Original Research Article

Decoding CNS Tumors by Histopathology and IHC

Shalaka S Shinde[1*], R. S. Patil[2], Purva Shinde[3]

[1]2nd year Junior Resident, [2]Associate Professor, [3]Assistant Professor, Department of Pathology, D. Y. Patil Medical College, Kolhapur, INDIA.
Email: shindeshalaka93@gmail.com

Abstract

Background: CNS tumors represents approximately less than 2% of all malignancies. Incidence of 1.9% of all tumors in India. Incidence of metastatic adenocarcinoma of prostatic origin accounts for <1% whereas incidence of metastasis from adenocarcinoma of pulmonary origin in brain is 25%. Due to heritable genetic syndromes, access to neuroimaging, an aging population, ionizing radiation and radiofrequency electromagnetic fields may lead to rare occurrence of CNS tumors. **Aim & Objective:** 1. Decoding CNS tumors by histopathology and IHC.2 Prevalence of CNS tumor as per age and gender. **Methods:** A hospital based prospective study. **Study setting:** Pathology Department of D. Y. Patil medical college, Kolhapur. **Study duration:** 6 months (March 2023 to August 2023).**Study population:** 26 Brain biopsy specimens for histopathological evaluation in the department of pathology. **Sample size: 26 Result:** A series of 26 cases were analyzed in six months with space occupying lesions in brain and spinal cord**.** Primary tumors accounting for 22 (84.62%) and 4 (15.38%) cases were metastatic. The most common age group affected was 21 to 60 years (69.23%). Glioblastoma Multiforme (GBM) was found to be the most common CNS tumor in 3rd and 4th decade. Diffuse Astrocytoma was the second most common tumor encountered in 21 to 60 years age group. Males (61.53%) were affected more than females (38.47%). Metastasis from adenocarcinoma of pulmonary origin, metastatic adenocarcinoma possibly of upper GI or pancreato-biliary origin and Glioblastoma multiforme Grade IV was found in females. Anaplastic Oligodendroglioma Grade III (15.38%) and Glioblastoma Multiforme Grade IV (11.53%) was found most common in Males. Among 26 cases the most common histological types found was Glioblastoma (23%), followed by Diffuse Astrocytoma (19.23%) and Anaplastic Oligodendroglioma (15.38%). According to revised WHO classification 16 cases diagnosed as Astrocytoma, Glioblastoma, Neurocytoma and Anaplastic oligodendroglioma were graded. Maximum cases were diagnosed in Grade II (43.75%), followed by Grade IV (37.5%) and Grade II (18.75%). There was no case detected in WHO grade I. Out of 4 metastatic tumors, Metastatic adenocarcinoma of prostatic origin and metastatic Angiosarcoma was detected in male. Metastasis from adenocarcinoma of Pulmonary origin and metastatic adenocarcinoma possibly of upper GI or Pancreato – biliary origin in female. Most common location of CNS tumors was frontal (42.30%) followed by parietal (19.23%) and spinal (15.38%). **Conclusion:** Histopathologic examination plays a significant role in diagnosis and grading of CNS tumors. Diagnostic challenges in CNS tumors can be resolved by application of IHC.

Keywords: Diagnosis, IHC, CNS Tumors

[*]**Address for Correspondence:**
Dr Shalaka S Shinde, 2nd year Junior Resident, Department of Pathology, D. Y. Patil Medical College, Kolhapur, INDIA.
Email: shindeshalaka93@gmail.com
Received Date: 20/03/2024 Revised Date: 19/04/2024 Accepted Date: 02/05/2024

Access this article online

Quick Response Code:

Website: www.medpulse.in

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 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.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.

Due to heritable genetic syndromes, access to neuroimaging, an aging population, ionizing radiation and radiofrequency electromagnetic fields may lead to rare occurrence of CNS tumors [7]. Brain tumors are misdiagnosed in adolescence and middle age due to changing endocrine function and lifestyle. CNS tumors causes diagnostic challenge due to overlapping of morphological features and divergent differentiation within the same tumor. [8-10] Benign tumors can be misdiagnosed as malignant tumors. Hence Immunohistochemical markers play a significant role for an exact diagnosis and subtyping.

AIM AND OBJECTIVE

1. Decoding CNS tumors by histopathology and IHC.
2. 2 Prevalence of CNS tumors as per age and gender.

METHODOLOGY

Study design: Observational study. **Study setting:** Pathology Department of D. Y. Patil medical college, Kolhapur. **Study duration:** 6 months (March 2023 to August 2023).**Study population:** 26 Brain biopsy specimens for histopathological evaluation in the department of pathology. **Sample size: 26**

INCLUSION CRITERIA:

1. **ALL PATIENTS WITH CNS PATHOLOGY ADMITTED IN D. Y. PATIL MEDICAL COLLEGE, KOLHAPUR**

EXCLUSION CRITERIA:

1. Inadequate sample
2. Incomplete proforma

Procedure

Record based Data was collected for 26 patients, A total of 26 cases. Predesigned and pretested proforma was used as tool for data collection. Written consent was taken before the collection of data. Clinical data including age, sex and clinical manifestations, complications and outcome were recorded.In this study we received 26 Brain biopsy specimens for histopathological evaluation in the department of pathology.Routine tissue processing was done and H & E – stained sections were subjected for microscopic evaluation. Followed by immunohistochemistry (IHC) technique in the diagnosis of brain tumors.

