Proton MR spectroscopy in the human brain

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^{1}H MR spectroscopy (MRS) provides a noninvasive tool for evaluating the concentrations of low-molecular weight biochemicals in the human brain. While the singlets of N-acetylaspartate, creatine and choline are readily discernible, precise measurement of many weak-resonance metabolites is not straightforward in standard, short-TE MRS. This is largely because most of the proton spins are J coupled and the resulting multiplets are extensively overlapped with each other on top of broad complex macromolecular signals. J-difference editing (MEGA) is often employed to overcome the spectral complexity, in which differing signal patterns of a J-coupled spin resonance are prepared in dual scans, followed by subtraction between the spectra to generate a signal at the resonance. This method is popularly used for detecting weakly-coupled spin metabolites, such as GABA, glutathione, and lactate. Long-TE MRS can improve spectral resolution in a single-scan fashion, with an advantage that the spectrum is simplified with the attenuation of macromolecule signals having short T_2 relaxation times. In particular, triple-refocusing MRS confers an effective means of manipulating the coherence evolution of strongly-coupled spin resonances and thus improving the spectral resolution. Optimized PRESS and triple-refocusing methods will be discussed for the detection of GABA, 2-hydroxygluratate, and glycine at 3T and 7T.