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SCIENTIFIC INVESTIGATIONS

A Multicenter, Prospective Study of a Novel Nasal EPAP Device in the Treatment of Obstructive Sleep Apnea: Efficacy and 30-Day Adherence

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Study Objectives: Evaluate the efficacy of a novel device placed in the nares that imposes an expiratory resistance for the treatment of obstructive sleep apnea (OSA) and evaluate adherence to the device over a 30-day in-home trial period.

Design: One diagnostic and 3 treatment polysomnograms were administered in a Latin-square design to identify the optimal expiratory resistance to be used during the 30-day in-home trial. Subjects had repeat polysomnography with the prescribed device at the end of the 30-day trial.

Setting: Multicenter study.

Participants: Participants (N = 34; age 27 to 67) with a baseline apnea-hypopnea index (AHI) ≥ 5.

Measurements and Results: The AHI was reduced from 24.5 ± 23.6 (mean ± SD) to an average of 13.5 ± 18.7 ($p < 0.001$) across initial treatment nights. The AHI was 15.5 ± 18.9 ($p = 0.001$) for the prescribed device at the end of the 30-day trial. Of 24 subjects with an AHI > 10 at baseline, 13 achieved an AHI ≤ 10 on the initial treatment nights; 10 had a similar response on the final treatment night. Percent of the night snoring decreased from 27.5 ± 23.2 to 11.6 ± 13.7 ($p < 0.001$) on initial treatment nights and 14.6 ± 20.6 ($p = 0.013$) at the end of the trial; Epworth Sleepiness scores decreased from 8.7 ± 4.0 at baseline to 6.9 ± 4.4 ($p < 0.001$) at the end of the trial; the Pittsburgh Sleep Quality Index improved from 7.4 ± 3.3 to 6.5 ± 3.6 ($p = 0.042$). Mean oxygen saturation increased from 94.8 ± 2.0 to 95.2 ± 1.9 ($p = 0.023$) on initial treatment nights and 95.3 ± 1.9 ($p = 0.003$) at the end of the trial. Sleep architecture was not affected. Participants reported using the device all night long for 94% of nights during the in-home trial.

Conclusions: Treatment with this novel device was well tolerated and accepted by the participants. An overall reduction in AHI was documented; however, therapeutic response was variable among the participants. Further research is required to identify the ideal candidates for this new therapeutic option in the management of OSA.

Keywords: Sleep apnea, OSA, therapy, CPAP, sleepiness

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Continuous positive airway pressure (CPAP) is effective in preventing airway collapse, improving sleep continuity and reversing behavioral and cardiovascular morbidity in patients with OSA.[1-4] Oral appliances constitute the other main alternative available for medical treatment of the condition. However, its effectiveness may be lower than CPAP.[5] Surgical procedures such as the uvulopalatopharyngoplasty (UPPP) have resulted in low response rates and those patients who do respond initially to surgery may develop OSA over time and require treatment with CPAP.[6-8] The introduction of palatal implants has generated significant interest, as it represents an outpatient procedure with minimal complications. However, a significant proportion of patients treated with the palatal implant procedure have shown no improvement in AHI.[9]

A recent review of therapeutic outcomes across different therapeutic interventions (CPAP, UPPP, and oral appliances) described reductions in the apnea-hypopnea index (AHI) of 75%, 30%, and 42%, respectively.[5] To date, no complete treatment for OSA is available, and patients frequently complain of the intrusive nature of the therapeutic devices.

The lack of acceptance or partial adherence to the available medical therapies is well documented in the literature.[10,11] Thus, there is a need for additional therapeutic options that are less intrusive and simpler to use. One alternative is Provent™ Sleep Apnea Therapy (Ventus Medical, Belmont CA), a small, lightweight, and quiet device that does not require an external power source. It consists of a one way valve that is inserted into the nares and secured to the outside of the nose with an adhesive substrate. The valve opens to allow for the unimpeded flow of air during inhalation but closes so that exhalation occurs against a fixed orifice. The expiratory flow resistance creates positive airway pressure during the expiratory phase, which appears to stabilize the pharynx and prevent its periodic collapse during sleep (Ian Colrain, personal communication).

