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Advancing glioblastoma treatment through iron metabolism: A focus on TfR1 and Ferroptosis innovations

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Abstract

Glioblastoma (GBM) represents a formidable challenge in oncology, characterized by aggressive proliferation and poor prognosis. Iron metabolism plays a critical player in GBM progression, with dysregulated iron uptake and utilization contributing to tumor growth and therapeutic resistance. Iron's pivotal role in DNA synthesis, oxidative stress, and angiogenesis underscores its significance in GBM pathogenesis. Elevated expression of iron transporters, such as transferrin receptor 1 (TfR1), highlights the tumor's reliance on iron for survival. Innovative treatment strategies targeting iron dysregulation hold promise for overcoming therapeutic challenges in GBM management. Approaches such as iron chelation therapies, induction of ferroptosis to nanoparticle-based drug delivery systems exploit iron-dependent vulnerabilities, offering avenues for enhance treatment efficacy and improve patient outcomes. As research advances, understanding the complexities of iron-mediated carcinogenesis provides a foundation for developing precision medicine approaches tailored to combat GBM effectively. This review explores the intricate relationship between iron metabolism and GBM, elucidating its multifaceted implications and therapeutic opportunities. By consolidating the latest insights into iron metabolism in GBM, this review underscores its potential as a therapeutic target for improving patient care in combination with the standard of care approach.

Keywords: Ferroptosis; Glioblastoma; Iron; Nanoparticles; Target therapy; Transferrin receptor.