

Kinetic analysis of [¹⁸F]Desmethoxyfallypride by human dynamic PET

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Objectives:

The purpose of this study is to characterize the [¹⁸F]DMFP kinetics in the first human dynamic PET studies with different analytical methods.

Methods:

PET studies on ten health volunteers, ages 24-44, were performed on a Siemens ECAT EXACT whole-body scanner after the intravenous bolus injection of 209 ± 50 MBq (mean \pm SD) [¹⁸F]DMFP. Each dynamic image set consists of 30 frames over 124 min (3x20 sec, 3x1, 3x2, 3x3, 15x5, 3x10 min) and 47 planes (matrix size 128x128, pixel size 2.06 mm, slice thickness 3.38 mm). ROI regions of cerebellum, caudate and putamen were drawn on the co-registered MRI images. A metabolite-corrected plasma time radioactivity was obtained for each study. The ROI kinetics were analyzed using six different methods described as below. A: Two-compartmental three-parameter (K_1 , k_2 , V_p). B: Three-compartmental five-parameter model (K_1 , k_2 , k_3 , k_4). C: Same model configuration as in B but fitting with fixed K_1/k_2 estimated from cerebellum which was used as reference tissue (receptor free, $k_3=k_4=0$). D: Logan plot with plasma input function. E: Logan plot with reference tissue. F: Lammertsma simplified reference tissue model. In methods A, B, and D, Binding potential ($BP=k_3/k_4$) was estimated indirectly by distribution volume

($DV=(K_1/k_2)(1+k_3/k_4)$) as $DV(\text{target tissue}) / DV(\text{cerebellum})-1$. Parameters estimated by above methods as a function of PET study time was investigated. Linear parametric imaging algorithms we developed before were applied to methods A and E to generate images of K_1 , R_1 , DV, BP.

Results:

K_1 , DV, BP estimates tend to be stable after 60 min study. The mean \pm SD of estimates (K_1 (ml/min/ml), DV, BP) for caudate and putamen using method C from 124 min study are (0.302 ± 0.078 , 8.733 ± 3.099 , 1.791 ± 0.409) and (0.362 ± 0.098 , 10.746 ± 3.588 , 2.437 ± 0.398), respectively. The estimates from different methods linearly correlated with each other with $R^2 > 0.90$. The K_1 , R_1 , DV, and BP images are of good image quality.

Conclusion:

All the above methods using cerebellum as reference tissue directly or indirectly provide reliable estimates of K_1 , DV and BP.

[¹⁸F]Desmethoxyfallypride ([¹⁸F]DMFP) is a potent PET ligand for quantitative assessment of dopamine D2-receptor.

[¹⁸F]Desmethoxyfallypride ([¹⁸F]DMFP) distribution in a human volunteer

