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Evaluating the biological response of aggressive glioma cell lines to synchrotron microbeam radiotherapy compared to broad-beam irradiation

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Background: Diffuse Intrinsic Pontine Glioma (DIPG) is an aggressive and infiltrative tumour of the brain-stem and is amongst the most lethal brain tumours affecting children. Current treatment options are largely ineffective with less than 10% of DIPG patients surviving to 2 years. Synchrotron Microbeam Radiotherapy (MRT) is a promising pre-clinical therapy which could drastically improve the prognosis of patients with DIPG by allowing much higher radiation doses to be delivered to the tumour without an increase in brain-stem toxicity.

Aim: To compare the response of DIPG cell lines to MRT versus conventional broad-beam (BB) radiotherapy using assays for sphere-forming capacity, cell-cycle and apoptosis, and to determine biologically equivalent MRT and BB doses.

Method: Three DIPG cell-lines were irradiated using MRT and BB. Cells were irradiated as single cells in 2mL tubes in two experimental sessions: July 2015 at the Australia Synchrotron (MRT) and October 2015 at the Walter and Eliza Hall Insititue (BB). MRT doses were 0Gy, 112Gy, 250Gy, 560Gy and 1180Gy and BB doses were 0Gy, 5.0Gy, 7.7Gy, 9.3Gy and 12Gy. Triplicates were used. After irradiation we performed cell-cycle and apoptosis assays and assessed cells for sphere-forming capacity.

Conclusion: Using DIPG cell lines, novel in MRT research, we determined biologically equivalent BB and MRT doses. Results will be used to inform future in-vivo experiments on DIPG-bearing rodents.

Keywords

Glioma, dose-response, microbeam radiotherapy, broad-beam radiotherapy, biological equivalence.

Primary author(s) : Mr SMYTH, Lloyd (University of Melbourne, Epworth HealthCare)

Co-author(s) : Dr DONOGHUE, Jacqueline (Hudson Institute of Medical Research); Dr CROSBIE, Jeff (RMIT); Prof. ROGERS, Peter (University of Melbourne)

Presenter(s) : Mr SMYTH, Lloyd (University of Melbourne, Epworth HealthCare)

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