COMPARATIVE *IN VIVO* MAGNETIC RESONANCE IMAGING ANALYSES OF THE HIPPOCAMPAL FORMATION AND WHOLE BRAIN

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Introduction

- **Magnetic Resonance Imaging (MRI) is increasingly being utilized to obtain *in vivo* brain imaging data for 3-dimensional visual assessment of anatomy/pathology as well as quantifiable data parameters in a fast, non-invasive approach.**
- **Hippocampal formation and whole brain volumes are one of the most frequently measured parameters.**
- **Performing MR imaging and assessment of such parameters in the research setting in animal models is complex and challenging.**
- **We aimed to describe the technical sequence modifications done to specific MR imaging sequences to fit different animal models for the assessment of hippocampal and whole brain volumes.**

Methods

Scanning

- **Brain imaging of the following animal models was performed on a Siemens 3T Magnetom Verio MRI scanner at the Texas A&M Institute for Preclinical Studies (image shown right): rat, pig, dog and whale fetus specimen.**

- **3-dimensional T2-weighted scan sequences as well as fluid attenuated inversion recovery (FLAIR) imaging and diffusion tensor imaging were performed using either the 15 channel knee coil or the 32 channel body coil.**

Image Processing & Analysis

- **Images were processed and viewed on a Siemens Syngo MRI workstation, Osirix Dicom viewer. Region-of-interest volumetry measurements were done utilizing Siemens Inveon Research Workplace software**

Scan Parameters

	Field of View (mm)	Repetition time (TR) in ms	Echo time (TE) in ms	Resolution	Voxel size (mm)
Rat	64 x 52	3610	Dual (27, 123)	256 x 205	0.3 x 0.3 x 1.5
Pig	160 x 160	3200	312	256 x 256	0.6 x 0.6 x 0.6
Dog	200 x 200	5000	82	256 x 256	1.0 x 1.0 x 2.3
Whale fetus specimen	377 x 240	7160	101	256 x 256	2.0 x 2.0 x 2.2

Table 1. Comparison of MRI scan parameters used in the different T2-weighted sequences used to scan the different animal models.

Rat Brain Imaging

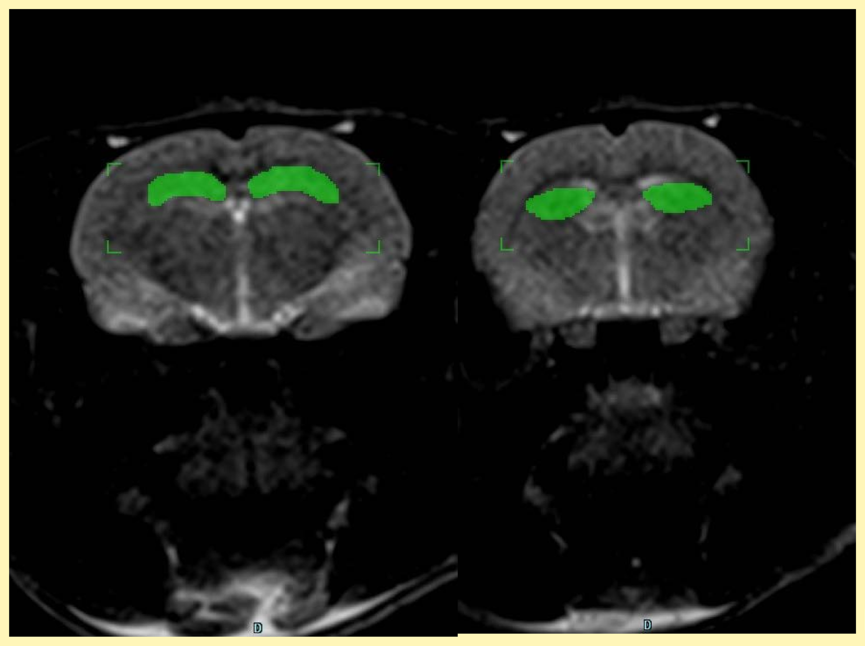

Fig 1. Stacked axial images of the rat brain. The green areas mark out the hippocampal formation.

