AbstractID: 9166 Title: Evaluation of electronic equilibrium conditions near brachytherapy sources

Introduction: For high-energy photon-emitting brachytherapy sources such as ^{60}Co, ^{137}Cs, ^{192}Ir, and ^{169}Yb, the main contribution of the systematic uncertainty in the dose distributions near the sources is understanding of electronic equilibrium and the contribution of β-rays due to radioactive disintegration. Thus, it is important to study these effects in detail to accurately depict dose distributions near these brachytherapy sources. This work studies the relative importance of β-ray contributions to total dose (β + γ + x-ray), and feasibility of using the approximation “collision kerma equals dose in electronic equilibrium conditions.” **Material and Methods:** Characteristics of kerma and dose distributions were studied for spherical ^{60}Co, ^{137}Cs, and ^{192}Ir sources with composition, encapsulation, and dimensions similar to those existing in the literature. Dose contribution of β-rays and γ+x-rays were individually examined using the GEANT4 Monte Carlo radiation transport code. **Results:** The comparison of kerma and dose rate distributions indicate ~ 20% electronic disequilibrium within 1 mm of sources, with ^{60}Co have the most pronounced effect. When examining the dose contribution of β-rays, ^{60}Co again had the most pronounced effect out to 5 mm beyond the capsule, with β-rays contributions for ^{192}Ir and ^{137}Cs 1.5 and 0.5 mm beyond the capsule, respectively. **Conclusion:** The dosimetric effect of β-rays for high-energy photon-emitting radionuclides and the influence of the electronic disequilibrium near of the sources were studied using Monte Carlo methods. For ^{60}Co and ^{137}Cs brachytherapy sources, electronic disequilibrium has an important role near the source. For ^{192}Ir the main perturbing dosimetric effect near the source is from β-ray contributions and not electronic disequilibrium.