Advanced pre-clinical MR imaging and spectroscopy at 4.7T

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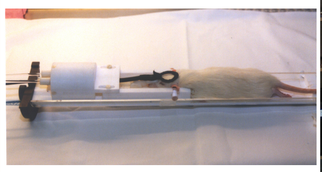
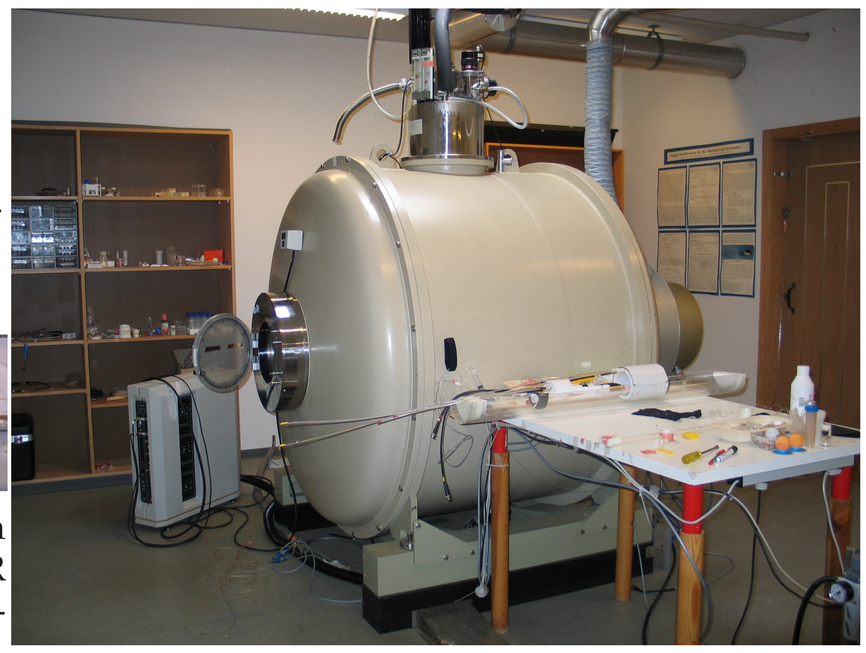
Introduction

Magnetic resonance imaging and spectroscopy can provide detailed information about the structure and function of most parts of the body. A multitude of imaging methods can be used to obtain images with different kinds of contrast based on the characteristics of the imaged tissue. The MR department at Hvidovre Hospital houses a pre-clinical MR system which has been in use since 1988. The system operates at 4.7 T and has been recently upgraded to provide an advanced pre-clinical MR scanner suitable for a variety of applications.

The 4.7 T magnet has an inner bore diameter of 15.4 cm which makes it ideally suited for magnetic resonance imaging of small animals such as rats and mice.

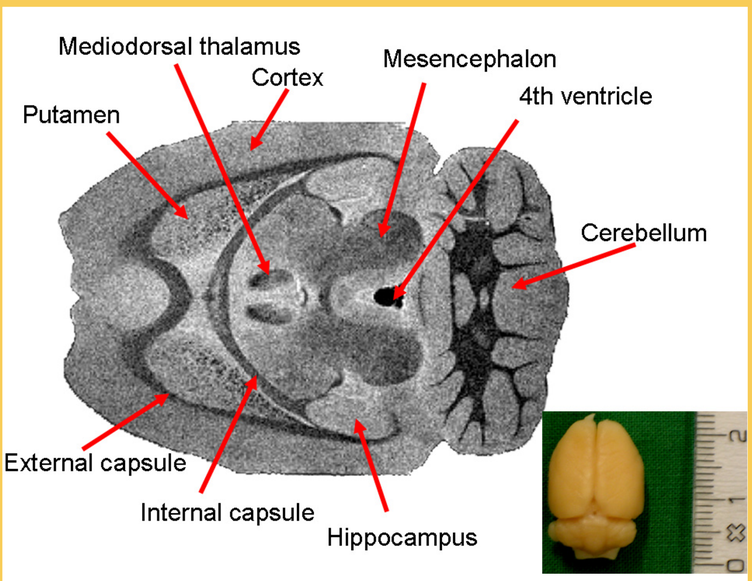


Rat positioned with a surface coil for MR imaging and spectroscopy.

