

Spectrum of Brain Tumors in a Tertiary Care Center: A Histopathological Perspective

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Abstract

Background: Central nervous system (CNS) tumors comprise a heterogeneous group of neoplasms with varied morphology, biological behaviour, and clinical outcomes. Histopathology remains central to diagnosis, with immunohistochemistry and molecular studies increasingly contributing to tumor classification. The aim is to evaluate the demographic characteristics and histopathological spectrum of CNS tumors diagnosed at a tertiary-care centre. **Material and Methods:** This observational, hospital-based study was conducted in the Department of Pathology, Pt. B. D. Sharma Post Graduate Institute of Medical Sciences, Rohtak, from January to December 2022. Histopathological specimens from patients with intracranial and intraspinal space-occupying lesions were evaluated. Tumors were classified according to the 2016 World Health Organization (WHO) Classification of Tumors of the Central Nervous System. Immunohistochemistry was performed wherever required. **Results:** A total of 41 tumors were identified, with patient ages ranging from 3 to 70 years. There were 19 males (46.3%) and 22 females (53.7%), giving a male-to-female ratio of 0.86:1. Neuroepithelial tumors constituted the largest group (32; 78.0%). Glioblastoma was the most frequent individual tumor (12; 29.3%), followed by grade 2 astrocytoma (10; 24.4%). Other neuroepithelial tumors included oligoastrocytoma (7.3%), anaplastic astrocytoma (4.9%), gliosarcoma (4.9%), pilocytic astrocytoma (2.4%), pleomorphic xanthoastrocytoma (2.4%), and oligodendroglioma (2.4%). Meningioma accounted for six cases (14.6%) and showed female predominance. Pituitary adenoma, neurilemmoma, and medulloblastoma occurred as single cases. **Conclusion:** Neuroepithelial tumors predominated, with glioblastoma being the most common diagnosis. Meningioma was the most frequent non-neuroepithelial tumor and showed female predominance. The study provides baseline institutional data and highlights the importance of histopathology supported by ancillary investigations in CNS tumor diagnosis.

Keywords: Brain tumors, central nervous system neoplasms, glioblastoma, astrocytoma, meningioma.

Received: 02 April 2026

Revised: 16 June 2026

Accepted: 15 August 2026

Published: 07 October 2026

INTRODUCTION

Brain and other central nervous system (CNS) tumors represent a diverse group of neoplasms arising from different cellular and anatomical compartments. They demonstrate considerable variation in morphology, biological behaviour, age distribution, and clinical outcome. CNS tumors account for a relatively small proportion of all cancers but contribute substantially to morbidity and mortality.^[1]

CNS tumors may arise from neuroepithelial cells, meninges, cranial and spinal nerves, sellar region structures, hematolymphoid cells, germ cells, or may represent metastatic disease. The relative frequency of individual tumor types varies between population-based studies and hospital-based histopathological series.^[2-4]

Hospital-based studies from India have demonstrated variation in the distribution of CNS tumors according to the population served and referral pattern of individual institutions. In a prospective study from Tata Memorial Hospital, Mumbai, 656 patients were registered in the neuro-oncology service during one year, of whom 580 had primary CNS tumors.

Astrocytomas constituted the largest primary CNS tumor

group, accounting for 38.7% of cases.^[3]

Similarly, a hospital-based brain tumor registry from the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, included 4,295 primary intracranial tumors diagnosed between 2010 and 2014.^[2]

The classification of CNS tumors has undergone major changes over the last decade. The 2016 WHO classification introduced a more integrated approach in which histological findings were combined with specific molecular alterations for several tumor entities.^[5] The fifth edition of the WHO Classification of Tumors of the CNS, published in 2021, further strengthened this molecular approach and substantially revised the classification

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DOI:
10.21276/amt.2026.v13.i3.1101

How to cite this article: Vaishali, Yadav S, Gupta V, Singh S, Chanchal, Soni S. Spectrum of Brain Tumors in a Tertiary Care Center: A Histopathological Perspective. Acta Med Int. 2026;13(3):526-529.

and terminology of several CNS neoplasms.^[6,7]

The 2021 WHO classification reorganized diffuse gliomas into biologically defined groups, including adult-type diffuse gliomas and paediatric-type diffuse gliomas, while also establishing distinct groups of circumscribed astrocytic tumors and glioneuronal and neuronal tumors.^[6,7] Modern classification therefore increasingly relies on integration of histomorphology, immunohistochemistry, and molecular findings.

