First pre-clinical study for lung carcinoma employing Synchrotron Microbeam Radiotherapy at the Australian Synchrotron

3. Translational and clinical research

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Introduction

Synchrotron Microbeam Radiation Therapy (S-MRT) spatially fractionates Synchrotron X-rays into an array of micro-planar beamlets. This spatial fractionation together with a FLASH mode delivery of the radiation allows for minimal normal tissue toxicity while delaying tumour growth or even ablating malignancies. Here, we wanted to use S-MRT to treat lung carcinoma in mice for the first time.

Methods

Lewis lung carcinoma-bearing mice were irradiated with crossfired arrays of either S-MRT or Synchrotron Broad Beam (S-BB) 11 days after tumour cell injection in their right lung. The S-MRT field size was 7x7 mm (50 µm beam width spaced by 400 µm) with a peak-dose of 400 Gy delivered in 418 ms. While S-BB delivered a homogeneus dose of 5.16 Gy in 5.4 ms (does rate 957Gy/sec). Mice were sacrificed when human endpoints were reached.

Results

Both treatments significantly increased the survival of the animals relative to the control group, however there was no difference between S-BB and S-MRT. Pleural effusion was observed after S-MRT in tumor-bearing mice but not in sham-implanted mice. This suggests that the presence of a tumour changes the response of the lung to S-MRT.

Conclusion

We made a first step towards the use of S-MRT for lung cancer, targeting precisely a localized lung carcinoma. This study suggests that the S-MRT parameters (beam configuration, peak dose, and dose rate for a full FLASH effect) need to adapt in relation to the sensitivity of the organ bearing the malignancy, in order to reduce collateral effects and increase survival.