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RXnanoBRAIN

Nanoparticles to optimize the effects of radiotherapy of brain tumors: Multi-scale modeling and experimental validation

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Glioblastoma multiforme (GBM) is the most difficult brain cancer to treat. Major challenges are the limitation of irreversible brain damage and the infiltrative part of the tumor tissue which is the ultimate cause of recurrence. The therapeutic ratio can be widely improved using an image-guided radiation therapy (IGRT). Radiosensitization by metal-based nanoparticles attracts significant interests and beyond this, radiotherapy is entering a new era with the emergence of promising clinical concepts for IGRT. We will design a novel theranostic AGuIX® design nanoparticle made of polysiloxane network, gadolinium (Gd) and bismuth (Bi) chelates that enable dual-modality (magnetic resonance (MR) and computed tomography (CT)) tumor imaging and radiation-dose enhancement providing clinicians with more options for precise tumor localization while mitigating toxicity in surrounding healthy tissue. Using physics modeling and multiscale Monte Carlo simulations, RXnanoBRAIN will provide a progress beyond the state-of-the-art by introducing a novel combination of imaging modalities for IGRT and treatment

planning in nanomedicine. As glioma-associated macrophages can be influenced by tumor derived cytokines, suppressing adaptive immune responses, their involvement will be characterized. Moreover, to restore radiosensitivity of hypoxic GBM cells, immune/transcription modulators and glycolysis inhibitors will be suggested. Non-invasive imaging using positron emission tomography with CT, MR spectroscopy and electron paramagnetic resonance oximetry, will allow us a complete longitudinal therapeutic monitoring.

