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ORIGINAL STUDY

The efficacy of CO_2 laser turbinoplasty in patients with chronic hypertrophic rhinitis assessed using 4-phase-rhinomanometry

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ABSTRACT

BACKGROUND. Chronic nasal obstruction due to chronic hypertrophic rhinitis is a very common health problem encountered in rhinology. In most of the cases, pharmacologic therapy is the treatment of choice. However, when the turbinate swelling becomes irreversible, it is refractory to both local and general medical treatment. In all these cases, inferior turbinate surgery may be a choice.

OBJECTIVE. The aim of this study was to assess the efficacy of CO_2 laser vaporization of the inferior turbinate mucosa for chronic hypertrophic rhinitis, by using the 4-phase-rhinomanometry.

MATERIAL AND METHODS. We performed a prospective study on 39 adult patients diagnosed with chronic hypertrophic rhinitis refractory to medical treatment. CO_2 laser turbinoplasty was performed in all patients under local anesthesia. The pre- and post-treatment evaluation, performed at 1, 3 and 12 months after surgery, consisted in clinical examination, nasal endoscopy and 4-phase-rhinomanometry.

RESULTS. CO_2 laser turbinoplasty restored nasal flow, with a significant statistical reduction of total nasal airway resistance ($p<0.05$), as confirmed by the 4-phase-rhinomanometry in 25 patients (64.1%) at one month and in 32 of the patients (82.05%) at three months post-treatment. The re-evaluation performed at 12 months after surgery showed a persistence of a normal nasal patency in 30 patients, representing 76.92%.

CONCLUSION. The CO_2 nasal turbinectomy is an effective treatment for nasal obstruction due to inferior turbinates hypertrophy. The effectiveness of turbinate surgery depends on the hypertrophy of the submucosal layer, which can be estimated if pre- and post-treament nasal air flow are compared by using 4-phase-rhinomanometry.

KEYWORDS: hypertrophic rhinitis, turbinoplasty, 4-phase-rhinomanometry, CO_2 laser turbinoplasty

INTRODUCTION

Chronic nasal obstruction due to chronic hypertrophic rhinitis is a very common health problem encountered in rhinology. Up to 20% of the European population suffers from nasal obstruction caused by inferior turbinate hypertrophy[1]. There are many causes which can lead to inferior turbinate enlargement, allergic and non-allergic types being the most common.

In most of the cases, pharmacologic therapy is the treatment of choice. However, when the turbinate swelling becomes irreversible, it is refractory to both local and general medical treatment. In all these cases, inferior turbinate surgery may be a choice[2].

Turbinate surgery has been reported as the eighth common procedure in otolaryngology practice[3]. Laser vaporization of the inferior turbinate mucosa is one of the therapeutic alternatives in the treatment of hypertrophic inferior turbinates, in the context of chronic rhinitis, whatever the etiology (allergic or non-allergic).

During the past years, different types of lasers have been developed - CO_2 laser, diode laser, N-YAG and Argon-plasma lasers - all of them achieving good functional results. Along with the functional efficiency, the

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laser effect upon the structure of the mucosa and cell reaction must be taken into account.

The aim of this study was to assess the efficacy of CO_2 laser vaporization of the inferior turbinate mucosa for chronic hypertrophic rhinitis, by using the 4-phase-rhinomanometry.

MATERIAL AND METHODS

A prospective study was performed on 39 adult patients, 24 males and 15 females (M/F=1.6/1), aged between 18 and 60 years (mean age = 34.38). All patients were diagnosed with chronic hypertrophic rhinitis refractory to medical treatment.

Study exclusion criteria:

1. Pregnancy;
2. Patients with cardio-vascular pathology (hypertension), rhinosinusitis;
3. Hard or uncooperating patients.

The clinical and paraclinical evaluation included anterior nasal rhinoscopy, nasal endoscopic examination and 4-phase-rhinomanometry.

Rigid nasal endoscopy was used to evaluate the extent of turbinate hyperplasia (Figure 1, Figure 2) and also to exclude other coexisting pathology.

Objective data about the nasal patency and the grade of nasal obstruction was given by the 4-phase-rhinomanometry. The measurement was performed for each nostril at the air pressure of 150Pa. The total flow (ccm/s) and total resistance (Pa/ccm/s) were evaluated before and after decongestion for the right and the left nostril. In the study were included those patients with moderate (18 patients, representing 46.16%, Figure 3) and severe nasal obstruction (21 patients, representing 53.84%, Figure 4) on rhinomanometry. In all cases, there was a normal nasal patency after decongestion.

