AbstractID: 11255 Title: Reporting and assessing radiation damage of normal structures in radiotherapy

Purpose: To verify the feasibility of reporting and assessing the radiation damage of normal structures using the equivalent uniform dose (EUD).
Material and methods: The EUD concept has been used to assess and report radiotherapy of human cancer. We proposed to use the EUD to document and assess the collateral damage of radiotherapy to normal structure. Utilizing the differential dose volume histogram (d-DVH) obtained from the clinical treatment planning system and the linear-quadratic radio-response model, we calculated the average normal cell survival fraction of normal structures of 15 patients treated by intensity modulated radiotherapy and field-in-field techniques. From the average survival fraction, we derived the EUD. For normal tissues, α/β=3.1 Gy was used. Three sets of model parameters with α = 0.366 Gy^{-1}, 0.211 $Gy^{-1}$and 0.108 Gy^{-1} were used to represent radiosensitive, moderate radiosensitive and radioresistant tissues, respectively.
Results: The EUDs of the optical nerve, eyes, brain stem, chiasm, glottis, cochlea, heart and spinal cord were calculated. The EUDs of each normal structure showed large variations from the plans of different patients although the prescription dose was the same. For the head-neck cancer with 60 Gy dose, if critical organs are treated as the radiosensitive normal tissue, the EUD ranges from 4.9 to 6.7 Gy for brain stem, from 2.6 to 3.0 Gy for optic nerve, and from 2.3 to 2.6 Gy for the average of eyes. The EUDs of all structures with different radio-sensitivities were evaluated.
Conclusions: The results suggest that EUD can be used to document and evaluate the radiation damage to normal structures, though some organs like spinal cord might be over- or under-contoured by oncologists thus provide inaccurate evaluation. A unified contouring policy and the EUD concept could provide a quantitative indication for evaluating radiation damage to those normal structures.