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Tumor heterogeneity and resistance in glioblastoma: the role of stem cells

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Abstract

Glioblastoma multiforme (GBM) is one of the most aggressive and treatment-resistant brain tumor, characterized by its heterogeneity and the presence of glioblastoma stem cells (GSCs). GSCs are a subpopulation of cells within the tumor that possess self-renewal and differentiation capabilities, contributing to tumor initiation, progression, and recurrence. This review explores the unique biological properties of GSCs, including their molecular markers, signalling pathways, and interactions with the tumor microenvironment. We discuss the mechanisms by which GSCs evade conventional therapies, such as enhanced DNA repair and metabolic plasticity, which complicate treatment outcomes. Furthermore, we highlight recent advancements in identifying novel biomarkers and therapeutic targets that may improve the efficacy of treatments aimed at GSCs. The potential of targeted therapies, including immunotherapy and combination strategies, is also examined to overcome the challenges posed by GSCs. Ultimately, a deeper understanding of GSC biology is essential for developing personalized treatment approaches that can enhance patient outcomes in glioblastoma.

Keywords: Biomarkers; Combination strategies; Glioblastoma multiforme; Glioblastoma stem cells; Immunotherapy; Treatment resistant brain tumor.

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