation, Thyroid, Benign, Nodule, Endocrinologist

Introduction

Radiofrequency ablation has recently been used as a less invasive alternative to surgery. It is reported to be a safe and effective method for reducing the size of benign thyroid nodules.[1)] However, in most studies on this topic, a radiologist or surgeon performed the procedure.[2–10)] Therefore, the present study examined the safety and efficacy of radiofrequency ablation performed by an endocrinologist.

Materials and Methods

Patients

Out of a total of 111 patients who received radiofrequency ablation between April 2010 and July 2013, 75 nodules >2 cm from 73 patients with at least 6 months of available postoperative follow-up data were included. There were 2 men and 71 women, with a mean age of 38.7 years (range, 14–65 years). Thyroid-stimulating hormone levels were within the normal

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range in all patients. The mean follow-up period was 11.5 months. All nodules were diagnosed as benign on at least two previous fine-needle aspiration cytology examinations. All the study participants provided written informed consent, and the appropriate ethics review boards approved the study design (KCHIRB-M-2014-039).

Pre-ablation Assessment

Prior to the radiofrequency ablation procedure, blood tests, including blood-clotting tests, were performed on all patients. All parameters were within normal ranges. A 10-MHz linear probe and real-time ultrasound system (EnVisor HD, HD7XE, Philips) were used. The following equation was used to calculate nodule volume: $V=\pi abc/6$ (V: volume, a: the largest dimension, b and c: the other two perpendicular dimensions). Prior to the procedure, patients were asked to grade their pressure symptoms and score them according to a 10-cm visual analogue scale (0-10 cm). The physician assessed and recorded the nodule grade as 1, no palpable mass; 2, an invisible but palpable mass; 3, a mass visible only to an experienced clinician; 4, an easily visible mass.

Procedure

The endocrinologist who performed the procedures (THK) had performed more than 600 fine-needle aspiration cytology examinations annually for over 5 years, and possessed a good understanding of the anatomical structure of the neck, and sufficient mastery of radiofrequency ablation methods. A radiofrequency generator (CoATherm Rf-G200 APRO KOREA Inc.; Cool-Tip RF system, Covidien; SSP-2000, Taewoong Medical Co., Ltd.) and an 18-gauge internally cooled electrode with a 1-cm active tip (I-type electrode APRO KOREA Inc.; Cool-Tip, Covidien; Well-point RF electrode, Taewoong Medical Co., Ltd.) were used. An intravenous line was secured preoperatively, and the patients were instructed to lie down straight and extend their neck. Local anesthesia with 2% lidocaine was administered at the puncture site, and an 18-gauge syringe was inserted first in order to assess the passage that the electrode needle would pass through and to facilitate its insertion. Under ultrasound guidance, the needle tip was first inserted into the deepest part of the nodule, and ablation was initiated at 40 W. Then, according to the hyperechoic change at the tip of the needle, an increase in impedance characterized by a popping sound indicated no further movement, and the power was automatically shut off. The previous process was then slowly repeated. If the patient could tolerate the procedure, the procedure was performed at 70 W. Ablation was performed near the danger triangle of the face by keeping sufficient margins to avoid damaging the recurrent laryngeal nerve.[1)] Patients underwent the procedure in the afternoon and were subsequently admitted to the ward until the next morning to monitor for complications. They were then discharged if there were no complications.

Follow-up

The size of the nodules was measured 1 and 6 months postoperatively and every 6-12 months thereafter. The volume reduction rate was calculated as follows: ([initial volume-final volume]×100)/initial volume. A successful treatment outcome was defined as a >50% reduction in volume.[11)]

Results

Two patients underwent treatment for 2 nodules, while the rest underwent treatment for 1 nodule. Radiofrequency ablation was performed only once for 51 of the nodules, and twice for 24 nodules. Prior to the procedure, the mean length of the nodules in their longest axis was determined to be 3.9 cm, and the mean volume was 17 mL. Postoperatively, the mean length was 2.5 cm, and the mean volume was 6.0 mL. The volume reduction rates 1 and 6 months postoperatively were 39.6% and 63.9%, respectively. The mean volume reduction rate was 69.7% after >6 months (mean follow-up, 11.5 months; Table 1). The treatment success rate (>50% reduction) was 84%. Only 1 nodule did not exhibit >50% reduction even after a second procedure. One nodule increased in size.

