

Role of Postoperative Continuous Positive Airway Pressure: Review Article

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ABSTRACT

Background: For those with Obstructive Sleep Apnea (OSA), the most effective therapy is continuous positive airway pressure (CPAP). CPAP uses positive airway pressure to keep the patients' respiratory passages open while they sleep (or are awake and breathing normally). End-expiratory alveolar pressure that exceeds ambient pressure is known as a "positive end-expiratory pressure" (PEEP). PEEP is created by CPAP, which maintains a predetermined pressure during the whole breathing cycle, including inhalation and exhalation. It has been shown to lower daytime exhaustion, cardiac risk factors, as well as blood pressure.

Objective: The primary therapy for OSA is CPAP. CPAP was evaluated in this study to see if it reduced blood pressure in OSA patients. Research on CPAP and blood pressure in various subgroups of people was analyzed specifically for this study.

Methods: Research was carried out through PubMed, Google scholar and Science direct using the terms [Continuous positive airway pressure And Positive end-expiratory pressure OR Obstructive Sleep Apnea]. References from relevant literature, including all identified research and reviews, were also evaluated by the authors, although only studies published between December 2007 and June 2021 were included.

Conclusion: Although the overall impact of CPAP on blood pressure is minimal, even modest reductions in blood pressure may benefit in the prevention of cardiovascular events. This impact on those with uncontrolled hypertension merits further investigation. Variability in blood pressure response to CPAP therapy gives an opportunity for more study on this topic. Constant CPAP use has long been associated with an increased risk of hypertension.

Keywords: Positive end-expiratory pressure, Continuous positive airway pressure, Obstructive Sleep Apnea.

INTRODUCTION

There are several types of positive airway pressures, but the most common are those that use continuous pressures to keep open an individuals' airways while they're inhaling and exhaling. During exhalation, alveolar pressure rises above ambient pressure, which is referred to as "positive end-expiratory pressure" (PEEP). In addition to creating PEEP, continuous positive airway pressure (CPAP) maintains the appropriate pressure during the entire breathing cycle (inspiration and exhalation)⁽¹⁾.

In centimeters of water pressure, it is referred as (cm H₂O). When a patient is inhaling or exhaling, BiPAP (BiPAP) generates pressures that alter in response to the patient's respiration. The two words used to describe them are EPAP and IPAP (inspiratory positive airway pressure)⁽²⁾.

No further pressure is used in CPAP therapy above the specified amount, and each breath is initiated manually by the patient. Because it keeps PEEP constant, reduces atelectasis, improves V/Q matching and increases alveolar surface area, CPAP also promotes oxygenation. When CPAP alone is insufficient to sustain breathing, noninvasive ventilation requires extra pressure assistance during inspiration (IPAP on BiPAP) (when CPAP alone is insufficient to maintain breathing)⁽³⁾.

Indications

There are several causes of airway collapse, and CPAP is utilised in the great majority of cases to preserve airway patency. Airway collapse may occur in adults and children with respiratory difficulties, obstructive sleep apnea (OSA), for example, a condition

in which a person's breathing is obstructed when he or she sleeps. An adenotonsillar hypertrophy, obesity, and hypotonia may all lead to obstructive sleep apneic syndrome⁽⁴⁾.

Patients in the neonatal intensive care unit (NICU) who lack surfactant in their lungs may benefit from continuous positive airway pressure⁽⁵⁾. CPAP may be used to treat hypoxia and improve breathing in infants with acute infections such bronchiolitis and pneumonia, or with collapsing airways like tracheomalacia. With hypoxic respiratory failure, it increases V/Q matching and cardiac output in patients with congestive heart failure⁽⁶⁾.

A combination of CPAP and PEEP can be used to improve oxygenation before endotracheal insertion. Use this device to extubate patients who are obese and have a condition that could benefit from positive pressure but does not require invasive breathing⁽⁷⁾.

Contraindications

Patients who are unable to breathe on their own cannot utilise CPAP. In individuals with low respiratory drive, invasive ventilation or non-invasive ventilation with CPAP and pressure support and a backup rate are both necessary options for treating their condition (BiPAP). CPAP contraindications include the following⁽⁸⁾:

- An anxious or uncooperative patient.
- Respiratory arrest or unstable cardiorespiratory status.
- Being unconscious and unable to keep their airways open.
- Facial, gastric, or esophageal surgery.

