Improvement of Multislice Oxygen-Enhanced MRI of the Lung by Fully Automatic Non-Rigid Image Registration.

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Purpose
In oxygen-enhanced MRI of the lung (O2-MRI) [1], inconsistencies of respiratory phase may influence the quality of parametric O2-maps [2-3]. In this study, fully automatic non-rigid image registration was assessed as a postprocessing method to improve the quality of O2-MRI [4-6].

Method and Materials
Twenty healthy subjects (mean age: 49.4y; age range: 41–63y) were investigated on a 1.5-T scanner. O2-MRI was obtained in four coronal planes using a nonselective IR-HASTE sequence (TE/TI=12/1200 ms). In each subject, 30 images per slice location were obtained at O2 and room-air ventilation. Both datasets were aligned spatially using fully automatic non-rigid registration (5–10 sec per slice location). Nonregistered (NR) and registered (R) images were used separately as inputs to two post-processing algorithms that calculated pixelwise coefficient of variation of signal per each ventilation phase (CV-t maps), and relative enhancement ratio between oxygen and room-air ventilation (RERO2 maps, Fig. 1). From those parametric maps, mean CV-t and RERO2 of both lungs were calculated using regions of interest (CV-t-oxygen-NR, CV-t-oxygen-R, CV-t-roomair-NR, CV-t-roomair-R; RERO2-NR, RERO2-R); coefficients of variation expressing spatial heterogeneity of RERO2 maps were also assessed (CV-s-O2-NR; CV-s-O2-R). Within-group, within-subject and within-slice comparisons between NR and R datasets were performed.

Results
In registered datasets CV-t was significantly reduced: CV-t-oxygen-NR=6.6% vs. CV-t-oxygen-R=5.5% (p<0.01; Fig. 2), CV-t-roomair-NR=7.6% vs. CV-t-roomair-R=6.5 (p<0.01; Fig. 3). RERO2-R was similar to RERO2-NR (Fig. 4).

Registration reduced spatial heterogeneity of RERO2: CV-sO2-NR=45.3% vs. CV-sO2-R=34.1% (p<0.01; Fig. 5).

Discussions
In O2-MRI, lung signal is measured repeatedly during different breathing cycles [1-3]. Inconsistencies of respiratory phase may hamper the quality of the O2-maps [2-3]. In this study, fully automatic non-rigid registration [5-6] reduced spatial misalignment among images and signal variability within the lung. O2-induced signal enhancement was not influenced by image registration, whereas spatial heterogeneity of parametric O2-maps decreased significantly.

Conclusions
Fully automatic non-rigid registration is a rapid and effective postprocessing method to improve the quality of multislice O2-MRI of the lung.

References: