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Mouse Imaging: How to Do it Fast, Cheap, & Better
Organizers: Klaas Nicolay, Ph.D. & Ivan Tkac, Ph.D.
Skill level: Basic to Intermediate

Tips for Advanced MRI Screening of Mice
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The recent widespread availability of mouse models of human diseases, and the need to routinely screen them for disease detection and follow-up, has generated a growing demand of sophistication from non-invasive imaging modalities. Non-invasive imaging shall provide fast high-quality *in vivo* data at cellular and molecular levels. Since the pioneering work by Lauterbur and Mansfield [1, 2], MRI has evolved fast to become one of the most resourceful techniques available in this arena. Hardware improvements (higher field strengths, high performance gradient and shim systems, and RF coils with improved SNR), along with significant software developments (tools for automated shimming, acquisition and (post-)processing of MR data), have enabled routine 'push-button'-type monitoring of small animal tissue's anatomy and biophysical parameters, such as water diffusion and its anisotropy, e.g. [3, 4]. Real-time assessment of dynamic processes, such as cardiac function, tissue perfusion, and brain activity, became possible in mice due to fast pulse sequences and alternative methods of k-space sampling, e.g. [5-7]. Contrast-enhancement mechanisms have been explored in endogenous and in exogenous particles to image disease progression (e.g. Alzheimer's [8]) and even single cells [9] and cell migration [10]. More recently, cryoprobes [11] and phased array coils [12, 13] have significantly improved MRI's sensitivity for mouse monitoring. Many of these technological developments have also improved the performance of the spectroscopy modality of MRI, i.e. spectroscopic imaging (MRSI), for preclinical mouse studies. Highly resolved, regional metabolic profiles of mouse tissues, e.g. brain [14, 15], can now be obtained and their changes quantified in many dimensions: space, volume, and time. Localized, multinuclear MRSI data (typically ^{1}H, but also ^{31}P, ^{19}F, and more recently with hyperpolarization of labeled substrates, ^{13}C), can be acquired along with MRI to complement tissue's water-based parameters with additional molecular information [16-18]. Most of these techniques provide an invaluable insight into the complexity of mouse-reproduced human diseases, e.g. cancer, as well as their response to therapy. The challenge then becomes which ones to choose, how to carry them out efficiently, and how to deal with the large amount of information generated in many cases, such as dynamic MRI and (dynamic) MRSI. This presentation will focus on selected preclinical examples outlining the practical aspects of choosing an MRI/MRSI technique and its implementation.

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