Using Cross-Correlation Function to Assess Dynamic Cerebral Autoregulation in Response to Posture Changes for Stroke Patients

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Stroke has been the leading causes of mortality in Taiwan, even in the world for decades. Previous researches indicate the causes of cardiovascular diseases are highly related to the change of physiological parameters. Stroke can be resulted from rapid change or unstable cerebral blood flow due to the ineffective cerebral autoregulation (CA). The cerebral autoregulation mecha-nism refers to the cerebral blood flow (CBF) tendency to maintain relatively constant in the brain. In this study, time-domain cross-correlation function was applied to evaluate the relationship between blood pressure and cerebral blood flow velocity signals acquiring from healthy subjects and stroke pa-tients both in supine and head-up tilt positions. There are 10 stroke patients (56.0$\pm$10.6 years) and 11 healthy subjects (58.4$\pm$8.0 years) included in this study. Results revealed that the mean arte-rial blood pressure (MABP) values of stroke patients in response to posture changes were reduced (supine: 117.99$\pm$17.50 mmHg; head-up tilt: 112.25$\pm$17.68 mmHg). However, MABP values in healthy subjects were be-come higher in head-up tilt position (supine: 88.34$\pm$8.20 mmHg; head-up tilt: 95.32$\pm$11.69 mmHg). Both of MABP values of healthy subjects in supine and head-up tilt were significantly lower than those in stroke patients ($p<0.05$). On the other hand, mean cerebral blood flow velocity (MCBFV) in healthy subjects remain constant (supine: 38.85$\pm$7.94 cm/s; head-up tilt: 39.44$\pm$11.62 cm/s). However, the values in stroke patients reduced in response to head-up tilt (supine: 41.26$\pm$7.74 cm/s; head-up tilt: 37.43$\pm$7.16 cm/s). In the results of cross-correlation function (CCF) analysis, max CCF values in healthy sub-jects were significantly higher than those in stroke patients ($p<0.05$) in both supine and head-up tile positions. It might indicate correlation of MABP and MCBFV was higher in healthy subjects. The max CCF index in stroke pa-tients were close to 0 second in both positions (supine: -0.35$\pm$3.36 sec; head-up tilt: -0.29$\pm$3.20 sec). In healthy subjects, max CCF values should be around 2 seconds. Hence, it indicated the phase difference almost did not exist between MABP and MCBFV. This reveals the buffer function of CA were low in stroke patients. Therefore, CA in stroke patients might be im-paired by the results in response to posture changes.