CO_2 laser surgery of hypertrophied inferior turbinates*

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SUMMARY

The inferior turbinates are responsible for nasal obstruction in patients with allergic and vasomotor rhinitis. Until today there is no satisfactory means of treating hypertrophied turbinates. One hundred and eighty-four patients with nasal obstruction due to hypertrophied inferior turbinates were treated with the CO_2 laser using the microscope and a micromanipulator. A few laser spots (1 W, 1 s, laser power density: 2,038 W/cm^2) were applied to the head of the turbinate. After a few days a positive effect was present. One hundred and twelve patients were followed for over 2 years. Six months after laser surgery, 87.5% had excellent or good results. After one year, 82.1% of the patients were satisfied, and after 2 years 80.4% were satisfied. The procedure involves little bleeding, no pain and can be done under local anaesthesia in an outpatient setting. Less post-operative wound care is necessary. Therefore, the CO_2 laser surgical technique can be considered as an effective method in the treatment of hyperthrophied turbinates.

Keywords: endonasal surgery, CO_2 laser, hypertrophied inferior turbinate, allergic rhinitis, nasal obstruction

INTRODUCTION

The incidence of allergic and vasomotor rhinopathies has increased steadily over the past years (Kawamura et al., 1993). Besides watery, clear nasal secretion, obstruction of nasal respiration due to hypertrophied turbinates is a major concern. Conservative treatment such as detumescent nose drops or antihistamine medication offers only few options, which prove ineffective in a considerable number of cases (Von Haacke and Hardcastle, 1985). Surgery is indicated if conservative measures were not successful.

Numerous surgical procedures for reducing hyperplastic inferior turbinates have been described, such as submucous turbinectomy (Fanous, 1986), inferior turbinoplasty (Mabry, 1987), conchotomy (Principato, 1979), total inferior turbinectomy (Ophir et al., 1985), turbinate lateralization (Thomas et al., 1987), cryotherapy (Motta et al., 1988), submucous electrosurgery (Talaat et al., 1987) or vidian neurectomy as a last resort (Nomura and Ichikawa, 1976). During the past few years different kinds of lasers were used again and again for turbinate reduction, achieving good results to a certain extent (Lenz, 1985; Levine, 1990; Dobrovic and Hosch, 1996).

A laser surgery procedure for turbinate reduction using a CO_2 laser has been employed at the Department of Otorhinolaryngology/Head and Neck Surgery of the University of Kiel since 1987. The present study discusses indications, the surgical procedure as such and the results of this method of treatment.

PATIENTS AND METHODS

From April 1, 1987 to June 30, 1993, a total of 184 patients were treated with the CO_2 laser at the Department of Otorhinolaryngology/Head and Neck Surgery of the University of Kiel, and a total of 404 turbinate reductions were performed. Of these 184 patients, 103 were females and 81 were males, the average age was 36.3±11.4 years. All patients suffered from chronic obstruction of nasal respiration with hypertrophied inferior turbinates due to perennial allergic rhinitis caused by housedust mites (n=137) or vasomotor rhinitis (n=47). Other pathological signs obstructing nasal respiration, such as a deviating septum or nasal polyps, were not observed.

Pre-operative assessment

Rigid and flexible endoscopy was used in every case to examine the nose in order to assess the extent of turbinate hyperplasia and to exclude other pathological findings. To obtain objective data about nasal obstruction, and to determine whether it was primarily due to hyperplastic mucosa rather than a hypertrophied turbinate bone, rhinomanometry was used to quantify the mucosal portion obstructing nasal respiration. After initial

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rhinomanometry in the swollen state, naphazoline nitrate solution (1:1,000) was applied to the mucosa of the inferior turbinates, first to the head of the turbinate, then to the middle one-third and finally to the posterior one-third. Rhinomanometry was done 10 min after decongestion of each respective region. In addition, the patient was asked to rate nasal breathing subjectively. Turbinate reduction by laser surgery was only pursued if the patient's subjective impression indicated a clearly improved nasal breathing after turbinate decongestion and if this was also objectified by the rhinomanometric results.

