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Innovations in intraoperative therapies in neurosurgical oncology: a narrative review

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Abstract

Purpose: High-grade gliomas (HGG) represent the most aggressive primary brain tumors in adults, characterized by high recurrence rates due to incomplete resection. This review explores the effectiveness of emerging intraoperative therapies that may extend survival by targeting residual tumor cells. The main research question addressed is: What recent intraoperative techniques show promise for complementing surgical resection in HGG treatment?

Methods: A comprehensive literature review was conducted, examining recent studies on intraoperative therapeutic modalities that support surgical resection of HGG. Techniques reviewed include laser interstitial thermal therapy (LITT), intraoperative brachytherapy, photodynamic therapy (PDT), sonodynamic therapy (SDT), and focused ultrasound (FUS). Each modality was evaluated based on clinical application, evidence of effectiveness, and potential for integration into standard HGG treatment protocols.

Results: Findings indicate that these therapies offer distinct mechanisms to target residual tumor cells: LITT provides localized thermal ablation; intraoperative brachytherapy delivers sustained radiation; PDT and SDT activate cytotoxic agents in tumor cells; and FUS enables precise energy delivery. Each method has shown varying levels of clinical success, with PDT and LITT currently more widely implemented, while SDT and FUS are promising but under investigation.

Conclusion: Intraoperative therapies hold potential to improve surgical outcomes for HGG by reducing residual tumor burden. While further clinical studies are needed to optimize these techniques, early evidence supports their potential to enhance the effectiveness of surgical resection and improve patient survival in HGG management.

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