ORIGINAL ARTICLE

Sleep Science

Acceptance and Adherence to Continuous Positive Airway Pressure Therapy in patients with Obstructive Sleep Apnea (OSA) in a Southeast Asian privately funded healthcare system

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ABSTRACT

Background: There is limited data on long term Continuous Positive Airway Pressure (CPAP) adherence in Southeast Asian countries. This is a prospective study on CPAP adherence among Obstructive sleep apnea (OSA) patients in a Southeast Asian privately funded healthcare system. **Methods:** Patients with moderate-severe OSA who had been initiated on CPAP at least one year previously were contacted for a scripted telephone interview to assess compliance and factors associated with CPAP adherence. **Results:** Of 135 consecutive patients diagnosed to have moderate to severe OSA, 78 (57.8%) were initiated on CPAP treatment while 57 (42.2%) rejected CPAP upfront. 41 (52.6%) who initiated CPAP remained adherent at one year. OSA severity (AHI, ODI) and symptomatic improvement after CPAP were associated with better adherence. Presence of machine related side effects was associated with lower adherence. Inconvenience, cost and poor disease perception were reported as major barriers to uptake of CPAP therapy. **Conclusions:** In this Southeast Asian privately funded healthcare system, almost half of all patients with significant OSA rejected CPAP treatment upfront, but adherence among those who started CPAP is comparable to other reports. Challenges with CPAP acceptance as well as CPAP adherence need to be addressed to improve outcomes.

Keywords: Patient Compliance; Sleep Apnea, Obstructive; Asia, Southeastern.

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INTRODUCTION

Continuous positive airway pressure (CPAP) is the primary treatment for obstructive sleep apnea (OSA) and has been proven to improve outcomes such as daytime sleepiness, cognitive performance, blood pressure, glucose control, cardiovascular status, quality of life and mortality[1-6]. Treatment efficacy is however limited by variable adherence. Using a minimum of 4 hours per night to define adherence, previous studies have reported that 29 to 83% of patients are non-adherent to CPAP therapy[7].

The past decade has seen the establishment of sleep laboratory facilities in countries like Singapore, Malaysia and Philippines with an increasing awareness of OSA. Information on CPAP adherence patterns in Asia however remains scarce. One report in Japan showed CPAP adherence rate after a 6 month period was 38%[8]. Another Japanese study reported 89.8% CPAP adherence rate at 5 years[9]. Other studies suggested a greater concern with CPAP acceptance. One study on a Chinese population reported one-third of OSA patients who declined CPAP therapy after CPAP titration[10] while another study performed in Taiwan reported an even lower CPAP acceptance rate of 39.7%, particularly among the elderly[11].

Predictors of CPAP adherence which are largely based on studies conducted in the Western population may be broadly classified into factors including disease and patient characteristics, treatment titration procedures, device factors, psychological and social factors[12]. The impact of disease severity and device factors on CPAP adherence however appears weak based on mixed findings reported in earlier studies. From recent studies including some that were done on Asian populations, socio-environmental background, education and psychological factors such as risk perception of disease and treatment outcome expectancies are increasingly recognized as potentially more important determinants of CPAP acceptance and long-term adherence.

The study on the Chinese population for instance revealed that patient characteristics could not predict subsequent CPAP adherence and the most common reasons cited for lack of adherence were poor adaptation to CPAP during the titration night, poor perception of need or benefits of treatment, and inconvenience[10]. Another study demonstrated how patient education and progressive muscle relaxation significantly improved CPAP adherence[13]. In Hong Kong CPAP acceptance was low among a group of bus drivers who were diagnosed with OSA despite significant improvement of symptoms with CPAP treatment[14].

The Southeast Asian population is unique in areas of ethnicity, health value beliefs, economic development and healthcare financing system. Specifically, unlike many other healthcare systems in the West, CPAP machines are not usually covered by state or private insurance and patients must pay for the devices and interfaces out-of-pocket. The cost of a CPAP machine is also substantial, with an Auto-titrating CPAP device costing S$1500-S$2000; which would be nearly half the median monthly income of the average Singaporean worker. Some of these factors may impact patients' decisions to accept or adhere to CPAP therapy. The objective of this study is to assess the CPAP adherence among newly diagnosed OSA patients who were prescribed CPAP therapy in a Southeast Asian privately funded healthcare system and to explore the reasons for patients who declined CPAP treatment upfront.

