Clinical Utility of MRS in Oncology: Pro-MRS

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Proton magnetic resonance spectroscopy (MRS) is now a mature technique with more than 20 years experience in the human brain. The main application of proton MRS to date has been in the evaluation of lesions in the central nervous system. At some institutions, including private practice radiology groups, it is not uncommonly used for certain indications, such as distinguishing malignant (neoplastic) from non-malignant lesions (1), or distinguishing residual or recurrent tumor from treatment effects such as radiation necrosis (2). Other potential applications include differential diagnosis of pediatric brain tumors, and tumor prognosis (3-7). Usually the diagnostic impression is based on the amplitude of the choline (Cho) signal, but information from N-acetyl aspartate (NAA), *myo*-inositol (mI), lactate (Lac) and lipids may also be useful.

Advantages of MRS include its ability to be performed on standard 1.5 or 3.0T scanners as part of a routine brain MRI examination, its low cost (e.g. compared to other metabolic imaging techniques such as FDG PET-CT), and its completely non-invasive nature. Since brain tumors are often heterogeneous, with areas of active tumor growth, edema, and necrosis (which are often difficult to distinguish on conventional MR sequences, particularly in the era of anti-angiogenic therapy), high-resolution multi-voxel MR spectroscopic imaging (MRSI) with extended coverage is the preferred technique (8), so long as it can be performed within a clinically feasible scan time. The spatial metabolic information from high-resolution MRSI may also be useful in guiding biopsy, excision, or targeted radiotherapy (e.g. gamma-knife or other localized radiotherapy) (9).

MRS in other organ systems is not at such an advanced stage as brain MRS, but studies have been performed in cancer of the prostate (10) and breast (11). However, MRS is not in general clinical use for these applications, mainly because of the appreciable technical challenges associated with MRS in the body, as well as the lack of current definition of the precise role that MRS may play in influencing patient management.

Widespread adoption of MRS (and in particular the MRSI technique for mapping of metabolite spatial distributions) is hampered by the lack of commercial development of robust acquisition, analysis and visualization tools for clinical use. It is therefore currently quite difficult to implement MRS and MRSI in the clinical environment without specialist support. Other issues that remain to be solved include radiologist and technologist training, reimbursement, standardization of techniques for both data acquisition and analysis/visualization, and interpretation. Despite these problems, the biological information provided by MRS is unique, and when performed by experienced expert operators, can provide important clinical information for diagnosis and treatment monitoring.

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