Extending the Webb-Nahum tumour control probability model for breast conserving therapy

Innovation/Impact: This study explains the discrepancy between the mathematical TCP modeling results and the clinical outcomes from the EBCTCG phase-III BCT trials by introducing an indolent cell fraction factor. The proposed TCP model addresses the heterogeneity of patients in two age groups and can be useful for developing new RT strategy on population basis.

Explanation: The residual tumour cells were always considered as the major cause of local recurrence [1]. We proposed a new TCP model with an additional factor, the fraction of indolent cells among tumour cells: TCP = ∫∫∫ β(s)P(α)P(ρ)V exp[-ρV^αexp(-αD)^*(1-s)] dV dρ dα ds (P(*) stands for the probability of a given factor, α stands for the radiosensitivity of tumour cells, s is the indolent-cell fraction factor and β(s) stands for its Beta distribution). To evaluate the residual cell volume and density (V & ρ) of patients after breast-conserving surgery, we built a mathematic model with the pathology data in a detailed microscopic disease study (MARGINS). The radiosensitivity α (assumed Gaussian distribution) and the ICF factor s were estimated through simulation based optimization process (Shor-Zhurbenko Algorithm [2]). Using this model, we could estimate the relationship between radiation dose and TCP response for BCT patients. The comparisons of different factors and dose-TCP relationship between two age groups were illustrated in Figure 1.

Figure 1: (a) Tumour cell quantity comparison: about 28.9% younger patients and 48.9% older patients have no tumour cells after surgery (b) Indolent-cell fraction comparison (c) Radiosensitivity comparison (d) The estimated radiation dose-TCP relationship curves for both age-group patients (error-bar: 1 standard deviation).