Subject-specific Modeling of Intra-arterial Nanoparticle Delivery for Glioma Treatments

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ABSTRACT

Nanoparticles are considered important vehicles for targeted release of drugs to treat brain tumors or gliomas, and other focal neurological diseases. The regional deposition of surface-functionalized nanoparticle is a dynamic balance between the forces of particle attachment and hydrodynamic forces that tend to dislodge them [1]. Few computational models have explored this relationship of regional nanoparticle delivery after intra-arterial (IA) injections in the Circle of Willis. . In this work we used computational tools to investigate the liposomal deposition under condition of cerebral hypoperfusion for different particle characteristics. The results were compared with observations from *in vivo* rodent experiments conducted with optically tagged nanoparticles, which can provide important insight into the pharmacokinetics of IA drug delivery [2]. Both experimental and simulation data supported the improvement in regional tissue deposition with transient cerebral hypoperfusion, cationic charge and larger particle size. Our model, which incorporates nanoparticle design parameters, intra-arterial injection profile, subject-specific anatomical features and realistic regional blood flow, provides the conceptual framework to understand and improve intra-arterial drug delivery to potentially avoid complications and failures observed during IA chemotherapy in glioma treatments [3].

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