AbstractID: 7788 Title: TCP MODEL PARAMETERS - EXTRACTING THESE FROM CLINICAL DATA ON 'MOVEABLE' PATIENTS

The Tumor Control Probability function (TCP, Webb & Nahum) models radiation induced cell kill and uses Poisson statistics to estimate the probability of local control. Its parameters may be derived by correlating archived plan data and treatment outcome results of clinical trials. We will exploit the data of a large randomized prostate trial (68Gy against 78Gy, 600+ patients) of patients treated between the years 1999 and 2003. For these patients the planning CT scan and organ delineations, and the 3D dose distribution as generated by the treatment planning system are electronically available.
However, we have no patient specific information on the location of tumor tissue inside the prostate (as could nowadays be imaged using MRI). Furthermore, the dose absorbed by the clonogen cells will have been influenced by errors in daily set-up and by organ motion. Although portal images were acquired for an off-line bony set-up protocol, no in-room soft tissue imaging was available to monitor organ motion. An additional uncertainty is introduced by the fact that the primary method of clinical follow-up is based on blood PSA levels, which means a detected failure may not be local.
To describe the interplay between the location of clonogen cells and the varying day-to-day position of the prostate, we use Monte Carlo treatment plan evaluation software that was developed in-house. This software samples population distributions of random and systematic errors to simulate many possible treatment histories. Maximum likelihood methods are then applied to determine the most probable TCP model parameters α and σ_α. Inspired by surveys of pathological specimens, the assumed density distribution of clonogen cells inside the prostate is modulated, and a body of clonogens located posteriorly outside the CTV is introduced to model extra capsular extension. The effects of such modulations on the TCP parameters and on the likelihood of the fit is studied.
In future trials, additional imaging will increase the amount of patient specific data on geometric variations and cell distributions, leading to a more accurate TCP model.

The TCP parameters thus acquired may be used for treatment planning purposes. If MRI imaging is available to gain knowledge about the location of tumor tissue inside the gland, treatment planning may be performed by optimizing the TCP function using a heterogeneous clonogen cell distribution. By using probability based optimization techniques (in which the effect of geometric errors on the tumor cell kill is modeled in the same way as in the TCP fitting procedure above), no PTVs need to be defined, and the optimization procedure can directly aim for the largest expected TCP (for a given expected rectum NTCP).

Educational Objectives:

1. Identify sources of uncertainty when basing a TCP model on clinical data
2. Understand a method to determine TCP parameters in the face of such uncertainties
3. Understand how these parameters may be used for treatment planning