

AbstractID: 6707 Title: A three-phase strategy for a partial implementation of biologically guided radiation therapy

**Purpose:**

Rapid advances in imaging and delivery technologies and our understanding of radiation responses herald the coming of the long-sought goal of practicing patient-specific biologically-guided radiation therapy (BGRT). In this work, we propose a three-phase, incremental approach for the clinical implementation of BGRT.

**Method and Materials:**

BGRT, beginning with patient-specific radiobiological parameters that may be extracted from biological images, can be implemented in three phases. Phase I includes planning population-based treatments with empirical knowledge of tumor and normal-tissue responses followed by plan evaluation with dose-volume parameters as the primary criteria and outcome predictions as secondary criteria. Phase II involves the use of biological images and/or tissue assays to identify tumor region of radioresistance, use of outcome modeling to estimate a dose boost needed to overcome the radioresistance, development of a treatment plan to deliver the boost which does not reduce the dose to other tumor regions and maintains the desired dose to all critical organs, and plan evaluation with outcome prediction models. In Phase III, individualized-BGRT plans derived using the validated outcome prediction models developed in Phases I and II are iteratively refined based on spatial and temporal varied patient-specific information. In all three phases, treatments will be delivered with image guidance. The 3D dose actually delivered to an individual patient will be documented. Patients will be periodically evaluated with imaging and/or assays. The acquired follow-up tumor and normal-tissue response data will be used to refine outcome prediction models.

**Results:**

A three-phase approach for a partial implementation of BRGT is proposed. An example of using physiological MRI to extract patient-specific radiobiological parameters required for BGRT is presented.

**Conclusion:**

The full implementation of BGRT in the clinic will require new technologies and additional research. However, even the partial implementation of BGRT treatment planning has the potential to improve clinical outcomes.