Kinetic Modeling of Radiotracer [11C]OMAR for Accurate PET Imaging of the Cannabinoid Receptor Type 1

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Positron emission tomography (PET) is considered the most advanced method of investigating neuroreceptor functionality. Promising radiotracers of PET, namely [11C]OMAR, present high binding affinity, specificity, and thorough brain uptake, but cannot be fully exploited until the recorded spatiotemporal PET data is properly transformed to interpretable parameters via kinetic analysis. Kinetic modeling of previous radiotracers identified the one tissue (1T), two tissue (2T) compartmental models and the multilinear analysis 1 (MA1) model as ideal models; thus, amongst these models, this study aimed to accurately model [11C]OMAR PET data for PET image generation. The 1T, 2T, and MA1 models were implemented in PET scans from 10 subjects using a regional and pixel-wise analysis approach to computing regional volumes of distribution. Model fit was assessed with coefficient of variation (COV), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and relative standard error (rSE). The 1T model showed reduced accuracy when assessing residuals of model fits and presented a low COV between subjects. The 2T and MA1 exhibited AIC of -120 to -60, SC of 0 to 10, and minimized rSE; however, for 10 of the 180 regions, 2T estimated a kinetic parameter larger than expectation by orders of magnitude, implying 2T was unreliable. The MA1 model was consistently accurate in fitting PET data and generated PET parametric images agreeing with regional analysis results. Identifying the proper modeling of [11C]OMAR will allow for the most accurate PET images to be generated, thereby improving maps of the cannabinoid receptor for clinical applications and disease diagnosis.

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