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Does Patient's Initial Evaluation Predict a Change in Optimal Pressure on CPAP Retitration?*

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ABSTRACT

Introduction: Only vindication of a nasal continuous positive airway pressure (CPAP) retitration procedure will be an actual change in the optimal CPAP pressure after that test. The purpose of this study was to identify any items in patient characteristics, clinical features, baseline PSG and initial CPAP titration as predictors of change in optimal pressure on CPAP retitration. Methods: 46 patients with obstructive sleep apnea (OSA) were divided in two groups: Group I (optimal pressure was changed on CPAP retitration): N = 30, M 22 and F 8, age 31 - 72, BMI 26 - 50 Kg/m^2, neck size 15 – 20", tonsillectomy in 8, narrow oropharynx in 15, uvuvlopalatopharyngoplasty (UP3) in 2, abnormal chin in 3, deviated nasal septum (DNS) and prior nose surgery in 1 each, initial CPAP pressure 6 - 19 cm, sleep efficiency 65% - 98%, REM latency 0 - 304 minutes and residual apnea hypopnea index (AHI) 0 - 23/hour. Group II (optimal pressure unchanged after CPAP retitration): N = 16, M 11 and 5 F, age 32 - 69, BMI 23 - 62 Kg/m^2, neck size 14.5 - 20", tonsillectomy in 6, narrow oropharynx in 5, abnormal chin in 4, corrective nasal surgery in 2, DNS in 1, initial CPAP pressure 8 - 13 cm of H2O, sleep efficiency 69% - 95%, REM latency 0 - 270 minutes and residual AHI 0 - 19/hour. The statistical analyses were performed using two-tailed Fisher's t test and unpaired t test. A p value of <0.05 was considered statistically significant. Results: Patient characteristics (age, gender, neck size, and BMI), clinical features (tonsillar status, oropharyngeal narrowing, chin abnormality, DNS/nasal surgery or UP3), baseline PSG or initial CPAP titration (sleep efficiency, REM latency, residual AHI and initial CPAP pressure) did not differ significantly between the 2 groups (p = 0.09 - 0.99). Conclusion: Patient characteristics, clinical features or variables on baseline PSG and initial CPAP titration do not predict a change in optimal pressure on CPAP retitration. The results suggest that 1) Significant weight change; 2) Patient's subjective feeling of pressure being too high or insufficient; 3) Residual or recurrent daytime sleepiness uncorrected by interface readjustments; 4) Post-operative evaluation after palliative UP3 Maxillomandibular advancement or tonsillectomy and adenoidectomy; and 5) Annual retitrations in high risk occupations (e.g. truck driver or pilot) are the best current, empiric and clinical guidelines for CPAP retitration.

KEYWORDS

Obstructive Sleep Apnea; CPAP Titration; CPAP Retitration

1. Introduction

The prevalence of obstructive sleep apnea (OSA) has been estimated to be 1% - 3%, 2% and 4% in children, middle aged women and men respectively [1-3]. The most reliably effective treatment for OSA is continuous positive airway pressure (CPAP) [4-6]. It is believed to prevent upper airway collapse during sleep by acting like a pneumatic splint [7,8]. A CPAP titration's objective is to identify an optimal positive airway pressure which is able to overcome airflow limitation in all sleep stages and body positions thereby preventing apneic/hypopneic events, snoring and respiratory effort related arousals,

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correct desaturations and improve sleep architecture.

However, the optimal CPAP is dynamic and is expected to vary over a period of time due to variety of reasons including but not limited to changes in upper airway e.g. adeno-tonsillar hypertrophy ; palliative and therapeutic interventions like adeno-tonsillectomy [9], UP3 [10], nasal surgery, mandibular advancement devices, tracheostomy and bariatric surgery [11]; craniofacial and pharangeal development in children; upper airway infection/obstruction/pathology such as rhinitis, nasal polyps or deviated nasal septum [12]; change in sleeping position; fluctuation in body mass index (BMI) and changes in lung volume [13].

Therefore, a re-evaluation of CPAP optimal pressure may be needed to change the initial pressure for effective OSA treatment. A retitration study is done annually as that is a frequency approved by most insurances or guided by the changes in objective/subjective measures of sleep and daytime somnolence on clinical follow up visits. The criteria for CPAP retitration are not clearly defined and the optimum pressure is not always different on reevaluation and in a number of OSA patients, it remains unchanged. This retrospective study was therefore designed to identify any characteristics present on initial clinic visit, baseline PSG and initial CPAP titration which might indicate/predict a change in optimal pressure on CPAP retitration.