In a previous experiment that used a threshold pressure relief valve, or PEEP valve, to generate expiratory positive airway pressure (EPAP), expiratory pharyngeal pressure led to improvements in the apnea index and duration of apneas, as well as measures of oxygen saturation.[12] In particular, the apnea index declined from > 30 on the control night to approximately

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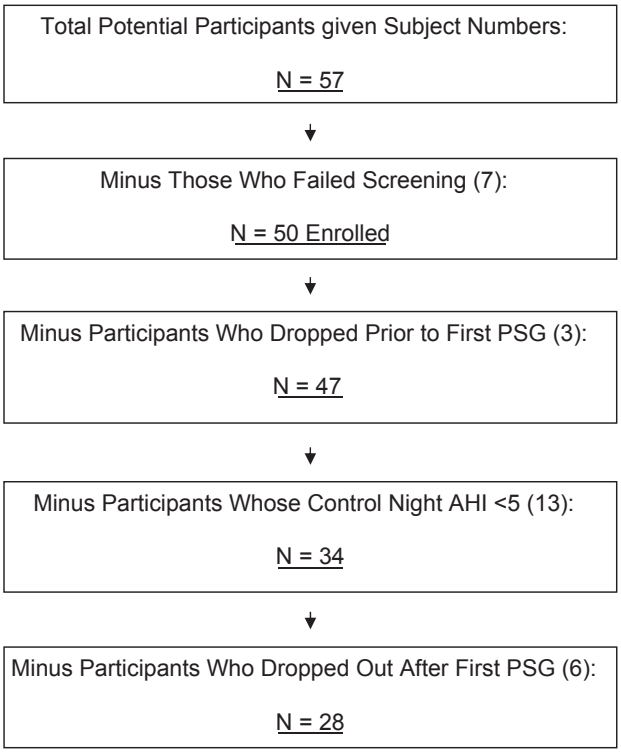

Figure 1—Summary of inclusion disposition for the screened population.

3 on the one night of PEEP valve use. There was a decrease in stages 1 and 2 sleep and an increase in stage 3/4 sleep; total sleep time was unaffected. A recent one-night study with the Provent device showed an acute benefit of the resistance-generated EPAP.[13] For 24 participants with varying OSA severity, AHI declined from 24.8 to 14.2 events per hour, oxygen desaturation index (ODI) declined from 14.6 to 9.9 events per hour, and the percent of the night spent snoring declined from 26.9% to 9.4%. After one night of use, 73% of participants found the device to be at least somewhat comfortable. This study supported the efficacy and potential benefit of the device.

The aims of the present study were to evaluate the efficacy of the novel device using different expiratory resistance levels and to assess adherence over a 30-day in-home trial. We report on a prospective, multicenter trial in which participants were randomly assigned to diagnostic polysomnography and 3 therapeutic sleep studies with 3 possible device resistances. Subjects were assigned to the most effective therapeutic device for nightly home use for 30 days and returned to the laboratory for a final nocturnal polysomnogram with use of the assigned device.

METHODS

Participants were recruited from 3 metropolitan areas (Dallas TX, Chicago IL, and the San Francisco Bay area) from newspaper advertisements, internet listings, and referrals from sleep clinics. Individuals were screened via telephone for inclusion and exclusion criteria through the Dallas central screening center prior to referral to the closest study center location. Inclusion criteria included adult participants who snored, had witnessed apneas, or had been diagnosed with OSA. Exclusion criteria included prior use of CPAP, uncontrolled or serious illness (i.e., cancer, COPD, CHF), comorbid sleep disorders, history of frequent and/or poorly treated severe nasal allergies, sinusitis, difficulty breathing through the nose, and persistent blockage of one or both nostrils. This study was approved by the Western Institutional Review Board (Seattle, WA). All participants signed informed consent prior to the initiation of any research activities. The sponsor of the study developed the protocol; an independent statistical analysis firm (QST Consultations, Ltd., Allendale, MI) entered data and calculated the p-values done via Student's *t*-tests.

The baseline visit consisted of a medical history and physical exam by the on-site physician investigator; subjects completed 4 nights of in-laboratory polysomnography (PSG) in random order with one control night and 3 nights using varying expiratory resistances (50, 80, and 110 cm H_2O•sec/liter). This was followed by 30 days in-home use of the device, and one final PSG night with the assigned device. Participants completed the Pittsburgh Sleep Quality Index (PSQI)[14] and the Epworth Sleepiness Scale (ESS)[15] both at the beginning of the study and after the in-home use period.

