Purpose: To assess the prognostic significance of changes in segmented lung volume, a physiological correlate of tumor volume changes, during the course of chemotherapy for patients with mesothelioma.

Methods: Serial chest CT scans were collected during the course of platinum-based chemotherapy for 64 patients with confirmed unilateral mesothelioma between 2002 and 2010. Lung volumes for each scan were calculated using an automated segmentation technique, the results of which were manually reviewed for accuracy prior to volume calculation. Diseased (ipsilateral) lung volumes were normalized by the respective contralateral lung volumes to account for differences in respiratory phase between the scans of each patient. Lung volume trajectories were modeled as the difference between normalized ipsilateral lung volumes at baseline and first therapy follow-up imaging time points (median span: 35 days). Correlation between volume changes and overall survival from diagnosis was assessed using the Log-Rank test and Cox Proportional Hazards modeling.

Results: Between baseline CT and first follow-up CT, the geometric mean of lung volume trajectories indicated a 6% increase in ipsilateral lung volume (and, by logical extension, a corresponding decrease in tumor volume). When discretized as lung volume gain versus volume loss, patients experiencing volume loss (n=21) had a median survival of 12.6 months, whereas patients with lung volume gain (n=43) had a median survival of 17.9 months (Log-Rank p=0.0028). As a continuous numerical parameter, lung volume trajectory was a significant imaging biomarker of patient prognosis (p=0.0044) in a multivariate model including histology, a known prognostic covariate.

Conclusions: Analysis of lung volume trajectories during the course of chemotherapy for patients with unilateral mesothelioma indicates that increases in lung volume are significantly associated with prolonged patient survival. This work motivates future investigations of lung volume as a therapy response metric, since changes in lung and tumor volumes are physiologically correlated.