METHODS

529 patients from an academic sleep clinic in Singapore underwent a diagnostic in-laboratory full polysomnography from January 2012 to June 2012. Of these, 135 consecutive patients were diagnosed with either severe OSA (AHI>30/hr) or symptomatic moderate-severe OSA (AHI>15/hr and ESS>10). Patients who had cognitive impairment, or whom opted for other forms of treatment (e.g. surgery or mandibular advancement devices) were excluded. This study was approved by the Singhealth Centralised Institutional Ethics Review Board.

Baseline variables

Baseline variables were systematically collected from a pre-existing database of patients who underwent Polysomnography (PSG) at our unit. These include age, sex, race and body mass index (BMI). Epworth Sleepiness Scale (ESS) was obtained at the initial consultation just before the PSG was performed.

Sleep Study and CPAP treatment

All sleep studies were PSG (Compumedics PS, Melbourne, Australia) which included continuous electroencephalogram, oculogram, electrocardiogram, electromyogram, respiratory channels including nasal and oronasal airflow, thoracic and abdominal respiratory movements and pulse oximetry; snore, position and video monitoring. All studies were scored by a Registered Polysomnographic Technologist (RPSGT) using the AASM 2007 criteria in which apnea was defined as cessation of airflow for >10 seconds. Hypopnea was reduction of airflow defined by 50% reduction in nasal pressure signal from the baseline associated with 4% oxygen desaturation from baseline or an arousal. Oxygen desaturation index (ODI) was the hourly average number of episodes of oxygen desaturation >4% from baseline.

All patients who were prescribed CPAP underwent CPAP counselling by a RPSGT prior to a CPAP trial, with each session lasting 15-30 minutes. During the session, patients were educated on the rationale, benefits and possible side effects of CPAP. They were also introduced to different types of mask interface, CPAP machines and fitted with an appropriate mask interface. Information leaflets and troubleshooting tips were provided.

CPAP treatment was initiated with home auto-PAP in most instances, except where the patient had underlying cardiorespiratory diseases, when a manual CPAP titration study was ordered. Patients would then be reviewed by the attending sleep physician after two weeks and either continued on auto-PAP or had their settings adjusted to a fixed CPAP pressure based on data from the two-week trial.

The patients also received a phone call two weeks after initiation of CPAP to troubleshoot problems that were identified. Follow-up consultations were subsequently guided by the patients' response to treatment, typically more frequent in the initial phase (2-8 weekly) and 3-6 monthly for those who showed stable response on treatment.

Telephone interview

Patients were contacted via telephone one year after they had been initiated on CPAP. The interview was conducted using a telephone interview script and questions were structured to obtain information required for the data collection sheet (Figures 1 and 2). Caregivers, spouses and partners were not permitted to respond to the interview on behalf of the patients. Machine and mask types, mask leakage, pressure settings and use of humidification were assessed for correlation with CPAP adherence. Patients were also asked to report any related side effects and their satisfaction with the use of CPAP.

Patients were asked if they slept and felt better compared to before initiation of CPAP therapy. Patients were also asked the reasons they were using CPAP and reasons for rejection of CPAP treatment if they were not.

CPAP adherence was defined as a self-reported CPAP usage of a minimum 4 hours/day for at least 70% of the nights each week. Patients were classified into 3 groups based on the level of CPAP adherence. Group 1 included patients who fulfilled the criterion for CPAP adherence as defined above. Group 2 included patients who were non-adherent to treatment, referring to those who used CPAP less than 4 hours/day or stopped using CPAP after an initial 1-month trial period. Group 3 included patients who rejected a CPAP trial upfront and did not receive any form of treatment for their OSA.

Statistical analysis

Analyses were performed using R 3.0.2 (http://www.R-project.org). Data was expressed as median with interquartile range for continuous variables. Proportions were reported for categorical data.

Differences in baseline characteristics between the 3 groups of patients were analysed using Kruskal-Wallis test for continuous variables and Fisher's exact test for categorical variables.

