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ORIGINAL ARTICLE

Long-Term Outcomes of Radiofrequency Ablation of the Inferior Turbinates

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Abstract Radiofrequency ablation of the inferior turbinates (RFAIT) is a minimally invasive surgical technique that reduces turbinate size and decreases nasal obstruction. Few studies have assessed long-term outcomes of this procedure using standardized, symptom-specific evaluation instruments. The primary aim of this study is to assess the long-term effectiveness of RFAIT using a standardized, symptom-specific evaluation instrument. An additional outcome evaluated is the effect of RFAIT on therapeutic CPAP pressures in centimetres of water pressure (cwp) and overall CPAP use. Patients who had received RFAIT >14 months previously were identified via retrospective chart review and underwent a telephone interview with several questions to include the Nasal Obstruction Symptom Evaluation (NOSE) scale. Additionally, data regarding therapeutic pressures for continuous positive pressure devices (CPAP) and CPAP use was obtained for patients using these devices as treatment for obstructive sleep apnoea. The average NOSE scale score for the 40 patients who completed the NOSE scale questionnaire in our study was 6.35 ± 3.98 (0-20 scale). Crusting and mild, self-resolving epistaxis were the most common complications in the perioperative period. In general, unforeseen complications occurred in <13 % of patients. The mean therapeutic CPAP pressures reduced from 11.4 ± 2.7 to 10.1 ± 3.2 cwp, $p = 0.085$. This study supports that radiofrequency ablation of the inferior turbinates has low complication rates, is well-tolerated, may decrease therapeutic CPAP pressures, and provides symptomatic improvement that is sustained >14 months post-procedure.

Keywords Turbinates · Turbinoplasty · Radiofrequency ablation · Nasal obstruction · Continuous positive airway pressure

Introduction

Up to 25 % of the general population report non-allergic nasal obstruction symptoms, and inferior turbinate hypertrophy is a common cause of this complaint [1]. Management of turbinate hypertrophy can be achieved by a variety of surgical techniques, including microdebrider-assisted inferior turbinoplasty, turbinate out-fracturing, radiofrequency ablation (RFA), laser surgery, and turbinectomy [2]. Due to the multifactorial pathogenesis of nasal obstruction, with anatomy, allergy, and sinus disease known to contribute to symptoms, there is poor correlation between post-treatment exam findings of nasal obstruction and patient reported quality of life outcomes [3–5]. Thus, researchers must assess patient-reported subjective outcomes in assessing effectiveness of surgical therapy for nasal obstruction rather than merely assessing objective anatomic obstruction.

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Systematic reviews of data assessing the outcomes of various surgical techniques for turbinate hypertrophy have overwhelmingly supported that inferior turbinate surgery is effective for obstructive nasal symptoms secondary to hypertrophic turbinates [2, 6]. No consensus has been reached, however, regarding which surgical technique is most effective in the long-term.

Radiofrequency ablation is a commonly utilized thermal technique that has rare complications and has the ability to be performed in the office under local anaesthesia. This technique generates a relatively low level of heat in the sub-mucosal layer of the turbinates, and thus preserves overlying mucosal integrity and mucociliary function of the turbinates [1].

While literature supports radiofrequency ablation as an effective procedure for managing nasal obstruction secondary to inferior turbinate hypertrophy, few studies have assessed long-term outcomes using disease-specific, validated instruments to assess patient symptoms. Interestingly, while only 19 % of inferior turbinate surgical outcomes research in the 1990s examined thermal techniques, this percentage jumped to 41 % in the 2000s, thought to be due to the popularization of radiofrequency ablation [2]. Prior to 2004, many of the studies examining outcomes of radiofrequency ablation utilized the Visual Analogue Scale (VAS), a single-item scale to assess health status after therapies [7]. With the development and validation of the disease-specific Nasal Obstruction Symptom Evaluation (NOSE) instrument in 2004, however, patients can now be surveyed in a reliable, specific manner about subjective assessment of nasal obstruction [3].

