International Journal of Advances in Medicine
Shyamala KK et al. Int J Adv Med. 2017 Apr;4(2):433-436
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20171036

Original Research Article

Comparative study on optimal continuous positive airway pressure and predicted continuous positive airway pressure in obstructive sleep apnoea

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Received: 22 December 2016
Accepted: 21 January 2017

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ABSTRACT

Background: Continuous positive airway pressure (CPAP) is the first line non-invasive and safest treatment of obstructive sleep apnoea (OSA). Optimal CPAP therapy prescribed is obtained by manual titration in lab setting. Due to lack of data in Indian population predicted CPAP pressure proposed by Hoffstein is used using body mass index (BMI), neck circumference (NC) and apnoea-hypopnoea index (AHI) to correlate with the optimal pressure by automatic CPAP titration.
Methods: The study was of retrospective and observational type. It included OSA patients diagnosed by overnight polysomnography (PSG) who had undergone automatic CPAP titration. The correlation of optimal pressure of automatic CPAP and predicted CPAP was studied.
Results: A total of 30 patients were included in the study of which 23 were males and 7 were females. It was found that 28 patients had severe OSA and 2 had moderate OSA. AHI significantly improved (P = 0.000) with automatic CPAP titration. The mean CPAP predicted pressure (8.77±2.05) was found lower than the therapeutic optimal pressure (13.03±3.18) prescribed and the value exceeded the range ±2 in 76% of patients.
Conclusions: Use of automatic CPAP limits the role for predicted formula for in lab titration/unattended home setting and patients who don't undergo CPAP titration study, reducing the cost of testing. However, the predicted pressure could be used as a starting pressure for initiation of CPAP titration in lab setting for manual titration.

Keywords: Automatic CPAP titration, CPAP, Optimal CPAP, Obstructive sleep apnoea, Prediction CPAP

INTRODUCTION

Continuous positive airway pressure (CPAP) is the standard first line and safest therapy in the treatment of obstructive sleep apnoea (OSA).[1] Gordan P described the mechanism by which positive airway pressure acts as pneumatic stent and keeps the airway open. He also described how the beneficial outcome of neurocognitive and cardiovascular consequences are achieved following treatment with CPAP.[2] Lee T described the role of bilevel positive airway pressure (BIPAP) and automatic positive airway pressure (APAP) in the treatment of OSA. The goal of CPAP titration is to prescribe effective lowest optimal pressure required to eliminate apnoea, hypopnea, snoring, repiratory effort related arousals in all body positions and sleep stages.[3] Standard CPAP titration is carried out during an overnight laboratory based polysomnography (PSG), a difficult procedure which is time consuming and needs manpower. Hofstein described a formula using apnoea hypopnea index (AHI), body mass index (BMI) and neck circumference (NC) to predict the optimal pressure which is widely used.[4,5]

Many other prediction formulas are also available with respect to different ethnicity.[6-11] Previous reports of differences between predicting CPAP level and optimal CPAP pressure using manual titration revealed that 83% of patients were within ± 2 cm H_2O and 95% were within ±3 cm H2O.[4,5] Chung-Chieh in his study observed automatic CPAP pressure was higher than predicted CPAP pressure.[12] Due to lack of Indian data, this study was carried out to compare the predicted CPAP pressure and optimal CPAP pressure using auto CPAP titration.

METHODS

The study was of retrospective and observational type. It included OSA patients diagnosed by overnight PSG who had undergone automated CPAP titration from August 2015 to July 2016 in Department of Pulmonology of Dr. BR Ambedkar Medical College. The study was approved by Institutional Ethical Committee. The optimal auto CPAP pressure titrated was determined using 95 percentiles (pressure level covered 95% of the study period provided by automatic CPAP device). Age, gender, weight, height, BMI, NC and AHI were recorded for calculating predicted pressure using Hofstein formula.

Ppred = (0.16 X BMI) + (0.13 X NC) + (0.04 X AHI) - 5.12

The data of predicted CPAP pressure and the optimal pressure were analysed using statistical method to study the relationship. Excel and SPSS (SPSS Inc, Chicago) software packages were used for data entry and analysis.

The results were averaged (mean±standard deviation) for each parameter and Student's 't' test was used to determine statistical difference between the two groups. A, 'p' value <0.05 was considered as statistically significant.

RESULTS

Out of the total 30 patients included in the study, 23 were males and 7 were females. It was found that 28 patients had severe OSA (AHI > 30 events /hour) and 2 patients had moderate OSA (AHI 15-30 events /hour). The anthropometric data of the study group is given in Table 1.

Table 1: Anthropometric measurements.

	Range	Mean±SD
Age (year)	30-75	49.74±11.59
BMI (kg/m^2)	26-46	32±5.18
NC (cm)	36-52	41.76±3.29
AHI	11-124	66.40±28.82

It was found that AHI before (66.40±28.82) (Table 2) and after automatic CPAP titration (mean 4.50±3.27) showed statistically significantly improvement (P = 0.000) (Table 3). There was found to be a relationship between predicted CPAP pressure and optimal automatic CPAP pressure. The mean CPAP predicted pressure (8.77±2.05) was found lower than the therapeutic optimal pressure (13.03±3.18) (Table 4). The difference value exceeded the range in ±2 in 76 % of patients and within range ±2 in 23 % (Figure 1, 2 and Table 5).