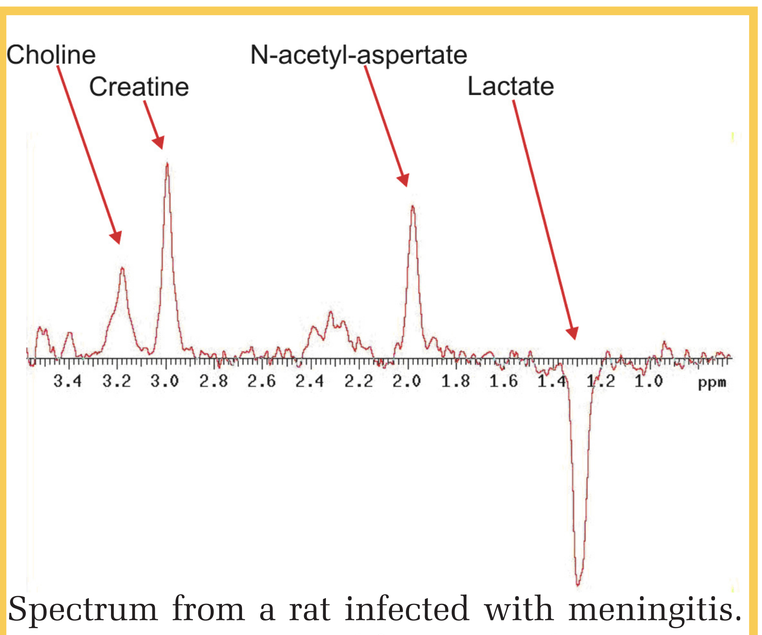


Ongoing work

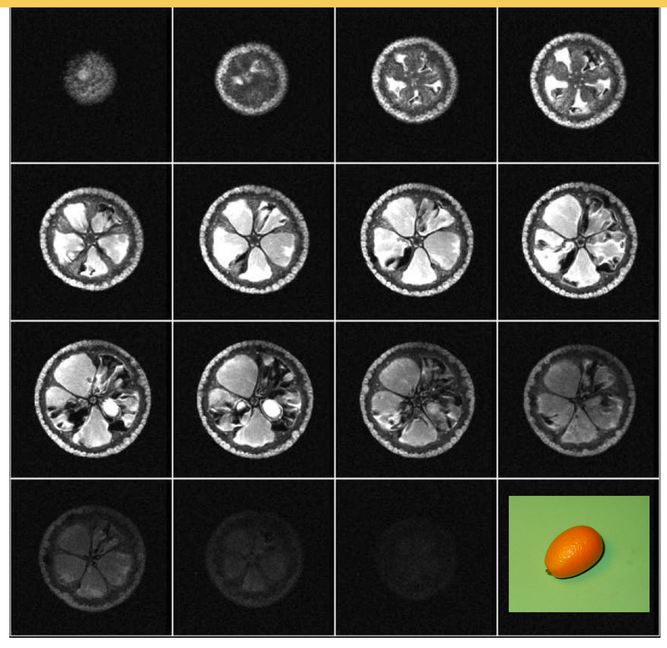
The group continues to develop and improve imaging and spectroscopy methods. A few applications are illustrated here.



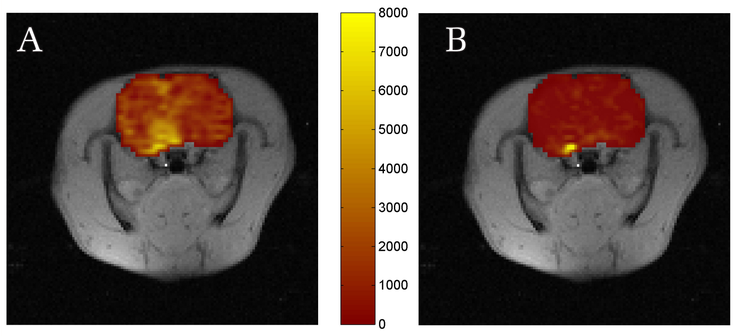
3D MR image of a post mortem rat brain showing microscopic anatomical structure.



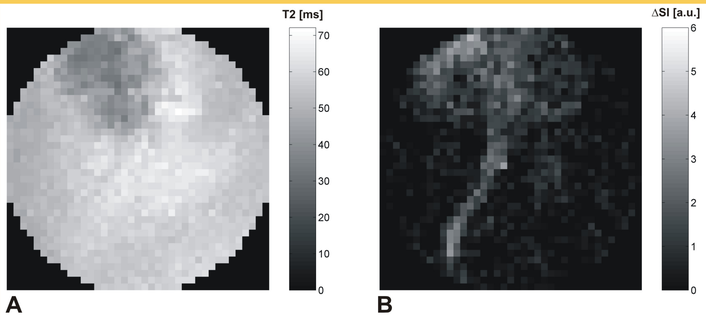
Spectrum from a rat infected with meningitis. The spectrum acquired from a voxel 3x3x3 mm^3 clearly shows increased lactate.



