A New Surgical Method of Dynamic Nasal Valve Collapse

Erdal Seren, MD

Objective: To describe a technique for internal nasal valve collapse using radiofrequency-induced thermo-therapy (RFITT).

Design: Prospective study.

Setting: Academic research center.

Patients: A total of 28 patients with nasal obstruction due to inspiratory nasal valve collapse were included in this study.

Intervention: Radiofrequency-induced thermo-therapy.

Main Outcome Measures: Visual analog scale score.

Results: Severity of obstruction scores improved in all patients, with the mean score improving at the left nostril from 8.2 before treatment to 3.4 after treatment and at the right nostril from 8.9 before treatment to 4.1 after treatment. The outcomes were measured using visual analog scale score before treatment and at 16 weeks after treatment. Improvement was shown in severity of obstruction ($P < .001$).

Conclusions: This new method appears to be safe, quick, bloodless, and painless. These good, encouraging preliminary results must be confirmed by further study and long-term follow-up.


THE NASAL VALVE AREA REPRESENTS the narrowest segment of the nasal airway. It is defined as the area bounded by the caudal end of the upper lateral cartilage, cartilaginous nasal septum, pyriform aperture, floor of the nose, and head of the inferior turbinate. The nasal valve, which is a portion of the nasal valve area, is the area of highest airway resistance. The nasal valve angle is the angle between the upper lateral cartilage and the nasal septum. Anatomical studies have shown that this angle classically ranges between 10° and 15° in the nose of white individuals. One of the most common causes of nasal obstruction is internal valve collapse.

Pathologic conditions of the nasal valve can also be divided into primary and secondary disorders: primary disorders are narrowness or excessively weak lateral nasal walls with resulting collapse phenomenon that are congenital or are acquired in the course of life without surgical or traumatic changes. A typical example is the tension nose, which often has elongated vertical nasal apertures (external nasal valve) and a narrow internal nasal valve that tends to collapse. Age-related changes of the nasal valve area leads to a change of the static conditions, which constitutes an often underrated problem. With increasing age, structural alteration processes occur in the cartilage involving a loss of the elastic properties. Furthermore, a loss of tone of the nasal musculature can be observed.

Treatment of internal valve problems usually involves 1 of 3 methods: scar revision, medial osteotomies, or on-lay grafting of the nasal dorsum. None of these methods is free of adverse effects such as pain, bleeding, and bone necrosis. Simpson and Groves first systematized submucosal diathermy of the inferior turbinate with the aim of obtaining adequate turbinate reduction with preservation of the overlying mucosa to avoid postoperative atrophic changes. The new bipolar radiofrequency-induced thermo-therapy (RFITT) has provided a gentler and minimal invasive therapy for turbinate hypertrophy. The effect of RFITT is achieved by...
coagulation of venous sinusoids within the turbinate, leading to submucosal fibrosis.\textsuperscript{3,7} Tissue is ablated by heat desiccation created by frictional energy. The maximal tissue temperature may reach from 60°C to 90°C. The chance of mucosal injury is reduced with RFITT because the probe is placed submucosally and temperatures are much lower.\textsuperscript{8}

RFITT uses very low levels of radiofrequency energy to create finely controlled necrotic lesions in soft-tissue structures. Following the general pattern of wound healing, the necrosis leads to scar formation and retraction of tissue, resulting in an overall reduction of volume in the treated area. Also, the retraction of tissue leads to an increase in the tone of nasal musculature. Over time, the scar tissue is partially resorbed by the body, causing further volume reduction. The necrotic tissue in the lesions is gradually replaced by scar tissue, which is then removed as part of the body's natural process.\textsuperscript{7,8}

The present study was conducted to elucidate the new applicability of radiofrequency energy to create fibrosis and retraction in the lateral cartilaginous nasal wall. Following the procedure leads to an increase in the tone of the nasal musculature with internal nasal valve collapse.

\section*{METHODS}

\section*{PATIENTS}

A total of 28 patients with nasal obstruction due to inspiratory nasal valve collapse were included in this study. The patients comprised 12 women and 16 men whose ages ranged from 18 to 51 years (mean age, 29.5 years). The preoperative evaluation included a complete history and clinical examination. Rigid endoscopy was performed to exclude other causes of nasal obstruction (turbinate hypertrophy, nasal polyp, septal deviation, or other nasal masses). Exclusion criteria included a history of bleeding disorders, prior radiation therapy to the nose, insulin-dependent diabetes, pregnancy, and poorly controlled hypertension. In all cases there was a varying degree of bilateral internal nasal valve collapse after minimal inspiratory effort (moderate and severe sensation of blockage). Ethics approval was obtained from the local director of medical research, and all patients gave a written informed consent.

