The Influence of Reconstruction Algorithm On the Measurement of Airway Dimensions Using Computed Tomography


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Abstract

The assessment of airway dimensions is important in understanding the pathophysiology of various lung diseases. A number of methods have been developed to measure airways on computed tomography, but no study has been done to validate the different CT scanning techniques and reconstruction algorithms. In our study, we constructed an artificial “airway” phantom using hollow plastic tubes and foam blocks. The phantom was CT scanned using axial or helical techniques, and the images reconstructed using a very high spatial frequency (GE “lung”) algorithm, a high spatial frequency (GE “bone”) algorithm, or a low spatial frequency (GE “standard”) algorithm. Custom software was then used to analyze the “airways” and measure lumen area (Ai) and “airway” wall area (Aaw).

Materials & Methods

12 hollow plastic tubes used for axial/helical comparison, 14 tubes for algorithm comparison.

Tubes ranged from 6.35 to 31.75 mm in diameter and were either 1.59 or 3.18 mm thick.

Polyurethane foam block was used as the “lung”

The phantom was placed so that the tubes were perfectly aligned with the z-axis of the CT scanner. The measurement of airway wall dimensions is important for understanding the pathophysiological mechanism underlying lung diseases, such as:

- asthma
- chronic obstructive pulmonary disease (COPD)
- cystic fibrosis

Computed tomography (CT) may be precise enough to allow quantitative measurements of airway dimensions in vivo.

However, there is no study assessing the effect of the different reconstruction algorithms or the different scanning techniques on the validity of the measurements.

Purpose

To assess the effect of the different scanning techniques and the different types of CT scanners on the measurement of airway dimensions.

Comparative study of the different reconstruction algorithms.

Comparison of Axial vs. Helical

Comparison of Different Reconstruction Algorithms

Results

(1) Difference between two scanning techniques

CT measurements obtained using the single-slice CT scanner were not significantly different from those obtained using the multi-slice CT scanner (p>0.05).

(2) Difference between single and multi-slice CT scanners

CT measurements obtained using the single-slice CT scanner were not significantly different from those obtained using the multi-slice CT scanner (p>0.05).

(3) Differences between three reconstruction algorithms

There was less error in the measurements using the “Bone” or “Standard” algorithm.

Conclusions

CT measurement of airway dimensions is independent of scanning technique (axial or helical).

CT measurement of airway dimensions is independent of type of CT scanner used (single-slice or multi-slice).

A high-spatial frequency algorithm (i.e., GE “Bone”) is recommended for the CT measurement of airway dimensions.