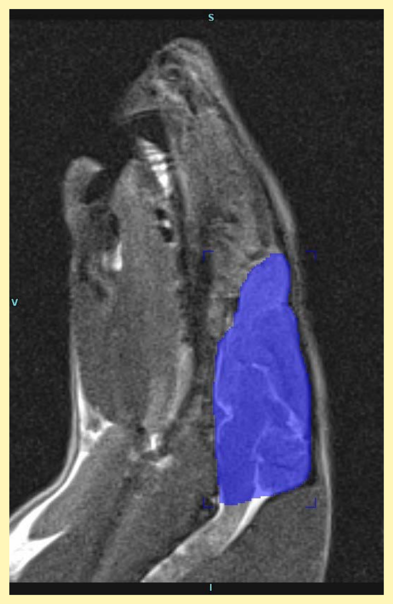

Fig 2. Sagittal image of the rat brain. The blue areas mark out the region of interest used to derive the whole brain volume.

Pig Brain Imaging

Fig 3. Axial image of the pig brain. The blue areas mark out the hippocampal formation.

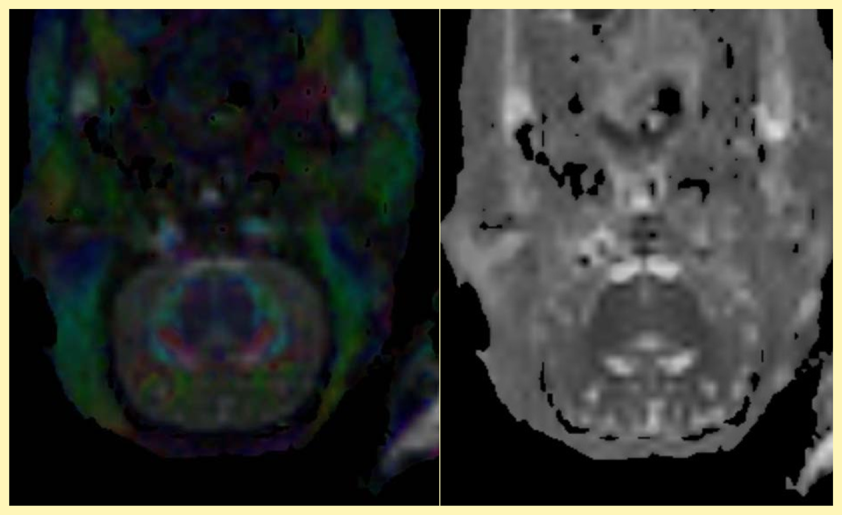

Fig 4. Fractional Anisotropy (FA) and Apparent Diffusion Coefficient (ADC) maps derived from Diffusion Tensor imaging of the pig brain.