Polysomnograms were conducted according to AASM guidelines.[16] The following parameters were monitored: EEG, EOG, EMG, EKG, respiratory effort, nasal pressure, pulse oximetry, and snoring duration via vibratory sensor. During both the control and treatment nights, nasal flow was transmitted via a nasal cannula to a pressure transducer for measurement of airflow. As a standard nasal cannula interferes with the valve functioning, the tips of the nasal cannulas were trimmed and affixed to the nasal expiratory resistance devices. Participants were given a breath alcohol test (Alcomate Prestige, AK Solutions, Palisades Park, NJ) prior to each night of testing. A Latin square design was used to balance order effects during the control night and the 3 initial treatment polysomnographies. Randomization was provided by the sponsor to each site via a closed envelope method labeled with a subject number and administered following enrollment.

Upon completion of all 4 initial nights in the laboratory, a pre-defined algorithm was used to select the optimum resistance level for the participant to use during the in-home period. The device producing the approximate maximal reduction in AHI was chosen for the 30-day in-home portion, with a bias toward a lower resistance device when more than one device gave results within 10% of greatest AHI reduction.

A daily log was kept by the participant during the in-home period, and weekly phone calls were conducted by study staff. Participants indicated in the negative or affirmative whether the device remained in place for the full duration of the sleep period. If a participant failed to answer this question or answered with a "no," then it was assumed that the device was not worn during that night. For analyses, "nights used" only included nights when the participant noted the device was still in place in the morning, and hence worn the entire night.

Site personnel and participants had no knowledge of the treatment resistance in the laboratory or during the period of in-home use. Devices were identical and identified only by a letter (A, B, or C). Each PSG night was given a unique, random number for identification. A single independent registered sleep technologist performed the scoring of all PSGs without knowledge of the participant, nature of the investigational device, treatment arm, or study order. Each breath during sleep was classified as either

normal, snoring, apneic, or hypopneic. Apneas and hypopneas were scored by recognized criteria.[17] The ODI was calculated as the total number of 3% or greater decreases in oxygen saturation per hour of sleep. Snoring events were scored according to the following rule: The beginning of a snoring event required ≥ 4 consecutive breaths demonstrating snoring on the piezo sensor. The end of an event required either 4 breaths without snoring activity or the commencement of an apnea or hypopnea. Snoring events were not scored if they occurred in association with an apnea or hypopnea, avoiding double counting of events.

Analyses

Analyses were performed on an intent-to-treat (ITT) basis. All participants who had at least one night in the sleep laboratory with an AHI > 5 were included. Missing control night values were imputed by taking an average of any initial treatment night values. Any missing initial treatment values were imputed by averaging the actual treatment night values, or if no initial treatment night values were available, then by using the control night values. Missing values for the final treatment night were imputed by averaging any actual initial treatment values, or if no initial treatments took place, then by using the control night values. Less than 10 epochs (5 min) of REM sleep on any sleep study was considered missing data, and imputation to calculate REM AHI was performed according to the same procedure. Missing ESS and PSQI values were also imputed using available observations. Note that there were only 2 assessments.

All variables are expressed as mean ± SD. Statistical processing was performed using SAS software (SAS Institute, Inc., Cary, NC)[18] with statistical significance based on 2-tailed hypothesis testing. Each participant served as his/her own control. Efficacy was determined by paired *t*-tests comparing values from the control night to those of the averaged initial treatment nights and final treatment night, with a Bonferroni correction for multiple comparisons. The primary endpoint (AHI) was considered significant if $\alpha < 0.016$; secondary endpoints were considered significant when $\alpha < 0.05$ with no correction for multiple comparisons.

RESULTS

Participants

A total of 57 participants were screened for the study. Seven did not meet eligibility requirements. Of the 50 participants enrolled, 3 withdrew before seeing the device or completing any of the in-laboratory nights. Thirteen had a control night AHI ≤ 5, leaving 34 subjects in the ITT population. Six participants had at least one time point imputed via the previously described method. Three of these did not complete all 4 initial PSG nights (all 3 were lost to follow-up) and 3 were withdrawn by their PI (2 were nonresponsive to treatment with the study device (AHI change from control to treatment: 71.3 to 62.0 and 104.5 to 99.0 events per hour), and one was responsive to treatment (AHI change from control to treatment: 85.6 to 31.3) but was diagnosed with coronary artery disease during the in-home portion of the study (see adverse events, below). Twenty-eight subjects completed the full protocol including the 30-day in-home period and the final treatment night PSG. (See Figure 1.)

