Abstract ID: 15733 Title: The effects of tissue inhomogeneities and biological effectiveness on the outcome prediction of electronic brachytherapy for accelerator partial breast irradiation

Purpose: To study the influence of tissue inhomogeneities and biological effectiveness on the outcome prediction of electronic brachytherapy (eBx) for accelerator partial breast irradiation (APBI).

Methods: The dosimetric influence of tissue heterogeneities was studied by Monte Carlo method and heterogeneous "virtual patient" phantoms created from the CT images and structure contours. The enhancement of the relative biological effectiveness (RBE) of the low-energy X-rays was modeled using biological effective dose (BED) distributions. 10 eBx APBI cases were involved in the study. For each case, the actual BED distribution, calculated with consideration of tissue inhomogeneities and RBE enhancement, was compared with the planned BED distribution without consideration of these two factors.

Results: On average, actual BED PTV V100 was 89.9% as compared to 95.2% of planned value. Actual BED PTV V200 was 0.67 times of the planned value, indicating that the high dose region in the target was overestimated in planning. Actual mean BED to the ipsilateral breast, the ipsilateral lung and the heart was 0.91, 1.78 and 1.28 times of the planned values, indicating that the toxicity to the normal organs was overestimated for the breast but underestimated for the lung and heart. Actual maximum BED to the skin was 16% lower than the planned value, but actual maximum BED to the ribs was 12.7 times higher, which indicates that toxicity to the skin was overestimated in planning but toxicity to the ribs was significantly underestimated.

Conclusion: Tissue inhomogeneities and RBE enhancement of low-energy X-rays will affect the plan quality of eBx APBI. This case study revealed that actual target coverage was lower than planned. The toxicity to the ipsilateral breast and the skin was overestimated in treatment planning but the toxicity to the ipsilateral lung, the heart and the ribs was underestimated.