Macrothink Institute™

Journal of Biology and Life Science
ISSN 2157-6076
2027, Vol. 18, No. 1

Recent Advances in the Study of Perioperative Symptom Clusters in Patients with Brain Tumors

Hongyun Li

Department of Neurosurgery, Affiliated Hospital of North Sichuan Medical College, China

Huaying Pan

Department of Gastrointestinal Surgery II, Affiliated Hospital of North Sichuan Medical College, China. Email: lhy231363@163.com

Received: October 20, 2026 Accepted: November 23, 2026 Published: November 25, 2026

doi:10.5296/jbls.v18i1.24174 URL: https://doi.org/10.5296/jbls.v18i1.24174

Abstract

Perioperative brain-tumor patients suffer multiple co-existing symptoms induced by tumor lesions, surgical trauma and therapeutic interventions, which severely impair quality of life and postoperative rehabilitation. This review systematically summarizes relevant research on perioperative symptom clusters in brain-tumor patients. It introduces the concept of symptom clusters as well as three key symptom roles: sentinel symptoms, core symptoms and bridge symptoms. Three major assessment tools including MDASI-BT, EORTC QLQ-BN20 and MSAS are compared, among which MDASI-BT shows good psychometric properties for Chinese brain-tumor populations. Symptom-cluster compositions differ between preoperative and postoperative phases and present dynamic evolutionary features with distinct heterogeneous patient subgroups. Influencing factors cover demographic-socioeconomic status, tumor characteristics, surgical modalities and perioperative medication. Current nursing strategies include standardized symptom monitoring, symptom-cluster-targeted interventions focusing on psychoeducation and bridge-symptom management, as well as hospital-home transitional care. Nevertheless, existing studies are dominated by cross-sectional surveys, lacking high-quality longitudinal evidence and validated specialized nursing protocols. Future multicenter longitudinal studies combined with symptom-network analysis are required to identify brain-tumor-specific key symptoms, develop stratified intervention schemes, and build digital continuous symptom-management systems, so as to facilitate precise perioperative symptom-cluster management in clinical neurosurgical nursing.

Keywords: Brain tumor, Symptom clusters, Perioperative period, Nursing intervention, Review

1. Introduction

The concept of "symptom clusters" was introduced into the field of oncology nursing in the early 21st century. Dodd et al. (2001) first proposed that when three or more symptoms occur simultaneously and are interrelated, they constitute a symptom cluster. Subsequently, Kim et al. (2005) revised this definition, suggesting that two or more highly correlated symptoms can form a symptom cluster, with symptoms within a cluster being interrelated and those across clusters being relatively independent. Although there is still no complete consensus in the academic community regarding the criteria for defining symptom clusters, the definition of "a combination of two or more interrelated, relatively stable symptoms" has become widely accepted (Miaskowski et al., 2017).

In symptom cluster research, a sentinel symptom refers to a symptom within a cluster that serves as an identifier and indicator, signaling the presence of other symptoms within the cluster (Brown et al., 2011). A "core symptom" is a highly central node in the symptom network that interacts with most other symptoms. A "bridge symptom" connects different symptom clusters; disrupting a bridge symptom can effectively block the synergistic reinforcement effects among symptom clusters (Liang et al., 2024). Identifying these three specific types of symptoms helps simplify assessment, enable precise intervention, and improve the efficiency of symptom management.

2. Assessment Tools for Perioperative Symptom Clusters in Patients with Brain Tumors

Due to their specific location, brain tumors present symptoms that combine both general tumor-related characteristics (fatigue, pain) and nervous system-specific features (cognitive impairment, epilepsy, focal neurological deficits). Therefore, assessment tools must balance general applicability with brain tumor specificity.

2.1 The MD Anderson Symptom Assessment Scale—Brain Tumor Module (MDASI-BT)

Developed by the MD Anderson Cancer Center in the United States based on the general-purpose MDASI, this scale includes brain tumor-specific items and is currently the most widely used assessment tool in research on brain tumor symptom clusters (Armstrong et al., 2006). The scale comprises 22 core symptom assessment items and 6 symptom interference items, using a 0–10 scoring system. The Chinese version of the MDASI-BT has undergone reliability and validity testing by domestic scholars. It consists of 28 items; exploratory factor analysis identified 6 common factors, accounting for 63.137% of the total variance. The Cronbach's α coefficient for the total scale is 0.920, and the split-half reliability coefficient is 0.894 (Pushuying et al., 2021). This scale is suitable for assessing the severity of symptoms and their impact on quality of life among brain tumor patients in China.

