Abstract ID: 15203 Title: A novel technique to use CT images for in vivo detection and quantification of the spatial distribution of radiation-induced damage to the esophagus

Purpose: Current dose-response studies use symptom endpoints (e.g. grade 2 esophagitis) as substitutes for data about actual tissue damage. CT imaging could provide objective spatial data on radiation-induced damage to the esophagus in lung cancer patients.
Methods: Deformable image registration techniques were used to register weekly CT images taken during radiotherapy treatment with the original planning CT image. The esophagus contours were automatically mapped. The impact of day-to-day variations in the degree of collapse of the esophagus was reduced by using thresholding to remove air from the esophagus. The cross-sectional area of the esophagus was then calculated for each CT slice. The results from surrounding slices were averaged to reduce apparent abrupt steps in cross-sectional area between adjacent CT slices caused by varying undulations/folds in the esophagus. Finally, the relative expansion of the esophagus was calculated as the ratio of the cross-sectional area of the esophagus in the weekly CT (minus air) to that on the corresponding CT slice in the planning image. This technique was applied to weekly CT images of 5 lung cancer patients (35 CTs), with acute esophageal toxicity grade 0 to 3. For these patients we examined (1) The correlation between the relative expansion of the esophagus and the clinical toxicity grade, and (2) the correlation between the spatial dose distribution and the spatial variation in esophageal expansion.
Results: The average maximum esophageal expansions for toxicity grades 0, 2, and 3 were 1.2, 1.7 and 1.9, respectively. The difference between grade 2 and 0 was statistically significant ($p=0.008$). The location and degree of variation of the changes in esophagus cross-section were found to be related to the high dose given at the same location.
Conclusion: Radiation-induced injury to the esophagus can be detected in CT images. This has potential for use in dose-response studies.