Univariate logistic regression analysis was performed to evaluate the variables associated with CPAP adherence. Factors

Phone Interview Script for 'Determinants of compliance to long-term continuous positive airway pressure therapy in patients with Obstructive Sleep Apnea'

Good morning/ afternoon, I'm _____ from the Sleep Disorders Unit, Singapore General Hospital. I'm calling to conduct an interview on CPAP compliance.

I presume that by now you would have received our letter for this interview. I would therefore like to seek your consent in conducting this 10-15 minutes interview.

[Patient can decline the interview]

[The actuals of the Interview]

Thank you for your help. You have certainly been very helpful in providing the information in improving patient's future experience in CPAP therapy.

Figure 1. Telephone Interview Script

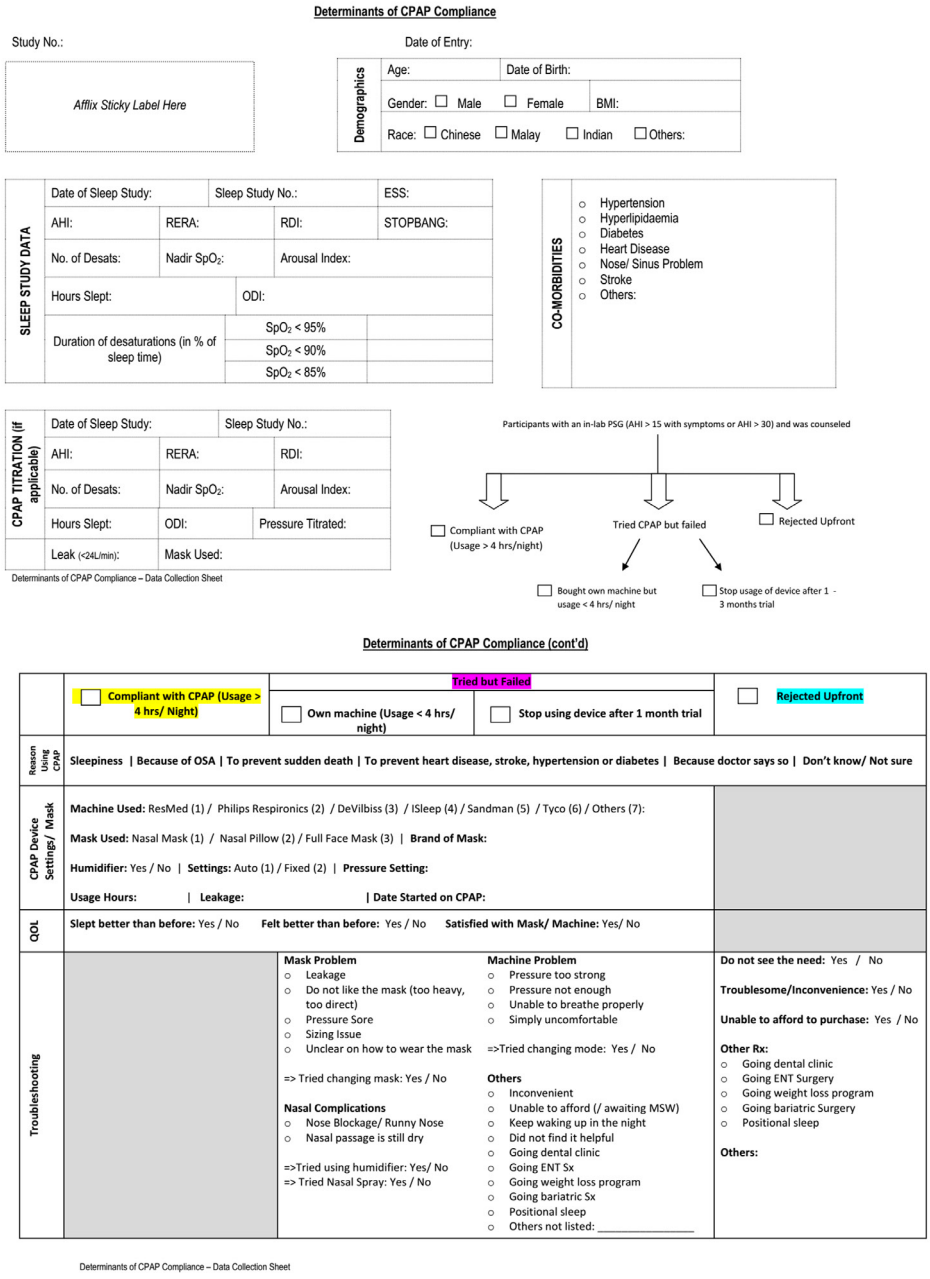

Figure 2. Data Collection Sheet

identified by the results of univariate logistic regression with $p<0.1$ were selected for multivariate analysis. The final set of variables were selected in the multivariable model by means of backward elimination with $p<0.05$ for statistical significance.

RESULTS

As shown in Figure 3, 166 patients met inclusion criteria. 17 patients received surgical treatment for OSA and another 14 were not contactable at 1 year, leaving 135 patients in the final analysis. 57 patients (42%) rejected CPAP therapy upfront (Group 3) and 78 proceeded with CPAP. At 1 year, 41 (53%) of these patients remained adherent with CPAP (Group 1) and 37 patients were non-adherent (Group 2). The patients in the compliant group had higher level of AHI, RDI and ODI compared to the patients in the non-compliant group and those who rejected CPAP treatment upfront (Table 1).

Univariate logistic regression analysis showed that patients with more severe OSA had better CPAP adherence (Table 2). Those who slept better (OR=5.61, 95% CI= (1.90, 9.27)) or felt better (OR=9.24, 95% CI= (2.96, 35.65)) after

