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Systematic characterisation of normal tissue toxicity using Synchrotron Radiotherapy

Background: Synchrotron Radiotherapy is characterised by high intensity beams which are capable of delivering dose-rates that are up to 10,000 times faster than conventional radiotherapy dose rates. Systematic normal tissue toxicity data is required in order to progress towards human clinical trials.

Aim: To assess the safety profile of both Synchrotron broad-beam radiotherapy (SBBR) and Microbeam radiotherapy (MRT) compared to conventional radiotherapy (CRT).

Method: A dose-escalation study using SBBR, MRT and CRT was performed on C57BL/6 mice (male and female, 8-10 weeks old). Mice received either Total Body Irradiation (TBI) or Partial Body Irradiation to their entire abdomen (PBI). Five mice were irradiated per group. Mice were monitored for signs of weight loss and other gastro-intestinal toxicities such as diarrhoea, and were euthanized according to strict intervention criteria.

Results: For TBI, all mice survived with no signs of diarrhoea up to peak MRT doses of 144 Gy. There was a dose-dependent increase in the incidence of sustained weight loss, with four out of five mice in the 144 Gy group showing at least 10% weight loss two weeks following irradiation. In the SBBR groups, 8 Gy led to irreversible weight loss and euthanasia for all mice within three weeks of irradiation. For PBI, all mice receiving 450 Gy MRT and 15 Gy SBBR experienced 20% weight loss, severe diarrhoea and dehydration within six days of irradiation, consistent with gastrointestinal syndrome, and were euthanized. All mice receiving less than 270 Gy MRT groups and 9 Gy SBBR groups survived, experiencing reversible weight loss and showing no signs of diarrhoea.

Conclusion: These are the first systematic dose-escalation toxicity data for MRT and high dose-rate SBBR using TBI and abdominal PBI. The threshold for irreversible gastro-intestinal toxicity lies between 270 and 360 Gy for MRT and between 12 and 15 Gy for high dose-rate SBBR. A comparison with toxicity data for conventional dose-rate broad beam radiotherapy is ongoing and will determine if ultra-high dose-rates provide a normal tissue sparing effect.

Lloyd. M. L. Smyth, Jessica. A. Ventura, Jacqueline Donoghue, Jeffrey. C. Crosbie & Peter A. W. Rogers

Are you a student?

Yes

Do you wish to take part in the Student Poster Slam?

Yes

What is your gender?

Male

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

Co-authors: CROSBIE, Jeff (University of Melbourne); Mrs VENTURA, Jessica (Royal Women's Hospital); Prof. ROGERS, Peter (University of Melbourne)

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

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