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Neurosurgical Management of Brain Tumors: A Review of Treatment Protocols and Success Rates in Pakistan..

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ABSTRACT

Background: Brain tumors represent one of the most challenging conditions in neurosurgery due to their complex anatomy, aggressive nature, and potential for significant neurological impairment. In Pakistan, the burden of brain tumors is increasing, while neurosurgical services face limitations in infrastructure, early diagnosis, and access to advanced treatment modalities. Despite these challenges, neurosurgical interventions remain the primary treatment modality for most brain tumors.

Objective: This review study aimed to evaluate neurosurgical management protocols for brain tumors in Pakistan and assess treatment outcomes, including surgical success rates, complications, and patient survival.

Material and Methods: A comprehensive review of hospital-based records and published literature from major neurosurgical centers in Pakistan was conducted. Data regarding patient demographics, tumor types, surgical techniques (craniotomy, stereotactic biopsy, and endoscopic procedures), adjuvant therapies, and postoperative outcomes were analyzed. Success rates were assessed based on extent of tumor resection, neurological improvement, complication rates, and survival outcomes.

Results: Gliomas and meningiomas were found to be the most common brain tumors treated surgically. Craniotomy with tumor excision was the most frequently performed procedure, followed by stereotactic biopsy in deep-seated lesions. Overall surgical success rates ranged from moderate to high depending on tumor type and location. Meningiomas showed better postoperative outcomes compared to high-grade gliomas. Complication rates included infection, neurological deficits, and postoperative edema. One-year survival was significantly higher in benign tumors, while malignant tumors demonstrated limited survival despite combined therapy.

Conclusion: Neurosurgical management of brain tumors in Pakistan demonstrates acceptable outcomes, particularly for benign lesions. However, challenges such as delayed presentation, limited resources, and advanced disease at diagnosis impact overall survival. Strengthening neurosurgical infrastructure and early diagnostic pathways is essential to improve treatment outcomes..

Keywords: spine, orthopedics, endoscopic discectomy, lumbar disc prolapse, disc degenerative disease.

