Machine Learning-Based Cognitive Status Prediction in Patients with Acute Ischemic Stroke Using EEG-Derived Network Attributes

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Introduction

Stroke is the major cause of mortality or vascular dementia worldwide. Functional connectivity, which includes not only a specific brain region's activity but also the interaction between different regions, could be the key in resolving this problem. If brain network structures provide more details about cognitive prognosis after stroke, EEG would be a powerful tool that could reveal the network vulnerability for post-stroke cognitive impairment in stroke patients. Therefore, we aimed to investigate which brain networks are relevant to the three-month cognition level and to assess whether the brain network can predict patients' cognitive status after acute ischemic stroke by using machine learning models.

Methods

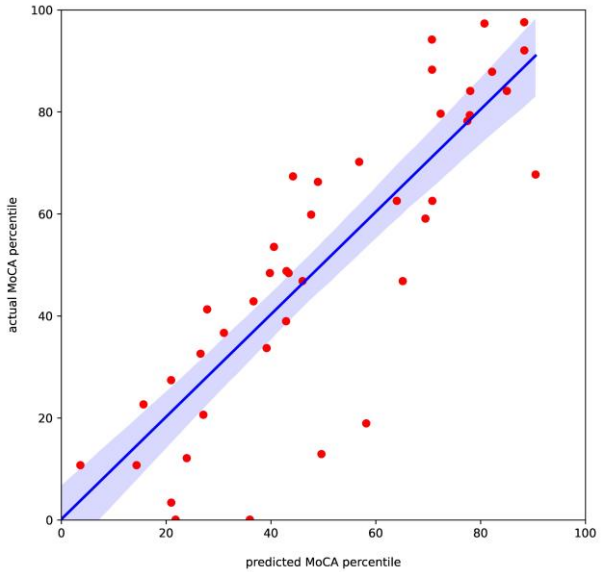
We retrospectively selected 87 ischemic stroke patients who underwent EEG.
The participants underwent Montreal Cognitive Assessment (MoCA) during admission (baseline) and after 3 months.
Source cortical activity was mathematically estimated by using sLORETA. Based on each source power, the functional connectivity between two ROIs was estimated using the iCOH method.
The participants were clustered according to lesion laterality, and then machine learning models were constructed to predict the cognition status of the left- and right-hemispheric lesion groups.

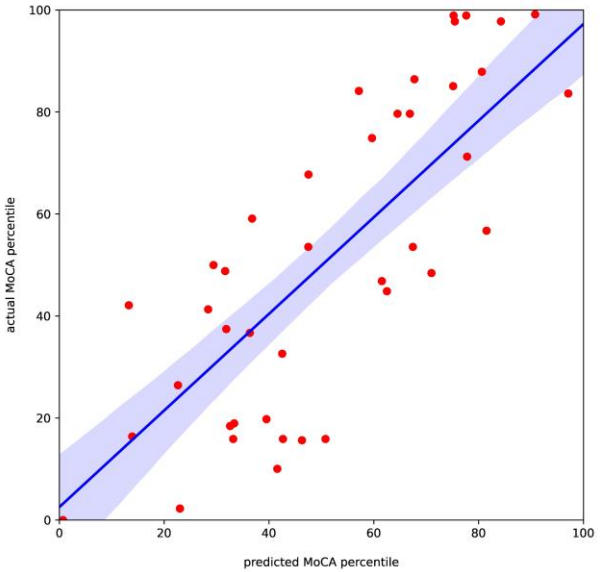
	Number of features	
	Left stroke group	Right stroke group
Frontal lobe	13	13
Temporal lobe	4	2
Parietal lobe	1	1
Occipital lobe	1	3
Isthmus	1	0
All	0	1

	Number of features	
	Left stroke group	Right stroke group
Delta	1	2
Theta	10	1
Alpha1	1	2
Alpha2	5	4
Beta1	2	4
Beta2	1	6
Beta3	0	0
Gamma	0	1

Results

The model predicting lesion laterality showed 96.97% accuracy.
The calculated R-squared of the two regression models which predicted the MoCA score were 0.7588 and 0.6458 for the left and right stroke groups, respectively.
Both models for left and right stroke groups selected from the frontal lobe.
Especially, most of features were selected from theta band in case of left stroke group.





Conclusions

The network attributes evaluated through machine learning-based EEG analysis is seemingly a major predictor of post-stroke cognitive function.
EEG in the acute stroke patients might be adopted to predict cognitive prognosis three months post-stroke.

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References

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