Research Square

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Development of a Risk Prediction Model for Early Postoperative Seizures After Glioma Resection and Optimization of Antiseizure medications Strategies Based on Decision Curve Analysis

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Abstract

Objective

To develop and validate a meta-analysis-based predictive model for the risk of early Postoperative seizure in gliomas. To use decision curve analysis to evaluate the clinical net benefit of a prophylactic antiseizure medications regimen based on risk stratification using this model, thereby providing an evidence-based foundation for individualized treatment decisions.

Methods

First, we conducted a systematic review of Chinese and English databases and performed a meta-analysis of risk factors for early Postoperative seizure in glioma patients. A risk scoring model was constructed based on pooled odds ratios. Subsequently, we validated the model externally using an independent retrospective cohort of 333 patients from our hospital. The model's discriminatory power was assessed using receiver operating characteristic (ROC) curves. Finally, to account for treatment confounding caused by the widespread use of prophylactic medication in the validation cohort, the natural risk of the disease was estimated using the counterfactual probability calibration method. Decision curve analysis was applied to quantitatively compare the net benefits of three strategies —"universal medication," "no medication," and "risk-stratified medication"—across different risk subgroups.

Results

The meta-analysis included 15 studies (3,409 patients) and identified 8 independent risk factors, which were used to construct a scoring model with a total score of 26 points. External validation demonstrated that the model had good discriminatory power (AUC = 0.854). Based on the scores, patients were classified into a low-risk group (0 points ≤ 12% of the total score; in this group, the optimal choice is to refrain from prophylactic medication). In the high-risk group, the treatment curves for stratified medication and universal medication overlapped significantly, and the net benefit was far higher than that of refraining from medication entirely.

Conclusion

This study developed and validated a high-performance predictive model for the risk of early Postoperative seizure following glioma surgery. Based on the risk stratification provided by this model, decision curve analysis further demonstrated that low-risk patients should avoid routine prophylactic use of antiseizure medicationss; moderate-risk patients should receive personalized, selective medication;

and high-risk patients are strongly recommended to undergo routine prophylaxis. This strategy improves patient outcomes while optimizing clinical net benefit.

Background

Gliomas are the most common primary malignant tumors of the central nervous system, accounting for 30% of all primary brain tumors and 80% of malignant brain tumors [1]. Epilepsy is one of the most common clinical symptoms in patients with gliomas, with an incidence rate as high as 60% to 90%, severely affecting patients' quality of life and prognosis [2]. Postoperative seizures not only prolong hospital stays and increase medical costs but may also lead to secondary brain damage and even be life-threatening.

Currently, the prevention of Postoperative seizure following glioma surgery primarily relies on empirical medication regimens, with a lack of individualized, precise guidance. Although previous studies have attempted to develop predictive models for the risk of Postoperative seizure following glioma surgery, they are generally limited by being single-center studies with small sample sizes. These studies have only completed risk stratification assessments and have not been translated into specific clinical medication decisions [3, 4], making it impossible to directly guide clinicians on when to use antiseizure medicationss. Decision curve analysis (DCA) is a method for quantifying the net benefit under different decision strategies, which can incorporate clinicians' relative preferences for intervention versus non-intervention[5]. However, existing models generally face the issue of "treatment confounding" caused by prophylactic medication in the validation cohort, leading to an underestimation of the natural risk of the disease.

This study aims to synthesize existing high-level clinical evidence through a meta-analysis to develop and validate a simple, widely applicable scoring model for predicting the risk of early Postoperative seizure in glioma patients. The study innovatively employs the counterfactual probability calibration method to correct for treatment-related confounding bias, combines decision curve analysis to quantify the net benefit of interventions, develops individualized preventive regimens using antiseizure medications (ASMs) for patients in different risk strata, and establishes a comprehensive application system spanning from risk identification to clinical intervention decisions.

Materials and methods

Model Development

Literature Search and Screening

The system searched Chinese and English databases, including PubMed, Web of Science, the Cochrane Library, Embase, China National Knowledge Infrastructure (CNKI), Wanfang Data, and VIP, covering the period from the databases' inception through May 2025. Chinese keywords: epilepsy, seizure, glioma,

astrocytoma, glioblastoma, oligodendroglioma, astrocytoma; English keywords: seizure, epilepsy, glioma, astrocytoma, oligodendroglioma. Inclusion criteria: (1) Study participants were patients with pathologically confirmed gliomas; (2) The study focused on the analysis of risk factors for early-Postoperative seizure in glioma patients; (3) The study design was a cohort study or a case-control study; (4) The language of the study was Chinese or English. Exclusion criteria: (1) Key data were missing or could not be extracted; (2) Full-text articles were unavailable; (3) Duplicate publications; (4) NOS score < 4 points.