Despite these advances, histopathology remains fundamental to the diagnostic process. Careful morphological assessment, supplemented by immunohistochemistry and molecular investigations where indicated, is essential for accurate diagnosis and appropriate clinical management.

The present study was undertaken to describe the demographic characteristics and histopathological spectrum of brain tumors encountered over a one-year period at a tertiary-care hospital in North India.

Aim

To study the age and sex distribution and determine the histopathological spectrum of brain tumors diagnosed at a tertiary care centre.

MATERIALS AND METHODS

This was an observational, hospital-based study conducted in the Department of Pathology, Pt. B. D. Sharma Post Graduate Institute of Medical Sciences, Rohtak.

Study Period: The study was conducted over a period of one year, from January 2022 to December 2022.

Study Material: Histopathological specimens obtained from patients with intracranial and intraspinal space-occupying lesions and received in the Department of Pathology during the study period were evaluated.

A total of 41 tumors were included in the final analysis.

Histopathological Examination

The specimens were processed by routine histopathological techniques and examined microscopically. The tumors were classified according to the 2016 WHO Classification of Tumors of the Central Nervous System, which was the classification system used for the original diagnoses.⁵

Immunohistochemistry was performed wherever considered necessary to establish or support the diagnosis.

Demographic information, including age and sex, was recorded. Tumors were categorized according to their histopathological diagnosis and major tumor category.

Statistical Analysis: The data were analysed descriptively.

Frequencies and percentages were calculated for individual tumor types and major histopathological categories. The male-to-female ratio was calculated from the sex distribution.

RESULTS

A total of 41 CNS tumors were identified during the study period. The age of the patients ranged from 3 to 70 years. There were 19 males (46.3%) and 22 females (53.7%), giving a male-to-female ratio of 0.86:1.

Neuroepithelial tumors constituted the largest histopathological category, accounting for 32 of 41 cases (78.0%).

Among individual tumor types, glioblastoma was the most frequent diagnosis, with 12 cases (29.3%), followed by grade 2 astrocytoma with 10 cases (24.4%).

Three cases of oligoastrocytoma were identified (7.3%). Anaplastic astrocytoma and gliosarcoma accounted for two cases each (4.9%). Pilocytic astrocytoma, pleomorphic xanthoastrocytoma, and oligodendroglioma were represented by one case each (2.4%).

Meningioma was diagnosed in six cases (14.6%) and showed a female predominance, with two male and four female patients.

One case each of pituitary adenoma, neurilemmoma, and medulloblastoma was identified.

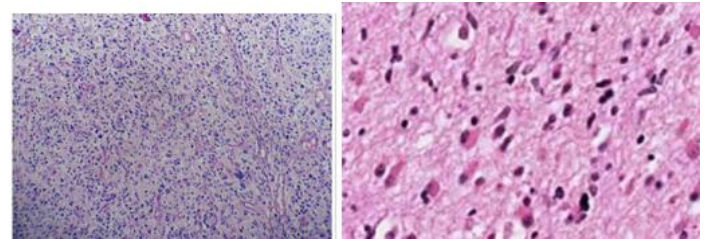


Figure 1: Glioblastoma(H&E stain;10x). Astrocytoma (H&E stain;40x)

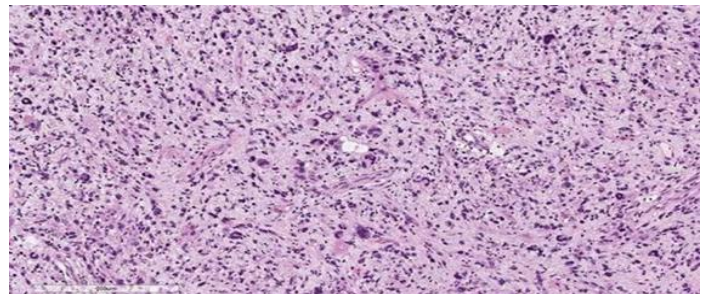


Figure 2: Pleomorphic xanthoastrocytoma(H&E stain;10x) looks like high grade glioma tumor, but has better prognosis.

