AbstractID: 11442 Title: Comparison of optimized interstitial HDR Brachytherapy plans using adaptive simulated annealing algorithm and physical, biological and hybrid cost functions

Purpose: Comparing the optimized interstitial High Dose Rate (HDR) Brachytherapy plans based on physical, biological and hybrid cost functions.

Method and Materials: Using an Adaptive Simulated Annealing (ASA) algorithm we have developed a method to optimize dwell times for HDR brachytherapy treatment planning. Three cost functions are used: (1) a function based on doses to PTV; (2) a logistic function based on generalized Equivalent Uniform Dose (gEUD) of PTV and organs-at-risk (OAR), and (3) a hybrid function, which includes physical dose-based objectives of PTV and gEUD-based objectives of PTV and OAR. We applied these functions to three gynecological cancer cases. Optimizations are run up to 75000 iterations. The prescription dose is normalized to the isodose volume covering 95% of the PTV. Plans are evaluated by DVH, isodose distributions, gEUD, tumor control probability (TCP), normal tissue complication probability (NTCP), homogeneity index (HI), and overdose index (OI) of the target and OARs.

Results: The optimized results of three cases based on the three cost functions are summarized. The physical model produces best target dose uniformity and lowest target maximum dose. However, the doses to OARs are also the highest. The gEUD model is able to increase gEUD to the target, reduce gEUD to the OARs, but produce less uniform dose and larger hot spots in the target. By choosing proper penalty factors, the hybrid model can produce balanced plans to achieve high gEUD to the target, low gEUD to the OARs and smaller hot spots on target.

Conclusion: We are able to optimize the dwell times of interstitial HDR brachytherapy using an ASA algorithm. The optimization results can be controlled by choosing different cost functions and penalty factors depending on clinical needs of patients.