AbstractID: 4971 Title: Relative Biological Effectiveness(RBE) and dosimetry of low energy photons(8keV) generated using miniature X-ray tubes

Purpose: To study the Relative Biological Effectiveness(RBE) and dosimetric characteristics of an 8keV photon beam generated by an insertable miniature electronic brachytherapy device developed by Advanced X-ray Technology, Inc.(AXT).

Method and Materials:

The AXT X-ray needle consists of a primary conventional X-ray tube with silver anode producing a 22 keV beam focused through a collimator into the applicator needle which has a secondary copper target generating an 8 keV fluorescent beam. The radio-resistant human tumor cell lines HGL21(glioblastoma) and MCF7 (breast) were irradiated at 22^{o}C using the AXT miniature needle and compared with a Co-60 beam at dose rates of approximately 6cGy/min and 12cGy/min. An extrapolation chamber was used in gradient mode to determine the dose rate within the AXT beam after initially determining the effective area of the collecting electrode in a Co-60 beam using the Bragg-Gray relationship.

Results: Cell surviving fraction (SF) was the primary end point in assessing the radiobiological effect. For the 8 keV beam, SF was found to be 0.056 for HGL21 and 0.018 for MCF7 for a dose of 2 Gy. This yields an RBE of 4.4 for HGL21 and 5.5 for MCF7 cells lines. The dose rate in the 8keV beam was found to vary linearly as a function of extrapolation chamber electrode spacing. This allows the use of the slope of the ionization gradient to determine the dose. The dose rate measured in free space at the location where the cells were irradiated was found to be 15.4 cGy/min.

Conclusion:

These high RBE values are not surprising given the stopping power of the very low energy recoil electrons produced in this beam, and support the premise that the AXT device will be an effective tool to treat tumor sites like brain, breast and prostate in which radio-resistance might limit conventional radiotherapy.

Comment [j1]: State the specific RBE values.