

Painting a global picture of basal ganglia network: from past to present!

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Since the 70s it has been thought that basal ganglia integrated sensorimotor, associative and limbic inputs and then projected this information through the thalamus to the motor cortex, supplementary motor area and frontal cortex, thus playing a relevant role in planning movement. Recent literature on basal ganglia networks is going beyond the classical "dogma" of dorsal striatum as the main station for cortical inputs in basal ganglia loops and several neurophysiological studies have suggested a more segregated organization of these neural circuits. In the classical view, various tract-tracing methods combined with immunohistochemistry and in situ hybridization demonstrated that the cortical information flows through the basal ganglia via a dual-network model, based on the "direct" and "indirect" routes. However, in addition to these two major projection systems, a glutamatergic hyper-direct pathway between cerebral cortex and subthalamic nucleus has been demonstrated first in monkeys and then in humans. Furthermore, we have recently shown a i) cortico-pallidal connection; ii) a cerebello-pallidal connection; iii) a cerebello nigral connection [1, 2]. Herein, we extensively examined basal ganglia network of fifteen healthy subjects by using probabilistic constrained spherical deconvolution tractography on magnetic resonance diffusion weighted imaging data and we also performed weighted connectivity analysis for each of the subcortical nuclei. In addition, we demonstrated for the first time tractographic evidences of the existence of a direct cortico-nigral pathway in humans. We found that substantia nigra is connected with cerebral cortex as a whole, with the most representative connections involving prefrontal cortex, precentral and postcentral gyri and superior parietal lobule. These findings would strengthen the hypothesis that the cortico-basal ganglia network consists of several, parallel, segregated, and functionally distinct, but homologous loop, and may be relevant for the comprehension of the pathophysiology of several basal ganglia disorders.

References

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Keywords

Basal ganglia; MR; Network.