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EFFECT OF COMPLIANCE TO TREATMENT ON BODY WEIGHT AND PHYSICAL ACTIVITY IN PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

"Sleep apnea treatment improves physical fitness"

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ABSTRACT

Obstructive sleep apnea-hypopnea syndrome (OSAHS) is associated with obesity and is characterized by repeated upper airway closure during sleep, causing systemic complications. The benefits of CPAP (continuous positive airway pressure) have been demonstrated on somnolence and survival, but data on weight loss and physical activity are controversial. Aim: to study whether compliance to CPAP promotes weight loss and physical activity in patients with OSAHS. Methods: 84 obese patients (BMI = 35 ± 4.3) with OSAHS and an indication for CPAP were included. OSAHS was diagnosed using an overnight cardio-respiratory polygraph. Compliance to CPAP was defined as more than 4 hours/ night use, for over 70% of the nights. Patients were divided into 3 groups according to compliance: non compliant (who refused CPAP, n = 28), poor users (n = 27) and compliant (n = 29). Physical activity (number of steps/day, counted using a belt pedometer) and body mass index were evaluated at baseline and after 3 months. Patients received similar lifestyle advice. Results: Compliant patients increased their daily physical activity by 56%, significantly more than non compliant patients (18.7 %) and poor users (17.9%) (t Student's p < 0.01).The weight reduction was significantly greater in the compliant group (-5.7%) than in the non compliant group (-3.9%) and in the poor users (-3.6%) (Wilcoxon's p < 0.01). Conclusion: Proper CPAP users reduce body weight and increase physical activity more importantly than non compliant ones and poor users under the same educational intervention.

KEYWORDS: *sleep apnea, obesity, physical activity*

1.Introduction

Obstructive sleep apnea-hypopnea syndrome (OSAHS) is a common chronic condition characterized by repeated upper airway closure during sleep, associated with intermittent hypoxemia, sleep fragmentation and potentially fatal cardio-metabolic consequences. [1] Obesity is the main risk factor for OSAHS, although sleep apnea also occurs in lean subjects. Cervical and abdominal fat deposition increases upper airway collapsibility. In addition to the mechanical effects, the metabolic activity of the adipose tissue plays a pathogenic role in OSAHS via inflammation, insulin resistance, atherogenic dyslipidemia and arterial hypertension, linking OSAHS to metabolic syndrome. [2]

Diagnosing OSAHS requires the simultaneous recording of several respiratory and cardiovascular parameters during sleep (polygraphy) with additional neurophysiologic channels (polysomnography). OSAHS is defined by an apnea-hypopnea index (AHI) of five or more obstructive episodes per hour associated with typical symptoms such as daytime somnolence, loud snoring, witnessed apneas, or awakenings with gasping. [1]

CPAP (continuous positive airway pressure) is the gold standard for treatment in OSAHS, which is applied to the upper airway through a nasal mask, acting like a pneumatic splinter and preventing the collapse of the soft tissue during sleep. The benefits of CPAP use include reduction of cardio-vascular complications, increased survival [3-6] and social effects like reduced somnolence and improved mood.[4]

Despite these positive results, many patients refuse of misuse CPAP. Compliance to CPAP is defined as using the therapy for more than 4 hours a night for at least 70% of the nights. [7] Studies show that 30% to 83% of patients do not meet these criteria [8], mainly because of claustrophobia, poor patient education and motivation, local side effects caused by the mask or the air pressure. [9]

Daytime somnolence is the major symptom of OSAHS, promptly reversed by CPAP. Since CPAP reduces effectively both somnolence and cardiovascular complications, a positive effect on daily activity and a consequent reduction in body weight can be expected. Literature data remain however controversial: despite the reduction in daytime somnolence, most studies report no benefit of CPAP use on body weight or daily activity [10-13], while other studies report some weight loss and increase in physical activity in small groups of patients. [14 – 16]

Aim: to study whether compliance to CPAP promotes weight loss and physical activity and in patients with OSAHS.

2. Materials and methods

Inclusion criteria:

We included 84 patients with symptomatic OSAHS who had an apnea-hypopnea index (AHI) over 10/hour and in whom there was a clear indication for CPAP. They were all obese at baseline (body mass index BMI $\geq 30 kg/m^2$). Acute respiratory, cardio-vascular or infectious intercurrences were ruled out by clinical examination and routine tests.

Sleep study:

OSAHS was diagnosed using overnight ambulatory cardio-respiratory polygraphy (Somnocheck Effort, WM 94200, Weinmann, Germany) including the simultaneous assessment of oro-nasal airflow (thermistor), oxymetry and pulse rate (finger pulse-oxymetry), thoracic and abdominal effort (pressure sensors attached to elastic bands), snoring (microphone), and body position (mercury capsule). The diagnostic criteria were those recommended by current guidelines [1]: OSAHS was ruled in the presence of at least 5 obstructive apneas (absence of the airflow for at least 10 seconds in the presence of thoracic and abdominal effort) or hypopneas (reduction by 50% of the airflow with the same characteristics), in addition to specific symptoms (somnolence, gasping).