Quality Assessment and Meta-Analysis

The quality of the included studies was independently assessed using the Newcastle-Ottawa Scale (NOS). Meta-analysis was performed using RevMan 5.4 software. For dichotomous variables, the odds ratio (OR) and its 95% confidence interval (CI) were used as measures of effect. Heterogeneity was assessed using the I^2 statistic: a fixed-effects model was used when $I^2 < 50\%$; otherwise, a random-effects model was used.

Scoring Model Development

Following the method described by Sullivan et al. [6], a scoring model for the classification point system was constructed based on the pooled OR values obtained from the meta-analysis. To eliminate the confounding effect of the treatment itself on model construction, the two factors “no prophylactic medication before surgery” and “no prophylactic medication after surgery” were excluded.

Model Validation

Validation Queue

A total of 333 patients who underwent their first tumor resection surgery in the Department of Neurosurgery at the Affiliated Hospital of Jining Medical University between January 2019 and December 2024, and who were pathologically confirmed to have glioma postoperatively with complete clinical data, were included in this study. Patients with other intracranial tumors or concurrent traumatic brain injury were excluded. The primary outcome was the onset of new-onset epilepsy within 7 days postoperatively, diagnosed based on clinical manifestations or electroencephalogram (EEG) findings (e.g., typical spikes, sharp waves, or spike-and-slow-wave complexes).

Statistical Methods

The scoring model was applied to the validation cohort to plot the receiver operating characteristic (ROC) curve and calculate the area under the curve (AUC) to assess discriminatory power. The optimal

cutoff value was determined using the Youden index, and patients were classified into low-, medium-, and high-risk groups. Statistical analysis was performed using SPSS 26.0 software.

Optimization of Medication Strategies

Calibration of Counterfactual Probabilities

The rate of postoperative prophylactic medication use in the validation cohort was as high as 96.7%, and the directly observed incidence of epilepsy was significantly lower than the risk associated with the natural course of the disease. Based on the hazard effects of postoperative non-use of prophylactic medication derived from the meta-analysis (pooled OR and 95% CI), the natural risk of epilepsy in the absence of medication was estimated using the counterfactual probability calibration method [7].

Decision Curve Analysis

The core metric in decision curve analysis is net benefit (NB), calculated using the following formula: NB = TP/N − (FP/N) × (T/(1-T)), where TP is the number of true positives, FP is the number of false positives, N is the total number of cases, and T is the probability of the risk threshold. Following the guidelines of the Epilepsy Foundation of America, the analysis focuses on the clinically reasonable threshold range of T = 2%–20% [8]. Assuming an odds ratio (OR) of 3.31 for postoperative prophylactic medication use, we compared the net benefit curves for the three strategies—“universal medication,” “no medication,” and “risk-stratified medication”—in low-, medium-, and high-risk subgroups, respectively. The analysis was performed using R version 4.3.0 (rmda and ggplot2 packages).

To ensure the robustness of the DCA results, a sensitivity analysis was conducted for the intermediate-risk group using the lower limit (2.55) and upper limit (4.29) of the 95% confidence interval for the OR of postoperative non-prophylactic medication use.

Results

Meta-analysis Results

An initial search yielded 3,283 studies; after a multi-stage screening process, 15 studies [9–23] were ultimately included, involving a total of 3,409 patients, among whom 552 developed Postoperative seizure (incidence rate: 16%). All studies were retrospective cohort studies with NOS scores ranging from 6 to 8; of these, 13 were of high quality (≥ 7) and 2 were of moderate quality (6). The meta-analysis revealed the following statistically significant risk factors and their combined OR values: history of epilepsy (OR = 3.53, 95% CI: 2.84–4.39), preoperative seizure frequency of ≥ 1 episode/day (OR = 3.10, 95% CI: 1.95–4.93), preoperative motor deficits (OR = 2.53, 95% CI: 1.83–3.51), low-grade glioma (OR = 2.06, 95% CI: 1.55–2.74), tumor diameter ≥ 5 cm (OR = 2.24, 95% CI: 1.62–3.11), cortical tumor involvement (OR = 2.89, 95% CI: 2.00–4.19), peritumoral edema (OR = 2.30, 95% CI: 1.17–4.52), and

postoperative hemorrhage into the tumor cavity (OR = 3.35, 95% CI: 2.18–5.16). The forest plot is shown in Fig. 1.