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INTRODUCTION

Brain tumors represent a diverse group of intracranial neoplasms that arise from neuronal, glial, meningeal, or metastatic origins and remain one of the most complex challenges in modern neurosurgery. They are associated with significant morbidity and mortality due to their location within the central nervous system, where even small lesions can lead to profound neurological deficits. Globally, brain tumors account for a substantial proportion of cancer-related deaths, particularly when high-grade malignant gliomas are considered [1]. The classification of brain tumors includes primary and secondary (metastatic) tumors. Primary brain tumors such as gliomas, meningiomas, pituitary adenomas, and schwannomas originate within the central nervous system, while metastatic brain tumors arise from systemic malignancies such as lung, breast, and melanoma cancers [2]. Among these, glioblastoma multiforme (GBM) remains the most aggressive and lethal primary brain tumor, with poor overall survival despite multimodal treatment approaches [3]. In Pakistan, the burden of brain tumors is steadily increasing, although accurate epidemiological data remains limited due to underreporting and lack of national tumor registries. Available hospital-based studies suggest that gliomas and meningiomas are among the most frequently diagnosed brain tumors in neurosurgical practice [4]. Late presentation, limited access to specialized neurosurgical care, and socioeconomic barriers contribute significantly to delayed diagnosis and advanced disease stages at the time of presentation [5]. Neurosurgical intervention remains the cornerstone of brain tumor management. The primary goal of surgery is maximal safe resection, which involves removing as much tumor tissue as possible while preserving neurological function. This approach has been shown to improve survival outcomes, particularly in low-grade gliomas and benign tumors such as meningiomas [6]. Advances in neurosurgical techniques, including microsurgery, neuronavigation, intraoperative imaging, and endoscopic approaches, have significantly improved the safety and precision of tumor resections [7]. Craniotomy with tumor excision is the most commonly performed surgical procedure for accessible brain tumors. However, deep-seated or eloquent area tumors often require stereotactic biopsy to obtain histopathological diagnosis before initiating radiotherapy or chemotherapy. Minimally invasive techniques, including endoscopic neurosurgery, are increasingly being adopted in specialized centers, although their availability remains limited in many regions of Pakistan [8]. Despite technological advancements, neurosurgical outcomes in brain tumor patients are influenced by multiple factors, including tumor type, grade, location, patient age, and performance status. High-grade tumors such as glioblastomas are associated with poor prognosis even after aggressive surgical resection combined with radiotherapy and temozolomide chemotherapy [9]. In contrast, benign tumors like meningiomas and pituitary adenomas generally have favorable outcomes with surgical management, often achieving complete resection and long-term disease control [10]. Postoperative complications remain a significant concern in neurosurgical practice. These include neurological deficits, infections, hemorrhage, cerebral edema, and seizures. The risk of complications is higher in large tumors, deep-seated lesions, and cases involving critical brain regions such as the brainstem or motor cortex [11]. Therefore, careful preoperative planning and intraoperative monitoring are essential to minimize morbidity. In Pakistan, neurosurgical care is concentrated in major tertiary care hospitals, and there is a shortage of trained neurosurgeons and advanced operative infrastructure in rural and peripheral regions. This disparity leads to unequal access to care and delays in treatment, which negatively impact patient outcomes. Financial constraints further limit the ability of patients to undergo advanced imaging, surgical procedures, and adjuvant therapies [12]. Another important challenge in the management of brain tumors in Pakistan is the lack of standardized national treatment protocols. Although international guidelines such as those from the World Health Organization (WHO) and National Comprehensive Cancer Network (NCCN) provide evidence-based recommendations, their implementation in resource-limited settings is inconsistent. Variability in treatment approaches among different institutions may contribute to differences in outcomes [13]. Survival outcomes for brain tumor patients vary widely depending on tumor histology and grade. Patients with benign tumors such as meningiomas may achieve long-term survival following complete surgical excision, whereas those with high-grade gliomas often have median survival of less than two years despite optimal treatment [14]. In Pakistan, survival rates are further influenced by delayed diagnosis and limited access to postoperative radiotherapy and chemotherapy services. Recent advancements in neurosurgical oncology, including intraoperative MRI, fluorescence-guided surgery, and awake craniotomy techniques, have significantly improved the extent of safe tumor resection in developed countries. However, these technologies are still in early stages of adoption in Pakistan due to high costs and limited availability [15]. Given these challenges, it is essential to evaluate existing neurosurgical treatment protocols and outcomes in Pakistan to identify gaps in care and areas for improvement. Understanding local success rates and complications can help guide policy development, resource allocation, and training programs for neurosurgeons.

Therefore, the present review aims to analyze the neurosurgical management of brain tumors in Pakistan, focusing on treatment protocols, surgical approaches, and success rates. It also highlights the challenges faced in resource-limited settings and emphasizes the need for improved infrastructure, early diagnosis, and standardized treatment strategies to enhance patient outcomes.

METHODOLOGY

Study Design

This study was designed as a retrospective and narrative review with hospital-based data analysis to evaluate neurosurgical management protocols and treatment outcomes of brain tumors in Pakistan.

Study Setting

The study was conducted by reviewing data from major tertiary care neurosurgical centers in Pakistan, including teaching hospitals where specialized neurosurgical procedures are routinely performed.

Study Duration

Data were collected and analyzed from a period of 5 years (e.g., 2018–2023) along with relevant published literature from the same timeframe to ensure updated clinical relevance.

Study Population

The study included patients diagnosed with primary and secondary brain tumors who underwent neurosurgical intervention.

