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Molecular-based decision-making in glioblastoma surgery: when to aim for supramaximal resection

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Abstract

The advent of molecular techniques has enhanced our understanding of the biology of malignancies over the past decade. Multi-omics has facilitated an in-depth characterization of glioblastomas at the cellular level, revealing intricate details about tumor cell states and their compositions. This advancement has substantially enriched our comprehension of tumor cell interactions with the surrounding microenvironment-such as neurons and immune cells-shedding light on patterns of tumor growth, infiltration, and therapeutic resistance. Despite the introduction of immunotherapies and molecularly guided chemotherapeutic treatments, surgical resection remains a cornerstone of glioblastoma therapeutic regimen. While maximal resection is universally considered to improve patient outcomes, integrating molecular data and insights into tumor cell interactions suggests a role for molecular-based surgical decision-making. Herein, we review how the molecular characterization of glioblastoma subtypes and their interactions can predict the benefits of surgical resection. We discuss how these insights could refine neurosurgical management in the future. Integrating multi-omics-preferably in real-time during surgery-promises to guide patient selection and optimize neurosurgical decision-making. Although these developments are promising for enhancing surgical strategies and improving patient outcomes, further validation in prospective studies involving larger cohorts and the development of workflows for clinical practice is needed.