CO_2 laser turbinoplasty was performed under local anesthesia (10% naphazolinated xylocaine). The surgery was performed in ambulatory setting and no postoperative nasal packing was needed. At one week after surgery, mucosal crusts were removed.

The pre- and postoperative subjective assessment of the nasal symptoms included the visual analogue scale (VAS) and SNOT-20 (Sino - Nasal Outcome Test-20).

The follow-up was performed at 1, 3 and 12 months after surgery. Nasal endoscopic examination and the 4-phase-rhinomanometry were used in evaluating the macroscopic aspect of the inferior turbinate mucosa and the nasal patency.

RESULTS

The symptoms related by the patients were: nasal obstruction (39 cases), rhinorrhea (23 cases), sneezing (16 cases), nasal itching (19 cases).

CO_2 laser turbinoplasty restored nasal flow as confirmed by the 4-phase-rhinomanometry in 25 patients (64.10%) at one month and in 32 of the patients (82.05%) at three months post-treatment. The reevaluation performed at 12 months after surgery showed a persistence of a normal nasal patency in 30 patients, representing 76.92%.

The pre-treatment mean value of total nasal airway resistance (NAR) was of 1.27 Pa/ccm/s at 150Pa. Rhinomanometry measurements performed at 1, 3 and 12 months after surgery revealed a significant reduction of NAR (Chart 1). At one month after surgery, we observed a reduction of NAR to a

Figure 1 Inferior turbinate hypertrophy

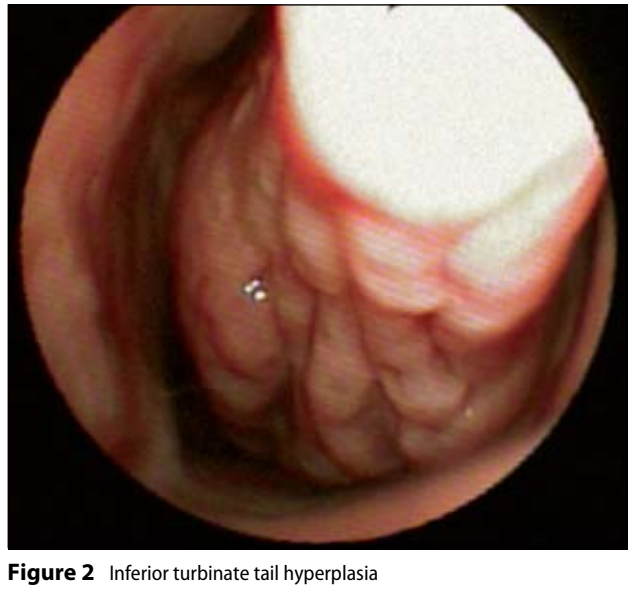

Figure 2 Inferior turbinate tail hyperplasia

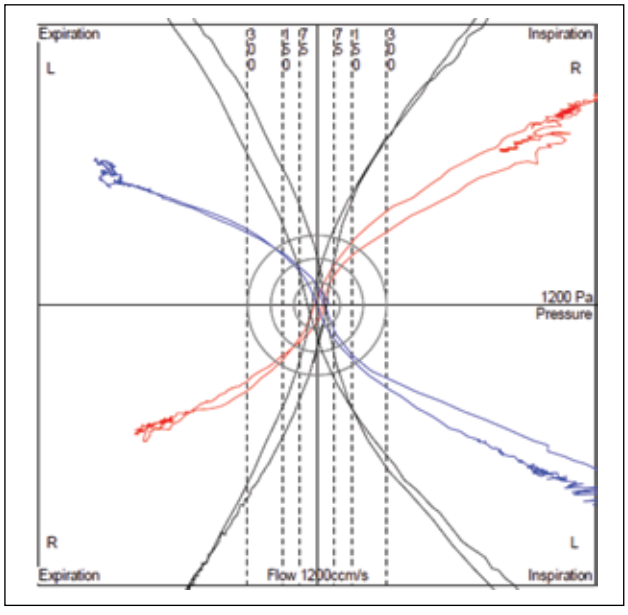

Figure 3 4-phase-rhinomanometry: moderate nasal obstruction. Normal nasal patency after decongestion

