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Review Article

Treatment of obstructive sleep apnea syndrome associated with stroke

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ABSTRACT

The association between sleep-disordered breathing and stroke has been a subject of increased interest and research. Obstructive sleep apnea (OSA) is an important risk factor for stroke incidence and mortality. Moreover, OSA is a common clinical outcome after stroke, directly influencing the patient's recovery. The treatment of choice for OSA is positive airway pressure (PAP) support and the PAP appliance is considered the most recommended clinical management for the treatment of patients with cardiovascular complications. However, the implementation of PAP in stroke patients remains a challenge, considering the increased frequency of motor and language impairments associated with the cerebrovascular event. In the present study, we reviewed the main findings describing the association between stroke and OSA treatment with continuous positive airway pressure. We also discussed the types of OSA treatment, the different options and indications of PAP treatment, PAP adherence and the clinical outcomes after treatment.

1. Introduction

Cerebrovascular disease is one of the most important causes of morbity and increased mortality [1]. It has been demonstrated that stroke patients present a high prevalence of sleep-disordered breathing (SDB) and other sleep disturbances [2]. Obstructive sleep apnea (OSA) increases the risk of stroke by twofold even after controlling for potential confounding factors [3].

Marin et al. [4] concluded in an observational study that in men, OSA may increase the risk of fatal and non-fatal cardiovascular events. Considering the high prevalence of SDB in the stroke population, it seems reasonable that OSA diagnosis and treatment may be crucial for primary and secondary stroke prevention [5]. Some possible mechanisms have been suggested. Dysphagia and paralysis of the accessory respiratory muscles may contribute to the pathophysiological mechanism of OSA after stroke [6,7]. The eventual central respiratory depression observed during the acute phase of stroke can also be linked to SDB prevalence in this period; however, there is a low prevalence of central sleep apnea post stroke [6].

Positive airway pressure (PAP) is the treatment of choice for OSA depending on its severity and patient's comorbidities [8]. When OSA is associated with cardiovascular complications, PAP is also the preferred treatment [9]. Excessive daytime sleepiness is an important indicator for OSA [10–12]. However, patients who suffer from stroke can have a weak perception of their daytime sleepiness or social isolation, and consequently, their Epworth scores are usually low [13]. The different clinical presentation of OSA in this patient group may lead to under-recognition and lack of treatment of SDB in these patients. Thus, considering the high prevalence of OSA, SDB must be investigated when there is a clinical history of obesity, snoring, systemic arterial hypertension, diabetes or stroke, particularly in male patients [14].

The standard method to diagnose SDB is full, attended polysomnography (PSG) or portable monitoring [15]. However, the higher complexity of cognitive and motor impairments in stroke patients and higher costs limit the use of PSG on a routine basis. A good alternative may be to conduct portable PSG studies on stroke patients admitted to hospital facilities. Currently, the ideal moment to perform a sleep study in these patients is not well established. In the present review, we discuss the association between stroke and SDB treatment with nocturnal non-invasive ventilation. We focused on the types and general indications of OSA treatment, PAP ventilation onset, choice of suitable equipment, PAP adherence, and the clinical outcomes after treatment.

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2. Types of PAP and indications

2.1. Continuous positive airway pressure

Continuous positive airway pressure (CPAP) is considered the gold standard treatment for OSA [8], and it normalizes sleep architecture, increases productivity, improves mood, and reduces excessive daytime sleepiness, traffic accidents and the risk of cardiovascular events [16]. Adherence to CPAP by the patient is also a crucial factor for treatment success. Some important and prevalent aspects should be considered during the ventilatory support of OSA after stroke [17,18]. Changes in the level of consciousness, ineffective cough, deglutition inability, and a higher incidence of nausea and vomiting must be monitored. Recently, reduction in pressure during expiration was implemented in CPAP, minimizing the difficulty in exhaling air (CPAP with expiratory relief). However, the effectiveness was found to be similar to conventional CPAP in OSA treatment [19].

2.2. Bilevel PAP

Bilevel positive airway pressure support, or bilevel PAP, adjusts to different inspiratory and expiratory levels. Bilevel PAP is used to treat OSA with pressure higher than 15 cmH_2O in conditions with hypoventilation syndrome and obesity or in central hypoventilation associated with OSA [20]. However, there is no evidence of better adherence or effectiveness of bilevel PAP compared with CPAP [21].

