AbstractID: 3113 Title: Radiosensitivity parameters for aerobic and hypoxic cells are related by a simple formula

Purpose:
Cells irradiated in an aerobic environment are much more sensitive to radiation than hypoxic cells. Although some new imaging modalities have the potential to provide information about the spatial distribution of hypoxic cells within a tumor, the question of how much additional dose must be delivered to hypoxic tumor regions to improve local tumor control requires estimates of intrinsic radiosensitivity parameters. Mechanistic considerations suggest that linear quadratic (LQ) parameters for hypoxic and aerobic conditions are related by $\alpha_H = \alpha_A / f$ and $(\alpha/\beta)_H = f \cdot (\alpha/\beta)_A$, where f is the ratio of DNA damage formed under aerobic to hypoxic conditions. *In vitro* cell survival data for five cells are used to examine the validity of the proposed expressions.

Method and Materials:
Estimates of α_H and $(\alpha/\beta)_H$ derived from a weighted least-squares fit to the survival data for hypoxic conditions are compared to estimates obtained from a three parameter [f, α_A and $(\alpha/\beta)_A$] fit to data for aerobic and hypoxic conditions. The paired bootstrap technique for regression is used to compute 95% confidence intervals on parameter estimates.

Results:
For all five cell lines, good fits to the survival data are obtained with values of f between 2.3 and 3.3. The estimated range for f is strikingly similar to the oxygen enhancement ratios reported in the literature for many types of DNA damage. The value of f also decreases as particle LET increases, as expected.

Conclusion:
Analysis of the *in vitro* survival data provides strong support for the hypothesized relationship between LQ parameters under aerobic and hypoxic conditions. The studies also suggest the intriguing possibility that radiosensitivity parameters for hypoxic cells can be estimated from parameters for aerobic cells (or vice versa) by introducing a single parameter (f) that is nearly independent of cell type.