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X-ray irradiator design and optimization study

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Introduction. As radiation research and cancer biology reach new horizons, the need for improved preclinical methodology has become paramount. In this work, we are interested in designing an x-ray based irradiator for small animals and cells, which is able to deliver a dose rate of 1 Gy/min. To do this, some measurements and Monte Carlo (MC) simulations have been performed to characterize different elements of the device.

Materials and methods. On the one hand, a detailed characterization of different x-ray generators has been performed in order to select the optimal beam parameters for our irradiator. Absolute dose measurements with EBT2 Gafchromic films [1] have been performed in 3 x-ray tubes [2-4]. Different voltages and beam intensities were studied. On the other hand, a shielding study has been done. We calculated the lead shielding required for our device so that the irradiations could be done in a controlled area (< 3 uSv/h). 150 and 250 kV beam voltages have been simulated and the worst-case scenario with no object and all the x-rays exiting the beam impacting directly on the lead wall was considered. The animal has been defined as a water cylinder in the MC simulations to calculate an estimation of the dose distribution.

Results. Dose estimations were done defining a water cylinder at 20 cm from the source. At this distance the area of the object exposed to radiation has a diameter of 8 cm, and an average dose of 1 Gy/min is delivered operating with 150 kV and 200 W and with 250 kV the needed power decreases to 150 W. The thickness of the lead walls needed to operate in a controlled area with the mentioned tube voltages were found to be of 4 mm and 9 mm, respectively. With these thicknesses, the leakage doses are 0.53 and 2.34 uSv/h [figure 1], leading to a maximum dose rate delivery of 5.62 and 1.28 Gy/min.

Conclusions. According to the results of this study, an x-ray-based irradiator could deliver about 1 Gy/min at 20 cm distance with 150 kV@200 W with a lead shielding of 4 mm, or with 250 kV@150 KW with 9 mm lead shielding. The lead shielding for 150 kV would be about 2 times less expensive, but it would require higher power increasing the heating of the anode. To reach a dose rate of 1 Gy/min in the animal it would be necessary to operate in a controlled area, as in both cases (150 kV, 4mm Pb and 250 kV, 9 mm Pb) the leakage dose was found to be higher than 0.5 uSv/h [table 1].

[1] Martišíková M, Jäkel O. Gafchromic® EBT films for ion dosimetry. Radiation measurements. 2010 Dec 1;45(10):1268-70.
[2] Toshiba electron tubes & devices. Technical data Rotanode E7252X. samedelektronik.com. http://www.samedelektronik.com/eng/pdffi
[3] Toshiba electron tubes & devices. Product information Rotanode E7869X. skphotoray.co.kr http://www.skphotoray.co.kr/datasheet/XR
[4] Thermo Scientific (2011). PXS10 microfocus High-resolution Microfocus x-ray source 130 kV. assets.thermofisher.com https://assets.thermofisher.com/TFS-Assets/CAD/Specification-Sheets/D20505~.pdf

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