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Nasal Obstruction Symptom Evaluation Score to Guide Mask Selection in CPAP-Treated Obstructive Sleep Apnea

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Abstract

Nasal obstruction is frequently reported by patients with sleep apnea and complicates the choice of a nasal or oronasal mask for continuous positive airway pressure (CPAP) therapy. However, the type of interface used for the delivery of CPAP is crucial to ensure tolerance and compliance. The aim of this prospective pilot study was to identify whether the validated Nasal Obstruction Symptom Evaluation (NOSE) score rated at CPAP initiation was associated with the type of mask used after 4 months of treatment. Patients completed the NOSE questionnaire before initiation with automatic CPAP. The mask used (nasal/oronasal) after 4 months was documented. In total, 198 consecutive patients with sleep apnea were included. NOSE score (>50/100) was independently associated with the use of an oronasal mask at 4 months (sensitivity, 34.8%; specificity, 87.5%). The NOSE questionnaire could be a simple decision-making tool to guide the choice of mask during CPAP initiation.

Keywords

sleep apnea, masks, nasal obstruction, CPAP, compliance, NOSE questionnaire

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The choice of mask type is crucial to ensure compliance with continuous positive airway pressure (CPAP) in patients with obstructive sleep apnea (OSA).[1] Nasal masks are usually the first choice; however, nasal obstruction can limit comfort and efficiency.[2,3] Patients who complain of nasal obstruction are fitted with oronasal masks[4] without undergoing a systematic objective assessment of obstruction. An evaluation tool that could determine whether to treat nasal obstruction and provide a nasal mask[2,5] or an oronasal mask at CPAP initiation would be useful for clinicians. Nasal obstruction, assessed by the Nasal Obstruction Symptom Evaluation (NOSE) questionnaire,[6] is associated with mouth opening during sleep, supporting the decision to switch from a nasal to an oronasal mask.[7] We hypothesized that the completion of the NOSE questionnaire at CPAP initiation would help to determine the most appropriate interface from the onset. The aim of this study was to evaluate if the NOSE score at CPAP initiation was associated with the type of mask used after 4 months of CPAP.

Methods

This observational prospective study was approved by our institutional review board (CECIC Rhône-Alpes-Auvergne, Clermont-Ferrand, IRB 5891). Between May and September 2015, adult patients with no craniofacial abnormalities, diagnosed with moderate to severe OSA by a pulmonologist, were asked to participate. According to French recommendations,[8] OSA diagnosis was determined by polysomnography or polygraphy in case of suspicion of the disorder based on clinical symptoms. Before CPAP initiation, patients completed the validated French version of the NOSE questionnaire.[9] This self-administered questionnaire measures nasal obstruction perceived by the patient in the past month using

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Table 1. Baseline Characteristics and 4-Month Follow-up (n = 198).[a]

Characteristic	Value
Patient characteristics	
Age, median (IQR), y	61 (50-70)
Sex (female)	69 (34.9)
BMI, median (IQR), kg/m^2	30 (27-36)
Current smoking (yes)	37 (18.7)
Nasal surgery for nasal obstruction (yes)	21 (10.6)
Medical treatment for nasal obstruction	7 (8.6)
Sleep apnea severity at diagnosis	
AHI, median (IQR), n/h	38 (30-50)
ESS score, median (IQR)	9 (6-14)
Type of mask at initiation	
Nasal mask	176 (88.9)
Oronasal mask	22 (11.1)
Type of mask at 4 months	
Nasal mask	152 (77.0)
Oronasal mask	46 (23.0)
Heated humidifier at 4 months	115 (58.0)
Nasal mask and HH at 4 months[b]	83 (54.6)
Oronasal mask and HH at 4 months	32 (69.6)
CPAP use at 4 months, median (IQR), h/night	5.1 (3.1-6.6)

Abbreviations: AHI, apnea-hypopnea index; BMI, body mass index; CPAP, continuous positive airway pressure; ESS, Epworth Sleepiness Scale; HH, heated humidifier; IQR, interquartile range; NOSE, Nasal Obstruction Symptom Evaluation questionnaire.
[a]Values are presented as number (%) unless otherwise indicated.
[b]Chi-square test comparing the proportion of heated humidifiers used with nasal mask vs oronasal masks (P = .072).

