

Supplementary Materials. Partial Volume Correction

The following from Gasparvoic et al.¹ were used to correct for partial volume effects:

$$M = \frac{S_{Mobs} * (f_{GM} * R_{GM} + f_{WM} * R_{WM} + f_{CSF} * R_{CSF}) * 2 * [H_2O]}{S_{H_2Oobs} (1 - f_{CSF}) * R_M * \#H_M}$$

M is the corrected resultant GABA level

S_{Mobs} is the uncorrected GABA signal

f_{GM} is the fraction of gray matter (GM), defined by an equation listed below

f_{WM} is the fraction of white matter (WM), defined by an equation listed below

f_{CSF} is the fraction of cerebrospinal fluid (CSF), defined by an equation listed below

R_{GM} is the relaxation attenuation factors for GM

R_{WM} is the relaxation attenuation factors for WM

R_{CSF} is the relaxation attenuation factors for CSF [H₂O] is the molal concentration of MR-visible water in metabolite solution, 55.51mol/kg

S_{H₂Oobs} is the observed water signal

R_M is the relaxation attenuation factors for the metabolite of interest (GABA), using a T_{1GABA}=1.31s² and T_{2GABA}=0.088s³

#H_M is the number of protons that give rise to the metabolite peak (GABA)⁴

$$R_M = e^{\left[\frac{-TE}{T_{2M}} \right]} \left(1 - e^{\left[\frac{-TR}{T_{1M}} \right]} \right)$$

TE is the echo time of the sequence

TR is the repetition time of the sequence

T_{2M} is the T2 of the tissue type or metabolite of interest (GABA)

T_{1M} is the T1 of the tissue type or metabolite of interest (GABA)

$$f_{GM} = \frac{f_{GM_vol} * \rho_{GM}}{f_{GM_vol} * \rho_{GM} + f_{WM_vol} * \rho_{WM} + f_{CSF_vol} * \rho_{CSF}}$$

This equation is use to calculate the fraction of WM and CSF as well.

ρ_{GM} is the density of GM, 0.78¹

ρ_{WM} is the density of WM, 0.65¹

ρ_{CSF} is the density of CSF, 0.97¹

f_{GM_vol} is the GM volumes determined by segmentation

f_{WM_vol} is the WM volume determined by segmentation

f_{CSF_vol} is the CSF volume determined by segmentation

References.

1. Gasparovic C, Song T, Devier D, Bockholt HJ, Caprihan A, Mullins PG et al. Use of tissue water as a concentration reference for proton spectroscopic imaging. *Magnetic resonance in medicine : official journal of the Society of Magnetic Resonance in Medicine / Society of Magnetic Resonance in Medicine* 2006; 55(6): 1219-1226.
2. Puts NA, Barker PB, Edden RA. Measuring the longitudinal relaxation time of GABA in vivo at 3 Tesla. *J Magn Reson Imaging*. 2013 Apr;37(4):999-1003.
3. Edden RA, Intrapirromkul J, Zhu H, Cheng Y, Barker PB. Measuring T2 in vivo with J-difference editing: application to GABA at 3 Tesla. *J Magn Reson Imaging*. 2012 Jan;35(1):229-34.
4. Govindaraju V, Young K, Maudsley AA. Proton NMR chemical shifts and coupling constants for brain metabolites. *NMR Biomed*. 2000 May;13(3):129-53.