

Feature Article

Medical and Nondental Treatments of Snoring and Sleep Apnea Syndrome

Nondental treatments of snoring and obstructive sleep apnea include behavioral changes and nasal continuous positive airway pressure.

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abstract

The prevalence, pathophysiology, and clinical and polysomnographic evaluation of obstructive sleep apnea are reviewed. The history of the development of nasal continuous positive airway pressure, diagnostic titration of the treatment, abolition of nocturnal apneas, and consolidation of sleep architecture by nasal continuous positive airway pressure and long-term patient compliance with the treatment are discussed. The effects of weight gain and weight loss on the severity of obstructive sleep apnea, and cardiovascular and behavioral complications of obstructive sleep apnea are reviewed. Behavioral treatments are discussed.

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*Blessings on him who first invented sleep.
It covers a man all over, thoughts and all, like a cloak.
It is meat for the hungry, drink for the thirsty, heat for the cold, cold for the hot.
It makes the shepherd equal to the monarch, and the fool to the wise.*

From *Don Quixote*
Miguel de Cervantes Saavedra

The 1995 report of the National Commission on Sleep Disorders Research, commissioned by Congress, estimated that some 10 million adults in the United States suffer from sleep apnea syndrome, most of whom do not know they have it.¹ An epidemiologic study of some 900 middle-aged adults who underwent polysomnography found the prevalence of obstructive sleep apnea to be 9 percent among men and 4 percent among women.² Through the use of polysomnography, the pathophysiology of the syndrome of obstructive sleep apnea has become well-understood.^{3,4} Sleep apnea is not a single disease but rather a pathophysiologic syndrome resulting from many diseases and abnormalities.⁵

Snoring and sleep apnea syndrome are the two ends of a spectrum of sleep-related compromise of the upper airway. A patient at the mildest end of the spectrum may snore only under certain circumstances, such as when sleeping supine or during REM (rapid eye movement) sleep.

The breathing of patients with greater degrees of upper airway obstruction during sleep is characterized by continuous snoring punctuated by apneas or hypopneas (partial obstructions of air flow) during REM sleep when the tone of the pharyngeal dilating muscles is most reduced or when in the supine position when the force of gravity on the soft tissues of the tongue and palate further reduces the diameter of the upper airway. At the severe end of the spectrum, the pharyngeal airway of the sleeping patient repeatedly collapses and obstructs completely. The sleeping patient has repetitive obstructive apneas lasting many seconds despite diaphragmatic and intercostal respiratory efforts. Each obstructive apnea is accompanied by drops in arterial oxygen of some 10 percent or 20 percent or more in non-REM sleep and greater drops during REM sleep. Each apnea is ultimately terminated when the patient arouses from sleep. Arousals increase the tone of the pharyngeal dilating muscles, allowing unobstructed breathing and rapid return of arterial oxygen saturation to normal. This process repeats itself hundreds of times during the night. The repetitive arousals from sleep, unappreciated by the patient and often numbering in the hundreds, cause fragmented sleep with a resulting complaint of daytime drowsiness.

Treatments

Nasal Continuous Positive Airway Pressure

Nasal continuous positive airway pressure is the most effective treatment for patients suffering from obstructive sleep apnea syndrome. It is most often used to treat patients whose obstructive sleep apnea is severe or moderate. In some cases, the treatment benefits those whose obstructive sleep apnea is only mild.⁶

Though arbitrary numbers are at best approximate, most sleep specialists classify an apnea-hypopnea index (the number of apneas plus hypopneas per hour of sleep) of 15 or 20 per hour as mild obstructive sleep apnea, an index of 20 to 50 or 60 as moderate, and an index of greater than 50 or 60 per hour as severe.

Nasal continuous positive airway pressure was developed by Sullivan and colleagues⁷ in Australia in 1981. Since its approval by the U.S. Food and Drug Administration in 1985, its use to treat patients with obstructive sleep apnea has become widely accepted. The American Sleep Disorders Association has estimated that some 40,000 prescriptions for nasal continuous positive airway pressure were written in the United States in 1991 and that the number has continued to increase. There are now six manufacturers of the equipment worldwide. The continuous positive airway pressure blower delivers air at above atmospheric pressure via an external face mask to the upper airway through the nares. Continuous positive airway pressure acts by providing a pneumatic "splint" to the upper airway. Thus it is a treatment for obstructive sleep apnea, not a cure.

