SUPERIORITY OF LOW ENERGY 160 KV X-RAYS COMPARED TO HIGH ENERGY 6 MV X-RAYS IN HEAVY ELEMENT RADIOSENSITIZATION FOR CANCER TREATMENT

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High energy X-rays in the MeV range are generally employed in conventional radiation therapy from linear accelerators (LINAC) to ensure sufficient penetration depths. However, lower energy X-rays in the keV range may be more effective when coupled with heavy element (high-Z or HZ) radiosensitizers. Numerical simulations of X-ray energy deposition for tumor phantoms sensitized with HZ radiosensitizers were performed using the Monte Carlo code Geant4. The results showed enhancement in energy deposition to radiosensitized phantoms relative to unsensitized phantoms for low energy X-rays in the keV range. In contrast, minimal enhancement was seen using high energy X-rays in the MeV range. Dose enhancement factors (DEFs) were computed and showed radiosensitization only in the low energy range < 200 keV, far lower than the energy of the majority of photons in the LINAC energy range. *In vitro* studies were carried to demonstrate the tumoricidal effects of HZ sensitized F98 rat glioma cells following irradiation with both low energy 160 kV and high energy 6 MV X-ray sources. The platinum compound, pyridine terpyridine Pt(II) nitrate, was initially used because it was 7x less toxic that an equivalent amount of carboplatin *in vitro* studies. This would allow us to separate the radiotoxic and the chemotoxic effects of HZ sensitizers. Results from this study showed a 10-fold dose dependent reduction in surviving fractions (SF) of radiosensitized cells treated with low energy 160 kV X-rays compared to those treated with 6 MV X-rays. This is in agreement with our simulations that show an increase in dose deposition in radiosensitized tumors for low energy X-rays. Due to unforeen *in vivo* toxicity, however, another *in vitro* study was performed using the commonly used, Pt-based chemotherapeutic drug carboplatin which confirmed earlier results. This lays the ground work for a planned *in vivo* study using F98 glioma bearing rats. This study demonstrates that while high energy X-rays are commonly used in cancer radiotherapy, low energy keV X-rays might be much more effective with HZ radiosensitization.