Individualized Prediction of Overall Survival Time for Patients with Primary Intramedullary Spinal Cord Astrocytoma: A Population-Based Study

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Abstract

Background: The incidence rate of primary intramedullary spinal cord astrocytoma is approximately 0.047 per 100,000 individuals per year, making it the second most common type of intramedullary spinal cord tumor. Due to its rarity, there is a scarcity of related research, and prognostic factors remain unclear. The aim of this study is to identify risk factors affecting the prognosis of patients with primary intramedullary spinal cord astrocytoma. Based on these factors, we aim to develop and visualize a prognostic model for predicting the overall survival time of patients with this condition, thereby facilitating individualized predictions of overall survival time for patients with primary intramedullary spinal cord astrocytoma.

Methods: This study selected patients diagnosed with primary intramedullary spinal cord astrocytoma between 1975 and 2016 from the United States SEER database, incorporating a total of 582 eligible patients. We employed the Kaplan-Meier method for survival analysis of various factors to preliminarily screen for potential prognostic influences. Univariate and multivariate Cox regression analyses were utilized to identify independent risk factors. A multivariate Cox regression model was constructed, and the model was visualized using a nomogram. Finally, various methods were applied to validate and evaluate the model.

Results: Multivariate Cox analysis revealed that tumor grade, age, and surgical approach are independent prognostic factors for overall survival (OS). A multivariate Cox regression model and a nomogram were developed based on these factors. The overall C-index of the model was 0.764, indicating good discriminative ability. Time-dependent ROC curve analysis showed the model had a good distinction with a 1-year survival rate AUC of 0.801 [95% CI: 0.763-0.839], a 3-year survival rate AUC of 0.842 [95% CI: 0.809-0.874], and a 10-year survival rate AUC of 0.855 [95% CI: 0.821-0.888]. Calibration plots also demonstrated good model calibration. Decision curve analysis (DCA) indicated that the nomogram had good clinical utility in predicting 1-year, 3-year, and 10-year OS. Internal validation based on enhanced bootstrap resampling showed good consistency between nomogram predictions and actual observations.

Conclusion: Lower WHO tumor grade, younger age groups, and undergoing gross total resection (GTR) surgery are significant protective factors affecting the prognosis of patients with primary intramedullary spinal cord astrocytoma. Among patients with Grade II astrocytoma, being female

appears to be a protective factor, whereas being male seems to be a protective factor in Grade III astrocytoma. Radiation therapy and chemotherapy do not appear to improve long-term survival; specifically, radiation therapy may lead to worse outcomes for low-grade spinal cord astrocytomas. The study found no impact of tumor size, year of diagnosis, race, or marital status on prognosis. We have developed the first model and nomogram to predict the prognosis of patients with primary intramedullary spinal cord astrocytoma, which demonstrates good predictive ability. The nomogram performed well in internal validation, offering a tool to help clinicians predict the overall survival time of patients with primary intramedullary spinal cord astrocytoma on an individual basis.

Keywords: Astrocytoma; Intramedullary astrocytomas; Nomogram; Overall survival; SEER.

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