A Mouse Model Is Useful For Evaluating Different Approaches of High-Dose Radiotherapy

Corresponding author: Juong G. Rhee

1. Radiation Oncology, University of Maryland School of Medicine, Baltimore, USA 2. Radiation Oncology, University of Maryland, Baltimore, USA 3. Radiation Oncology, University of Maryland School of Medicine 4. Radiation Oncology, University of Maryland

Categories: Medical Physics, Radiation Oncology
Keywords: grid, spatially fractionated radiation therapy (grid), lattice radiotherapy, microbeam radiotherapy

How to cite this abstract

Abstract

OBJECTIVES: High-dose radiotherapy has merits in treating bulky human tumors. Three different approaches were evaluated by using an animal model.

METHODS: The dorsal skin of C3H/HeJ mice was shaved, lifted, and sutured on a titanium holder to fix the skin for a known geometry. The holder has an oblique open window (16x14 mm), where pluripotent mouse NE cells were injected into the skin. Tumor growth was monitored by using a caliper.

RESULTS: To simulate stereotactic body radiation therapy (SBRT), tumors grown to 5-10 mm in diameter were irradiated with 13 Gy daily for 4 days for a total of 52 Gy of 250 Kv X-rays (2.2 Gy/min). Among 14 tumors exposed, 13 of them were not regrown during 36 days of observation period. The cure rate for SBRT was 13/14 (93%).

A miniature version of existing MLC grid was milled with copper blocks to make 25 holes of 2.0 mm squares (1:3 open-to-closed ratio), which was converged from the source of the X-rays. This grid allows ¼ of target area (oblique window) to be exposed. The 52 Gy (SBRT dose) was delivered to each quarter daily for 4 consecutive days to cover the whole 4 quarters of target area exposed, which is called quadruple grid radiotherapy (QGRT). The cure rate for QGRT was 9/12 (75%).

When skin fur regrowth in irradiated area was quantified as a sign of recovery, a Student’s t-test showed that the regrowth for QGRT was much greater (p=0.0003) than that for SBRT.

In QGRT trials, some low-dose pockets were noted, so that the grid opening was widened from 2.0 to 2.4 mm squares, in which beam overlap was inevitable. To compensate the dose (9.7%) caused by overlaps, a priming dose (8-12 Gy) was adopted prior to quadruple grid exposures. This modified treatment plan is named as wQGRT. The cure rate for wQGRT was 13/15 (87%).

Chi-squared test shows that tumor cure rates among SBRT, QGRT and wQGRT are not different (p=0.451).

CONCLUSIONS: Our mouse model appears to be useful in evaluating that wQGRT offers tumor cure rates equivalent to SBRT, and with reduced normal tissue damage.