Determination of Pressure Titration

In virtually all sleep centers, a patient that has or is suspected to have obstructive sleep apnea undergoes "titration" to determine the pressure appropriate for the patient. The patient is monitored overnight in a sleep recording laboratory in the standard fashion. After the procedure is thoroughly explained, the lights are turned off; and the patient's sleep state, body position, oxygen saturation, respiratory rate, heart rate, snoring sounds and pressure are recorded and monitored continuously. The patient is also observed by the technologist using a low-light camera. The treatment mask is placed over the patient's nose, and titration is begun at a low pressure, typically 5.0 centimeters of water. After the

patient falls asleep and snoring and apneas appear, the pressure is gradually increased by 1 centimeter of water increments.

The end point of the titration is the abolition of all arousals, snoring, apneas, and hypopneas in both REM and non-REM sleep and steady transcutaneous oxygen saturation values of 95 percent to 98 percent at sea level. The pressure requirement may be several centimeters of water higher in REM sleep than in non-REM sleep. The technologist must be sure that the titration is performed with the patient in the supine position during some portion of the night, most desirably during both REM and non-REM sleep. The procedure takes several hours to measure pressure under all sleep conditions. Within a few minutes of establishing an open upper airway, a patient with severe sleep apnea may begin to have long periods of REM sleep and Stage 4 non-REM sleep.⁸ This "recovery sleep" pattern after years of sleep fragmentation lasts about a week. Patients often report an immediate increase in alertness after a single night's treatment (**Figure 1**).

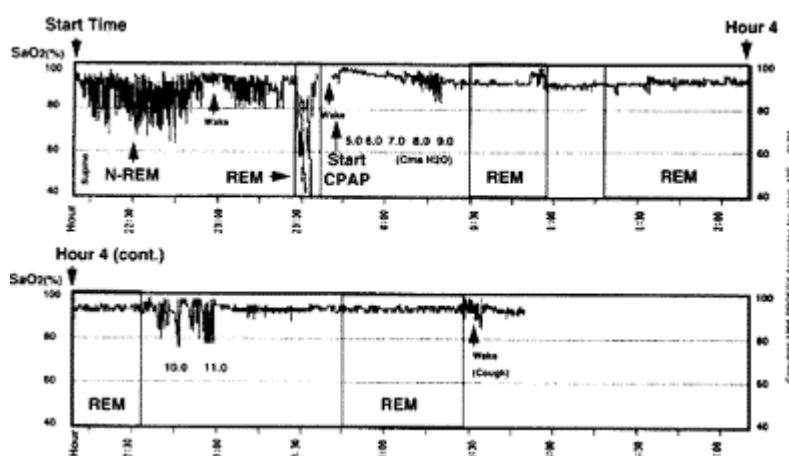


Figure 1. Oximetry/split-night continuous positive airway pressure titration.

In the past, the patient would undergo a seven- to eight-hour diagnostic recording night in the sleep laboratory and then, if indicated, would have a second recording night for titration of pressure. In recent years, for financial considerations and patient convenience, a single split-night protocol has become widely used to establish the diagnosis of

obstructive sleep apnea and to titrate pressure in the same night.⁹ While protocols vary, the split-night titration is successful in 70 percent to 90 percent of the recording nights.¹⁰ In achieving a successful study, much depends on the instruction and preparation given to the patient before the split-night study.¹¹ In many protocols, a patient whose sleep-disordered breathing is observed during the first half of the night to be mild is allowed to sleep without an attempt at continuous positive airway pressure. Patients with moderate or severe obstructive sleep apnea are most likely to successfully complete a split-night titration, though the pressure requirements of some patients whose apnea-hypopnea index is less than 40 per hour may be underestimated by 2 to 3 centimeters of water.^{12,13}

Those patients with significant obstructive sleep apnea who are unable to sleep or to tolerate nasal continuous positive airway pressure during the split night are encouraged to return for a full night of titration after full and careful discussion of all the therapeutic options. Patient preferences, clinical symptoms, the severity of polysomnographic findings, and medical co-morbid conditions, considered collectively by both doctor and patient, ultimately determine the treatment(s) of the patient's sleep disorder.

Compliance at Home

Once acclimated to continuous positive airway pressure, most patients usually have little

