

Trachea Air: Internal Reference Standard For CT Lung Densitometry

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RATIONALE: The nominal CT number of air is -1000HU. In contemporary multi-slice CT scanners, the CT number of air in the trachea is greater than -1000HU. Consequently, the value of trachea air CT number of an individual subject's image might be used as an internal reference standard for CT lung densitometry.

METHODS: The median trachea air CT number of 103 selected COPDGene subject images was measured. The median provides an estimate of the central tendency of trachea air CT numbers that is insensitive to their non-normal distributions caused by truncation of the CT numbers at -1024HU. A uniform body mass index (BMI) selection of smokers with normal spirometry was scanned using 6 different CT scanner models. The images reconstructed with the standard kernel were evaluated. In addition, 84 inspiration and expiration exam images from one scanner were analyzed.

RESULTS: The deviation of the trachea CT number from -1000HU ranged from 0HU to 80HU. A systematic variation associated with scanner model and BMI (Figure 1) was observed. The deviation of the trachea CT number from -1000HU increased as the collimation of CT scanner models increased. The Sensation16 (a 16 slice scanner) and Sensation64 (a 64 slice scanner) have similar collimations and similar deviations. The expiration trachea CT number deviations from -1000HU were greater the inspiration deviations (Figure 2).

CONCLUSIONS: Trachea CT number is unlikely to be useful as internal reference standard for individual lung density measurements because variations of configurations of the tissues surrounding the trachea cause it to vary. For example, during expiration the configuration of the tissues are different than inspiration and the CT numbers of trachea air increase. The increase of the trachea CT number associated with increased BMI and x-ray beam collimation suggest that trachea CT number is greater than -1000HU, because the CT reconstructions do not deal with detected scattered x-rays appropriately. These imperfect reconstructions will also cause lung density errors.

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Figure 1

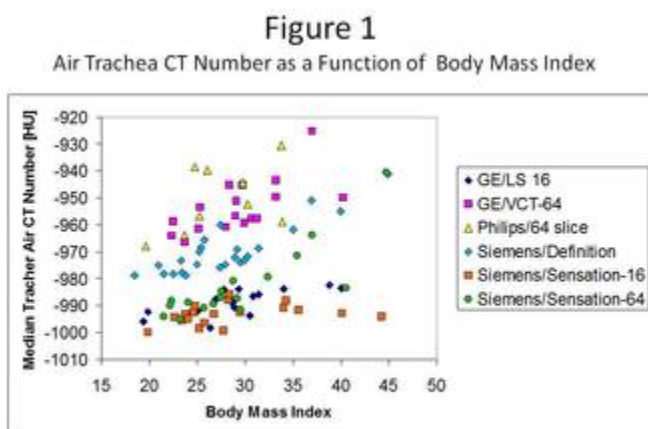
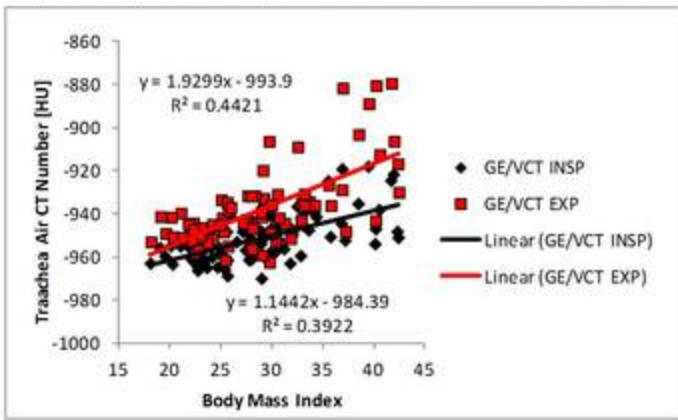


Figure 2

Figure 2

Inspiration-Expiration Comparison of Air Trachea CT Number in 84 Cases



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