Imaging Psychiatric Disorders in a Multidisciplinary World

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This presentation will illustrate how combining structural MRI and Positron Emission Tomography (PET) imaging, with state-of-the-art resolution and analytical techniques, provides a unique tool to study neurochemical pathways in the living human brain, and to unravel alterations in neurotransmission associated with psychiatric disorders.

The human striatum can be organized into limbic, associative and sensorimotor subdivisions, which process information related to emotional, cognitive and motor function. Dopamine (DA) projections ascending from the midbrain provide important modulatory input to these striatal subregions. PET and MRI were used to study DA transmission and stimulation of DA D_2 receptors following the administration of amphetamine in these functional subdivisions of the human striatum. D_2 receptor availability (V_3") was measured with PET and [^{11}C]raclopride in fourteen healthy volunteers under control conditions and following the intravenous administration of amphetamine (0.3 mg/kg). Anatomical criteria were developed to delineate structural subdivision of the striatum on MRI images. PET images were motion corrected and coregistered to the MRI images. Based on the volume of the subregions measured on the MRI, partial voluming correction was applied to the PET signal. Amphetamine induced a significantly larger reduction in D_2 receptor availability (ΔV_3") in limbic (ventral striatum, -15.3± 11.8%) and motor (postcommisural putamen, -16.2 ± 9.6%) regions compared to associative regions (caudate and precommisural putamen, -8.1 ± 7.2%). This region of interest analysis was then confirmed by a voxel-based analysis. Subjects were also asked to rate their subjective experience following amphetamine, and reported an increase in euphoria which was associated with a greater ΔV_3" in limbic and motor regions, but not in the associative regions. These results demonstrate significant differences in the DA response to amphetamine between the functional subdivisions of the human striatum. The mechanism behind these regional differences in amphetamine-induced DA release remain unclear, but could be related to the pattern of asymmetrical feed forward mediating the integration of limbic, cognitive, and motor function via the DA cell bodies in the ventral midbrain. The implication of these findings for the development of addictions and psychoses will be discussed. The use of this technique to elucidate alterations of DA function in schizophrenia, cocaine abuse and alcoholism will be presented.