difficulty going to sleep when using the small, quiet modern machines, provided that the nasal mask is comfortable and there are no air leaks. Early objective measures of patients' use at home found only fair compliance.¹⁴ However, a more recent 10-year European study that excluded patients who had died or been successfully treated with surgery or weight loss found 79 percent of patients still using home continuous positive airway pressure an average of five to six hours per night.¹⁵ Patients with more severe obstructive sleep apnea (an apnea-hypopnea index greater than 15) had better compliance than those whose condition was less severe. Nasal congestion, a common complaint early in the course of use, usually resolves in one to two weeks but can reduce patient use during that time. Patient acceptance of home treatment depends on the skill and care used in fitting the mask, the adjustment of the head strap and hose, and use of air humidification. Written instruction regarding the value and importance of using continuous positive airway pressure and frequent follow-up visits to the sleep physician or technologist are vital in improving patient comfort and achieving long-term patient compliance.¹⁶ Of great importance is the face mask, the interface between patient and air source, which has undergone considerable design improvements in the 14 years since its introduction. The early face masks were of a plastic that became hard and uncomfortable after one or two months because of the effect of skin oils. Patients now have a choice of lighter-weight nonhardening silicone "floating" masks, double-layered "bubble" masks, or gel masks, available in many sizes. Modern masks also have quiet, light-weight nonmechanical air valves without moving parts. Another innovation, nasal "pillows," cover only the nares and are preferred by some patients. Masks are held on the face with head straps of simpler design and are attached to lighter and more flexible hoses, which deliver heated or nonheated humidified air.

These interface interchangeably with continuous positive airway pressure machines from many manufacturers. In contrast to the earliest American-made machines, which weighed 10 to 12 pounds and were by today's standards noisy and bulky, modern machines are compact and quiet and have advanced electronics that respond quickly to changes in air flow requirements. Additionally, most machines have a pressure "ramping" capability that allows the patient to fall asleep with the mask in place at a low pressure. Over the ensuing 15 to 30 minutes, the pressure gradually rises to the prescribed level. This design feature contributes greatly to improved patient acceptance of nasal continuous positive airway pressure. Recently, self-adjusting units have been developed by several manufacturers. Experience with a small number of patients suggests that the time of use of the auto-adjusting units may be increased by as much as one hour per night compared to time using conventional units.¹⁷ These machines are more expensive than standard ones, and standards for their clinical use are still evolving. In sum, the majority of patients beginning home treatment who are carefully managed continue to use the machine for many years because of the immediate and dramatic improvement in daytime performance and alertness (**Figure 2**).¹⁸

Management of the Patient on Home Treatment

Supervision by physicians and sleep center technicians skilled and experienced in the treatment of patients with obstructive sleep apnea and other sleep disorders is essential in maintaining patient tolerance and compliance with home continuous positive airway pressure.

The machines should be calibrated periodically with a water manometer to correct any pressure

"drift." Physicians should be alert to the effects of weight gain or weight loss on pressure requirements. A patient who experiences a large weight gain will require an increase of pressure, possibly necessitating a repeat titration sleep study. Where actual home use is uncertain, machines with recording capability may be used to assess a patient's compliance. Some patients who require very high pressures or those with coexisting chronic obstructive lung disease may be unable to tolerate continuous positive airway pressure but may find bi-level treatment more acceptable.¹⁹ With bi-level treatment, the inspiratory and expiratory pressures are separately controlled. By lowering the expiratory pressure, the work of breathing is reduced and patient comfort is improved compared to using a fixed high pressure.

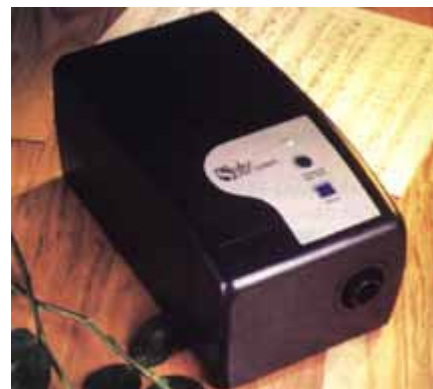


Figure 2. Respironics "Solo" continuous positive airway pressure machine.

Travel and Durability

Modern continuous positive airway pressure units are compact, about the size of a large loaf of bread, weigh 4 to 6 pounds and are easily carried on airplanes, cars, and even motorcycles. They can operate on 110 or 220 volts AC or 12 Volts DC. The units have an average life span of about four to five years, but some have lasted longer. Masks, head straps, and hoses may need replacement after about two years, and the small particle air filters should be changed every one to two months.

Weight Loss

Obesity is a predisposing factor for snoring and sleep apnea; 75 percent of obstructive sleep apnea patients are obese.²⁰ While the prevalence of obstructive sleep apnea (based on an apnea-hypopnea index of greater than 15 per hour) in the general population is 4 percent for women and 9 percent for men,² the prevalence among obese patients is much higher. Indeed in one university obesity clinic, 40 percent of men and 3 percent of women were found to have obstructive sleep apnea severe enough to warrant treatment.²¹

