Physiology of MPTP tremor

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Abstract:

Rhesus and vervet monkeys respond differently to treatment with 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine hydrochloride neurotoxin (MPTP). Both species develop akinesia, rigidity, and severe postural instability. However, rhesus monkeys only develop infrequent, short episodes of high-frequency tremor, whereas vervet monkeys have many prolonged episodes of low-frequency tremor. After MPTP treatment, the spiking activity of many pallidal neurons became oscillatory and highly correlated. Oscillatory autocorrelation functions were dominated by lower frequencies, cross-correlograms by higher frequencies. The phase shift distribution of the oscillatory cross-correlograms of pallidal cells in MPTP-treated vervet monkey were clustered around 0 phase shift, unlike the oscillatory correlograms in the MPTP-treated rhesus monkey, which were widely distributed between 0 degrees and 180 degrees. Analysis of the instantaneous phase differences between tremors of two limbs in the MPTP monkeys and human parkinsonian patients showed short periods of tremor synchronization. We thus concluded that the rhesus and the vervet models of MPTP-induced parkinsonism may represent the tremulous and nontremulous variants of human parkinsonism. We suggest that the tremor phenomena of Parkinson's disease (PD) are related to the emergence of synchronous neuronal oscillations in the basal ganglia. Finally, the oscillating neuronal assemblies in the pallidum of tremulous parkinsonian primates are more stable (in time and in space) than those of parkinsonian primates without overt tremor.

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