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Does heterogeneity affect [^{11}C]flumazenil binding maps?

This document describes the simulations of the partial volume effect (PVE) on the apparent flumazenil binding results.

Regional concentration of benzodiazepine receptors

Alkire and Haier (2001) used the following [^{3}H]flunitrazepam binding values based on the measurements by Zezula et al. (1988) to calculate correlations between their [^{18}F]FDG results and benzodiazepine receptor densities:

Table 1. Regional values for benzodiazepine binding densities (Zezula et al. 1988; Alkire & Haier 2001).

Brain region	**[^{3}H]flunitrazepam (fmol·(mg protein)$^{-1}$)**
Occiput	550
Temporal	538
Hippocampus	528
Frontal	508
Precentral	481
Thalamus	343
Cerebellum	309
Caudate	307
Putamen	304
Pons	140
Corpus callosum (white matter)	100

Determination of model parameters for ideal grey and white matter

Lassen et al. (1995) suggest that DV_F+DV_{NS} for white matter is close to the average value for the grey matter-dominated regions. Therefore, the variable admixture of white matter will not result in a change in k_5/k_6 in the three-tissue compartment model or bias in k_2 and k_3 in the two-tissue compartment model.

Simulation of heterogeneity by mixing grey and white matter

PVE correction has been applied to DV images produced with spectral analysis (Koepp et al. 1997; 1998), and PVE was found to be necessary to detect bilateral changes in a subtype of epilepsy.

References

1. Alkire MT, Haier RJ. Correlating *in vivo* anaesthetic effects with *ex vivo* receptor density data supports a GABAergic mechanism of action for propofol, but not for isoflurane. *Br J Anaesth* 2001; 86: 618-626.
2. Koepp MJ, Hand KSP, Labbé C, Richardson MP, Van Paesschen W, Baird VH, Cunningham VJ, Bowery NG, Brooks DJ, Duncan JS. In vivo [^{11}C]flumazenil-PET correlates with ex vivo [^{3}H]flumazenil autoradiography in hippocampal sclerosis. *Ann Neurol* 1998; 43(5): 618-626.
3. Koepp MJ, Labbé C, Richardson MP, Brooks DJ, Van Paesschen W, Cunningham VJ, Duncan JS. Regional hippocampal [^{11}C]flumazenil PET in temporal lobe epilepsy with unilateral and bilateral hippocampal sclerosis. *Brain* 1997; 120: 1865-1876.
4. Lassen NA, Bartenstein PA, Lammertsma AA, Prevett MC, Turton DR, Luthra SK, Osman S, Bloomfield PM, Jones T, Patsalos PN, O'Connell MT, Duncan JS, Andersen JV. Benzodiazepine receptor quantification in vivo in humans using [^{11}C]flumazenil and PET: application of the steady-state principle. *J Cereb Blood Flow Metab* 1995; 15: 152-165.
5. Zezula J, Cortes R, Probst A, Placacios JM. Benzodiazepine receptor sites in the human brain: autoradiographic mapping. *Neuroscience* 1988; 25: 771-795.