

**A Review of the Literature on Cardiovascular Outcomes of Various Treatment Options in
Adults with Obstructive Sleep Apnea**

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“In adult patients with obstructive sleep apnea (OSA), does continuous positive airway pressure (CPAP) treatment, as compared to alternative treatments such as upper airway surgery or mandibular advancement devices, result in reduced cardiovascular events?”

ABSTRACT

PURPOSE

The purpose of this literature review is to determine if continuous positive airway pressure (CPAP) treatment of adult obstructive sleep apnea (OSA) results in better cardiovascular outcomes as compared to alternative treatments, such as upper airway surgery or mandibular advancement devices.

METHODS

A literature review was performed by utilizing online research databases, including MEDLINE, PUBMED, and Cochrane Library, to evaluate treatment options for OSA and their cardiovascular outcomes and benefits, if known. Comparison of the most common treatment options for adult OSA was performed. These treatment options include CPAP, upper airway surgery and mandibular advancement devices. The twenty most pertinent publications were reviewed and analyzed. The types of publications reviewed were observational studies, randomized controlled studies, a scientific statement by the American Heart Association, and a randomized crossover study.

RESULTS

According to the latest research, CPAP has been shown to have the most cardiovascular benefit for adult patients with OSA. CPAP has been clearly demonstrated to lower blood pressure, to improve left ventricular ejection fraction, to reduce the risk for cardiac arrhythmias, heart attacks, and strokes, and to lower the risk for all cause mortality. There are not enough studies to date that show any significant improvement in cardiovascular outcomes when adult OSA patients are treated with upper airway surgery or mandibular advancement devices.

CONCLUSIONS

CPAP has been proven to have greater cardiovascular benefit, when compared to upper airway surgery or mandibular advancement devices, in the treatment of adult OSA. An abundant amount of information has demonstrated the benefits of CPAP treatment, including a reduced risk for hypertension, heart attacks, cardiac arrhythmias, strokes and all cause mortality. Conversely, treatment of adult OSA with either upper airway surgery or mandibular advancement devices has not been demonstrated to have any significant impact on cardiovascular outcomes. Further studies are needed to determine if upper airway surgery or mandibular advancement devices have any significant effect on cardiovascular outcomes in adult OSA.

RESULTS

Introduction.

Obstructive Sleep Apnea (OSA) is a sleep-related breathing disorder which is characterized by repetitive episodes of respiratory disturbance during sleep. Diagnostic criteria for OSA is defined as an average of 5 or more apneic or hypopneic episodes of sleep per hour.¹ A cessation in ventilation for ≥ 10 seconds associated with ongoing ventilatory effort is considered an obstructive sleep apneic event. Obstructive hypopneas are defined as decreases in ventilation, with an associated fall in oxygen saturation or arousal, but not a complete cessation in ventilation.² Collapse of the pharyngeal airway occurs, thereby causing an interruption of ventilation. The collapse of the pharyngeal airway occurs posterior to the tongue, uvula and soft palate. During sleep as the muscle activity diminishes, the support of the soft palate tissue also diminishes causing a collapse of the airway. These events are most commonly seen during rapid eye movement (REM) sleep because this stage of sleep causes a hypotonia of the upper airway muscles.³ The size of the upper airway is dependent by not only soft tissue but also by craniofacial

skeletal factors. Patients who are obese have a predisposition to sleep apnea because of the increased amount of adipose tissue in the neck area which can further compound the narrowing of the airway. This does not mean that patients who are of normal body weight are not at risk. Patients who have normal body weight but who have enlarged tonsils or craniofacial abnormalities resulting in a narrow airway are also at risk. Quite frequently, patients with OSA have a characteristic narrow jaw structure, resulting in a narrow upper airway.