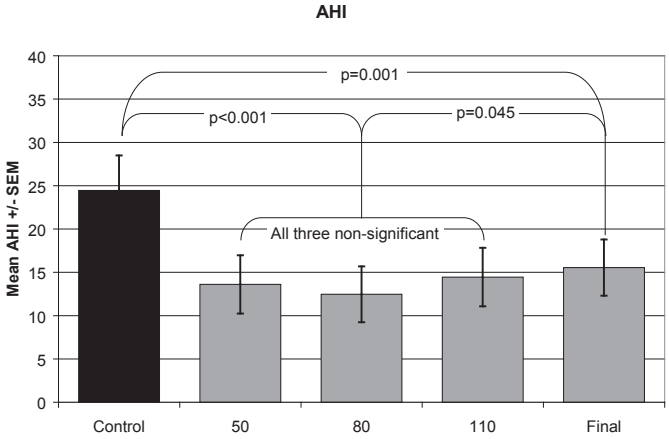

Figure 2—The apnea-hypopnea index (AHI) for the Control and Final sleep laboratory visit, and for each resistance level used during the initial nights in the laboratory ("50" is the device with 50 cm H_2O•sec/liter expiratory resistance; "80" is the device with 80 cm H_2O•sec/liter expiratory resistance; and "110" is the device with 110 cm H_2O•sec/liter expiratory resistance)

Mean age was 49.8 ± 10.2 years with a range from 27 to 67. Body mass index (BMI) ranged from 18 to 45 kg/m^2 with a mean of 30.1 ± 5.9. There were 6 female participants. The predominant ethnicity reported by participants was Caucasian (n = 26) with Hispanic (n = 2), Asian or Pacific Islander (n = 1), African-American (n = 3), other ethnicities (n = 1), and unknown (n = 1) representing the remainder.

The average AHI was 24.5 ± 23.6 on the control night. The AHI was 13.6 ± 19.6 on the initial treatment night with the 50 cm H_2O·sec/liter resistance device, 12.5 ± 18.8 on the initial treatment night with 80 cm H_2O·sec/liter resistance device, and 14.4 ± 19.7 on the initial treatment night with 110 cm H_2O·sec/liter resistance device. (See Figure 2.)

Devices for the 30 night in-home portion of the study were assigned to the 28 subjects who completed the protocol and one subject who was withdrawn during his in-home period. Fourteen participants were assigned the 50 cm H_2O·sec/liter resistance device, 10 the 80 cm H_2O·sec/liter resistance device, and 5 the 110 cm H_2O·sec/liter resistance device. No significant differences were shown based on age, BMI, gender, and AHI, based on the assigned therapeutic resistance level.

Table 1—Sleep Architecture for Each Phase of the Study (Average ± SD)

	Control	Initial treatment nights average	Final treatment night (30-day follow-up)
Sleep efficiency (%)	77.8 ± 15.0	77.4 ± 12.0	75.2 ± 16.2
Stage 1%	21.0 ± 16.1	21.8 ± 13.8	22.6 ± 12.2
Stage 2%	50.1 ± 13.8	51.1 ± 9.6	52.1 ± 9.3
Stage 3/4%	5.3 ± 7.5	5.0 ± 5.4	4.0 ± 4.5
Stage REM%	23.6 ± 7.3	22.1 ± 5.5	21.3 ± 7.7

There were no significant differences between the control, treatment and final nights on sleep efficiency or sleep architecture variables.

