

Optimizing Surgical Outcomes in Intramedullary Spinal Cord Tumors: A Histology-Driven Paradigm Based on 578 Consecutive Cases

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Introduction

Intramedullary spinal cord tumors (IMSCTs) primarily comprise gliomas (including astrocytomas and glioblastomas), neuronal and mixed neuronal-glial tumors (e.g., gangliogliomas), ependymal tumors (e.g., ependymomas), and vascular tumors (e.g., hemangioblastomas). The current standard of care involves surgical resection upon detection of intramedullary space-occupying lesions, with postoperative management tailored to tumor histology. To evaluate the efficacy of histology-driven, individualized treatment strategies for IMSCTs, emphasizing surgical resectability, adjuvant therapies, and functional outcomes.

Materials and Methods

We conducted a retrospective review of pathologically confirmed IMSCT cases treated surgically at our institution between January 1, 2014, and December 31, 2024 (10 years), supplemented by our team's prior research findings. Regular follow-ups were performed to assess outcomes.

Results

This study analyzed surgically treated intramedullary spinal cord tumors (IMSCTs), including gliomas (53 Grade I-III astrocytomas, 38 Grade IV glioblastomas), neuronal/mixed tumors (25 Grade I cases), ependymomas (298 Grade II, 19 Grade III, 53 myxopapillary), and 92 hemangioblastomas. Tumor resectability was classified as Type I-III based on tumor infiltration pattern: Type I (non-infiltrative, GTR feasible), Type II (minimal infiltration, GTR possible), Type III (extensive infiltration, unresectable). Intraoperative ultrasound and DREZ approach optimized resection while minimizing neurological damage. Neurophysiological monitoring (SEPs/MEPs/D-waves) preserved functional pathways, with D-waves reliably predicting motor outcomes. For astrocytomas, maximal safe resection was followed by observation (low-grade) or radiotherapy (high-grade). Ependymomas showed superior outcomes with GTR, while residual disease required adjuvant radiotherapy (≥ 50 Gy). Hemangioblastomas exhibited better functional recovery in sporadic versus VHL-associated cases, with GTR improving RFS in VHL patients. Stereotactic radiosurgery achieved clinical improvement in 17.9% of patients with small residual/recurrent lesions.

Conclusion

In this large cohort of 578 IMSCTs, a histology-driven strategy combined with maximal safe resection and multimodal monitoring was associated with favorable functional and survival outcomes. IMSCT management requires histology-specific strategies integrating surgical precision, multimodal monitoring, and adjuvant therapies. Future studies should optimize radiation techniques and targeted therapies to enhance outcomes.