Adherence to Continuous Positive Airway Pressure Therapy for Obstructive Sleep Apnea: Impact of Patient Education after a Longer Treatment Period

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Key Words

Continuous positive airway pressure • Obstructive sleep apnea syndrome • Patient education • Treatment adherence

Abstract

Background: Continuous positive airway pressure (CPAP) is the standard treatment for obstructive sleep apnea (OSA) but it is often cumbersome so that adherence to CPAP therapy is limited. **Objectives:** We evaluated adherence to CPAP therapy after an additional educative intervention in OSA patients after a longer treatment period. **Methods:** A short patient information program covering many aspects of symptoms, consequences and treatment of OSA was created, and standardized information sessions were developed to be given by an experienced sleep physician to >6,000 participants of patient support group meetings throughout Germany. They also received a booklet containing the essential information of the lectures. Of the 526 randomly selected members of these support groups receiving the anonymized questionnaire by mail, 475 CPAP patients sent the questionnaire back. Of these CPAP patients, 243 participated in a lecture and had received a booklet (information group) and 232 CPAP patients had not attended a lecture (control

group). **Results:** In the information group, a significantly higher daily usage of CPAP devices (6.9 ± 0.9 h/day) was reported compared with the control group (5.7 ± 1.3 h/day; $p < 0.001$). Furthermore, the score in the Epworth Sleepiness Scale (ESS) was found to be significantly lower in the information group (median ESS = 6, interquartile range, IQR, 4–8 vs. median = 11, IQR 8–13; $p < 0.001$). **Conclusions:** Patients who attended our short information program showed a higher daily usage and a lower subjective daytime sleepiness. These results suggest that patients on CPAP therapy may benefit from education even after a longer treatment period.

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Introduction

The obstructive sleep apnea (OSA) syndrome is increasingly being recognized as a disorder associated with an increased risk for cardiovascular diseases [1] and adverse effects on quality of life mainly by excessive daytime sleepiness, depression and impairments in both mental and physical performance [2]. The prevalence of OSA is estimated to be at least 4% in men and 2% in women [3]. The standard treatment of OSA is continuous pos-

Table 1. Topics of the lectures

Basic information about sleep-related breathing disorders (snoring/sleep apnea)
Physiology of sleep and breathing during sleep
Pictures of typical patterns of disturbed breathing during sleep
Signs and symptoms of sleep-related breathing disorders
Impact of sleep-related breathing disorders on quality of life
Long-term complications of sleep-related breathing disorders
Diagnostic/therapeutic approach to sleep-related breathing disorders

itive airway pressure (CPAP), first described by Sullivan et al. [4] in 1981. CPAP has been demonstrated to improve daytime performance and reduce cardiovascular effects associated with OSA [5, 6].

To reach those beneficial effects, patients should use their CPAP devices regularly. CPAP adherence in patients with obstructive sleep apnea has been intensively studied [7–14]. The main endpoint of most studies was CPAP usage time per night. Up to now, it is still unclear how long CPAP therapy should be applied to be successful. The effect of CPAP therapy might be dose dependent [8, 15]. Usage of the CPAP device for at least 4 h per night and >70% of the nights is discussed to be a reasonable threshold for good adherence [12, 16]. Various factors associated with good adherence could be identified, including female gender, increasing age, reduction of daytime sleepiness by CPAP [8] and severity of OSA [7, 17].

One important way to improve adherence is patient education [18–22]; patient education is therefore recommended in all patients receiving CPAP therapy for OSA [23]. Most previous studies focused on the effect of patient education before, during or shortly after the initiation of CPAP therapy. To date, there are hardly any data on the effect of educational interventions in patients on long-term CPAP treatment. Thus, the aim of this study was to investigate the effect of an educative intervention presented as a short comprehensive patient information program applied after a longer period of CPAP therapy on adherence and subjective daytime sleepiness in patients with OSA.

Patients and Methods

Patient Information Program

A patient information program was developed consisting of a standardized 120-min lecture emphasizing the cardiovascular and psychosocial impacts of snoring and OSA as well as beneficial

effects of CPAP therapy. Proper handling of CPAP devices, masks, humidifiers and other accessories was taught and various methods to reduce side effects of CPAP were demonstrated together with a variety of practical ‘tips and tricks’. Pros and cons of alternative therapies were discussed.

