

***In vivo* <sup>1</sup>H Spectroscopy of the Caudate Nucleus in Macaca mulatta brain**  
C. JUCHEM<sup>1</sup>, M.A. AUGATH<sup>1</sup>, H. MERKLE<sup>2</sup>, N.K. LOGOTHETIS<sup>1</sup>, AND  
J. PFEUFFER<sup>1</sup>

<sup>1</sup>Max Planck Institute for Biological Cybernetics, Tübingen, Germany

<sup>2</sup>Laboratory of Functional and Molecular Imaging, NIH/NINDS, Bethesda, MD.

## INTRODUCTION

The neostriatum is important for the control of movement and certain cognitive functions [1]. Loss of striatal neurons or degeneration of the dopaminergic nigrostriatal pathway leads to devastating neurologic disorders. Recent studies about the reduction of Parkinson symptoms in primats [2,3] demonstrate the value of *in vivo* study of striatal neurochemistry.

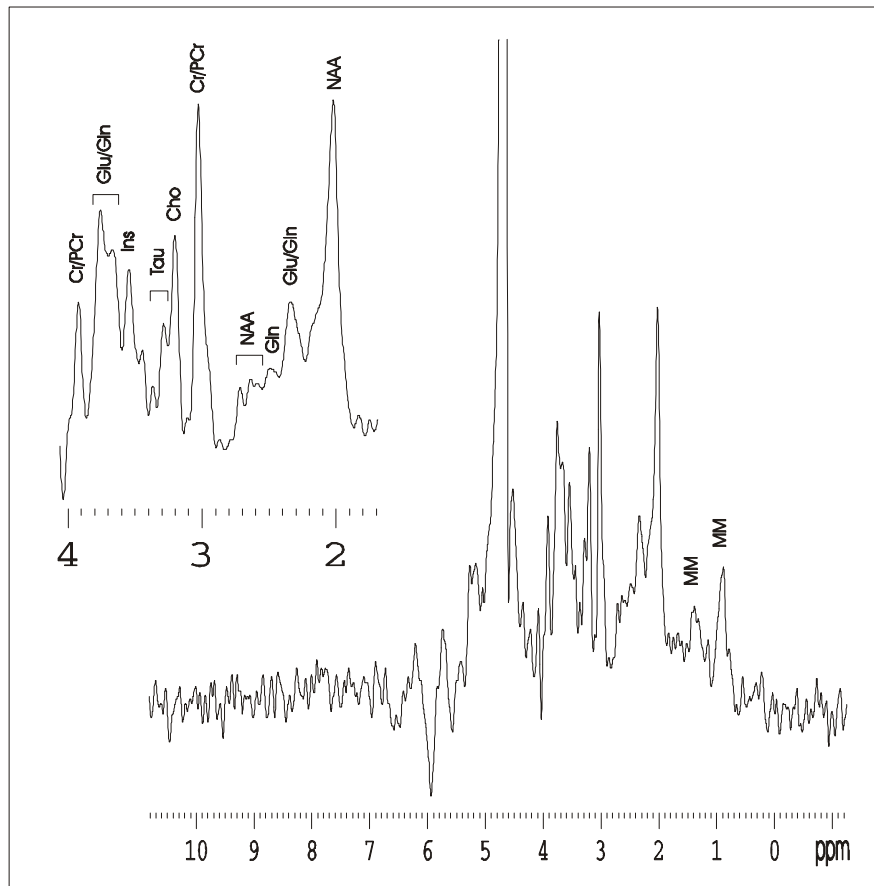
Here we present a pilot MRS study in monkeys, in which we conducted *in vivo* measurements of metabolite concentrations of a 0.7cc voxel positioned in the caudate nucleus of a macaque monkey. Our general aim is to combine this methodology with other invasive techniques, such as microdialysis or electrophysiology in order to couple the macroscopic changes visualized with MRS with their underlying neurophysiological events.

## METHODS

Measurements were made on a *vertical* 4.7T/40cm Bruker Biospec scanner. A custom-made saddle coil of 110mm diameter was used for anatomical scout images and for the spectroscopic studies [4]. Shimming with FASTMAP led to a water line width of 11 Hz in the voxel. A STEAM sequence with TE=10ms, TM=10ms, TR=4s and NR=256 was used for localized spectroscopy. Water suppression was achieved by 3 CHESS pulses. Only zero order phase correction was done. A reference water signal was used for eddy current compensation and absolute spectral quantification of the metabolites. The special monkey handling including the anesthesia and the positioning within the magnet by a special hoist has been described elsewhere [5]. Spectra were acquired from a 9x9x9mm<sup>3</sup> voxel centered dorsal on the left caudate nucleus.

## RESULTS

The <sup>1</sup>H metabolite spectrum at a short TE of 10ms is shown in the figure, demonstrating a good baseline definition and no fat contamination from the outer volume. The major metabolites (even strongly coupled ones) were assigned and quantified: NAA (11mM), glutamate/glutamine (Glu/Gln,15mM), choline-containing compounds (Cho,3mM), myo-inositol (Ins,8mM), creatine/phosphocreatine (Cr/PCr,12mM) Macromolecular resonances (MM) contribute broad peaks at 0.9 and 1.4ppm and underlying the metabolites between 2-4ppm might lead to overestimated concentrations.



## DISCUSSION

The employed anesthetized-monkey setup permits, compared to human studies, data acquisition under optimally stable physiological conditions for several hours without the usual motion artifacts and instabilities. Due to the smaller monkey head, a smaller magnet bore and, thus, a higher magnetic field of  $>4.7\text{T}$  can be used resulting in enhanced sensitivity. The combination of MRS with other invasive techniques finally leads to a capacious description of neurophysiological events.

- [1] *Curr. Biol.* 10, 509 (2000)
- [2] *Brain* 123, 1380 (2000)
- [3] *Brain Research Reviews* 36, 222 (2001)
- [4] *MAGMA* 8, 532 (1999)
- [5] *Nature Neurosci.* 2, 555 (1999)