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EVALUATION OF THE FEASIBILITY OF RTA (RADIOFREQUENCY THERMAL ABLATION) IN TREATMENT OF PATHOLOGIES OF THE UPPER AIRWAY: A COMPREHENSIVE CLINICAL STUDY

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ABSTRACT

Background: As a therapy strategy, radiofrequency thermal ablation, or RFTA, has been more and more popular lately. Compared to traditional operations, it offers benefits like less pain, quicker healing, and less postoperative care.

Aim: The purpose of this study was to determine whether RF thermal ablation could be used to treat upper airway tissue pathologies.

Methods: The current study comprised a total of 28 healthy volunteers who had respiratory disorders related to sleep disorders. The subjects who were included had their soft palates exposed to radiofrequency energy. All subjects had evaluations using cephalometric analysis, Epworth Sleepiness Scale, Snoring Score, visual analog scale (VAS) ratings, and inflammatory laboratory values.

Results: Two days after RFTA, tissue loss, mucosal ulcerations, slight speech difficulties, swallowing difficulties, soft palate swelling, and mild discomfort were all resolved right away. Soft palate length shrinkage was associated with decreased snoring in regular snorers. Not a single evaluated laboratory metric showed any discernible difference. VAS ratings were low and erratic. Six patients showed signs of relapse.

Conclusion: The current study comes to the conclusion that RFTA is a suitable and minimally invasive treatment option for those with habitual snoring and excessive daytime sleepiness who do not have any corresponding structural abnormalities.

Keywords: Visual Analogue Scale (VAS), snoring (RFTA), soft palate, upper airways, posterior airway space (PAS), and radiofrequency thermal ablation.

INTRODUCTION

In various fields of medicine, radiofrequency thermal ablation, or RFTA, is a widely used therapeutic technique that has been shown to be safe, effective, and reproducible through precise, regulated sessions. In the fields of cardiology, neurosurgery, urology, and oncology, it is extensively studied. In terms of otolaryngology, it is utilized in patients with obstructive sleep apnea as part of the Somnoplasty procedure for snoring reduction through the palatal, turbinate, and tongue base reductions.1. RFTVR has a lot of benefits over traditional

tonsillectomy because it results in smaller tonsils. It is distinguished by a lesion that is precisely controllable. Tissue retraction and scar formation are observed during wound healing as a result of radiofrequency treatment, which causes a reduction in volume.2.

Compared to traditional procedures, RTA offers a number of benefits, including less pain, quicker recovery, and less postoperative care. Temperature-controlled radiofrequency (TCRF) was initially described by Power et al. for both in vivo and in vitro tissue ablation in the upper airway. As a result, attention was drawn to the study and use of radiofrequency to the upper airway's soft tissues.3

Radiofrequency needle ablation functions at a lower temperature (65–100 °C) and at a higher current flow with equivalent cutting efficacy than traditional electrosurgery. With the use of frictional heating brought on by ions following alternating currents that are changing in direction, this high current flow quickly elevates the tissue temperature locally, causing irreversible tissue damage, protein denaturation, coagulation, and thermal injury.

4 Tissue coagulum attaches to the electrode and insulates it with a sudden current density reduction upon reaching the 100o C threshold owing to boiling, hence halting tissue injury, lesion formation, and tissue repair. Electrode sensors have recently been added to electrosurgical equipment in order to monitor local tissue temperature and prevent electrode-tissue from approaching 100 degrees Celsius. Conversely, temperatures in the tissues reached by electrocautery methods and lasers can reach 750°C to 900°C, which is far higher than what is required for therapies and can cause harm to surrounding structures as well as tissue. Therefore, compared to electrosurgery, the needle ablation technique should result in less collateral tissue damage.5

A loud inspiratory sound called snoring is caused by partial blockage and vibrations in the oropharynx. Most cases of snoring are caused by structural abnormalities, with functional pharyngeal hypotonia being the primary cause of blockage. Medical intervention is required when snoring is linked to obstructive sleep apnea syndrome (OSAS) or causes social disruptions. Between 9 and 35% of adults in general and those between the ages of 60 and 65 are more likely to snore regularly.Six Neuromuscular regulation is primarily responsible for upper airway collapse. Vibrations in chronic snorers cause lesions in the afferent and efferent neurons that supply the tissues of the upper airway. The goals of surgically managing the soft palate tissues in snoring subjects are to reduce, harden, and stabilize the soft palate.

Surgical procedures do, however, come with a high risk of morbidity and consequences.7. Therefore, the goal of this investigation was to determine whether radiofrequency thermal ablation could be used to treat the degenerative diseases affecting the tissues of the upper airways.

