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# Histopathological Profile of Central Nervous System Tumors in a Peripheral Tertiary Care Centre of West Bengal

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## Abstract

**Introduction** Central nervous system (CNS) tumor incidence is very low in comparison to other organ neoplasm. Recent increase in the incidence may be due to exposure of the population to various risk factors, genetic mutation, or improved diagnosis with advancement in diagnostic modalities. This study aims to observe the histopathological spectrum of CNS tumors with their clinical profile and basic demography at a single center in a peripheral region in West Bengal.

**Material and Methods** A retrospective study was conducted in the department of pathology, Gouridevi Institute of Medical Sciences and Hospital (GIMSH), Durgapur, West Bengal, over a period of 2 years from October 2018 to September 2020 on CNS tumors. Basic demographic data, tumor site, and histopathological profile were obtained from medical records and further analyzed and graded according to the World Health Organization (WHO) classification.

**Result** Among 42 cases of CNS tumors, 29 cases were from different regions of the brain and 13 cases were from the spinal cord, with a male to female ratio (1.21:1); the commonest age group was the sixth decade and most common tumor was meningioma, followed by astrocytic tumors.

**Conclusion** The present study helps provide information regarding the burden of disease in our area. Despite the use of modern imaging techniques that help in the provisional diagnosis of disease, histological examination is the gold standard in diagnosis of varied types.

**Keywords**
- CNS tumor
- histopathology
- meningioma

## Introduction

The annual incidence of tumors of the CNS ranges from 10 to 17 per 100,000 persons for intracranial tumors and 1 to 2 per 100,000 persons for intraspinal tumors; the majority of these are primary tumors, and only one-fourth to half are metastatic.[1]

Previously incidence of brain tumor in India was very low, but over the time, with evolution of newer investigative neuroimaging techniques in India during the past two decades, it has become obvious that brain tumors are as common in this country as elsewhere in the world.[2] The clinical course of brain tumor is strongly influenced by patterns of growth and location. Thus, some low grade glial tumors

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infiltrate large regions of the brain and lead to serious clinical deficits and poor prognosis. Because of this capacity to diffusely infiltrate the white and gray matters, a tumor may not be amenable to complete surgical resection without compromising neurologic function and also, any CNS neoplasm, regardless of histologic grade or classification, may have lethal consequences if situated in a critical brain region.[1] Treatment protocols and experimental trials of CNS tumors are usually based on the World Health Organization (WHO) classification which segregates tumors into one of four grades according to their biologic behavior, ranging from grades I to IV. Conventionally, brain tumors are classified according to the cell of origin or the site of origin such as neuroepithelial origin (including astrocytic tumors, oligodendroglial tumors, oligoastrocytic tumors, ependymal tumors, choroid plexus tumors, neuronal and mixed neuronal-glial tumors, pineal tumors, and embryonal tumors), tumors of cranial nerves, tumors of the meninges, lymphomas and hematopoietic neoplasms, germ-cell tumors, tumors of the sellar region, and metastases. The WHO classification of CNS tumors 2016 uses molecular parameters in addition to histology to define many tumor entities, thus formulating a concept for how CNS tumor diagnoses should be structured in the molecular era.[3]

The majority of brain tumors are sporadic lesions, and, till date, heritable genetic syndromes and prior ionizing radiation exposures, such as computed tomography scans and X-rays, are the only known risk factors accounting for less than 10% of all brain tumors. Recently, the International Agency for Research on Cancer also classified overexposure to low frequency, nonionizing electromagnetic waves through mobile phones as possibly act as potential risk factors for brain tumors such as glioma, meningioma, and acoustic neuromas.[4]

CNS tumors show a bimodal age distribution with one peak in children and second peak in 45 to 70 years of age.[5] The tumors are more common in males with the exception of meningiomas which are more frequently seen in females.

