Predicting the Cancer Cure Rate Improvement for Combined Gene Therapy and Radiation Therapy

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Lay-language version of paper MO-E-517B-7
Monday, July 15, 2002
AAPM/COMP/CCPM Meeting, Montréal, Quebec

Genetic radiotherapy, an innovative marriage of gene therapy and radiation therapy, can increase cancer cure rates by significant amounts compared to the cure rates offered by radiation treatment alone, we have found. In genetic radiotherapy, cancer cells are infected with a virus that makes these cells more sensitive to--and more easily destroyed by--radiation such as x rays. This technique is currently evolving from laboratory studies to human clinical trials. Since this is a new technique, no data exists on the cancer cure rates that this technique can offer. In this work we have developed a model to predict the increase in cancer cure rates for genetic radiotherapy.

Our model incorporates human patient data from large clinical trials as well as experimental data from laboratory work. To calculate the projected cancer cure rates, the model considers the fraction of cells in the tumor that are genetically modified (transduced), and the amount by which these genetically transformed cells increase their sensitivity to radiation.

An example of our results is shown in the attached figure, which highlights that the impact of genetic radiotherapy is likely to be
maximized when all of the tumor cells have become genetically modified. Analyzing presently achievable laboratory capabilities, we predict an increase in cure rate of 15% when genetic radiotherapy is used instead of conventional radiation treatments on non-genetically-altered cancer cells. Exploring an ideal situation in which all of the cancer cells are genetically modified, we find the technique can theoretically increase the cancer cure rate by as much as 70%. Thus our results indicate that genetic radiotherapy has the potential to significantly improve cancer cure rates compared to conventional radiotherapy.

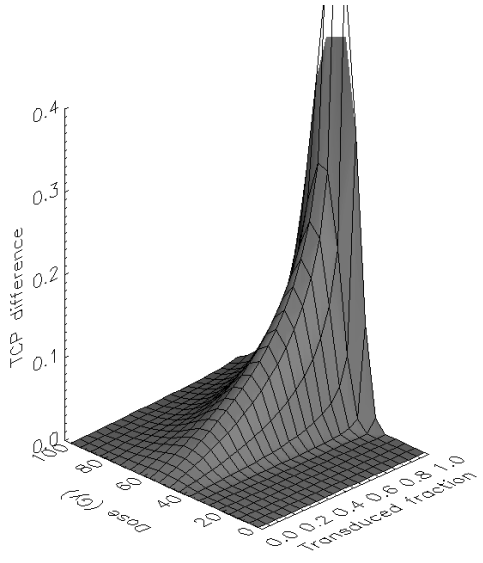

Figure caption. The TCP, or predicted cure rate, increase for genetic radiotherapy compared to radiotherapy only (z-axis) is plotted as a function of the radiotherapy dose (y-axis) and the fraction of genetically modified (transduced) cells (x-axis). This figure shows that the impact of genetic radiotherapy is likely to be maximized when all of the tumor cells have become genetically modified.