Brain network approach to cognition and neurodegenerative diseases

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The brain is a network composed of neuronal connections. Its network properties have been explored to study cognitive functions as well as for investigating brain disorders. Tau and amyloid-ß, two key pathogenic proteins in Alzheimer’s disease (AD) have been reported to propagate transneuronally through the brain network as the disease progresses. It is thus assumed that the propagation and the distribution of pathogenic proteins can be predicted using the brain network. We aimed to predict the distribution of tau and amyloid-ß in the brain of patients with AD, using a transneuronal propagation model. Patients with AD who underwent resting-state functional MRI, diffusion tensor imaging, and PET with tau and amyloid tracer were analyzed. Using the brain network, we developed a transneuronal propagation model under the hypothesis that pathogenic proteins propagate to and accumulate in regions at a short path length from their regions of origin or of prior accumulation and demonstrated that this model predict well the distribution of the tan and amyloid-ß. These findings indicate that transneuronal propagation is valid in a large and complex network. Since transneuronal propagation is considered a general process of neurodegenerative disease progression, the present approach can be applied to other neurodegenerative diseases. In addition, quantifying the cognitive reserve and exploring genetic polymorphism for precision medicine in AD.