Table 2—Apnea/Hypopnea Index (AHI) by Device Resistance and Time Point

Patient ID	Control	Initial Therapy			Ave. of Initial Therapy	Final Therapy
		50	80	110		
114	104.5	91.8	101.2	104.1	99.0	99.0*
210	85.6	55.1	15.0	23.8	31.3	31.3*
215	71.3	68.4	58.1	59.6	62.0	62.0*
217	56.6	18.3	20.9	29.2	22.8	23.6
306	53.8	10.5	10.1	9.3	10.0	10.2
203	35.7	14.3	1.8	4.7	6.9	5.1
218	30.7	4.2	10.0	0.4	4.9	15.8
309	29.5	7.9	2.7	30.7	13.8	19.1
220	25.2	7.3	11.7	12.5	10.5	9.9
301	24.8	3.9	5.5	8.7	6.0	22.1
313	22.2	0.6	7.4	0.9	3.0	0.8
319	21.9	7.3	5.0	23.4	11.9	3.3
104	21.5*	21.5*	19.8	23.2	21.5	21.5*
312	20.0	12.2	3.8	12.6	9.5	17.7
209	18.2	3.0	4.7	3.9	3.9	3.3
113	17.0	3.0	1.5	1.5	2.0	2.6
206	17.0	11.1	15.1	18.1	14.8	20.6
311	16.2	4.1	6.8	6.1	5.7	4
214	16.1	5.0	7.6	11.5	8.0	3.6
304	16.1	16.8	8.2	8.3	11.1	8.8
216	15.3	10.0	17.4	16.0	14.5	13.9
213	14.9	5.9	3.2	10.8	6.6	1.5
212	14.3	9.5	4.6	4.0	6.0	10.7
205	14.1	11.6	10.1	6.1	9.3	18.9
208	9.7	15.5	11.6	7.6	11.6	8.4
314	9.5	2.6	4.2	6.5	4.4	15.4
316	9.0	10.7	12.5	14.1	12.4	20.2
202	7.3*	7.3*	4.7	9.9	7.3	7.3*
107	6.4	0.0	2.6	3.6	2.1	13.9
305	6.1	4.2	0.8	0.6	1.9	3.2
308	5.4	1.0	1.3	2.7	1.7	0.4
221	5.2	8.1	11.2	9.7*	9.7	9.7*
310	5.2	4.0	21.5	2.3	9.3	19.9
211	5.1	5.9	1.2	5.0	4.0	0.9

AHI values throughout the study sorted by control AHI. The first digit in the patient ID identifies the study site. One subject per row. Column headings: "50" from the 50 cm H_2O•sec/liter device, "80" from the 80 cm H_2O•sec/liter device, "110" from the 110 cm H_2O•sec/liter device, "Ave. of Initial Therapy" is the average of the "50," "80," and "110" devices, "Final Therapy" followed the 30 night in home portion of the study. Imputed values are identified with an *.

Sleep Efficiency and Architecture Analyses

The average total sleep time on the control night was 5.7 ± 1.4 hours, on the average of the three initial treatment nights 5.6 ± 1.1 hours (p = ns), and at the 30-day follow-up night 5.5 ± 1.4 hours (p = ns). There were no significant differences between the control night and either the average of the initial treatment nights and the final 30-day follow-up night for sleep stage percentages or sleep efficiency. (See Table 1.)

Device Utilization

The average time between each of the first 4 polysomnograms was 3 days (range 1-16 days). Of the 34 subjects in the ITT population, 29 took devices home. Of the 5 subjects (15%) that did not take devices home, 3 were lost to follow-up prior to the in home portion of the study, and 2 were withdrawn by the investigator prior to the in-home portion. Of the 29 who participated in the in-home portion of the study, the average possible number of nights participants could have worn the device (total possible in home use number of nights) was 31.2. Participants reported using the device for an average of 29.4 nights (94.4%).

Primary Analyses

The average AHI of the 3 initial treatment nights was derived in order to assess the efficacy of the device. The average AHI on the control night was 24.5 ± 23.6; on the average of the 3 initial treatment nights 13.5 ± 18.7, and at the 30-day follow-up night 15.5 ± 18.9. The initial treatment nights average AHI was significantly lower than the control night AHI ($p < 0.001$; see Figure 2). The 30-day follow-up AHI was significantly lower than the control night AHI ($p = 0.001$). The AHI for the initial treatment nights and the 30-day follow-up night were not significantly different after correcting for multiple comparisons ($p = 0.045$). Fourteen of the 34 participants (41%) had an AHI reduction ≥ 50% compared to control at the 30-day follow-up. (See Table 2.)

Additional Analyses

Table 3 shows comparisons of the control night to the average of the three initial treatment nights and the final treatment night. In addition to the overall AHI, the apnea index (AI), REM AHI, percent of sleep time snoring, and mean oxygen saturation were all improved for the initial treatment nights and final treatment night compared to the control night. The average apnea duration, oxygen desaturation index (ODI), and minimum oxygen saturation did not differ between the control night and any of the treatment nights. The global score on the PSQI significantly decreased from 7.4 ± 3.3 at baseline to 6.5 ± 3.6 ($p = 0.042$) at 30 day follow-up. ESS scores decreased significantly from 8.7 ± 4.0 at baseline to 6.9 ± 4.4 ($p < 0.001$) at 30-day follow-up.