Patient self-support groups throughout Germany were contacted and these lectures were given during their meetings. Each of the meetings involved about 20–80 patients. Usually, all members of a support group were invited to the lecture. Before study commencement, the patients’ feedback to the lectures had been used to continuously improve the information program. During the study period, all lectures were given in a nearly identical way by one experienced sleep physician (A.P.). An interactive presentation style was practiced using Microsoft® PowerPoint® presentations with instructive graphics and pictures together with video sequences. At the end of the lectures, the patients were given the opportunity to address their personal problems with CPAP therapy. For reinforcement and information, a booklet was given to the participants, summarizing all topics of the lecture together with a glossary. The topics of the lectures are shown in table 1.

124 such lectures were given to >6,000 participants throughout Germany. It was not checked if all participants were members of the respective support group. The study protocol was approved by the local ethics committee.

Evaluation of the Information Program

Support groups receiving the above-described standardized training lecture were asked to provide member lists including all members who are active at the time the lecture was done, i.e. members joining the support group meetings regularly (5,264 CPAP patients). Ten percent of all persons on each member list (526 CPAP patients) were randomly selected.

These self-support group members received an anonymized questionnaire by mail at least 90 days after each lecture asking for data on biometrics and CPAP usage (total time on CPAP therapy, number of days used/week and number of hours/night). In addition, the patients were asked about their self-assessment of their information status regarding sleep apnea and its therapy. For this question, a visual analogue scale ranging from 1 (very good information status) to 10 (no information) was used. Patients were also asked about their apnea-hypopnea index at the time of diagnosis, if known. Moreover, all 526 patients received a German version of the Epworth Sleepiness Scale (ESS) [24] for evaluation of their subjective daytime sleepiness. Moreover, they were asked whether they had attended the lectures and had received the information booklet or not to classify the study population as information or control group. Finally, the patients who attended the lectures were pleased to provide information on the period between the lecture and completion of the questionnaire.

Data Collection and Statistical Analysis

Metric data are presented as means $\pm$ SD. Ordinal data are expressed as medians and interquartile ranges (IQR). The mean CPAP usage per day (in hours) was calculated using the formula: mean usage (h/day) = total usage (h/week)/7.

Comparisons between groups with mean values and normally distributed data were performed using Student’s t test for independent variables. To compare median values and non-normally distributed data, we used the Mann-Whitney U test. The comparison of percentages between groups was done using the χ^2 test.

Table 2. Biometric and treatment period data as reported in the questionnaire

	Control group (n = 232)	Information group (n = 243)	p value
BMI	32.0 ± 4.7 (20.7–45.4)	32.3 ± 4.8 (22.5–48.8)	0.664
Age, years	59.7 ± 9.5 (35–81)	59.3 ± 9.8 (33–82)	0.844
Sex			
Male	170 (73.3%)	192 (79.0%)	
Female	62 (26.7%)	51 (21.0%)	
Time on CPAP, months	51.1 ± 32.2 (2–191)	54.9 ± 28.6 (5–133)	0.153
ESS score	11 (8–13)	6 (4–8)	<0.001

There were no significant differences between both groups.
Means ± SD and medians (IQR) are presented.

For differences between groups, we considered a two-tailed $p < 0.05$ to be significant. Pearson's test or Spearman's test was applied to calculate correlation coefficients, as appropriate.

All statistical analyses were performed using SPSS (version 15.0; SPSS, Chicago, Ill., USA).

Results

Of the 526 mailed questionnaires, 475 were returned and analyzed (90.3%). Of these 475 patients, 243 belonged to the information group and 232 to the control group. The basic characteristics of the information and control groups are shown in table 2.

There were no significant differences in age, body mass index and gender between both patient groups. The treatment period (time between initiation of CPAP therapy and questionnaire evaluation) did also not significantly differ between both groups. The mean latency between the standardized training lecture and the evaluation of the questionnaires was 226 ± 108 days, with no significant difference between both groups. Patients of the information group rated their information status significantly higher (median = 1; IQR = 1–2 vs. median = 9; IQR = 6–9; $p < 0.001$).

One hundred and forty patients in the control group and 148 patients in the information group reported an apnea-hypopnea index at the time of diagnosis (27.5 ± 20.7 vs. 29.4 ± 21.4 ; nonsignificant).

Daily CPAP Usage

Patients who had participated in the information program reported a significantly higher mean daily usage than the control group (6.9 ± 0.9 vs. 5.7 ± 1.3 h/day; $p < 0.001$; table 3). The scatter plot showed a tendency towards higher daily usage with increasing time on CPAP

Fig. 1. Correlation of treatment period (months) and daily CPAP usage (h). □/--- = Information group; ●/— = control group.

therapy (fig. 1). Dividing the study population into two groups, using the median (group 1 with usage period < 52.5 months and group 2 with ≥ 52.5 months), showed that patients using their CPAP device for ≥ 52.5 months had a significantly higher daily usage in the total study population (6.5 ± 1.2 vs. 6.2 ± 1.3 h/day; $p = 0.038$). In the control group, we found a significantly higher daily usage in those patients with longer time on CPAP therapy (5.9 ± 1.2 vs. 5.5 ± 1.4 h/day; $p = 0.025$) whereas the information group did not show that dependency (6.9 ± 1 vs. 6.9 ± 0.9 h/day; nonsignificant).

