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Application of Advanced MR Methods for Fetal Imaging: Spectroscopy, Diffusion Tensor Imaging (DTI) and Arterial Spin Labeling.

Single-shot fast spin echo (SSFSE) sequences form the mainstay of fetal imaging, providing high quality, motion insensitive, anatomical images of the fetus with reasonably high ($1 \times 1 \times 2 \text{ mm}^3$) spatial resolution. Lacking from such studies are the metabolic and functional aspects of tissue available from more advanced magnetic resonance methods such as spectroscopy, diffusion tensor imaging (DTI) and arterial spin labeling (ASL) techniques. In this lecture, a review of a prospective study involving over 40 fetal imaging examinations performed at 1.5 T which incorporated – in addition to standard SSFSE imaging - single voxel long echo spectroscopy of fetal brain, diffusion tensor imaging of fetal brain, and arterial spin labeling with the goal of assessing placental perfusion characteristics. In particular we will review and rate the quality of the spectra acquired, the ability of DTI to provide mean apparent diffusion coefficient (ADC) and fractional anisotropy (FA) values from the fetal brain and also provide a preliminary assessment of placental perfusion measurement efforts with pulsed arterial spin labeling. The techniques, their ability to add to diagnostic in the fetal setting, and their feasibility in the difficult realm of clinical fetal imaging where motion, lipid contamination and susceptibility artifacts all can degrade data quality will be discussed within the context of the fetal imaging study completed on this representative cohort.