AbstractID: 13831 Title: Ventilation from Four Dimensional Computed Tomography: Density versus Jacobian Methods

Purpose: Two calculation methods to produce ventilation images from four-dimensional computed tomography (4D CT) acquired without added contrast have been reported in the literature. In previous work, we demonstrated a method to obtain ventilation images using deformable image registration and the underlying CT density information. A second method performs the ventilation image calculation from the DIR result alone, using the Jacobian determinant of the deformation field to estimate local volume changes resulting from ventilation. Two implementations of the Jacobian-based methodology are evaluated, as well as a density change-based model for calculating the physiologic specific ventilation from 4D CT. **Materials and Methods:** ^{99m}Tc-labeled aerosol single photon emission computed tomography (SPECT) is the standard clinical method used to obtain ventilation images in patients. The distributions of ventilation obtained from the CT-based ventilation image calculations are compared with those obtained from the clinical SPECT ventilation. The standard method is prone to airway deposition artifacts, which are further characterized. Seven patients with 4D CT imaging and standard ^{99m}Tc-labeled aerosol SPECT/CT ventilation imaging obtained as part of a prospective validation study were selected. **Results:** Results demonstrate the equivalence of the Jacobian-based implementations for quantifying the specific ventilation on a voxel scale. Additionally, both Jacobian- and density change-based methods correlated well with global measurements of the resting tidal volume. Finally, correlation with the clinical SPECT was assessed using the Dice Similarity Coefficient, which showed significantly higher (p-value $< 10^{-4}$) correlation with density change-based specific ventilation than with either Jacobian-based implementation. **Conclusion:** Both 4D CT ventilation methods performed well globally, showing good correlation with image segmentation-based measures of the resting tidal volume. However, CT density change-based calculations achieved better spatial correlation with clinically acquired SPECT images. Future work will directly address the impact of spatial registration errors on degradation of both density change- and Jacobian-based ventilation methods.