**Table 1** Frequency of different histopathological variants of CNS tumors with age and sex distribution and WHO grading

| Histopathological diagnosis | Frequency (%) | Mean age (y) | Male/female ratio | WHO grading |
|---|---|---|---|---|
| Tumors of the meninges ($n = 18$) | 42.86 | | | |
| Meningothelial | 08 (19.05) | 50 | 5/3 | Grade I |
| Transitional | 04 (9.52) | 38 | 1/3 | Grade I |
| Psammomatous | 02 (4.76) | 40 | 0/2 | Grade I |
| Fibroblastic | 01 (2.38) | 31 | 0/1 | Grade I |
| Angiomatous | 01 (2.38) | 58 | 0/1 | Grade I |
| Atypical | 01 (2.38) | 67 | 0/1 | Grade II |
| Papillary (anaplastic) | 01 (2.38) | 56 | 1/0 | Grade III |
| Tumor of neuroepithelial tissue ($n = 16$) | 38.09% | | | |
| Astrocytic tumors | 21.4% | | | |
| Diffuse astrocytoma<br>Glioblastoma | 05 (11.9)<br>04 (9.52) | 55<br>47 | 3/2<br>3/1 | Grade II<br>Grade IV |
| Oligodendroglial tumors<br>Oligodendroglioma | 02 (4.76) | 61 | 1/1 | Grade II |
| Anaplastic oligodendroglioma | 01 (2.38) | 56 | 1/0 | Grade III |
| Mixed gliomas<br>Oligoastrocytoma | 01 (2.38) | 62 | 1/0 | Grade II |
| Ependymal tumors<br>Ependymoma | 02 (4.76) | 50 | 1/1 | Grade II |
| Embryonal tumors<br>Medulloblastoma | 01 (2.38%) | 12 | 1/0 | Grade IV |
| Tumors of cranial and paraspinal nerves ($n = 5$) | 11.9% | | | |
| Schwannoma | 04 (9.52) | 44 | 2/2 | Grade I |
| Neurofibroma | 01( 2.38) | 39 | 1/0 | Grade I |
| Lymphomas and hematopoietic neoplasms ($n = 1$) | | | | |
| Lymphoma | 01 (2.38) | 55 | 1/0 | |
| Metastatic carcinoma | | | | |
| Adenocarcinoma ($n = 2$) | 02 (4.76) | 60 | 1/1 | |

Abbreviations: CNS, central nervous system; WHO, World Health Organization.

 

The present study was conducted with a view to have insight into the pattern of CNS neoplasms in our region and to categorize and grade them according to WHO guidelines.

## Materials and Methods

The present study was a retrospective analysis of the data on CNS tumors which involved the blocks, histopathological slides, and patients' clinicopathological details. The study included 42 cases of diagnosed CNS tumors over a period of 2 years from October 2018 to September 2020 in the Pathology Department of the Tertiary Care Hospital and Medical College in Durgapur, West Bengal. Basic demographic data, tumor site, and the hematoxylin and eosin (H&E) stained histopathological slides of biopsy received were evaluated. The cases were diagnosed and categorized according to WHO 2016 classification of tumors of CNS. We included all cases of tumors of brain and spinal cord of all age group. The nonneoplastic conditions of the CNS were excluded.

## Result

Out of 42 CNS tumor cases that were diagnosed histopathologically, 23 patients (54.76%) were male and 19 patients (45.24%) were female, thus male-to-female ratio being 1.21:1 and the most common age group affected were sixth decade followed by fifth decade with a mean age of 50 years. A total of 29 cases affected the different region of brain and arose intracranially, whereas 13 cases affected the spinal cord. Tumors of meninges (42.86%) were the commonest followed by tumors of neuroepithelial cells (38.09%) and cranial and peripheral nerve sheath tumors (11.90%; ►**Table 1**). The different CNS tumors were classified according to the recent WHO classification system and the primary CNS tumors were graded from I to IV. According to the data we got from the archives, common symptoms of brain tumors were headache, seizures, visual disturbances, vomiting, gait disturbances, and behavioral problems, whereas the spinal cord tumors mostly presented as paraplegia and neurodeficit of root of a particular nerve.

The mean age in meningiomas was found to be 49.33 years, and female preponderance was seen with sex ratio of 1:1.57. Meningothelial meningioma was the most common variant among meningioma followed by transitional variant and psammomatous variant. Six cases including one case of anplastic meningioma out of 18 cases occurred in the spinal cord, and the most common location was thoracic part of spinal cord (►**Table 2**).

The tumors of neuroepithelial tissue comprised mainly of astrocytic tumors (21.42%) followed by oligodendroglial tumors, ependymal tumors, mixed gliomas, and embryonal tumor (►**Table 1**). In contrast to meningioma, neuroepihelial tumors are more common in males with a sex ratio of 2.2:1. Out of 16 cases, one case of glioblastoma and one case of ependymoma occurred in spinal cord (►**Table 2**).

Third most common tumor was tumors of cranial and paraspinal nerves. Four cases of schwannoma and one case of neurofibroma were obtained and all the cases arose from the spinal cord.

**Table 2** Distribution of central nervous system tumors among brain and spinal cord

| Tumor | Brain | Spinal cord |
|---|---|---|
| Meningioma ($n = 18$) | 12 | 6 |
| Meningothelial | 5 | 3 |
| Transitional | 3 | 1 |
| Psammomatous | 1 | 1 |
| Fibroblastic | 1 | 0 |
| Angiomatous | 1 | 0 |
| Atypical | 1 | 0 |
| Papillary(anaplastic) | 0 | 1 |
| Tumor of neuroepithelial tissue ($n = 16$) | 14 | 2 |
| Diffuse astrocytoma | 5 | 0 |
| Glioblastoma | 3 | 1 |
| Oligodendroglioma | 2 | 0 |
| Anaplastic oligodendroglioma | 1 | 0 |
| Oligoastrocytoma | 1 | 0 |
| Ependymoma | 1 | 1 |
| Medulloblastoma | 1 | 0 |
| Tumors of cranial and paraspinal nerves ($n = 5$) | 0 | 5 |
| Schwannoma | 0 | 4 |
| Neurofibroma | 00 | 1 |
| Lymphoma | 1 | 0 |
| Metastatic adenocarcinoma | 2 | 0 |
| Total | 29 (69.05%) | 13 (30.95%) |

We found only one case of CNS lymphoma of non-Hodgkin's type in an elderly male patient and two cases of metastatic deposit in brain. Both the metastatic deposits were of adenocarcinoma.

## Discussion

The burden of CNS tumors is very low in our society among adults, while they form the second most common childhood tumors after leukemia.[6] In adults, the predominant CNS tumor types are glial neoplasms, meningiomas, and metastatic deposit. Whereas in children, besides gliomas, other major tumor types including primitive embryonal neoplasms are also common. In recent times, an enhanced understanding of these biological differences between adult and childhood CNS tumors has led to investigations in distinct molecular and genetic pathways and therapeutic approaches for each tumor type.

The present study comprises of 42 cases of CNS tumors from a single center. All cases irrespective of age had been

 

categorized according to the recent WHO classification. The male-to-female ratio was 1.21:1, but meningioma cases had female preponderance which correlated with the studies done by Yeole[7] and Ghanghoria et al[8] and the most common age group affected were sixth decade followed by fifth decade with a mean age of 50 years which correlated with another study done in north India by Hamdani et al.[9] In our study, the most common CNS tumors are in descending order are tumors of meninges (42.86%), followed by tumors of neuroepithelial tissue (38.09%) and tumors of the cranial and paraspinal nerves (11.9%). The same was found by Surawicz et al[10] in the United States, and Lee et al[11] in Korea also noticed that the most common tumor was meningioma. However, Patty[12] and Das et al.[13] reported astrocytomas to be the most common tumors in their studies. There may be role of various genetic and environmental factors among the populations of different countries which creates the difference between the relative frequency and the tumor distribution.

