Application of a generic dynamic reconstruction algorithm on PET whole-body pharmacokinetic studies

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Vision 600) with standard free-breathing trunk acquisition (FB) with an ordinary non-motion-corrected reconstruction (ORD) and the motion-corrected reconstruction (EM), in addition to a dedicated lung Breath-Hold (BH) acquisition lasting between 20-40 s. Low-activity emulations were reconstructed to simulate scans with 10%, 25%, 50% and 75% of the standard injected activity (2MBq/kg) using ordinary and motion correction-algorithms. SUVmax, SUVmean, and Signal-to-Background-Ration (SBR) of malignant nodules were measured across scans. ***Results:*** Six malignant lung nodules, measuring 15.3±7.6 mm, showed increased FDG uptake with SUVmax, SUVmean (g/mL) and SBR of 7.6±3.7, 4.6±2.3 and 16.3±6.8 for ORD; 8.0±3.6, 4.7±2.2 and 17.1±6.4 for EM; and 10.2±5.1, 5.1±2.6 and 22.1±9.7 for BH respectively. EM and BH increased SUVmax by 23% and 34% in comparison to ORD, respectively. At low-activity simulation scans of 10%, 35%, 50% and 75% the injected activity, EM led to a minimal increase of SUVmax of 2.0%, 0.3%, 3.8% and 2.8% in comparison to ORD, with no effect on SBR, except a slight increase of 1.6% and 1.8% for 50% and 75% of the decimated activity, respectively. ***Conclusion:*** This study shows that the motion correction reconstruction algorithm can increase FDG uptake measured in malignant lung nodules with standard injected activity. The combination of breath-hold PET/CT and motion correction algorithm may optimize PET/CT performance in lung cancer evaluation. ***References:*** None

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Aim/Introduction: Dynamic PET is an ideal tool to study in vivo pharmacokinetics. When applied to the whole-body with regular scanners, however, large temporal gaps in the acquisition result to low count statistics, making whole-body parametric imaging very challenging. The aim of this study is to improve whole-body parametric imaging, using a generic 4D reconstruction algorithm adapted for dynamic whole-body protocols that does not assume a specific kinetic model. Its application is demonstrated on a research protocol that studies the function of Organic Anion Transporting Polypeptides (OATP, SLCO) transporters in drug delivery to tissues. ***Materials and Methods:*** The acquisition protocol was implemented on a PET/MR scanner, with whole-body passes of five bed positions each. The data were reconstructed with a regular 3D-OSEM algorithm and a novel 4D reconstruction algorithm, adapted for imaging with overlapping beds and incorporating the dynamic spectral model [1]. From this model, whole-body images were estimated for each time frame in addition to the K_1 parametric map, assumed to reflect the activity of OATP transporters at the blood-tissue interface. ***Results:*** Visual comparison of the whole-body dynamic frame images shows clearly lower noise and higher contrast for the 4D reconstruction compared to 3D. The two reconstructions provide similar quantification over large organs/regions of interest in the body. In the liver the root mean square difference (RMSD) of the time activity curves of the two reconstructions is 50 Bq/cc, with an average reduction of variance across frames of 50% for the 4D reconstuction compared to 3D. ***Conclusion:*** The 4D reconstruction method using the spectral model has shown to greatly improve image quality in whole-body dynamic imaging while maintaining quantification. It also shows the feasibility of doing whole-body parametric imaging with currently available scanners, based on the proposed 4D reconstruction algorithm and minimum assumptions on the underlying kinetics. In the protocol demonstrated here, whole body parametric images provide a tool for direct detection of organs with OATP expression, such as the liver. Further work is required for improving quantification of regions in the field of view that are not completely modeled with the spectral model, like the bladder, using additional dynamic models. ***References:*** 1) Reader, A. J. & Verhaeghe, J. Phys. Med. Biol. 59, R371-R418 (2014).

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Voluntary body motion in WB dynamic PET imaging

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Aim/Introduction: Recent introduction of high sensitivity SIPM-based PET systems provides the ability to acquire WB dynamic protocols, leading to images of improved image quality and allowing the estimation of WB parametric maps. In such studies, patient body motion (BM), can manifest itself both across and within dynamic frames. Therefore understanding its prevalence in clinic and optimizing acquisition protocols, is of particular interest in order to maximize clinical potential. ***Materials and Methods:*** 37 WB dynamic ^{18}F-FDG patient datasets, were prospectively acquired on an 25cm FOV PETCT system (Discovery MI). Patients were injected on the scanner's bed (2±0.5MBq/kg) and dynamic acquisition over a large blood pool was initiated simultaneously (10±4 min), followed by multiple (11±3 frames) sequential WB passes (35sec/bed) for up to 60±10min post-injection. Data were reconstructed using