Table 3. Daily CPAP usage (h/day) depending on gender, treatment period and age as reported in the questionnaire

	Total	Control group	Information group
All patients	6.3 ± 1.3	5.7 ± 1.3	6.9 ± 0.9
Gender			
Male	6.3 ± 1.3	5.6 ± 1.2	6.9 ± 0.9
Female	6.5 ± 1.3	5.9 ± 1.3	7.1 ± 0.9
p value	NS	NS	NS
Treatment period			
<52.5 months	6.2 ± 1.3	5.5 ± 1.4	6.9 ± 0.9
≥52.5 months	6.5 ± 1.2	5.9 ± 1.2	6.9 ± 1.0
p value	0.038	0.025	NS
Age			
<60 years	6.2 ± 1.1	5.6 ± 1.1	6.7 ± 0.9
≥60 years	6.5 ± 1.4	5.8 ± 1.4	7.2 ± 0.9
p value	0.001	NS	<0.001

All differences between the control and information group were highly significant ($p < 0.001$).

NS = Nonsignificant. Means ± SD.

There was no gender-related difference in daily CPAP usage. In the total study population and in the information group, daily CPAP usage was significantly higher in patients aged ≥ 60 years but not in the control group.

Daytime Sleepiness

The median ESS score in the information group (median = 6, IQR 4–8) was significantly lower than in the control group (median = 11, IQR 8–13; $p < 0.001$).

There was a negative correlation of the ESS score with daily CPAP usage ($r = -0.33$, $p < 0.001$), indicating that patients with longer daily CPAP usage tended to report less daytime sleepiness. When the study population was divided according to the median value of daily CPAP usage into one group with a daily usage < 6.5 h/day ($n = 228$) and another with ≥ 6.5 h/day ($n = 249$), patients using their CPAP device < 6.5 h/day showed a significantly higher ESS score (median = 10; IQR: 7–13 vs. median = 7; IQR: 4–10; $p < 0.001$).

Discussion

Some data suggest that patient information might improve CPAP adherence [18–23] in OSA. Most previous studies focused on patient information prior or during the initiation of CPAP therapy [18, 25, 26] but not after a

longer treatment period. In the present study, we evaluated the impact of a comprehensive patient information program for CPAP patients after a longer treatment period.

In our study, the patients who had reported attendance at the information program were found to have a significantly higher daily usage of the CPAP device and significantly lower subjective daytime sleepiness established by the ESS compared with the control group. On the one hand, regular attendance at support group meetings could indicate increased motivation which is associated with better CPAP adherence. On the other hand, possibly patients encountering problems with CPAP treatment and consequently adhering less to CPAP therapy are less reluctant to contact a support group. Since all patients were recruited from support group member lists, these aspects should not bias our study, but the results cannot easily be conferred to patients who are not members of support groups.

We did not ask for CPAP devices, pressure mode (e.g. conventional vs. auto-CPAP) or way of pressure delivery (e.g. nasal vs. full face mask). Thus, the effect of the therapy system on our results was not determined and has to be taken into account in future studies. However, we do not expect any significant effect because patients from many different prescribers were investigated. Moreover, conventional CPAP is still the most frequently prescribed kind of CPAP therapy in Germany.

However, potential limitations of our study remain because we did not carry out a randomization; instead an allocation to the information/control group was done based on the patients' statement. Patients with poor therapy adherence who have attended our lectures but did not change their adherence thereafter may have stated that they did not attend, whereas patients who did not attend, although they knew that it took place, stated attendance because of a bad conscience or they feared negative consequences for example by their health insurance despite the anonymized survey. Both groups had a similar size and showed similar biometric data, and no significant differences in time on CPAP therapy. We decided to perform a comparison of both groups although other important confounders of CPAP adherence were not evaluated by our questionnaire. Especially daytime sleepiness in untreated OSA, initial response to CPAP therapy and quality of patient education prior or during therapy initiation might be significant confounders. Reduction of daytime sleepiness by CPAP [8] and severity of OSA [7, 17] were associated with good adherence. Maybe patients in the information group a priori had higher adherence

because of the above-mentioned factors. Furthermore, patients with a good early therapy success are possibly more motivated to keep the quality of therapy at a high standard and utilize offers like our lecture more often than patients with less successful therapy.