Building a Risk Scoring Model

A risk scoring model was constructed based on the above 8 independent risk factors, with the following scores assigned to each factor: history of epilepsy (4 points), preoperative seizure frequency ≥ 1 per day (4 points), preoperative motor deficits (3 points), low-grade glioma (2.5 points), tumor diameter ≥ 5 cm (2.5 points), tumor involvement of the cortex (3.5 points), peritumoral edema (2.5 points), and postoperative hemorrhage within the tumor cavity (4 points), for a total score of 26 points (Table 1).

Table 1
Risk Scoring Model for Early Postoperative Seizures After Glioma Resection

Risk Factor	Score
History of preoperative seizures	4
Preoperative seizure frequency ≥ 1 per day	4
Preoperative motor dysfunction	3
Low-grade glioma	2.5
Tumor diameter ≥ 5 cm	2.5
Cortical involvement	3.5
Peritumoral edema	2.5
Postoperative intracavitary hemorrhage	4
Total score	26

External Model Validation

The validation cohort included 333 patients, comprising 20 (6.0%) in the Postoperative seizure group and 313 in the non-epilepsy group. The specific clinical characteristics of the validation cohort are shown in Table 2. The AUC of the model's ROC curve was 0.854 (95% CI: 0.782–0.926) (Fig. 2). The Yoden index determined the optimal cutoff value to be 6.25 points; however, 6.5 points was selected for practical reasons, yielding a sensitivity of 0.90 and a specificity of 0.677. Based on this, patients were divided into three groups: low-risk group (0 points ≤ score < 6.5 points), moderate-risk group (6.5 points ≤ score < 13 points), and high-risk group (13 points ≤ score ≤ 26 points). The actual Postoperative seizure incidence rates for the three groups were 0.94% (2/213), 12.84% (14/109), and 40.0% (4/10), respectively.

Table 2
Baseline Clinical Characteristics of the Validation Cohort

Clinical Index	Seizure Group (n = 20)	Non-seizure Group (n = 313)
History of preoperative seizures	16	51
Preoperative seizure frequency ≥ 1 time per day	4	6
Preoperative motor dysfunction	2	52
Low-grade glioma	11	98
Tumor diameter ≥ 5 cm	9	73
Cortical involvement	12	138
Peritumoral edema	10	123
Postoperative intracavitary hemorrhage	0	4
Preoperative prophylactic antiseizure medicationss	14	124
Postoperative prophylactic antiseizure medicationss	19	298

Results of Decision Curve Analysis

After counterfactual calibration, the natural risks of epilepsy in the low-, medium-, and high-risk groups were adjusted to 3.79%–6.14%, 22.2%–31.4%, and 70.5%–79.8%, respectively. When the counterfactual OR was set to 3.31, decision curve analysis (Fig. 3) showed that in the low-risk group, the standardized net benefit of the all-intervention strategy was negative at all threshold probabilities. The risk stratification strategy yielded a very slight positive net benefit only within the extreme ranges of the threshold probability. In the moderate-risk group, all interventions showed a slight positive net benefit only within an extremely narrow range where the threshold probability was less than approximately 12%, and the benefit level was consistently lower than that of the risk stratification strategy. For the risk stratification strategy, the net benefit gradually turns negative once the threshold probability exceeds 12%. In the high-risk group, the curves for “stratified medication” and “universal medication” overlap significantly, and the net benefit is far higher than that of “no medication at all.”

Since counterfactual probability adjustment relies on the pooled OR value (3.31) obtained from the meta-analysis, we conducted a sensitivity analysis focused on the moderate-risk group—to which the decision is most sensitive—to test the robustness of the DCA analysis (Fig. 4). Regardless of fluctuations in the OR value, the strategy of “prescribing medication to all moderate-risk patients” yields only a marginal benefit within a very narrow range of low thresholds, and this benefit is consistently lower than that of the stratified strategy. Once the threshold exceeds 12%, the net benefit of this strategy rapidly turns deeply negative, resulting in clear net harm. This conclusion was consistent across all sensitivity

analyses. When the clinical decision threshold exceeds 12%, regardless of the intervention's effectiveness, the net benefit of all intervention strategies is lower than that of "no intervention at all," and observation remains the optimal choice. This conclusion is also entirely consistent.

