Abstract:

PURPOSE: Spatial resolution in myocardial imaging is impaired by both cardiac and respiratory motion owing to motional blurring. We investigated the feasibility of a dual cardiac-respiratory gated positron emission tomography (PET) acquisition using a clinical PET/computer tomography (CT) scanner. We describe its implementation and present results on the respiratory motion observed.

METHODS: The correlation between diaphragmatic excursion measured by real-time magnetic resonance imaging (MRI) and the expansion of the chest measured with an elastic belt was studied in six subjects. PET list mode acquisitions were then performed in 12 patients, six of them injected with 13N-ammonia and six with 18F-FDG. In parallel, the ECG and respiratory signals of the patients were recorded and the list mode file correspondingly sorted using a dual gated approach. Respiratory motion of the heart was quantified by measuring the displacement between the inspiratory and expiratory images in the diastolic phase by means of intensity-based non-rigid image registration.

RESULTS: The correlation between diaphragmatic excursion and expansion of the chest was excellent (R2=0.91), validating the ability of the elastic belt to provide an adequate respiratory trigger. Respiratory signals corresponding to the chest expansion showed a large inter-patient variability,
requiring adapted algorithms in order to define suitable respiratory gates. Dual gated PET series were successfully acquired for both groups of patients, showing better resolved myocardial walls. The average respiratory motion of the heart measured by PET was 4.8 mm, with its largest component in the craniocaudal direction. Moreover, a deformation of the heart with respiration was observed, with the inferior wall moving significantly more than the anterior. CONCLUSION: Dual gated cardiac PET studies were performed successfully and showed better resolved myocardial walls as compared with ungated acquisitions. The respiratory motion of the heart presented a significant elastic component and was of the same magnitude as the spatial resolution of current PET cameras.