### Tumors of the Meninges

We found meningothelial meningioma (WHO grade I) as the commonest subtype and the commonest location of meningioma in brain was meninges of temporoparietal region. We found the oval to spindle cells forming classical whorls in meningothelial variant (►**Fig. 1A**). Many psammoma bodies are found in psammomatous variety (►**Fig. 1C**). One atypical meningioma (WHO grade II) was found in the frontal lobe of brain which was recurrent and produced headache, drowsiness, and vomiting after incomplete removal, as it partially invaded the brain tissue. Histopathological features of atypical meningioma in this case were necrosis, patternless growth at places, and increased cellularity (►**Fig. 1D**). Another case of papillary meningioma (WHO grade III) arose from the spinal cord and the patient presented with paraplegia of rapid onset. The histopathological features were increased mitoses (> 20/10 HPF), areas of necrosis, and more than 50% papillary architecture with appreciable papillae at the edges of tumor (►**Fig. 1B**).

### Tumor of Neuroepithelial Tissue

In the present study, the most common neuroepithelial tumor is WHO grade-II diffuse astrocytoma followed by WHO grade-IV glioblastoma with male preponderance which well correlated with other studies. Microscopically, diffuse astrocytomas have a cellular density that is greater than normal white matter with variable degrees of nuclear pleomorphism. The glioblastoma was characterized by necrosis and vascular proliferation in addition with hypercellularity (►**Fig. 2A** and **B**). The lowest age of occurrence of

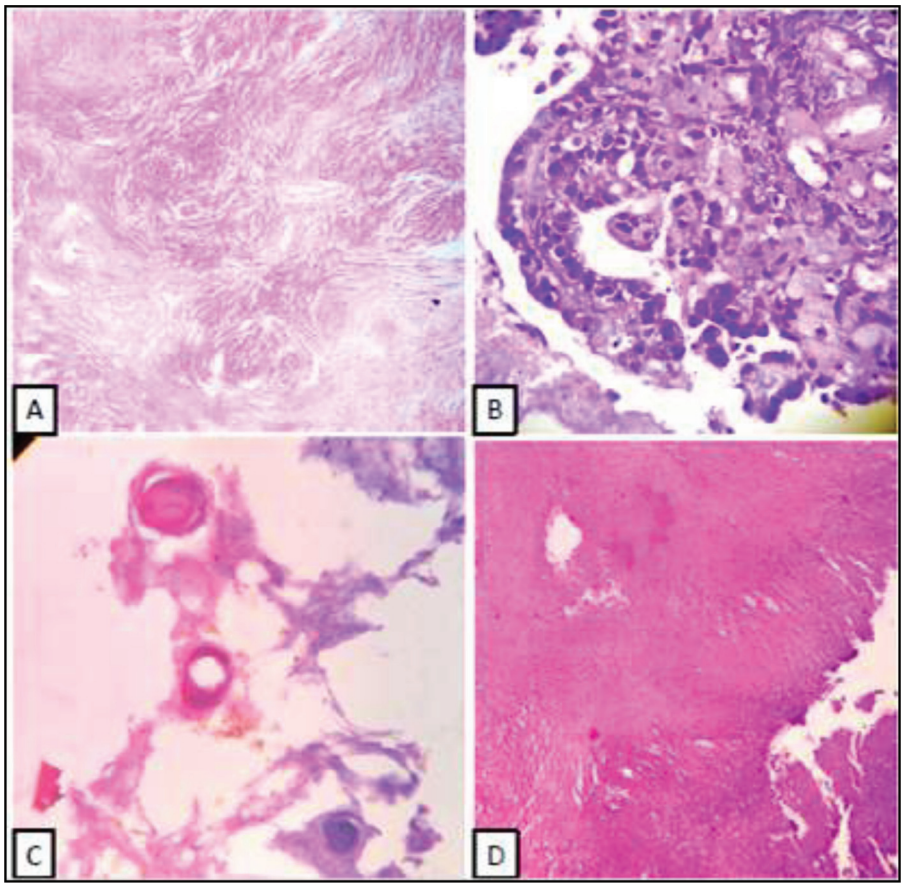


**Fig. 1** (**A**) Classical whorls of meningothelial meningioma (H&E; ×10) (**B**) Presence of papilla in papillary (anaplastic) meningioma (H&E; ×40) (**C**) Psammoma bodies in psammomatous meningioma(H&E; ×10). (**D**) Necrosis and hypercellularity in atypical meningioma(H&E; ×10). H&E, hematoxylin and eosin.

