Difference of Quantitative EEG between Alzheimer's disease (AD) dementia and non-dementia AD

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INTRODUCTION

- Alzheimer's disease (AD) is the most common cause of dementia.
- However, accumulation of **beta amyloid plaque in the brain which is the main pathology of AD** could result various spectrum of cognitive functional stages from preclinical level to overt dementia.
- Hence, it is important to understand **functional differences between dementia and non-dementia AD** to **predict progression forward to dementia at prodromal or preclinical stage of AD**.

METHODS

Subjects, Clinical Diagnosis

- 45 Alzheimer's disease subjects (all confirmed by brain amyloid-beta PET).
- Neurocognitive test, Activity of Daily Living (ADL) and MRI were conducted for clinical diagnosis (dementia and non-dementia).

EEG acquisition & analysis

- Subjects' resting state (eyes closed) EEGs from 19 channels were measured for about 3 minutes.
- Figure.1 below shows the data analysis procedure.

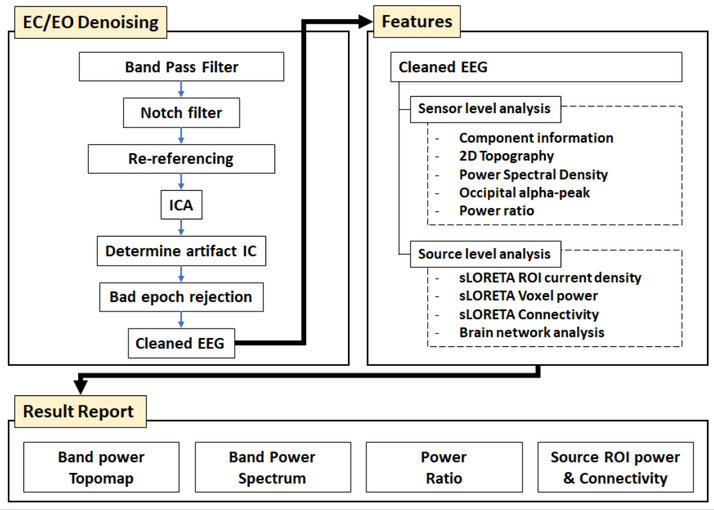

Figure 1. Quantitative EEG analysis procedure

- Various features were calculated from the acquired EEG data using the online platform (iSyncBrain ™, iMediSync Inc., Seoul, Korea) for EEG signal analysis.
- Calculated features were divided into dementia or non-dementia groups according to their clinical labels, statistically significant differences between the groups were then analyzed.

RESULTS

Table 1. Results of clinical diagnosis

Group	N (male/female)	Age (years±SD)	CDR (mean±SD)
Non-dementia (G1)	25 (10/15)	72.05±6.89	0.23±0.25
Dementia (G2)	20 (6/14)	76.76±7.54	1.15±0.53

- Mid frontal channel (Fz) showed the most distinctive enhancement of theta power (G1 < G2).
- Beta1 (12~15Hz) was significantly decreased at both temporoparietal area in dementia AD group (G1>G2).
- Similar patterns were observed in cortical source current density.

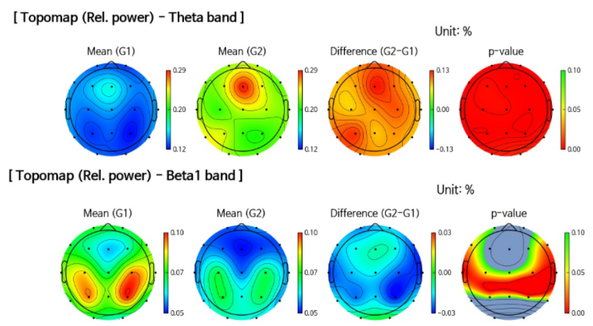

Figure 2. Topomap Relative power (Theta & Beta1 band)