Discussion

Through a systematic review and meta-analysis, this study synthesized clinical data from 15 high-quality studies (involving a total of 3,409 patients). Based on these data, we identified eight independent risk factors for early Postoperative seizure following glioma resection and developed a risk scoring model with a total score of 26 points. In the independent validation cohort, the model demonstrated good discriminatory ability, with an area under the receiver operating characteristic curve (AUC) of 0.854. More importantly, this study introduced, for the first time in this field, a combined decision curve analysis calibrated using counterfactual probabilities, effectively overcoming the interference of treatment confounding in model validation. This approach provides a clear, quantified, and individualized medication decision pathway for patients in different risk strata.

Compared with previously published models for predicting Postoperative seizure in gliomas [24–28], this model offers several significant advantages. First, it has a higher level of evidence: the model is based on high-level evidence from meta-analyses, and all predictive factors have been validated using multicenter, large-sample data, ensuring the model's robustness and generalizability. Second, it offers outstanding clinical utility: the model is presented as a simple arithmetic scoring system, and the required variables consist entirely of clinical, imaging, and pathological information routinely collected during the neurosurgical perioperative period, including history of epilepsy, tumor size, pathological grade, and intracranial hemorrhage status. Clinicians can rapidly complete the assessment at the bedside without the need for additional equipment or complex calculations. This makes it easier to implement across healthcare facilities of all levels compared to "black-box" models that rely in part on genetic sequencing [25] or imageomics[26], making it easier to implement across healthcare facilities at all levels. Furthermore, this study achieved innovation in decision-making translation: the research did not stop at risk identification but used decision curve analysis to translate risk scores into stratified clinical treatment recommendations. In particular, the introduction of counterfactual probability calibration effectively addressed the issue of risk underestimation caused by widespread medication use in the validation cohort, making the results of the decision curve analysis more closely aligned with real-world clinical decision-making scenarios.

The core clinical value of this study lies in providing clinicians with a clear risk-stratified treatment strategy. For low-risk patients, decision curve analysis shows that the net benefit of any treatment strategy is negative. This means that, in this patient population, the side effects of prophylactic antiseizure medicationss (such as dizziness, drowsiness, rash, and drug interactions) and the associated economic burden outweigh the benefits gained from preventing a small number of epileptic events. Therefore, routine prophylactic medication should be avoided, which is fully consistent with the medical principle of "first, do no harm." For moderate-risk patients, individualized interventions based on

risk stratification are the standard recommendation. This strategy has undergone rigorous sensitivity analysis and represents the optimal management approach for the moderate-risk population. Specifically: if the clinical decision threshold is ≤ 12%, initiating stratified intervention yields clear clinical benefits; if the clinical decision threshold is > 12%, observational follow-up is the preferred approach for all patients in this group. In this scenario, the net benefit of any intervention is negative, making the observational strategy more advantageous. Regardless of the clinical scenario, a one-size-fits-all approach of “routine prophylactic medication for all” in the moderate-risk group is strictly prohibited, as this strategy would cause unnecessary harm to the majority of patients in all scenarios. At the same time, risk stratification should not be completely abandoned to avoid missing high-risk individuals within the group who could truly benefit from medication. For high-risk patients, the benefits of prophylactic medication are significant. Whether the “universal medication” or “stratified medication” strategy is adopted, the net benefit is significantly superior to “no medication at all.” Given the possibility of false negatives in the model, the simpler and safer “universal medication” strategy is recommended to minimize the risk of missing high-risk patients.

Based on the results of this study, we propose a targeted clinical decision pathway: for all patients scheduled for glioma surgery, a risk score should be calculated immediately after surgery using the scoring system. For low-risk patients with a score < 6.5, routine prophylactic medication is not recommended; for intermediate-risk patients with a score of 6.5 ≤ score < 13, individualized, selective medication is appropriate; and for high-risk patients with a score of 13 ≤ score ≤ 26, routine prophylactic medication is strongly recommended.

This study has certain limitations. First, the validation cohort consists of single-center retrospective data; although counterfactual calibration was performed, selection bias may still exist. Future prospective, multicenter studies are needed to further validate the model’s performance. Second, counterfactual calibration assumes that treatment outcomes are homogeneous across all patients; however, in actual clinical practice, differences in the types and doses of antiseizure medicationss, as well as patient adherence, may lead to some bias in the estimation of natural risk. Furthermore, the decision curve analysis only quantifies the trade-off between epileptic events and overtreatment, without incorporating specific quantitative measures of adverse drug reactions. In the future, integrating cost-utility analysis could provide clinicians with a more comprehensive basis for decision-making. Finally, the effectiveness of this model in improving clinical outcomes has not yet been validated through prospective intervention studies. Follow-up randomized controlled trials or effectiveness studies could be designed to compare the differences between “model-guided decision-making” and “conventional empirical decision-making” in terms of patient prognosis and health economics, thereby further validating the model’s clinical value.

