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COMMENT

Hypertension and blood pressure variability in patients with obstructive sleep apnea

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Comment on original article, Cheng et al.'s "Obstructive Sleep Apnea in Relation to Beat-to-Beat, Reading-to-Reading, and Day-to-Day Blood Pressure Variability" [1].

Obstructive sleep apnea (OSA) is associated with hypertension and cardiovascular disease [2, 3]. In 786 hospitalized patients with hypertension, Cheng et al. performed 10-min awake beat-to-beat blood pressure (BP) monitoring ($n = 705$), 24-h ambulatory BP monitoring (ABPM) ($n = 779$), 7-day home BP monitoring ($n = 445$) and the full overnight polysomnography. Variability independent of the mean (VIM), average real variability (ARV), and maximum–minimum difference (MMD) were used as indices of BP variability. In univariate analysis, VIM and MMD in awake beat-to-beat systolic BP, and sleep systolic and diastolic ARV and MMD increased from patients without obstructive sleep apnea syndrome (OSAS), to patients with mild, moderate and severe OSAS. After adjustment for confounders, this increasing trend for VIM and MMD in awake beat-to-beat systolic BP remained statistically significant. This study reported clinically significant results. However, it has several limitations.

The first limitation is that the authors measured only awake beat-to-beat BP during daytime and not sleep beat-to-beat BP during nighttime. If sleep beat-to-beat BP had been available, the BP variability between awake and sleep beat-to-beat BP could be compared, which may become additional important findings. For example, it is clinically important whether 10-min awake beat-to-beat BP variability can predict severity of sleep beat-to-beat BP variability.

OSA induces intermittent hypoxia, recurring microarousals, sleep fragmentation, increased sympathetic nerve activity, BP elevation, and increased BP variability. In patients with OSAS, hypoxemia induced by sleep apnea episode is followed by a rapid rise in BP (sleep BP surge). Kuwabara and Kario et al. succeeded in detecting sleep BP surge in patients with OSAS using an original noninvasive device that measures brachial BP based on oscillometric method triggered by hypoxemia due to apnea episode [4]. Using the same device, Sasaki et al. revealed that peak systolic BP triggered by hypoxemia was significantly higher during rapid eye movement (REM) sleep compared with those in non-REM stage 1 and stage 2 sleep [5]. Moreover, the same study indicated that lowest oxygen saturation percentage during each sleep apnea episode was associated with maximum hypoxia-triggered systolic BP and maximum systolic BP surge. Sleep BP surges, which occur repeatedly during sleep, elevate sleep BP and increase sleep BP variability. Sympathetic nerve activation induced by hypoxia is one of the key pathophysiological mechanisms of sleep BP surge [6]. Besides, sympathetic nervous activation occurs not only during nighttime but also extends into the daytime [7]. This causes sustained daytime hypertension in patients with OSAS. Fig. 1.

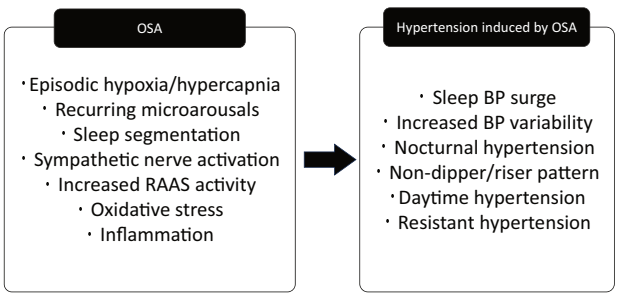

Fig. 1 Association between obstructive sleep apnea (OSA) and hypertension. BP indicates blood pressure, OSA obstructive sleep apnea, RAAS renin-angiotensin-aldosterone system

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Even today, the gold standard of BP measurement for office BP, ABPM, and home BP is the brachial BP measurement. In recent years, finger BP monitoring devices, including Finometer device used in the study by Cheng et al., have allowed to measure beat-to-beat BP noninvasively. Although BP based on finger BP monitoring devise is less accurate than BP based on brachial BP measurement, only finger BP monitoring device allows measuring whole of dynamically fluctuating BP in patients with OSAS. This is a major advantage of beat-to-beat BP monitoring. Using data from 330 patients with sleep disordered breathing (mean 3% oxygen desaturation index, 21.0 ± 15.0/h), Hoshide et al. measured nighttime beat-to-beat BP based on BP determined by pulse transit time (PTT) obtained at the site of finger. The authors reported that the average systolic beat-to-beat BP, maximum systolic and diastolic beat-to-beat BP, standard deviation (SD) of systolic and diastolic beat-to-beat BP, and coefficient variation (CV) of systolic and diastolic beat-to-beat BP were significantly higher than the respective values of intermittent BP determined by PTT at fixed time intervals [8].

The second limitation of the study by Cheng et al. is that 80% of the study participants were taking antihypertensive medication. Antihypertensive medications decrease elevated BP induced by OSA [9, 10]. Therefore, it is possible that BP and BP variability differed between patients taking antihypertensive medications and those not taking antihypertensive medications, which may have influenced the results of this study.

A notable result reported by Cheng et al. is that VIM and MMD in awake beat-to-beat systolic BP were increased in patients with severe OSAS, especially in younger, obese patients. Yoshida et al. previously reported a case of a 36-year-old young male having severe OSAS and obesity who experienced three nocturnal-onset stroke events [11]. This patient had large sleep BP surges, and his maximum sleep systolic BP measured by hypoxia-triggered sleep BP monitoring device had reached 209 mm Hg. The authors concluded that sleep BP surge in patients with OSAS could be a strong trigger of cardiovascular events. As Cheng et al. stated in the discussion, increased awake beat-to-beat BP variability may help to stratify risk in patients with OSAS. Regarding this, long-term prospective studies are needed.

Compliance with ethical standards

Conflict of interest The author declares no competing interests.

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