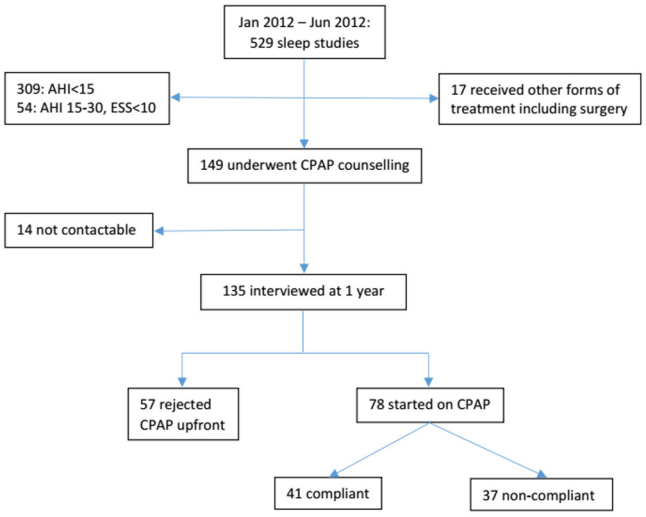

Figure 3: Patient enrolment flowchart

using CPAP also demonstrated better adherence (Table 2). Multivariate analysis revealed that only those who felt better (OR=13.74, 95% CI= (3.46, 74.38)) after using CPAP had better adherence. Machine-related problems (OR=0.23, 95% CI= (0.05, 0.80)) were associated with poor adherence (Table 2).

Humidification, nasal complications and mask-related side effects were not shown to affect adherence in the current study. There was also no significant difference in adherence rate among the 28 patients (20.7%) who underwent manual CPAP titration compared to those who were titrated using autoPAP.

92% (72/78) of our patients were using auto-titrating CPAP therapy and no difference in compliance were found between fixed and autoPAP users.

Reasons for rejecting CPAP upfront are listed in Table 3. Half of the patients did not provide any reason for declining treatment. One patient hoped to improve his symptoms through participation in a weight loss program.

DISCUSSION

The present study demonstrated that the majority of our patients with significant OSA rejected CPAP upfront and CPAP adherence was not ideal in those who tried. Overall 70% of patients with significant OSA in whom PAP therapy is indicated are not on effective treatment. There is a wide variation in reported rates of CPAP acceptance and adherence even in different parts of Asia itself based on various studies as outlined in Table 4.

Increased sleep apnea severity as measured by AHI has previously been associated with better CPAP adherence although the effect size is small[17-19]. Our study confirmed this finding in the local population. Unlike previous reports, daytime sleepiness as measured by the ESS was not identified as a predictor of adherence. Adherence was also negatively correlated with machine related side effects.

