QIBA Lung Density Technical Committee
Update

Thursday, May 22, 2014
Philip F. Judy

Current Status: Profile Development

- Lung Density Profile in progress:
  - Claims
    1. Precision Claim limited by validity/acceptance of volume correction
    2. Bias Claims: Will use fraction of lung less than -950 HU and Perc15 as reference standards
  - Status of Section 3
    1. Standardize evaluation of AEC and iterative reconstruction for quantitation
      A barrier to clinical application is radiation dose level
    2. Describe and validate volume correction
  - Status of Section 4 (Compliance Procedures)
    Describe use of the COPDGene Phantom – Will use MOP developed by U of Iowa and used in several multi-institutional studies as basis.
1. Precision Claims: Precision Claim limited by validity/acceptance of volume correction

- “Densitometric progression was closely related to changes in lung volume and a significant proportion of the density loss appeared to be related to apparent ‘progressive hyperinflation’.”
- The basic metric using the volume correction is the lung tissue mass. Volume correction eliminates biological information.
- Medical utility of lung tissue mass metric is an open question.

2. Bias Claims: Will use Fraction of lung less than -950 HU and Perc15 as reference standards

- Example – Bias of fraction less than -960 HU
- We have demonstrated that the fraction ratio plotted as function of the fraction average is equivalent to the Bland-Altman of log transformed fraction.
2. Bias Claims: Will use Fraction of lung less than -950 HU and Perc15 as reference standards

- This plot demonstrated that the Fraction of lung less than -960 HU is as much as 0.5 the Fraction of lung less than -950 HU.
- Large variations at smaller fraction suggests that single parameter description of lung histogram is too simple. We will need a more complex model to characterize the full range of lung densities.

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1. Standardize evaluation AEC and interactive reconstruction for quantitation

Summary of Automatic Exposure Control (AEC) Results on the GE Discovery CT 750 HD Scanner with Preliminary Results from the Siemens Definition 64 Scanner

A Rodriguez, F Ranallo, SB Fain
UW-Madison

Experimental Design

Phantoms are COPD Gene with:
- A: 25 X 35 cm urethane attenuation ring that is near water electron density (standard)
- B: 30 X 38 cm urethane attenuation ring (elliptical)
- C: 38 X 38 cm urethane attenuation ring (circular)

• Standard Lung protocol for Severe Asthma Research Program (SARP)
  - Median target dose (~ 100 mAs)

Phantoms used

- A
- B
- C
1. Standardize evaluation AEC and iterative reconstruction for quantitation: Summary/Conclusions

- Azimuthal variation is best tested by the larger 30 x 38 cm and 38 x 38 cm dimension rings but none of the rings show significant variation in azimuthal attenuation or mA in the Smart mA mode.
- Variation in mA (and dose) can be tested for a fixed noise index (or reference mAs) using all three rings - attaining 3 levels of attenuation:
  - Using the Siemens CareDose 4D, all 3 phantom sizes produced mAs values that were less than the set target effective mAs and therefore had [absorption] less than the reference standard patient as determined by Siemens.
- The AEC modes of the GE and Siemens scanners produced significantly different variations in mAs from the smallest to largest phantoms:
  - The GE scanner produced an mAs variation of nearly 7
  - The Siemens scanner produced an mAs variation of only about 4
  - This will affect the variation of noise and patient dose for the different scanners.

2. Describe and validate volume correction

1. Volume correction is a procedure that corrects density measurements caused by variations in level of respirations.
2. We are modeling the lung histogram to predict published effects of volume corrections in humans and phantoms to validate volume correction.

H. Chen-Mayer, P Judy, B. Stoel
Activities/Projects In Progress

- Presently no NIBIB-funded projects
- Future project proposals
  - Standardize Evaluation AEC and iterative reconstruction for quantitation
- Other activities
  - QIBA/STR Lung QCT Conference - March 15, 2014
  - Volume correction – Precision
  - Histogram modeling for bias determination

Standardize Evaluation AEC and iterative reconstruction for quantitation
PI: Sean Fain, UW-Madison

- Primary goals and objectives
  - To determine the impact of AEC and IR for qCT of lung density and airway measurements across scanner platforms.
  - To establish equivalent performance for AEC and IR across the major vendor platforms represented in the installed base of 64 slice systems (e.g. GE, Siemens, Philips, Toshiba).
  - Vendors investigators involved
    • Siemens (Matthew Fuld)
    • Toshiba (Bernice Hoppel)
    • Philip and GE (Investigators needed)
Challenges/Next Steps/Future Plans

• Will use audit of DICOM Header for compliance to specifications, so buy-in by vendors is critical
• Vendor investigator comments on acquisition and reconstruction specifications.
  • Siemens (Matthew Fuld)
  • Toshiba (Bernice Hoppel)
  • Philips and GE (Investigators needed)
• Effective collaboration with CT vendors and Analysis Computer Program vendors has been baries – Will go to their meeting (SPIE).