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Electroencephalographic Analysis According to Cognitive Ability in Basal Ganglia Stroke Patients

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Introduction

- Damage in the Basal Ganglia (BG) may cause cognitive impairment similar to that caused by frontal cortex injury.
- Electroencephalography (EEG) patterns can be affected by specific disease conditions like cognitive impairment. Theta and Delta waves are often seen in drowsy subjects, while Alpha and Beta waves are seen during mental activity.
- In this study, we investigated EEG characteristics according to cognitive ability in BG stroke patients through a comparison analysis with different cognitive function.

Subjects and Methods

Study Design & Study Participants

- This was a retrospective study that collected BG stroke patients and healthy controls who received cognitive evaluations in a single hospital in between 2021 January and 2022 December.
- Inclusion criteria: BG stroke patients who had Full Scale Intelligence Quotient (FSIQ) <85 or Mini-Mental State Examination (MMSE) <24 to the cognitive impairment subgroup (G1). (FSIQ was considered the first priority in group allocation.)
- The BG stroke patients with FSIQ ≥ 85 or MMSE ≥ 24 were assigned to the normal cognition subgroup (G2). (FSIQ was considered the first priority in group allocation.)
- Healthy subjects who had no brain lesions with MMSE ≥ 24 were assigned to the control group (G3).

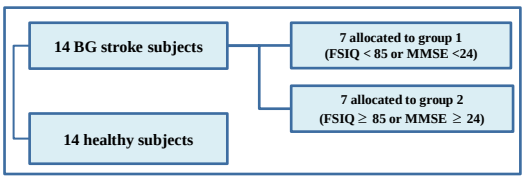
Measurement method

- EEG examination was performed by using the standard 10-20 system (iSynwave, iMediSync, Republic of Korea).
- In BG patients, EEG was performed within 3 months after onset.
- The whole brain was examined according to five regions (frontal, central, temporal, parietal, occipital).
- EEG frequency bands were divided with the following boundaries: Delta (1~4 Hz), Theta (4~8 Hz), Alpha (8~12 Hz), Beta (12~30 Hz) and Gamma (30~45 Hz).
- In subgroup analysis, we classified Beta waves into Beta 1 (12~15 Hz) and Beta 2 (15~20 Hz) waves.

Statistical analysis

- Data was analyzed with a 3-way ANOVA test, in Statistical Parametric Mapping (SPM).

Figure 1. Participant Enrollment Flowchart



Result

- Seven BG stroke subjects were assigned to each G1 and G2, and 14 healthy subjects were assigned to G3.
- In all five regions, Theta/Alpha Ratio (TAR) was highest in G1 (Figure 1) and also Delta/Alpha Ratio (DAR) was highest in G1 (ps <0.05) (Figure 2).
- When analyzed with Beta wave subgroups, Theta/Beta Ratio and Theta/Beta2 Ratio were highest in G1(ps <0.05), which indicates lowered Alpha and Beta band powers and elevated Delta and Theta band powers in G1 (Figure 3).
- As Alpha and Beta powers decrease and Delta and Theta band powers increase, there was a statistically significant increase of power ratios in G1 (p <0.05) (Figure 3).

Figure 1. Comparison of Theta/Alpha Ratio (TAR) in Each Brain Region

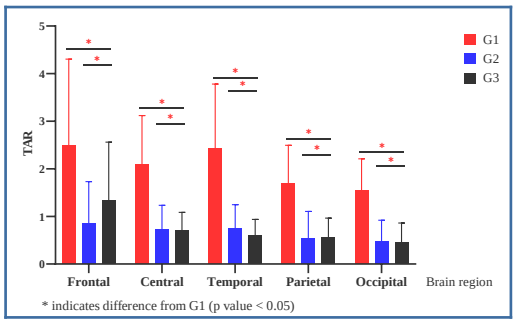


Figure 2. Comparison of Delta/Alpha Ratio (DAR) in Each Brain Region

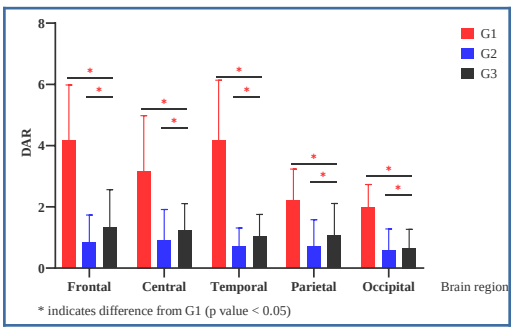
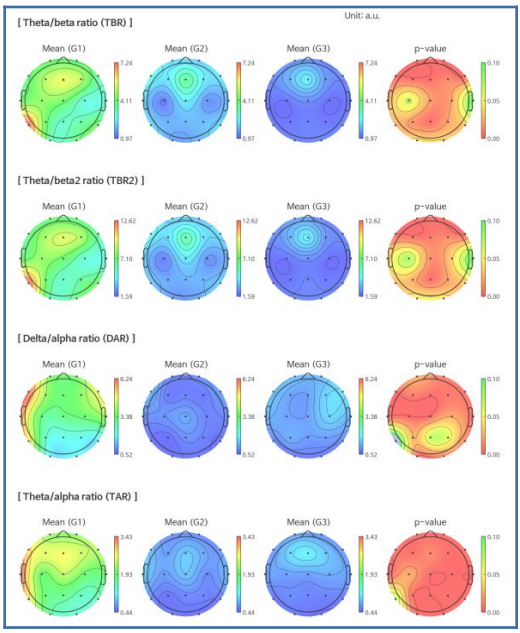


Figure 3. Topography of EEG Wave Ratios in Each Group



Conclusion

- This study demonstrates the differences of EEG band dynamics in BG stroke patients according to different cognitive ability.
- Beta and Theta band power and ratios may be the associated markers in evaluating cognitive function in BG stroke patients.

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