Conclusions

Based on a meta-analysis, this study developed and validated a predictive scoring model for the risk of early Postoperative seizure in glioma patients, incorporating eight clinical variables. The model

demonstrated good discriminatory power and clinical utility. Through counterfactual probability calibration combined with decision curve analysis, we have, for the first time, provided an individualized preventive medication decision pathway based on risk stratification: low-risk patients should avoid routine medication; moderate-risk patients should receive personalized, selective medication; and high-risk patients are strongly recommended to undergo routine preventive medication. This strategy is expected to reduce the incidence of Postoperative seizure while avoiding unnecessary adverse drug reactions and waste of medical resources, thereby providing evidence-based support for precision medicine in neurosurgery.

Abbreviations

AUC: Area Under the Curve

ASM: Antiseizure medications

CI: Confidence Interval

DCA: Decision Curve Analysis

EEG: Electroencephalogram

MRI: Magnetic Resonance Imaging

NB: Net Benefit

NOS: Newcastle-Ottawa Scale

OR: Odds Ratio

ROC: Receiver Operating Characteristic

Declarations

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Not applicable

Authors' contributions

Zhongqian Sun: Study design, clinical data collection, statistical analysis, manuscript original drafting.

Yuanyuan Zhao, Tieying Ning, Ling Wang: Case screening, clinical data sorting, literature retrieval and screening.

Junchen Zhang: Study design, Project supervision, critical revision of manuscript, funding acquisition.

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Data availability

The raw clinical datasets generated and analyzed during the present study are not publicly available due to restrictions related to patient privacy and institutional data management policies. Reasonable requests for de-identified analytical datasets can be submitted to the corresponding author upon legitimate academic demand.

Ethics approval and consent to participate

This retrospective observational study was approved by the Ethics Committee of the Affiliated Hospital of Jining Medical University (Approval No.: 2024-167). Formal written informed consent from individual patients was waived by the ethics committee because all analyses were performed on de-identified retrospective clinical data without additional invasive examinations or patient intervention.

Notably, the corresponding author Dr. Junchen Zhang was affiliated with the Affiliated Hospital of Jining Medical University before 2026; after 2026, he transferred to Qingdao Central Hospital, University of Rehabilitation Science and Health.

Consent for publication

Not applicable. All clinical data used in this manuscript have been fully anonymized, and no identifiable individual patient information, clinical images or personal details are included. No separate patient consent for publication is required.

Competing interests

All authors declare that there are no competing financial, professional or personal interests that could influence the design, conduct or interpretation of this research. The authors have no relevant affiliations or financial involvement with any organization that might conflict with the work presented in this paper.

References

1. Ostrom QT, Price M, Neff C, et al. CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2016–2020. Neuro Oncol. 2023;25(12 Suppl 2):iv1–99.
2. van Breemen MS, Wilms EB, Vecht CJ. Epilepsy in patients with brain tumours: epidemiology, mechanisms, and management. Lancet Neurol. 2007;6(5):421–30.

