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Cognitive and Emotional Factors Related to Obstructive Sleep Apnea Diagnoses: A Brief Review

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Abstract

Sleep apnea is a clinical condition characterized by cessation of breathing in the sleeper due to pharyngeal airway closure. The reduction in air exchange results in decreased cerebral blood circulation with consequential behavioral deficits cognitively and emotionally. Untreated sleep apnea is associated with chronic illnesses of depression, cardiovascular disorder, obesity and diabetes mellitus. Measured cognitive behavior before and following CPAP treatment demonstrates the cognitive deficit as the effectiveness of CPAP treatment. Emotional factors related to sleep apnea diagnosis and adherence to treatment are facilitated in patients with cognitive behavior therapy (CBT) interventions by sleep specialists. This is a brief review paper that presents findings about cognition and emotional factors related to sleep apnea. This is a brief review paper.

Keywords

OSA, Sleep Apnea, Sleepiness, Executive Functioning, Reactive Depression, Death Anxiety, Compliance, Sleep, Intellectual Ability

1. Introduction

Obstructive sleep apnea is a serious chronic disease that is underdiagnosed. The disease has characteristics of breathing cessation, sometimes for as long as two minutes followed by a gasp for air with a deep, quick inhalation through the nose and rapidly expelled out the mouth causing a loud snore from the vibration of the throat tissue. The collapse of the upper airway dilator muscles and soft tissues of the pharyngeal wall is diagnosed by five or more respiratory events as measured by the Apnea Hypopnea Index. Loud snoring and choking sounds characterize

the gasping for air that results from the aperture closures [1]. The resultant hypoxia of the brain from the arousals from sleep needed to establish breathing is associated with reductions in cerebral arterial oxygen supplies resulting in measured cognitive and resultant emotional changes in functioning. In the United States, some 24% of men and 9% of women have symptoms associated with obstructive sleep apnea (OSA). OSA occurs with obesity in men and presents more commonly in post menarche phase of the menstrual cycle for women when the protective function of estrogen is lowest. **Figure 1** displays the upper airway that may collapse during sleep in patients with sleep apnea.

Neural control of breathing propels the sleeper to take in this breath, however, the pace of the air intake and expulsion as well as the lack of essential breath exchange for alveoli to receive transfer of oxygen from capillaries is compromised. There is an association between body morphology and OSA with larger habitus (e.g., BMI > 35) corresponding to OSA [1] [2]. Additionally, behaviors that relax the throat tissue and person, such as alcohol/recreational drugs and inhalation of tobacco deteriorate throat tissue/lung tissue integrity [1]. Further, epidemiological studies have identified an association between undiagnosed sleep apnea conditions associated with chronic health conditions such as hypertension and depression. There is an association between metabolic disorder and OSA [3].

An all-night polysomnogram (PSG) study is used to formally diagnose sleep apnea. The number of times that the sleeper's breathing ceases and the corresponding changes in heartbeat are carefully monitored with strict scoring criteria to assist the patient's breathing when criteria about the breathing compromises are expressed [4] [5]. A continuous positive airway pressure (CPAP) instrument is presented and explained to the patient before the start of the sleep study as the timing of the need for it may occur. Some patients have chosen treatments of surgical intervention where pharyngeal and laryngeal tissue is surgically removed to increase the breathing opening for the patient [6]. Contemporary treatments include nasal surgery and stimulation of cranial nerves to the tongue to improve the air exchange for the patient. Non-medical treatments include the use of dental appliances to position the tongue down and forward thus opening the aperture of the throat for air exchange. Positional training includes having the sleeper keep off their back position for sleep an index from the all-night PSG called the apnea hypopnea index (AHI) is used in the diagnosis of sleep apnea [7]. The various treatment approaches are determined by a sleep specialist using the sleep or medical interview, self-report measures and the all-night PSG. The value of the AHI is used along with these measures to determine the treatment.

The Behavioral Sleep Medicine specialist commonly works with sleep apnea patients at several points in the course identifying and treating the sleep apnea [8] [9] [10]. The quality of life of the sleeper is determined by both interview and specialized self-report measures in this area. During the interview and/or when CPAP treatment begins the patient may experience discomfort and behavioral strategies to improve compliance are employed [11].