5 items, each rated from 0 to 20 on a 5-point Likert scale. The total score represents the sum of the responses to the 5 items and ranges from 0 to 100. Higher scores indicate more severe symptoms.[10]

Age, sex, anthropometric data, Epworth Sleepiness Scale score, and OSA severity were also documented.

Patients were initiated with automatic-CPAP (minimum-maximum pressures [median] = 6-12 cmH_2O) by technicians blinded to the NOSE score. All patients were initiated with a nasal mask that was tested during a diurnal trial in supine position. Oronasal masks were used if the patient had major difficulty breathing with the nasal mask. Humidifiers were not installed at initiation. Ten to 15 days later, a technician visited the patient at home to adjust (if necessary) the treatment (eg, addition of humidifier; change in mask size, model, or type; educational support regarding fitting of the mask). The final mask used (nasal or oronasal) was documented at the 4-month visit.

Data Analysis

Data were analyzed using Statistical Analysis System software version 9.4 (SAS Institute, Cary, North Carolina). Continuous data were expressed as medians (interquartile range) and categorical data as percentages. Univariate conditional regression models were used to estimate the risk of using an oronasal mask after 4 months according to the NOSE score at initiation ($>50/\leq 50$) (threshold chosen based on the smallest Akaike information criterion), sex, ear/nose/throat (ENT) medical treatment (yes/no), history of nasal obstruction surgery (yes/no), age (<median/>median), obesity (yes/no), and active smoking (yes/no). All the variables that were significant in the univariate analysis were then entered into a multivariate conditional regression model. For multivariate analysis, at least 10 observations are needed to obtain sufficient power for each independent variable included.[11] Therefore, to include up to 5 independent variables in the multivariate conditional regression model,[7] it was necessary to include 50 patients with oronasal masks. Since the prevalence of oronasal mask use is about 25% in this population,[1] we estimated a total sample size of 200 patients.

Results

In total, 214 consecutive patients completed the NOSE questionnaire at CPAP initiation. All patients asked to participate accepted. At initiation, 88.9% of patients were fitted with a nasal mask. A total of 198 (92.5%) patients were still undergoing treatment at 4 months (dropout rate 7.5%) and were included in the analysis. Patient characteristics are reported in **Table 1**.

The univariate conditional regression model showed that a NOSE score >50, male sex, a history of surgery for nasal obstruction, and age (>59 years) were associated with use of an oronasal mask at 4 months. In the multivariate analysis, only a NOSE score >50 was significantly associated with use of an oronasal mask at 4 months (**Table 2**). The sensitivity of a NOSE score >50 to predict oronasal mask use at 4 months was 34.8%, and the specificity was 87.5% (positive predictive value = 45.7%; negative predictive value = 81.6%).

Discussion

A NOSE score >50/100, indicating severe nasal obstruction symptoms, was independently associated with use of an oronasal mask after 4 months of CPAP.

Patients often report nasal symptoms during CPAP initiation, and unstandardized questions cannot determine the extent to which these symptoms will affect CPAP tolerance and whether the patient should be fitted with an oronasal mask at initiation. The NOSE questionnaire standardizes the evaluation of nasal symptoms. The results showed that a NOSE score ≤50 before CPAP initiation is a specific marker of long-term nasal mask tolerance. Conversely, its poor sensitivity prevents its use to determine which mask to propose at CPAP initiation. Therefore, patients with a NOSE score >50 should be closely monitored with regard to potential switching from a nasal to oronasal mask, or both interfaces could be provided at CPAP initiation. The lack of sensitivity of the NOSE score to identify the use of an oronasal mask highlights the contribution of other factors to the type of mask finally adopted by the patient. Other than nasal symptoms, age, sex, history of ENT surgery, and smoking status may be determining factors in the decision-

Table 2. Variables That Predicted Use of an Oronasal Mask after 4 Months of CPAP Treatment (Univariate and Multivariate Logistic Regression Models).