3. Chen QN, Gai SQ, Wang AX, et al. Development and validation of a random survival forest model for predicting postoperative seizures in patients with glioma[J]. Chin J Neurosurg. 2025;41(6):584–92.
4. Wang J, Luo X, Chen C et al. Preoperative MRI for postoperative seizure prediction: a radiomics study of dysembryoplastic neuroepithelial tumor and a systematic review [J]. Neurosurg Focus,2022,53(4):E7.
5. Vickers AJ, Elkin EB. Decision curve analysis: a novel method for evaluating prediction models. Med Decis Mak. 2006;26(6):565–74.
6. Sullivan LM, Massaro JM, D'Agostino RB, Sr. Presentation of multivariate data for clinical use: The Framingham Study risk score functions. Stat Med. 2004;23(10):1631–60.
7. Morgan SL, Winship C. Counterfactuals and Causal Inference: Methods and Principles for Social Research. Cambridge: Cambridge University Press; 2015.
8. Glantz MJ, Cole BF, Forsyth PA, et al. Practice parameter: anticonvulsant prophylaxis in patients with newly diagnosed brain tumors [RETIRED]. Neurology. 2000;54(10):1886–93. Report of the Quality Standards Subcommittee of the American Academy of Neurology.
9. Qiu BH, Gong FH, Fang LX, et al. Analysis of influencing factors for postoperative seizures following glioma resection[J]. J South Med Univ. 2008;28(12):2233–4.
10. Tan XS. Analysis of clinically relevant factors for early postoperative seizures after glioma resection[D]. Shantou University; 2011.
11. Gui XB, Fu XM, Niu CS, et al. Analysis of risk factors for early postoperative seizures after supratentorial glioma resection[J]. Chin J Stereotact Funct Neurosurg. 2012;25(5):287–90.
12. Hu JT, Lü YX, Wang H, et al. Analysis of influencing factors of postoperative seizures in patients with glioma[J]. Shaanxi Med J. 2014;43(4):471–3.
13. Yang SW, Xia L, Gao CQ, et al. Analysis of risk factors for early postoperative seizures following glioma surgery[J]. Chin J Practical Nerv Dis. 2015;18(24):24–6.
14. Skardelly M, Brendle E, Noell S, et al. Predictors of preoperative and early postoperative seizures in patients with intra-axial primary and metastatic brain tumors: A retrospective observational single center study [J]. Ann Neurol. 2015;78(6):917–28.
15. Song YJ. Analysis of relevant factors for early postoperative seizures following glioma resection[D]. Soochow University; 2017.
16. Hasimujiang Reheman, Yang XP. Analysis of prevalence and risk factors of early postoperative seizures after glioma resection[J]. Oncol Progress. 2017;15(8):947–9.
17. Bech KT, Seyedi JF, Schulz M, et al. The risk of developing seizures before and after primary brain surgery of low- and high-grade gliomas [J]. Clin Neurol Neurosurg. 2018;169:185–91.
18. Chen YD, Peng B, Luo DD, et al. Risk factors for early postoperative seizures after glioma resection[J]. Chin J Minim Invasive Neurosurg. 2019;24(5):204–7.
19. Wang WY. Analysis of risk factors and construction of risk prediction models for early postoperative seizures after resection of common intracranial tumors[D]. Wenzhou Medical University; 2020.

20. Zhang XC, Ma JP, Zhu CY, et al. Logistic regression analysis of risk factors associated with early postoperative seizures in patients with glioma[J]. J Cancer Prev Treat. 2021;34(2):138–42.
21. Tian C, Wu RQ, Zhang X, et al. Analysis of relevant influencing factors of postoperative seizures after craniotomy for glioma[J]. Chin J Med J. 2022;57(12):1337–40.
22. Ge J, Du W. Risk factors and development of prediction models for early postoperative seizures following craniotomy glioma resection[J]. Journal of Nurses Training, 2024, 39(18): 1947–1951, 1965.
23. Li QQ, Su Y, Qiu HY, et al. Analysis of risk factors and establishment of prediction models for early postoperative seizures after glioma resection[J]. Mod Med J. 2025;53(2):286–93.
24. Das KK, Singh A, Mishra P, et al. Postoperative Seizure Control in Adult Diffuse Insular Gliomas Presenting with Seizures: A Retrospective Single-Center Experience and Proposal of a Novel Risk Scoring System. Neurol India. 2023;71(4):682–8.
25. Wang Z, Yang P, You G, et al. Predicting the likelihood of postoperative seizure status based on mRNA sequencing in low-grade gliomas. Future Oncol. 2018;14(6):545–52.
26. Sun K, Liu Z, Li Y, et al. Radiomics Analysis of Postoperative Epilepsy Seizures in Low-Grade Gliomas Using Preoperative MR Images. Front Oncol. 2020;10:1096.
27. Pan SP, Zheng XL, Zhang N, et al. A novel nomogram for predicting the risk of epilepsy occurrence after operative in gliomas patients without preoperative epilepsy history. Epilepsy Res. 2021;174:106641.
28. Li L, Zhang C, Wang Z, et al. Development of an integrated predictive model for postoperative glioma-related epilepsy using gene-signature and clinical data. BMC Cancer. 2023;23(1):42.

