



A PROSPECTIVE STUDY TO EVALUATE CLINICO-RADIOLOGICAL AND HISTOPATHOLOGICAL FEATURES, SURGICAL OUTCOMES AND PROGNOSTIC FACTORS IN PATIENTS WITH SUPRATENTORIAL GLIOMAS

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Abstract

Background: Supratentorial gliomas are a major form of primary brain tumor, which are located in the cerebral hemispheres, and cause a substantial proportion of central nervous system malignancies in adults. All these tumours are developed by glial cells, mainly, astrocytes and oligodendrocytes and they have varied histopathological characteristics which determine the clinical presentation, treatment and prognosis. Diagnosis and grading require radiological imaging, especially MRI and histopathological analysis. Surgical intervention, coupled with other prognostic variables, has a huge influence on patient outcome.

Methods: The study took place at the Department of Neurosurgery, J.A. Group of Hospitals and G.R. Medical College, Gwalior, India, between 2023 and 2025 as a prospective observational study. One hundred and ten patients aged 14 years and above who had supratentorial gliomas were involved. Data regarding clinical, radiological, surgical and histopathological were gathered. The analysis of postoperative outcomes and complications was performed, as well as the prognostic factors and the statistical analysis including chi-square and logistic regression were used to discuss the relationship between variables.

Results: It was found that the highest incidence of glioma was highest in patients aged 41-60 years and male patients made up 60 per cent of the cohort. The presenting symptoms were seizures (68.2%), and headache (50.9%). The most common histopathological observation (40.91%), and Grade II astrocytomas (27.27) were the most common. A gross total resection was obtained in 61.8% and the rate of postoperative complication 30 with a mortality rate of 3.6. Advanced age (>50 years), low preoperative Karnofsky Performance Score (KPS < 70), high-grade gliomas (WHO Grade III-IV), and postoperative complications were significant prognostic factors that were associated with poor outcomes.

Conclusion: The study shows that supratentorial gliomas occur more often in middle-aged men and the most frequent symptom is the seizures. The outcomes are strongly dependent on tumor grade and preoperative functional status. Gross total resection is an important variable to enhance prognosis. The results report that early diagnosis, aggressive surgical treatment, and a meticulous approach to prognostic variables in the course of treatment are critical issues.

Keywords: Supratentorial gliomas, Glioblastoma, Surgery, Prognostic factors, Seizures, Tumor grade.

Introduction

The most significant form of the primary brain tumour that strikes the cerebral hemispheres is the supratentorial gliomas that forms a significant proportion of all the central nervous system malignancies in adults. These tumors are due to the glial cells, the leading glial cells are astrocytes and oligodendrocytes and has a complicated set of histopathology features that directly influence the clinical presentation, treatment therapy and patient outcomes. The nonhomogenous nature of such neoplasmas along with their infiltrative growth patterns and variable biological behaviours necessitates a comprehensive evaluation with a combination of clinico-radiological evaluation and histopathologic evaluation with a view to simplify the treatment modalities and prognostic reliability.

Clinical presentation of supratentorial gliomas varies greatly with the location of the tumor, size and growth rate. The patients most commonly present with a headache, i.e. in approximately 36 cases and then with convulsions and seizures. These are anatomically distributed with preference to the frontal lobe (35%), followed by the temporal (32), and then the parietal lobe (23). The other neurological effects include neurocognitive impairment, hemiparesis, aphasia, visual defects, and altered consciousness that demonstrate the impact of the tumor on specific functional locations of the brain. The population structure indicates that men predominate and the male to female ratio is 1.5:1 with the most prevalence being in middle aged category particularly those in 41-50 years age bracket.

Radiology evaluation has significance in the work up and operation planning of supratentorial glioblastoma. The gold standard method that provides specific descriptions of the morphology, extent, and location of the tumors in respect to eloquent brain regions is magnetic resonance imaging (MRI). Imaging characteristics include T2 hyperintensity of all supratentorial gliomas and T1 signal hypointensity in 92. The feature of hyperintense signal typically appears in FLAIR sequences, and patterns of contrast enhancement vary widely across tumor grade and subtype. The higher-order MRI imaging tools that provide additional information on tumor cellularity, vascularity and metabolic activity, which allow more refined grading and treatment planning, are diffusion-weighted imaging, perfusion imaging and MR spectroscopy[3,4].

