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THE PREFRONTAL OXYGENATION AT THE ONSET OF UNRESTRAINED OVERGROUND WALKING IN HUMANS

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Our laboratory recently found that prefrontal oxygenation (as index of regional cerebral blood flow) increased 5 s prior to the onset of arbitrary cycling, preceding the systemic circulatory responses and muscle vasodilatation. The in advance increase in prefrontal oxygenation was absent when exercise was forced to start by a cue, suggesting that the prefrontal oxygenation may be in association with in advance activation of central command.

The data was obtained in a restrained laboratory condition and it cannot be neglected that psychological stress, if any, might modify the increased prefrontal oxygenation at the onset of exercise. To clarify the possibility, we examined oxygenation from multiple prefrontal regions during unrestrained overground walking. Prefrontal oxygenated- and deoxygenated-hemoglobin concentrations (Oxy-Hb and Deoxy-Hb) were measured during walking with wireless near-infrared spectroscopy and were compared among three types of start mode (arbitrary, cued, and countdown).

Arbitrary walking produced an increase in prefrontal Oxy-Hb prior to the onset of exercise, whereas such increase was absent in the cued walking. Although walking started by a countdown also increased the prefrontal Oxy-Hb prior to the onset of exercise, the in advance increases in prefrontal Oxy-Hb tended to be weaker than that with arbitrary start. The prefrontal Deoxy-Hb was unchanged prior to the onset of exercise, irrespective of the start modes. The in advance increase in prefrontal Oxy-Hb was found in the lateral prefrontal regions, including the dorsolateral prefrontal cortex and Broca's area. On the other hand, the in advance increase was attenuated or disappeared in the medial prefrontal regions, including the frontopolar and orbitofrontal areas.

These findings suggest that when exercise is started arbitrarily, the lateral prefrontal cortex is activated prior to the onset of exercise, which may be in association with a signal responsible for the generation of central command for cardiovascular regulation.

Key words: prefrontal cortex, near-infrared spectroscopy, walking, arbitrary start, central command