2. Methods

2.1. Subjects

We studied forty six patients with OSA who presented at our sleep lab for CPAP retitration. The patients were evaluated by a board-certified neurologist who is also a board-certified sleep specialist, in a nationally accredited sleep center by a detailed medical history supplemented with standard sleep-wake questionnaire, neurological examination and examination relevant to sleep disorder evaluation such as neck size, chin size and position, jaw alignment, oropharyngeal examination. The patients were divided into two groups according to whether CPAP pressure on retitration study changed (Group I) or remained unchanged (Group II).

Thirty patients were in Group I (22 males and 8 females, age range 31 - 72 years, BMI range 26 - 50 Kg/m^2, neck size range 15 - 20", 8 patients with tonsillectomy, narrow oropharynx in 15 patients, 2 patients with UP3, abnormal chin in 3 patients, deviated nasal septum (DNS) and prior nose surgery in one patient each, initial CPAP pressure range 6 - 19 cm of H2O, sleep efficiency range 65% - 98%, REM latency range 0 - 304 minutes and residual AHI range 0 - 23/hour).

Sixteen patients were in Group II (11 males and 5 females, age range 32 - 69 yr, BMI range 23 - 62 Kg/m^2, neck size range 14.5 - 20", 6 patients with tonsillectomy, 5 patients with narrow oropharynx , abnormal chin in 4 patients, corrective nasal surgery in 2 patients, DNS in 1 patient, initial CPAP pressure range 8 - 13 cm of H2O, sleep efficiency range 69% - 95%, REM latency range 0 - 270 minutes and residual AHI range 0 - 19/hour.) Both groups were matched for age, gender, neck size, BMI, tonsillar status, oropharangeal narrowing, chin abnormality and upper airway surgery.

2.2. PSG

Single overnight PSGs were performed on forty six patients utilizing the AASM guidelines [14] prior to those most recently updated in 2005. The older data were analysed as currently it is hard to accumulate enough patients due to restrictions placed on CPAP retitrations by insurance companies. A 12 channel montage was utilized recording EEG, EOG, EKG, submental and tibial EMG, naso-oral airflow, thoracic and abdominal effort and O2 saturation by pulse oximeter. Sandman Elite hardware and software was utilized. The patients were evaluated in an accredited sleep laboratory in sound attenuated rooms, monitored by an infra-red camera. The records were scored by Rechtkaffen and Kale's method which was the prevalent method of scoring at that time [15] except for combining stages 3 and 4 as delta sleep and scoring movement time as arousal (2 - 15 sec) or awakenings (>15 sec) depending on duration. Various indices of sleep architecture analyzed were sleep efficiency, number of awakenings, number of stage shifts, percentage of various stages of sleep, sleep latency (*i.e.* latency to 3 consecutive epochs of stage 1 or first epoch of stage 2, REM or delta sleep), wake after sleep onset, latency to first REM period and apnea-hypopnea index (AHI). Apneas and hypopneas were scored according to guidelines prevalent at that time and are reproduced in **Table 1**.

2.3. CPAP-Titration and Retitration Studies

The polysomnograms performed with CPAP measured the same parameters as the baseline study. The range of pressure of the CPAP was set from 4 to 20 cm of H2O. During retitration studies the CPAP pressure was usually started several cm of water below the prescribed level and was gradually increased until the optimal pressure was found. Optimal pressure was defined as one which eliminated apneas, hypopneas, respiratory arousals, UARS, snoring and O2 desaturations in both supine position and REM sleep while improving sleep efficiency and decreasing sleep disruption as measured by improved stage 1 percentage and decreased stage-shifts. The study was not controlled for the sleep technologist but in general our sleep laboratory staff has a very low turnover rate.

2.4. Statistical Analysis

The statistical analyses were performed using two-tailed Fisher's exact test or one tailed unpaired t test. A p value of <0.05 was considered statistically significant.

3. Results

The results of this study failed to identify any items in patient characteristics, clinical features, initial PSG and initial CPAP titration as predictors of change in optimal pressure on CPAP retitration. There was no significant difference between age, gender, neck size, BMI, tonsillar status, oropharangeal narrowing, chin abnormality, upper airway surgery, sleep efficiency, REM latency, degree of sleep disruption, baseline AHI, residual AHI and initial CPAP pressure in Group I and Group II patients (p value = 0.09 - 0.99).

The results are summarized in Table 2.

Table 1. Scoring criteria for respiratory events.

