

Simulation on PVE in [¹¹C]PE2I PET studies

Simulation of partial volume corrected regional curves

White matter (WM) regions were drawn on the three PET studies. In this simulation, it was assumed that 1) all WM behaves similarly and can be represented by the drawn WM ROIs, 2) the WM volume fraction inside every other ROI is 25% ($f_{WM}=0.25$), and 3) there is no radioactivity spillover from surrounding tissue in the WM ROI.

Thus, the true regional TACs were calculated using the equation E1 and program dftcalc 1.2:

$$C_{true}(t) = \frac{C_{measured}(t) - f_{WM} C_{WM}(t)}{1 - f_{WM}} \quad (E1)$$

These TACs, and the tissue ratio to metabolite corrected plasma are shown below.

Bias caused by non-corrected PVE

Regional binding parameters were estimated using two methods: DVR as ROI/cerebellum ratio from plasma-input Logan analysis, and BP from SRTM. Programs logan 1.9 and lhsrtm 1.4 were used.

Assumption is that the true results are achieved from TACs corrected for PVE, and other results are compared to these. First, results are calculated from non-PVE corrected TACs. Secondly, results are calculated from PVE-corrected TACs except cerebellum TACs are not PVE corrected; this may be the actual situation if PVEOut is used. The following tables show the biases (%) caused by the total or partial lack of PVE correction for putamen and thalamus:

Put	No PVE corr. for any regions		No PVE corr. for cerebellum	
	Logan-DVR	SRTM-BP	Logan-DVR	SRTM-BP
jkar	-23.70	-38.62	+3.93	-18.10
joma	-26.91	-39.22	-1.85	-18.83
maut	-17.33	-33.71	+6.30	-12.17
mean	-23	-37	+3	-16

Tha	No PVE corr. for any regions		No PVE corr. for cerebellum	
	Logan-DVR	SRTM-BP	Logan-DVR	SRTM-BP
jkar	-1.356	-13.16	+3.93	+128.7
joma	-5.456	-21.76	-1.85	+18.16
maut	-4.301	-18.57	+6.30	+20.44
mean	-4	-18	+3	+56

The linearity of Logan plots and the fitted curves from SRTM were similar between PVE “corrected” and uncorrected TACs (not shown).

Conclusion

PVE leads to substantial negative bias in binding parameters, and the bias is larger in regions of high binding. This will also lead to biased occupancy values.

PVE-induced bias is higher if reference-input models are applied than with plasma input. If PVC is applied only to cerebrum, cerebellum-input leads to spurious results in low-binding areas, whereas plasma-input models produce acceptable results.