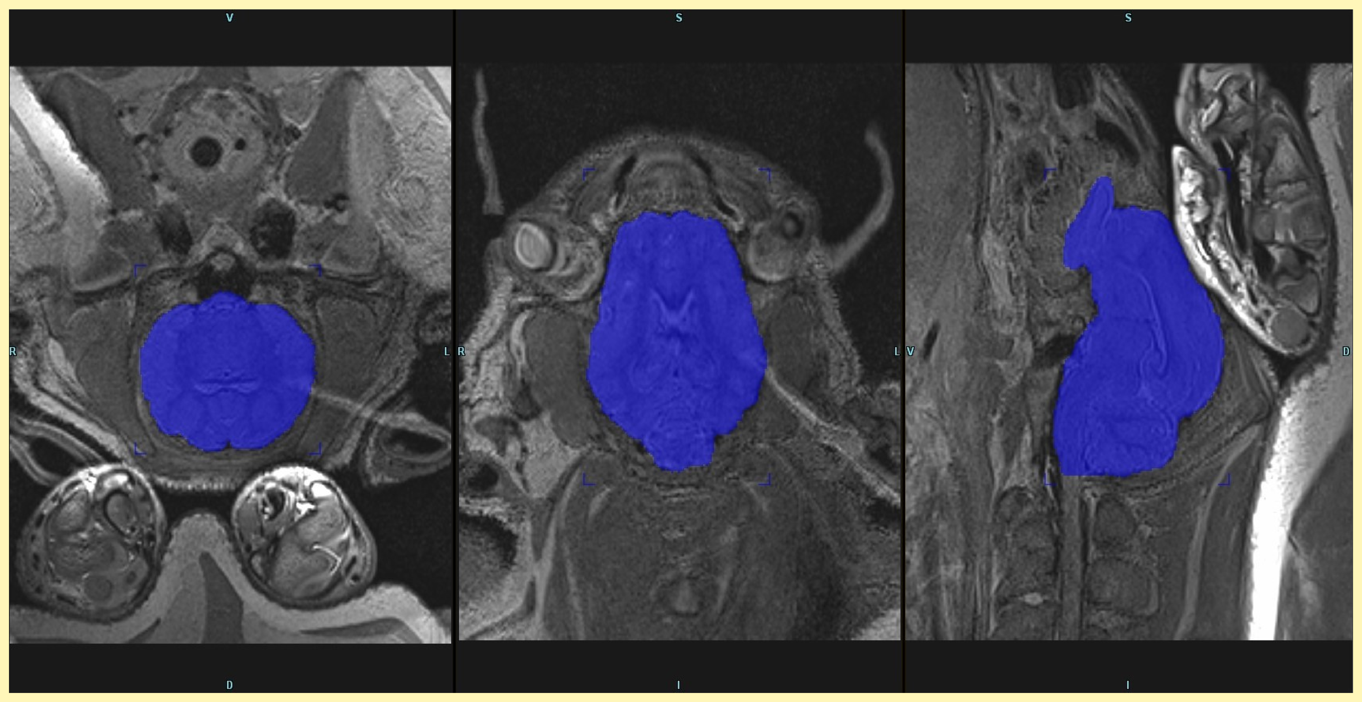

Fig 5. Axial, coronal and sagittal images of the pig brain. The blue areas mark out the region of interest used to derive the whole brain volume.

Hippocampal and Whole Brain Volumetry

	Mean hippocampal volume (mm^3)	SEM	Mean whole brain volume (mm^3)	SEM
Rat	79.3	15.7	2720.2	54.0
Pig	591.8	16.4	80669.8	24.0
Dog	1425.7	127	110200	205

Table 2. Average volumes of the hippocampal formation and whole brain (inclusive of olfactory bulb and cerebellum) in the different animal models.

Dog Brain Imaging

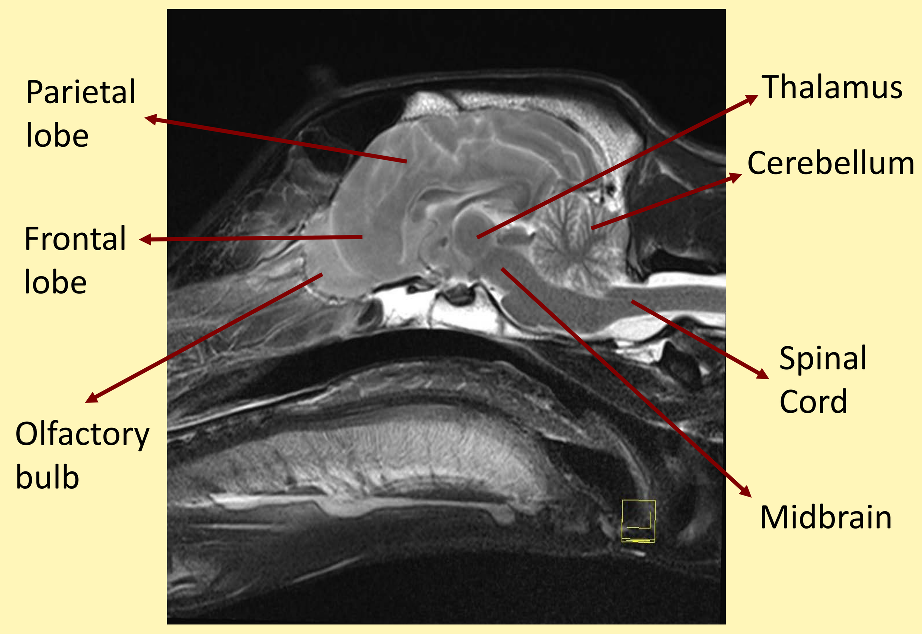

Fig. 6. T2-weighted sagittal image of the dog brain labelled with important anatomical structures.

