Sleep Stage Influence on the Autonomic Modulation of Sleep Apnea Syndrome

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Introduction: Hypoxia induced by sleep apnea syndrome (SAS) leads to the deregulation of the autonomic nervous system (ANS), resulting in an abnormally increased sympathetic activity. Since ANS modulation varies throughout the night, notably for each sleep stage, the autonomic assessment of SAS patients at night could provide new insights in the understanding of the disease.

Methods: The hypnogram and heart rate signals of 81 patients were collected during a polysomnography. They were classified as mild-moderate (n=44) or severe (n=37) based on their apnea-hypopnea index (AHI), by setting the cut-off point at 30. Spectral heart rate variability (HRV) series were extracted by a Smoothed Pseudo Wigner-Ville distribution approach. These series were then averaged for each sleep stage, in order to compare the sympathetic modulation of mild-moderate and severe patients at the following phases: rapid eye movement (REM), S1, S2 and SWS (slow wave sleep). Moreover, their variability for the whole night was quantified by the standard deviation.

Results: Severe patients showed higher LF_{nu} values (normalized power at the low-frequency band) for non-REM stages (S1: $p=0.004$; S2: $p<0.001$; SWS: $p<0.001$), while no significant differences between groups were observed at REM sleep ($p=0.059$). Indeed, while patients with mild-moderate SAS showed significant differences among sleep stages ($p=0.014$), severe patients showed a similar sympathetic modulation throughout the night ($p=0.978$). Moreover, significantly lower LF_{nu} standard deviations were noted in severe patients ($p<0.001$).

Conclusion: Severe SAS seems to be associated with an increased sympathetic modulation at non-REM sleep. Moreover, a decreased autonomic variability throughout the night may be related to a reduced adaptability of the cardiovascular system, characterizing a more advanced stage of the disease. These results provide further evidence for the role of autonomic alterations induced by hypoxia, with a potential impact on the use of HRV, together with AHI, for the study of SAS severity.