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COMMENTARY

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Obstructive sleep apnea syndrome and the nocturnal blood pressure profile

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1 | INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) affects 2%-7% of the adult population and is the most common sleep-related breathing disorder.[1] It is the most frequent cause of secondary and difficult-to-treat hypertension and represents a well-known risk factor for hypertension-associated end-stage organ damage.[2,3] The investigation of blood pressure (BP) behavior and of its determinants in OSAS patients helps to understand some pathophysiologic aspects of hypertension, stratify the cardiovascular risk profile, and support indication for therapy in affected patients.

2 | NOCTURNAL BP PROFILE ASSESSMENT

The assessment of nocturnal BP profile has important clinical relevance. Indeed, clinical studies have demonstrated that nocturnal BP and BP variability (BPV) are more closely associated with the risk of developing target-organ damage and future cardiovascular events in comparison to awake BP and BPV.[4,5] Ambulatory blood pressure monitoring (ABPM), which currently represents the gold standard of nocturnal BP assessment, measures the individual BP at fixed time intervals. Because of the lack of any synchronization with sleep apnea, ABPM can fail to detect apnea-related BP fluctuations and, hence, underestimate the extent of cardiovascular risk.[6]

In this issue of *The Journal of Clinical Hypertension*, the study by Kuwabara and colleagues explored the association between polysomnography-derived sleep parameters and nocturnal BP indices as derived by an oxygen-triggered nocturnal BP monitoring system.[7] This is an information technology-based system, which indicates BP measurements when oxygen desaturation falls below a set variable threshold continuously monitored by pulse oxymetry.[8] In this way, the system allows the detection of the nocturnal BP surge triggered by hypoxic apnea episodes.

The study clearly demonstrated that, in OSAS patients, the hypoxia-peak systolic BP, defined as the maximum systolic BP value measured by the oxygen-triggered function, and the nocturnal systolic BP surge, defined as the difference between the hypoxia-peak systolic BP and the average of the systolic BP values within 30 minutes before and after the hypoxia-peak systolic BP, were higher, ranged more broadly, and were more closely associated with respiratory-related polisomnographic parameters than maximum and mean nocturnal systolic BP obtained by the fixed-interval function through conventional ABPM.[7] In particular, the lowest oxygen saturation (SpO_2), defined as the minimum SpO_2 value during sleep, was the strongest independent determinant of either hypoxia-peak systolic BP or nocturnal systolic BP surge.[7]

These findings suggest that the severity and frequency of the decrease in SpO_2 have a strong impact on the nocturnal BP trajectories, and the hypoxia-triggered nocturnal BP measurement may be a promising technique to improve the cardiovascular evaluation of OSAS patients. Noteworthy, in OSAS patients cardiovascular events occur more frequently during sleep, and hypoxia-triggered nocturnal BP surge and exaggerated BP fluctuations can be contributing factors.[9,10]

3 | FROM PATHOPHYSIOLOGY TO CLINICAL PRACTICE: IMPLICATIONS AND FUTURE CHALLENGES

The strong independent relationship between the lowest SpO_2 and hypoxia-peak systolic BP might be attributed to apnea duration. Longer apnea periods can induce more severe reduction of SpO_2, stronger activation of sympathetic nervous system, and greater Valsalva effect and result into higher BP surge. The severity of OSAS

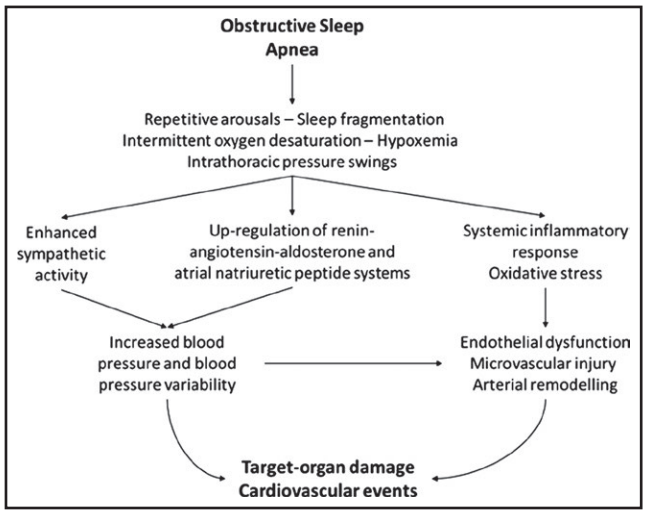

FIGURE 1 Obstructive sleep apnea and target-organ damage. Associations between obstructive sleep apnea and target-organ damage pathology (see text for details)

is currently defined according to the number of apnea-hypopnea episodes, but the degree of desaturation during breathing events would be even more informative and clinically meaningful with regard to the hemodynamic and cardiovascular effects.

The recurrent obstruction of the upper airways during sleep leads to intermittent oxygen desaturation, intrathoracic pressure changes, and repetitive arousals, which contribute to the alteration of systemic BP and promote target-organ damage through heterogeneous and synergetic mechanisms (Figure 1).[11,12] The enhanced sympathetic activity, which derives from either the activation of carotid body chemoreceptors triggered by episodic hypoxemia or the generalized stress induced by sleep fragmentation, leads to catecholamine surge and baroreceptor sensitivity impairment.[13] Furthermore, the up-regulation of the renin-angiotensin-aldosterone and atrial natriuretic peptide systems in response to raised renin levels and intrapleural pressure swings promotes the body fluid redistribution.[14] Crucially, over time, these autonomic and neurohumoral derangements perpetuate beyond the offending events and persist into the daytime, resulting in a disturbance of the overall circadian BP rhythm and an increase in short- and long-term BPV.[15] In this respect, there is accruing evidence that not only high absolute BP levels but even their fluctuations are closely related to the development and progression of organ damage[16–25] by promoting arterial remodelling, microvascular damage, hemodynamic instability, and vascular reactivity impairment.[26-29] In addition, recurrent intermittent hypoxia and subsequent reoxygenation, which resembles the ischemia-reperfusion cycle, can stimulate the release of reactive oxygen species, inflammatory cytokines, and vasoactive mediators that further promote endothelial injury and dysfunction.[30,31]

Future studies are warranted to identify polysomnographic parameters, BP and BPV indices, and serum biomarkers, which may be of aid to characterize the disease pathways and severity. The improvement of the clinical assessment through composite scoring systems incorporating variables that can take into account OSAS pathophysiology would be useful to identify the high-risk patients, individualize the management, and monitor the quality of treatment and BP control. In the era of precision medicine, understanding the BP patterns, the mechanisms causing and maintaining hypertension, and the effects of therapies in controlling BP and BPV[32–40] plays a key role in defining effective therapeutic interventions to improve unfavorable cardiovascular outcomes.

CONFLICT OF INTEREST

None.

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