Figures

Risk factor	Included studies	OR (95% CI)	Heterogeneity
History of epilepsy	[9–13, 15–17, 21–23]	3.53 (2.84–4.39)	I^2 = 0%, P < 0.00001
Preoperative seizure frequency ≥ 1/d	[12, 18, 20]	3.10 (1.95–4.93)	I^2 = 0%, P < 0.00001
Preoperative motor deficits	[16, 18, 20]	2.53 (1.83–3.51)	I^2 = 48%, P < 0.00001
Frontal lobe tumors	[18, 23]	2.71 (0.97–7.57)	I^2 = 71%, P = 0.06
Fronto-temporal lobe tumors	[12–13]	1.70 (0.75–3.82)	I^2 = 80%, P = 0.2
Low-grade glioma	[10, 14–15, 18, 20, 22–23]	2.06 (1.55–2.74)	I^2 = 42%, P < 0.00001
Tumor diameter ≥ 5 cm	[18, 20, 22–23]	2.24 (1.62–3.11)	I^2 = 26%, P < 0.00001
Cortical involvement	[10, 22–23]	2.89 (2.00–4.19)	I^2 = 0%, P < 0.00001
Peritumoral edema	[13, 16, 18–19]	2.30 (1.17–4.52)	I^2 = 76%, P = 0.02
Postoperative tumor cavity hemorrhage	[11–12, 18, 21]	3.35 (2.18–5.16)	I^2 = 0%, P < 0.00001
No preoperative prophylactic medication	[10, 16, 18, 20]	3.80 (1.79–8.10)	I^2 = 71%, P = 0.0005
No postoperative prophylactic medication	[10, 15–16, 18, 20–23]	3.31 (2.55–4.29)	I^2 = 13%, P < 0.0001

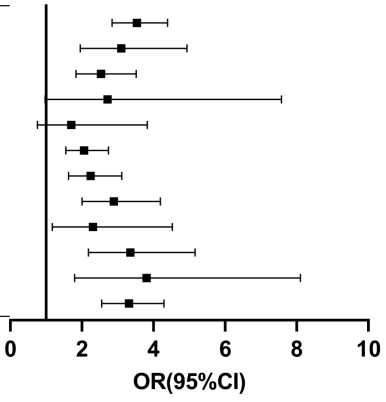

Figure 1

Forest plot of pooled odds ratios for risk factors of early postoperative seizures after glioma resection. OR>1 indicates the factor is associated with an increased risk of early postoperative seizures.

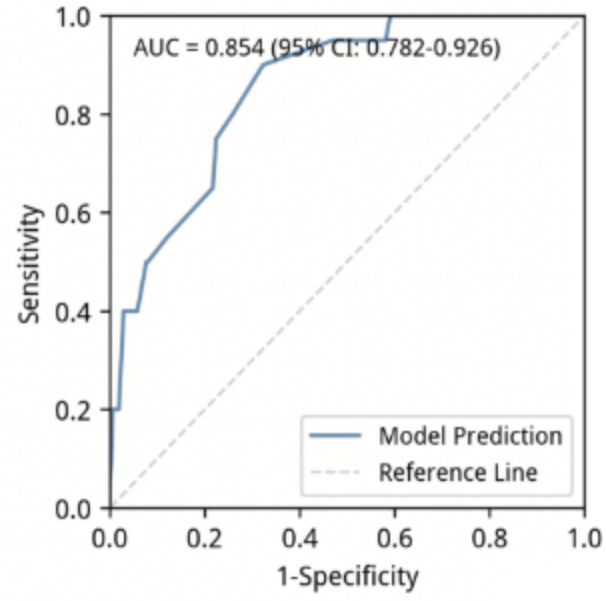

Figure 2

Receiver operating characteristic curve of the risk prediction model for early postoperative seizures after glioma resection