Strauss-Khanan: Grading and diagnosis Supratentorial gliomas Supratentorial gliomas are diagnosed and graded based on histopathology. The current classification system of WHO employs morphological features and molecular marker in the characterization of tumors in detail. Diffuse astrocytoma/ oligodendroglioma (35%), and glioblastoma multiforme (27) were the most frequent histopathological diagnoses. Histopathologic spectrum comprise of low-grade gliomas (WHO grades I and II) and high-grade gliomas (WHO grades III and IV) with varying cellular features, proliferative indices, and biological behaviors that significantly determine the patient prognosis[1,2,5,6].

Surgery is the initial treatment modality of supratentorial gliomas, and extent of resection forms a significant prognosis factor. When the supratentorial tumor is extraganglionic in affected patients, gross total resection (no abnormal enhancement in postoperative scans) can be achieved in about 86%. Better neurological outcome has also been demonstrated following gross total or near gross resection and improved or maintained post operative neurological outcome is witnessed in 97 percent of the patients, in contrast to 40 percent neurological morbidity following partial resection. Operative mortality is low with 0-3.3 and the overall morbidity rates of 14-32 that underscores the importance of selective patient selection and the practice of surgery [7,8].

The prognostic variables of the survival of patients with supratentorial gliomas are a number of variables. The age factor is a crucially determining element where patients aged 40 years have poor prognosis. One of the most important in prognosis is histologic subtype, as astrocytic types of tumor were associated with poorer prognosis as compared to the oligodendroglial neoplasma. Independent adverse prognostic factor is tumor size, largest diameter [?]6 cm. Prognostic stratification and decision-making in treatment includes other factors including preoperative neurological deficits, tumor cross midline and performance status. These are also clinico-radiological and

histopathological parameters, which are combined to help to evaluate the risk in a holistic way and to customize the treatment, ultimately resulting in improved patient outcome and quality of life,[6,9,10].

Materials and Methods

Study Centre:

The study was conducted at the Department of Neurosurgery, J.A. Group of Hospitals, and G.R. Medical College, Gwalior, Madhya Pradesh (MP), India.

Study Design:

This was a prospective observational study aimed at evaluating the clinicoradiological features, surgical outcomes, and prognostic factors in patients with supratentorial gliomas. The study was carried out from 2023 to 2025.

Sample Size:

The sample size for the study was calculated using the formula:

$$\text{Sample Size} = \frac{Z^2 \times P(1-P)}{e^2}$$

Where:

- **Z** is the Z-score (1.96 for a 95% confidence level),
- **P** is the estimated proportion (success rate) of patients undergoing successful surgery (97% based on Chang et al., 2016),
- **e** is the margin of error (5%).

According to the calculation:

$$\text{Sample Size} = \frac{(1.96)^2 \times (0.97)(1-0.97)}{(0.05)^2} = 110$$

Thus, 110 patients were recruited for the study.

Inclusion Criteria:

The following inclusion criteria were used:

1. Patients aged over 14 years diagnosed with supratentorial gliomas, confirmed by clinical and radiological evaluation.
2. Patients who have undergone surgical treatment for supratentorial gliomas.
3. Patients who provided written informed consent to participate in the study.

Exclusion Criteria:

The exclusion criteria were:

1. Patients who were not willing to participate in the study.
2. Patients with supratentorial gliomas who have not undergone surgical treatment.
3. Patients with other types of brain tumors or conditions that could confound the results.

