

Beyond usual data in ambulatory blood pressure monitoring: look for obstructive sleep apnea

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Abstract

Obstructive sleep apnea (OSA) is a frequent condition in hypertensive patients, characterized by repeated episodes of partial or complete upper airway obstruction during sleep (hypopneas and apneas). The pathophysiological changes in OSA have serious consequences on the individual's cardiovascular health. The episodes of intermittent hypoxia lead to endothelial dysfunction, arterial stiffness and alterations of nitric oxide metabolism, favoring higher blood pressure (BP) values. Ambulatory blood pressure monitoring (ABPM) can diagnose and evaluate hypertensive patients. There is growing evidence that certain patterns in ABPM results are linked to OSA. OSA is frequently associated with nondipping BP patterns and nocturnal hypertension. Nondipping blood pressure patterns are described as less than a 10% reduction of nocturnal blood pressure values. Patients belonging to this category possess a significant risk for adverse cardiovascular outcomes. Several factors are involved in altering circadian blood pressure variabilities, such as sedentary lifestyle, high sodium diets, smoking, altered neurohormonal regulations, diabetes, and chronic renal disease. Nondipping profiles, especially the reverse pattern, are associated with OSA, irrespective of sleep-related symptoms, making it a potential indicator for screening patients for OSA. Moreover, nondipping BP can be a predictor of BP response to continuous positive airway pressure (CPAP), suggesting the role of ABPM in OSA management.

Keywords: obstructive sleep apnea, ambulatory blood pressure monitoring, hypertension, cardiovascular risk, nondipping blood pressure.

Introduction

Obstructive sleep apnea

OSA is the most common sleep-related respiratory disorder, more common in the male population [1]. Approximately 13% of men and 6% of women have moderate-severe OSA, with an apnea-hypopnea index (AHI) greater than 15 per hour of sleep, unfortunately with a rising prevalence due to the increase

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and persistence of risk factors (smoking, obesity, sedentary lifestyle) [2–4].

OSA is a frequent yet underdiagnosed condition in hypertensive patients. OSA is a cause of hypertension, independently of other factors, especially in people younger than 60 years old [4].

OSA is suspected in patients with unexplained excessive sleepiness, fatigue, or unrefreshing sleep. Moreover, in patients with unexplained nocturia, nocturnal gastroesophageal reflux, morning headache, or frequent nocturnal awakenings, particularly in the setting of snoring, witnessed nocturnal apneas, or overweight body habitus, testing should be considered. Patients whose occupation involves driving or patients with resistant hypertension may also benefit from screening for OSA [5].

Laboratory-based polysomnography is the standard diagnostic test for OSA, during which sleep and respiratory parameters are monitored: oxygen hemoglobin saturation (finger pulse oximetry), airflow through the nose (nasal cannula), snoring, respiratory effort, sleep stage and arousal, electrocardiogram, leg movement and body position [5].

OSA is characterized by frequent breathing pauses caused by changes in muscle tone during sleep, which lead to hypopnea (partial) or apnea (total upper airway collapse) [6].

The diagnostic criteria for OSA are established if the number of obstructive events (apneas, hypopneas, respiratory event-related arousals) identified on polysomnography is over 15 per hour or over 5 per hour if the patient complains of daytime sleepiness, unrefreshing sleep, unintended sleep episodes during the daytime, snoring, breathing interruptions, waking up due to gasping or choking [7, 8].

AHI typically quantifies the presence and severity of OSA, defined as the total episodes of apneas and hypopneas per hour of sleep. OSA has different severity levels: mild OSA (AHI between 5 and 15), moderate OSA (AHI between 15 and 30) and severe OSA (AHI over 30 episodes per hour) [5].

The consequences of OSA include hypoxemia, hypercapnia, pronounced changes in intrathoracic pressure, high sympathetic activity [7], lower levels of oxyhemoglobin saturation, adverse cardiovascular outcomes, cortical arousal, interrupted sleep patterns, daytime sleepiness [9], behavioral changes [6].

An observational study conducted by Marin and colleagues over a mean follow-up period of 10 years included patients with untreated obstructive sleep apnoea-hypopnoea, patients with CPAP treatment, healthy men and simple snorers [10]. Patients with severe OSA under no treatment had an increased incidence of fatal and non-fatal cardiovascular events than untreated patients with mild-moderate disease, simple snorers, patients with CPAP treatment and healthy participants [11, 12].

OSA is associated with left ventricular hypertrophy [13], ischemic heart disease [14], heart failure

[15], arrhythmias [16], increased intima-media thickness [17] and stroke [18].

OSA diagnostic score (clinical and ABPM results)

There are several scoring systems proposed to detect patients with OSA. Therefore, these clinical tools help prioritize patients who have the most severe forms of OSA or on whom polysomnography should be performed [19].

The Berlin questionnaire (BQ) was the first screening clinical score for OSA, classifying patients as either high-risk or low-risk for OSA. BQ comprises 11 items within 3 different categories about snoring and witnessed apneas, daytime sleepiness and fatigue and reported obesity and hypertension [19].

The OSA50 questionnaire comprises 4 items that best predict a diagnosis of severe OSA: obesity (quantified by waist circumference), snoring, witnessed apneas and age over 50 years [19].

