Individualized Brain Radiomics-Based Network Tracks Distinct Subtypes and Abnormal Patterns in Prodromal Parkinson's Disease

Abstract:

Individuals in the prodromal phase of Parkinson's disease (PD) exhibit significant heterogeneity and can be divided into distinct subtypes based on clinical symptoms, pathological mechanisms, and brain network patterns. In this study, we aimed to identify the subtypes of prodromal PD using the brain radiomics-based network and examine the unique patterns linked to the clinical presentations of each subtype. To achieve these, individualized brain radiomics-based network was constructed for normal controls (NC; $N=110$), prodromal PD patients ($N=262$), and PD patients ($N=108$). Data-driven clustering approach using the radiomics-based network was carried out to cluster prodromal PD patients into two subtypes. Then, the dissociated patterns of clinical manifestations, anatomical structure alterations, and gene expression between these two subtypes were evaluated. Clustering findings indicated that one prodromal PD subtype closely resembled the pattern of NCs (N-P; $N=159$), while the other subtype was similar to the pattern of PD (P-P; $N=103$). Significant differences were observed between the subtypes in terms of multiple clinical measurements, neuroimaging for morphological changes, and gene enrichment for synaptic transmission. Identification of prodromal PD subtypes based on brain connectomes and a full understanding of heterogeneity at this phase is essential for early and accurate PD diagnosis and effective neuroprotective interventions.