Common physical features of a patient who may have OSA may include obesity, increased neck circumference, an oral exam which reveals a low extending soft palate, large uvula, erythema and possible swelling of the soft palate including the pharyngeal pillars, large tonsils, large tongue, high arched hard palate, overbite of the upper teeth, nasal passage obstruction, or evidence of hypothyroidism and acromegaly.⁴

Sleep apnea is important to recognize and treat as patients who suffer from this disorder have increased risks for many other health problems, especially cardiovascular disease and events. Patients who have sleep apnea are at risk for a multitude of diseases and disorders which include hypertension, arrhythmias, congestive heart failure, myocardial infarction and stroke.² Mooe et al reported a 62% relative increase in cardiovascular events in patients with OSA and a 10.1% absolute increase in a composite endpoint of cardiovascular events (death, cerebrovascular event, and myocardial infarction).⁵ The prevalence of OSA in the general population is high. Most of the studies to date have shown that about 1 in 5 adults has at least mild OSA and 1 in 15 has moderate or severe OSA.² OSA affects both women and men and as stated earlier, both obese and normal weight individuals. More recent information indicates that women and men are affected equally after the age of 50. The gold standard for accurately diagnosing OSA is to have the patient undergo a polysomnogram in an accredited sleep disorders center.

Treatment Options.

There are primarily three generally accepted treatment options for OSA. The gold standard for treatment of adult OSA is CPAP. CPAP treatment is comprised of a small machine which sits at the bedside and filters room air under pressure through a face mask into the upper airway to keep the airway stented open.⁶ The actual pressure which is used for each patient's CPAP treatment is determined during the overnight polysomnogram performed in a sleep center. The goal of the CPAP is to maintain a patent airway to avoid the desaturations and arousals caused by apneic or hypopneic events. Problems tolerating therapy may occur but a study showed that nightly use of more than 90 percent can be achieved when close follow up is provided by a health professional skilled in CPAP use.⁷ Initially offering proper education, a variety of masks for the patient to choose from, having the patient use the ramp feature (which helps titrate the patient's pressure slowly thereby improving patient comfort), using proper humidification of the inspired air, close follow up and reviewing the downloaded data available from machines which have a smartcard feature, all are techniques which can improve compliance. Serious complications of CPAP use are rare.⁸

Surgery of the upper airway is another means of OSA treatment. Uvulopalatopharyngoplasty is the most common procedure. It is a surgical intervention that removes part of the uvula and soft palate thereby removing obstructive tissue in the airway. Unfortunately, only 40-60% of patients receive an improvement in their OSA symptoms following the procedure.⁴ There is also surgery of the jaw which is done on patients who have maxillomandibular airway obstruction. Patients who have these types of surgery generally have a prolonged postoperative recovery. Lingual or oral numbness and malpositioning of the jaw are possible complications.⁶ Other surgical procedures include tonsillectomy, adenoidectomy, relief of nasal obstruction, and somnoplasty which uses radiofrequency energy to shrink part of the tongue and soft palate.

Oral appliances (mandibular advancement devices) are considered another treatment for mild to moderate sleep apnea.⁹ These devices worn during sleep move the tongue and mandible forward. An analysis done by the American Academy of Sleep Medicine reported oral appliances could improve

snoring effectively but only 52% were successful at relieving OSA.² Insurance companies generally do not cover the cost of these devices which can be an obstacle for patients. The cost is about \$1500 or more. Patients considering the oral device have an initial sleep study to assess the severity of their OSA and another sleep study is done once the patient is treated, to ensure the effectiveness of the device.⁶

Results.