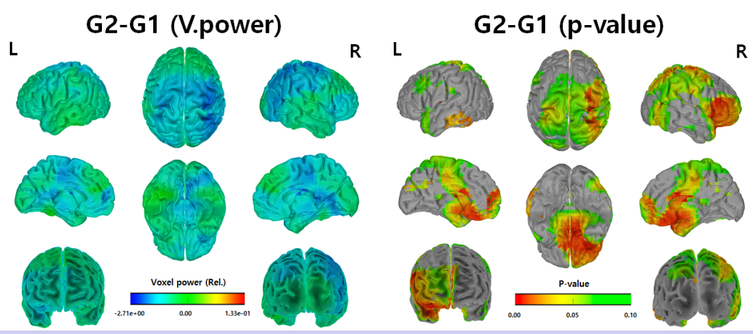

Figure 3. Cortical source current density power and p-value (Beta1 band)

- iCoh among ROIs of default mode network (DMN) was significantly decreased (G1 > G2) at alpha2 band (10~12Hz).

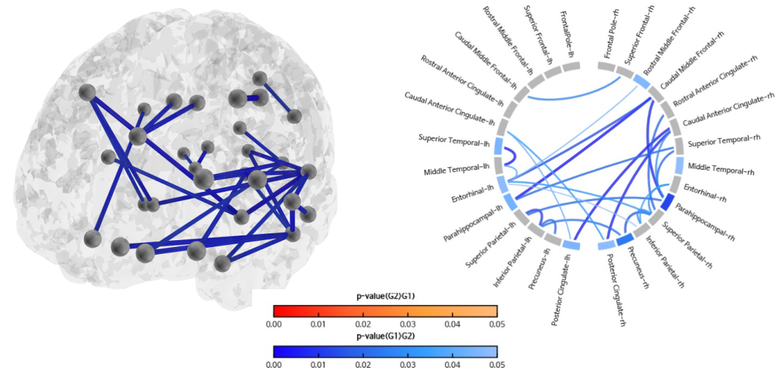

Figure 4. iCoh among ROIs of DMN (alpha2 band)

- At bilateral frontal pole, rostral middle frontal, anterior cingulate, parahippocampus and precuneus, the characteristic path length significant increased at theta band (G1<G2).
- In contrast, cluster coefficient of theta band significantly decreased (G1>G2).

Table 2. Results of Brain network analysis (theta band)

Measure	Band	Group	ROI: Frontal Pole Left	Frontal Pole Right	Rostral Middle Frontal Left	Rostral Middle Frontal Right	Rostral Anterior Cingulate Left	Rostral Anterior Cingulate Right	Parahippocampal Left	Parahippocampal Right	Precuneus Left	Precuneus Right
Characteristic Path length (global efficiency)	Theta	G1	**0.07**	**0.073**	**0.07**	**0.07**	0.08	0.08	**0.08**	0.08	**0.07**	**0.07**
		G2	**0.09**	**0.085**	**0.08**	**0.08**	0.09	0.09	**0.09**	0.09	**0.08**	**0.09**
		p	**0.00***	**0.00***	**0.04***	**0.01***	0.09	0.06	**0.01***	0.11	**0.03***	**0.01***
Cluster Coefficient (local efficiency)	Theta	G1	0.51	0.51	**0.51**	**0.51**	**0.53**	**0.53**	**0.54**	**0.54**	**0.50**	**0.50**
		G2	0.47	0.46	**0.45**	**0.45**	**0.46**	**0.46**	**0.49**	**0.47**	**0.45**	**0.45**
		p	0.07	0.07	**0.02***	**0.04***	**0.01***	**0.01***	**0.02***	**0.00***	**0.02***	**0.04***

(*p<.05)

CONCLUSIONS

- AD dementia showed increase of theta and decrease of Beta1 at both scalp and cortical level compared to non-dementia AD subjects.
- Both global and local network efficiencies of theta wave were significantly deteriorated in AD dementia.
- **QEEG could effectively discriminate dementia and non-dementia in ADs.**

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