Anaesthetic settings

Turbinate reduction with the CO_2 laser was generally done under local anaesthesia on an out-patient basis. Local anaesthesia consisted of an infiltration anaesthesic (1% lignocaine) in conjunction with a topical anaesthesic (4% lignocaine). A vasoconstrictive agent should not be added to the topical anaesthesic. The procedure was done under general anaesthesia only if the patient was a child or at the patient's express request.

CO_2 laser surgical technique

CO_2 lasers (mediLas Sharplan 1050; Sharplan Lasers, Freising, Germany and OPMI-LAS CO_2 50; Zeiss, Oberkochen, Germany) were used to apply a few laser spots to the head of the swollen turbinate (Figure 1). Depending on the micromanipulator used, laser power amounted to 1-4 W for 1 s. Laser light was applied using a microscope (OPMI-1, Zeiss, Oberkochen, Germany) and a micromanipulator at a distance of 400 mm. Until 1991 the "Microslad 719" micromanipulator (Sharplan Lasers, Freising, Germany) with a focus diameter of 0.64 mm was used. Since 1992 we have been using the "Acuspot 711" micromanipulator (Sharplan, Freising, Germany) with a focus diameter of 0.25 mm. Carbonization particles were removed at the end of the procedure with a moist cotton applicator in order to prevent foreign body reactions. A nasal tampon was inserted for 1-2 days.

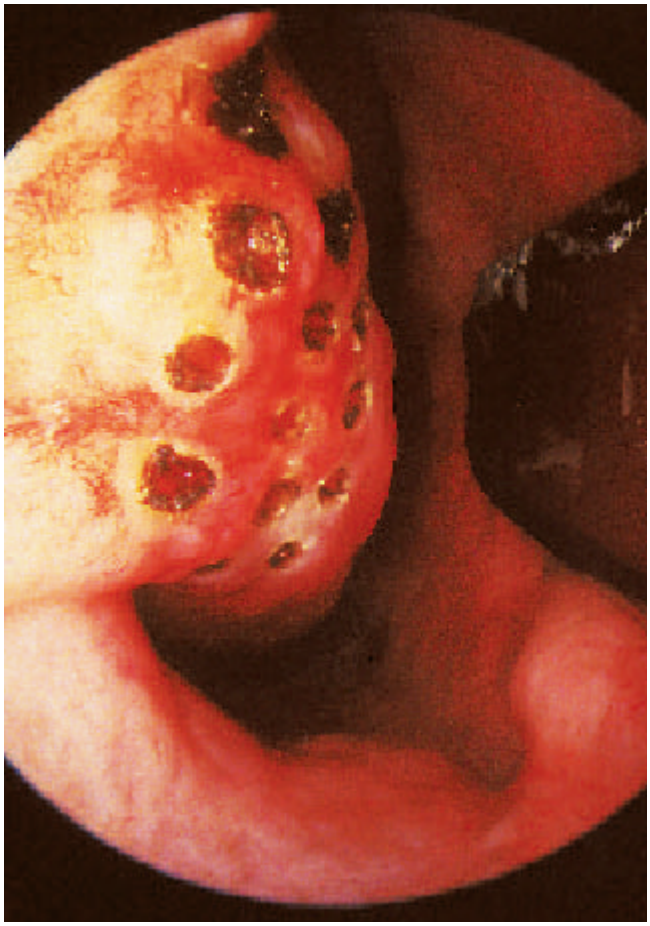

Figure 1. Hyperplastic inferior turbinate just at the end of the CO_2 laser treatment. The laser spots on the head of the turbinate can be seen. The volume of the turbinate is already reduced.