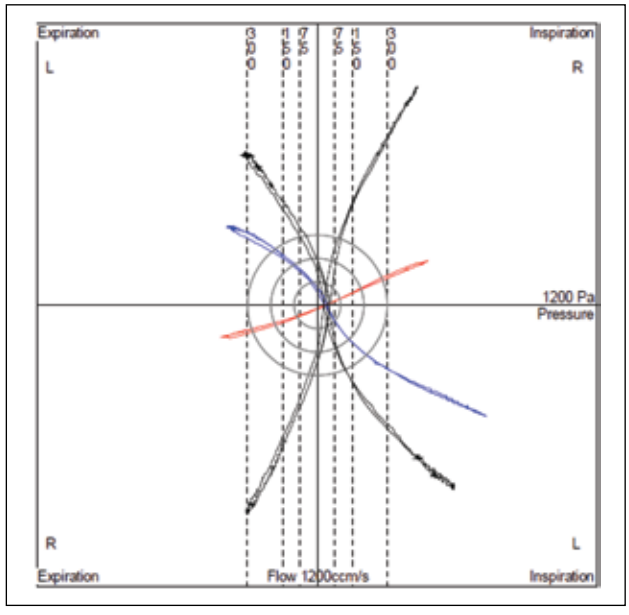

Figure 4 4-phase-rhinomanometry: severe nasal obstruction. Normal nasal patency after decongestion

mean value of 0.85 Pa/ccm/s. After three months, there was a reduction in mean total resistance from the pretreatment measurements to 0.73 Pa/ccm/s. The same results were found 12 months after surgery.

The objective results were sustained by the subjective functional ones. The overall symptomatic improvement was correlated with the visual analogue scale at 1, 3 and 12 months after surgery. There was a significant statistical difference ($p<0.05$) between the initial and follow-up VAS results regarding the nasal obstruction (Chart 2), rhinorrhea (Chart 3) and sneezing (Chart 3), as shown in Table 1. The same results were given by the SNOT-20.

No postoperative complications like synechia, bleeding, or other adverse events occurred in our CO_2 laser-treated patients.

DISCUSSIONS

The purpose of inferior turbinate surgery is to restore nasal flow, to improve nasal breathing and coexisting symptoms, while preserving the normal physiologic function of the turbinate's mucosa.

There are various surgical techniques described, such as partial turbinectomy, submucosal resection, cryosurgery, conchotomy, turbinate lateralization, inferior turbinoplasty, Argon-plasma surgery, submucous electrosurgery or vidian neurectomy[4,5,6,7,8,9].

Different types of lasers have been used, their advantages being less bleeding and tissue trauma, faster healing and even no hospitalization. The effect of CO_2 laser upon nasal patency and subjective symptoms have been assessed by Lippert and Werner[10]. In their study, 81.2% of the patients were satisfied at one year

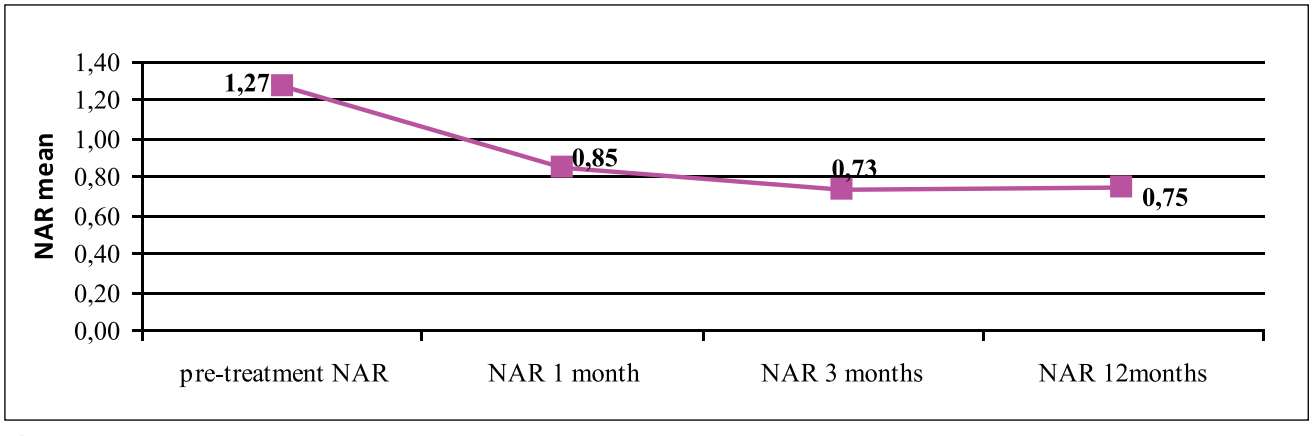

Chart 1 Pre- and post-treatment valueof total nasal airway resistance (NAR)