MATERIALS AND METHODS

The goal of the current investigation was to determine whether RF thermal ablation could be used to treat upper airway tissue pathologies. The subjects from the Institute's Department of Otorhinolaryngology made up the study population. All study participants gave their written and verbal informed consent after being fully told about the study's thorough design.

The study comprised a total of 28 patients with sleep disordered breathing (SDB) who were of both genders and aged between 18 and 62. All of the subjects had to have soft palate surgery since their snoring had been bothering them socially and causing them to be excessively sleepy during the day for at least a year. Body Mass Index (BMI), Oxygen Desaturation Index (ODI), Sella-Nasion point B (SNB) angle, and Posterior Airway Space (PAS) were all computed for the 28 participants who were included.

A thorough history taking and physical examination were performed on each patient. Fiberoptic Naso-pharyngoscopy was used to measure the degree of obstruction, and cephalometric radiographs were used to look at the anatomy of the upper airway. Subjects with significant blockage sites at the soft palate comprised the majority of those who were included. In the study. All subjects were managed with Radiofrequency thermal ablation (RTFA). A cephalometric head holder was used to establish that all individuals had lateral cephalometric radiographs taken before to RTFA and three months after RTFA in the same anatomic position. Before and after RTFA, all common soft-tissue and bone landmarks (PNS-P and PW) were assessed. Subjects with behavioral or neurological diseases, pacemaker implantation, history of prior palatal surgery, coagulopathy, degrees of blockage inside posterior airspace, and/or micrognathia were excluded. With the soft palate (mid-part) already anesthetized with topical Xylocaine 10 mg/dose, 10 mg/ml lidocaine with epinephrine was injected using a 24-gauge needle.

Using an RF generator with needle electrodes (VidaMed® generator, model no. 7200, double-needle electrode, Tuna 3, model 6193), radiofrequency radiation was given at 460 + 1 kHz. A protective thermal cheat, 10 mm in length, was positioned proximally on both needle electrodes to prevent surface damage. Needle electrodes were inserted beneath the palatal mucosa between the palatal arches on both sides of the uvula. The one lesion was treated twice at a one-week interval with 5 W of energy, giving the lesions 600 J and 300 J of energy, respectively.

None of the individuals received any medication after surgery. They were instructed, nevertheless, to take ketoprofen or ibuprofen as needed.

The VAS was used to measure postoperative morbidity, and patients scored their symptoms on a range of 0-100, from no symptoms to severe symptoms. The following symptoms were evaluated: pain, swelling sensation in the oropharynx, trouble opening the mouth, difficulty eating, difficulty drinking, and/or difficulty speaking. Questionnaires for the Epworth Sleepiness Scale (ESS) and the Snoring Score (SS) were recorded prior to treatment, as well as three and twelve months after treatment. Leukocyte counts, blood hemoglobin, C-reactive protein, and creatine kinase levels were among the hematological characteristics measured. In order to measure the inflammatory host response after treatment, they were evaluated prior to each session as well as postoperatively on the second day and the first week after the final session.

Using SPSS software version 21 (Chicago, IL, USA) for statistical assessment and one-way ANOVA and t-test for result formulation, the gathered data were examined. The data were presented as a mean, standard deviation, percentage, and number. At $p<0.05$, the significance threshold was maintained.

RESULTS

The goal of the current investigation was to determine whether RF thermal ablation could be used to treat upper airway tissue pathologies. In all, 28 individuals with sleep-disordered breathing (SDB) who were between the ages of 18 and 62, male and female, were involved in the study. Table 1 shows the demographic details of the research participants. The average age of the research participants was found to be 29.6±1.6 years. In the current study, there were 17.85% (n=5) females and 82.14% (n=23) males. The study participants had a mean BMI of 28.4±2.36. In the study patients, ODI 4% was 0.7, PW was 12 mm, PNS-P was 44.4 mm, and mean PAS was 14 mm.

The current investigation evaluated the postoperative problems that the participants in the study reported. Soft-tissue swelling was observed to be the most frequent postoperative complaint, reported by 64.28% (n=18) of study participants, followed by blanching of the soft palate in 35.71% (n=10) of study participants. As indicated in Table 2, further reported problems included mucosal ulceration in 3.57% (n=1) study participants, speech difficulties in 10.71% (n=3) research subjects, swallowing difficulties in 7.14% (n=2) study subjects, and tissue loss in 3.57% (n=1) study subjects. Over the course of the 2-week follow-up period, all of the documented postoperative problems diminished gradually.

On assessing the mean VAS scores in the study subjects, it was seen that for soft palate blanching, at postoperative days 1, 2, 7, and 21 the VAS score was 64 (23-77), 37 (2-64), 17 (0-58), and 3 (0-34) respectively.

