Original Contribution

Relationship Between Electrical Brain Responses to Motor Imagery and Motor Impairment in Stroke

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Abstract

Background and Purpose—New strategies like motor imagery based brain-computer interfaces, which use brain signals such as event-related desynchronization (ERD) or event-related synchronization (ERS) for motor rehabilitation after a stroke, are undergoing investigation. However, little is known about the relationship between ERD and ERS patterns and the degree of stroke impairment. The aim of this work was to clarify this relationship.

Methods—EEG during motor imagery and execution were measured in 29 patients with first-ever monolateral stroke causing any degree of motor deficit in the upper limb. The strength and laterality of the ERD or ERS patterns were correlated with the scores of the European Stroke Scale, the Medical Research Council, and the Modified Ashworth Scale.

Results—Mean age of the patients was 58±15 years; mean time from the incident was 4±4 months. Stroke lesions were cortical (n=8), subcortical (n=11), or mixed (n=10), attributable to either an ischemic event (n=26) or a hemorrhage (n=3), affecting the right (n=16) or left (n=13) hemisphere. Higher impairment was related to stronger ERD in the unaffected hemisphere and higher spasticity was related to stronger ERD in the affected hemisphere. Both were related to a relatively stronger ERS in the affected hemisphere.

Conclusion—The results of this study may have implications for the design of potential poststroke rehabilitation interventions based on brain-computer interface technologies that use neurophysiological signals like ERD or ERS as neural substrates for the mutual interaction between brain and machine and, ultimately, help stroke patients to regain motor control.

Key Words:
- event-related desynchronization
- event-related synchronization
- motor impairment
- rehabilitation
- spasticity
- stroke recovery