Table 1. Changes in nodule size and volume during follow-up

	Initial	At 1 month	At 6 months	Last follow-up (mean, 11.5 months)
Number of nodules	75	74	52	75
Volume, mean (SD), mL	17.0 (15.3)	10.1 (9.7)	6.5 (9.6)	6.0 (8.5)
Largest diameter, mean (SD), cm	3.9 (1.0)	3.3 (1.0)	2.8 (1.2)	2.5 (1.2)
Volume reduction rate (%)		39.6	63.9	69.7

SD: standard deviation

Regarding safety, the level of pain the patients complained of during the procedure varied. Only 1 patient had the procedure terminated because of the pain, while the others tolerated the entire procedure even if they felt pain. The procedure was aborted in 1 patient because of hemorrhaging of the thyroid parenchyma, but follow-up examination showed no further bleeding.

The mean preoperative and postoperative symptom scores, as graded by the patients, were 3.97±2.95 and 1.84±4.63, respectively. The preoperative and postoperative nodule grades, as assessed by the physicians, also decreased from 3.7±0.53 to 1.8±1.38.

No major complications such as voice change, nodule rupture, or brachial plexus injury were observed postoperatively.[12]

Discussion

Radiofrequency ablation was recently reported to be an effective method for treating benign thyroid nodules. Shin et al.[13] reported 1- and 6-month postoperative volume reduction rates of 33-58% and 51-85%, respectively. The present study showed similar results, with volume reduction rates of 39.6%, 63.9%, and 69.7% at 1, 6, and >6 months (mean follow-up, 11.5 months) postoperatively, respectively. No major complications were observed. The present study mostly targeted solid nodules >2 cm. Lim et al.[14] reported that the 6-month volume reduction rate for nodules with solidity of >50% was 67.6%, which is similar to that in the present study.

The success rate (>50% volume reduction) of radiofrequency ablation was 84% in the present study. The majority of nodules that did not decrease by >50% involved only a single procedure, and there was only 1 case of failure (increased nodule size) even after 2 procedures.

Lim et al.[14] performed radiofrequency ablation at least twice for 73 out of 126 nodules (58%) and at least thrice for 43 patients, with 7 nodules (5.6%) increasing in size. In these cases, the increase in size occurred around the untreated periphery of the nodules. In the present study, the procedure was performed twice on 14 nodules (18.7%), while 2 nodules (2.7%) increased in size, although 1 of them shrank after an additional procedure. For 1 nodule, follow-up observations were not performed after the second treatment. When the procedure was performed at least twice, besides the 1 nodule mentioned above (that shrank by 30%), all nodules shrank by >50%. The initial volume of the nodule treated twice was 15.9 mL, while the initial volume of the nodule treated once was only 7.4 mL; the initial volume of the nodule treated twice was larger than that of the nodule treated once. While the practitioner's experience can influence the efficacy of the procedure,[15] the vascularity and density of the thyroid nodule are also considered to have effects.

The overall cystic portion within the nodule can affect the decrease in nodule size after high-frequency treatment. Among the 75 nodules, only 9 nodules (12%) had a cystic portion of ≥50%. In our study, the percent of nodules (12%) with a ≥50% cystic portion was less than that reported by Lim et al.[14] which was 28%.

In conclusion, radiofrequency ablation is an effective procedure for reducing the size of benign thyroid nodules >2 cm, and is not associated with any major complications. Careful observation of the effects of nodule size reduction is necessary through long-term follow-up examinations. Endocrinologists who have

anatomical knowledge of the thyroid and its surrounding structures, along with sufficient knowledge of a radiofrequency machine, can effectively and safely perform radiofrequency ablation to reduce the size of nodules.

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