The Effect of Light Intensity as Determined by Cage Rack Position on Tumor Growth in a Mouse Model of Melanoma

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Abstract

Within the typical laboratory animal housing facility, animals may be exposed to varying intensities of light as a result of cage type, cage position, light source, and other factors. While evidence exists that light contamination during the dark phase of the light cycle can impact the growth of tumors in laboratory rodents, no studies evaluating the differential effect of light intensity during the light phase on tumor growth have been published. The effect of cage face light intensity as determined by cage rack position was evaluated in the C57Bl6 mouse model of melanoma using transplantable B16F10 cells. Animals were housed in individually ventilated cages placed at the top, middle, or bottom of the rack in a diagonal pattern so that the top cage was closest to the ceiling light source, 10 mice per light exposure group. Cage face light intensity was measured with a digital illuminance meter to be 3.1 lx (bottom), 169.0 lx (middle), and 320.8 (top) lx. Following a two-week acclimation period at the assigned cage position, animals were administered 1.3 x 10^6 B16F10 melanoma cells subcutaneously. Tumor diameters of mice were measured with a digital caliper at days 12, 15, and 18. ANOVA analysis of tumor diameters showed the middle light intensity group to have significantly smaller ($P < 0.001$) tumors on every day they were measured compared to high and low light groups. Likewise, when mice were euthanized 18 days after tumor cell administration, mean tumor weight was significantly (P <0.001) less in middle light intensity mice (1.21 $\pm$ 0.79 g) compared to high (6.32 $\pm$ 2.74 g) and low (5.98 $\pm$ 3.25 g) light intensity mice. In summary, the light intensity to which animals are exposed may vary markedly with cage location and can significantly influence experimental tumor growth, thus supporting the idea that light is an important experimental variable.

Objective

Illumination is noted in the 8th edition of *the Guide* to be an important experimental variable, with intensity sufficient to accommodate both animal care and the well-being of animals being the overall goal. However, within the typical housing environment, light intensity can vary substantially based upon cage position in relation to the light source, thus representing a potential experimental variable. The objective of this study was to evaluate the effect of light intensity as determined by cage rack position on tumor growth in a mouse model of melanoma.

Procedure

- B16-F10 mouse melanoma cells (ATCC, Manassas, VA) were grown to confluence in DMEM media containing 10% FBS and 1% Penicillin-Streptomycin. Thirty 6-8 week-old female C57Bl6 mice (Harlan, Indianapolis, IN) were each administered (SC) 1.3 x 10^6 B16F10 melanoma cells over the flank.
- Animals were housed in individually ventilated cages placed at the top, middle, or bottom of a 98-cage Allentown rack (10 mice per position, 5 mice per cage) in a diagonal pattern so that the top cage was closest to the ceiling light source. For each position there were two cages located side by side.
- Racks were full and cages were bedded with hardwood bedding. Mice were provided ad libitum access to feed and water.
- Cage face light intensity was measured with a digital illuminance meter to be 3.1 lx (bottom), 169.0 lx (middle), and 320.8 (top) lx. Intensity was measured twice weekly to ensure consistency of light intensity.
- The tumors were allowed to grow for 18 days before the mice were euthanized.
- Tumor diameters of mice were measured with a digital caliper at days 12, 15, and 18.
- Samples of tumors were fixed for in 10% NBF for histology.
- All data were analyzed using one-way ANOVAs followed by Tukey's HSD using the statistical computing program R (R Foundation for Statistical Computing). Differences were considered significant when $P < 0.05$. Rates of growth were calculated as linear.

Results

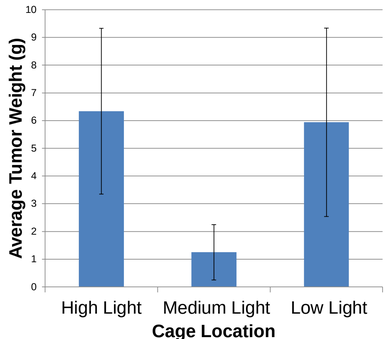

Figure 1. Melanoma tumor weights in C57mice by light intensity.

Results

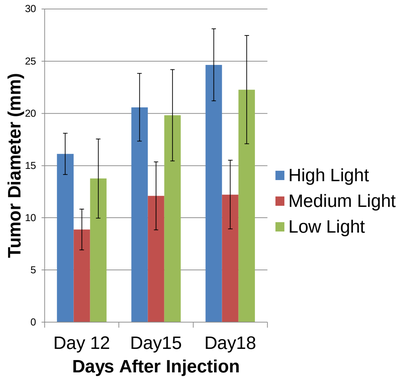

Figure 2. Melanoma tumor diameter in C57 mice by light intensity

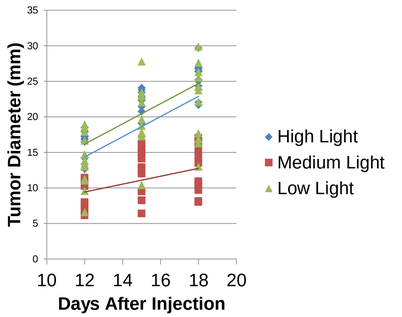

Figure 3 Melanoma rate of growth in C57 mice by light intensity

Conclusion

The middle light intensity group (169 lx) had significantly smaller ($P \leq 0.001$) tumors on every day they were measured compared to high (320 lx) and low (3.1 lx) light groups. There was no significant difference noted between high and low light tumors ($P > 0.05$). These findings reflect and confirm that not only were tumors in high and low light intensity mice larger, but they also grew faster. In summary, light intensity as determined by cage position may significantly impact experimental results and is, therefore, an important experimental variable.