2013 Scientific Sessions
Saturday, October 12, 2013
1:00 – 5:00 p.m.

Presenter: James Costello, MD, PhD

Title of Abstract: **Quantitative Measurement of Pulmonary Biomechanics with MRI Lung Volumetry**

Institution: University of Arizona

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Modality: MR

Organ System: CV

Intro: To compare MRI quantitative measurements of lung biomechanics with the gold-standard of spirometry.

Purpose: With the combination of advanced MR imaging of the lungs and post-processing techniques using semi-automated atlas-based image segmentation, MRI functional imaging provides accurate and reproducible direct measurements of lung biomechanics, outperforming conventional spirometry.

Methods Used: The study received institutional review board approval and enrolled twenty control subjects with no respiratory disease history. Each control subject generated three sequential sets of static 3D GRE MR images at end inspiration and end-expiration. Employing a semi-automated atlas-based image segmentation technique, analysis of MR imaging data yielded direct measurements of forced vital capacity. During a subject's MRI data acquisition, three sequential spirometry measurements provided a reference standard for comparison.

Results of Abstract: With a strong linear correlation between forced vital capacity measurements ($R = 0.72$, $p = 0.001$), MRI lung volumetry compared accurately to spirometry. There existed no statistically significant difference between the accuracy of the two techniques, p-value = 0.69. MRI lung volumetry demonstrated an enhanced level of precision (average standard deviation of 0.09), outperforming conventional spirometry (average standard deviation of 0.253). A two-sided t-test distinguished a strong difference in the two technique's reproducibility of results (p-value = 0.07).

Discussion: MRI lung volumetry provides robust radiation free techniques to precisely and to accurately measure lung biomechanics in a single, fast, and repeatable examination. This direct volumetric technique contrasts with spirometry which indirectly assesses pulmonary biomechanics by evaluating differences in inspired and expired volumetric flowrate.

Scientific and/or Clinical Significance? On a reproducible basis, MRI lung volumetry represents a more dynamic tool to quantitatively assess changes in aerated lung volume. Diagnostic tools with high precision demonstrate enhanced sensitivity for assessing lung biomechanics and for potentially offering valuable insight into early diagnosis of disease progression. MRI lung volumetry can quantitatively measure small changes in lung performance with a level of accuracy similar to spirometry but with a measure of enhanced reproducibility unequaled by spirometry.

Relationship to existing work This work introduces a new quantitative technique to accurately and precisely measure pulmonary biomechanics.