Response Shift in Perception of Sleepiness in Obstructive Sleep Apnea-Hypopnea Syndrome Before and After Treatment with Nasal CPAP

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Study Objectives: After nasal continuous positive airway pressure (nCPAP) treatment, several symptoms such as hypersomnolence, daytime fatigue, and impaired concentration improve in patients with obstructive sleep apnea-hypopnea syndrome (OSAHS). A variability of perception of pretreatment sleepiness (response-shift phenomenon) experienced in OSAHS patients before and after nCPAP treatment may reflect informative shifts in an individual’s internal standards, in values and priorities, or in the conceptualization of perceived sleepiness. The objective of this study is to determine whether there is a response shift in perceptions of pretreatment sleepiness before and after nCPAP treatment in patients with OSAHS. We investigated the response shift in Epworth Sleepiness Scale scores before and after nCPAP.

Design: Thirty-one consecutive OSAHS patients filled out the subjective ESS before nCPAP treatment (Pre-ESS). After a mean of about 10 months of nCPAP treatment, the patients filled out the ESS again, which was designated as the Post-ESS. Then they were asked to complete the scale again, recalling sleepiness before nCPAP treatment (Response Shift–Pre-ESS). The control group consisted of 11 patients with OSAHS who had not yet received nCPAP treatments and were matched for age, body mass index, and respiratory disturbance index.

Setting: University Hospital in, Japan.

Interventions: N/A.

Measurements and Results: There was a significant response shift in ESS scores before and after nCPAP treatment (Pre-ESS: 8.5 [95% Confidence interval [CI], 7.1-9.9] vs Response Shift–Pre-ESS: 11.1 [95% CI, 9.5-12.8], P < .002). A significant number of patients (P < .02) had not recognized the degree of sleepiness experienced before treatment until after they had received nCPAP treatment. Eight had pretreatment ESS scores ≥ 11 and 18 had posttreatment ESS scores ≥ 11 on the Response Shift–Pre-ESS. In the control group, ESS did not change significantly from the first to the second testing performed before nCPAP treatment (first ESS, 8.8 [95% CI, 5.3-12.3]; second ESS, 8.3 [95% CI, 4.7-11.8]; P = .95). Conclusions: Response shifts should be taken into consideration when explaining factors underlying individual differences in susceptibility to daytime sleepiness.

Key Words: Epworth Sleepiness Scale, quality of life, nasal continuous positive airway pressure, perception of sleepiness

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INTRODUCTION

OBSTRUCTIVE SLEEP APNEA (OSA) HAS BEEN SAID TO BE ASSOCIATED WITH CARDIOVASCULAR AND OBESITY-RELATED DISEASES SUCH AS HYPERTENSION, MYOCARDIAL INFARCTION, STROKE, AND LIVER DYSFUNCTION.1-5 In addition to the contribution of obstructive sleep apnea-hypopnea syndrome (OSAHS) to cardiovascular diseases, the hypersomnolence experienced with OSAHS improves,16 and impaired laboratory driving-performance skills are also reversed.17 This variability among OSAHS patients before and after treatment, dis- cernment of some OSAHS patients with regard to activities such as driving performance is disturbed.15 After treatment, such as by nasal continuous positive airway pressure (nCPAP), hypersomnolence in patients with OSAHS improves,16 and impaired laboratory driving-performance skills are also reversed.17 This variability among OSAHS patients before and after nCPAP treatment may be a reflection of some of the same factors as noted above in relation to perceived QOL or in the conceptualization of perceived sleepiness, in addition to changes in actual health

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status.18 This response shift before and after nCPAP treatment might explain why self-report measures underestimate the severity of sleepiness in the setting of chronic hypersomnolence that is recognized in OSAHS patients.

Engelman et al19 reported that values of the ESS changed significantly between presentation and after nCPAP therapy of 22 weeks duration. Although data in that report actually demonstrated a response shift with regard to ESS changes before and after nCPAP treatment, the authors did not explicitly state it as such. In addition, that study did not include a control group.

We hypothesized that there is a response shift in perceptions of pretreatment sleepiness before and after nCPAP treatment in patients with OSAHS. We evaluated the response shift in ESS scores in OSAHS patients before and after nCPAP.

METHODS

Subjects

The medical ethics committee at our institution reviewed and approved the study. All subjects provided written informed consent. Two groups of patients were studied: a response group who received nCPAP treatment and a control group who had not received such treatment.

