AbstractID: 8201 Title: A linear-quadratic-linear formulation to model radiation dose-response

Purpose: Recent technological advances enable radiotherapy to be delivered in a highly conformal manner almost anywhere in the body. This has renewed interest in hypofractionation wherein the tumor is delivered a few fractions of large dose/fraction. Extrapolating clinical experience with conventional fractionations to fractions of high dose is important when designing hypofractionated regimens. **Methods and Materials:** The concept of biologically effective dose (BED) based on the linear-quadratic (LQ) formulation $e^{-(\alpha D + \beta D^2)}$ is useful for intercomparing conventional fractionations but is suspect at high dose because the LQ curve bends continuously on the log-linear plot. A linear-quadratic-linear (LQ-L) formulation which better fits the final exponential response of experimental dose-response studies at high dose is described. This new formulation requires only one new term, the dose D_T at which the LQ curve transitions to a linear tail. LQ-L is applied to published dose-response curves and the clinical implications of LQ-L are examined across a wide range of fractionations. **Results:** For fractions of high dose, the LQ formulation underestimates the dose per fraction required to maintain equivalency with conventional regimens. The LQ-L model fits a wide variety of experimental survival data over a wide range of dose. When $D_T = 2\alpha/\beta$ Gy, the line tangent to the LQ curve at D_T intersects the $e^{-\alpha D}$ and $e^{-\beta D^2}$ curves at dose α/β and also closely fits the linear response in the high dose region of many *in vitro* studies. **Conclusion:** For fractions of high dose LQ-L gives better estimates of BED than LQ because LQ-L better fits experimental dose-response in the high dose region. This is particularly important when planning hypofractionated regimens for reactions with low α/β such as prostate cancer or late sequelae because $D_T \approx 2\alpha/\beta$ Gy for these reactions falls within the contemplated range of hypofractional doses.