Simultaneous measurement of GABA and GSH using HERMES at 3T

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Introduction

- GABA is the main inhibitory neurotransmitter in the human brain
- GSH (glutathione) is the most abundant redox compound in the brain, serving an important role in minimizing damage caused by reactive oxygen species
- Spectral editing of the MR spectrum (Fig. 1) allows selective detection of low-concentration compounds, such as GABA and GSH

Pitfalls:
1. Selectively edits one metabolite at a time and from one brain region
2. Requires relatively long acquisition times within the time constraints of an MR examination

AHA: Hadamard Editing and Reconstruction of MEGA-edited Spectroscopy (HERMES) to simultaneously edit GABA and GSH

Methods

HERMES editing of GABA and GSH

- Requires four sub-experiments (A, B, C, D), which can be combined to form GABA- and GSH-edited spectra (Fig. 2)
- Hadamard encoding treats each metabolite orthogonally, allowing for independent editing without signal cross-talk between the metabolite spectra

Simulations
- FID Application
- Voxel-center only
- Shaped refocusing and editing pulses
- 20-ms (62-Hz FWHM) editing pulses

Phantom
- Three phantoms: 4 mM GABA, 4 mM GSH + 4 mM GABA, 10 mM GABA
- TR/TE 2000/80 ms
- 47 mL isotropic voxel
- ~11 min per acquisition

In vivo
- HERMES & MEGA-PRESS
- 10 healthy adult subjects
- TR/TE 2000/80 ms
- 320 averages
- ~245 ppm

Results

Simultaneously acquired HERMES spectra are shown in orange and green on Fig. 1. In vivo HERMES and MEGA-PRESS spectra from all subjects. Hadamard reconstruction of the sub-experiments yields the separate GSH- and GABA-edited spectra.

Discussion

- Simulated, phantom and in vivo HERMES spectra show: 1) Excellent segregation of edited signals, and 2) Strong agreement with separately acquired MEGA-PRESS data
- In practice, HERMES allows simultaneous editing of both GABA and GSH within the same duration and with equivalent SNR as a single MEGA-PRESS measurement
- Incorporating editing labes at 1.5 ppm into the OFFGABA scans would result in a macromolecular-suppressed GABA-edited experiment

References

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