Purpose: To assess a partial volume correction (PVC) method for a non-invasive PET image based simplified kinetic analysis.

Methods and Materials: A phantom was designed with a cylinder tank and six fillable cylinders to simulate vessels with a range of inner diameters from4.8 to 28.6mm. F-18 in aqueous solution was injected into the vessels and the tank with an activity concentration ratio of 1.5 to 1. The PET FOV was 576mm and voxel size 4x4x4mm. CT images of this phantom were used to create a digital 3D PET phantom model. The inner and outer vessel cylinders and the tank were automatically contoured and the known true F-18 activities were assigned to the vessels and tank volume. The CT-based model was then convolved with a 3D Gaussian PET point spread function to create the simulated phantom. For both simulated and physical phantoms, PVC was applied to recover the F-18 uptakes using a 3x3 geometric transfer matrix (GTM) method. Recovery coefficients of the vessels were calculated before and after PVC.

Results: Severe underestimations in vessel uptake were observed for both simulated and physical phantoms before PVC. After PVC the vessel uptakes recovered closer to the true uptake values. For the simulated phantom, complete PVC recovery was achieved for all vessel sizes with an accuracy <0.2%. For the physical phantom, the PVC recovery was <5% for all vessel sizes except for the smallest vessel (4.8mm) where the vessel uptake was overestimated by 20%.

Conclusions: Non-invasive PET image based simplified kinetic analysis is feasible provided that partial volume corrections are applied to recover vessel tracer uptake. Blood activity may be corrected for partial volume error with better than 5% accuracy using the GTM method for vessels larger than 10mm in diameter. A patient study is needed to confirm these results in clinical settings.