To date, only a small number of groups have completed randomized, prospective trials of RFA versus placebo. While the data confirms the efficacy of RFA for nasal obstruction, the studies possess limitations, including short-term follow-up (ranging from 6 weeks to 6 months) and use of the VAS scale rather than a disease-specific symptom evaluation instrument [8, 9].

In 2011, Garzaro et al. [10] reported case series data of long-term RFA outcomes for inferior turbinate hypertrophy using the NOSE scale. In their study of 35 patients, nasal obstruction was significantly improved at both 2-months and 2-years post-procedure. The aim of our study is to expand the current body of literature assessing long-term symptom outcomes of RFA using the NOSE scale questionnaire and to quantitatively assess the frequency and type of complications in the post-radiofrequency ablation population.

Methods

This study is a retrospective case series and was carried out at the Department of Otolaryngology and Head and Neck Surgery (Sleep Surgery Division) at Stanford University, with 40 participating patients. The study was approved by the Institutional Review Board of Stanford University under protocol 26168. The inclusion criteria are: adult patients who underwent isolated RFA of the inferior turbinates $\geq$14 months prior to data collection on an outpatient basis at the Sleep Surgery Clinic. Exclusion criteria are those patients who had other procedures in addition to RFA of the inferior turbinates (e.g. septoplasty) and those who went to the operating room to have the procedure. None of the patients were compensated for participating in the study and patients could opt out at any time during the phone survey.

Surgical Procedure

Radiofrequency ablation was performed in the outpatient Sleep Surgery Clinic of the Otolaryngology Department of Stanford University. The head of the inferior turbinate was topically anesthetized with 1 % lidocaine and phenylephrine. After a few minutes, 2 cc of 2 % lidocaine was then infused bilaterally. The Celon Radiofrequency turbinate wand at a setting of 15 W was then introduced into the submucosal inferior turbinate tissue for approximately 15 s (the exact duration was based on the auto-stop function which is depends on 3D impedance feedback which is detected by the machine algorithm). This process was repeated 3 times in the caudal aspect of the inferior turbinate. Patients were then instructed to take over-the-counter acetaminophen for pain and were not prescribed narcotic medication or antibiotics.

Subjects

Participating subjects were retrospectively identified by reviewing electronic medical records. All patients who had undergone radiofrequency ablation in the Sleep Surgery Clinic as an isolated procedure were eligible. A total of 106 patients were identified and called via telephone. Of these 106 potential study participants, phone contact was successfully made with 48 patients (the remaining 58 patients were unable to be reached by phone). Eight patients declined to participate, and 40 patients completed the NOSE survey and ancillary questions over the phone, for a participation rate of 83.3 % of those who were successfully contacted.

Subjective Evaluation

Patients were surveyed 14–30 months after undergoing radiofrequency ablation therapy. Given that most prior studies of radiofrequency ablation of the inferior turbinates evaluated surgical outcomes less than a year after the procedure took place, we deemed that surveying patients

>12 months after the procedure constituted "long-term" outcomes [11]. Patients' subjective degree of nasal obstruction was evaluated by their completion of the 5-item NOSE instrument over the phone. Patients were also asked to answer supplementary questions relating to complications, as well as their overall perception of whether breathing was improved relative to before the procedure. All statistical analyses were performed using Microsoft Excel (Redmond, WA).

Additionally, the data regarding therapeutic pressures for continuous positive pressure devices (CPAP) and CPAP use was obtained for patients using these devices as treatment for obstructive sleep apnoea. The CPAP 95th percentile pressures and CPAP use data was obtained from the CPAP devices themselves during the clinic visit and documented in the electronic medical record, which was then reviewed as part of this study.

