The Improvement of Spectral Quality in Muscle ^{31}P MRS Using NOE Effect

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Purpose: To evaluate the improvement factors of phosphorus metabolite signal intensities in muscle MRS using Nuclear Overhauser Enhancement (NOE), which is the double resonance technique.

Materials and Method: The 31P MR spectra of gastrocnemius muscle were measured with and without NOE effect on a 1.5T whole-body scanner/spectrometer(Siemens Vision Plus, Erlangen, Germany) using 1H-31P dual tuned surface coil. The sequence parameters were TR/TE=323/2.3 msec, slice thickness = 40 mm and 8x8 phase encoding steps for 2D CSI. Four normal volunteers and one patient were included in this study. After postprocessing the MRS raw data, the signal enhancements(%) were estimated for α-ATP, β-ATP, γ-ATP, Pi, PCr. The PME and PDE were not included in analysis due to smallness of these signals.

Results: The NOE enhancement for muscle 31P MRS were: α-ATP(0%), β-ATP(21%), γ-ATP(22%), Pi(27%), and PCr(30%). The most NOE enhancement was seen on PCr and the least enhancement on α-ATP. The differences of NOE enhancement among metabolites were believed resulting from the differences in the intermolecular dipole-dipole interactions between water and phosphates. With the improvement on signal-to-noise ratio (SNR) of metabolite signals, muscle 31P MRS always showed high quality spectrum. The NOE enhanced spectrum of patient provides clear identification of major metabolites and showed very high α-ATP level compared to the spectrum of normal control.

Conclusion: Without increasing magnetic field strength and voxel size, the NOE effect gives rise to the 31P muscle spectrum with higher SNR. Therefore, improved SNR in 31P MRS of muscle gave better identification of each metabolites and increased the diagnostic value of muscle MR spectroscopy.