

Letter to the Editor

All Factors Influencing Microstate Changes in Stroke Patients must be Taken into Account before the Stroke is Blamed as the Only Determinant

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Academic Editor: Bettina Platt

Submitted: 17 November 2024 Revised: 28 December 2024 Accepted: 10 January 2025 Published: 29 July 2025

Keywords: ischemic stroke; microstate analysis; power spectrum analysis; resting-state EEG; transition probabilities

We read with interest the article by Lu *et al.* [1] regarding microstate changes in stroke patients that are assessed by extracting transition probabilities from resting electroencephalogram (EEG). The transition probabilities were correlated positively with the Fugl-Mayer Assessment (FMA) and the Action Research Arm Test (ARAT) scores [1]. The analysis of the microstates revealed that the 19 stroke patients showed a reduced occurrence of microstate A (sensorimotor network), and that the transition probability from microstate A to D correlated positively with the FMA [1]. The authors concluded that stroke patients exhibit abnormal temporal dynamics of cerebral activity [1]. The study is interesting, but some points should be discussed in more detail.

First, the electrical activity of the cortex can be highly dependent on the location and volume of the stroke [2]. Subcortical strokes can produce a completely different resting EEG pattern from strokes that involve the cortex. Brainstem strokes may present completely differently on the resting EEG from supratentorial strokes involving the cortex. Also, the extent of the stroke nucleus can strongly influence the cortical electrical activity [3].

Second, whether only patients with an ischemic stroke or also with a hemorrhagic stroke were included, was not mentioned. If patients with hemorrhagic stroke were also included, whether the hemorrhage was accompanied by edema or not should be mentioned, because the degree of perifocal edema can strongly influence cortical electrical activity [4]. It is also important to know how many patients with hemorrhagic stroke had or did not have intraventricular intrusion.

Third, the latency between the acute stroke and the EEG recordings was not measured, or was not included in the analysis. The cortical electrical activity may strongly depend on the “age” of the stroke [5]. The “older” the stroke, the more likely it is that cortical activity, and thus

EEG activity, will recover. Electrical activity may also depend on the response to stroke rehabilitation. Patients who have full functional and structural recovery may be associated with normal electrical activity, compared to patients who do not fully recover. Therefore, the final outcome of the 19 patients must be included in the analysis.

Fourth, a previous stroke was an exclusion criterion, but the exclusion was based on history only, suggesting that patients with a previous subclinical stroke on imaging were included in the study. This issue should be clarified.

Fifth, stroke may be manifested not only by limb weakness but also by dysarthria, aphasia, or dysphagia. However, the FMA does not record and assess these features, which is why the severity of the deficits may have been misclassified. Furthermore, the ARTA test is inadequate to assess the bulbar symptoms of stroke patients.

Sixth, patients taking anti-seizure and antipsychotic drugs were excluded, but not patients taking sedatives or hypnotics. Since the latter can greatly reduce cortical activity at rest, we should know how many of the patients suffered from insomnia, anxiety, or depression, and required appropriate medication. Those patients also need to be excluded from the analysis.

Overall, this interesting study has significant limitations that put the results and their interpretation into perspective. Addressing these limitations could strengthen the conclusions and support the message of the study. Microstate changes in stroke patients may depend not only on stroke but also on various other influencing factors that need to be excluded before final conclusions about microstate changes in stroke patients can be drawn.

Author Contributions

JF was responsible for the design and conception, discussed available data with coauthors, wrote the first draft, and gave final approval. JGM: contributed to literature



search, discussion, correction, and final approval. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

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