Recent studies show that upper body obesity carries an increased risk of snoring, sleep apnea, and hypertension. In the population study cited above² the severity of patients' obstructive sleep apnea correlated better with neck size than with body mass index (height in meters divided by weight in kilograms).²² Among men with a neck circumference of 15 3/4 inches to 17 inches, 18 percent had obstructive sleep apnea. Of those with a neck circumference greater than 17 inches, 31 percent had obstructive sleep apnea.²² There was a similar relation of increasing neck size to severity of the condition among the women. Weight loss is beneficial in reducing the severity of the condition. Studies of obese sleep apnea patients treated by weight loss using gastric bypass have shown improvement or abolition of obstructive sleep apnea in all.²³ The relationship between weight loss and decline in apnea index is probably not linear, supporting the observation that even modest weight loss may improve snoring and apneas in some

patients.²⁴ The upper airway of patients with obstructive sleep apnea is abnormal in shape: It is elliptical with the long axis oriented anteroposteriorly. This contrasts with the normal airway, whose elliptical shape is oriented transversely.²⁵ This alteration in airway shape among obese sleep apneatics is probably due to fat deposition in the neck adjacent to the muscles and soft tissues forming the pharyngeal airway. Weight loss probably benefits patients by decreasing the amount of fat surrounding the upper airway, thereby allowing it to dilate more fully to become less compliant and less prone to collapse and obstruct in sleep. With these observations in mind, modest weight loss even to a level above ideal body weight may be reasonable and beneficial in patients with obstructive sleep apnea.

Causes and Complications -- Evaluation and Treatment

Predisposing Endocrine Disorders

Hypothyroidism, acromegaly, and testosterone administration can cause, predispose, or exacerbate obstructive sleep apnea.

These should be considered, ruled out, or treated when appropriate.

Drugs, Alcohol and Anesthesia

Alcohol depresses respiratory drive and increases arousal threshold in patients with sleep apnea and has been demonstrated to worsen obstructive sleep apnea when imbibed before bedtime. Some sedating drugs, such as barbiturates and chloral hydrate, behave similarly. The long-acting benzodiazepine, flurazepam (Dalmane), may worsen obstructive sleep apnea in some patients with pre-existing disease.²⁶ However, the intermediate half-life benzodiazepine hypnotic, temezepam (Restoril),²⁷ may be safely given to elderly patients with mild obstructive sleep apnea; and the short-acting hypnotic benzodiazepine, triazolam (Halcion), improves sleep architecture in patients with *central* sleep apnea.²⁸ Obstructive sleep apnea patients undergoing general or light anesthesia or parenteral narcotics merit careful monitoring. Endotracheal intubation may be difficult because of the shape of the airway, combined with a short, thick neck. After extubation, obstructive sleep apnea patients are more prone to experience upper airway obstruction and should be monitored closely, especially while in the supine position.

Cardiovascular Disease

Half of patients with obstructive sleep apnea are hypertensive and may require multiple medications. Apnea patients have an increased prevalence of esophageal reflux,²⁹ accelerated coronary artery disease,³⁰ frequent cardiac arrhythmias,³¹ and premature death.³²

Behavioral Abnormalities

Patients with obstructive sleep apnea are sleepy during the day. Subtle impairments of memory and judgment may be observed.

Behavioral Treatments

Sleep Position Training

Patients whose all-night polysomnograms show snoring and apneas exclusively or predominantly when sleeping in the supine position can benefit significantly by sleeping in the lateral decubitus position. A number of small position-sensitive alarm devices that are strapped to the patient's chest or abdomen have been successful in training the patient to sleep on his or her side. The same can be accomplished by inserting two tennis balls (one is not sufficient) in a sock that is pinned or sewn to the back of the sleeping garment.³³

Sleep Hygiene

The patient should be counseled to avoid alcohol near bedtime. Erratic sleep schedules, shift work, and trans-meridian flight disrupt the sleep-wake schedule, thereby resulting in reduced total sleep time and increased daytime sleepiness. A patient on home nasal continuous positive airway pressure should take his or her machine on all trips where electric power is available. Those living at or traveling to high altitudes should consider adding a humidifier to the blower to combat drying of the nasal mucosa. These are inexpensive and are available from all machine manufacturers. Nasal and sinus allergies should be promptly treated to maximize compliance.

Elevation of Head of Bed

A patient with congestive heart failure, severe lung disease, or treatment at very high pressures may find nasal continuous positive airway pressure easier to tolerate if the head of the bed is elevated 3 to 6 inches or sometimes more.

Other Mechanical Devices

Nasal obstruction causing increased nasal resistance may produce nasal snoring and can predispose the nasopharyngeal airway to collapse, resulting in obstructive apneas. Nasal dilators may sometimes be helpful in patients with nasal snoring due to narrowing of the anterior nasal passages.³⁴

Medications

There are no medications that specifically or uniquely benefit obstructive sleep apnea .

Author

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