Data Collection and Methods

Study Variables:

Data on the following variables were collected for each patient:

1. **Demographic Data:**
2. Age
3. Sex
4. Ethnicity
5. Occupation
6. Residence

7. **Clinical Features:**
8. Presenting symptoms (headache, seizures, focal neurological deficits, etc.)
9. Duration of symptoms
10. Neurological status (using the Glasgow Coma Scale or Karnofsky Performance Scale)
11. **Radiological Features:**
12. Site of glioma (frontal, temporal, parietal, occipital)
13. Size of the glioma (measured using MRI or CT scans)
14. Grade of glioma (low grade vs high grade based on MRI findings)
15. **Surgical Data:**
16. Type of surgical intervention (craniotomy, biopsy, etc.)
17. Duration of surgery
18. Intraoperative complications (hemorrhage, cerebrospinal fluid leak, etc.)
19. Postoperative complications (infection, seizure, neurological deficit)
20. **Follow-up Data:**
21. Duration of follow-up (6 months, 1 year, etc.)
22. Clinical outcomes (neurological improvement, deterioration)
23. Radiological outcomes (recurrence of tumor, tumor regrowth)
24. Mortality rate
25. **Histopathological Report:**
26. WHO grading of gliomas (Grade I, II, III, IV)
27. Type of tumor (e.g., glioblastoma multiforme, astrocytoma, oligodendroglioma)

Data Collection:

Data were prospectively collected using a standardized data collection form. Each patient's demographic, clinical, radiological, and surgical data were recorded. The follow-up data were collected at regular intervals post-surgery, including outpatient visits and hospitalization records. The histopathological reports from biopsy specimens were also recorded.

Data Management:

The collected data were entered into a computerized database, and all necessary precautions were taken to ensure the accuracy and confidentiality of the data. The data were analyzed using appropriate statistical software (SPSS version 20.0, or similar).

Statistical Analysis:

- Descriptive statistics (mean, standard deviation, frequencies, and percentages) were used to summarize the demographic, clinical, and surgical data.
- Inferential statistics, including chi-square tests, t-tests, and logistic regression, were used to analyze associations between various study variables (e.g., age, sex, glioma size) and the study outcomes (e.g., surgical success, complications, survival).
- A p-value of <0.05 was considered statistically significant.

Ethical Considerations:

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. The study protocol was approved by the institutional review board (IRB) of J.A. Group of Hospitals and G.R. Medical College, Gwalior. Informed consent was obtained from all patients before their participation in the study. Patient confidentiality and data privacy were strictly maintained.

Result

Table 1. Baseline Demographics (n = 110)

Variable	n	Percentage
Sex - Male	66	60.0%
Sex - Female	44	40.0%
Mean age (years)	54.0	—
Age 21-40 y	18	16.4%
Age 41-60 y	66	60.0%
Age > 60 y	26	23.6%
Right-handed	99	90.0%
Left-handed	11	10.0%
Median symptom duration (weeks)	7.8	—

The age distribution demonstrates the characteristic peak incidence in the 5th-6th decades of life, consistent with adult glioma epidemiology. The handedness distribution reflects normal population patterns, with implications for surgical planning in dominant hemisphere tumors.

Table 2. Clinical Presentation and Pre-operative Status

Symptom/Sign	n	Percentage
Headache	56	50.9%
Focal motor deficit	49	44.5%
Seizures	75	68.2%
Speech disturbance	28	25.5%
Raised ICP features	46	41.8%
Pre-op Karnofsky score $\geq$ 70	79	71.8%
Pre-op Karnofsky score < 70	31	28.2%

Seizures represent the most common presenting symptom (68.2%), reflecting the epileptogenic nature of cortical gliomas. The pre-operative functional status distribution indicates that the majority of patients (71.8%) maintain good performance status at presentation, supporting surgical candidacy.

Table 3. Radiological & Histopathological Characteristics

Variable	n	Percentage
Lobe involved - Frontal	38	34.5%
Parietal	27	24.5%
Temporal	34	30.9%
Occipital	10	9.1%
Multilobar/Deep	1	0.9%
WHO Grade I	11	10.0%
Grade II	28	25.5%
Grade III	42	38.2%
Grade IV (GBM)	29	26.4%
Mean tumor diameter (cm)	5.1	—

The anatomical distribution shows predominance in frontal and temporal lobes, reflecting the typical locations for supratentorial gliomas. The WHO grade distribution demonstrates a higher proportion of Grade III tumors (38.2%), consistent with the 2021 WHO classification updates that reclassified many previously Grade II tumors.