Table 1. Patient characteristics

Factor	Frequency (proportion)			*P*-value
	Compliant (n=41)	Non-compliant (n=37)	Rejected upfront (n=57)	
Age	50 (42, 58)	51 (43, 62)	50.5 (41.5, 61)	0.6853
Male Sex	35 (85.4)	31 (83.8)	38 (66.7)	0.0638
Race				0.2707
Chinese	37 (90.2)	28 (75.7)	46 (80.7)	
Malay	2 (4.9)	2 (5.4)	4 (7.0)	
Indian	1 (2.4)	6 (16.2)	7 (12.3)	
Others	1 (2.4)	1 (2.7)	0 (0)	
BMI (kg/m2)	30 (28.4, 34.6)	29.0 (27.3, 31.2)	30.0 (27, 36.8)	0.3649
AHI	63.7 (48.2, 73.1)	49.1 (36.5, 61.7)	43.9 (31.5, 58.3)	0.0014
RDI	68.6 (58.3, 76.7)	57.2 (44.4, 70.7)	52.7 (39.1, 66.1)	0.0049
ESS	11 (8, 16)	11.5 (6, 15)	11 (9, 13.5)	0.9585
ODI	58.0 (42.5, 69.7)	43.9 (23, 53.3)	35.6 (26.9, 54.8)	0.0082
Nadir SpO_2	72 (62, 78)	74 (72, 79)	75 (68, 79)	0.2142
Manual titration study done	11 (26.8)	8 (21.6)	9 (15.8)	0.3759
Comorbidites				
Nocturia	13 (31.7)	17 (45.9)	23 (43.4)	0.4349
Hypertension	21 (51.2)	23 (62.2)	23 (40.4)	0.1230
Hyperlipidemia	17 (41.5)	18 (48.6)	18 (51.4)	0.2437
Diabetes	4 (9.8)	9 (24.3)	17 (29.8)	0.0517
Heart Disease	4 (9.8)	7 (18.9)	7 (12.3)	0.4766
Stroke	2 (4.9)	3 (8.1)	1 (1.8)	0.3743

Data presented as n (%) or median (interquartile range).
Definition of abbreviations: BMI=body mass index; AHI=apnea-hypopnea index; RDI=respiratory disturbance index; ESS=Epworth sleepiness scale; ODI=oxygen desaturation index

Table 2. Univariate analysis: Predictors of CPAP adherence

Predictors	OR (95% CI)	*P*-value
Age	0.98 (0.94, 1.02)	0.393
Sex		
• Male*		
• Female	0.89 (0.25, 3.11)	0.847
Race		
• Chinese*		
• Non- Chinese	0.34 (0.08, 1.15)	0.094
BMI	1.04 (0.97, 1.13)	0.279
AHI	1.03 (1.01, 1.06)	0.011
RDI	1.02 (1.00, 1.05)	0.043
ESS	1.01 (0.93, 1.11)	0.767
ODI	1.03 (1.01, 1.05)	0.019
Nadir SpO_2	0.96 (0.91, 1.00)	0.066
Manual titration study done	1.33 (0.47, 3.88)	0.593
Reasons for using CPAP		
Sleepiness	4.64 (1.09, 32.01)	0.061
Because of OSA	1.68 (0.55, 5.28)	0.360
Reduce CVS/stroke risk	1.74 (0.16, 38.49)	0.656
Because doctor says so	0.51 (0.17, 1.52)	0.235
CPAP Device factors		
Humidification	1.45 (0.56, 3.79)	0.448
Nasal complications	2.91 (0.62, 20.85)	0.209
Pressure mode		
• Fixed*		
• Auto	0.53 (0.07, 2.89)	0.477
Mask-related side effects	0.41 (0.15, 1.05)	0.066
Machine-related side effects	0.13 (0.02, 0.56)	0.013
Treatment Outcomes		
Slept better than before	5.16 (1.69, 18.03)	0.006
Felt better than before	8.71 (2.73, 34.08)	0.0006

Definition of abbreviations: BMI=body mass index; AHI=apnea-hypopnea index; RDI=respiratory disturbance index; ESS=Epworth sleepiness scale; ODI=oxygen desaturation index. *Reference category

Table 3. Reasons for declining CPAP therapy

Reasons	Frequency (proportion)
Do not see the need	9 (15.8%)
Troublesome/Inconvenient	12 (21.1%)
Unable to afford	7 (12.3%)
Weight loss program	1 (1.8%)
No reason given	29 (50.9%)

NB: Patients may provide multiple reasons for decline of CPAP.