Table 1: Histopathological spectrum and sex distribution of CNS tumors

Tumor Category	Histopathological Diagnosis	No. of Cases	Percentage	Male	Female
Neuroepithelial	Pilocytic astrocytoma	1	2.4%	0	1
Neuroepithelial	Grade 2 astrocytoma	10	24.4%	7	3
Neuroepithelial	Anaplastic astrocytoma	2	4.9%	1	1
Neuroepithelial	Oligoastrocytoma	3	7.3%	2	1
Neuroepithelial	Pleomorphic xanthoastrocytoma	1	2.4%	1	0
Neuroepithelial	Glioblastoma	12	29.3%	3	9
Neuroepithelial	Gliosarcoma	2	4.9%	1	1
Neuroepithelial	Oligodendroglioma	1	2.4%	1	0
Meningeal	Meningioma	6	14.6%	2	4
Sellar	Pituitary adenoma	1	2.4%	0	1
Cranial/paraspinal nerve	Neurilemmoma	1	2.4%	0	1

Embryonal	Medulloblastoma	1	2.4%	1	0
Total	—	41	100.0%	19	22

Table 2: Distribution according to major tumor category

Major tumor category	Number	Percentage
Neuroepithelial tumors	32	78.0%
Meningeal tumors	6	14.6%
Sellar tumors	1	2.4%
Cranial/paraspinal nerve tumor	1	2.4%
Embryonal tumor	1	2.4%
Total	41	100%

DISCUSSION

CNS tumors comprise a heterogeneous group of neoplasms, and their reported frequency varies according to the study population, referral pattern, and diagnostic methodology.^[2-4] In the present study, neuroepithelial tumors constituted the predominant group (78.0%), with glioblastoma (29.3%) being the most frequent individual tumor, followed by grade 2 astrocytoma (24.4%).

The predominance of gliomas in the present study is comparable with observations from other Indian tertiary-care centers. Jalali and Datta reported astrocytomas as the largest group among primary CNS tumors in their prospective Indian study.^[3] Similarly, the NIMHANS brain tumor registry identified glioblastoma, meningioma, and nerve sheath tumors among the major histological groups in adults.^[2] Differences in the relative frequencies between studies may be related to sample size, referral patterns, and case selection.

Glioblastoma was the most common tumor in our series. Its relatively high proportion should be interpreted cautiously because this was a small, hospital-based histopathological study and not a population-based incidence study. In the larger Jaipur hospital-based registry, glioblastoma accounted for 18% of primary intracranial tumors.^[4]

Meningioma was the most common non-neuroepithelial tumor in our study, accounting for 14.6% of cases, with a female predominance (4 females and 2 males). Female predominance among meningiomas has also been reported in Indian hospital-based registries.^[2,4]

Only three paediatric tumors were identified in the present series. Therefore, conclusions regarding paediatric tumor distribution are limited. A multicentric Indian study of 3,936 paediatric brain tumors reported astrocytic tumors as the most frequent group, followed by embryonal tumors and other paediatric CNS neoplasms.^[9]

An important consideration is the classification system used in this study. The original diagnoses were made according to the 2016 WHO classification and have therefore been retained without retrospective conversion to WHO CNS5 entities.^[5] The 2016 classification introduced molecularly integrated diagnoses, while WHO CNS5 further strengthened molecular classification and revised several tumor entities.^[6,7]

In particular, oligoastrocytoma is no longer recognized as a distinct adult-type diffuse glioma in WHO CNS5. However, the three cases diagnosed as oligoastrocytoma in the present study have been retained under their original diagnosis

because systematic molecular testing, including IDH and 1p/19q assessment, was not performed.^[5-7]

Overall, the findings demonstrate the predominance of neuroepithelial tumors in this institutional series and emphasize the continuing importance of histopathology, supplemented by immunohistochemistry and molecular testing, for accurate CNS tumor diagnosis.

Limitations

The present study has several limitations.

First, it was a single-centre study with a relatively small sample size. Second, it was based on histopathological evaluated cases and therefore cannot be used to calculate population-based incidence rates. Third, the study used the 2016 WHO classification because this was the classification system under which the original diagnoses were made.