Somnolence quantification:

Daytime somnolence was measured using the 24 point Epworth scale, a self-administered questionnaire which evokes 8 situations in which the probability to fall asleep is rated from 0 to 3. A score over 10 is considered pathological. [17]

CPAP initiation and compliance:

Patients received information on the role, the use and the mentainance of the CPAP machine and mask. The therapeutic pressure was established after 1 or 2 nights of titration with an automatic positive airway pressure device under polygraphic control. Compliance to CPAP was measured by reading the memory card of the CPAP machine at 3 months. Compliance to CPAP was defined as more than 4 hours/ night use, for over 70% of the nights. Patients were divided into 3 groups according to compliance: non compliant (who refused CPAP, n = 28), poor users (n = 27) and compliant (n = 29).

Daily physical activity:

Physical activity (number of steps/day) was assessed using a belt pedometer (Maxxima MHP-1 Digital Premium Pedometer, USA), which was worn by the patients for 1 week at baseline and 3 months after the indication for CPAP.

Evaluation of effort tolerance:

All the patients underwent a standardized 6 minutes walking test (6MWT) with the assessment of pulse oxymetry and Borg dyspnea scale. 6MWT was performed according to the standard protocol currently recommended by guidelines. [18]

Patient education:

Patients received similar lifestyle advice consisting in dietary counseling and promotion of gradual increase of daily physical activity, based on the performance achieved at the 6MWT.

Statistics:

The programs used for the statistical analysis were Excel 2000 and the Multiple Regression (v1.0.26) in Free Statistics Software (v1.1.23-r6) by the Office for Research Development and Education, 2008. Data were expressed as means ± standard deviations. Correlations between datasets were made using Pearson's correlation coefficient r and comparisons between groups and between datasets at baseline and at 3 months were analyzed using Wilcoxon's sum of ranks test for comparing small numbers and t Student's test for matched and for unmatched samples, where a $p < 0.05$ expressed significance. The probability for a certain respone was expressed using odds ratio (OR).

Written consent from patients and approval of the local Ethics Committee were obtained.

3. Results

Population:

The age in the whole group was 52.1 ± 4.7 years, with a mean BMI 35 ± 4.3 kg/m^2 and a mean AHI 29.3 ± 12.1 /h.

The compliant group was significantly more somnolent (Wilcoxon's $p < 0.05$), had more severe forms of OSAHS expressed by a higher AHI (t Student's $p < 0.01$), and had a lower daily physical activity at baseline than the poor users group and the non-compliant group (t Student's $p < 0.01$) (Table 1). The compliant patients were more obese than the non-compliant ones (t Student's $p < 0.05$). The difference in BMI between compliant patients and poor users was not significant. The mean age was higher in the non-compliant group than in the other two groups, but the differences were not significant ($p > 0.05$). The comparisons between the baseline parameters of the poor users and the non-compliant group revealed no significant differences.

Change in body weight:

There was an overall 4.4% reduction in body weight in the whole group in the 3 months of follow-up (Table 2). In none of groups the weight reduction presented statistical significance when baseline values were compared with those at 3 months (Wilcoxon's and t Student's test for matched pairs $p > 0.05$). However, weight reduction percentage was significantly greater in the compliant group (5.7%)

when compared to the weight loss in non compliant group (3.9%) and in the poor users (3.6%) (Wilcoxon's $p < 0.01$). Non-compliant patient lost with 0.3% more weight than poor users, but the difference was not significant.

Table 1. *The characteristics of the groups at baseline (means ±SD)*

Parameters	Groups			
	Whole group N=84	**Compliant N= 29**	**Poor users N= 27**	**Non-compliant N= 28**
Age (years)	52.1 ± 7.5	52.7 ± 8.3	50 ± 6.9	53.5 ± 6.9
BMI (kg/m2)	35 ± 4.3	36.6 ± 4.3	34.8 ± 4.5	33.7 ± 3.8
AHI (/h)	29 ± 12.1	36.7 ± 13.5	27 ± 9.8	23.9 ± 8.6
Somnolence (/24)	13.9 ± 4	15.5 ± 3.1	13.3 ± 3.4	12.9 ± 4.8
Physical activity (steps/day)	3520 ± 1341	3127 ± 1367	3571 ± 1182	3881 ± 1396
Number of women	16 (21%)	7 (24%)	4 (11%)	2 (27%)

Table 2. *Changes in physical activity, weight and somnolence in the 3 months of follow*-up

Parameter change	Whole group	Compliant	Poor users	Non-compliant
Change in BMI	-4.4% *	-5.7% *	-3.6% *	-3.9% *
Change in somnolence	-23.7 **	-35.8 **	-18.1 **	-15.2*
Change in physical activity	32.1 **	57.6 **	17.9 **	18.7 **

* $p > 0.05$ ** $p < 0.01$

Change in physical activity:

A significant increase in daily physical activity was observed in the whole group (from 3520 to 44393 steps/day) and in all of the subgroups (3120 to 4469 in the compliant group, 3571 to 4149 in the poor users group and 3881 to 4537 in the noncompliant group) ($p < 0.01$) (Fig. 1). However, the compliant group increased daily physical activity by 56%, significantly more than non compliant patients (18.7 %) and poor users (17.9%) (t Student's for matched pairs $p < 0.01$).