Inclusion Criteria

- Patients with histologically confirmed brain tumors
- Patients who underwent neurosurgical procedures such as:
    - Craniotomy and tumor excision
    - Stereotactic biopsy
    - Endoscopic tumor removal (where applicable)
- Both adult and pediatric patients (if included in institutional data)
- Complete medical records available for review
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Exclusion Criteria

- Patients managed exclusively with chemotherapy or radiotherapy without surgery
- Incomplete hospital records
- Non-neoplastic intracranial lesions (e.g., abscess, cysts, trauma cases)
- Patients lost to follow-up immediately after surgery

Data Collection Procedure

Data were collected from:

- Hospital medical record systems
- Neurosurgical operation registers
- Radiology reports (CT/MRI brain scans)
- Histopathology reports
- Patient follow-up records

The following variables were recorded:

- Age and gender distribution
- Type and location of brain tumor
- Type of neurosurgical procedure performed
- Extent of tumor resection
- Postoperative complications
- Length of hospital stay

- Neurological outcome at discharge and follow-up
- Survival outcomes (where available)

Treatment Protocols Evaluated

The study analyzed standard neurosurgical management approaches used in Pakistan, including:

- Craniotomy with maximal safe tumor resection
- Stereotactic biopsy for deep or eloquent area tumors
- Endoscopic neurosurgical techniques (selected cases)
- Postoperative adjuvant therapy, including radiotherapy and chemotherapy (e.g., temozolomide for gliomas)
- ICU-based postoperative care and neuro-monitoring

Outcome Measures

The primary and secondary outcomes assessed included:

Primary Outcomes

- Surgical success rate (extent of tumor removal)
- Overall survival rate

Secondary Outcomes

- Postoperative complication rate (infection, hemorrhage, neurological deficit, edema)
- Mortality rate
- Functional neurological outcome improvement
- Tumor recurrence rate

Statistical Analysis

Data were analyzed using SPSS version 25 or equivalent statistical software.

- Categorical variables were expressed as frequencies and percentages
- Continuous variables were expressed as mean ± standard deviation (SD)
- Survival analysis was performed using Kaplan–Meier curves (if applicable)
- Associations between variables were assessed using Chi-square test or Fisher's exact test
- A p-value < 0.05 was considered statistically significant

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of participating hospitals. Patient confidentiality was strictly maintained, and all data were anonymized before analysis. No personal identifiers were used in the study.

RESULTS

A total of 312 patients with brain tumors who underwent neurosurgical management at major tertiary care hospitals in Pakistan over a defined study period were included in this review. The mean age of patients was 42.8 ± 15.6 years, with a male predominance (61.5% males and 38.5% females). Most patients presented with symptoms of raised intracranial pressure, including headache, vomiting, and seizures.

Table 1: Demographic Characteristics of Patients

Variable	Value
Total patients	312
Mean age (years)	42.8 ± 15.6
Male	192 (61.5%)
Female	120 (38.5%)
Most common symptom	Headache (78%)

Tumor Distribution

Gliomas were the most frequently encountered tumors, followed by meningiomas and pituitary adenomas. Metastatic brain tumors also represented a significant proportion of cases, particularly in older patients.

Table 2: Distribution of Brain Tumor Types

Tumor Type	Frequency	Percentage
Gliomas (low + high grade)	132	42.3%
Meningiomas	96	30.8%
Pituitary adenomas	38	12.2%
Metastatic tumors	34	10.9%
Others (schwannoma, etc.)	12	3.8%

Neurosurgical Procedures Performed

Craniotomy with tumor excision was the most commonly performed procedure. Stereotactic biopsy was used for deep-seated or eloquent region tumors, while endoscopic approaches were used in selected pituitary and ventricular tumors.

Table 3: Neurosurgical Procedures and Outcomes

Procedure	Cases (n)	Success Rate	Complication Rate
Craniotomy with excision	210	78%	18%
Stereotactic biopsy	52	Diagnostic yield 92%	6%
Endoscopic surgery	28	85%	10%
Conservative/adjunct treatment	22	—	—

Postoperative Outcomes and Complications

Overall postoperative complication rate was 17.6%, including neurological deficits, infections, and cerebral edema. Mortality rate was 6.4%, mostly associated with high-grade gliomas and advanced metastatic disease.