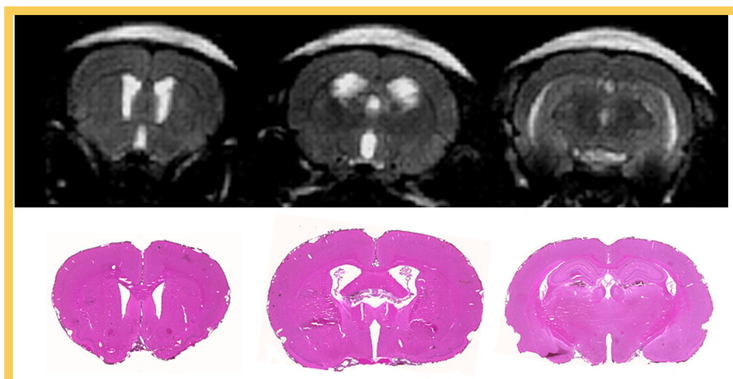
In order to test the system capabilities after the upgrade a range of fruits and vegetables were scanned, in this case a kumquat.



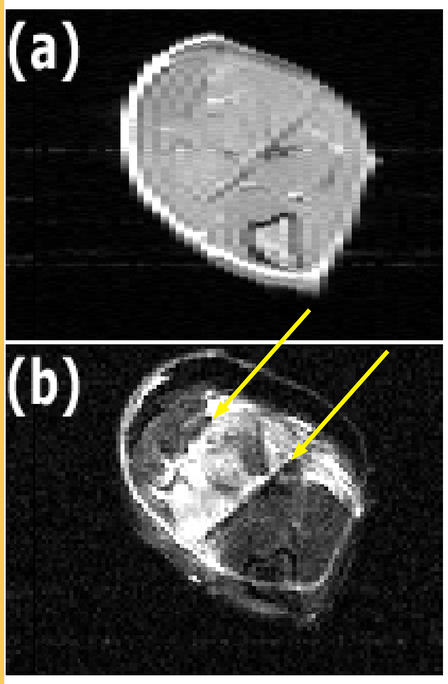
Perfusion weighted EPI images of a rat brain overlaid on anatomical images before (A) and after (B) sacrifice. Pulsed arterial spin labeling (ASL) was performed using the Flow-sensitive Alternating Inversion Recovery (FAIR) method.



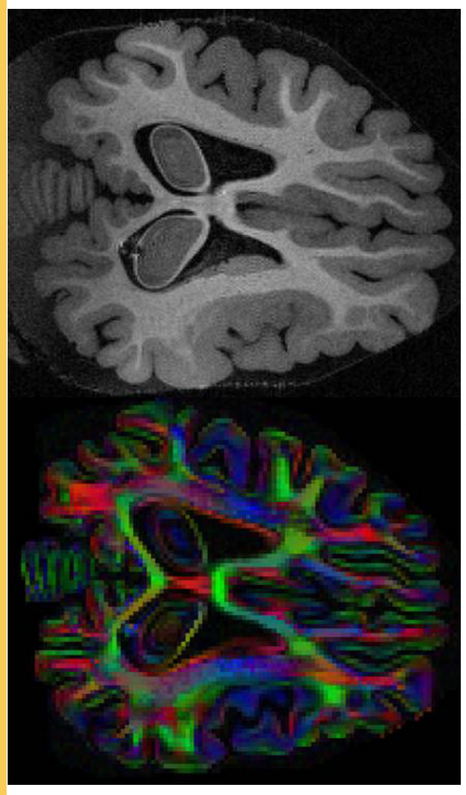
Images of a Matrigel angiogenesis assay implanted under the skin in a mouse. Fitted T2 values after injection of an iron-oxide contrast agent (A). Difference-image between T2*W images acquired before and after injection of the contrast agent highlighting perfused areas (B).



T2W MR images and matching histological slices of a rat infected with meningitis showing hydrocephalus.



T1W (a) and T2W (b) images acquired 80 minutes after electroporation of a rat leg muscle. Note the hyperintensity in (b) between the needles indicative of edema. The arrows indicate a needle track.



Anatomical image from a perfusion fixed pig brain together with the corresponding diffusion tensor image calculated from diffusion weighted images acquired using 61 diffusion sensitizing directions.

Conclusion:

The pre-clinical scanner is used within a wide range of projects. MR methods may be applied as a diagnostic tool and to study the effect of differing therapeutic strategies. The possibility of repeated studies on the same animal minimizes the number of research animals used. The pre-clinical work aims at developing methods that may ultimately be used in the clinic.

Acknowledgements

The images on this poster are the result of research projects carried out by the pre-clinical group together with internal and external collaborators from a number of institutions within the Copenhagen area.