Purpose:

To compare lung volume and respiratory motion in supine and upright positions to assess the potential advantages of treating thoracic cancer patients in an upright position.

Methods:

A multi-position MRI scanner (FONAR, Melville, NY) was used to take MRI images of 4 healthy volunteers in both supine and upright setup positions (expected total accrual: 15 volunteers). In each case, a volumetric scan was acquired during breath-hold at end of normal expiration, followed by a series of sagittal cine MR scans taken during normal respiration. The exhale volume images were imported into a treatment planning system and lung volumes were delineated and compared for different setup positions. The trajectory of points inside the lung were tracked in the cine images and analyzed using a deformable image registration technique and a principal component analysis (PCA) model.

Results:

The average exhale lung volume was 38% (894cc) larger (range: 23%-57%, 570-1211cc) when volunteers were in the upright position compared with the supine position. The amplitude of motion for a set of landmark points in the lung volume ranged from <2mm (distant from the diaphragm) to 29 mm (close to the diaphragm) in the superior-inferior direction. A linear fit to the amplitude of respiratory motion vs. distance from the diaphragm for all 4 volunteers indicated no difference on average in the range of motion for the two setup positions, but there was variability between individuals.

Conclusions:

While the magnitude of motion was similar, the absolute lung volumes were much larger in the upright position than in the supine position, which suggests that treating thoracic patients in the upright position may allow for a reduction in the mean lung dose.

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