Post-operative evaluation

Follow-ups were done once a week for 4 weeks and every 3 months from then on. The minimum follow-up period was 2 years (n=112). A rhinomanometric evaluation was done in addition to the endoscopic examination of the nose. The patients had to fill in a standardized questionnaire derived from Von Haacke and Hardcastle (1985), which contained the following questions: (1) Was the operation a success?; (2) Which complaints have improved due to the operation?; (3) Did any complications develop after the operation such as dryness of the nasal mucosa, crust formation, nose bleeding or sensation of unpleasant odours?; (4) How long did the positive therapeutic effect last?; and (5) Would you consent to this procedure once again?

RESULTS

Already 1 week after the CO_2 laser surgical procedure for turbinate reduction, the patients reported improved nasal breathing, a lasting and clearly positive effect was observed after 2 weeks. Most of the allergic patients (n=110; 80.2%) reported a significant improvement of their symptoms in terms of decreased watery nasal discharge and less sneezing. In 61.3% of the cases (n=84) no further anti-allergic medication was necessary. Statistically, IgE and RAST had no influence on the efficiency of CO_2 laser treatment. Six months after laser surgery, 98 patients (87.5%) still were free of symptoms. After one year, 92 patients (82.1%) and after two years 90 patients (80.4%) were still satisfied with the outcome of the operation (Table 1). There were no significant differences in the long-term results between allergic and non-allergic patients.

Table 1: Therapeutic success rates at 6, 12, and 24 months after CO_2 laser surgery (n=112).

follow-up period	No. of satisfied patients
6 months	98 (87.5%)
12 months	92 (82.1%)
24 months	90 (80.4%)

Crust formation at the head of the inferior turbinate commonly occurs in the process of healing after laser surgery. Until 1991, when the micromanipulator with the broader focus was still being used, post-operative wound care and especially the removal of mucosal crusts required 14-22 days. After introduction of the narrower focus, the period of post-operative care lasted only 8-10 days in 95% of the cases. By then the mucosa had

almost completely healed and no further wound care was necessary. The rate of complications was low and slight secondary haemorrhages, which occurred in only 4 cases (3.6%), could be managed without anterior nasal packing.

Two patients complained about dryness of the nose. Unpleasant odours and formation of synechias were not observed. Approval of this surgical technique is high: 103 out of 112 patients (92%) treated with the CO_2 laser would once again consent to the procedure.

DISCUSSION

Various kinds of lasers have been used in nasal turbinate reduction in the past. By far, most experience has been gained using argon lasers (Lenz, 1985). There are also reports on the successful application of the CO_2 laser (Kawamura et al., 1993; Lippert and Werner, 1995), the KTP laser (Levine, 1990), the Ho:YAG laser (Oswal and Birmingham, 1992), the magnet laser (Mamedov, 1991) and the Nd:YAG laser (Lippert and Werner, 1996). Little bleeding and tissue traumatization are considered to be advantages of the laser surgical procedures. Comparative studies with the above-mentioned conventional methods also indicated that laser surgery showed very promising long-term results (Elwanny and Harrison, 1990). An assessment of the published results must necessarily be limited because of the small number of cases, the short follow-up periods in some instances and the use of different modes of treatment, which preclude comparison.

Accurate diagnosis adhering to strict criteria is an essential prerequisite if the laser surgical procedure to treat hypertrophied turbinates is to be effective and successful. Obstruction of nasal respiration must mainly be due to pronounced mucosal swelling (Johnson, 1990). The localization of turbinate hyperplasia will determine which kind of laser to use. The CO_2 laser is especially effective if nasal obstruction is caused by a hyperplastic head of the turbinate, which is true in most of the cases (Lenders and Pirsig, 1990). However, if the entire mucosa is hyperplastic then the Nd:YAG laser should be used alone or together with the CO_2 laser (Werner and Rudert, 1992; Lippert and Werner, 1995).

