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abstract

Performance Analysis of the Sulfamic Acid/EPR System in the Assessment of Doses Delivered in HDR Brachytherapy Treatment

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Performance Analysis of the Sulfamic Acid/EPR System in the Assessment of Doses Delivered in HDR Brachytherapy Treatment

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Introduction: Accurate verification of the absorbed dose delivered in high-dose-rate (HDR) brachytherapy is essential to ensure treatment safety and effectiveness, and to avoid clinically significant underdosing or overdosing. This study investigates an experimental dosimetric approach for independent dose verification around a 192Ir HDR brachytherapy source.

Methodology: A cylindrical phantom made of epoxy resin was designed to reproduce clinical brachytherapy conditions. The phantom accommodates a 192Ir source and multiple dosimeters positioned on predefined circular trajectories to allow spatial dose mapping. Computed tomography (CT) imaging was performed to localize the dosimeters accurately and to enable dose calculation using a treatment planning system (TPS). Sulfamic acid samples (80 ± 1 mg) were used as dosimeters and irradiated using a a Nucletron microSelectron HDR afterloader at the Ryad Oncologia Clinic (Casablanca). Two irradiation protocols were conducted: one to establish a calibration curve over the dose range 1–8 Gy, and a second to measure the dose distribution around the source. The irradiated samples were analyzed using electron paramagnetic resonance (EPR) spectroscopy, employing the peak-to-peak signal evaluation method.

Results: The sulfamic acid dosimeters exhibited a strong linear EPR response within the investigated dose range. Experimental measurements enabled the assessment of the radial dose distribution and dose gradient around the ^192Ir source. The measured absorbed doses were compared with TPS calculations, demonstrating good agreement in terms of spatial dose variation. The combined standard measurement uncertainty was estimated to be approximately 8% (k = 2).

Conclusion: The results demonstrate that the sulfamic acid/EPR dosimetry system, used in conjunction with an epoxy resin-based cylindrical phantom, provides a reliable and sensitive method for dose verification in HDR brachytherapy.This approach shows strong potential for quality assurance applications and for independent verification of delivered doses in clinical brachytherapy practice.

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