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Molecular imaging through ^1H MRS and MRSI in everyday routine: improvements in various clinical applications and parameter optimization of spectroscopic imaging sequences.

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In the era of molecular imaging, in-vivo ^1H Magnetic resonance spectroscopy (MRS) and spectroscopic imaging (MRSI) are impacting dramatically upon virtually all areas of clinical medicine. MRS and MRSI should be able to identify key biochemical changes, much before the tumour becomes detectable by other functional imaging methods that mainly rely upon single markers that are not entirely sensitive or specific for malignant activity. Combined with other imaging techniques in a rapidly advancing modality like MRI offer the ability to estimate the presence of metabolites yields much information regarding tissue. Molecular imaging through magnetic resonance could be potentially suited for screening and repeated monitoring since it entails no exposure to ionizing radiation. Incorporation of these tools in clinical practice is, however, limited due to the considerable amount of user intervention. In this work various acquisition parameters and their effects in spectrum quality are investigated. In order to assess the quality of various spectroscopic techniques (2D and multi-slice MRSI, multiple echo SI), a series of experiments were conducted using a standard solution. The application of water and fat suppression techniques and their compatibility with other parameters were also investigated. The stability of the equipment, the appearance of errors and artifacts and the reproducibility of the results were also examined to obtain useful conclusions for the interaction of acquisition parameters. All the data were processed with specialized computer software (jMRUI 2.2) to analyze various aspects of the measurements and quantify various parameters such as signal to noise ratio (SNR), full width at half maximum (FWHM), peak height and j-modulation. The experience acquired from the conducted experiments was successfully applied in acquisition parameter optimization and improvement of clinical applications (2D MRSI of prostate, brain and muscle MRS) by significantly improving the spectrum quality, SNR (up to 75%), spatial resolution in 2D MRSI, water and fat suppression and in some cases reducing exam times (up to 60%).

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