Contribution ID: **5** Type: **Contributed Oral Presentation**

Assessment of cystamine's radioprotective ability under high dose-rate irradiation: a Monte Carlo multi-track chemistry simulation study

Thursday 28 September 2023 17:00 (13 minutes)

This contribution was presented as poster instead

The biological effects of radiation to healthy organs surrounding tumour target volumes are a fundamental dose-limiting restriction in radiotherapy (RT). To protect healthy organs from ionizing radiation, and to reduce morbidity or mortality, various radioprotectors agents have been used. The clinical involvements of these radioprotective agents have emerged as promising medications with antitumor effect. However, the conventional radiotherapy treatment and cure are still limited by acute or chronic toxicities to normal tissue. Recently, a fundamentally different paradigm of radiation therapy based on delivering radiation at ultra-high dose rates has emerged. Although FLASH radiotherapy appears to significantly improve the therapeutic ratio of cancer treatment, the protection of surrounding healthy tissue has nevertheless not been shown to be complete. It would therefore be expected that the combination of cystamine with FLASH-RT would further improve the therapeutic ratio of cancer cure. This study aims to investigate the radical-scavenging properties of cystamine by examining the behavior of this compound with respect to the primary species produced in the radiolysis of the Fricke dosimeter under various dose-rate irradiation conditions. The radiolytic oxidation of Fe2+ ions to Fe3+ was used as a measure of the radioprotective ability of cystamine as a function of dose rate. Our simulations revealed that cystamine provides a greater tissue protection at pulsed (FLASH) dose rates compared to conventional radiotherapy (RT) irradiation

Key words: cystamine, radioprotector, antioxidant, aerated ferrous sulfate (Fricke) dosimeter, water radiolysis, high-energy protons, Ultra-High Dose-Rate, Monte Carlo multi-track chemistry simulation, reaction scheme, competition kinetics, radiation chemical yields (G values), FLASH radiotherapy, nuclear power plant accident, nuclear weapons deployment, nuclear/radiological.

Abstract Category

Medical Physics

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Session Classification: Parallel Session 1

Track Classification: Physics Research