Purpose:

Repair kinetics of radiation damage in mouse lung remains controversial. Using the generalized LQ (gLQ) model that was developed to address the dilemma of the LQ model in high dose range we investigate repair kinetics of mouse lung to radiation.

Methods:

In an animal study (Vegesna et al. Radiother Oncol 1989; 15:115), mouse lungs were irradiated with repeated dose from 1.6 Gy to 14.3 Gy. The endpoint was death due to radiation pneumonitis. A repair half-time $T_{1/2}=1.5$ hour derived from the data of reciprocal of LD50 (lethal dose for 50% mortality) vs. dose-per-fraction was much longer than the repair half-time of 0.4 hour published in the literature. In this study, the same dataset was reanalyzed by using both the LQ and the gLQ models. The least $\chi^2$ method was adopted to fit the data and to evaluate the merit for the two models.

Results:

The combined repair half-times of 0.4 and 4 hour were used in the gLQ and LQ models, the gLQ model fit the data better than the LQ model: the reduced $\chi^2$ is 0.46 vs. 3.8, and $a/\beta$ is 2.4 vs. 2.6, respectively. However, when only the fast mode of repair time (0.4 hour) was used, the LQ model couldn't produce the downward curvature based on the low dose data while the gLQ predicted well the high dose data. The gLQ model fit the data much better than the LQ model: the reduced $\chi^2$ is 0.16 vs. 2.3, and $a/\beta$ is 2.4 vs. 3.0, respectively, yielding the consistent $a/\beta$ ratio.

Conclusions:

The gLQ model provides a consistent interpretation of the mouse lung data across fraction sizes up to 14 Gy. Therefore, the gLQ model is able to extend our clinical experience accumulated from conventional low-dose fractionation to high dose irradiation schedules, including SRS/SBRT and HDR brachytherapy.