2.2 European Organization for Research and Treatment of Cancer (EORTC) QLQ-BN20

The EORTC QLQ-BN20 is a brain tumor-specific module of the EORTC QLQ-C30. It consists of 24 items and assesses neurological symptoms specific to brain tumor patients, treatment-related adverse effects, and the impact of the disease on daily life (Osoba et al., 1996). This questionnaire covers five domains—uncertainty about the future, visual

impairment, communication difficulties, motor dysfunction, and emotional distress—and includes seven item-specific symptoms such as headache, seizures, somnolence, and weakness in both legs (Chakravarti et al., 2025). With Cronbach's α coefficients ranging from 0.753 to 0.869 and correlations between items and their respective dimensions all exceeding 0.4, this scale demonstrates good reliability and validity. It has been widely used among patients with various brain tumors, including gliomas and meningiomas, and is suitable for symptom assessment in international multicenter studies (Taphoorn et al., 2010).

2.3 Memory Symptom Assessment Scale (MSAS)

The MSAS assesses 32 physical and psychological symptoms, measuring symptom experience across three dimensions: frequency, severity, and distress (Portenoy et al., 1994). The major subscales demonstrate good internal consistency, with Cronbach's α ranging from 0.83 to 0.88. Factor analysis supports a three-factor structure, and criterion validity has been confirmed through correlations with clinical status and quality of life. The strength of this scale lies in its ability to simultaneously assess the multidimensional attributes of symptoms; however, it lacks brain tumor-specific items and is often used in conjunction with specific modules in brain tumor patients (Hao et al., 2025).

Currently, the application of assessment tools for brain tumor symptom clusters remains primarily limited to cross-sectional studies, with relatively few longitudinal follow-up studies. Future research should emphasize longitudinal designs to dynamically observe the evolution of symptom clusters. Furthermore, the application of electronic assessment platforms based on patient-reported outcomes (such as mobile applications) among brain tumor patients is still in its infancy and warrants further exploration.

3. Classification and Characteristics of Perioperative Symptom Clusters in Patients with Brain Tumors

Perioperative symptom clusters in patients with brain tumors exhibit varying characteristics depending on the tumor location and surgical stage.

3.1 Preoperative Symptom Clusters

During the preoperative phase, patients face the psychological shock of receiving a diagnosis and fear of the unknown associated with surgery; symptoms are primarily psychological and emotional in nature, as well as neurological. A cross-sectional study of patients with sella turcica tumors showed that the most common and severe preoperative symptoms were visual changes (68.0%) and dry mouth (55.7%), with psychological distress being the primary accompanying symptom (Yeernuer et al., 2025). Preoperative symptom clusters can affect patients' tolerance of surgery and increase the risk of postoperative complications.

3.2 Postoperative Symptom Clusters

Symptoms in the postoperative phase worsen dramatically in the short term. The aforementioned study showed that the most common postoperative symptoms were pain (94.3%) and dry mouth (94.3%), which had the greatest impact on patients' general activities and mood (Yeernuer et al., 2025). The composition of symptom clusters changed compared to

the preoperative period; while psychological and neurological symptom clusters persisted, new clusters emerged, including gastrointestinal symptoms (nausea, vomiting, and decreased appetite) and sleep-related symptoms (insomnia and somnolence). Gastrointestinal symptoms may be related to anesthetic agents, postoperative stress, and the use of diuretics; sleep disturbances; on the other hand, they are associated with pain, environmental disturbances, and the effects of corticosteroids on melatonin secretion (Armstrong et al., 2016).

3.3 Dynamic Evolution of Symptom Clusters

Peroperative symptom clusters in brain tumor patients are not static but follow a dynamic trajectory. A longitudinal study of patients with primary brain tumors found that latent profile analysis identified six distinct symptom subgroups (entropy = 0.964), including the transient postoperative burden subgroup, the stable symptoms with emerging cognitive impairment subgroup, the distress-dominated subgroup, the low-burden subgroup, the elderly high-level persistent severe subgroup, and the nausea-dominated recovery subgroup (Li et al., 2025). This heterogeneity suggests that a generalized description of "average symptom trends" may mask the existence of high-risk subgroups; clinical care should therefore be based on stratified management following individualized assessments.

