Isolated nasal surgery in the treatment of adult obstructive sleep apnea syndrome – Pilot study

Original Article

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Abstract

Objective: to evaluate the effects of isolated nasal surgery in the treatment of Obstructive Sleep Apnea Syndrome (OSAS), through the impact on the reduction of the Apnea-Hypopnea Index (AHI), the Oxygen Desaturation Index (ODI), the minimal peripheric oxygen saturation (SpO2min) and in the results of the Epworth Sleepiness Scale (ESS).
Study Design: retrospective cohort study
Material and methods: Clinical processes of patients diagnosed with OSAS who had complete clinical assessment with polysomnography, drug induced sleep endoscopy (DISE) and Computed Tomography (CT) of the paranasal sinuses and pharynx, were analyzed. Those who underwent isolated nasal surgery as a therapeutic procedure and performed a control polysomnography were selected. The following variables, before and after the intervention, were submitted to statistical analysis: AHI, ODI, SpO2min, ESS result and weight.
Results: Of the fifteen patients, mostly male (13/86.6%), there was a statistically significant improvement of the AHI ($p=0.019$), ODI ($p=0.008$) and ESS ($p=0,015$) after surgery. There was no statistically significant association between SpO2min ($p=0.089$) or weight ($p=0.862$) before and after surgery.
Conclusions: Isolated nasal surgery can be effective in OSAS, in selected patients.

Keywords: Nasal surgery; Obstructive sleep apnea

Introduction

Obstructive sleep apnea (OSA) is the most common sleep disorder and is characterized by recurrent episodes of partial or complete obstruction of the upper airways during sleep, which leads to episodes of apnea, hypopnea, or respiratory effort-related microarousals[1]. The most common risk factors are old age, male sex, obesity, and craniofacial dysmorphia. OSA causes well-known symptoms such as daytime hypersomnolence, headache, insomnia, and problems concerning concentration, memory, and mood. If it is not properly addressed and treated, it is associated with an increased risk of adverse events such as driving accidents, neuropsychiatric dysfunction, brain and cardiovascular morbidity, pulmonary hypertension, type 2 diabetes, and metabolic syndrome[2,3].

Mild OSA is defined by an apnea-hypopnea index (AHI) between 5 and 15 events/h, and treatment is only recommended in the presence of obstructive sleep apnea syndrome (OSAS). OSAS is characterized by an AHI>5 associated with symptoms such as excessive daytime sleepiness with Epworth Sleepiness Scale (ESS)>11 or the presence of two or more of the following symptoms: repetitive episodes of nocturnal breathing cessation, feeling of non-restorative sleep, frequent awakenings during sleep, daytime tiredness and fatigue, and difficulty in concentrating. The treatment of OSA is advised for moderate apnea (15<AHI<30) and severe apnea (AHI>30), even in the absence of symptoms due to the associated increased cardiovascular risk[3].

The first-line treatment of moderate or severe OSA is continuous positive pressure ventilation, which can be administered in various ways, including continuous, automatic, and bilevel positive airway pressure. This method was described for the first time in 1981 and highly effective in improving or eliminating hypoxemia and consequent microarousals[4,5]. However, the rate of patient adherence is often suboptimal, varying between 40% and 85%, due to sociodemographic and psychosocial factors and the adverse effects of the therapy—nasal congestion and airway dryness—which reduce its effectiveness[6,7]. Approximately 8% of patients stop using CPAP in the first night, and around 50% abandon the therapy during the first year of use. Even with the implementation of behavioral measures, this trend has been stable in recent years[8]. Thus, other more individualized treatment options should be considered for patients who refuse or cannot tolerate ventilation therapy after considering the nature of the obstruction and the patient's preference[9]. Examples of treatment include positional therapy, mandibular advancement devices, and surgery, in addition to measures such as weight loss and abstaining from alcohol and medications that can cause muscle hypotonia[9,10]. Surgery, which is usually multilevel, has curative potential and high effectiveness (because it does not depend on patient adherence) and thus plays an important role, being advocated by some authors as the first-line treatment in selected cases[11,12]. Moreover, the American Academy of Sleep Medicine (AASM) strongly recommends that patients with OSA and BMI<40 Kg/m^2 who are intolerant or non-adherent to CPAP be referred to a sleep surgeon[10].

Several factors must be considered while selecting the surgical technique—the presence of a fixed or dynamic anatomic obstruction and preservation of physiological function[13].

Nasal surgery has been shown to contribute to reduced upper airway resistance with beneficial effects, such as improved quality of life and sleep, adaptation to CPAP, and better outcomes of multilevel surgery. Nevertheless, it is argued that it does not decrease the AHI and is not recommended as the sole procedure to treat moderate to severe OSA[14-16]. However, some authors have claimed that nasal surgery alone can improve the AHI in adequately selected patients and should be considered a treatment option in this condition[17,18]. This study aimed to determine the effectiveness of nasal surgery when used alone for the treatment of OSAS.