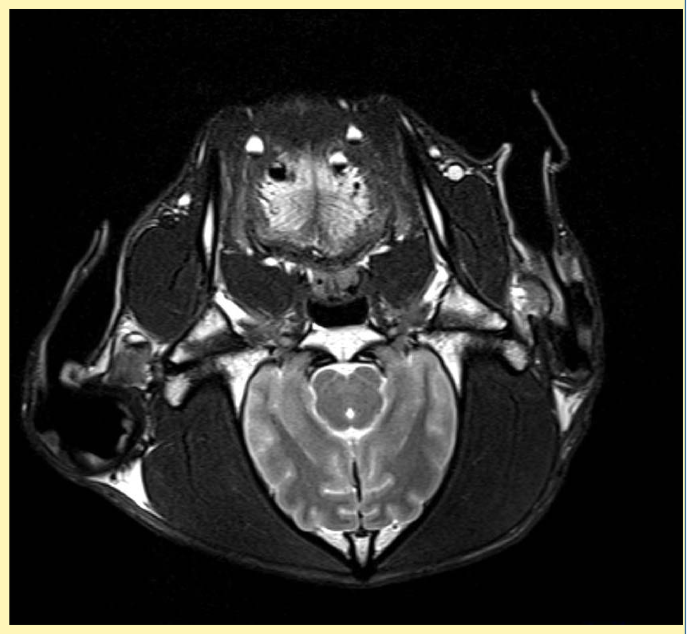

Fig. 7. T2-weighted axial image of the dog brain at the level of the midbrain.

Specimen Brain Imaging – Whale Fetus

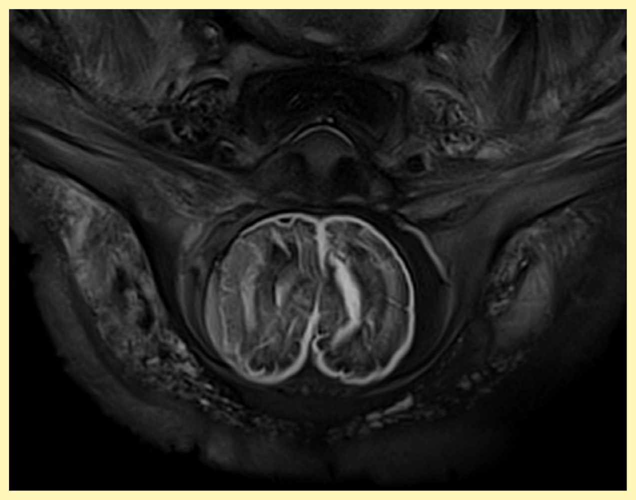

Fig. 8. 2-dimensional axial image of the whale fetus brain specimen at the level of the corpus callosum.

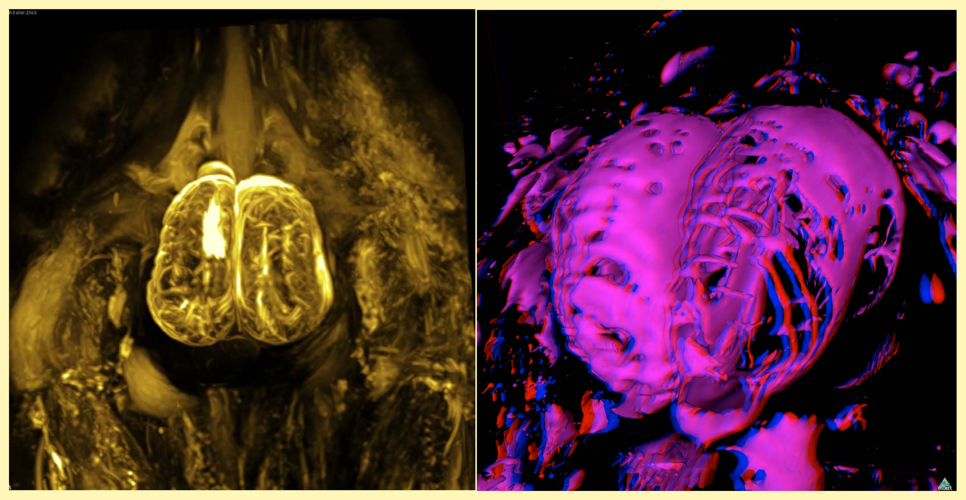

Fig. 9 and 10. Different types of 3-dimensional reconstructed images of the whale fetus brain specimen. The image in yellow is just above the level of the corpus callosum. The image in pink clearly demonstrates the gyri and sulci of the cerebral lobes.

Perspectives and Significance

1. Our data supports previous observations that study sequences typically used in human brain imaging can be modified to perform *in vivo* imaging in different animal models while attaining superior image resolution.

2. Our study also demonstrates that the hippocampal formation and whole brain volumes can be measured in different animal models utilizing a standardized region-of-interest image analysis approach.

3. This imaging approach can be applied to various animal models to study the etiology of several neurological conditions including Alzheimer's disease, Parkinson's disease, stroke and epilepsy, and even substance abuse and head trauma.

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Contact

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