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Longitudinal follow-up of brain metabolism in rat models of progressive Parkinson's disease using Magnetic Resonance Spectroscopy Imaging.

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Purpose / Introduction

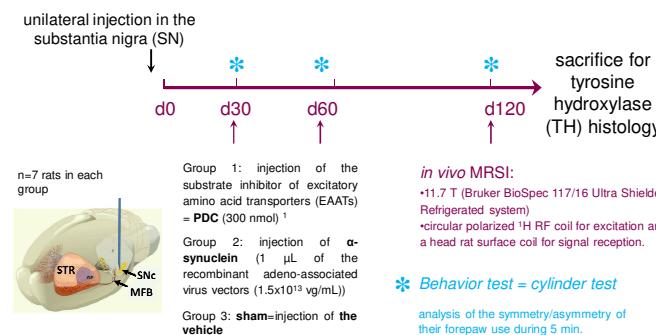
Parkinson's disease (PD) is characterized by: **i)** selective and progressive loss of nigral dopamine (DA) neurons, **ii)** unilateral to bilateral evolution pattern and **iii)** late appearance of motor deficits ($\geq 50\%$ of DA neurons have degenerated).

The development of animal models mimicking these features has opened new possibilities to study the disease's evolution. Here, longitudinal **magnetic resonance spectroscopy imaging** was used to **follow up metabolites distribution** in key basal ganglia components in two rat models of progressive PD.

Objective: provide novel insights onto the pathological alterations associated with the progression of the neurodegenerative process.

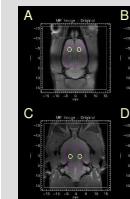
Subjects and Methods:

❖ Experimental design:



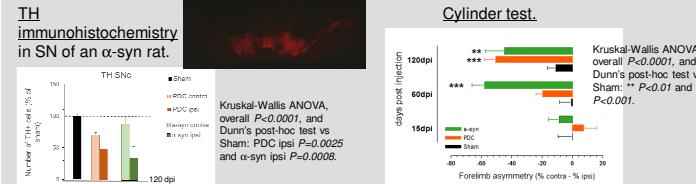
❖ NMR experiments:

- Coronal images = fast spin echo T_2 -weighted RARE; 256x256; 2 mm slice thickness
- MRSI acquisition = CSI with a semi-LASER voxel volume selection (dimensions in mm: FOV 32x32x2, voxel size = 10x10x2, image size = 20x20, resolution = 1.6x1.6x2, TR = 2000ms, TE = 24ms, VAPOR for water suppression).

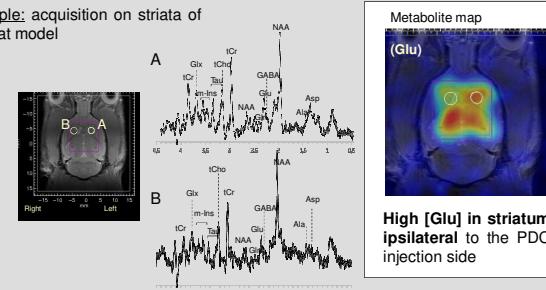


T2 coronal MRI slices covering the motor cortex (Cx), the dorsal striatum (STR), subthalamic nucleus (STN) and substantia nigra (SN) in A, B, C and D respectively.
CSI voxels are in purple. Yellow circles are voxels for each structure at right and left.

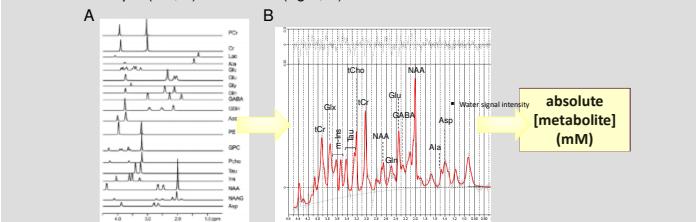
Results



MRSI example: acquisition on striata of a PDC PD rat model

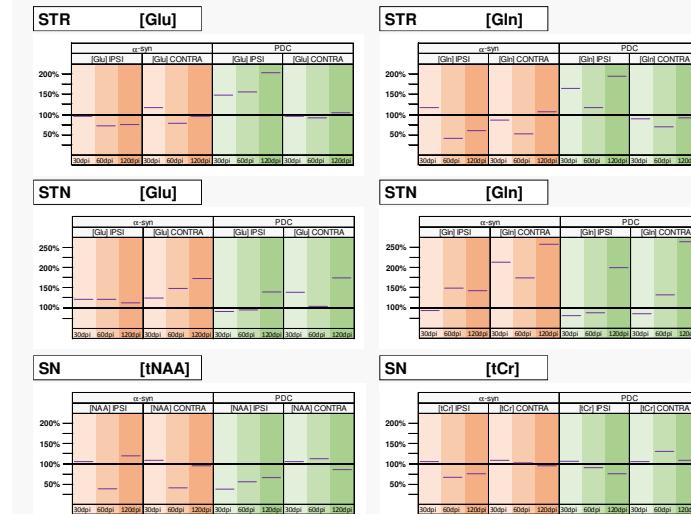


MRSI data are processed under CSIAPo². A metabolite map is generated. Spectra from ipsi (left, A) and contra (right, B) striata of the side of lesion are extracted.



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Illustration of the evolution of selected metabolite concentrations (as % of SHAM):



Conclusions

- MRSI = useful technique for **longitudinal characterization of metabolite profiles** in animal models of PD.
- specificities** of the neurochemical changes within key basal ganglia components in the two PD rat models: the well-established α -synuclein and a new one, the PDC model.
- Uni- to bilateral progression of neurodegeneration in the PDC model: involvement of the **subthalamic nucleus contralateral** to the PDC injection side.

- Assous et al. Neurobiol. 2014;65:69-81
- Le Fur et al. Magn Reson Mater Phy. 2010;23(1):23–30.
- Provencher. Magn Reson Med. 1993;30(6):672–679.