MR Histology- Cool Images- But Who Cares?

G. Allan Johnson, Alexandra Badea, Evan Calabrese, Chunlei Liu, and Luke Xie,
Duke, Center for In Vivo Microscopy

Target Audience: Basic scientists engaged in neuroscience, developmental biology, genetic mouse models, drug discovery, toxicology

Objectives: Provide practical applications that are in use now.

Purpose: Magnetic resonance histology (MRH) was first suggested in 1993 [1]. Much of the work in the last twenty years has focused on methods development. Those methods have matured to the point where one can now use MRH to address interesting biological questions. The goal of this presentation is to see where and how MRH can be used to provide new insight.

Methods: *Active staining,* to perfuse/fix tissue with contrast and fixative provides signal enhancement up 10 fold. Special *hardware* including high field magnets, strong gradients, and hi Q specialty rf coils is required to optimize the sensitivity. *Novel pulse sequences* have been developed to provide unique contrast options, eg, susceptibility contrast and diffusion tensor imaging. *Image processing pipelines* have been developed to streamline reconstruction of very large, multidimensional image arrays, provide robust data reduction, enable sophisticated registration and atlasing and yield quantitative statistical analysis

Results: MRH is now being used routinely to examine links between a wide range of genes and associated neurologic disorders (e.g. autism, dystonia, schizophrenia) [2] [3] [4]. Others are using MRH to provide quantitative assessment of developmental problems induced by alcohol or other toxic insult [5] [6]. MRH is also finding wide use as a screening tool for toxicology [7] [8].

Conclusion: MRH has gone from a laboratory curiosity to a valuable tool for basic scientists. There is still enormous room for improvement. Scans are too long. Costs are too high. The knowledge base is small. But work in many laboratories is now addressing these problems.

References:

1. Johnson, G.A., et al., Magnetic Resonance Quarterly, 1993. **9**(1): p. 1-30.
2. Ellegood J et al Autism Res, 2011. **4**(5): p. 368-76
3. Ulug A. et al Proc Natl Acad Sci U S A, 2011. **108**(16): p. 6638-43
4. Badea, A., et al NeuroImage, 2007. **34**(4): p. 1363-1374.
5. Parnell S. et al Alcohol Clin Exp Res, 2009. **33**(6): p. 1001-11
6. Sulik, K., et al., Alcohol, 2011. **45**(3): p. 282.
7. Morgan, D.L., et al., Tox. and App Pharm., 2004. **200**(2): p. 131-145.
8. Johnson, G.A., et al Toxicol Pathol, 2011. **39**(1): p. 85-91.