 

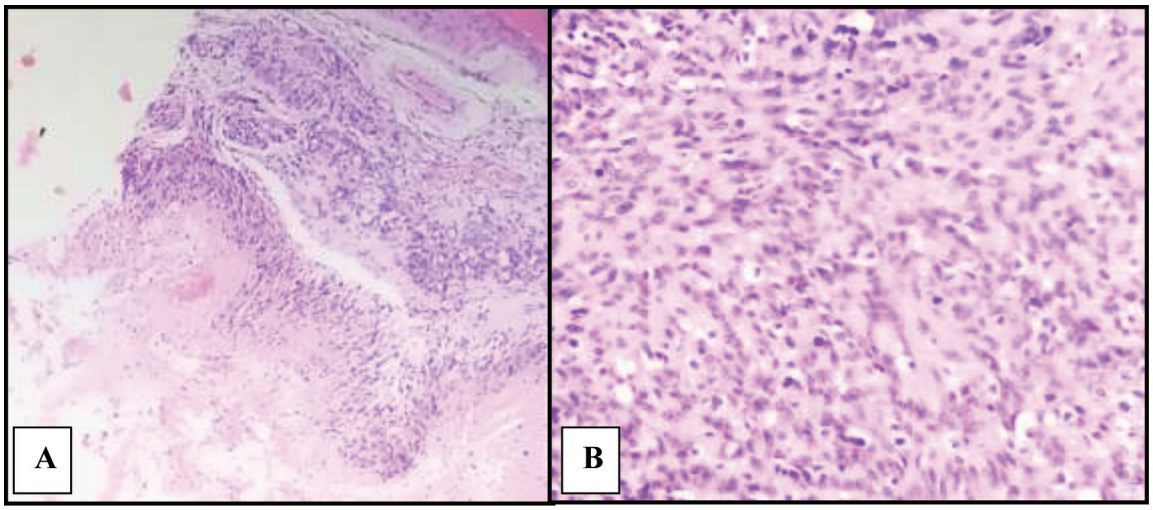


**Fig. 2** (**A**) Glioblastoma showing palisaded necrosis and vascular proliferation (H&E; ×10) (**B**) Increased cellularity and mitoses in Glioblastoma (H&E; ×40). H&E, hematoxylin and eosin.

glioblastoma in our study is 32 years. Cerebrospinal fluid metastasis was found in one case of glioblastoma. Oligodendroglioma (WHO grade II) is another type of glioma composed of oligodendrocytes. Tumor nuclei are round, with cleared cytoplasm forming "halos" and vasculature composed of thin-walled capillaries. Anaplastic oligodendrogliomas (WHO grade III/IV) are characterized by a higher cell density, nuclear anaplasia, detectable mitotic activity, and necrosis (►**Fig. 3A**). Ependymoma arises from ependyma-lined ventricular system or from central canal of spinal cord. Ependymoma (WHO grade II) is composed of cells with regular, round to oval nuclei, and abundant granular chromatin. Tumor cells frequently form rosettes.

Medulloblastoma is a malignant embryonal tumor corresponds to WHO grade IV composed of sheets of undifferentiated cells with scanty cytoplasm and hyperchromatic nuclei. Sometimes rosettes may be found.