Response-Shift Group

Subjects were 31 consecutive patients (28 men, 3 women) with OSAHS who were determined by polysomnography (n = 21) or night oximetry (n = 10) and clinical symptoms to be candidates for nCPAP treatment.2 Airflow during polysomnography was measured by nasal and oral thermistors. All participants who underwent polysomnography had an apnea-hypopnea index of 20 or greater. Ten patients with night oximetry had a 4% desaturation index of 40 or greater. The respiratory disturbance index (RDI) was defined as (1) the number of apnea plus hypopnea episodes per hour of sleep that resulted in more than 4% oxygen desaturation (SaO2) compared to the basal SaO2 before apnea or hypopnea and (2) the number of desaturation (> 4%) events per hour.

Control Group

The control group consisted of 11 age-, body mass index (BMI)-, and RDI-matched patients with OSAHS who had not yet received nCPAP treatment.

Sleepiness

With the ESS, subjects score themselves on a scale of 0 (not at all like to fall asleep) to 3 (very likely to fall asleep) according to how easily they would fall asleep in 8 different situations, with possible overall scores of 0 to 24. The higher the score, the sleepier the individual. A score of 11 or higher is considered to represent an abnormal degree of daytime sleepiness.9

Design

Response-Shift Group

All patients in the response-shift group filled out the ESS before nCPAP treatment (Pre-ESS) without input from family or friends. After more than 1 month of nCPAP treatment, they filled out the ESS again, which was designated as the Post-ESS. Finally, the patient filled out the ESS again by responding to the items through recall of sleepiness before nCPAP treatment (Response Shift–Pre-ESS). The subjects completed the ESS at each time point in the hospital.

Control Group

The 11 patients in the control group filled out the ESS twice at more than 1-month intervals before nCPAP treatment. The ESS was part of a standard clinical protocol. The participants remained blinded to the hypothesis of the study.

Statistical Analysis

Data are presented as 95% confidence intervals (95% CI). The data were tested by nonparametric methods because the distribution of the data was widely scattered. The Mann-Whitney U test was used to compare the results between the patients in the response-shift group and the control group. Differences between 2 conditions were tested for significance by the Wilcoxon signed-rank test. Differences between values obtained for more than 3 conditions were tested for significance by the Friedman test. If there was a significant difference by the Friedman test, intergroup differences were evaluated with the Wilcoxon signed-rank test. Spearman rank correlation coefficients were calculated to analyze the correlation between variables. A P value of < .05 was considered to be significant.

RESULTS

Response-Shift Group

Age and BMI in the 31 consecutive OSAHS patients were 48 years (95% CI, 44-52) and 30 kg/m² (95% CI, 28-31), respectively. No patient dropped out or failed to complete the ESS a second time. Clinical characteristics of the response-shift group are shown in Table 1, and their Pre-ESS, Response-Shift–Pre-ESS and Post-ESS scores are shown in Figure 1. Post-ESS and Response-Shift–Pre-ESS were taken after a mean of 299 days (range, 200-396 days) of nCPAP treatment. There was a significant response shift in ESS scores before and after nCPAP treatment (Pre-ESS: 8.5 [95% CI, 7.1-9.9] vs Response-Shift–Pre-ESS: 11.1 [95% CI, 9.5-12.8], P < .002) (Figure 1). Their measured compliance with CPAP, using a built-in clock, was 4.2 hours (range, 3.4-5.0 hours) per day. More patients initially underdrewed (68%) than overrated (19%) sleepiness as assessed by the ESS (P < .02)(Figure 2). For example, 8 patients had an ESS score of 11 or more before treatment, whereas 18 had such a score after nCPAP treatment.

Changes in RDI or the severity of desaturation during sleep before or after nCPAP treatment were not correlated with the degree of the response shift in ESS before and after nCPAP treatment. The degree of difference in the response shift in ESS before and after nCPAP treatment was not correlated with the duration of nCPAP use.

Control Group

Age (mean, 53 years; 95% CI, 44-61 years), RDI (mean, 46 per hour; 95% CI, 38-54 per hour), BMI (mean, 28 kg/m²; 95% CI, 26-30 kg/m²), and ESS before nCPAP treatment (mean, 8.8; 95% CI, 5.3-12.3) in the control group did not differ significantly from those in the response-shift group. The ESS scores did not change significantly from the first, performed more than 1 month before nCPAP treatment, and second testing (first ESS, 8.8; 95% CI, 5.3-12.3 and second ESS, 8.3; 95% CI, 4.7-11.8; P = .95). The duration between the first and second testing was 50 days (95% CI, 31-69).