Material and Methods

The clinical records of patients aged 18 years or older who attended the Snoring and Sleep Apnea Clinic of the Hospital CUF Tejo between January 1, 2018, and August 30, 2021, were reviewed and screened. The purpose was to identify patients with a diagnosis of OSAS who were evaluated by polysomnography, drug-induced sleep endoscopy (DISE), and computed tomography (CT) of the paranasal sinuses and pharynx. The patients who underwent nasal surgery as the sole treatment

procedure and control polysomnography after the surgery were selected. Patients with incomplete data, those who underwent multiple surgical interventions (multilevel surgery), and those who did not undergo control polysomnography were excluded. A total of 15 patients were evaluated. The following variables were analyzed (before and after the surgical intervention): AHI, ODI, SpO_2min, ESS scores, and body weight. This assessment was performed during a period of three to six months after the surgery.
Descriptive statistical analysis of the sample was performed using the IBM SPSS Statistics 25 software . The significance level was set at 5% ($p<0.05$).

Results

Thirteen of the 15 patients (86.6%) included in the study were men, and only two (13.4%) were woman. The mean age was 47 years (minimum 35 years, maximum 69 years, standard deviation [SD] 8.19). At the time of diagnosis, the mean weight of the patients was 85.92 kg (95% confidence interval [CI] 80.47–91.37, SD 2.47), mean AHI was 17.58/h (95% CI 11.86–23.65, SD 2.6), mean ODI was 19.73/h (95% CI 15.27–24.19, SD 2.02), SpO_2min was 80.33 % (95% CI 76.24–84.41, SD 1.85), and the mean ESS score was 8.75 (95% CI 6.31–19.50, SD 1.10). Table 1 shows the data of the patients before the surgical intervention.

Table 1
Pre-surgery data

Variable	N (total = 15)
Male/Female	13/2
Age	47 years (min. 35 – max. 69) (SD 8.19)
Weight	85.92 kg (SD 2.47) (CI 80.47–91.37)
AHI	17.58/h (SD 2.6) (CI 11.86–23.65)
ODI	19.73/h (SD 2.02) (CI 15.27–24.19)
SpO_2min	80.33% (SD 1.85) (CI 76.24–84.41)
ESS	8.75 (SD 1.10) (CI 6.31–19.50)

Abbreviations: AHI, apnea-hypopnea index; ODI, oxygen desaturation index; SpO2min, minimum peripheral oxygen saturation; ESS, Epworth Sleepiness Scale; SD, standard deviation; CI, confidence interval.

Regarding the surgical procedures, all patients underwent septoplasty and inferior turbinoplasty. In some patients, there was a need to add other nasal surgical procedures. One patient also had nasal valve surgery, three patients had additional endoscopic endonasal surgery (for polypectomy, middle meatotomy, and/or anterior ethmoidectomy), and one patient required additional rhinoplasty.
Compared to the values before the surgery, tests of association showed a statistically significant improvement after the surgery in the following: mean AHI, which decreased from 17.58/h (SD 2.6) to 9.18/h (SD 2.4) ($p=0.019$); mean ODI, which decreased from 19.73/h (SD 2.02) to 8.3/h (SD 2.38) ($p=0.008$); mean ESS score, which decreased from 8.75 (SD 1.1) to 6.5 (SD 1.01) ($p=0.015$). There were no statistically significant differences between the SpO_2min before (80.33%, SD 1.85) and after the surgery (85.22%, SD 1.56) ($p=0.089$), nor between the weight before (85.92 kg) and after (85.86 kg) the surgery ($p=0.862$).
Table 3 lists the results of the tests of association for the analyzed variables before and after the surgery.

Discussion

In this study, there was a statistically significant improvement in the AHI, ODI, and daytime sleepiness after nasal surgery. The reported physiological mechanisms through which nasal obstruction conditions or contributes to OSA include the Starling resistor model, shunting of airflow through a collapsible oral airway, blockage of the nasal respiratory reflex, and reduced nitric oxide production[19]. Moreover, complete resistance of the airway correlates with the respiratory effort, with the nasal cavities accounting for more than half of this resistance[20]. Reduced nasal flow is associated with decreased sleep quality, increased daytime sleepiness, and increased risk of snoring and OSA[21]. Paradoxically, nasal surgery has been shown to be effective in improving the adaptation to CPAP, quality of life, and daytime sleepiness, but its effect on the reduction in the AHI is usually negligible[21,22]. In this study, there