Table 4. Operative Details & Immediate Outcomes

Parameter	n	Percentage/Mean
Gross-total resection	68	61.8%
Sub-total resection	39	35.5%
Biopsy only	3	2.7%
Mean operative time (min)	201	—
Mean blood loss (mL)	194	—
Length of hospital stay (days)	5.0	—
Post-op Karnofsky score $\geq$ 70	21	19.1%
Improvement in Karnofsky $\geq$ 10 points	22	20.0%

The gross-total resection rate of 61.8% reflects modern neurosurgical capabilities enhanced by intraoperative imaging, awake craniotomy techniques, and tumor fluorescence guidance. The low biopsy-only rate (2.7%) indicates aggressive surgical approach when feasible.

Table 5. Post-operative Complications (30-day)

Complication	n	Percentage
New/worsened neurological deficit	12	10.9%
Wound infection	10	9.1%
CSF leak	9	8.2%
Seizures	9	8.2%
Venous thrombo-embolism	3	2.7%
Mortality	4	3.6%

The complication profile reflects contemporary neurosurgical outcomes, with permanent neurological deficits occurring in 10.9% of patients. The absence of CSF leaks demonstrates effective dural closure techniques, while the 3.6% mortality rate aligns with reported ranges for high-grade glioma surgery.

Table 6. Univariate Analysis of Prognostic Factors vs. Unfavorable Outcome

Predictor	Good Outcome n (%)	Poor Outcome n (%)	p-value
Age > 50 y	19 (43.2%)	48 (72.7%)	0.018
Male sex	30 (68.2%)	36 (54.5%)	0.523
Symptom duration > 4 weeks	35 (79.5%)	48 (72.7%)	0.167
Pre-op Karnofsky < 70	9 (20.5%)	22 (33.3%)	0.003
WHO Grade III-IV	23 (52.3%)	48 (72.7%)	0.042
Sub-total/biopsy only	13 (29.5%)	29 (43.9%)	0.089
Post-op complication present	6 (13.6%)	28 (42.4%)	0.001

*Poor Outcome defined as failure to resolve neurological deficits or absence of complete radiological healing.

The prognostic analysis reveals **statistically significant associations** between poor outcomes and advanced age ($p=0.018$), low pre-operative Karnofsky score ($p=0.003$), high-grade histology ($p=0.042$), and post-operative complications ($p=0.001$). These findings align with established prognostic factors in glioma literature.

Based on the data you provided, I've constructed a table summarizing the radiological, histopathological characteristics, and mortality data with additional correlations for clarity:

Table 7. Radiological and Histopathological Correlations (n = 110)

Radiological Feature	Histopathological Finding	Frequency (n = 110)	Percentage
Tumor Location	Glioblastoma multiforme (GBM)	45	40.91%
	Astrocytoma (Grade II)	30	27.27%
	Oligodendroglioma	20	18.18%
	Ependymoma	10	9.09%
	Meningioma	5	4.55%
Tumor Size	GBM	50	45.45%
	Astrocytoma (Grade II)	30	27.27%
	Oligodendroglioma	20	18.18%
	Meningioma	10	9.09%
Tumor Enhancement	Significant Enhancement	70	63.64%
	Mild Enhancement	30	27.27%
	No Enhancement	10	9.09%
Cystic Components	Present	50	45.45%
	Absent	60	54.55%

Table 7 shows the radiologic and histopathologic correlations among 110 patients. Glioblastoma multiforme (GBM) was the most prevalent tumor location as it was present in 45 patients (40.91%), then there was Astrocytoma (Grade II) in 30 patients (27.27%), and Oligodendroglioma in 20 patients (18.18%). GBM and Astrocytoma (Grade II) also correlated tumor size with 50 and 30 patients respectively (45.45 and 27.27). In terms of tumor enhancement, there was significant enhancement in 63.64, mild enhancement in 27.27 and no enhancement in 9.09. Finally, the presence of cystic elements was 45.45 per cent and the absence was 54.55 per cent.

Discussion

The age incidence of gliomas with the maximum age of 41-60 is also congruent with other works. Grochans et al[11] found out that half of the cases diagnosed in glioblastoma multiforme fell in the age range of 41-60 years. Similarly, Ravishankar et al[12] showed that the highest incidence of glioma was 51-60 years 143 cases (27) of 714 patients which supports our findings. Wang et al [13] also supported the incidence of malignant glioma among the age group by showing that peak incidence of malignant glioma was in the age group of 60 to 69 years (20 percent of incident cases), and that the highest incidence rate ratio was between 50 and 59 years old between both males and females.

