In Vivo Subcellular MR Spectroscopy and MR Imaging of *Xenopus laevis* Ooctye and Embryo

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In vivo magnetic resonance (MR) spectra are typically obtained from voxels which spatial dimensions far exceed those of the cells they contain [1]. This study was designed to evaluate the potential of localized MR spectroscopy to investigate sub-cellular phenomena. Using a high magnetic field and a home-built microscopy probe with large gradient field strengths, we achieved voxel sizes of $(180\ \mu m)^3$.

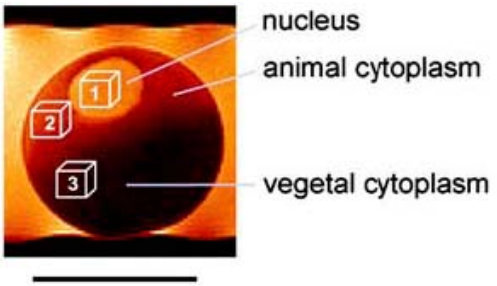

Figure: High-resolution MR image of oocyte. Scale bar, 1mm. Isotropic voxels of $(180\ \mu m)^3$ were selected for MRS.

In the large oocytes of the frog *Xenopus laevis*, the voxel size is small enough to allow the recording of the first compartment-selective in vivo MR spectra from the animal and vegetal cytoplasm as well as the nucleus. We also used localized spectroscopy to monitor the uptake of diminazene aceturate, an anti-trypanosomal agent, into compartments of a single living oocyte. The resulting spectra from the nucleus and cytoplasm revealed different uptake kinetics for the two components of the drug.

And, by applying high field MR microscopy to the *Xenopus laevis* system, we achieved the high temporal and spatial resolution required for observing subcellular dynamics during early cell divisions *in vivo*. Previously reported *in vivo* studies did not cover the very early embryonic stages, mainly for sensitivity reasons [2]. We present image series of dividing cells and nuclei and of the whole embryonic development from the zygote onto the hatching of the tadpole. Additionally, biomechanical analyses from successive MR images are introduced. These results demonstrate that MR microscopy can provide unique contributions to investigations of differentiating cells and tissues *in vivo*.

[1] S.C. Grant, N.R. Aiken, H.D. Plant, S. Gibbs, T.H. Mareci, A.G., Webb, and S.J. Blackband, “NMR spectroscopy of single neurons”, *Magn. Reson. Med.* **44,** 19–22 (2000).
[2] S.F. Gilbert, Developmental biology. 7th edition. (Sinauer Associates Inc., Sunderland. 2003).