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Circulating biomarkers in high-grade gliomas: current insights and future perspectives

Suchet Taori [1 2], Ahmed Habib [2], Samuel Adida [1 2], Neslihan Nisa Gecici [2], Nikhil Sharma [2], Michael Calcaterra [1], Anthony Tang [1], Sumaarg Pandya [1], Arnav Mehra [1], Hansen Deng [2], Hayat Elidrissy [2], Yassine Alami Idrissi [2], Mohammadreza Amjadzadeh [2], Pascal O Zinn [3 4]

Affiliations

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Abstract

Purpose: High-grade gliomas (HGG) represent a challenging subset of brain tumors characterized by aggressive nature and poor prognosis. Histopathology remains to be the standard for diagnosis, however, it is invasive, prone to sampling errors, and may not capture the full tumor heterogeneity and evolution over time. In recent years, there has been a growing interest in the potential utility of circulating biomarkers, obtained through minimally-invasive liquid biopsies, providing an opportunity for diagnosis, prognostication, monitoring treatment response and developing targeted therapies.

Methods: We have reviewed the literature on circulating biomarkers for HGG, including circulating tumor cells (CTCs), circulating tumor-derived exosomes/extracellular vesicles (ctEVs), circulating tumor-derived DNA (ctDNA), circulating tumor-derived miRNA (ctmiRNA), and circulating tumor-derived proteins.

Results: CTCs provide real-time information about tumor characteristics for molecular profiling and monitoring treatment response, yet their low numbers in circulation makes detection challenging. ctEVs carry a range of biomolecules and are easily detectable. However, they are not exclusively released from tumor cells and heterogeneity in their content requires standardized isolation and analysis methods. ctDNA is another promising biomarker with its levels correlating with the disease stage. However, its low concentration in blood requires highly sensitive techniques for identification and differentiation from normal cell-free DNA. ctmiRNA and tumor-derived proteins show promise but are limited by their susceptibility to dilution and lack of specificity in current technology.

Conclusion: This review highlights the transformative potential of circulating biomarkers in the management of HGG, with implications for improving patient outcomes, optimizing treatment strategies, and advancing precision oncology in neuro-oncology practice.

Keywords: Biomarker; Diagnostics; Glioma; Liquid biopsy; Precision medicine; Prognosis.

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