4. Factors Influencing Perioperative Symptom Clusters in Patients with Brain Tumors

4.1 Demographic and Socioeconomic Factors

Age is a key factor influencing symptom experience. Studies have found that older patients experience a heavier postoperative symptom burden, which may be related to decreased physiological reserve and an increased prevalence of comorbidities (Li et al., 2025). Place of residence (rural vs. urban) and household income level are negatively correlated with symptom severity; patients with lower socioeconomic status have a significantly higher symptom burden, which may be associated with delayed medical care, lower health literacy, and limited support resources. A study developing a predictive model for the risk of symptom cluster distress in brain tumor patients, based on eight influencing factors, showed that age, payment method, disease duration, Karnofsky Performance Status score, financial toxicity, self-efficacy, and medical coping strategies were all significant predictors (Ying et al., 2025).

4.2 Disease- and Treatment-Related Factors

Tumor type and grade are key determinants of symptom clusters. There are differences in symptom cluster types between patients with gliomas and those with meningiomas; patients with high-grade gliomas experience a significantly higher symptom burden than those with low-grade tumors or benign meningiomas (Armstrong et al., 2016). Tumor location also influences symptom presentation: supratentorial tumors are more likely to cause cognitive impairment and seizures, whereas infratentorial and brainstem tumors more frequently lead to balance disorders, ataxia, and cranial nerve symptoms (Li et al., 2025).

Among surgery-related factors, the surgical approach (craniotomy vs. transsphenoidal), extent of tumor resection, and dosage of intraoperative anesthetics can all influence the occurrence and severity of postoperative symptoms. In addition, commonly used

perioperative medications (such as mannitol and dexamethasone) can themselves cause electrolyte imbalances, gastrointestinal symptoms, and sleep disturbances, constituting important iatrogenic factors in symptom clusters (Zhang et al., 2023).

5. Nursing Interventions for Perioperative Symptom Clusters in Patients with Brain Tumors

5.1 Symptom Assessment and Monitoring

Precise symptom management begins with precise assessment. Nurses should use standardized tools (such as the MDASI-BT) to assess patients' symptoms regularly before surgery, after surgery, and following discharge (Pushuying et al., 2021). Based on the concept of the symptom network, monitoring should focus on sentinel symptoms (e.g., pain may indicate an increased overall symptom burden) and core symptoms to achieve an efficient "targeted yet comprehensive" assessment (Liang et al., 2024).

5.2 Symptom Cluster-Oriented Intervention Strategies

5.2.1 Psychoeducational Interventions

Providing patients with information about their condition, the surgical procedure, and potential postoperative symptoms prior to surgery can effectively alleviate preoperative anxiety and depression. For psychological and emotional symptom clusters, cognitive behavioral therapy and peer support can help patients develop positive coping strategies (Zhang et al., 2023).

5.2.2 Symptom Cluster-Specific Interventions

For the core triad of postoperative pain, sleep disturbances, and fatigue, a combination of multimodal analgesia, an optimized sleep environment, and progressive exercise training can be applied. For gastrointestinal symptom clusters, prophylactic antiemetics, acupressure, and dietary guidance can alleviate nausea and vomiting. For neurological symptom clusters, early rehabilitation training and cognitive function training aid in the recovery of neurological function (Zhang et al., 2023).

5.2.3 Targeted Interventions for Bridge Symptoms

Identifying key symptoms that link multiple symptom clusters—such as sleep difficulties, which are associated with psychological, physical, and cognitive domains—and targeting them for intervention may yield a "single-point intervention, multi-point benefit" effect. Studies in breast cancer patients undergoing chemotherapy have confirmed that fatigue, as a core symptom, and sleep disturbances and loss of appetite, as bridging symptoms, are key targets for breaking the cycle of synergistic symptom reinforcement (Liang et al., 2024).