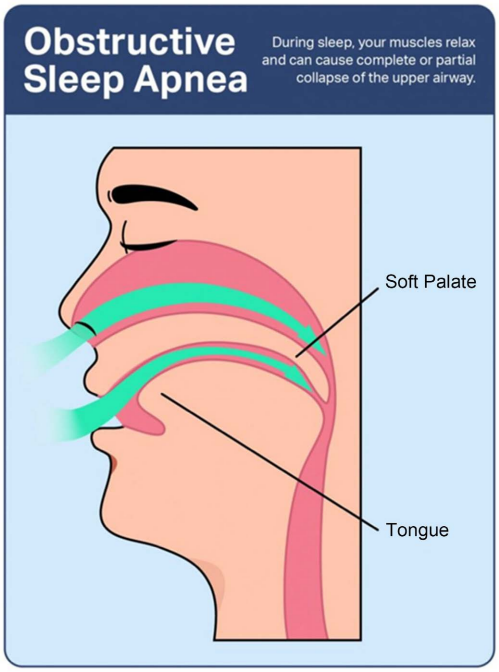

Figure 1. Obstructive sleep apnea.

Treatment of sleep apnea is essential to the sleeper's health [1]. Correlational studies have identified an association between untreated sleep apnea and depression, hypertension, diabetes mellitus and obesity [11] [12] [13]. Researchers have reported that depression can occur because of OSA with estimates of 5% to 63% of OSA patients reporting symptoms of depression [10]. Further, as the severity of OSA increases the risk and intensity of depression increases [10]. The Department of Motor Vehicle Transportation reports sleepiness secondary to undiagnosed sleep disorders as a source of driving accidents and fatalities [1] [12]. Research findings have indicated that among non-commercial drivers, untreated OSA increases the risk of motor vehicle accidents three to thirteen-fold [10]. Metabolic syndrome, which is characterized by waist circumferences, is greater than forty inches. Triglycerides/lipoproteins/fasting blood glucose increases. Metabolic syndrome impacts the sleeper's health to the extent of some two to two- and one-half fold odds of developing moderate sleep apnea [10] [13] [14]. Hypertension resulting from metabolic syndrome has also been studied in epidemiological studies and identified as corresponding to OSA. Also, if the CPAP treatment is prescribed for a patient and they do not comply, they are at high risk for hypertension and cardiovascular disease [15] [16]. This correspondence is substantial in that the extent of compliance to CPAP treatment is related to the extent of severity of OSA. Metabolic syndrome is characterized by increases in blood glucose. Study reports have identified improvement in endocrine functioning in metabolic syndrome patients complying with CPAP for their OSA condition. Blood pressure parameters. Also, endocrine studies track patients' weight loss from their Obesity condition [10].

2. Impact of OSA

OSA changes as is the focus of this chapter also occur in executive functioning areas of attention, concentration, persistence to task and short-term memory. Untreated severe OSA has been associated with Alzheimer's conditions where deficits in executive functioning occur [17] [18]. This serious condition renders the sleeper compromised in behavioral tasks involving these functions such as judgment, decision making and insight. Also, features are needed in adopting a new, healthy lifestyle.

Torelli and associates identified damage to brain regions in patients with OSA. The volumetric segmentation of cortical and subcortical structural damage was identified. Additionally, a reduction in neuropsychological testing was associated with moderate OSA [13]. Research findings indicate a decline in executive functioning as measured by neuropsychological testing in moderate (per the AHI index) OSA patients [19]. These findings were in adult patients. An association in cognitive deficits in children and adolescents exists. A research tracked the changes in brain functioning using imaging at various levels of severity in OSA patients [16] [19]. Positive changes in cognitive functioning with the use of CPAP use in OSA patients have been measured [19]. Improvements in processing speed and short memory three months following CPAP use in OSA patients have been found [16]. MRI imaging studies have identified untreated severe OSA patients with disrupted pathways [7].

Interestingly, exercise which modulated blood flow and blood pressure readings has been associated with improvements in CPAP effectiveness for OSA. OSA is commonly associated with a lack of exercise. Levels of nighttime plasma levels and cognitive functioning in OSA patients have been traced [20]. ROC analysis indicated high specificity and sensitivity of nighttime plasma levels and cognitive functioning [20].

