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Revealing cellular characteristics of the brain in vivo using magnetic resonance imaging

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Magnetic resonance imaging generates image contrast via interactions between the nuclear magnetic moment of atoms and applied magnetic fields. Hydrogen has a non-zero magnetic moment and is abundant in the water within human tissue, making it the predominant source of signal in MRI. Moreover, the active nature of MRI, where the spins are "excited"and then the magnetic fields they emit are subsequently measured, leads to a rich landscape of potential contrast mechanisms. One such contrast is the molecular diffusion of water, which can be measured using diffusion MRI (dMRI). Diffusion MRI provides unique insight into microscopic tissue structure because the distance water molecules diffuse in the time scales relevant to dMRI is comparable to cell sizes (˜µm), and cell membranes inhibit diffusive motion. However, a limitation of the "apparent diffusion coefficient"measured with traditional dMRI is that it is an over-simplification of the complex dynamics of diffusion in tissue. In contrast, diffusion dynamics depend on the size, shape, packing density, and permeability of cellular structures, among other tissue properties. Fortunately, it is possible to indirectly probe these different tissue properties using advanced diffusion MRI methods that manipulate additional acquisition parameters. This presentation will introduce diffusion MRI and its clinical applications, along with recent advances that offer improved microstructural specificity.

Keyword-1

DT-MRI

Keyword-2

MRI imaging

Keyword-3

Author: BARON, Corey

Presenter: BARON, Corey

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