Concerning the soft palate swelling, it was seen that the mean VAS scores at day 1, day 2, day 7, and day 21 postoperatively were 68 (47-88), 27 (4-64), 16 (1-48), and 4 (0-40) respectively in the study subjects (Table 3). It was seen that the mean VAS scores were higher in all the study subjects for both soft palate swelling and blanching. However, the mean VAS scores decreased significantly in all the subjects by day 21.

DISCUSSION

The goal of the current investigation was to determine whether RF thermal ablation could be used to treat upper airway tissue pathologies. In all, 28 individuals with sleep-disordered breathing (SDB) who were between the ages of 18 and 62, male and female, were involved in the study. The average age of the research participants was found to be 29.6±1.6 years. In the current study, there were 17.85% (n=5) females and 82.14% (n=23) males. The study participants had a mean BMI of 28.4±2.36. In the study patients, ODI 4% was 0.7, PW was 12 mm, PNS-P was 44.4 mm, and mean PAS was 14 mm.

These demographics were similar to those of the investigations conducted by Pazos G. et al.9 in 2001 and Robinson S. et al.8 in 2003, where the authors evaluated people who shared similar characteristics with the current study. RTFA procedures are typically associated with postoperative problems. The current investigation evaluated the postoperative problems that the participants in the study reported. Soft-tissue swelling was observed to be the most frequent postoperative complaint, reported by 64.28% (n=18) of study participants, followed by blanching of the soft palate in 35.71% (n=10) of study participants. Additional issues included mucosal ulceration in 3.57% (n=1) study subjects, speech difficulties in 10.71% (n=3) study subjects, swallowing difficulties in 7.14% (n=2) study subjects, and tissue loss in 3.57% (n=1) study subjects.

Over the course of the 2-week follow-up period, all of the documented postoperative problems diminished gradually. These outcomes were similar to those of studies conducted by Baack L et al. (10 in 2001) and Erik JK et al. (11 in 2005), the authors of which also observed similar issues following RTFA, with soft palate edema emerging as the most frequent issue.

The success of RTFA was evaluated in the current study using VAS scores. When the mean VAS scores of the research subjects were evaluated, it was observed that the VAS scores for soft palate blanching were 64 (23-77), 37 (2-64), 17 (0-58), and 3 (0-34) on postoperative days 1, 2, 7, and 21.

In reference to the soft palate swelling, the study subjects' mean VAS ratings were 68 (47-88), 27 (4-64), 16 (1-48), and 4 (0-40) on days 1, 2, 7, and 21 postoperatively. It was observed that for both soft palate swelling and blanching, the mean VAS ratings were higher across all study participants. By day 21, however, the mean VAS scores dropped considerably across the board for all courses. These outcomes were in line with those of Blume MB et al. (2002), whose VAS ratings were similar to those of the current investigation.

CONCLUSION

Within its limitations, the present study concludes that RFTA can be considered as an acceptable and minimally invasive substitute for treating subjects of habitual snoring and daytime sleepiness having no associated anatomical abnormalities. However, the present study had a few limitations including a small sample size, short study duration, and geographical area biases. Hence, more longitudinal studies with a larger sample size and longer monitoring period will help reach a definitive conclusion.

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S. No	Characteristics	Value (Mean±S. D) n (%)
1.	**Mean age (years)**	29.6±1.6
2.	**Age range (years)**	18-62
3.	**Gender**	
a)	Males	23 (82.14)
b)	Females	5 (17.85)
4.	**Mean BMI**	28.4±2.36
5.	**ODI 4%**	0.7

6.	**PW (Mm)**	12
7.	**PNS-P (Mm)**	44.4
8.	**Mean PAS (Mm)**	14

Table 1: Demographic characteristics of the study subjects

S. No	Complications	Number (n)	Percentage (%)
1.	**Swelling of the soft palate**	18	64.28
2.	**Mucosal blanching**	10	35.71
3.	**Speech difficulty**	3	10.71
4.	**Swallowing difficulty**	2	7.14
5.	**Mucosal Ulceration**	1	3.57
6.	**Tissue Loss**	1	3.57

Table 2: Complications following RTFA in the study subjects

S. No	Follow up duration (days)	VAS score for soft palate blanching	VAS score for soft palate swelling
1.	**1**	64 (23-77)	68 (47-88)
2.	**2**	37 (2-64)	27 (4-64)
3.	**7**	17 (0-58)	16 (1-48)
4.	**21**	3 (0-34)	4 (-40)

Table 3: Mean VAS scores from day 1 to day 21 in the study subjects