Variable	OR (95% CI)	*P* Value
Univariate conditional regression models		
NOSE score (>50 vs ≤50)	4.03 (1.81-8.95)	<.001
Sex (male vs female)	2.17 (1.01-4.64)	.047
Otolaryngology medical treatment (yes vs no)	0.94 (0.29-3.03)	.92
Surgery for nasal obstruction (yes vs no)	3.01 (1.15-7.86)	.024
Age (median value: ≥59.1 vs <59.1)	2.02 (1.01-4.02)	.046
Obesity (yes vs no)	1.47 (0.74-2.92)	.27
Current smoking	1.12 (0.47-2.62)	.8
Multivariate conditional regression model		
NOSE score (>50 vs ≤50)	3.74 (1.64-8.56)	.002
Sex (male vs female)	2.0 (0.9-4.44)	.09
Surgery for nasal obstruction (yes vs no)	2.58 (0.93-7.11)	.07
Age (median value: ≥59.1 vs < 59.1)	1.97 (0.95-4.1)	.07

Abbreviations: CI, confidence interval; CPAP, continuous positive airway pressure; NOSE, Nasal Obstruction Symptom Evaluation questionnaire; OR, odds ratio.

making process and should be integrated in a composite score to aid in the choice of the most appropriate interface. One major limitation of this pilot study was that details on comorbidities, associated treatments, and nasal-specific surgical interventions were not documented.

Conclusion

The NOSE score could be a simple tool for the objective assessment of nasal obstruction related to symptoms before initiation of CPAP, facilitating the choice of an appropriate interface. Further studies are needed to confirm these findings.

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Author Contributions

Marius Lebret, conception, interpretation, drafting of the manuscript; **Nathalie Arnol**, conception, interpretation, drafting of the manuscript; **Jean-Benoît Martinot**, interpretation, drafting of the manuscript; **Renaud Tamisier**, conception, interpretation, drafting of the manuscript; **Chrystèle Deschaux**, interpretation, drafting of the manuscript; **Jean-Louis Pépin**, conception, interpretation, drafting of the manuscript; **Jean-Christian Borel**, Conception, interpretation, drafting of the manuscript.

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References

1. Borel JC, Tamisier R, Dias-Domingos S, et al. Type of mask may impact on continuous positive airway pressure adherence in apneic patients. *PLoS One*. 2013;8:e64382.
2. Camacho M, Riaz M, Capasso R, et al. The effect of nasal surgery on continuous positive airway pressure device use and therapeutic treatment pressures: a systematic review and meta-analysis. *Sleep*. 2015;38:279-286.
3. Kempfle JS, BuSaba NY, Dobrowski JM, Westover MB, Bianchi MT. A cost-effectiveness analysis of nasal surgery to increase continuous positive airway pressure adherence in sleep apnea patients with nasal obstruction. *Laryngoscope*. 2017;127:977-983.
4. Clinical guidelines for the manual titration of positive airway pressure in patients with obstructive sleep apnea. *J Clin Sleep Med*. 2008;4:157-171.
5. Poirier J, George C, Rotenberg B. The effect of nasal surgery on nasal continuous positive airway pressure compliance. *Laryngoscope*. 2014;124:317-319.
6. Stewart MG, Witsell DL, Smith TL, Weaver EM, Yueh B, Hannley MT. Development and validation of the Nasal Obstruction Symptom Evaluation (NOSE) scale. *Otolaryngol Head Neck Surg*. 2004;130:157-163.
7. Lebret M, Arnol N, Contal O, et al. Nasal obstruction and male gender contribute to the persistence of mouth opening during sleep in CPAP-treated obstructive sleep apnoea. *Respirology*. 2015;20:1123-1130.
8. Lemarié E, Valeyre D, Housset B, Godard P. Sleep apnea syndrome: clinical practice guidelines [in French]. *Rev Mal Respir*. 2010;27:804-805.
9. Marro M, Mondina M, Stoll D, Gabory L de. French validation of the NOSE and RhinoQOL questionnaires in the management of nasal obstruction. *Otolaryngol Head Neck Surg*. 2011;144:988-993.
10. Lipan MJ, Most SP. Development of a severity classification system for subjective nasal obstruction. *JAMA Facial Plast Surg*. 2013;15:358-361.
11. Sauerbrei W, Royston P, Binder H. Selection of important variables and determination of functional form for continuous predictors in multivariable model building. *Stat Med*. 2007;26:5512-5528.