- A wound or injury to the face.
- Copious respiratory secretions.
- Syndrome of air leaks.
- Vomiting and severe nausea.

Clinical significance

This is the typical method of administering PEEP in hospitals. Moreover, sleep apnea is often treated in outpatient settings or at home. CPAP enhances the quality of sleep, lowers or eliminates snoring, and reduces daily weariness. People claim enhanced focus, memory, and cognitive abilities. It may help reduce blood pressure and relieve pulmonary hypertension. It is safe for all ages, including children, to use CPAP. Preserves residual capacity via improving V/Q matching⁽⁹⁾.

The undesirable side effects of artificial respiration, such as excessive sedation and negative pressure ventilation, have nothing to do with CPAP (barotrauma and volutrauma). Blood gases, vital signs, and the patient's clinical profile should be frequently checked in an inpatient situation. If any signs of deterioration are seen, mechanical ventilation must be considered⁽¹⁰⁾.

Complications

Patients may have difficulty during the first few nights of CPAP therapy while they adjust to the device. Initially, many patients find the mask cumbersome, confining, or unattractive. Increasing the relative humidity may help alleviate the detrimental consequences of these conditions. When worn properly, a mask may reduce the risk of pressure sores by preventing the skin from coming into direct contact with the face⁽¹¹⁾.

Every three to six months, the mask and tube need to be cleaned and inspected. People who are admitted to the hospital with stomach bloating or distension may have nausea, vomiting, and aspiration. By lowering the stomach's pressure or decompressing it with a tube, this risk can be reduced⁽¹²⁾.

Compliance

Compliance with CPAP treatment remains a substantial difficulty in both inpatient and outpatient settings, despite its multiple advantages. To guarantee long-term success, physicians must often assess patient compliance and do follow-up visits, particularly after commencing CPAP therapy. The patient must disclose any undesirable symptoms that might impede adherence, and the physician must treat these symptoms. For long-term monitoring, an office visit is required to review equipment, adjust settings, and ensure that mask and interface are properly fitted. Therapeutic efficacy is maximized by the availability of support groups and continual patient education on the necessity for regular dose^(13,14).

Due to delirium, agitation, extreme youth in children, or advanced age in the elderly, some hospitalized patients who might greatly benefit from CPAP are unable or unwilling to wear the mask. Until

the medication is no longer required, low-dose fentanyl or dexmedetomidine may be provided to increase treatment compliance. Using any sedative or anxiolytic on these people can have an impact on their level of consciousness and respiratory drive, thus they need to be well monitored while being administered any medication⁽¹⁵⁾.

An important public health issue, OSA is characterised by recurring episodes of partial or total obstruction of the upper airway, which results in increased breathing effort, fragmented sleep, and occasional hypoxia. OSA (especially intermittent hypoxia) can lead to a range of intermediate pathways, such as oxidative stress, inflammation, endothelial dysfunction, sympathetic activation, as well as metabolic dysfunction, which may raise cardiovascular risk⁽¹⁶⁾.

With cardiovascular disease, OSA is more common than other conditions. OSA affects fewer than half of people with high blood pressure. Between 64% and 83% of people with resistant hypertension (RH) are found to have obstructive sleep apnea, depending on the definition of OSA. OSA is not only common in hypertensive people, but there is mounting evidence that it is associated with increased arterial stiffness, cardiac remodeling, and poor control of blood pressure (BP)⁽¹⁷⁾.

Patients with normotension benefit from CPAP, and the results of a meta-analysis have been critically analyzed.

Few studies have examined the cardiovascular effects of OSA treatment independent of changes in blood pressure, and this is an area that needs further investigation. Clinical trials involving normotensive individuals with severe OSA looked at the impact of CPAP on early markers of atherosclerosis and arterial stiffness, and the results were promising. People with severe OSA who had CPAP for four months saw significant reductions in the levels of catecholamines, C-reactive protein, pulse-wave velocity, and carotid intima thickening (adherence 6 hours each night)⁽¹⁸⁾.