A great variety of CO_2 laser surgical techniques is described in the literature. Selkin (1985) uses the CO_2 laser to resect the hypertrophied mucosa of the turbinate in a line (15-18 W), whereas Elwany and Harrison (1990) almost completely vaporize the mucosa in the anterior one-third of the turbinate (20-30 W). Fukutake et al. (1986) remove the entire mucosa of the inferior turbinates by evaporization (20-25 W, once a week for 5 weeks).

In contrast to the techniques mentioned above, we apply single laser spots (laser power density: 2,038 W/cm^2; period of application: 1 s) to the head of the swollen turbinate. With this laser energy density the CO_2 laser penetrates about 1 mm into the tissue. Depending on the extent of the shrinkage of the turbinate one to three additional laser light applications are administered to the same spot with exactly the same parameters. This results in penetration depths of up to 4 mm.

Very high temperatures develop at the laser application site. This leads to the formation of a scar in the submucosal tissue with subsequent skrinkage of the turbinate. The thermal damage to the adjacent tissues is low. Laser light application with the single-spot technique leaves enough epithelialized mucosa to render immediate re-epithelialization. Until 1991, CO_2 laser light was applied using a micromanipulator with a focus diameter of 0.64 mm and working at a distance of 400 mm. In order to achieve a similar effect on the turbinate mucosa, one needed to apply more power with this broad focus than with the "Acuspot 711" with a beam diameter of 0.25 mm, which has been used since 1992. Compared to laser light application with high power and broad focus, the carbonization and necrosis zone is considerably narrower if laser light reduced in power and focus is used (Lippert et al., 1994). This in turn involves less tissue traumatization with intact mucosal islets between the laser spots. A substantial decrease in post-operative crust formation since the "Acuspot 711" was introduced is clinical evidence for this observation. Post-operative formation of crusts is more extensive after application of Nd:YAG laser light in the non-contact mode.

Sometimes excessive fibrin exudation can be observed, requiring postoperative wound care for many weeks (Principato, 1979). Extensive epithelial scars clearly disturb the function of the turbinate mucosa, entailing a tendency towards recurrent crust formation, dryness of the nasal mucosa or atrophic rhinitis (Simpson et al., 1983). Moderate scar formation, on the other hand, is desirable especially in cases of allergic rhinitis, in order to effectively interrupt allergic reactions in the superficial layer of the submucosa, which is the probable site of the allergic reaction (Fukutake et al., 1987; Kawamura et al. 1993). The positive effect of CO_2 laser treatment on allergic rhinitis shows clinically in an improved nasal breathing, in a decrease of watery nasal discharge and in less sneezing. Furthermore, in over 60% of the patients suffering from perennial housedust-mite allergy the dose of anti-allergic drugs could be reduced.

Long-term results are the decisive criterion in assessing the suitability of a surgical technique, especially in comparison to other, already established methods. In order to evaluate this, a group of patients treated with laser surgery was followed up for 2 years. Their results were compared with those obtained in a retrospective study of cases in which only electrocoagulation had been used (Lippert and Werner, 1995). The CO_2 laser surgical technique proved to be by far superior to electrocoagulation.

The most significant difference between the laser technique and turbinate cauterization, next to the lower rate of complications, is the better long-term result achieved by the laser, which is possibly due to more pronounced scar formation of the turbinate mucosa. Consent to another round of laser surgery is also conspicuously higher than to electrocoagulation. The favourable acceptance of laser surgery may be attributed to its effectiveness on the one hand, and to the fact that the procedure is fast, involves little pain and can be done in an outpatient setting, on the other hand.

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ANNOUNCEMENT

15th INTERNATIONAL COURSE IN FUNCTIONAL CORRECTIVE NASAL SURGERY

Utrecht, The Netherlands, June 15–20, 1997

From June 15 to June 20, 1997, the 15th International Course in Functional Corrective Nasal Surgery will be given at the University Hospital, Utrecht, The Netherlands, under the direction of professor E.H. Huizing. The course will consist of lectures, video-demonstrations, cadaver demonstrations and live TV-surgery. The official language spoken during the course is English.

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