AbstractID: 14083 Title: TCP-based dose-painting by numbers at the example of a prostate case with 18F-choline PET

Purpose: A biologically adaptive radiation treatment method to maximize the TCP is shown. Functional imaging is used to acquire a heterogeneous dose prescription in terms of dose-painting by numbers and to create patient-specific IMRT plans.

Method and Materials: Adapted from a method for selective dose escalation under the guidance of spatial biology distribution, a model, which translates heterogeneously distributed radiobiological parameters into voxelwise dose prescriptions, was developed. At the example of a prostate case with 18F-choline PET imaging, different sets of reported values for the parameters were examined concerning their resulting range of dose values. Furthermore, the influence of each parameter of the linear-quadratic model was investigated. A correlation between PET signal and proliferation as well as cell density was assumed. Using our in-house treatment planning software Direct Monte Carlo Optimization, a treatment plan based on the obtained dose prescription was generated. Gafchromic EBT films were irradiated for evaluation.

Results: When a TCP of 99% was aimed for, the maximal dose in a voxel of the prescription exceeded 100 Gy for every considered set of parameters. With a less ambitious aim for the TCP, one of the parameter sets resulted in a dose range of 87.1 Gy to 99.3 Gy, still yielding a TCP of 94.7%. The TCP of the plan decreased to 73.5% after optimization based on that prescription. The dose difference histogram of optimized and prescribed dose revealed a mean of -1.64 Gy and a standard deviation of 4.02 Gy. Film verification showed a reasonable agreement of planned and delivered dose.

Conclusion: If the distribution of radiobiological parameters within a tumor is known, this model can be used to create a dose-painting by numbers plan which maximizes the TCP. It could be shown, that such a heterogeneous dose distribution can be planned and applied.