AbstractID: 5215 Title: Estimate of radiobiological parameters from clinical data for treatment planning of liver irradiation

Purpose:
Several different dose fractionation regimens are being developed in clinical trials for liver irradiation. For example, RTOG is initiating a new hypofractionation regimen (RTOG 0438) to treat liver cancer patients. To evaluate the radiobiological equivalence between different regimens, which is useful in the design of these trials, requires reliable radiobiological parameters. The purpose of this work is to estimate a plausible set of such parameters for liver tumor based on published clinical data.

Method and Materials:
A phenomenological expression inspired by the linear-quadratic (LQ) formalism was developed to fit a series of clinical survival data for radiotherapy of hepatocellular carcinoma patients. The data are from different institutes using different fractionation (e.g., 1.5, 1.8 or 4.88 Gy). The phenomenological expression consists of 6 fitting parameters including radiosensitivity parameters α and α/β, potential doubling time $T_{b,}$ and clonogenic cell number K. The expression considers the prescription dose, dose per fraction, overall treatment time and the elapsed time at which the survival data were collected. We have developed an algorithm to take into account the tumor cell repopulation during the elapsed time.

Results: The newly developed phenomenological expression was found to fit well to the available clinical data. Based on the fitting, we have estimated a set of plausible radiobiological parameters for liver tumor: $\alpha/\beta = 12.8 \pm 1.0$ Gy, $\alpha = 0.013 \pm 0.002$ Gy, the potential doubling time: 123 ± 9 days, and colonogenic cell number: 1302 ± 47. Using this set of parameters we have calculated a series of dose fractionation regimens that are biologically equivalent based on BED.

Conclusion: A plausible set of radiobiological parameters have been obtained based on clinical data. These parameters may be used for radiation treatment planning of liver tumor, in particular, for the design of new treatment regimens aimed for dose escalation.