Results

Analysis

Our patient sample was comprised of 27 (67.5 %) men and 13 (32.5 %) women. The average age of the patients in this study was 50.3 ± 13.8 years old. In our study population, the average NOSE score was 6.35 ± 3.98 out of total possible score of 20 (Table 1). After completing the NOSE survey, our patients were subsequently asked to assess whether they felt that their breathing was improved or not improved as compared to before the procedure. 39 out of the 40 original patients completed this question. 30 out of 39 patients (77 %) reported improvement in breathing as compared to before the procedure. 8 of these 30 patients (27 %) felt that breathing was significantly improved compared to before the procedure, 13 patients (43 %) felt that it was moderately improved, and 9 felt (30 %) that it was mildly improved.

Complications

Twelve patients (30 %) reported mild epistaxis in the immediate post-operative period. Only 1 patient reported epistaxis which required cauterization (silver nitrate in the clinic). 34 patients (85 %) reported crusting in the nares after the procedure. Of patients who had crusting, 23 patients (68 %) reported symptoms that lasted for less than or equal to 2 weeks, 9 (26 %) lasted for between 2 and 4 weeks, and 2 patients' (6 %) symptoms lasted longer than 4 weeks. 5 patients (12.5 %) self-reported unanticipated complications, which included a vasovagal episode during the procedure, significant pain, significant crusting requiring a return visit to clinic, a subjective perception of increased quantity of nasal infections post-procedure, and a sensation of irregular texture in their nares, see Table 2.

Of the 40 patients evaluated, 19 patients had no CPAP data available, and 13 patients had either pre or post-CPAP data, but not both. The remaining 8 patients were followed between 2 and 22 months after surgery. The therapeutic (95th percentile) CPAP pressures reduced from 11.4 ± 2.7 to 10.1 ± 3.2 cwp, for a mean difference of 1.3 ± 1.5, standard error of mean 0.62, confidence interval (−0.26 to 2.93), $p = 0.085$ (Table 3). There were two patients who demonstrated improved CPAP compliance, with no specific number of hours stated in the notes. The patients who were assessed for post-radiofrequency ablation of the inferior turbinates effect on therapeutic CPAP pressures were noted to have stable weight, except for patient #4 whose BMI increased by 2.3 kg/m^2 during the follow-up period.

Table 1 NOSE scale scores for 40 responding patients

	Nasal obstruction or stuffiness	Nasal blockage or obstruction	Trouble breathing through my nose	Trouble sleeping	Unable to get enough air through my nose during exercise or exertion	Total score
M ± SD	1.65 ± 1.00	1.17 ± 0.96	1.24 ± 1.11	1.42 ± 1.30	0.87 ± 0.99	6.35 ± 3.98

There are 5 questions, each up to 4 points each

M mean, *SD* standard deviation

Table 2 Frequency of complications for 39 responding patients

Complication	Crusting	Crusting duration ≤2 weeks	Crusting duration 2–4 weeks	Crusting duration ≥4 weeks	Mild epistaxis	Epistaxis requiring cauterization	Unanticipated complications
Number of patients (%)	34 (85)	23 (68)	9 (26)	2 (6)	12 (30)	1 (2.5)	5 (12.5)

Table 3 Effect of radiofrequency ablation of the inferior turbinates on therapeutic CPAP pressures measured in centimetres of water pressure (cwp) and CPAP compliance

Patient number	Pre-nasal surgery BMI	Post-nasal surgery BMI	Pre-nasal surgery CPAP pressure	Post-nasal surgery CPAP pressure	Duration between surgery and follow-up data (months)	Effect of nasal surgery on pressures (centimetres of water pressure) or use
1	32.92	32.78	N/A	N/A	2	Improved CPAP compliance
2	–	–	N/A	N/A	2	Improved CPAP compliance
3	31.25	31.14	13	11.1	19–22	Pressure decreased by 1.9 cwp
4	33.66	35.96	13.8	14.1	8–11	Pressure increased by 0.3 cwp
5	20.38	21.12	13.8	12.4	6–7	Pressure decreased by 1.4 cwp
6	24.41	24.42	10.5	6.5	19–20	Pressure decreased by 4 cwp
7	26.93	27.03	6.7	6	2	Pressure decreased by 0.6 cwp
8	27.18	25.86	10.6	10.3	19	Pressure decreased by 0.3 cwp
Total						*Mean difference 1.33 ± 1.52 cwp

