GABA concentration in left and right sensorimotor cortex is correlated across individuals

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Introduction

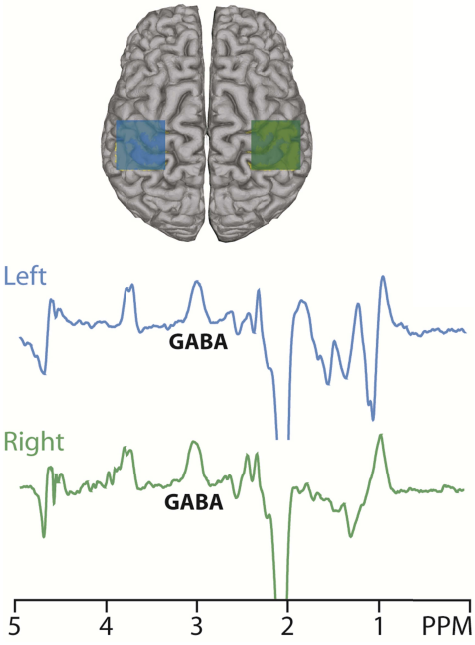
Studies[1-5] of individual differences in GABA concentration as measured by edited MRS have recently demonstrated the potential to link non-invasive measures of neurochemistry with individual differences in perceptual and cognitive function. While a number of these studies[2-5] have linked regional GABA concentration to function, to date no inter-regional correlations in GABA have been observed. This is important, as rather than individuals being defined as globally 'high- or low-GABA', concentration differences are regionally and functionally specific.

We sought to investigate if areas which are known to be strongly functionally connected[6], such as the left and right sensorimotor cortex, would have correlated GABA concentrations. In this study we hypothesize that individual differences in GABA concentration will correlate between the left and right sensorimotor cortex.

Methods

Participants 10 healthy right-handed male participants aged 30.5±6 years were recruited and gave informed consent to participate in the study, as approved by the Cardiff University School of Psychology ethics committee.

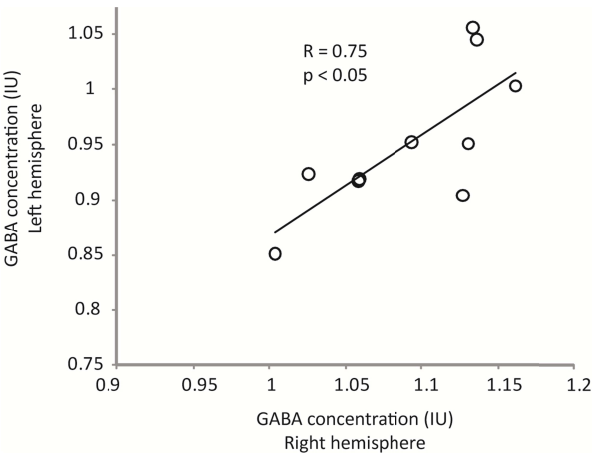
Acquisition Edited MRS measurements of GABA were made in two (3x3x3) cm^3 'sensorimotor' volumes centred on the left and right motor hand knob with two repeats per voxel (see right). All scanning was carried out on a GE Signa HDx 3T MRI scanner, using an 8-element head coil for receive and the body coil for transmit. Prior to each MRS acquisition, a 1mm^3 isotropic-resolution T1-weighted anatomical scan (FSPGR), and a sagittal and coronal Fast Spin Echo (FSE) were acquired to determine anatomical voxel placement. MEGA-PRESS sequence parameters were: TE 68ms; TR 1800 ms; 16 ms Gaussian editing pulse applied alternately at 1.9 and 7.46 ppm (ON and OFF experiments); 320 transients; 2k datapoints; 2 kHz spectral width. In order to perform the bilateral measurements symmetrically, the water-fat shift direction associated with the left-right and head-foot slice selection were reversed for the left hemisphere (relative to right).



Analysis All data was analysed using our in-house software programmed in Matlab. GABA concentration in 'institutional units' was quantified from the ratio of the integral of the edited GABA signal (determined by fitting to a Gaussian model) to the integral of the unsuppressed water signal from the same volume (determined by fitting to a Lorentzian-Gaussian model) and a constant multiplier used to account for differences in T1 and T2 relaxation times of water and GABA and the editing efficiency.

Results

Good quality edited MRS spectra were acquired in all 10 subjects (bilateral spectra from one subject are shown above right). A strong positive correlation existed between GABA concentration in left and right sensorimotor regions ($r = 0.75$, $p < 0.05$) as shown right. In right-handed subjects, left hemisphere GABA concentration is lower than in right-hemisphere ($p<0.001$).



Discussion

To our knowledge, this is the first report of inter-individual correlation of GABA concentration between regions. Previous studies[1-4] have not made bilateral measurements and have focused on functionally distinct regions. The observed strong positive correlation between right and left sensorimotor cortex GABA concentration shows that those subjects with high GABA concentration in right sensorimotor cortex also tend to have high GABA in left sensorimotor cortex. A previous study[5] showed no correlation between right sensorimotor and visual GABA concentration. Further studies of inter-regional correlation will be important in interpreting the functional significance and biological basis of individual differences in GABA concentration.

References 1. Edden RAE et al. *J Neurosci* (2010) 29:15721. 2. Sumner P et al. *Nat Neurosci* (2010) 13:825. 3. Boy F et al. *Curr Biol*. (2010) 20:1779. 4. Boy F et al. *Biol Psych* (2011) 70:866. 5. Puts NAJ et al. *J. Neurosci* (in press) 6. McGlone F et al. *Behav Brain Res* (2002) 135:147. 7. Tommerdahl M et al., *J Neurosci* (2006) 26:5970. 8. Haegens et al. *J. Neurosci* (2011) 31:5197.