Subtraction Imaging for Improved Detection of Change in Ground Glass Nodules in Chest Computed Tomography

Purpose

To demonstrate that image subtraction improves detection of change in pulmonary ground glass nodules identified on chest CT.

Methods

We recruited 33 participants with 37 ground glass nodules from a lung cancer screening trial. Each participant had at least one follow-up scan (86 scans total; 2 to 4 scans per participant). Pairs of scans of the same nodule were presented in random order, and 4 observers with varying experience in chest CT were asked to rate growth and density change between the two images (increase, no change, decrease). The experiment was repeated with a new random sequence, where additionally subtraction images (after data registration) were provided for each pair of nodules. An experienced chest radiologist established a reference standard using all available information. Weighted kappa statistics κ_w were used to assess inter-observer agreement and agreement with the reference standard.

Results

The reference standard established a regression over time in 5/37 ground glass nodules and no change in 16/37 nodules. In 16/37 nodules the size increased, and in 8/16 nodules density increased as well. When the subtraction image was available, average inter-observer κ_w improved from 0.46 to 0.53 for size change and from 0.36 to 0.50 for density change. Average agreement with the standard of reference improved from $\kappa_w = 0.53$ to 0.63 for size change and from 0.48 to 0.57 for density change.

Conclusion

Subtraction imaging improves the detection of subtle changes in pulmonary ground glass nodules and decreases intra-observer variability.