Adverse Events

A total of 6 adverse events occurred during the study. One event, headache, was deemed possibly related to the device. One patient experienced chest pain resulting in an emergency room admission. The patient was diagnosed with coronary artery disease and a coronary stent was implanted. This serious adverse event was deemed unrelated to the study device. This patient was withdrawn from the study. The 4 other adverse events—sinus allergy and headache, passenger in a workplace vehicle accident, premature ventricular contractions noted during the polysomnogram, and earache, sniffling, sore throat—were not serious and were not considered to be device related.

DISCUSSION

This study evaluated a novel therapeutic device that uses nasal expiratory airflow resistance to create EPAP for the treatment of OSA. The therapeutic benefits of the Provent device were documented polysomnographically. A previous pilot study demonstrated therapeutic benefits vis-à-vis the AHI, oxygen desaturation index, and amount of snoring during one night of device use.[13] The present study confirmed these

Table 3—Summary of Additional PSG Analysis for Each Phase of the Study (Average ± SD)

	Control	Ave. of Initial Therapy	Final Therapy	Significance: Control vs Ave. of Initial Therapy	Significance: Control vs Final Therapy
AHI	24.5 ± 23.6	13.5 ± 18.7	15.5 ± 18.9	p < 0.001	p = 0.001
Apnea index	12.3 ± 17.5	5.9 ± 14.7	7.3 ± 14.9	p < 0.001	p = 0.007
Ave. apnea duration	18.9 ± 4.0	17.8 ± 3.9	18.9 ± 4.1	p = ns	p = ns
REM AHI	30.6 ± 25.7	17.2 ± 18.9	19.0 ± 21.1	p < 0.001	p = 0.001
% sleep time snoring	27.5 ± 23.2	11.6 ± 13.7	14.6 ± 20.6	p < 0.001	p = 0.013
O_2 desaturation index	11.0 ± 17.5	8.9 ± 14.0	9.2 ± 14.3	p = ns	p = ns
Mean O_2 saturation	94.8 ± 2.0	95.2 ± 1.9	95.3 ± 1.9	p = 0.023	p = 0.003
Min. O_2 saturation	85.0 ± 7.4	85.1 ± 7.7	85.1 ± 8.1	p = ns	p = ns

"Ave. of Initial Therapy" is the average of the results from the initial study nights using the 50, 80, and 110 devices; "Final Therapy" followed the 30-night in-home portion of the study.

therapeutic effects, and extended those findings by showing continued improvement in the AHI, AI, and snoring after 30 days of use.

The full range of sleep disordered breathing severity was represented in this study; however, the preponderance of the study group had mild to moderate OSA (average AHI 19.1 ± 12.9; ESS = 8.2 ± 4.1). Patients with mild to moderate OSA may be less likely to embrace CPAP therapy, which is the gold standard in the treatment of OSA.[4] Low acceptance or partial adherence to CPAP therapy remains a significant barrier to treatment in this category of patients. Subjects self-reported using the Provent device for a full night on 94% of treatment nights. These results are encouraging, and will need to be confirmed with additional objective demonstration of treatment adherence. Any novel therapeutic intervention aimed at this population will need to demonstrate both effectiveness and acceptance, followed by good treatment adherence rates.

Results of this study are comparable to those of the previous study using the Provent device.[13] While some previous reports in the literature have shown promising results with EPAP,[12] a recent study using a CPAP machine to impose positive airway pressure during the expiratory phase in 10 subjects with OSA showed no significant improvements in AHI or oxygen desaturation index.[19] It is possible that the means by which EPAP is created, namely through the use of an air blower versus the use of a passive valve mechanism, may effect treatment efficacy.