Table 4: Summary of studies on CPAP acceptance and adherence rates in Asian countries

Source/year	Country	Study period	Acceptance Rate (%)	Adherence Rate (%)
Wang Y et al./2012[10]	China	30 months	67	65
Hui DS et al./2001[15]	Hong Kong	3 months	100	72
Tokunaga T et al./2013[9]	Japan	19 months	91	90
T Tanahashi et al./2012[8]	Japan	6 months	87	38
Hussain SF et al./2014[16]	Pakistan	1 year	80	76
Yang MC et al./2013[11]	Taiwan	9 months	40	64

Several factors may be responsible for the poor rate of CPAP uptake. Firstly, a polysomnography is usually covered by health insurance or deductible from Medisave, which is a national healthcare savings scheme requiring all Singaporeans to set aside a portion of their salary for medical expenses. Purchase of CPAP equipment however, requires cash payment upfront. This may explain why many were willing to undergo a sleep study but not accept treatment after.

The authors of a study in Taiwan similarly cited a lack of coverage for the purchase of CPAP devices under the health insurance systems in Taiwan, and income of patients as potential confounding factors that affected CPAP acceptance although this had not been properly evaluated in the study. The same study reported increased comorbidities, lower excessive daytime sleepiness and lower AHI severity to be significant factors associated with lower CPAP acceptance rate. In our study patients who rejected CPAP treatment upfront had lower AHI severity but their comorbidities and ESS were not significantly different compared to the patients who accepted CPAP treatment.

The impact of affordability on CPAP adherence may be more complicated. Financial incentive compared to a control group was shown to be an independent predictor of initial CPAP acceptance among OSA patients in a low-income group in Israel, although CPAP adherence rate was no different at 35% and 39% respectively at the one-year follow up[20]. The same authors reported that the odds of CPAP acceptance increased by 140% for each increase in the income level category in another study from Israel[21].

In Japan where all forms of medical treatment including CPAP are paid for by a national healthcare scheme, similar results on CPAP compliance were found. Although initial CPAP acceptance rate was high, long term adherence was low at 38% and independent of income level[8]. The evidence suggests that although lowering the initial cost of CPAP to the user may increase the rate of initial CPAP acceptance, long term compliance remains poor and is probably more dependent on non-financial factors.

We sought the reasons for rejection among those who declined CPAP therapy upfront. Inconvenience, affordability issues and poor disease awareness were main reasons for rejection of CPAP treatment. We noted that a significant proportion (15.8%) of the patients rejected therapy upfront as they did not see the need for treatment. These patients may not have been fully aware prior to their sleep study of the implications of a diagnosis of OSA, including the need for long term CPAP therapy. It may be prudent to initiate CPAP counselling prior to ordering a polysomnography to better manage patient expectations.

A major strength of the current study was its reflection of patients' acceptance and adherence to CPAP treatment in real life scenario where short-term reinforcing intervention via telephone support and increased interaction with the healthcare provider were provided. In addition, the telephone interview method of data collection allowed the researchers to ensure

patients understood the questions and that all responses were usable.

There were however a number of limitations in our study. Firstly, the small sample size diminished the power to detect differences between the different groups of patients, and might account for the wide confidence intervals for some of the reported odds ratio. Another limitation was the reliance on patient self-reporting, which has been previously shown to overestimate CPAP use compared to objective measurement[22,23]. However, with this understanding, the findings of the study did suggest that the issue of poor CPAP acceptance and adherence reported here remained significant.

CONCLUSION

In summary, in a Southeast Asian privately funded healthcare system, a large proportion of patients with significant OSA reject CPAP treatment upfront. More effort is required to address the illness perception in these patients. Among those prescribed CPAP therapy, adherence rate is poor. Increased OSA severity and presence of CPAP side effects were correlated with reduced CPAP adherence.

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