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SY18-01

Toward an Optimized Amide Proton Transfer (APT) MRI Sequence and Protocol for Clinical Applications

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Amide proton transfer (APT) or more generally chemical exchange saturation transfer (CEST) imaging is a novel molecular MRI technique that generates image contrast based on endogenous cellular proteins in tissue. Currently, APT-MRI holds great promise for abundant clinical molecular imaging applications. However, the current APT imaging protocols vary substantially among different institutes, far from being optimized. A main reason is that the APT experimental parameters are often limited by scanner hardware constraints (particularly amplifier duty cycle) and specific absorption rate (SAR) requirements. In addition, inconsistent and controversial results have been reported by different research groups due to the choice of different CEST/APT metrics, reference images, and different experimental parameters. Lastly, a major limitation for routine clinical use is the long scan time required because of the use of a long RF saturation pulse (or pulse train), and a series of multiple RF saturation frequencies to acquire a Z-spectrum. A faster APT scan would not only help to improve patient comfort and compliance, but also could be used to improve image quality. A fast imaging strategy is thus essential for translating APT-MRI technology to daily clinical practice. In this study, a highly sensitive (via time-interleaved parallel RF transmission), accelerated (via compressed sensing), and quantitative (via extrapolated semisolid magnetization transfer reference) APT MRI method for clinical use was developed. The integrated APT-MRI approach can maximize APT signal effects on clinical scanners by avoiding RF amplifier limitations to the saturation pulses, while staying with the relatively low SAR. High-quality 3D APT imaging of human brain tumors can be acquired within a clinically feasible time.

Keywords : CEST, APT,

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SY18-02

Vessel wall imaging: atherosclerosis and beyond

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Intracranial vessel wall MR imaging (VWI) is a promising adjunct to conventional angiographic imaging with CTA, MRA, or DSA in the assessment of selected cerebrovascular abnormalities in the CNS. By providing information about the inner and outer boundaries of the artery, information may be obtained to supplement luminal or perfusion biomarkers and potentially improve diagnostic accuracy. Technical requirements should ideally include 3D sequences with isotropic voxel dimensions and multiplanar reformatting, high spatial resolution, adequate spatial coverage and suppression of blood/CSF signal. VWI should be read in conjunction with MRA, and other conventional pulse sequences visualizing multiple tissue weightings, to detect vessel wall thickening, enhancement, and other features. The technique has multiple potential uses in the context of ischemic stroke and intracranial hemorrhage. This presentation will focus on examples of atherosclerotic plaque, infectious and inflammatory vasculitis, and Moyamoya Disease. Potential pitfalls include vasa vasorum enhancement, veins, and slow flow.

Keywords : Vessel wall imaging, MRI, Black blood

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SY18-03

Towards Unraveling the Structural, Functional & Molecular Fingerprints of Brain Function and Disorders

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Brain mapping is one of the most exciting frontiers of contemporary science. It provides this generation of scientists the opportunity to make major advances on a historic question: how the brain works and what goes wrong when it is injured or diseased. Magnetic resonance (MR)-based neuroimaging techniques have been widely used for brain research because of their noninvasiveness and multimodal capabilities. Exploiting the rich information contents of MR signals, we can obtain structural, functional and metabolic information of the brain. MR spectroscopic imaging (MRSI) is a beautiful integration of MR spectroscopy and MR imaging, which can provide metabolic status of tissues in vivo without exogenous molecular labels. But its clinical applications have been limited due to long scan time and poor spatial resolution. In this talk, I'll show a new capability for rapid high-resolution metabolic imaging by using a recently developed subspace-based imaging technique called SPICE (SPectroscopic Imaging by exploiting spatiospectral CorrElation). In a 5-min scan, we can acquire metabolic maps from the whole brain at a nominal spatial resolution of 2.0 x 3 x 3 mm^3. We have successfully performed SPICE scans on stroke patients, traumatic brain injury (TBI) patients and brain tumor patients. Our experimental study yielded very encouraging results and showed that ultrahigh-resolution MRSI can capture neurometabolic alterations induced by stroke, TBI and brain tumors effectively.

Keywords : Magnetic resonance spectroscopic imaging, High resolution, Stroke, Traumatic brain injury, Brain tumor