

AbstractID: 13172 Title: The sensitivity of BED and TCP parameters to dose heterogeneity in brachytherapy treatments

**Purpose:** To investigate the sensitivity of radiobiological parameters to dose heterogeneity in brachytherapy. **Materials and Methods:** Biological effective dose (*BED*) is calculated using a homogeneous and a heterogeneous model. The homogeneous model is based on the minimal peripheral dose to the target and does not take into account the heterogeneity of the dose distribution in brachytherapy. The heterogeneous model (recommended by the AAPM TG137) is capable of taking the dose heterogeneity into account. Different Monte Carlo calculation protocols were used for five breast permanent seed implant patients. The tumor control probability (*TCP*) was calculated for both the homogeneous and the heterogeneous models. **Results:** The homogeneous model is overestimating the *BED* in all calculation cases. This overestimation is higher for plans with higher  $D_{90}$  values. For example, by about 10% for a plan with  $D_{90}=40$  Gy, this overestimation increases to 30% when the  $D_{90}=90$  Gy. Depending on the  $D_{90}$ , the homogeneous model overestimates the *TCP* vis-à-vis the heterogeneous model. Although the difference between the two models is large for intermediate  $D_{90}$  (between 40 Gy and 80 Gy), however, they agree well for higher  $D_{90}$  doses above 80 Gy. The 50% control dose is higher by 13 Gy while the  $\gamma_{50}$  parameter is lower by 60% in the heterogeneous compared to the homogeneous model. **Conclusion:** The *BED* is always overestimated by the homogeneous model for all brachytherapy plans. The difference between the homogeneous and the heterogeneous *TCP* models is large at intermediate  $D_{90}$  (40Gy to 80Gy) but they agree at higher  $D_{90}$ . Because of the elevated dose heterogeneities, the homogeneous model is not suitable for brachytherapy. A more accurate estimation of the *BED* and the *TCP* will improve outcome predictions for brachytherapy treatments.