On each occasion the patients were asked evaluate their nasal blockage that they routinely experienced and were asked to score their symptoms on a visual analog scale (VAS) from 0 to 10, with 10 indicating total blockage and 0, no sensation of blockage. The minimum score required for acceptance into the study was 6 or greater.

\section*{SURGICAL TECHNIQUE}

The operation was performed with local anesthesia, and topical lidocaine hydrochloride, 4\%, pledges were placed in the nose for 5 minutes. The surgical procedures were performed in the Department of Otorhinolaryngology of the Giresun state hospital. The vestibular skin, nasofacial sulcus, and alar rim were injected with 5 mL of lidocaine hydrochloride, 1\%, with 1:100,000 epinephrine. A stair-step incision was made with a No.15 blade. The soft tissues were elevated, and the lateral crus was everted using a double-skin hook placed at the cephalic rim. A mucosal packet was then created by dissecting the vestibular mucosa from the under surface starting from the junction of the intermediate crus toward the pyriform aperture.

RFITT was then performed with the turbinate probe (Celon-ProBreath; Celon AG Medical Instruments, Berlin, Germany) and an RFITT unit (CelonLab ENT; Celon AG Medical Instruments). The needles of the probe were inserted the full length of the mucosal packet toward the pyriform aperture oblique (\textbf{Figure 1}). The unit was set at partially rectified current, and the power was set at 10. Ten-second bursts of electrical current were delivered using a foot switch. Every patient received (each nasal cavity) 100 J into the mucosal packet. The diameter of coagulation was 4.6 mm (the coagulation diameter of 4.6 mm is a specification introduced by the company as product information). We performed the same procedure 2 cm above and 2 cm below this area (\textbf{Figure 2}). Then wounds were closed using 4-0 plain catgut sutures. All patients received 8 mg of intravenous dexamethasone intraoperatively. No antibiotic was given and nasal packing or expensive instrumentation was not required. The patients were then discharged and advised to use over-the-counter acetaminophen as directed for any postprocedure pain.

\section*{POSTOPERATIVE FOLLOW-UP}

All patients were examined weekly for 16 weeks. Any complications related to the procedure were registered. At the end of
the follow-up period, all patients were evaluated using nasal endoscopy and a patient questionnaire (Figure 3).

STATISTICAL ANALYSIS

The VAS scores for pretreatment and posttreatment visits were compared using the paired t test, and statistical significance was defined as $P < .05$. All analyses were performed by using Statistica 6.0 software (StatSoft Inc, Tulsa, Oklahoma).

RESULTS

There were no major complications during or after any procedure. One patient developed very marked edema in spite of corticosteroid administration. Then this edema resolved with oral dexamethasone therapy. There were 3 patients, who complained of mild to moderate pain during and shortly after treatment. These patients took acetaminophen as directed and received full relief of discomfort. No postoperative bleeding occurred. Also, there was no incidence of atrophic changes of mucosa or vestibular skin.

Statistical analysis of the improvement in nasal airway performance for the right nostril at 16 weeks showed that the improvement achieved was significant ($P < .001$) (Figure 4A). Similar statistically significant results were also seen with the left nostril ($P < .001$) (Figure 4B). Severity of obstruction scores improved in all patients, with the mean score improving for the left nostril from 8.2 pretreatment to 3.4 after treatment and for the right nostril from 8.9 before treatment to 4.1 after treatment. These improvements were all statistically significant.

After the procedure, a considerable improvement was clinically observed in 26 patients (93%) in terms of breathing. However, 2 patients (7%) consulted us for a new procedure because of their breathing problems.

COMMENT

In this study, we evaluate the safety of RFITT for the treatment of nasal obstruction due to nasal valve collapse. There were no notable complications and minimal morbidity. Furthermore, our study demonstrated a statis-
ally significant improvement in symptoms of nasal obstruction after treatment compared with before treatment.