5.3 Continuity of Care

Brain tumor patients have a limited length of stay following surgery but continue to face persistent symptom distress after discharge. A randomized controlled trial of a postoperative home care intervention based on dependency care theory demonstrated that the intervention

significantly improved self-care abilities in patients with primary brain tumors, reduced symptom severity and symptom interference, and alleviated the burden on caregivers (Dağdelen & Zincir, 2024). Another study of patients who had undergone brain tumor surgery showed that a supportive care intervention delivered via telephone in the early postoperative period significantly reduced patients' symptom distress and care needs and improved their depressive symptoms (Wu & Lin, 2023). Future research should develop a comprehensive dynamic management plan for symptom clusters covering the entire "preoperative–postoperative–post-discharge" continuum.

6. Summary and Outlook

Growing attention has been paid to perioperative symptom-cluster research among brain-tumor patients. Existing studies have clarified the concept of symptom clusters and three pivotal symptom categories: sentinel, core and bridge symptoms. Valid assessment tools including MDASI-BT, EORTC QLQ-BN20 and MSAS are available for this population. Previous evidence has described preoperative and postoperative symptom-cluster profiles, highlighted their dynamic perioperative evolution, and revealed heterogeneous symptom subgroups. Demographic-socioeconomic factors, tumor pathology, surgical approaches and perioperative medications are major influencing variables. Preliminary nursing practices covering standardized assessment, targeted symptom-cluster interventions and transitional care have shown promising benefits for relieving symptom distress and improving self-care capacity.

However, notable gaps still persist. Most studies rely on cross-sectional designs, while high-quality longitudinal investigations tracking symptom dynamic changes remain limited. Uniform clinical assessment specifications are lacking, and digital symptom-monitoring tools are still underdeveloped. The internal interaction mechanisms of symptom clusters are not fully clarified, and brain-tumor-specific core and bridge symptoms require further verification. Furthermore, most nursing strategies are derived from small-sample explorations; multicenter randomized controlled evidence for specialized intervention protocols is insufficient, and whole-cycle hospital-home continuous symptom management remains inadequate.

Future research should prioritize multicenter large-sample longitudinal studies to map typical symptom-cluster trajectories across different brain-tumor subtypes. Symptom-network analysis should be adopted to identify disease-specific core and bridge symptoms for precise intervention. Researchers need to develop and validate stratified nursing protocols and test their effectiveness via rigorous randomized controlled trials. Moreover, digital health platforms ought to be constructed to realize continuous symptom monitoring spanning pre-operation, post-operation and post-discharge stages, so as to optimize symptom management and clinical outcomes for brain-tumor patients.

Acknowledgments

Not applicable.

Author contributions

Not applicable.

Funding

Project of the 2024 Scientific Research Development Program, Clinical Medical College & Affiliated Hospital of North Sichuan Medical College (2024MPRW003).

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Macrothink Institute.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

Open access

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/).

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

References

Armstrong, T. S., Mendoza, T., Gring, I., Coco, C., Cohen, M. Z., Eriksen, L., … & Cleeland, C. (2006). Validation of the M.D. Anderson Symptom Inventory Brain Tumor Module (MDASI-BT). *Journal of Neuro-Oncology, 80*(1), 27–35. https://doi.org/10.1007/s11060-006-9135-z

Armstrong, T. S., Vera-Bolanos, E., Acquaye, A. A., Gilbert, M. R., Ladha, H., & Mendoza, T. (2016). The symptom burden of primary brain tumors: Evidence for a core set of tumor- and

treatment-related symptoms. *Neuro-Oncology, 18*(2), 252–260. https://doi.org/10.1093/neuonc/nov166

Brown, J. K., Cooley, M. E., Chernecky, C., & Sarna, L. (2011). A Symptom Cluster and Sentinel Symptom Experienced by Women With Lung Cancer. *Oncology Nursing Forum, 38*(6), E425–E435. https://doi.org/10.1188/11.ONF.E425-E435

Chakravarti, S., Gupta, S. R., Myneni, S., Elshareif, M., Rogers, J. L., Caraway, C., … & Mukherjee, D. (2025). Clinical Outcome Assessment Tools for Evaluating the Management of Gliomas. *Cancers, 17*(10), 1659. https://doi.org/10.3390/cancers17101659

Dağdelen, D., & Zincir, H. (2024). Effects of dependent care theory-based post-surgical home care intervention on self-care, symptoms, and caregiver burden in patients with primary brain tumor and their caregivers: A randomized controlled trial. *Supportive Care in Cancer, 32*(5), 296. https://doi.org/10.1007/s00520-024-08488-1