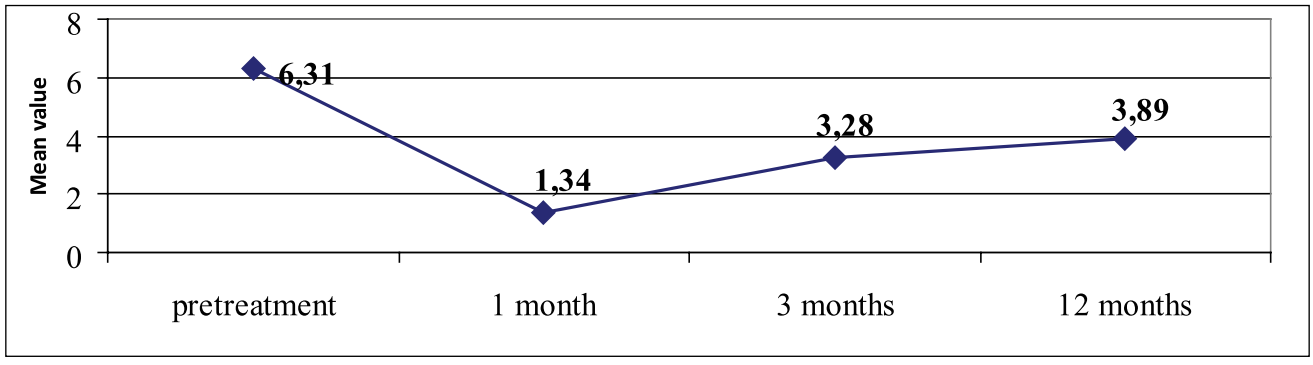

Chart 2 Pre- and post-treatment nasal obstruction symptom evaluation with the visual analogue scale (VAS)

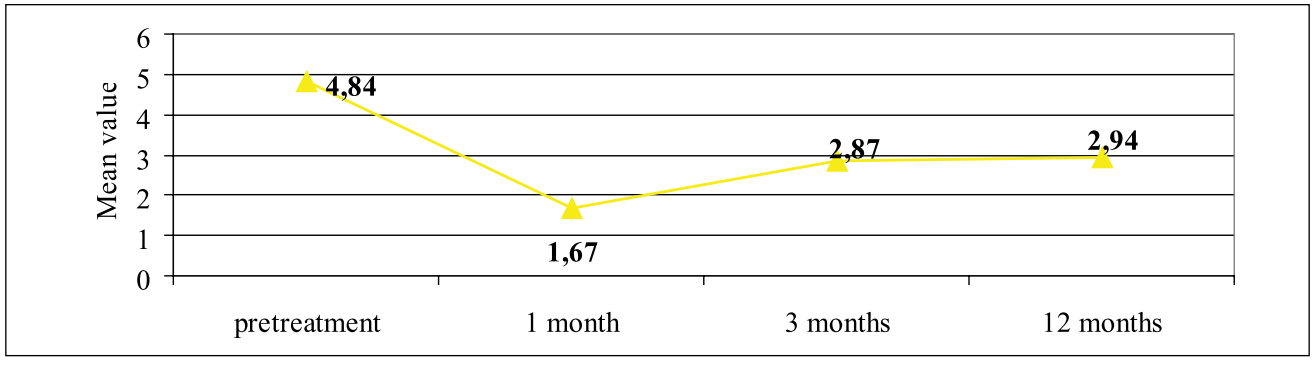

Chart 3 Pre- and post-treatment rhinorrhea symptom evaluation with the visual analogue scale (VAS)