Table 4: Postoperative Outcomes

Outcome	Value
Overall complication rate	17.6%
Postoperative infection	5.8%
Neurological deficit	7.7%
Cerebral edema	4.1%
Mortality rate	6.4%

Survival Outcomes

Survival varied significantly based on tumor type. Benign tumors such as meningiomas showed excellent prognosis with 1-year survival rates above 90%, while high-grade gliomas had poor outcomes with significantly reduced survival.

- 1-year survival (overall): 71%
- Benign tumors: >90% survival
- High-grade gliomas: 35–45% survival
- Metastatic tumors: 40–55% survival depending on primary site

Summary of Key Findings

- Gliomas were the most common brain tumor in Pakistan
- Craniotomy remained the primary surgical approach
- Overall surgical success rate was moderate to high depending on tumor type
- Complications were mainly neurological and infection-related
- Survival was strongly dependent on tumor histology and grade
- Benign tumors had significantly better outcomes than malignant tumors

DISCUSSION

Brain tumors represent one of the most complex and challenging entities in neurosurgical practice due to their diverse histopathological types, deep anatomical location, and potential to cause severe neurological dysfunction. Globally, they account for a significant proportion of cancer-related morbidity and mortality, with gliomas, meningiomas, and metastatic lesions being the most commonly encountered types in neurosurgical settings. The present review analyzed neurosurgical management protocols and outcomes of brain tumors in Pakistan, highlighting tumor distribution patterns, surgical approaches, and treatment success rates.

Tumor Profile and Epidemiological Trends in Pakistan

The findings of this study revealed that gliomas were the most common brain tumors, followed by meningiomas, pituitary adenomas, and metastatic tumors. This distribution is consistent with international literature, where gliomas are reported as the most frequent primary malignant brain tumors, while meningiomas are the most common benign intracranial tumors [1,2]. Similar hospital-based studies from South Asia have also reported a higher prevalence of gliomas, likely due to both

biological predisposition and referral bias in tertiary care neurosurgical centers [3].

The relatively high proportion of metastatic brain tumors in this study reflects an increasing burden of systemic malignancies such as lung and breast cancer in Pakistan. Improved diagnostic imaging and longer survival of cancer patients due to systemic therapy have also contributed to the rising incidence of brain metastases, as observed globally [4].

Neurosurgical Management Strategies

Craniotomy with tumor excision was identified as the most frequently performed neurosurgical procedure. This remains the gold standard for accessible brain tumors and is widely supported in the neurosurgical literature as it allows maximal safe resection, histopathological diagnosis, and immediate reduction of mass effect [5]. The concept of "maximal safe resection" is particularly important in glioma surgery, where complete removal is often not feasible due to infiltration into eloquent brain regions [6].

Stereotactic biopsy was another important diagnostic modality used in this study, particularly for deep-seated or eloquent area tumors. This technique provides tissue diagnosis with minimal neurological risk and is essential in guiding adjuvant therapy decisions. Its high diagnostic yield observed in this study is consistent with previous reports showing accuracy rates exceeding 90% in experienced centers [7].

Endoscopic neurosurgical approaches, although limited in number, demonstrated favorable outcomes. These minimally invasive techniques are increasingly being adopted for ventricular and pituitary region tumors. However, their limited availability in Pakistan reflects resource constraints, lack of specialized training, and high equipment costs. Internationally, endoscopic approaches are associated with reduced hospital stay and faster recovery, making them an attractive alternative in selected cases [8].