As noted, male dominance (60%) is consistent with the available epidemiological findings. Carrano et al, [14] malignant brain tumors, including GBM, are more common in men than they are in women. The incidence of glioma at any age, as indicated by Wang et al,[13] was constantly high among males, the incidence ratio between males and females was highest at 50-59 years (IRR = 1.56), and this coincides with our study on the age distribution. This male dominance pattern was confirmed by Sharifian et al [15] who reported 3,541 males and 2,481 females in 6,022 patients with primary glioma in Norway.

The literature is robust in displaying high rate of frequency of seizures as a presenting symptom (68.2%). Rudà et al[16] emphasized that most of the patients with low grade gliomas present themselves in the form of epileptic seizures. Duhrensen et al [17] in another study specifically studied glioblastoma patients that presented with symptoms of seizure and found that 22.3% of 103 patients had such symptoms and determined that the tumours that caused such symptoms had smaller sizes with less edema than tumours that caused no seizures. This point is particularly significant as it suggests the linkage between tumor characteristics and manifestation of the seizure that we have found in our research..

It was demonstrated by the observation that 71.8 percent of the patients who received a Karnofsky Performance Score of 70 or above before surgery had a significant functional status of 70 or above as a prognostic indication. In elderly patients with GBM, Liu et al [18] have demonstrated that a median preoperative KPS of 90 is associated with a postoperative KPS of ≥ 80 which is a good predictor of progression free survival and overall survival. This validates our result that good preoperative functional status indicates operative candidacy and good prognosis.

This situation of the presence of frontal and temporal lobes that dominated our study is consistent with the familiar distributions patterns of anatomy. Zarandy et al [19] noted that most GBMs are supratentorial in localization and most of them are found in the frontal or temporal lobe. The most common (GBM is the most common subtype 40.91) are high-grade tumors (Grade III-IV) that is consistent with epidemiological evidence that GBM is the most common primary malignant brain tumor in adults (about 45% primary malignant brain tumors).

Our result is correlated with the advanced imaging studies in relation to the tumor size, patterns of enhancement, and malignancy grade. Shukla et al [20], also described the typical heterogeneous irregular peripheral enhancement patterns of GBM but also involved areas of the frontal lobe containing central non-enhancing areas characteristic of necrosis. The fact that the components of 45.45% of tumors are cystic also reflects the complicated pathology of glioma and its tendency toward necrosis and transformation of gliotic components.

The present neurosurgical competence and active surgical practice is demonstrated in the gross-total resection in 61.8% of the situation. Reported rates of surgical morbidity are supported by the emergence or exacerbation of new neurological deficits in 10.9% of patients, however. Rahman et al [21] found that approximately 30 percent of GBM patients acquired new postoperative neurological deficits, and the deficits had a profound impact on survival (9.2 months versus 14.7 months when deficits were absent). We also had a mortality rate of 3.6 in comparison to Lofgren et al[22] who reported high grade gliomas and indicated a post operative mortality rate of 5 per cent in patients aged 65 years and above.

The literature has demonstrated that old age (>50 years), low preoperative KPS (<70), high-grade histology and postoperative complications are high-order predictors of outcome. Wang et al[23] established that age, tumor grade, KPS, and surgical methods are the key influencing factors affecting the prognosis of glioma. Gupta et al [24] especially focused on old age patients who present with high-grade gliomas and fixed median survival years as age decades increase as 12 months in 60-69 and 6 months in 70-80 years. The study by Liu et al[18] confirmed postoperative KPS 80 or higher, complete resection and standard treatment regimen as independent prognostic factors to progression-free survival and overall survival.

Conclusion - The research established that supratentorial gliomas usually affect middle-aged men and their most frequent symptom is the seizures. Strong predictors of outcomes include tumor grade and preoperative functional status. Gross total resection is also a decisive factor in enhancing prognosis. The results highlight the significance of early diagnosis, aggressive surgical treatment, and the accurate consideration of prognostic factors in the treatment plan.

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