Microsurface Coil MR Microscopy of *Aplysia* Neurons with Direct Histological Correlation

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Introduction

MR microscopy has evolved from images of large cells (frog ova, (2)) through smaller cells (*Aplysia* neurons (2)), until recently when the first mammalian cells were imaged (3). Although mammalian cell imaging is feasible, scan times are long on these small cells, and the cell nucleus has yet to be visualized. Thus studies of larger cells still have a role in MR studies for interrogating the cellular origins of signal changes in MRI. In this study we explore the use of microsurface coils to improve resolution and scan times, and through the use of fixed and sectioned cells, for the first time obtain a direct correlation between histology and MRM. Further, we have investigated the effect of techniques that do or do not digest the satellite cells surrounding the neurons, which may have significant implications for understanding the compartmental origins of signal changes in MRI.

Experimental

Experiments were performed on a 600MHz vertical Bruker system in AMRIS using strong planar gradients and surface microcoils. The flat surface microcoils offer improved SNR at the expense of rf homogeneity. To take advantage of the microcoils, *Aplysia* neurons were isolated without the use of collagenase, thus leaving satellite cells on the surface of the neuron. Cells were then fixed, and the cells cleaved in half and placed on the 500 micron diameter micxrocoils in a chamber containing supportive fluid to minimize susceptibility effects. Direct correlation with optical microscopy was then performed.

Results and Discussion

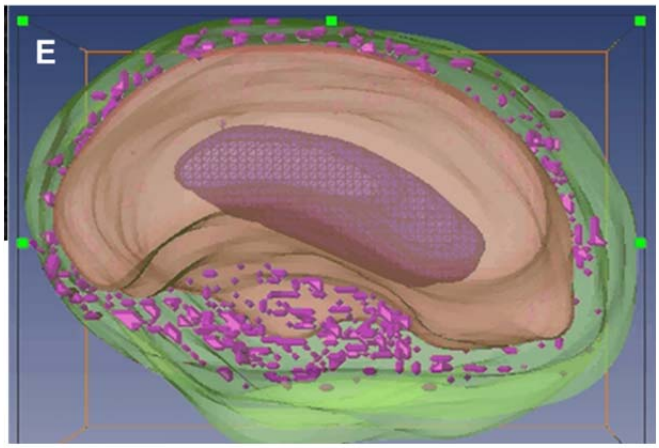

Figure 1. 3D reconstruction of an L7 neuron

Figure 1 shows a 3D reconstruction of a neuron that could be correlated with histology (histology not shown). The central pink area is confirmed as the cell nucleus, the light brown surrounding it the cell cytoplasm. The cell surface is green, and the pink dots surrounding the cell are the satellite cells. Image resolution is 7.8 microns using a 3D gradient echo sequence.

Conclusions

These data represent the first direct correlation of MR microimages of single isolated neurons with histology, and confirms the designation of the compartmental assignments Further, the satellite cells generate a hypointense MR signal at the cell boundary and may impact the interpretation of the origins of signal changes in tissues, which is still and unresolved and contentious issue. Further studies aim to perturb these systems and develop working mathematical models of MR signals in tissues.

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References

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