Respiratory event	Airflow reduction	Respiratory effort	O2 Desaturation	Duration
Obstructive apnea	>90%	Continued/Increased	-	10 sec or more
Hypopnea	>50% & <90%	NA	-	10 sec or more
	>30% & <50%	NA	3% or more and/or terminated by a respiratory arousal	10 sec or more
Central apnea	>90%	Reduced > 90%	-	10 sec or more
Mixed apnea	>90%	Reduced more than 90% for at least 5 seconds prior to continued or increased effort	-	10 sec or more

Table 2. Statistical difference between the study groups (df = 44).

	t value	Standard error of difference	Two-tailed "p value"	95% Confidence interval
Patient characteristics				
Age	0.4966	3.692	0.6219	−9.2739 to 5.6071
Gender*	-	-	0.7441	-
Neck size	0.0000	0.310	1.0000	−0.6200 to 0.6200
BMI	0.4846	2.136	0.6303	−5.3391 to 3.2691
Clinical characteristics				
Tonsillar status*	-	-	0.5115	-
Oropharangeal status*	-	-	0.3496	-
Chin morphology*	-	-	0.2163	-
Nasal morphology*	-	-	0.3247	-
Baseline PSG parameters				
Sleep efficiency	1.2477	3.241	0.2192	−2.5011 to 10.5875
Wake before sleep	0.4579	6.240	0.6494	−15.4587 to 9.7439
Wake during sleep	1.7103	12.287	0.0948	−21.0155 to 3.7992
Stage 1%	1.1202	4.177	0.2691	−3.7561 to 13.1131
Stage 2%	0.2764	3.849	0.7837	−6.7086 to 8.8356
Delta %	1.3006	2.986	0.2007	−9.9133 to 2.1467
REM %	1.1206	2.542	0.2690	−7.9827 to 2.2851
REM latency	0.9984	26.102	0.3239	−26.6537 to 78.7745
AHI	0.5090	9.510	0.6135	−14.3645 to 24.0463
REM AHI	0.9689	8.668	0.3383	−9.1066 to 25.9025
Supine AHI	0.3090	11.038	0.7589	−25.7027 to 18.8814
SaO2 nadir	0.3892	2.758	0.6992	−4.4959 to 6.6422
Initial CPAP titration parameters				
Sleep efficiency	0.4582	4.064	0.6491	−10.0535 to 6.3291

Continued

Wake before sleep	0.3729	5.407	0.7110	−8.8810 to 12.9142
Wake during sleep	0.3257	11.795	0.7462	−19.9303 to 27.6135
Stage 1%	1.3746	3.114	0.1762	−1.9956 to 10.5572
Stage 2%	1.1570	3.548	0.2535	−3.0457 to 11.2557
Delta %	1.7269	2.566	0.0912	−9.6009 to 0.7401
REM %	1.7701	3.026	0.0836	−11.4557 to 0.7423
REM latency	0.3125	21.750	0.7562	−50.6301 to 37.0383
Residual AHI	0.7611	1.943	0.4507	−5.3937 to 2.4367
Initial CPAP optimal pressure	0.2277	0.896	0.8209	−1.6021 to 2.0103

*Fisher exact test.

4. Discussion

An identification of a predictor(s) for a change in optimal CPAP pressure on CPAP retitration would be an attractive solution to cut down health costs and reduce sleep laboratories backlog substantially by minimizing the number of unnecessary retitration studies. Also, recognition of patients who might need a different pressure may improve compliance and reduce the risks of OSA not optimally treated.

However, our study results failed to disclose any predictor(s) in patient characteristics, clinical features, baseline PSG or variables on initial CPAP titration.

The limitations of the study include limited number of subjects and inability to perform multivariate logistic regression analysis due to that reason. However, it is hard to find a large number of such patients in a given lab due to current climate of insurances severely restricting repeat titration studies.

Thus intuitive and empiric clinical criteria such as 1) body mass index fluctuation; 2) patient's subjective feeling of pressure being too high or insufficient; 3) subjective measures of non refreshing sleep and excessive daytime sleepiness despite interface readjustments; 4) postoperative evaluation after palliative UP3, bariatric surgery, tonsillectomy and adenoidectomy or MMA (Maxillo-mandibular Advancement) surgery; and 5) annual retitrations in high risk occupations (e.g. commercial truck drivers, heavy machinery operators or pilots) remain the best current clinical guidelines for CPAP retitration.

In this author's experience, there are some other variables which signal the need for retitration but are hard to evaluate in a scientific study. They include, 1) Inadequate first titration with not enough supine and REM sleep; 2) Patient's difficulty in adjusting to the CPAP machine during first 72 hours of use; 3) Unsatisfactory compliance summary results from the computer chips in the CPAP including excessive leaks and inadequately controlled AHI and hypoxia despite several interface readjustments; and 4) Climbing blood pressure, poorly controlled blood sugars in diabetics or interruption of patient's clinical course by a complication such as myocardial infarction, stroke.

Conflict of Interests

No conflict of interest is present.

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