STRUCTURAL AND FUNCTIONAL ALTERATIONS IN THE OLFACTION SYSTEM ASSOCIATED WITH PARKINSON DISEASE

J. Klucken1, C. Mössnang2,3, J. Kalis4, N. Mallog4, B. Winner5, G. Schuierer4, M. Greenlee2, J. Winkler1

1Division of Molecular Neurology, University Hospital Erlangen, Erlangen, 2Institute for Experimental Psychology, University of Regensburg, Regensburg, 3Department of Psychiatry, Psychotherapy and Psychosomatics, RWTH Aachen University, Aachen, 4Institute of Neuroradiology, University of Regensburg, Regensburg, 5Nikolaus-Fiebiger-Center for Molecular Medicine, University Hospital Erlangen, Erlangen, Germany

Introduction: Olfactory impairment is an important premotor symptom in Parkinson's disease (PD). PD patients are often not aware of their smelling deficiency which requires simple olfactory testing. Neuropathological findings report early degenerative changes in the olfactory bulb (OB) in PD, potentially preceding the conversion into the motor-stage of the disease. Thus, impaired olfaction and associated neuronal changes might serve as a biomarker to identify subjects with an increased risk to develop PD.

Aim: We tested the hypothesis that impaired olfaction in PD is based on degeneration of the OB and dysfunction of primary and higher order olfactory structures resulting in reduced neuronal activity in associated cortical areas.

Methods: Olfactory structures (OB size) and network dysfunctions were assessed by structural and functional event-related MR (fMRI) imaging using air dilution olfactometry in PD patients.

Results: Structurally, we detected reduced OB volumes in PD. fMRI showed an overall hyperactivation of the olfactory network in PD. Interestingly, a preserved ability to discriminate odor in primary olfactory structures was lost in higher ordered olfactory structures. These dysregulated activation patterns in distinct parts of the olfactory network in PD might represent both dysfunctional disinhibition and compensatory up-regulation of neural activity at different levels of olfactory information processing.

Conclusions: Our results propose that impairment of olfactory network function is a dynamic process during the course of PD based on structural pathology and reactive functional changes. Structural and functional information has the potential to serve as diagnostic marker in different stages of PD.