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Data-driven clustering of neurodegenerative diseases based on EEG spectrum power-law decay: the DaCNES Study

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Background: Neurodegenerative diseases are common causes of impaired mobility and cognition in the elderly. Among them, tauopathies (including Alzheimer's Disease, Progressive Supranuclear Palsy and Corticobasal Degeneration) and α-synucleinopathies (including Parkinson's Disease and Multiple System Atrophy) were considered. The neurodegenerative processes and relative differential diagnosis were addressed through a qEEG non-linear analytic method.

Objectives: To test accuracy of the power law exponent β applied to EEG in differentiating neurodegenerative diseases and to explore differences in neuronal connectivity among different neurodegenerative processes based on β.

Methods: N = 230 patients with a diagnosis of tauopathy or α-synucleinopathy and at least one artifact-free EEG recording were selected. Welch's periodogram was applied to signal epochs randomly chosen from continuous EEG recordings. Power law exponent β was computed as minus the slope of the power spectrum versus frequency in a Log-Log scale. A data-driven clustering based on β values was performed to identify independent subgroups.

Results: In bilateral frontal-temporal regions, β index values were significantly higher for Parkinson's Disease with respect to the atypical parkinsonisms; in parietal areas, differences remained significant only for Progressive Supranuclear Palsy and Corticobasal Degeneration. Data-driven clustering based on β differentiated tauopathies (overall lower β values) from α-synucleinopathies (higher β values) with high sensitivity and specificity. Tauopathies also presented lower values in the correlation coefficients matrix among frontal sites of recording.

Conclusions: Statistically significant differences in β index values were found between tauopathies and α-synucleinopathies. Hence, β index is proposed as a possible biomarker of differential diagnosis and neuronal connectivity.