Nasal valve collapse is a common cause of nasal airway obstruction. The valve area is commonly weakened secondary to rhinoplasty, aging, trauma, and other causes. Internal nasal valve and the nasal valve area play a critical role in nasal resistance. In the absence of other causes of nasal obstruction, the internal nasal valve and nasal valve area constitute the flow-limiting segment of the nose. Inspiratory collapse of the lateral nasal side walls with normal inspiratory negative pressure suggests inadequate rigidity of nasal supporting structures. Inspiratory collapse at the external valve is visible on examination and is indicative of flaccid soft tissue in this location. Similarly, inspiratory collapse may compromise function and is indicative of flaccid soft tissue in this location.

The underlying pathogenetic mechanism of stenoses of the nasal valves is rooted in Poiseuille’s law. When the nasal valve area is constricted, the flow volume increases clearly and a greater negative inspiratory pressure has to be developed in compensation, which can consecutively result in a suction phenomenon of the wings of the nose. The actual collapse of the nasal wings is due to the mobile lateral nasal wall as a matter of principle. In the case of preexisting weakening of the lateral nasal wall and the alae due to the aforementioned causes, a suction phenomenon may occur even at rest due to the Bernoulli effect. The suction of the lateral wall of the vestibule, however, can be an absolutely physiological phenomenon in healthy subjects in the case of forced respiration (>500 mL/s). In this case, the necessary inspiratory pressure is higher than the transmural pressure of the nasal wall and thus causes the collapse of the wings of the nose.

The complexity of nasal valve repair techniques and its variable results combined with the fact that patients with valve collapse have often had previous surgery or are of advanced age are some of the reasons that this problem often goes untreated. Selection of the appropriate surgical intervention depends on the proper identification of the anatomic cause of the collapse. Generally, treatment of internal valve problems usually involves 1 of 3 methods: scar revision, medial osteotomies, or on-lay grafting of the nasal dorsum. But these methods include some complications, such as bleeding, infection, poor cosmetic outcome, continued valve insufficiency, oversized graft with extrusion or external deformity, and poorly sized pocket with graft migration.

Therefore, we developed a new technique for internal nasal valve collapse. This study was designed to evaluate the efficacy of RFITT for the treatment of nasal valve collapse. Unipolar cauterization works with an indifferent electrode. The single active electrode destroys tissue in a circumferential manner around the needle through heat dissemination and carbonization. Several authors described noticeable obliteration of the blood vessels and interruption of terminal cholinergic nerve fibers.

Radiofrequency is a procedure in which tissue is shrunk by electrical energy. This energy is converted to heat as a result of tissue resistance, but unlike electrocautery, the heat is generated in the tissues themselves and the actual electrodes remains cold. Tissue destruction is limited to area between the needles of the probe. This minimizes the risk of avascular necrosis.

On a cellular level, the tissue damage and recovery from RFITT demonstrates the body’s typical pattern of tissue injury, followed by scar formation and retraction of tissue. One hour after the treatment, the lesion site shows the typical effects of tissue coagulation: the cells have a structureless, homogenous appearance and there is edema and congestion within the tissues. At 3 weeks, the lesion is white and glossy, with well-formed scar tissue. The VAS is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. The VAS was chosen as the measurement tool in this study because it has been used effectively to evaluate patients who underwent radiofrequency treatment. Maxwell describes VAS as easy to use, sensitive, and accurate when testing differences within subject comparisons. Lund has also described the use of linear visual scales in the office evaluation of nasal obstruction, noting that they are of great value for comparing sequential evaluations. Objective testing with acoustic rhinometry and rhinomanometry was considered but not used owing to their questionable reliability and reproducibility. Acoustic rhinometry causes distortion of the nasal valve area during testing, and rhinomanometry has up to a 50% day-to-day variation in results. Therefore these objective measurements were not included in this study.

In conclusion, RFITT is a new technique devised to minimize and simplify surgery performed with local anesthesia. It takes 5 minutes and has a specific clinical application in chronic nasal obstruction because of nasal valve collapse in adults. It is less invasive than traditional surgical techniques and has less morbidity, lower medical costs, and faster return to full activity. The benefits are sustained at 16 weeks after treatment, but long-term efficacy is still unclear.

Submitted for Publication: September 23, 2008; final revision received April 7, 2009; accepted April 23, 2009.

Correspondence: Erdal Seren, MD, Devlet Hastanesi Kulak-Burun-Boğaz Servisi, Giresun 28100, Turkey (eseren@yahoo.com).

Financial Disclosure: None reported.

REFERENCES