Table 2
Tests of association

Variable	Before surgery	After surgery	p-value
AHI	17.58/h (SD 2.6) (CI 11.86–23.65)	9.18/h (SD 2.4) (CI 3.83–14.53)	0,019
ODI	19.73/h (SD 2.02) (CI 15.27–24.19)	8.3/h (SD 2.38) (CI 3.06–13.55)	0,008
SpO_2	80.33% (SD 1.85) (CI 76.24–84.41)	85.22% (SD 1.56) (CI 81.55–88.44)	0,089
ESS	8.75 (SD 1.10) (CI 6.31–19.50)	6.50 (SD 1.01) (CI 4.26–8.74)	0,015
Weight	85.92 kg (SD 2.47) (CI 80.47–91.37)	85.86 kg (SD 2.42) (CI 80.53–91.20)	0,862

was a significant improvement in daytime sleepiness, as assessed by the ESS, which was associated with a significant reduction in the AHI.

Wu *et al*. obtained similar results in a meta-analysis in which the authors analyzed 18 articles with a total of 587 patients who underwent nasal surgery as the sole treatment and observed a significant improvement in the AHI and ESS scores[17]. The patients' mean age in that study was 44 years, and 90.5% of the patients were male, characteristics similar to those of the population evaluated in this study.

Currently, the AHI is considered the primary parameter for the evaluation of OSA, while ODI and SpO_2min are considered secondary measures. We observed a statistically significant reduction between the ODI scores before and after the surgery. There is no reference in the literature regarding the use of this parameter to evaluate the effectiveness of nasal intervention in patients with OSA. Nevertheless, we deem this reduction important because it reflects a reduction in intermittent hypoxia, whose harmful effects (release of reactive oxygen species and inflammatory mediators) contribute to the comorbidities seen in these patients[23].

However, there was no association between minimum SpO_2 before and after the surgery. Notably, these values were low ab initio, with a mean value of 80.33% (CI 76.24-84.41), which indicates an undiagnosed disease of the lower respiratory tract and/or the presence of other important variables that were not analyzed, namely smoking. The relationship between body weight reduction and a decrease in the severity of OSA is well established[24]. In our study, the association between the initial weight and weight after the surgical intervention was not statistically significant (p=0.862), which makes weight variation an improbable causal factor of the observed associations.

Thus, in this study, nasal surgery alone was effective in treating OSA in some patients as it allowed a reduction in the AHI to values below five events/h. Moreover, it was effective in the treatment of OSAS in all patients, as they all achieved an AHI below 15 events/h without symptoms (as assessed by the ESS scores) and therefore did not require complementary treatments.

Despite the promising results, most studies on this topic report that the role of nasal surgery in the treatment of OSAS or OSA is limited to an improvement in snoring, adherence to CPAP, or the outcomes of multilevel surgery. Similar to our study (although prospective), Friedman et al. conducted a study with 50 patients to evaluate the improvement in sleep after nasal surgery alone[25]. They showed an expected subjective improvement in the nasal symptoms and daytime hypersomnolence without a consistent statistically significant improvement in the respiratory disturbance index. The improvement in SpO_2min depended on the severity of OSA. However, there was a statistically significant reduction in the levels of CPAP pressure required to correct OSA, which demonstrates the fundamental role of nasal surgery in the treatment of OSA. In a meta-analysis conducted by Ishii *et al*., in which 10 studies with a total of 320 patients were analyzed, the authors demonstrated a significant improvement in the ESS scores but not in the AHI[26]. Similarly, in another meta-analysis conducted by Li *et al*. (13 studies, 474 patients), the authors reported an improvement in snoring and daytime sleepiness after nasal surgery alone but not in the AHI[27].

The main limitation of this study was the small sample size, although many studies included in the abovementioned meta-analyses[17,26,27] also had a limited number of participants (approximately 20 patients). Although this study had a significant number of patients undergoing nasal surgery for the treatment of OSA/OSAS, not all of them underwent control polysomnography, either because of access difficulties or because they felt better and deemed it unnecessary.

Nevertheless, the dissemination of the data obtained in this study is important because it reinforces the role of the otorhinolaryngologist in the sleep team as a professional who can offer a range of therapeutic options, including surgery, and the importance of monitoring the effect of the chosen treatment. According to the AASM, OSA should be addressed as a chronic disease that requires prolonged multidisciplinary vigilance. Further, patients should be provided with multiple treatment options, depending on the severity of their condition, risk factors, anatomic constraints, and their individual preference[28].

Conclusions

In adequately selected patients, nasal surgery alone can be an effective treatment for mild to moderate OSAS, although randomized controlled studies with larger samples are required to confirm these findings.

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Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

Data Confidentiality

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

Protection of humans and animals

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the 2013 Helsinki Declaration of the World Medical Association.

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Availability of scientific data

There are no datasets available, publicly related to this work.

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