Comparative Analysis of Nanoparticle Uptake in Blood-Brain Barrier Cell Types for Glioblastoma Treatment

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Abstract:

Effective drug delivery to the brain is a major challenge in the treatment of different neurological diseases due to the restrictive nature of the blood-brain barrier (BBB). Nanoparticles offer a promising potential route for brain targeting through controlled drug transport, sustained release, protection from premature degradation, and enhanced targeting of tumor tissue within the central nervous system (CNS).

This study investigates the chemical composition and biocompatibility of two distinct nanoparticle formulations, poly(lactic-co-glycolic acid) (PLGA) nanoparticles and gold nanoparticles (AuNPs) loaded with drugs shown to be effective in treating glioblastoma multiforme (GBM), across critical cell types involved in the BBB, namely astrocytes, which provide essential BBB structural support, and brain microvascular endothelial cells, which form the primary physical barrier restricting drug entry into the CNS. Understanding how the nanoparticles interact with each BBB cell type is quite crucial for predicting their ability to traverse the barrier and reach tumor tissue effectively.

By comparing uptake efficiency, internalization mechanisms, intracellular distribution, cytotoxicity profiles, and cellular stress responses across these diverse BBB cell types, this research aims to identify the most promising nanoparticle platform for eventual GBM therapy.