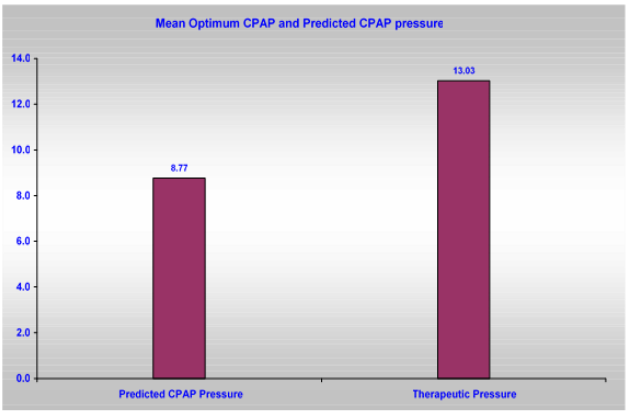

Figure 1: Mean optimum CPAP and predicted CPAP pressure.

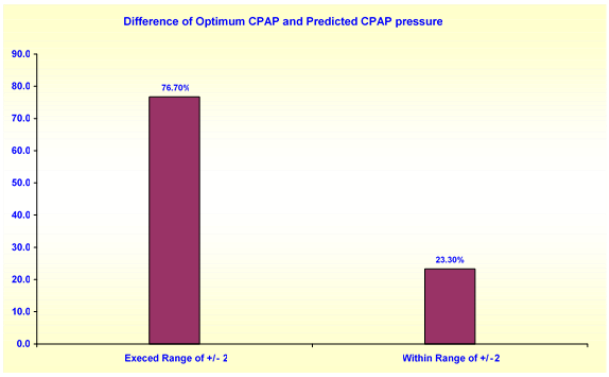

Figure 2: Difference of optimum CPAP and predicted CPAP pressure.

Table 2: Difference in AHI before and after CPAP titration.

Differences in the polysomnography before and with CPAP titration	Paired differences		't' value	'p' value
	Mean	Std. deviation		
AHI	66.40	28.82	12.621	0.000

Table3: Effect of CPAP on AHI and the optimal pressure.

CPAP	N	Mean	Std. deviation	Std. error mean
AHI	30	4.50	3.27	0.60
Therapeutic pressure	30	13.03	3.18	0.58

Table 4: Optimum CPAP and predicted CPAP pressure.

	Mean	Median	Mode	Std. deviation	Minimum	Maximum
Predicted CPAP pressure	8.77	8.00	7	2.05	6	14
Therapeutic pressure	13.03	12.50	12	3.18	7	18

Table 5: Difference of optimal and predicted CPAP.

Predicted -therapeutic pressure	Frequency	Percent
Exceed range of ±2	23	76.7
Within range of ±2	7	23.3
Total	**30**	**100.0**

DISCUSSION

In our study, we observed that the mean CPAP predicted pressure was found lower than the therapeutic optimal pressure prescribed. The value exceeded the range of ±2 in 76 % of patients as against described by Zoe Oliver and Hofstein.[4] Hofstein described the difference between predicted CPAP and optimal CPAP pressure was within 2 cm of H2O in 83% of patients and 95% within 3 cm of H2O with manual titration.[5,6] It is stated that theoretically the automatic CPAP pressure and predicted CPAP pressure should have the same distribution with predicted CPAP pressure and manually titrated pressure. Nahmias et al reported formula including ideal body weight ratio, respiratory disturbance index and nadir oxyhaemoglobin saturation.[13] Another study conducted by El Sohl et al found that ability to estimate the optimal pressure can be improved by using computer analysis involving neural networks that rely on a combination of anthropometric and clinical data.[14] In a study conducted by Stradling JR et al it was found that one-night titration was not precise and was subjected to random variation.[6] In a study conducted by Lin IF et al it was found that obesity and severity of sleep apnea were the two most important predictors of CPAP setting effectively abolishing the apneas.[11] Chung - Chieh stated in his study that automatic CPAP pressure were higher than predicted CPAP pressure.[12] The automatic CPAP pressure did not correlate well with predicted CPAP pressure. The role of predicted CPAP pressure is limited; however it can simplify titration in laboratory testing with manual titration using as starting pressure.

The predicted CPAP pressure was found to be lower than automatic CPAP pressure. The use of automatic CPAP for titration in lab, home settings/ unattended and patients who don't undergo titration procedure could reduce the cost and manpower involved in lab manual titration procedure.

ACKNOWLEDGEMENTS

Authors would like to thank all the participants for their support and co-operation during the study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Shyamala KK, Khatri B, Suresh A, Rajendran G. Comparative study on optimal continuous positive airway pressure and predicted continuous positive airway pressure in obstructive sleep apnoea. Int J Adv Med 2017;4:433-6.