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Knowledge Mapping of Exosomes in Glioblastoma: A Bibliometric Analysis From 2006 to 2025

Jiale Li ¹, Duorong Wu ², Zigui Chen ¹, Changfeng Miao ³, Jiachong Wang ¹, Qisheng Luo ^{4 5}

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Abstract

Background: Glioblastoma (GBM) is the most aggressive primary malignant brain tumor, marked by profound heterogeneity, diffuse invasion, and rapid recurrence, resulting in poor survival despite standard therapy. Growing evidence indicates that exosomes mediate key processes in GBM, including tumor microenvironment remodeling, angiogenesis, invasion, immune modulation, and therapeutic resistance, and show translational promise as biofluid-based biomarkers and as engineered delivery vehicles to address blood-brain barrier limitations. Although research on exosomes in GBM has expanded rapidly, the field's global knowledge structure and evolving hotspots and frontiers remain unclear. Therefore, this study performs a bibliometric analysis from 2006 to 2025 to map publication trends, collaboration networks, influential journals and references, and emerging themes in GBM exosome research.

Methods: Publications related to exosomes in GBM from 2006 to 2025 were retrieved from the Web of Science Core Collection (WoSCC) database. VOSviewer, CiteSpace, and the R package "bibliometrix" were used to perform the bibliometric analysis and visualization, including assessments of publication trends, collaboration networks, co-citation patterns, and keyword co-occurrence.

Results: The authors included 789 publications from 64 countries/regions, led by China (273) and the United States (223). Output increased markedly after 2019, peaking in 2024 (117). Massachusetts General Hospital and Harvard-affiliated institutions were leading contributors; the International Journal of Molecular Sciences published the most papers, and Neuro Oncology was the most co-cited journal. The field centers on endogenous exosome mechanisms in GBM and translational applications for liquid biopsy and blood-brain barrier targeted delivery, with emerging hotspots in the tumor microenvironment, immunotherapy, and drug delivery.

Conclusions: Exosome research in GBM has expanded rapidly, with growing global participation and clear shifts toward translationally oriented themes. Current hotspots concentrate on tumor microenvironment regulation, immunotherapy-related mechanisms, and exosome-based liquid biopsy and brain-targeted delivery strategies. This knowledge mapping clarifies the field's intellectual structure and emerging frontiers, and may help guide future mechanistic studies and clinical translation of exosome-focused approaches in neuro-oncology.

Keywords: Bibliometric analysis; exosomes; glioblastoma.

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