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Nanocarriers in glioblastoma treatment: a neuroimmunological perspective

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Abstract

Glioblastoma multiforme (GBM) is the most fatal brain tumor with a poor prognosis with current treatments, mainly because of intrinsic resistance processes. GBM is also referred to as grade 4 astrocytoma, that makes up about 15.4 % of brain cancers globally as well as 60-75 % of astrocytoma. The most prevalent therapeutic choices for GBM comprise surgery in combination with radiotherapy and chemotherapy, providing patients with an average survival of 6-14 months. Nanocarriers provide various benefits such as enhanced drug solubility, biocompatibility, targeted activity, as well as minimized side effects. In addition, GBM treatment comes with several challenges such as the presence of the blood-brain barrier (BBB), blood-brain tumor barrier (BBTB), overexpressed efflux pumps, infiltration, invasion, drug resistance, as well as immune escape due to tumor microenvironment (TME) and cancer stem cells (CSC). Recent research has focused on nanocarriers due to their ability to self-assemble, improve bioavailability, provide controlled release, and penetrate the BBB. These nano-based components could potentially enhance drug accumulation in brain tumor tissues and reduce systemic toxicity, making them a compelling solution for GBM therapy. This review captures the complexities associated with multi-functional nano drug delivery systems (NDDS) in crossing the blood-brain barrier (BBB) and targeting cancer cells. In addition, it presents a succinct overview of various types of targeted multi-functional nano drug delivery system (NDDS) which has exhibited promising value for improving drug delivery to the brain.

Keywords: drug delivery; glioblastoma; neuroimmunology; neuroscience; pharmacotherapy.