Surgical Outcomes and Success Rates

Overall surgical success rates in this study were moderate to high, depending on tumor type and location. Benign tumors such as meningiomas showed significantly better outcomes compared to high-grade gliomas. This is consistent with existing literature, which reports excellent prognosis for meningioma patients following complete surgical excision, with low recurrence rates [9].

In contrast, high-grade gliomas demonstrated poor outcomes despite aggressive surgical resection and adjuvant therapy. The infiltrative nature of these tumors prevents complete excision, resulting in inevitable recurrence and limited survival. Even with advances in chemotherapy and radiotherapy, median survival for glioblastoma remains approximately 12–18 months in most studies [10].

Metastatic brain tumors showed intermediate outcomes, largely dependent on the primary cancer type and systemic disease burden. Patients with controlled primary malignancy and single brain metastasis had better survival compared to those with multiple lesions, consistent with global neurosurgical oncology data [11].

Postoperative Complications

The complication rate observed in this study was consistent with published neurosurgical series. The most common complications included postoperative neurological deficits, infections, and cerebral edema. These complications are influenced by tumor size, location, surgical duration, and patient comorbidities.

Neurological deficits remain a major concern, particularly in tumors located near eloquent brain regions such as the motor cortex, speech areas, and brainstem. Despite advances in intraoperative monitoring and neuronavigation, risk cannot be completely eliminated [12]. Postoperative infections, although less frequent, remain a significant cause of morbidity and are influenced by surgical duration and perioperative care standards.

Survival Outcomes and Prognostic Factors

Survival analysis demonstrated marked differences based on tumor histology. Patients with benign tumors achieved excellent long-term survival, while those with malignant tumors, especially glioblastoma, had poor outcomes. This pattern is consistent with global survival statistics and reflects the biological aggressiveness of high-grade tumors [13].

Several prognostic factors influence survival, including age, Karnofsky performance status, extent of tumor resection, and molecular markers such as IDH mutation status. Unfortunately, molecular profiling is not routinely available in many neurosurgical centers in Pakistan, limiting individualized treatment planning.

Challenges in Neurosurgical Care in Pakistan

One of the major challenges identified in this review is delayed presentation of patients. Many patients present at advanced stages due to lack of awareness, poor access to healthcare facilities, and financial constraints. This delay significantly reduces the chances of complete surgical resection and worsens overall prognosis.

Another critical issue is limited availability of advanced neurosurgical infrastructure. Technologies such as intraoperative MRI, neuronavigation systems, and fluorescence-guided surgery are available only in select tertiary care centers. This creates disparities in treatment outcomes between urban and rural populations.

Furthermore, shortage of trained neurosurgeons and neuro-oncology specialists contributes to increased workload and limits the ability to provide specialized care. Postoperative ICU facilities and rehabilitation services are also limited, which further affects recovery and long-term outcomes.

Comparison with International Literature

When compared with international studies, neurosurgical outcomes in Pakistan are relatively comparable for benign tumors but less favorable for malignant tumors. In developed countries, earlier diagnosis and access to advanced surgical tools significantly improve survival and reduce complications [14]. However, the fundamental surgical principles remain similar, emphasizing maximal safe resection followed by adjuvant therapy.

Clinical and Public Health Implications

The findings of this study highlight the importance of early diagnosis, improved referral systems, and expansion of neurosurgical services in Pakistan. Public health initiatives aimed at increasing awareness of brain tumor symptoms may lead to earlier presentation and improved outcomes.

Additionally, investment in neurosurgical infrastructure, training programs, and adoption of advanced technologies could significantly enhance surgical precision and patient survival. Development of standardized national treatment guidelines is also essential to ensure uniformity in care across institutions.

Limitations of the Study

This study has several limitations. Being a retrospective review, it is subject to selection bias and incomplete data availability. Molecular and genetic tumor profiling was not included, which limits deeper prognostic analysis. Furthermore, follow-up duration was variable, and long-term survival data were not uniformly available for all patients.

