The human pedunculopontine nucleus: a precise anatomical and neurochemical description using immunohistochemistry and stereotaxic approach for DBS implantation

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Introduction

Since the first identification of the pedunculopontine nucleus (PPN) in 1909 by Jacobsohn and its more detailed description later in 1954 by Olszewski and Baxter, the delineation of tegmental structures and their terminologies have been a source of continual confusion. It was then unsurprising that controversies regarding PPN anatomical localization were raised in the neu- rosurgical community when this nucleus became a new promising target for the treatment of freezing of gait by DBS. Particularly worth noting is the marked variation encountered in the literature regarding the site of electrode implantation in the brainstem. Indeed, while all studies report electrode im- plantation in the PPN per se, some suggest a target localized in the caudal midbrain while others advocate an electrode implantation more caudally in the pons. Thus, detailed anatomical and neurochemical data on the human brainstem are deeply needed to clarify the positions of tegmental structures of interest for DBS.

Methods

Here, the application of an immunohistochemical ap- proach for choline acetyltransferase (ChAT), a reliable marker of cholinergic neurons has allowed us to provide a precise anatomical description of the human PPN and surrounding structures in the sagittal plane.

Results

We detected the presence of a dense cluster of ChAT+ neurons that corresponds to the PPN pars compacta lying at the pontomesencephalic junction along the ros- tral surface of the superior cerebellar peduncle. Taking into account the different stereotaxic approaches used in DBS literature, we provided a set of coordinates corresponding to the PPN.

Learning Objectives

To better understand brainstem neuroanatomy in relation to stereotaxic methods for DBS PPN implantation.

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Conclusions

These new immunohistological data obtained from post-mortem material on sagittal plane provide relevant anatomical basis to precisely localize the PPN and its surrounding structures. This allow the reevaluation of the exact position of DBS electrodes already implanted in the so-called PPN while providing a faithful anatomoclinical approach to determine which specific brainstem structures must be targeted to treat gait disorders by DBS.