Systematic molecular testing was not performed in all cases. Consequently, retrospective assignment of the tumors to specific WHO CNS5 molecular categories was not attempted.

In particular, historical diagnoses such as oligoastrocytoma, grade 2 astrocytoma, anaplastic astrocytoma, and glioblastoma may require molecular reassessment if archived tissue is available.

CONCLUSION

Neuroepithelial tumors constituted the predominant group in this tertiary-care series, with glioblastoma being the most common individual tumor, followed by grade 2 astrocytoma. Meningioma was the most frequent non-neuroepithelial tumor and showed female predominance.

The study provides useful baseline data on the histopathological spectrum of CNS tumors. Diagnoses have been retained according to the 2016 WHO classification used at the time of reporting and were not retrospectively converted to WHO CNS5 categories in the absence of systematic molecular data. Larger multicentric studies incorporating contemporary molecular classification are warranted.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- GBD 2016 Brain and Other CNS Cancer Collaborators. Global, regional, and national burden of brain and other CNS cancer, 1990-2016: a systematic analysis for the Global Burden of Disease

- Study 2016. *Lancet Neurol.* 2019;18(4):376-393. doi:10.1016/S1474-4422(18)30468-X.
2. Jaiswal J, Shastry AH, Ramesh A, Chickabasaviah YT, Arimappamagan A, Santosh V. Spectrum of primary intracranial tumors at a tertiary care neurological institute: a hospital-based brain tumor registry. *Neurol India.* 2016;64(3):494-501. doi:10.4103/0028-3886.181535.
3. Jalali R, Datta D. Prospective analysis of incidence of central nervous tumors presenting in a tertiary cancer hospital from India. *J Neurooncol.* 2008;87(1):111-114. doi:10.1007/s11060-007-9487-z.
4. Meel M, Choudhary N, Kumar M, Mathur K. Epidemiological profiling and trends of primary intracranial tumors: a hospital-based brain tumor registry from a tertiary care center. *J Neurosci Rural Pract.* 2021;12(1):145-152. doi:10.1055/s-0040-1721622.
5. Louis DN, Perry A, Reifenberger G, von Deimling A, Figarella-Branger D, Cavenee WK, et al. The 2016 World Health Organization Classification of Tumors of the Central Nervous System: a summary. *Acta Neuropathol.* 2016;131(6):803-820. doi:10.1007/s00401-016-1545-1.
6. Louis DN, Perry A, Wesseling P, Brat DJ, Cree IA, Figarella-Branger D, et al. The 2021 WHO Classification of Tumors of the Central Nervous System: a summary. *Neuro Oncol.* 2021;23(8):1231-1251. doi:10.1093/neuonc/noab106.
7. WHO Classification of Tumours Editorial Board. *Central Nervous System Tumours.* 5th ed. Lyon: International Agency for Research on Cancer; 2021.
8. Dahuja G, Gupta A, Jindal A, Jain G, Sharma S, Kumar A. Clinicopathological correlation of glioma patients with respect to immunohistochemistry markers: a prospective study of 115 patients in a tertiary care hospital in North India. *Asian J Neurosurg.* 2021;16(4):732-737. doi:10.4103/ajns.AJNS_377_20.
9. Jain A, Sharma MC, Suri V, Kale SS, Mahapatra AK, Tatke M, et al. Spectrum of pediatric brain tumors in India: a multi-institutional study. *Neurol India.* 2011;59(2):208-211. doi:10.4103/0028-3886.79142.
10. Wesseling P, Capper D. WHO 2016 Classification of gliomas. *Neuropathol Appl Neurobiol.* 2018;44(2):139-150. doi:10.1111/nan.12432.
11. Brat DJ, Aldape K, Colman H, Holland EC, Louis DN, Jenkins RB, et al. cIMPACT-NOW update 3: recommended diagnostic criteria for "Diffuse astrocytic glioma, IDH-wildtype, with molecular features of glioblastoma, WHO grade IV." *Acta Neuropathol.* 2018;136(5):805-810. doi:10.1007/s00401-018-1913-0.
12. Dasgupta A, Gupta T, Jalali R. Indian data on central nervous tumors: a summary of published work. *South Asian J Cancer.* 2016;5(3):147-153. doi:10.4103/2278-330X.187589.