AbstractID: 10913 Title: Modeling tumor-volume variation during fractionated radiotherapy for non-small cell lung cancer

Purpose: To validate the four-level population tumor model using tumor volumetric changes obtained using on-board imaging techniques during fractionated radiotherapy for non-small-cell lung cancer.
Method and Materials: The four-level population tumor model is based on separation of tumor cell population into four subpopulations: 1) oxygenated viable cells, 2) oxygenated lethally damaged cells, 3) hypoxic viable cells, and 4) hypoxic lethally damaged cells. The oxygenated lethally damaged cells are removed from tumor using an exponential decay model. The hypoxic lethally damaged cells stay in tumor for unlimited time; therefore, their removal is governed by reoxygenation process. The model utilizes the following six radiobiological parameters: alpha, beta, potential doubling time Tpot, half-life T1/2 of lethally damaged cells, initial hypoxic fraction R and reoxygenation rate A. To test the model, we use the clinical data on volumetric tumor changes during fractionated radiotherapy for non-small-cell lung cancer obtained using Tomotherapy and Cone-Beam CT at different institutions.
Results: Our preliminary data indicate that adenocarcinoma and squamous cell carcinoma demonstrate different rate of tumor volume variation after irradiation; therefore only cases have been selected where adenocarcinoma o squamous cell carcinoma diagnosis was available. Another problem of accurate tumor-volume simulation for lung tumors is a significant hypoxic tumor fraction according to the experimental data obtained using fluoromisonidazole PET imaging. The hypoxic tumor fraction can be between 1.3% and 94.7.9% with a median value of 47.6%. Our model with average values of radiobiological parameters describes majority of lung squamous carcinoma cases. However, significant discrepancies have been observed between the model and clinical data for lung adenocarcinoma.
Conclusions: The proposed radiobiological model with average values of parameters can be used for simulation of tumor-volume for lung squamous cell carcinoma with acceptable accuracy. However, this approach does not describe the tumor volume variation for significant fraction of lung adenocarcinoma cases.