95th percentile therapeutic CPAP pressures are reported, which decreased for patients #3–8, except patient #4 whose BMI increased by 2.3 kg/m^2 during the follow-up period

* Standard error of the mean is 0.62, confidence interval is −0.26 to 2.93, p value is 0.085

Discussion

Radiofrequency ablation is a widely utilized thermal technique for reducing tissue bulk of the inferior turbinates in order to minimize symptoms of nasal obstruction, which has been gaining popularity in the last decade due to the ease of performing the procedure in clinic and minimal complications [2]. This technique has the advantages of being a relatively quick, in-office procedure that can be performed under local anaesthesia with minimal pain. Long-term symptomatic outcomes of this therapy have not been extensively characterized. In our retrospective long-term outcomes study of 40 patients who underwent radiofrequency ablation of their inferior turbinates in the clinic setting, we utilized the validated NOSE scale questionnaire to assess nasal obstruction symptoms at >14 months post-procedure.

Based on review of the literature, NOSE scores for patients with nasal obstruction secondary to turbinate hypertrophy prior to undergoing surgical treatment can range from 11.57 to 13.03 [1, 10]. Prior studies that have assessed NOSE scores of patients who have undergone RFA of the inferior turbinates report average post-procedure scores ranging from 6.94 at 6 months to 2.07 at 2 years [1, 10]. The average NOSE score value of 6.35 in our patient population at >14 months falls between the values reported in these two prior studies and similarly suggests a marked long-term improvement in nasal symptoms post-procedure in our population.

Other than our study, our review of the literature identified only one other study to date that has examined long-term symptomatic post-RFA outcomes utilizing the NOSE scale, and our data supports their assertion that effectiveness in treating nasal obstruction is maintained even more than a year after the procedure [10]. Furthermore, our study patients reported minimal unforeseen complications and nearly 80 % of patients report that breathing is improved as compared to before the procedure. Additionally, this study demonstrates a post-treatment therapeutic CPAP pressure reduction of 11.4 ± 2.7 to 10.1 ± 3.2 cwp, for a mean difference of 1.3 ± 1.5, with $p = 0.085$. Although the p value did not reach statistical significance, there was a trend toward significance; one patient whose post-treatment pressure increased had gained weight, with a BMI increase of 2.3 kg/m^2 during the follow-up period, and weight gain has been known to increase required pressures, so the effect of the surgery cannot be fully known in this patient.

We found that radiofrequency ablation of the inferior turbinates in our patients has provided relief of nasal obstruction which has persisted >14 months post-procedure. Given the ease of this in-office procedure, radiofrequency ablation may represent a useful tool for clinicians to utilize for patients with symptoms of nasal obstruction.

There are limitations to this study. Given that this was a retrospective study, we are limited by the amount of documentation that was annotated in the electronic medical record of each provider. Additionally, we were unable to get in contact with approximately half of the potential patients who met inclusion criteria; however, 40 out of 48 patients who were successfully contacted did completed the NOSE survey and ancillary questions, for a participation rate of 83.3 %. A further limitation is that the degree of inferior turbinate hypertrophy was not quantitatively characterized prior to or after treatment, however, the new inferior turbinate classification system [12] (grades 1–4) was published after this study was performed.

Conclusion

This study supports that radiofrequency ablation of the inferior turbinates has low complication rates, is well-tolerated, and provides symptomatic improvement that is sustained >14 months post-procedure.

Compliance with Ethical Standards

Conflicts of interest None.

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