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Emerging extracellular vesicle-based carriers for glioblastoma diagnosis and therapy

Jingjing Wang [1 2], Yue Liu [1 2], Fengbo Liu [1 2], Shaoyan Gan [1 2], Shubham Roy [1 2], Ikram Hasan [1 2], Baozhu Zhang [3], Bing Guo [1 2]

Affiliations

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Abstract

Glioblastoma (GBM) treatment is still a big clinical challenge because of its highly malignant, invasive, and lethal characteristics. After treatment with the conventional therapeutic paradigm of surgery combined with radio- and chemotherapy, patients bearing GBMs generally exhibit a poor prognosis, with high mortality and a high disability rate. The main reason is the existence of the formidable blood-brain barrier (BBB), aggressive growth, and the infiltration nature of GBMs. Especially, the BBB suppresses the delivery of imaging and therapeutic agents to lesion sites, and thus this leads to difficulties in achieving a timely diagnosis and treatment. Recent studies have demonstrated that extracellular vesicles (EVs) exhibit favorable merits including good biocompatibility, a strong drug loading capacity, long circulation time, good BBB crossing efficiency, specific targeting to lesion sites, and high efficiency in the delivery of a variety of cargos for GBM therapy. Importantly, EVs inherit physiological and pathological molecules from the source cells, which are ideal biomarkers for molecularly tracking the malignant progression of GBMs. Herein, we start by introducing the pathophysiology and physiology of GBMs, followed by presenting the biological functions of EVs in GBMs with a special focus on their role as biomarkers for GBM diagnosis and as messengers in the modulation of the GBM microenvironment. Furthermore, we provide an update on the recent progress of using EVs in biology, functionality, and isolation applications. More importantly, we systematically summarize the most recent advances of EV-based carriers for GBM therapy by delivering different drugs including gene/RNA-based drugs, chemotherapy drugs, imaging agents, and combinatory drugs. Lastly, we point out the challenges and prospects of future research on EVs for diagnosing and treating GBMs. We hope this review will stimulate interest from researchers with different backgrounds and expedite the progress of GBM treatment paradigms.