AbstractID: 10440 Title: Tumor Cell Survival Dependence on the Dose Delivery Modalities and a Statistical Model to Bridge in Vitro Results and Clinical Outcome

Abstract:

Purpose: To study the influence on tumor cell survival from state of the art radiation therapy techniques and to model tumor cell survival after a 30 fraction 60 Gy treatment with the assumption of tumor cell intrinsic heterogeneity.

Methods and materials: Fractions of 2 Gy radiation were delivered to H460, PC3 and MCF-7 cells by Helical TomoTherapy (HT), 7 field radiation therapy (7F) simulating conventional IMRT delivery, and 2 minute continuous dose delivery (CDD), simulating recently developed volumetric rotational arc therapy (ie Elekta VMAT and Varian Rapid-Arc). Cell survival was determined by Clonogenic assay. A statistic model that assumes the normal distribution of the relative cell survival was developed to predict the cell survival after 30 fractions of treatment.

Results: The H460 and MCF-7 cells showed strong dependency on the treatment modalities. The number of viable H460 cell colonies was 23.2% and 27.7% lower in group irradiated by CDD compared with HT and 7F respectively, the values were 36.8% and 35.3% for MCF7 cells. The differences between CDD and HT or 7F were not significant for PC3 cells. Statistical modeling indicates that instead of the several magnitudes of survival difference predicted by simple exponential extrapolation, the reduced tumor cell killing due to spatial and temporal modulation is in the range of 10% to 30% for a wide range of means and standard deviations in the model.

Conclusions: Tumor cell survival may be strongly dependent on the dose delivery pattern in a single 2 Gy fraction, but the difference did not expand exponentially with the increasing number of fractions if tumor cell heterogeneity was considered. The survival difference plateaus in such a way that may be difficult to observe for patient population with large heterogeneity. Continuous dose delivery may still improve the tumor control from intensity modulated radiation therapy.