AbstractID: 13804 Title: PET/CT guided dose redistribution for HDR interstitial brachytherapy of cervical cancer

Purpose:

Advances in functional imaging may allow identification and targeting of tumor sub-volumes based on their biological characteristics, allowing selective boosting of dose to radio-resistant sub-volumes during treatment planning. The purpose of this study was to redistribute high dose regions toward the PET-hot regions as identified on PET/CT images during High-Dose-Rate (HDR) brachytherapy for cervical cancer while maintaining a clinically acceptable DVH.

Material and Methods:

FDG-PET and CT images were acquired and registered. The tumor volume was contoured and segmented into sub-volumes based on their Standardized Uptake Values (SUV) in PET images. The sub-volumes with higher SUV were considered metabolically active and therefore required higher radiation dose. The integral tumor was prescribed a uniform dose from external beams followed by a boost dose delivered by HDR interstitial brachytherapy. The HDR treatment plan was optimized using a home-brew software implementation of an Adaptive Simulated Annealing (ASA) algorithm. The tumor dose was then redistributed by increasing and decreasing the prescription dose to sub-volumes with higher and lower SUV respectively such that the integral tumor prescription dose was kept constant. A routine cervical cancer case with both uniform and PET-guided plans is presented. Both plans were optimized based on a generalized Equivalent Uniform Dose (gEUD) cost function and renormalized to V100=95% of prescribed dose to the integral PTV. Their isodose distributions and DVHs were compared.

Results:

The PET-guided plan had larger hot spots in and near the PET sub-volume while the DVH of PTV was kept the same as that of the uniformly prescribed plan. Doses to critical organs were also reduced in the PET-guided plan.

Conclusions:

The approach described used PET/CT imaging guiding dose redistribution within PTV so that the hot spots encompass metabolically active tumor sub-volumes. An IRB approved treatment protocol is underway to study the clinical efficiency of this approach.