2.3. Automatic positive airway pressure

Automatic positive airway pressure (APAP) consists of an automatic ventilatory support that adjusts the pressure levels in upper airway according to patient's needs via airflow and pressure sensors. APAP was first used to optimize the CPAP adherence to automatic pressure titrations. As defined by the American Academy of Sleep Medicine (AASM), APAP is not recommended for patients with congestive heart failure, chronic obstructive pulmonary disease, hypoventilation syndrome, non-snoring patients or patients with associated central apneas [22]**.** There are few studies demonstrating the effectiveness and safety of APAP use for SDB treatment during the first weeks after a stroke event. Mulgrew et al. [23] demonstrated that APAP with expiratory relief was as effective as conventional CPAP for reducing the AHI. In addition, a trend toward improving patient satisfaction and preference was observed. In cases where there is no improvement in symptoms, a revaluation with titration PSG in the laboratory is necessary [22].

2.4. Adaptive servo-ventilation

Adaptive servo-ventilation (ASV) is a new therapy that provides positive expiratory airway pressure and inspiratory pressure support. ASV is automatically adjusted, according to a breath-by-breath analysis of the patient, with the goal of maintaining ventilation at 90% during a 3-min reference period. ASV has been increasingly used for treatment of central apneas and Cheyne–Stokes respiration in patients with heart failure [24]. There is a lack of data regarding the safety and benefits of ASV treatment in stroke patients. A recent systematic review found only a 7% frequency of primarily central apnea in patients with ischemic or hemorrhagic stroke and transient ischemic attack. Considering that stroke patients present predominantly obstructive respiratory events, ASV does not seem suitable [25]. Furthermore, ASV is a high-cost therapeutic approach for the treatment of SDB compared with CPAP, which could discourage its use in stroke patients.

3. CPAP adherence

For OSA treatment, CPAP must be used for at least 4 h per night for more than 70% of the time. There is a dose–response relationship between the amount of CPAP use and reduction of daytime sleepiness as well as improvement in the quality of life [26]. However, 39–83% of all OSA patients fail to adhere to the PAP treatment [27]. The main causes of non-adherence to PAP are claustrophobia, facial or thoracic discomfort, mask leakage or irritation, upper-airway obstruction, or other sleep disorders such as insomnia and aerophagia [28–30].

Factors associated with favorable adherence include education addressing PAP treatment, family support, knowledge of OSA risks, adequate mask fit, and use of a heated air humidifier [31–34]. The AASM recommends continuous PAP monitoring and effective follow up of the patient to ensure rapid and effective correction of any problems [20]. The majority of PAP machines provide an objective measure of device use. Continuous monitoring of the patient allows identification and management of early difficulties and complaints, such as sleep fragmentation and daytime sleepiness.

Education programs providing information to patients and their families about their sleep disorder and the importance of PAP treatment promote better adherence to CPAP [34]. Cognitive behavioral therapy may also be administered to increase the amount of PAP use and improve motivation and the perception of the long-term benefits of PAP treatment [35]. Patients must been evaluated at least once per year during PAP therapy. It is important to examine the mask and the PAP machine as well as to double check clinical complaints (Table 1) [36].

An important aspect associated with PAP adherence is the presence of several motor limitations in stroke patients. Brown et al. [37] tested two different headgear systems, one with a head frame and another with traditional strap headgear. The length of time the patient wears and removes each mask and the difficulties in putting on and removing the mask were recorded. All participants reported that the frame headgear was easier to apply and remove than the straps. These results reinforce the importance of the selection of headgear that is easier to apply in a CPAP interface in great part of stroke patients. Also, aphasia is very common after stroke affecting language aspects associated with dominant frontal or temporal lobes resulting in difficulties producing and/or understanding speech. The success

Table 1
Factors associated with continuous positive airway pressure adherence.

Good adherence	Poor adherence
Severe OSA (>30 events/h)	Mild OSA
Somnolence and other symptoms correction	Young and single adult
Associated comorbidities	High PAP pressure
Rapid benefits (<7 days)	Claustrophobia
Comfortable mask	Difficulties in mask adjustment
Automatic titration	Limited education
APAP vs Bilevel PAP vs CPAP	Limited support or absence of the physician or family
Humidifier use	Refusal to acknowledge the problem
Partner shares the bed	Lack of knowledge
Encouragement of the partner	Skin irritation
Elderly patient; female gender	Nasal obstruction
Professional education and support	Symptoms persistence
Self-reference	Depressive symptoms
Self-management of chronic diseases	Lack of patient's effectiveness perception
Behavioral initiative to changes	Dementia, decreased cognition
	Languages barriers
	Lack of health insurance

OSA, obstructive sleep apnea; APAP, automatic positive airway pressure; PAP, positive airway pressure; CPAP, continuous positive airway pressure.From "Principles and Practice of Sleep Medicine", 5th edition (2010), by MH Kryger, T Roth and Dement WC. Copyright 2010 WB Saunders. Adapted with permission.