3. Cognitive Functioning Issues and OSA

In an exploration of neural differences between children with and without OSA [21], resting state fMRI technology was used as the dependent variable to measure the distinctions. Left angular gyrus region, right insula, and left medial superior frontal gyrus increases were detected in OSA patients as compared to matched controls. In addition, the results indicated an inverse correlation between the increased activity regions and verbal IQ and performance IQ low scores in OSA patients as compared to age-matched controls [21] [22]. The impaired cognitive functioning typical of OSA patients may be related to aberrant activations in brain regions involved in cognition [23]. A positive correlation between the measurement of an evoked potentials technique to measure baseline and post-CPAP treatments in OSA patients has been found [6]. Their results indicated a slight reversal in frontal regions but not other areas of hypoxic cerebral damage. In a meta-analytic review, [24] [25] documented a series of studies demonstrating subdomains (e.g., attention, concentration, short-term memory-recall) decrements and

slight to medium improvements following CPAP treatment regimes in adult OSA participants versus age-matched controls. The multidimensional nature of executive functioning is characterized in this analysis as attention, attention shifting, sustained attention and other more detailed, specific aspects. Measurements of CPAP treatment are used as it addresses cases of OSA with high levels of cognitive impairment from reduced cerebral oxygen perfusion from recurrent pharyngeal collapses during sleep using a mental status exam [24] [25]. The researchers reported younger versus older OSA patients with the same levels of CPAP compliance expressed more cognitive improvements following CPAP treatment and examined the relationship between demographic factors of gender and age in OSA patients. Decrements in social cognition were reported in male, middle-aged OSA patients [26]. The comprehensive neuropsychological protocol used in the study indicated decrements, in general, in the sample of OSA patients in areas of vigilance sustained attention, psychomotor and impulse control [19] [20] [24]. Research studies have examined the components of obesity, weight loss, and cognitive ability in OSA patients [25]. A stepped-care approach was advocated for successful weight loss, reductions in OSA health loss increased psychological involvement as evidenced by the completion of behavioral therapy treat- ments. In OSA patients with severe symptomology, greater changes in cognitive abilities were determined once CPAP treatments ensued [6]. Other neuropsychological assessment research findings indicated that the cognitive deficits measured in their OSA participants accounted for daytime functioning difficulties in maintaining tasks and initiating activity. Using a standard neuropsychological protocol to start assessments (*i.e.*, Intelligence testing, Mental Status test, Phonemic Verbal Fluency) demonstrated straight forward testing of cognitive functioning in OSA patients [25] [26]. The participants demonstrated higher body mass indices, neck circumferences, AHI, and excessive-daytime sleepiness with decremented scores on the neuropsychological testing [26]. Reports of OSA patients in CPAP treatment performed at higher levels than those without on-digit vigilance-time tasks of executive functioning [4] [25]. The improvements were obtained on the measurement of night two of CPAP treatment. Figure 2 depicts the psychological behavior impacting sleep apnea in patients.

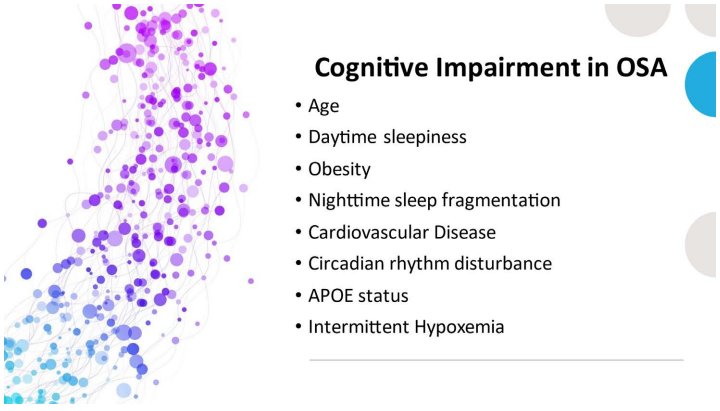

Figure 2. Model of obstructive sleep apnea.