Varying degrees of expiratory resistance were utilized in this study. Comparable therapeutic responses were achieved with each of the three resistance levels, and these benefits were sustained over a one month period. The overall response rate, defined as a 50% or more reduction in the AHI for this novel device during the initial three treatment nights was 59%. The response rate at the end of 30 days decreased to 41%. These rates are comparable to or better than those documented for oral appliances or following soft tissue surgery to the upper airway, but lower than that documented for CPAP therapy.[4,20]

The lack of apparent benefits in sleep architecture will require investigation in future studies. Derangements in sleep architecture are more pronounced in patients with severe OSA. The present study included a large number of patients with mild to moderate OSA in whom baseline sleep architecture was minimally, if at all, abnormal. Despite these limitations, the subjects did not express any concerns about their sleep quality. Importantly, the improvements in AHI and snoring were paralleled by improved subjective sleep quality and daytime alertness. The improvement in ESS was comparable to that found in studies measuring change in ESS scores with CPAP treatment.[21]

Device use in this study was based on subjective reports, and while these assessments are generally overstated, a high rate of adherence was reported. In clinical practice, the clinician is frequently faced with having to make a decision between a therapy that has a better success rate (such as CPAP therapy) and other available treatments that have relatively lower response rates but are more likely to be used by the patient. In this context, the device represents a welcome addition to the available armamentarium to treat these patients. While overall therapeutic response was documented, the data reflect variable (and at times inconsistent) benefit from this treatment. Among subjects with moderate to severe OSA (AHI > 15/hour; N = 24 [see Table 2]), 13 achieved an AHI ≤ 10 during initial treatment nights and 10 achieved similar response on the last sleep laboratory assessment (at the end of the 30-day trial). Eight subjects showed a consistent therapeutic response across the entire study. The lack of data characterizing the effect of position on AHI represents a limitation of the study. It is possible that differential time spent in the supine position might account for some of this variability. Clearly, future research will need to identify the physiological effects of EPAP during sleep and help determine the effect of position on the degree of therapeutic response.

The availability of this device in the treatment of OSA will require a better understanding of the clinical profile of patients who most likely benefit from this therapy. At present there is no available data to guide clinicians on this task. Based on the present results, it is plausible to suggest that those with mild to moderate OSA seem to be the best candidates for this treatment. Clearly, patients with severe OSA should first consider the gold standard in the treatment of this condition. It is also appropriate to question what ought to be the minimum degree of severity at which this treatment may represent a reasonable therapeutic intervention. Two considerations are relevant in this context: (1) Data suggesting that even a low AHI confers increased risk for cardiovascular disease,[22] and (2) Patients are frequently motivated to pursue (and continue therapy) in an effort to minimize the negative effects of snoring on a spouse or bed partner. This study documented a substantial reduction in the percent of time spent snoring during both

the first few nights of treatment and after one month of device use. Unlike CPAP machines, which are often perceived as too intrusive, this novel device is quiet and unobtrusive. These qualities and its ease of use may prove advantageous in improving therapeutic adherence and may even result in a demand for this type of device among people with minimal evidence of disease but with significant snoring. While no subject experienced a serious adverse event that was attributed to the device, three subjects with severe OSA were withdrawn by one of the investigators during the study. Two were judged to be nonresponsive to the device. Based on the available data the prudent use of the device requires physicians to determine treatment acceptance and initial therapeutic response. The effectiveness of the device for long-term use, i.e., longer than 30 days, has not been evaluated in controlled trials. Therefore, the physician who elects to continue treatment for extended periods should monitor the patient's clinical progress and periodically re-evaluate the long term usefulness of the device.

In summary, this novel nasal EPAP device reduced and/or normalized the AHI while improving subjective perception of sleep quality and daytime alertness; however, considerable heterogeneity in response to the device was noted despite the high adherence rates reported by the subjects. While future research will be required to better identify the role of this novel device in the treatment of OSA populations, the available data suggest that the device represents a viable therapeutic option in the management of OSA.

DISCLOSURE STATEMENT

This study was supported by Ventus Medical. Dr. Rosenthal has received research support from Ventus Medical and Respironics and has participated in speaking engagements for Respironics. Bryan Loomas was an employee of Ventus Medical at the time of this study. Dr. Kram has participated in speaking engagements for Boehringer Ingelheim and Sepracor. The other authors have indicated no other conflicts of interest. Rajiv Doshi, Bryan Loomas, and Robyn Woidtke (all with Ventus Medical, Inc.) designed the protocol. Data collected at Sleep Medicine Associates of Texas, Chicago Sleep Group, and California Center for Sleep Disorders. There was no off-label use.

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