Treatment planning for radiation mediated gene therapy

Planning for gene therapy, alone and in combination with radiation, poses problems similar in some respects to those encountered in planning for external beam radiotherapy, brachytherapy and radioimmunotherapy. Modeling of the modulation of radiosensitivity, radioprotection and direct cell killing by gene therapy agents can aid in optimization of gene and radiation fractionation regimes. This combines aspects of biological modeling of radiation response in tumors and normal tissue, and of biodistribution calculations for radioimmunotherapy. Image-based evaluation of therapy effects may facilitate adaptive treatment strategies analogous to those previously developed for external beam therapy. Integration of information from anatomic and functional imaging modalities will be essential to the success of such an approach. Simultaneous optimization of distributions of radiation dose and gene therapy agent, similar to inverse planning of IMRT dose distributions, may also prove useful. Incorporation of biological modeling directly into this planning process will be a key challenge.