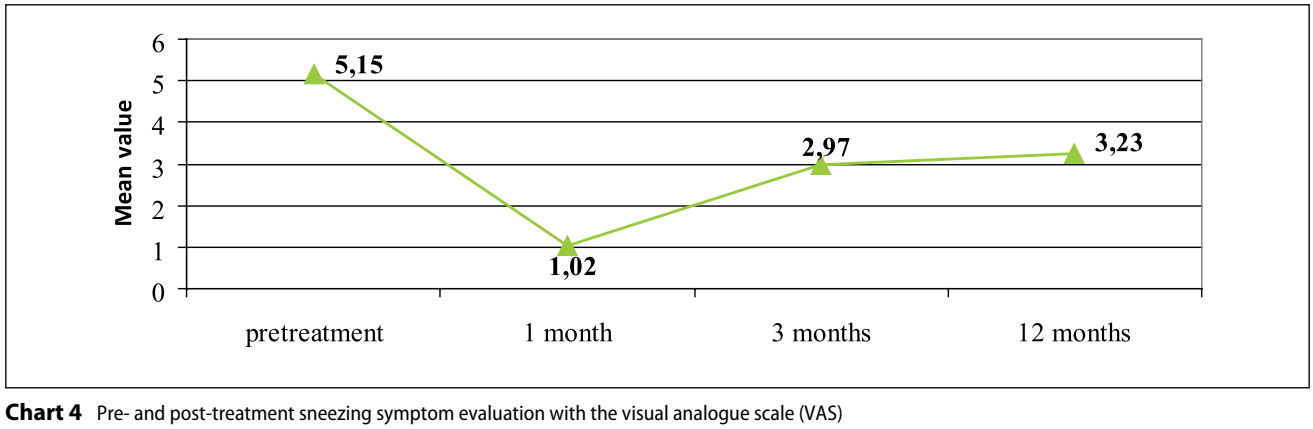

Chart 4 Pre- and post-treatment sneezing symptom evaluation with the visual analogue scale (VAS)

Table 1
Evolution of symptoms according to VAS results

Symptoms	Pretreatment	1 month	3 months	12 months	p value
Nasal obstruction	6.31	1.34	3.28	3.89	<0.05
Rhinorrhea	4.84	1.67	2.87	2.94	<0.05
Sneezing	5.15	1.02	2.97	3.23	<0.05
Itchy nose	3.95	1.33	2.59	3.07	-

after surgery, results than can be compared with our study observations.

The main aim of CO_2 laser turbinate surgery is preservation of a well-functioning mucosa membrane, creating a sufficiently large air space, and maintenance of a physiological airway resistance. Very high temperatures develop at the laser application site, which leads to the formation of a scar in the submucosal tissue with subsequent shrinkage of the turbinate. The thermal damage to the adjacent tissues is low. The thickening of the basilar membrane, with degeneration of the epithelial cells, numerous goblet cells, neutrophils and eosinophils, edema, nasal mucus overproduction and inflammatory infiltration in corium can be found at histopathological electron microscopy of nasal mucosa, in patients with chronic hypertrophic rhinitis[11,12].

After CO_2 laser turbinoplasty, the amount of evaporated mucosa can influence the volume reduction, the normal function of the turbinate's mucosa and olfactory function, too[13]. Therefore, we consider that, with the exception of the compensatory turbinate hyperplasia, a surgical reduction of the inferior turbinate should only be indicated if a three months conservative therapy has not had any subjective and objective (rhinomanometry) success.

To have an objective measure of the nasal patency, the literature recommends the rhinomanometry to be performed. From the technical point of view, rhinomanometry determines the nasal airway resistance by measuring the nasal airflow and differential pressure. The 4-phase rhinomanometry is a relatively new technique, which separates the ascending and descending parts of the pressure-flow curves during expiration and inspiration, providing in this way supplementary information[14,15]. In subjects with normal nasal airway path, the mean total resistance measured at 150Pa has been reported to be less than 0.75 $Pa/cm^3/s$, this meaning a very low obtruction and resistance and very high conductance[16]. The greater the total resistance value, the greater the severity of the nasal obstruction, fact observed also in our study comparing the nasal endoscopic examination and rhinomanometry results.

CONCLUSIONS

Our results show that CO_2 laser turbinoplasty is a safe and effective way of improving nasal flow. The effectiveness of turbinate surgery depends on the hypertrophy of the submucosal layer which can be estimated by comparing the pre- and post-treament nasal air flow, by using 4-phase-rhinomanometry.

Our study provides significant data showing the efficacy of CO_2 laser surgery of the inferior turbinate, by using rhinomanometry testing. We recommend performing 4-phase-rhinomanometry without and then with decongestion in any candidate for laser-assited turbinoplasty.

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