## Tumors of Cranial and Paraspinal Nerves

We found all cases of schwannoma and neurofibroma occurred in the spinal cord. Schwannomas here were mostly cellular schwannoma with less prominent Antoni's B areas (►**Fig. 4A**). Neurofibroma was less cellular consisting of spindle cells admixed with mast cells in myxoid background (►**Fig. 4B**). Most of them presented with segmental radiculopathy caused by nerve root compression.

We found only one case of non-Hodgkin lymphoma of B-cell type in an HIV positive male patient which was further confirmed by immunohistochemistry (IHC) from outside (►**Fig. 3B**). It was found positive for CD45 and CD19 and Bcl6.

Two cases of metastatic deposits were found of which one case was from a female patient with unknown primary and other was a male patient of lung adenocarcinoma (►**Fig. 5A,B**).

The present study only reflects the histopathological spectrum of brain tumors from our center. Diagnosis of

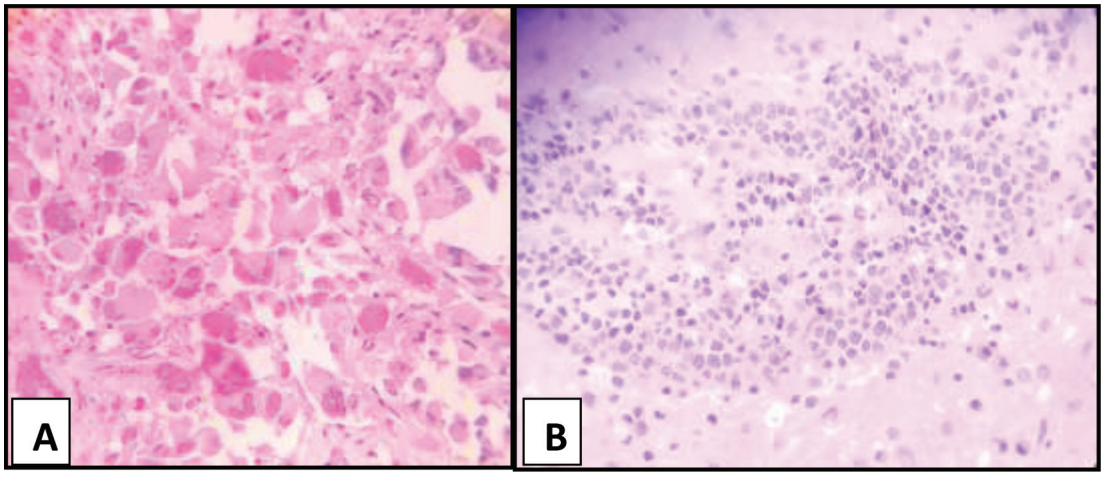


**Fig. 3** (**A**) Anaplastic oligodendroglioma showing high cellularity, nuclear anaplasia and detectable mitotic activity (H&E; ×40). (**B**) Diffuse aggregates of large lymphoid cells in CNS non-Hodgkin's lymphoma (H&E; ×40). H&E, hematoxylin and eosin.

 