Hao, Y. R., Wu, H. Y., & Huang, Y. Q. (2025). Symptom Clusters in Patients with Brain Tumors: A Systematic Review. *Seminars in Oncology Nursing, 41*(2), 151815. https://doi.org/10.1016/j.soncn.2025.151815

Li, R. Q., Zhang, Z. K., Zhang, X., Song, J. F., Wu, Y. W., Wu, L. Z., … & Zeng, L. (2025). Identification of distinct symptom profiles in primary brain tumor patients: A prospective longitudinal study. *BMC Neurology, 26*(1), 53. https://doi.org/10.1186/s12883-025-04595-6

Liang, M. Y., Zhong, T., Knobf, M. T., Chen, L. S., Xu, M., Cheng, B. B., … & Ye, Z. J. (2024). Sentinel and networked symptoms in patients with breast cancer undergoing chemotherapy. *European Journal of Oncology Nursing, 70*, 102566. https://doi.org/10.1016/j.ejon.2024.102566

Miaskowski, C., Barsevick, A., Berger, A., Casagrande, R., Grady, P. A., Jacobsen, P., … & Marden, S. (2017). Advancing Symptom Science Through Symptom Cluster Research: Expert Panel Proceedings and Recommendations. *JNCI-Journal of the National Cancer Institute, 109*(4), djw253. https://doi.org/10.1093/jnci/djw253

Osoba, D., Aaronson, N. K., Muller, M., Sneeuw, K., Hsu, M.-A., Yung, W. K. A., … & Newlands, E. (1996). The development and psychometric validation of a brain cancer quality-of-life questionnaire for use in combination with general cancer-specific questionnaires. *Quality of Life Research, 5*(1), 139–150. https://doi.org/10.1007/BF00435979

Portenoy, R. K., Thaler, H. T., Kornblith, A. B., Lepore, J. M., Friedlander-Klar, H., Kiyasu, E., … & Norton, L. (1994). The Memorial Symptom Assessment Scale: An instrument for the evaluation of symptom prevalence, characteristics and distress. *European Journal of Cancer, 30A*(9), 1326–1336. https://doi.org/10.1016/0959-8049(94)90182-1

Pu, S. Y., Yao, Q. Q., Jiang, W., & Luo, Y. F. (2021). Reliability and validation study of the Chinese version of M.D. Anderson Symptom Inventory Brain Tumor Module. *Chinese Journal of Nursing, 56*(6), 855–860. https://doi.org/10.3761/j.issn.0254-1769.2021.06.009

Taphoorn, M. J. B., Claassens, L., Aaronson, N. K., Coens, C., Mauer, M., Osoba, D., … &

Bottomley, A. (2010). An international validation study of the EORTC brain cancer module (EORTC QLQ-BN20) for assessing health-related quality of life and symptoms in brain cancer patients. *European Journal of Cancer, 46*(6), 1033–1040. https://doi.org/10.1016/j.ejca.2010.01.012

Wu, L. C., & Lin, Y. H. (2023). The Effects of Supportive Caring on Symptoms Distress, Nursing Needs, and Depression in Patients With Brain Tumor After Surgery: A Preliminary Study. *Hu Li Za Zhi The Journal of Nursing, 70*(1), 48–59. https://doi.org/10.6224/JN.202302_70(1).08

Yeernuer, N., Lu, P. W., Mao, L. L., Xu, J. X., Wang, Q. S., & Zhao, R. (2025). Perioperative symptom cluster characteristics and supportive care needs of sellar tumor patients: A cross-sectional study. *Supportive Care in Cancer, 33*(8), 676. https://doi.org/10.1007/s00520-025-09696-z

Ying, L., Su, Y. M., Xiang, Q., Duan, Y. Y., Zou, D. L., Luo, H. D., & Zhou, Z. H. (2025). Construction and validation of a risk prediction model for symptom cluster distress in brain tumor patients: A cross-sectional study. *BMC Cancer, 25*(1), 1803. https://doi.org/10.1186/s12885-025-15281-8

Zhang, R., Wang, D. M., Liu, Y. L., Tian, M. L., Zhu, L., Chen, J., & Zhang, J. (2023). Symptom management in adult brain tumours: A literature review. *Nursing Open, 10*(8), 4892–4906. https://doi.org/10.1002/nop2.1795