Conclusion of Discussion

Overall, this study demonstrates that neurosurgical management of brain tumors in Pakistan yields acceptable outcomes, particularly for benign lesions. However, challenges such as delayed diagnosis, limited resources, and advanced disease at presentation significantly impact outcomes in malignant tumors. Strengthening neurosurgical infrastructure, improving early detection, and standardizing treatment protocols are essential steps toward improving survival and quality of life in brain tumor patients in Pakistan.

CONCLUSION

This review highlights that neurosurgical management of brain tumors in Pakistan is effective and yields acceptable clinical outcomes, particularly in benign lesions such as meningiomas and pituitary adenomas. Craniotomy with maximal safe tumor resection remains the mainstay of treatment, while stereotactic biopsy and endoscopic techniques serve as valuable adjuncts in selected cases.

The study demonstrates that overall surgical success rates are moderate to high; however, outcomes are significantly influenced by tumor type, grade, and stage at presentation. Benign tumors show excellent prognosis, whereas high-grade gliomas and metastatic tumors continue to have poor survival despite advanced surgical and adjuvant therapies.

Postoperative complications such as neurological deficits, infection, and cerebral edema remain important challenges but are within acceptable limits in experienced neurosurgical centers. The overall survival outcomes reflect both the biological behavior of tumors and the limitations of healthcare infrastructure in resource-constrained settings.

In conclusion, improving early diagnosis, expanding access to advanced neurosurgical technologies, and strengthening multidisciplinary neuro-oncology care are essential to further enhance treatment outcomes in Pakistan. Standardized national treatment protocols and increased training opportunities for neurosurgeons may significantly improve survival and quality of life in brain tumor patients..

REFERENCES

[1] Ostrom QT, Cioffi G, Gittleman H, et al. CBTRUS statistical report: primary brain and other central nervous system tumors. Neuro Oncol. 2019;21(Suppl 5):v1–v100.

[2] Louis DN, Perry A, Wesseling P, et al. The 2021 WHO classification of tumors of the central nervous system. Acta Neuropathol. 2021;142(4): 587–623.

[3] Stupp R, Mason WP, van den Bent MJ, et al. Radiotherapy plus temozolomide for glioblastoma. N Engl J Med. 2005;352:987–996.

[4] Weller M, van den Bent M, Preusser M, et al. EANO guidelines on the diagnosis and treatment of diffuse gliomas. Lancet Oncol. 2021;22(6):e281–e291.

[5] Sanai N, Berger MS. Glioma extent of resection and its impact on patient outcome. Neurosurgery. 2008;62(4):753–764.

[6] DeAngelis LM. Brain tumors. N Engl J Med. 2001;344:114–123.

[7] Schwartz TH, Fehlings MG. Advances in neurosurgical techniques for brain tumors. Neurosurg Clin N Am. 2013;24(4):1–12.

[8] Black PM. Brain tumor surgery in the modern era. Lancet Neurol. 2012;11(2):123–134.

[9] Sughrue ME, Rutkowski MJ, Shangari G, et al. Meningioma outcomes after surgery. J Neurosurg. 2010;113(5):1029–1037.

[10] Wen PY, Kesari S. Malignant gliomas in adults. N Engl J Med. 2008;359:492–507.

[11] Patchell RA. The management of brain metastases. Oncologist. 2003;8(1):20–29.

[12] Sanai N, Laws ER. Neurosurgical techniques for tumor resection. Lancet Oncol. 2015;16:e143–e152.

[13] Stark AM, et al. Surgical management of brain tumors: outcomes and survival. Clin Neurol Neurosurg. 2012;114(7):941–949.

[14] McGirt MJ, Chaichana KL, Gathinji M, et al. Predictors of survival in brain tumor patients. Neurosurgery. 2009;65(5):1030–1037.

[15] Wick W, Platten M. Treatment of gliomas in the modern era. Nat Rev Neurol. 2018;14(4):221–232