AbstractID: 14000 Title: Dose to medium or dose to a water cavity embedded in medium? A Monte Carlo study

Purpose: The target for radiotherapy is to sterilize cells by imposing damage to their DNA content. It is therefore of interest to study the relations between the dose calculated to a tissue medium, $D_{m,m}$, with an representative average atomic composition versus the dose $D_{n,m}$ specifically absorbed by the cell nuclei, and the dose $D_{w,m}$ to a cell nuclei surrogate represented as a water cavity embedded into tissue. The simulations were performed for six types of tissues and three different brachytherapy sources.

Methods and Materials: Absorbed dose calculations were performed by GEANT4 MC code version 9.2 using the Penelope physics package. Three different sources, ^{192}Ir to represent high energy conditions, ^{169}Yb for intermediate energies and a low energy brachytherapy source ^{125}I, were simulated. The photon spectra used in this study were taken from http://www.physics.carleton.ca/clrp/seed_database. The ^{192}Ir spectra was from Nucletron, microSelectron-HDR v2 and for ^{125}I from Nucletron, SelectSeed, 130.002. Particle spectra for ^{192}Ir and energy spectra for ^{125}I were also scored to calculate the dose with different cavity theories and compare it with MC calculated doses.

Results: The MC calculated $D_{m,m}$, $D_{w,m}$ and $D_{n,m}$ ratio shows the largest value for ^{125}I brachytherapy source and the cortical bone material, adipose tissue and prostate tissues(ICRU). The difference between $D_{w,m}$ and $D_{n,m}$ is also largest for the cortical bone and ^{125}I source. For the ^{192}Ir source, the ratio was 1 for the soft tissues while for the cortical bone it was higher.

Conclusion: Monte Carlo calculations made it possible to report the dose as absorbed dose to medium. Accurate reporting of treatment planning requires a stringent standard for dose definition. MC calculations can be used to develop conversion factors to convert dose according to different definitions for different brachytherapy sources.