The Role of the Nose in Obstructive Sleep Apnea: A Short Review

Die Rolle der Nasenatmung bei obstruktiver Schlafapnoe

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Abstract

A variety of causes may result in nasal obstruction including allergic and non-allergic rhinitis, anatomic abnormalities, and postoperative nasal packing. There is both an epidemiological and clinical relationship between nasal obstruction and sleep disordered breathing. Subsequently, improving nasal patency via surgical or non-surgical means is expected to relieve sleep disordered breathing. The present review will discuss and review some of the literature related to the pathophysiological interaction of the human nose and sleep disordered breathing and provide a summary of the effects of related intervention trials.

Impact of nasal obstruction

Obstructive sleep apnea syndrome (OSAS) is a common condition with a prevalence of 2 – 4% of men and 1 – 2% of women. A variety of risk factors have been reported for OSAS, including obesity, male gender, craniofacial abnormalities, and/or nasal obstruction. The latter has been supported by a number of observational and cross-sectional studies that have demonstrated a relationship between nasal obstruction and obstructive sleep apnea [1]. Nasal obstruction may result from allergic and non-allergic rhinitis, anatomic abnormalities, postoperative nasal packing, and/or experimental nasal occlusion. In a population-based study, Young et al. [2] previously suggested a relationship between frequent symptoms of nasal obstruction (5 or more nights a month) and reports of habitual snoring, chronic excessive daytime sleepiness, or chronic nonrestorative sleep. Subsequently, improving nasal patency via surgical or non-surgical means is expected to relieve sleep disordered breathing. We will discuss and review some of the literature related to the pathophysiological interaction of the human nose and sleep disordered breathing and provide a summary of the effects of related intervention trials. Some of the therapeutic intervention trials presented in this review have been summarized in a 2011 Task Force Report of the European Respiratory Society [3].

Zusammenfassung

The effects of nasal occlusion on sleep and breathing

Olsen et al. [9] studied the effects of experimental nasal obstruction on sleep and breathing in eight male volunteers (30 to 50 years of age). None of the subjects was obese; furthermore none of the subjects reported sleep problems or difficulties in breathing through the nose. The subjects were randomised into two groups. One night subjects were studied with the nose open and a second night with the nose obstructed using a small amount of cotton and Vaseline placed inside the nasal vestibule and covered with an adhesive tape. The authors demonstrated an increased number of arousals, more frequent sleep stage changes, and a significant increase in the number of obstructive apneas and hypopneas during sleep associated with nasal occlusion. Furthermore, the subjects complained about dry mouth, sore throat, frequent awakenings, and restlessness following the night of experimental nasal obstruction. Using a similar study design, Zwillich et al. [10] investigated the effects of nasal obstruction on polysomnographically derived parameters in ten normal men between the age of 25 and 45. Nasal occlusion was accomplished using an inflatable balloon that was placed into each nostril. The subjects slept during 3 consecutive nights with all instruments in place, including one standard acclimatisation night, one night with the balloon inflated and another night with the balloon deflated. The order of the obstructed and non-obstructed night was randomised. Consistent with the findings above, the authors observed more frequent arousals, decreased slow wave sleep, and a significantly increased number of (predominantly central) apneas per night during obstructed sleep (total number of apneas 88±34) than non-obstructed sleep (total number of apneas 34±19). Lavie and colleagues [11] extended these findings, as they used an experimental design that included unilateral or bilateral nasal occlusion. They studied 5 men and 5 women between 20 and 27 years of age on four nights (no occlusion, either left or right, or bilateral occlusion of the nostrils with an adhesive tape). Both partial and complete nasal occlusion was associated with an increased number of apneas and hypopneas, as well as disturbed sleep architecture, with the respective study findings being more pronounced with bilateral nasal occlusion. In a subsequent report, Lavie [12] studied the effects of nasal obstruction in 6 sons of sleep apnea patients (mean age 21 yrs, BMI not reported). Nasal occlusion resulted in a marked increase in the total number of apneas from 18 to 303 per night in this group, an observation that was much weaker in matched controls. This report provided early evidence of potential inheritability of upper airway obstruction during sleep.

Nasal obstruction may also be a result of bilateral nasal packing following nasal surgery. Results from earlier studies monitoring peri- and postoperative oxygen saturation in patients who received total nasal packs after septoplasty, revealed evidence of significant postoperative nocturnal hypoxemia. Regli et al. [13] performed a case-control trial using polygraphy prior to and after nasal packing in a group of 15 patients with OSAS (median AHI 14/hr, 80% male, median age 50 yrs, median ESS 13, median BMI 31 kg/m²) and another group of 25 individuals without OSAS (median AHI 11/hr, 76% male, median age 46 yrs, median ESS 5, median BMI 26 kg/m²). The authors observed a significant increase in postoperative AHI in both groups (median AHI 37/hr in non-OSAS and 39/hr in OSAS-group) and an increase in the oxygen desaturation index in patients without sleep apnea. Most recently, Friedman et al. [14] tested the effect of postoperative nasal packing on sleep parameters between patients with mild obstructive sleep apnea and those with moderate to severe ob-

**Table 1** Nasal obstruction and OSA. Pathophysiological impact of nasal obstruction in the development of obstructive sleep apnea.

<table>
<thead>
<tr>
<th>Breathing through the human nose results in</th>
<th>Partial or complete nasal occlusion results in</th>
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<tbody>
<tr>
<td>– ventilation</td>
<td>– oral breathing periods</td>
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<tr>
<td>– upper airway dilator</td>
<td>– upper airway resistance</td>
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<tr>
<td>– muscle activity</td>
<td>– obstructive apnea events</td>
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<td>– upper airway stability</td>
<td>– arousals</td>
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Nasal surgery on obstructive sleep apnea

The majority of reports on nasal surgery as a single-intervention in OSA have been published either as case-series or retrospective analyses [3]. One report [21] was conducted as a prospective, randomised, sham-controlled trial. The most frequently observed pathologic finding in the preoperative ENT examination was nasal obstruction due to deviated nasal septum. Accordingly, septal surgery (submucosal resection with or without turbinectomy) was the most frequently applied surgical technique in these reports. All the studies that have performed rhinomanometry reported significant postoperative improvements in total nasal resistance, indicating postoperative improvements in nasal airflow patency in patients. Overall, the large majority of studies reported no significant changes in the AHI (RDI) (mean preoperative AHI range 14 – 56/hr vs. mean postoperative AHI range 15 – 48/hr), including the above mentioned study [21], which was conducted as a randomised sham-controlled intervention trial in a matched population. One study [22] reported a significant improvement in AHI and sleep architecture in patients with normal preoperative cephalometric measurements, but no beneficial effect in a group of patients with abnormal cephalometric measurements prior to surgery, suggesting that the success of nasal surgery may be predictable by preoperative anatomic findings. Despite the lack of beneficial effects with respect to the AHI, there have been improvements in either sleepiness scales or daytime energy levels, and a reduction in therapeutic CPAP pressure required to alleviate OSA in some of the studies. Thus on the basis of the above mentioned findings, nasal surgery as a single intervention cannot be recommended for treatment of obstructive sleep apnea [3].

Conclusions

The nasal breathing route is important to upper airway stability. Studies of nasal obstruction demonstrated initiation or worsening of sleep disordered breathing. Relief of nasal obstruction via intranasal decongestants and/or steroids, or via nasal surgery have been shown to attenuate sleep disordered breathing.

Conflict of interest

The author has no conflict of interest.
References

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