Comparison of a short-TE whole brain MR spectroscopic imaging to single voxel spectroscopy for measurement of metabolite concentrations in human brain

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Target audience: Researchers using MRSI to study metabolite changes in human brain.

Purpose: To evaluate a short TE whole brain MR spectroscopic imaging (wbMRSI) for detection of focal metabolite in human brain by comparing the results with those of Single-Voxel Spectroscopy (SVS).

Methods: Ten male and ten female healthy volunteers aged 28 ± 4 years were scanned at a 3T system (Verio, Siemens, Erlangen). Scan protocol included an EPSI acquisition (TR/TE = 1550/17.6 ms) with parallel imaging and GRAPPA reconstruction (1) over a field-of-view (FOV) of 280 x 280 x 180 mm for wbMRSI; an axial T1-weighted 3D MPRAGE with the same angulation as that of EPSI; and three SVS's using stimulated echo (TR/TE = 1550/20 ms, 192 acquisitions, voxel volume 4 ml) acquired at right parietal white matte (pWM), occipital gray matter (oGM), and basal ganglia (BG). Scan times for EPSI was 16 minutes. EPSI data were analyzed using the MIDAS software package (2) to obtain brain metabolite maps, from which concentrations of n-acetyl-aspartate (NAA), choline (Cho), total creatine (tCr), glutamine/glutamate (Glx), and myo-inositol (mI) was measured in Regions of Interest (ROIs) where the SVS measurements were located. In addition, metabolite concentrations were also measured at two ROIs chosen at cerebellar white (cbWM) and gray matter (cbGM), respectively. SVS data were analyzed with LCModel (3). All concentrations were estimated in ratio to tissue water and to tCr. Coefficients of variation (COVs) for each metabolite concentration in ratio to water, defined as standard deviation of the difference between measurements divided by the mean values from the measurements, were calculated for wbMRSI and SVS, respectively.

Results: No statistically difference between metabolite concentrations of males and females was found, thus the data were combined for further analysis. COVs showed similar variations for both wbMRSI and SVS, which correlated to the metabolite amplitude (smallest for NAA, and largest for mI or Glx) and line width (LW, with larger values having a larger COV) (Table 1). The scaling used for the wbMRSI resulted in higher concentration ratios to water (Fig.1 left); however, concentrations in ratio to tCr derived from both acquisitions are close to each other with similar distributions (Fig.1 right). Linewidths were narrower for all wbMRSI measurements due to the smaller voxels used, and application of B0 correction before measurement over the ROI.

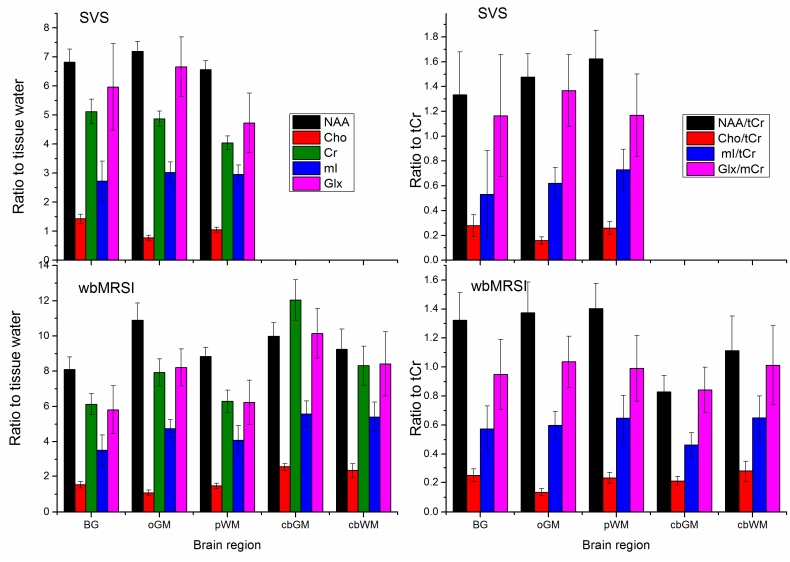

Figure 1: Metabolite concentrations as a ratio to water (left column) and to tCr (right column), derived from data acquired with SVS (top row) and wbMRSI (bottom row), respectively.

Table 1. Coefficients of variation of wbMRSI and SVS

	NAA	Cho	tCr	mI	Glx	LW	LW
wbMRSI	COV	COV	COV	COV	COV	COV	**Mean**
BG	6.5	9.7	7.8	19.7	17.6	10.6	**6.5**
oGM	7.4	9.6	8.0	8.1	9.0	8.3	**4.9**
pWM	4.9	8.2	7.5	16.5	15.2	9.2	**5.3**
cbGM	6.1	7.3	7.4	11.0	11.0	9.0	**5.9**
cbWM	10.6	15.0	10.9	12.4	16.0	24.3	**7.4**
SVS	COV	COV	COV	COV	COV	COV	**Mean**
BG	6.5	10.9	8.3	25.4	25.0	28.0	**11.2**
oGM	4.8	11.0	5.4	12.0	15.5	21.9	**6.0**
pWM	4.7	8.0	5.9	11.1	21.8	13.8	**5.8**

Discussion/Conclusion: The short TE wbMRSI can be used to estimate focal brain concentrations of NAA, Cho, tCr, mI, and Glx with comparable or better COVs to those obtained using SVS measurements, within a clinically acceptable scan time of 16 minutes. The wbMRSI method has a considerable advantage that metabolite concentrations could be evaluated at multiple user-defined ROIs. It is necessary for each acquisition technique to have its own reference for quantification purpose.

References:

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