Title of the Contribution:
Systematic Comparison of the Performance of Integrated Whole-Body PET/MR Imaging to Conventional PET/CT for 18F-FDG Brain Imaging in Patients Examined for Suspected Dementia.

Abstract:
Technologic specifications of recently introduced integrated PET/MR instrumentation, such as MR-based attenuation correction, may particularly affect brain imaging procedures. To evaluate the qualitative performance of PET/MR in clinical neuroimaging, we systematically compared results obtained with integrated PET/MR with conventional PET/CT in the same patients examined for assessment of cognitive impairment. Thirty patients underwent a single-injection (18)F-FDG, dual-imaging protocol including PET/CT and integrated PET/MR imaging in randomized order. Attenuation and scatter correction were performed using low-dose CT for the PET/CT and segmented Dixon MR imaging data for the PET/MR. Differences between PET/MR and PET/CT were assessed via region-of-interest (ROI)-based and voxel-based statistical group comparison. Analyses involved attenuation-corrected (AC) and non-attenuation-corrected (NAC) data. Individual PET/MR and PET/CT datasets were compared versus a predefined independent control population, using 3-dimensional stereotactic surface.
projections. Generally, lower measured PET signal values were obtained throughout the brain in ROI-based quantification of the PET signal for PET/MR as compared with PET/CT in AC and NAC data, independently of the scan order. After elimination of global effects, voxel-based and ROI-based group comparison still revealed significantly lower relative tracer signal in PET/MR images in frontoparietal portions of the neocortex but significantly higher relative signal in subcortical and basal regions of the brain than the corresponding PET/CT images of the AC data. In the corresponding NAC images, the discrepancies in frontoparietal portions of the neocortex were diminished, but the subcortical overestimation of tracer intensity by PET/MR persisted. Considerable region-dependent differences were observed between brain imaging data acquired on the PET/MR, compared with corresponding PET/CT images, in patients evaluated for neurodegenerative disorders. These findings may only in part be explained by inconsistencies in the attenuation-correction procedures. The observed differences may interfere with semiquantitative evaluation and with individual qualitative clinical assessment and they need to be considered, for example, for clinical trials. Improved attenuation-correction algorithms and a PET/MR-specific healthy control database are recommended for reliable and consistent application of PET/MR for clinical neuroimaging.