There is a prevalence of sleep-related breathing disorders in coronary artery disease patients which is 2 fold greater than in non-CAD patients.² Therefore, it is important to know which treatment is best for OSA patients in order to reduce their risk of future cardiovascular events. According to the data available, it is well known that CPAP therapy is the gold standard for OSA. In the study conducted by the Kaneko et al at the Toronto Rehabilitation Institute, the patients who received CPAP treatment for their OSA saw a reduced daytime systolic blood pressure, reduced heart rate, reduced left ventricular end systolic dimension, and an improved left ventricular ejection fraction.¹⁰ In a study conducted by Pepperell et al, in patients with severe sleep apnea, nasal CPAP use reduced blood pressure, lowered vascular risk, and improved excessive daytime sleepiness and quality of life.¹¹ Also, a long term follow up study conducted by Milleron et al, indicated that treating OSA in CAD patients was associated with a decrease in the occurrence of new cardiovascular events.¹² In this study, the two forms of treatment were nasal CPAP or upper airway surgery. The limitation of that study was a small number of 54 patients and the absence of randomization. Somers et al found that CPAP markedly and acutely decreased blood pressure and sympathetic response during sleep.¹³ Recently published in Chest, a study showed that Bilevel systems (machines which allow independent adjustment of the airway pressures during inspiration and expiration), were superior to CPAP in improving LVEF in patients with diastolic dysfunction and OSA. A limitation of this study was the small number of patients used in the trial.¹⁴

According to the Scientific Statement reported this year from the American Heart Association regarding Sleep Apnea and Cardiovascular Disease, they reported that there is a higher prevalence of

arrhythmias in patients with OSA and the number of these arrhythmias increases with the number of the apneic episodes and the severity of the oxygen desaturation. The statistic of nocturnal arrhythmias in OSA patients is about 50%. Some of the more common arrhythmias during sleep include nonsustained ventricular tachycardia, sinus arrest, second degree atrioventricular conduction block, frequent premature ventricular contractions and atrial fibrillation. It is also reported that patients who have untreated OSA who have undergone successful cardioversion for atrial fibrillation, have an 82% risk for recurrence of atrial fibrillation within one year, which is nearly double the risk seen in effectively treated OSA patients who have been successfully cardioverted.²

In a randomized crossover study of 12 weeks of effective CPAP treatment versus sham CPAP use in 23 patients with OSA, decreases in echocardiographic measurements of pulmonary arterial systolic pressure was seen in the effective CPAP users.¹⁵ Two patients were excluded from the analysis because of intolerance to CPAP. Larger randomized trials are needed to understand the full effectiveness of CPAP on pulmonary arterial pressure.

The effects of CPAP on long term cardiovascular outcomes in male patients with severe OSA were reported in an observational study in 2005. The patients with untreated severe OSA had a higher incidence of fatal and non-fatal cardiovascular events than did untreated patients with mild to moderate OSA, simple snorers, patients treated with CPAP, and healthy participants. They found in these patients, that CPAP treatment reduced the risk of fatal and non-fatal cardiovascular events.¹⁶

Notably, there is not enough research or data available to show that treatment with oral appliances or upper airway surgery provides any significant cardiovascular benefit for patients with OSA.

DISCUSSION

After review of all the data available regarding adult OSA patients and the three treatment options mentioned previously, it is clear that patients who have successful CPAP treatment of their OSA receive

the most cardiovascular benefit. Reviewed studies showed cardiovascular improvements in blood pressure, left ventricular ejection fraction, heart rate, arrhythmias, pulmonary arterial pressure, and myocardial infarction. Although there was no study available which showed clear reduction of risk for stroke after treatment with CPAP, based on the information, it is reasonable to infer that risk for stroke is also reduced in OSA patients treated with CPAP, since blood pressure improvements have been demonstrated with CPAP use.

Conversely, there are no adequate studies to date showing upper airway surgery or oral appliances offer any significant cardiovascular benefit to patients with OSA. More studies are needed to determine what benefits these alternative treatments provide for patients with OSA.

Based on the information available, CPAP treatment is the most effective treatment for OSA and it reduces the risk for adverse cardiovascular events. It is important to prevent potential cardiovascular events in our patients and CPAP treatment gives us an opportunity to intervene and better assist our patients. Adult patients with OSA gain from not only feeling better with CPAP treatment, but they also benefit by a reduced risk for future cardiovascular events, which ultimately improves their quality of life.

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