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Titel des Beitrags: Motion correction strategies for integrated PET/MR.

Abstract: Integrated whole-body PET/MR facilitates the implementation of a broad variety of respiratory motion correction strategies, taking advantage of the strengths of both modalities. The goal of this study was the quantitative evaluation with clinical data of different MR- and PET-data-based motion correction strategies for integrated PET/MR. The PET and MR data of 20 patients were simultaneously acquired for 10 min on an integrated PET/MR system after administration of (18)F-FDG or (68)Ga-DOTANOC. Respiratory traces recorded with a bellows were compared against MR self-gating signals and signals extracted from PET raw data with the sensitivity method, by applying principal component analysis (PCA) or Laplacian eigenmaps and by using a novel variation combining the former and either of the latter two. Gated sinograms and MR images were generated accordingly, followed by image registration to derive MR motion models. Corrected PET images were reconstructed by incorporating this information into the reconstruction. An optical flow algorithm was applied for PET-based motion correction. Gating and motion correction were evaluated by quantitative analysis of apparent tracer uptake, lesion volume, displacement, contrast, and signal-to-noise ratio. The correlation between bellows- and MR-based signals was 0.63 ± 0.19, and that
between MR and the sensitivity method was 0.52 ± 0.26. Depending on the PET raw-data compression, the average correlation between MR and PCA ranged from 0.25 ± 0.30 to 0.58 ± 0.33, and the range was 0.25 ± 0.30 to 0.42 ± 0.34 if Laplacian eigenmaps were applied. By combining the sensitivity method and PCA or Laplacian eigenmaps, the maximum average correlation to MR could be increased to 0.74 ± 0.21 and 0.70 ± 0.19, respectively. The selection of the best PET-based signal for each patient yielded an average correlation of 0.80 ± 0.13 with MR. Using the best PET-based respiratory signal for gating, mean tracer uptake increased by 17 ± 19% for gating, 13 ± 10% for MR-based motion correction, and 18 ± 15% for PET-based motion correction, compared with the static images. Lesion volumes were 76 ± 31%, 83 ± 18%, and 74 ± 22% of the sizes in the static images for gating, MR-based motion correction, and PET-based motion correction, respectively. Respiratory traces extracted from MR and PET data are comparable to those based on external sensors. The proposed PET-driven gating method improved respiratory signals and overall stability. Consistent results from MR- and PET-based correction methods enable more flexible PET/MR scan protocols while achieving higher PET image quality.

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