Table 1—Basic Characteristics of 31 Patients with Obstructive Sleep Apnea Syndrome and Effects of Nasal Continuous Positive Airway Pressure

<table>
<thead>
<tr>
<th>Variables</th>
<th>Before CPAP (n = 31)</th>
<th>After 300 days of CPAP (n = 31)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (95% CI) of nCPAP treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory disturbance index, no./h</td>
<td>55 (49-60)</td>
<td>2 (1-4)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Lowest SaO2 %</td>
<td>60 (54-66)</td>
<td>88 (86-90)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>SaO2 &lt; 90%, percentage of time</td>
<td>31 (24-39)</td>
<td>0.6 (0.2-1.0)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Epworth Sleepiness Scale score</td>
<td>8.5 (7.1-9.9)</td>
<td>4.3 (3.3-5.3)</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

CPAP refers to continuous positive airway pressure.
DISCUSSION

In this study, we found that the perceived sleepiness (ESS score) that was determined before nCPAP treatment changed significantly after treatment, as evaluated by ESS scores before and after nCPAP treatment. This represents a “response shift” such as has been described by Schwartz et al. The diagnosis of OSAHS is dependent not only on the apnea hypopnea index, but also on clinical symptoms, of which daytime sleepiness is the most important. Therefore, it is important to determine whether a response shift exists with OSAHS patients before and after treatment.

Engleman et al cited “underreporting of sleepiness and driving impairment in patients with sleep apnoea/hypopnoea syndrome.” In that report, ESS scores of 99 patients with OSAHS were obtained, first at presentation and then after treatment with nCPAP therapy of a median of 22 weeks’ duration. Therefore, differences in the duration between the 2 measurements in our report and theirs exist (22 weeks vs 10 months). However, in both studies, more patients initially underestimated than overestimated sleepiness; 67% versus 29% (P < .001) cited by Engleman et al, and 68% and 19% reported here. Although Engleman et al did not mention the response-shift phenomenon as such, we are convinced that this phenomenon played a role in our results that showed differences in the subjects’ perception of sleepiness before and after nCPAP treatment. Recently, the fundamental importance of the “response shift” phenomenon has been recognized in social and medical science. Therefore, the presence of this phenomenon should be considered in evaluating sleepiness and health-related QOL for patients with OSAHS before and after nCPAP treatment.

Although there is a significant relationship between sleepiness and the RDI, sleepiness as rated by the ESS score varies widely. Therefore, the presence of this phenomenon should be considered in evaluating sleepiness and health-related QOL for patients with OSAHS before and after nCPAP treatment.

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Figure 1—Epworth Sleepiness Scale (ESS) scores of Pre-ESS, Response-Shift–Pre-ESS, and Post-ESS in 31 patients with more than 1 month of nasal continuous positive airway pressure (nCPAP) treatment. Pre-ESS refers to ESS scores before nCPAP treatment, Response-Shift–Pre-ESS; ESS scores before nCPAP treatment, which were recalled after nCPAP treatment; Post-ESS, ESS scores after nCPAP treatment.

Figure 2—Relationship between Pre-Epworth Sleepiness Scale (ESS) and Response-Shift–Pre-ESS in 31 patients with more than 1 month of nasal continuous positive airway pressure (nCPAP) treatment. Pre-ESS refers to ESS scores before nCPAP treatment; Response-Shift–Pre-ESS, ESS scores before nCPAP treatment, which were recalled after nCPAP treatment.
REFERENCES

might change when patients with OSAHS are asked to recall the degree of sleepiness prior to treatment with OSAHS should be treated according to their sleepiness. We should take this into consideration when deciding whether patients with OSAHS before nCPAP treatment. Therefore, it can be considered that the changes in the ESS in this report were due to the response-shift phenomenon.

Based on the results of this study, the response shift after nCPAP treatment should be taken into consideration when deciding whether patients with OSAHS should be treated according to their sleepiness. We should recognize that perceptions of the degree of sleepiness prior to treatment might change when patients with OSAHS are asked to recall the degree of their pretreatment sleepiness after they have been treated with nCPAP.

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REFERENCES


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