AbstractID: 10671 Title: Outcome Prediction of Cervical Cancer: Kinetic Model of Tumor Regression during Radiation Therapy

Purpose: A kinetic model on describing tumor response to radiation therapy (RT) was developed to analyze the tumor regression data and predict the RT outcome for cervical cancer.

Methods and Materials: Eighty patients of cervical cancer (stages IB2-IVA) completed four sequential magnetic resonance imaging (MRI) scans before, during and after RT. The median follow-up time is 5.5 years (range 0.2–9.4 years). A kinetic model incorporating three major effects: radiation cell killing, dead-cell resolving, and tumor repopulation, was developed to fit the volumetric regression data measured by serial MRI scans. The derived radiobiological parameters were correlated with long-term clinical outcome.

Results: The tumor regression kinetics was significantly different for the two outcome groups: local control vs. local failure. The tumor regression rate and model parameters correlated significantly with the treatment outcome ($p<0.001$), with a median 2-Gy surviving fraction (S_2) of 0.65 and a median half-time of dead-cell resolving ($T_{1/2}$) of 7.9 days for locally controlled tumors, vs. $S_2=0.70$ and $T_{1/2}=18$ days for locally recurrent tumors. The 6-year local tumor control rate was 87% vs. 54% for patients with $S_2<0.70$ vs. ≥ 0.70 ($p=0.001$), and 95% vs. 57% for patients with $T_{1/2}<22$ days vs. ≥ 22 days ($p<0.001$), respectively. Similarly the 6-year disease-free survival was 73% vs. 41% for the patients with $S_2<0.70$ vs. ≥ 0.70 ($p=0.025$), and 87% vs. 52% for patients with $T_{1/2}<22$ days vs. ≥ 22 days ($p=0.002$), respectively.

Conclusion: The kinetic model well fits the temporal change of 3D tumor volume measured by serial MRI. Our data demonstrated that the locally recurrent tumors were not only radioresistant, but also had slow dead-cell resolving probably due to the poor tumor microcirculation. This approach shows promise for volume-based tumor response modeling and potential to refine outcome prediction.