COMPARISON OF CEREBROVASCULAR AND CARDIOVASOCULAR RESPONSES TO DYNAMIC ORTHOSTATIC STRESS USING SINUSOIDAL LOWER-BODY NEGATIVE PRESSURE

Ishibashi Keita[1], Oyama Fuyuki[1], Yoshida Hisao[1], Higuchi Shigekazu[2], Iwanaga Koichi[1], Yasukouchi Akira[2]

[1]*Graduate School of Engineering, Chiba University, Chiba, Japan*
[2]*Faculty of Design, Kyushu University, Fukuoka, Japan*

In the evolution of human bipedalism, gravity is one of the essential environmental factors to which humans had to adapt. The high metabolic demand of the human brain necessitates the upward delivery of a large proportion of the cardiac output (CO), and the relatively large length of human legs causes blood pooling in the legs along with orthostatic stress. The ability of cerebral vasculature to maintain relatively steady blood flow in the face of changing mean arterial pressure (MAP), termed cerebral autoregulation (CA), is critical to adapt to gravity. Although CA is an integral component of the systemic circulation system, little is known about the relationship between cardiovascular regulation and dynamic CA in response to transient changes in MAP, such as during changes in posture. We examined the cerebrovascular and cardiovascular responses to dynamic orthostatic stress using sinusoidal lower-body negative pressure (SLBNP), which can simulate orthostatic blood shifts. We measured the middle cerebral arterial blood flow velocity (MCAv) and cerebral blood oxygenation (OxyHb), MAP and CO in 13 adult male subjects. Two different periodic changes (18- and 90-sec of 0 to −40 mmHg) of SLBNP were provided. The transfer function of gain to MAP (that is, vascular conductance during the 90-sec period) was significantly larger than that of the 18-sec period in all parameters (MCAv, OxyHb, and CO), but the conductance ratio between 90-sec and 18-sec was significantly larger in CO compared to MCAv. These results suggest that the systemic regulatory system including CA could be responsive to the slow fluctuations of MAP and that CA is relatively stable over a wide range of MAP fluctuations in frequency. The unique characteristic of CA could also include the ability to maintain relatively steady blood flow in the face of changing frequencies of MAP fluctuation.

Key words: *cerebral autoregulation, whole body coordination, gravitational stress*

Contact information: Ishibashi Keita, e-mail: ishibasi@faculty.chiba-u.jp.