The STOP-BANG questionnaire, originally validated in a preoperative elective surgery population, consists of 8 questions about snoring, tiredness, observed apneas, high blood pressure, obesity, age over 50 years, neck circumference over 40 cm and male gender [19].

Ambulatory blood pressure monitoring

A useful tool frequently used in clinicians' daily practice is ambulatory blood pressure monitoring (ABPM), which provides a 24-hour report of BP values. It can identify different BP profiles and contributes to choosing the optimal therapeutic strategies. Moreover, the ABPM also has prognostic implications in predicting target organ damage and cardiovascular risk. In the case of OSA, ABPM is considered relevant, but its utility still needs to be established [20].

The sleep-wake cycle influences both the BP and the heart rate during 24h. During the non-rapid eye movement sleep phase (NREM), the sympathetic activity is decreased and the parasympathetic activity increases; therefore, the BP decreases by 10–20%, leading to the usual night “dipping”. On the other hand, it is known that during rapid eye movement sleep phase (REM), there are some transient BP surges because of sympathetic hyperactivity [20].

OSA elicits various mechanisms that may disrupt this regular interaction. Among these mechanisms, there are sympathetic activation, endothelial dysfunction, a decrease in baroreflex sensitivity, systemic inflammation and dysregulation of the metabolism [20]. As a counter-regulatory mechanism, the sympathetic tonus is also increased during the apneic episodes. Therefore, high values of BP and

heart rate can persist into the next day [20]. It is known that OSA may contribute to the non-dipping ABPM profile and nocturnal hypertension. Previous studies showed that non-dipping patterns are found in 48–84% of patients diagnosed with OSA [21]. However, nocturnal hypertension and nondipping patterns are not pathognomonic of OSA; therefore, several patients with OSA may present a normal dipping pattern. This can be explained by other associated conditions that impact the autonomic control of BP and by the inability of ABPM to capture the BP oscillation simultaneously with the respiratory event. The study of Crinion *et al.*, which involved 100 hypertensive patients who underwent ambulatory blood pressure monitoring, indicates that individuals with nondipping blood pressure profiles are at higher risk of OSA [22]. Thomas and colleagues evaluated OSA patients with ambulatory blood pressure monitoring and concluded that severe OSA and nocturnal hypoxemia were associated with elevated nocturnal blood pressure values [23].

Results of ABPM and their associations with OSA

Suggestive indicators for OSA should be used in hypertensive patients. ABPM may be useful for OSA recognition in this category of individuals.

Torres and colleagues [24] conducted a study to determine which ABPM variables can identify OSA in untreated hypertensive patients who snore. A total of 69.5% of patients were dippers, but 86.6% of the total number of patients had nocturnal hypertension. Home polygraphy revealed that 46.6% of patients had moderate-severe OSA (with AHI over 15). The score created and verified by this team provided a sensitivity of 84% and a specificity of 64%, a final score of over 113 points, indicating the possibility of finding patients with AHI over 15. The Scoring System for the Identification of Moderate to Severe OSA includes male sex; mean daytime BP < 109 mmHg; obesity (defined by the simultaneity of body mass index over 30 and abdominal circumference over 102 cm in men and abdominal circumference over 102 cm and over 88 cm in women); minimum diastolic nighttime BP over 63 mmHg and mean nocturnal heart rate (pulsations per minute) [24].

Continuous positive airway pressure, obstructive sleep apnea and hypertension

Hypertension is common in OSA patients, being both a result and a frequently associated comorbid-

ity in this respiratory condition. CPAP, in addition to the standard hypertension treatment, can lower BP in patients with OSA and resistant hypertension. The study conducted by Martinez-Garcia *et al.* for a period of 12 weeks indicated that CPAP decreased 24-hour mean and diastolic BP and improved nocturnal BP response pattern [25].

The work of Shafazand led to a similar conclusion. In patients with moderate-severe OSA and resistant hypertension despite optimal antihypertensive treatment, the addition of CPAP to the treatment led to better control of 24-hour mean blood pressure values after 12 weeks [25].

A randomized trial indicated that patients with severe OSA treated with CPAP, compared to the ones receiving no treatment, had a lower rate of masked hypertension [26].

Nondipping BP predicts BP response to CPAP treatment in patients with OSA [26]. Therefore, the role of ABPM in the management of OSA patients is crucial not only for a complete evaluation of the cardiovascular risk but also for monitoring the treatment response of OSA patients.

Conclusions

OSA is a frequent but fortunately treatable disease that can significantly influence the individual's cardiovascular risk. Based on clinical scores, the initial clinical assessment of patients is essential for properly managing each case. ABPM results can be an important tool in the steps of OSA diagnosis. As many studies suggested, the nondipping BP profile can be regarded as an indicator of OSA. Referring patients with nondipping BP for polysomnography can identify a serious number of patients suffering from OSA, which can benefit from adequate treatment and consequently lower their cardiovascular risk. More studies are needed to investigate the correlation between BP variability and OSA risk, but also the outcomes of OSA treatment regarding BP and global cardiovascular risk.

Conflict of interest

The authors declare no conflict of interest.

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