Decoding the Impact of Hypoxia on Decision Making Via Behavioral Responses, ERPs, and Intracranial Dipoles

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Hypoxia is a common occurrence in various clinical disorders, including respiratory diseases like obstructive pulmonary diseases, and ischemic brain lesions. It can also occur in healthy individuals who are exposed to extreme operational environments, such as high-altitude or low air-pressure situations, often paired with low temperatures [1-2]. Despite facing hypoxia, many individuals are still required to perform their tasks, which demand high-level cognitive abilities and the capacity to select, optimize, and inhibit behavior. This includes emergency situations [3]. While there is extensive knowledge of the physiological effects of hypoxia, understanding of its impact on neurocognitive function is limited. Impairments in memory, inhibition, and novelty detection are recognized, but there is a lack of systematic observations on its influence on decision making, arousal, orienting, executive control functions of visuospatial attention, and motor workload [4-6]. There is still less information about the activation of neural networks involved in these functions.

To investigate the influence of hypoxia on these functions and their associated neural systems, a group of participants underwent two experimental sessions. In each session, they breathed either ambient air or 12.5% oxygen-reduced air. Participants performed four cueing visuospatial tasks based on Posner's Attention Network Test. EEG was recorded from 128 scalp sites, and event-related potentials (ERPs) and behavioral responses (RTs) were obtained.

The results showed that hypoxia impaired the activation of attention orienting network. Both the RTs to targets and amplitude of ADAN and LDAP ERPs components indicated that hypoxia had detrimental effects on attention orienting. The neural activation in the right anterior cingulate cortex, left superior parietal lobule, and frontal gyrus was enhanced under hypoxia, as indicated by the bioelectrical dipoles for the decision-making task. We believe that these findings advance our understanding of the neurocognition of decision making and attentional mechanisms in both healthy and clinical conditions.

References

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