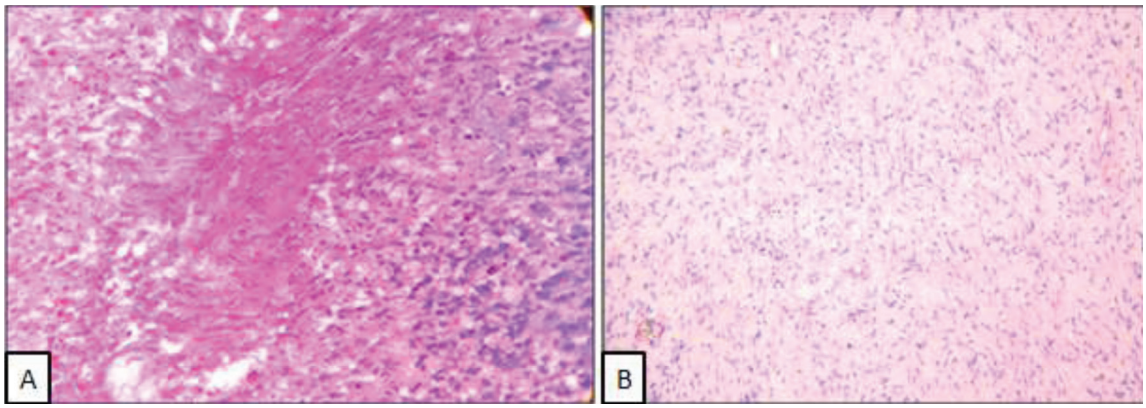


**Fig. 4** (**A**) Schwannoma with less prominent Antoni's B areas (H&E; ×10). (**B**) Neurofibroma composed of spindle cells in myxoid background (H&E; ×10). H&E, hematoxylin and eosin.

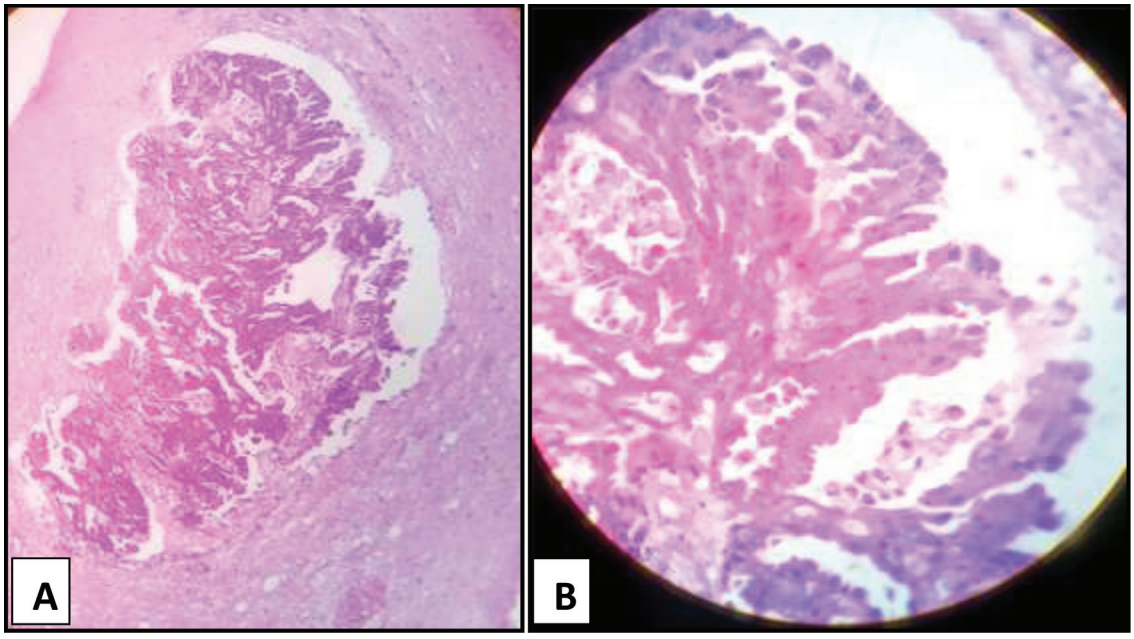


**Fig. 5** (**A**) Metastatic deposit of adenocarcinoma in brain; (H&E; ×10). (**B**) Papillae of metastatic deposit in brain; (H&E; ×40). H&E, hematoxylin and eosin.

high-grade gliomas was further confirmed by IHC from outside.

## Conclusion

Tumors of the CNS have the diverse clinical and histopathological profile. Rising global trends in the incidence of CNS tumors have been observed irrespective of age. Although advance imaging modalities are available nowadays, still histopathology is considered as the gold standard in their diagnosis. IHC also plays a major role in improving diagnosis. This single-center study represented a very small part of peripheral and rural West Bengal. In-depth studies across various hospitals in the state are required to have a representative data on the incidence of brain tumors and also to better understand the epidemiological profile and etiology of primary brain tumors and guide research toward those with the highest mortality and/or incidence.

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Conflict of Interest
None declared.

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