4. Emotional Factors Related to OSA

The diagnosis of a chronic condition such as obstructive sleep apnea sometimes provokes an emotional reaction in patients. Aside from the need for ongoing medical appointments, and the costs of medical care and treatment, the emotional reaction of being diagnosed with a chronic condition is daunting to some [27]. The frustration at the betrayal of their body to sustain them, the rectory awareness now that they are in the medical care of the gravity of the OSA condition on their body and the amount of risk for other chronic conditions of diabetes mellitus, depression, and hypertension. Reductions in coping self-efficacy in newly diagnosed OSA patients [11]. Additionally, the researchers found increases in hostility and psychological distress in OSA patients. Reported research findings indicated reductions in cognitive flexibility, speed of information processing and general cognitive and emotional performance for women with OSA [11]. Slight improvements in ratings of depression and anxiety in OSA patients were found following CPAP treatments [19]. Studies have reported concurrent negative emotion ratings and poor sleep in patients before their diagnosis of OSA [1] [12]. Following treatment, the researchers identified studies confirming improvements in emotional functioning in terms of depression and concentration ratings [26]. Additional changes in cognitive functioning than emotional functioning in OSA patients were measured with fMRI imaging [1] [12]. The cerebrocerebellar pathway was considered to have the most immediate decrements from hypoxia damage due to the apnea and thus, the authors explain, account for more cerebral functioning tasks related to cognition rather than emotions [12] [22] [26]. In children undergoing a tonsillectomy to treat their OSA, Waters and colleagues report reductions in parent rating of children's behavioral excesses reflecting their somatic discomfort of OSA.

5. Treatments and Consequences of OSA

Medical evaluation and treatment are essential for obstructive sleep apnea. Sleep specialists may recommend cognitive behavioral treatments (CBT) in addition to the medical treatments for OSA [1] [2] [27]. The CBT approaches facilitate the patient's understanding of sleep, their sleep pattern and the need to engage in a healthy lifestyle (*i.e.*, nutrition, exercise, and exposure to natural light) to change their state [25] [28]. As OSA is behaviorally characterized by excessive daytime sleepiness and nighttime disturbed sleep with frequent awakenings, addressing these factors becomes paramount to assisting the patient in health. Reported advantages of CBT is helpful in conjunction with medical care for OSA to address important issues of compliance and to provide an immediate source of encouragement and information to the patient [1] [2] [29] [30] [31]. The underlying factors of poor uptake, misuse of the CPAP and discontinuation of treatment are more fully addressed with CBT interventions. A meta-analytical study conducted by Menzies and associates identified cognitive, emotional and endocrine changes in childhood populations with OSA before and after treatment. Treat-

ments that minimally involved behavioral follow-up and support were recommended to increase adherence [29] [30] [31]. Patients subjective perception of the problem and need for treatment, while not motivating them to seek treatment, is sufficient to sustain the patient's reaction to needing treatment [18]. It may be that it is at this intervention point where CBT interventions may be useful [1] [6] [14]. Reductions of hypochondriasis and depression were reported in patients with six months of CPAP treatment. Again, it may be the perceived need for treatment and not necessarily the action to obtain treatment that is most salient to patients. Findings from an analysis of CBT and CPAP use in OSA patients [8] [18]. Detailed meta-analytic reviews have indicated the same findings [15] [18].

6. Implications

With considerable high prevalence rates, OSA continues to be a sleep disorder of concern for immediate diagnosis and treatment [30] [31]. Significant cognitive functioning decrements and subsequent emotional reactions to diagnosis and treatment warrant neuropsychological assessment and treatment. Demonstrated changes in cognitive functioning resulting from as little as two nights of CPAP treatment point to the necessity to diagnose the cognitive changes monitor them and convey the positive changes [1] [11]. The technology of CBT interventions has indicated effectiveness in increasing compliance with CPAP treatment and ancillary sleep hygiene changes. More detailed, specific factors of motivation and intent to change are necessary to consider as a part of CBT interventions in the future. Statistical modeling using contemporary health psychology models of behavior change to healthy behaviors would be instrumental in more precisely designing and emphasizing aspects of the effective CBT approaches to OSA that support the essential medical interventions for OSA.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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