Enrico Marani, Tjitske Heida, Egbert A.J.F. Lakke, and Kamen G. Usunoff

The Subthalamic Nucleus
Part I: Development, Cytology, Topography and Connections

With 29 Figures

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Enrico Marani  
Tjitske Heida  
Department of Biomedical Signals and Systems,  
University of Twente,  
7500 AE Enschede  
The Netherlands  
e-mail: e.marani@utwente.nl  
e-mail: t.heida@el.utwente.nl  

Egbert A.J.F. Lakke  
Department of Neurosurgery,  
Leiden University Medical Centre,  
2300 RC Leiden  
The Netherlands  

Kamen G. Usunoff  
Department of Anatomy & Histology,  
Medical University Sofia,  
1431 Sofia  
Bulgaria  
e-mail: uzunoff@medfac.acad.bg
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Abstract

This monograph (Part I of two volumes) on the subthalamic nucleus (STN) accentuates the gap between experimental animal and human information concerning subthalamic development, cytology, topography and connections. The light and electron microscopical cytology focuses on the open nucleus concept and the neuronal types present in the STN. The cytochemistry encompasses enzymes, NO, glial fibrillary acidic protein (GFAP), calcium binding proteins, and receptors (dopamine, cannabinoid, opioid, glutamate, γ-aminobutyric acid (GABA), serotonin, cholinergic, and calcium channels). The ontogeny of the subthalamic cell cord is also reviewed. The topography concerns the rat, cat, baboon and human STN. The descriptions of the connections are also given from a historical point of view. Recent tracer studies on the rat nigro-subthalamic connection revealed contralateral projections. Part II of the two volumes (volume 199) on the subthalamic nucleus (STN) starts with a systemic model of the basal ganglia to evaluate the position of the STN in the direct, indirect and hyperdirect pathways. A summary of in vitro studies is given, describing STN spontaneous activity as well as responses to depolarizing and hyperpolarizing inputs and high-frequency stimulation. STN bursting activity and the underlying ionic mechanisms are investigated. Deep brain stimulation used for symptomatic treatment of Parkinson’s disease is discussed in terms of the elements that are influenced and its hypothesized mechanisms. This part of the monograph explores the pedunculopontine–subthalamic connections and summarizes attempts to mimic neurotransmitter actions of the pedunculopontine nucleus in cell cultures and high-frequency stimulation on cultured dissociated rat subthalamic neurons. STN cell models – single- and multi-compartment models and system-level models are discussed in relation to subthalamic function and dysfunction. Parts I and II are compared.