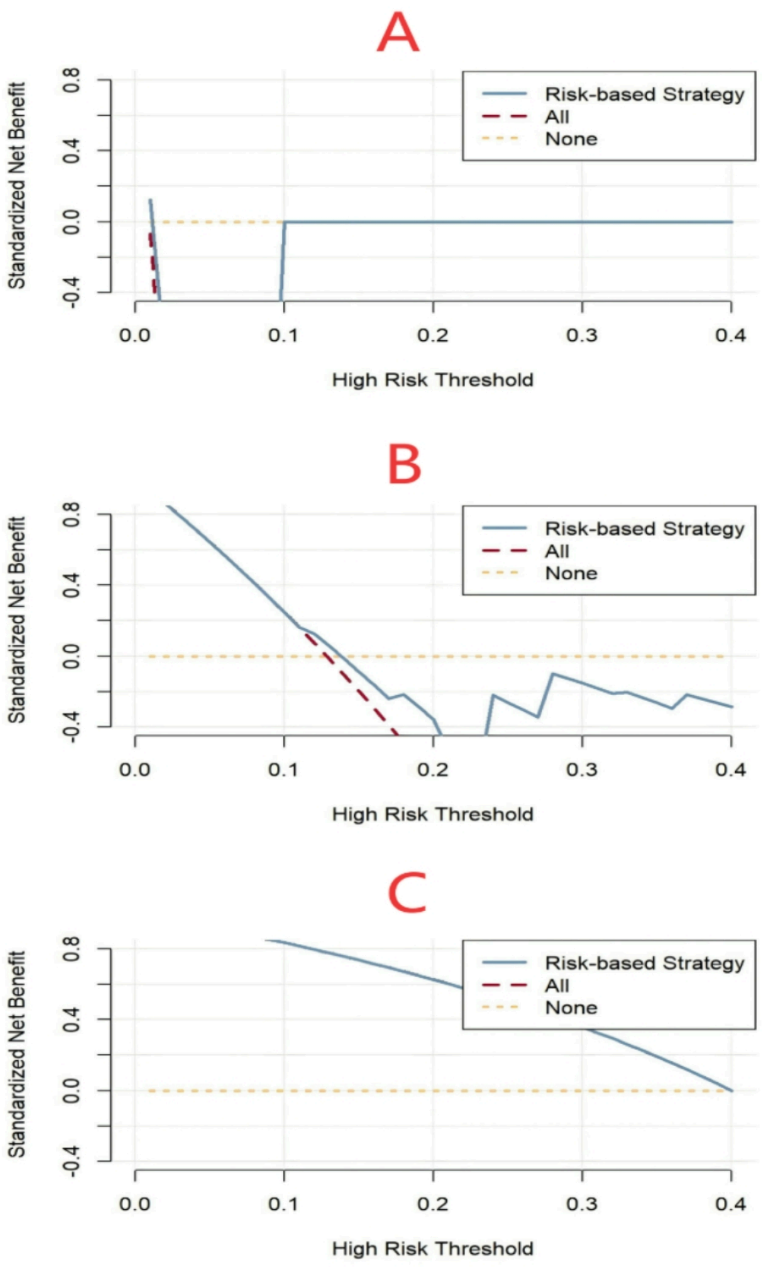

Figure 3

Decision curves for different risk strata with OR = 3.31 (A: Low-risk group; B: Moderate-risk group; C: High-risk group. Solid blue line: Risk-stratified medication guided by the model; Dashed red line: Universal medication for all patients; Dashed yellow line: No prophylactic medication for all patients)

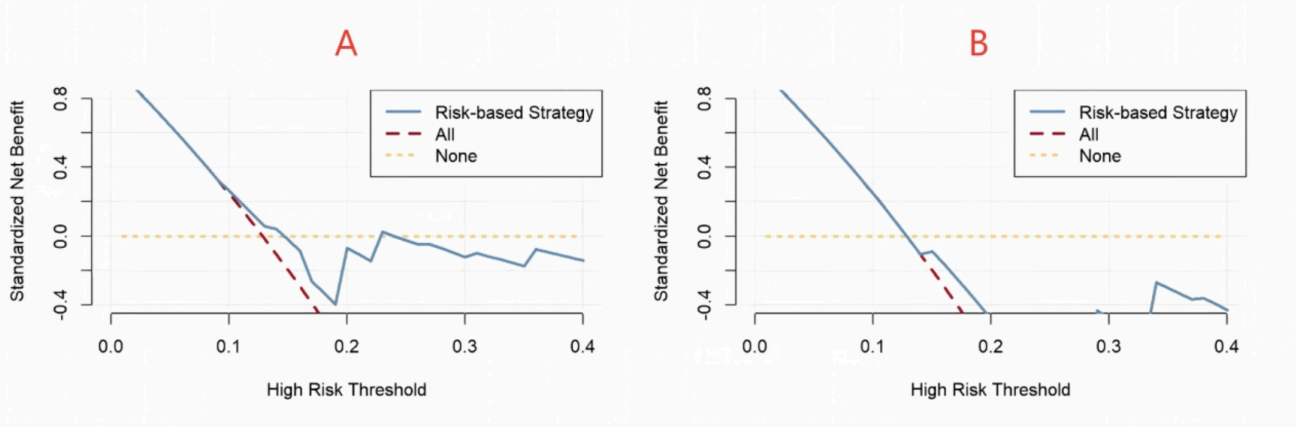

Figure 4

Sensitivity analysis of decision curve analysis for the moderate-risk group (Solid blue line: Model-guided risk-stratified medication; Dashed red line: Universal prophylactic medication for all patients; Dashed yellow line: No prophylactic medication for all patients)