Non-invasive quantification and SUVR validation of [^{18}F]-florbetaben with total-body EXPLORER PET

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Introduction: The total-body EXPLORER PET scanner supports the acquisition of a full human body in one scan and permits noninvasive Image-Derived Input Functions (IDIFs) as an alternative to arterial blood sampling (Badawi, JNM 2019). Our aim is to quantify amyloid buildup in older individuals with kinetic models that leverage dynamics in aorta IDIFs and the brain utilizing [^{18}F]-Florbetaben EXPLORER PET and validate with standardized uptake value (SUVR).

Methods: Fourteen adults (9 cognitively-normal, 2 Mild Cognitive Impairment, and 3 Alzheimer's disease) aged 66-86 underwent dynamic total-body ^{18}F-florbetaben PET (United Imaging) for 110min. Regions of interests were drawn in the middle descending aorta and eroded to exclude the vessel walls to derive IDIFs. The PET volumes were motion corrected (FSL-MCFLIRT) and linearly registered (FSL-FLIRT) to T1W image. The DKT ATLAS was used to segment brain cortical regions that are involved in neurodegeneration for PET SUVR measurements. PET SUVR means were calculated from 7 index regions and the cerebellar gray matter as the reference. Dynamic time activity curves from the same brain regions were fit to the two-tissue compartment model (2TCM) using population metabolite-corrected IDIFs; and the Multi-linear Reference Tissue Model (MRTM) to calculate distribution volume ratio (DVR) with reference to cerebellar gray (Ichise, JCBFM 2003).

Results: Amyloid-positive patients showed the highest SUVR in brain index regions individually. Higher SUVR accumulation was observed in index regions compared to cerebellum at later time points in amyloid-positive cases. SUVR and DVR from kinetic models were strongly correlated; with slight overestimation of SUVR compared to DVR. DVR values from the MRTM were lower than (86.7% of) DVR quantified by 2TCM.

Discussion: Absolute quantification of amyloid binding from total-body [^{18}F]-florbetaben PET data is feasible using aorta IDIFs and shows high agreement to SUVR in discriminating positive and negative scans.

Conclusions: Total-body EXPLORER PET enables high quality kinetic modeling for accurate measures of amyloid accumulation in clinical research of aging and dementia.

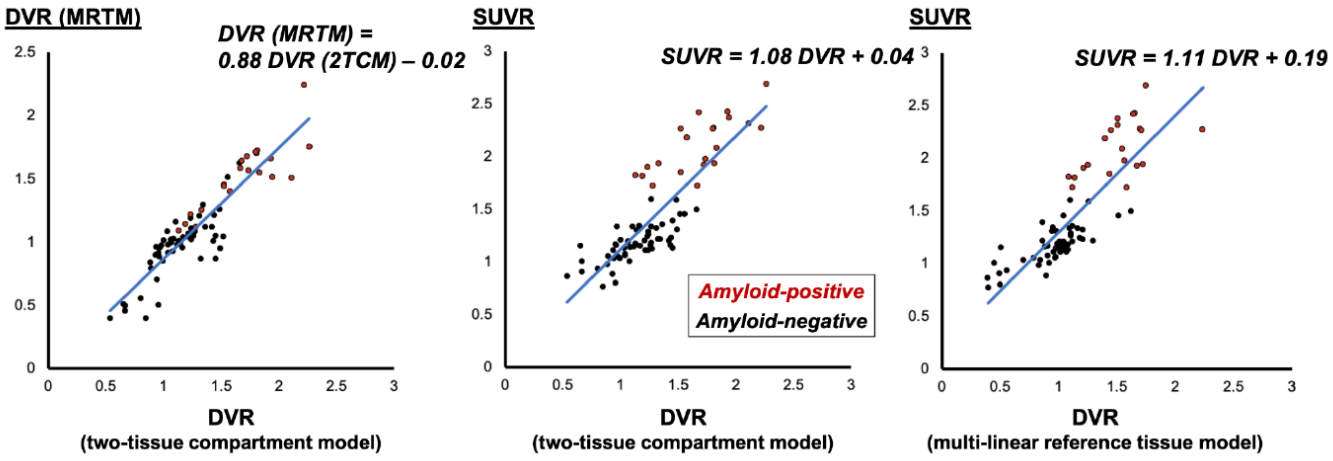

Figure 1. Linear regression analysis of amyloid quantification in brain index regions with correction for subject clustering.