We did not perform sample size calculation for lack of results of comparable interventions, and therefore we could not estimate any expectable difference. For the purpose of our study, inclusion of approximately 500 patients seemed to suffice. Most other studies investigated <100 patients. Consequently, we sent the questionnaire to 10% of all active members on the member lists, which resulted in a study cohort of 526 patients. For sample size calculation of a randomized controlled trial, the expectable effect should be assumed less because of the above-mentioned limitations.

Another major limitation of our study is the lack of pre-interventional data on CPAP usage. The differences in CPAP usage (6.9 vs. 5.7 h/day) were highly significant. However, we are not able to show improvement by our data. Possibly adherence and consequently daytime sleepiness were already significant better in the information group prior to the lectures, but this seems not very probable in our opinion.

Our main endpoint is based on self-reported CPAP usage. The uncertain validity of the patients' statements might be considered to be a major limitation of our study, since previous studies comparing subjective and objective adherence in the same patients showed significant differences, with a tendency to overestimate the real usage time by the patients [9, 11]. In our study, a mean CPAP usage of 5.7 ± 1.3 h/day was reported in our control group together with a quite high ESS score of 11 (IQR 8–13), possibly indicating a tendency to overestimate CPAP usage also in our study. On the other hand, we compared self-reported CPAP adherence of both study groups. Thus, the subjective measures should actually be acceptable. However, patients in the control group could have stated a higher daily usage because they missed the lecture resulting in a bad conscience when receiving the questionnaire. Therefore, the real difference between both groups would have been higher. On the other hand, CPAP patients who attended the lectures could overestimate their daily usage because of fear for consequences of low adherence leading to a less or even nonexistent difference between both groups in reality.

The results of this study correlate with the results of Russo-Magno et al. [27], for example; in their study, 20 of 33 study patients used their CPAP device 5 h/night or longer (therefore being defined as compliant). It appeared

that 95% of these patients belonged to a support group and had received an information program. Three further studies [8, 17, 18] indicated beneficial effects of education programs but failed to provide data showing to what extent adherence was improved by the information programs since no control groups were studied. In contrast to our study, most education programs had been applied prior or during the initiation of CPAP therapy in the sleep laboratory [8, 16, 18, 21, 25, 26]. We performed patient education partially several years after therapy initiation and could show improvement of adherence even after a long treatment period.

Subjective daytime sleepiness established by the ESS was significantly lower in our information group than in our control group. In contrast, Hoy et al. [18] did not find differences in subjective daytime sleepiness in their patients, who had been randomized to a standard or an intensive information group. However, the standard group had received comprehensive information together with practical training during the initiation of CPAP therapy and thus might have been better educated than our control group.

In our patients, good CPAP adherence was associated with a lower ESS score. This finding supports the hypothesis that improving CPAP adherence may increase beneficial effects of CPAP therapy. However, some authors interpret such data with caution and hypothesized that patients might underestimate the severity of their symptoms as soon as they are treated [28]. We cannot rebut such arguments for lack of objective data on daytime symptoms.

Our study points out that even when longer periods of time have passed after initiation of CPAP therapy adherence can possibly be improved by well-designed information programs. However, intensive patient education in the sleep laboratory during the initiation phase of treatment is mandatory and additional information programs at a later time cannot serve as a substitute, since long-term adherence to CPAP therapy is largely determined by the initial treatment period [17].

It could be of interest to study the efficiency of less comprehensive information programs. Enforcement by telephone alone has not been demonstrated to be sufficient [29]. Chervin et al. [21] found a more considerable effect on improving adherence by brochures than by regular phone calls. So we decided not only to perform a standardized lecture but also to hand out a booklet to the participants. It remains to be seen which elements of information programs are most effective. For the next generation of CPAP patients, web-based information distri-

bution may play an important role although the design of educational interventions has to be balanced against the costs. Further research should be carried out to analyze the effect of regular repeated information on OSA patients taking economical aspects for the patient and the health care system into account.

In summary, our data showed higher CPAP adherence and less daytime sleepiness in patients who attended a

short comprehensive information program after a longer treatment period consisting of a lecture and a booklet. Due to the above-mentioned limitations of the study, we were not able to prove that this was an effect of our intervention. The effect of repeated education of OSA patients has to be validated in a prospective randomized controlled trial. Our results suggest that this may be an important intervention to improve adherence.

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