COMPOSITION OF DAILY TUMOR CONTROL PROBABILITIES FOR FRACTIONATED NON HOMOGENEOUS EXTERNAL BEAM THERAPY.

Introduction: A number of methods for computing tumor control probabilities from dose response models have been developed. Most authors consider independence among voxels in order to obtain TCP for a planning target volume (PTV) multiplying probabilities for every voxel. This value is then raised to "n", the number of fractions, in order to obtain TCP for the global, fractionated treatment.

The fact is that at the beginning of every fraction the ratio active tumor cells/non active tumor cells is different and thus, probabilities change from fraction to fraction.

Methods: A two compartment method has been developed to take this fact into account: the first compartment is the one containing surviving clonogens, and the other one is the rest of the cells in the tumor.

The intra fraction tumour control probability is still computed under the assumption of independence of voxels, but the cumulative effect of radiation is modeled in a novel way.

Results: The following equation has been derived:

$$TCP(n,\nu) = \prod_{k=1}^{n}\left[\frac{\left(n\cdot P\left(d_k\right)\right)^{\nu(d_k)}}{\left(\nu\left(d_k\right)\right)!}\cdot e^{-n\cdot P\left(d_k\right)}\right]$$

where ν(d) is the number of cells receiving dose "d", obtained multiplying the differential DVH by the cell density; and P(d) is the dose response function.

Conclusions: The use of standard repopulation models to account for interruptions in the course of treatment becomes feasible as well, combining them with the equation above to obtain a personalized estimate of tumor control probability.

This method is rigorous, flexible and can be personalized to any course of treatment, including interruptions and non standard schedules. It is also independent of the dose response relationship.