Obstructive sleep apnea therapy did not significantly lower blood pressure, indicating that its benefits in avoiding cardiovascular disease are not dependent on it. Study participants who had baseline blood pressure measures that were close to normal and who were not taking any drugs were studied by **Bazzano et al.**⁽¹⁹⁾ to see how CPAP affected their health. CPAP was found to have only a minor influence on diastolic blood pressure. This study demonstrated that OSA therapy with CPAP has a minor or non-existent effect on trial participants with normal blood pressure at the start of the study. To test if OSA therapy reduces blood pressure in those with normal blood pressure, some randomized trials included normotensive patients⁽²⁰⁾.

Continuous positive airway pressure's effect on blood pressure was evidently influenced by this discrepancy, as the meta-analysis clearly demonstrates.

There may be a connection between the inclusion of normotensive or hypertensive patients whose blood pressure was well-controlled at the start of the trial due to the use of multiple antihypertensive medications and CPAP's modest benefits on blood pressure reduction (2 mmHg)⁽²¹⁾.

On the prevention of persistent hypertension in OSA patients with pre-hypertension and masked hypertension.

Cardiovascular problems and chronic hypertension are preceded by pre-hypertension and disguised hypertension. Frequently, OSA patients report undetected hypertension. It is plausible to hypothesize that individuals with OSA with pre-hypertension or masked hypertension may be helped by CPAP therapy⁽²²⁾.

It was hypothesized that CPAP would be more effective in patients with severe OSA who also had pre-hypertension or masked hypertension, and this was tested in a randomized trial using office blood pressure monitoring and 24-hour ambulatory blood pressure monitoring, respectively⁽²³⁾.

Non-CPAP treatment or CPAP treatment was given to patients for three months. At the beginning of the study, the prevalence of pre-hypertension and concealed hypertension was comparable. Blood pressure did not change considerably in the control group. Patients' blood pressure dropped by 5 and 4 mmHg, respectively, after CPAP therapy^(24,25).

Pre-hypertensive OSA patients who use CPAP have lower blood pressure; according to this finding, hypertension may be avoided if OSA is detected and treated early in asymptomatic, normotensive patients⁽²⁶⁾.

People who were sent to a sleep clinic as controls, those who had untreated OSA, and those who were treated with continuous positive airway pressure were all studied in a prospective cohort study to determine the risk of developing hypertension. A higher hazard risk (HR) for incident hypertension was found in OSA patients who weren't eligible for CPAP treatment, a higher HR was found in those who were refused treatment and the adjusted HR was found in those who weren't adhering to treatment, but the adjusted HR was lower in those who were receiving CPAP treatment for OSA patients (HR: 0.71)⁽²⁷⁾.

What is the effect of CPAP for non-RH OSA cases?

Obstructive sleep apnea treatment has less effect on blood pressure among participants who started out with normal or well-controlled blood pressure, as was previously mentioned⁽²⁸⁻³¹⁾. In addition, a number of studies have merged normotensive and hypertensive individuals, as shown by at least one meta-analysis published within the last year. It is puzzling that very few randomised controlled studies investigate all individuals with hypertensive OSA. In just fifty percent of these investigations, a little decrease in blood pressure was seen, according to a recent meta-analysis⁽³²⁻³⁴⁾.

Huang et al.⁽³⁵⁾ found that valsartan, an antihypertensive medication, had greater effects than CPAP. However, when combined with CPAP, the two treatments seemed to lower blood pressure even more. This randomised trial included hypertensive individuals with coronary artery disease revealed that CPAP reduces blood pressure by 8 mmHg. As a result, CPAP was found to be a more effective treatment for hypertension (defined as a resting blood pressure of 140/90 or 130/80 mmHg in diabetics). However, diastolic blood pressure was not statistically different between the two groups.

CONCLUSION

Obstructive sleep apnea is common in hypertensive individuals, especially those with the RH subtype. There is still a lack of awareness of the prevalence of OSA in cardiovascular patients, particularly those with hypertension. Although the overall impact of CPAP on blood pressure is minimal, even modest reductions in blood pressure may benefit in the prevention of cardiovascular events. This impact on those with uncontrolled hypertension merits further investigation. Variability in blood pressure response to CPAP therapy gives an opportunity for more study on this topic. Constant CPAP use has long been associated with an increased risk of hypertension. Even experienced CPAP users, however, may experience slight changes in blood pressure. Therefore, biomarkers are becoming increasingly popular as a way to identify those who will benefit from CPAP therapy.

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