

The Effect of Different Intermittent Hypoxia Severity on Cognitive Function in Rats: The Roles of Autonomic Regulation and Sleep

探討不同強度的間歇性缺氧引發認知功能障礙中自律神經及睡眠的角色

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Background

Intermittent hypoxia (IH) induced by sleep apnea is considered to be the risk factor for the development of hypertension, cardiovascular disease and cognitive dysfunction.^{1,2} Animal studies have shown IH causes sleep fragmentation, autonomic dysregulation and cognitive impairment. However, few papers explore the damages under different IH intensities.^{3,4}

Aims & Objectives

This study aims to explore the effects of different IH intensities on autonomic function, sleep patterns, blood pressure and cognitive functions in Wistar-Kyoto rat (WKY) and spontaneously hypertensive rat (SHR).

Methods

In the first part, 24-hour physiological signals test will be recorded individually at different intensities of 8-hour IH, including hypoxia duration (5, 10 and 15 seconds) and frequency (15, 30 and 60 cycles/hour), and followed by behavioral test (Novel Objects Recognition Test (NOR)). Each intensity would be separated by 1-day washout periods. In the second part, rats will be recorded physiological signals at different intensities of IH for 3 weeks, and cognitive behaviors, included 8-arm maze force swim and high elevated maze, and biomarkers, included oxygen stress, TNF α and Casp3, will be examined during the third week.

Results

In the first part, the accumulated paradoxical sleep (PS) time in IH groups with 15-second hypoxia duration and 60 cycles/hour was lower than those in RA group, and the IH group with 60 cycles/hour had the worst sleep quality, as interruption and delta% brain wave in quiet sleep (QS), in WKY. The R-R interval (RR) is lower in 15-second hypoxia duration and 60 cycles/hour IH group than RA group. In NOR behavioral test, 60 cycles/hour IH group has lowest score and 10 seconds hypoxia duration has highest scores in WKY. As for SHR, 10-seconds, 15-seconds hypoxia duration and 60 cycles/hour IH group had lowest QS and PS times, and 60 cycles/hour IH group is lowest in parasympathetic nerve. In behavioral test, 5-second hypoxia duration and 60 cycles/hour IH group had highest score and 10-second hypoxia duration IH group had lowest score.

Discussion & Conclusion

The IH groups with 15-second hypoxia duration and 60 cycles/hour for 8 hours had poor sleep quality and autonomic nerve function in WKY and SHR. Both species have different mechanism to react to different intensity of intermittent hypoxia. In which, WKY have more arousal and SHR have more awake.