Compliant patients were more likely to increase physical activity with more than 50% than poor users (OR = 10.5; 95% CI =2.03 to 54.2) and than non-compliant patients (OR = 24; 95% CI = 2.81 to 204.6).

Daytime somnolence:

Daytime somnolence decreased significantly in the compliant group ($p < 0.01$). Poor users also declared significant reduction in daytime somnolence ($p < 0.01$). However, compliant patients differed significantly from poor users ($p = 0.02$) and from non-compliers ($p < 0.01$) from the point of view of the reduction in daytime somnolence.

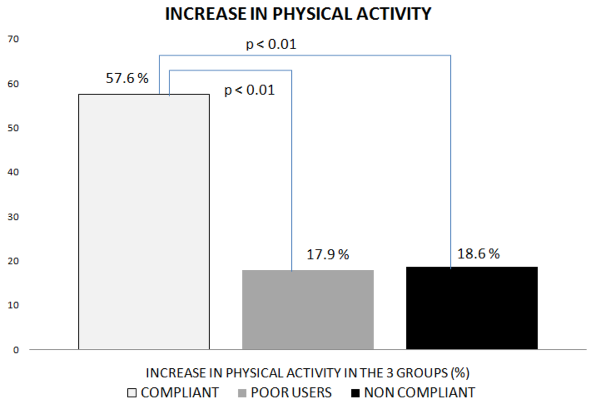

Figure 1. *The increase in physical activity in the 3 groups*

Correlations between parameters:

There was a very strong negative correlation between the change in body weight the increase in daily physical activity (r = - 0.75) (Figure 2). The decrease in daytime somnolence correlated significantly with the improvement in daily activity (r = - 0.59) and with the body weight reduction (r = 0.53).

Multiple stepwise regression analysis has shown that the major predictors for the increase in daily physical activity were physical activity at baseline, weight reduction and the reduction in somnolence. The regression formula is:

Increase in physical activity = - 8.742 -0.0041 x Baseline physical activity - 10.56 x Weight reduction - 0.361 x Reduction in somnolence.

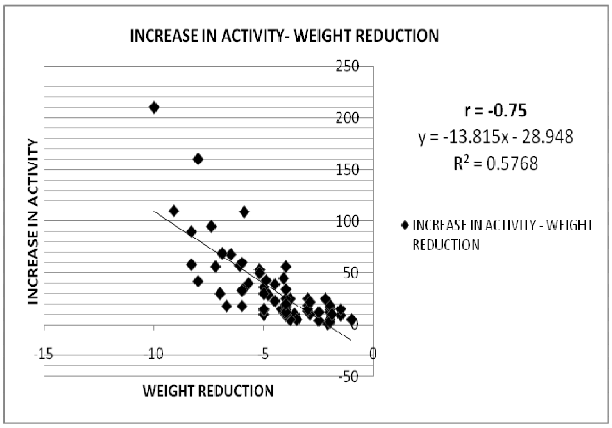

Figure 2. *Scatter-plot illustrating the correlation between the increase in physical activity and weight reduction*

4. Discussion

The links between OSAHS, obesity, somnolence, sedentary lifestyle and poor exercise tolerance are multidirectional and include physical deconditioning, cardiac co morbidities, altered dietary preferences and reduced metabolic rate in sleep disturbances via hypothalamic dysfunction. Chronic sleep deprivation is associated with sedentary lifestyle and weight gain. On the other hand intermittent hypoxemia triggers the release of inflammatory cytokines involved like TNF alpha, which stimulates catabolism. Although the benefits of CPAP have been demonstrated on somnolence and survival, most of the existing evidence does not support a positive effect on weight loss and increased physical activity.

To our knowledge, this is the largest sample of patients where data on weight loss and increased physical activity under CPAP are significant and correlate with the reduction in daytime somnolence.

In opposition to other studies, we performed an educational intervention in addition to the CPAP use. Moreover, the immediate feedback offered to the patients by the type of pedometer we used is proven to stimulate physical activity, which makes these instruments useful in rehabilitation and may explain the overall improvement in functional parameters in our study, compared to other studies which report more modest results.

Shortcomings of this study:

The 3 groups could not be well matched at baseline, the compliant patients bearing a more severe form of OSAHS and thus being more somnolent and sedentary. The patients who were more sedentary at baseline were more likely to increase their daily physical activity. This severe status was in fact the reason for the compliance to treatment, which is a characteristic of patients with OSAHS, making sample matching difficult.

Another bias factor is that patients who are compliant to one medical recommendation (like CPAP) tend to be compliant to the other interventions (lifestyle change).

5. Conclusions

Proper compliers to CPAP reduce body weight and increase physical activity more importantly than non compliant ones and poor users under the same educational intervention. These anthropometric and functional outcomes correspond to the decrease in daytime somnolence.

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