RESULT AND OBSERVATIONS

TABLE NO.1: DISTRIBUTION OF CASES ACCORDING TO AGE

Age in years	Frequency	Percentage
10- 30	07	26.92%
31- 50	11	42.30%
51- 70	08	30.76%
Total	26	26 (100%)

The above table shows majority of cases found in 31 to 50 years age group 11 cases (42.30%) followed by 8 cases in 51 to 70 years age group (30.76A%) and 7 cases in 10 to 30 years age group (26.92%)

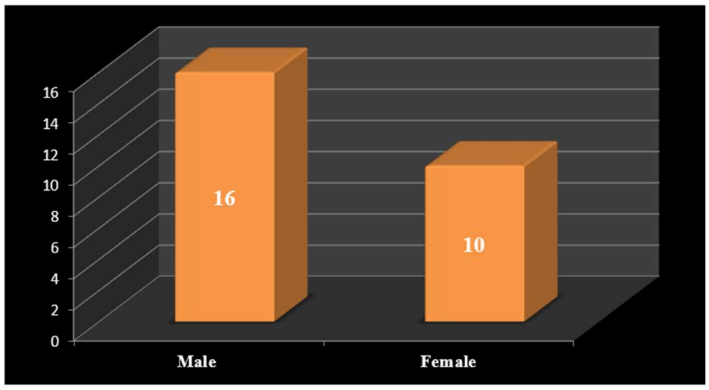

Figure 1: Distribution of cases as per sex

THE ABOVE FIGURE SHOWS MAJORITY OF PATIENTS WERE MALESCONTRIBUTING 16 (61.53%) AS COMPARED TO FEMALES 10 (38.47%).

Table no 2: Distribution of cases as per Diagnosis

CASES	AGE	GENDER	TUMOR SITE	IDH 1	TUMOR TYPE	IHC
1	36 years	M	Parasagital	R132H mutant	IDH1 mutant (R132H- mutant) Diffuse astrocytoma Grade II	GFAP positive, Mib1 index 2%
2	19 years	M	D5 – D9 Extradural lesion	-	Burkitt Lymphoma	CD20, CD10, BCL – 6, cMYC, CD3, Mib proliferation 95%
3	55 years	M	Right occipital lesion	-	Metastatic adenocarcinoma of Prostatic origin	PSA
4	23 years	M	Right fronto-temporo- parietal	-	Reactive Gliosis	GFAP, ATRX, Mib1 – 1%
5	45 years	F	Corpus Callosum	-	Glioblastoma Grade IV	GFAP
6	50 years	M	Paraspinal lesion	-	Diffuse Large B – cell lymphoma	LCA, CD20, CD10, BCL – 2, BCL –6, CD3, Mib1 – 40%
7	65 years	F	Left fronto-temporal region	R132H mutant	Glioblastoma Grade IV	GFAP, p53, ATRX, Mib1 – 20%
8	55 years	F	Intraventricular	-	Central Neurocytoma - II	Synaptophysin, S- 100, GFAP, Mib1 – 2%
9	45 years	F	Left Parasagital	R132H mutant	Diffuse Astrocytoma Grade II	Mib1 – 2%, GFAP
10	60 years	F	Spinal lesion	-	Infiltration by Plasmacytoma	CD138, MUM1, Kappa light chain restriction
11	51 years	M	Right Insular Glioma	R132H mutant	Diffuse Astrocytoma Grade II	Mib1 index 2%, ATRX reactive glial cells, GFAP

12	47 years	F	Right fronto-parietal	-	Metastasis from adenocarcinoma of pulmonary origin	CK7, TTF 1, Napsin A
13	30 years	M	Left frontoparietal SOL	R132H mutant	Anaplastic oligodendroglioma III	GFAP, retained nuclear expression ATRX, p53 90%, Mib 50%
14	60 years	F	Right Cerebellum		Metastatic adenocarcinoma possibly of upper GI or pancreato-biliary origin	CK7, CK20, Ca19.9 focally and CDX2
15	40 years	M	Left frontal, basifrontal	R132H mutant	Anaplastic oligodendroglioma III	GFAP, retained nuclear expression ATRX, p53-70%, Mib1 -10%
16	28 years	M	Left Parieto-occipital	R132H mutant	Anaplastic oligodendroglioma Grade III	GFAP, retained nuclear expression, p53-90%, Mib1 – 30%
17	36 years	F	Cerebellar		Reactive Gliosis	Focal nuclear expression of ATRX
18	30 years	M	Left fronto-parietal	R132H	Glioblastoma Grade IV	GFAP, p53-75%, Mib1 – 20%
19	61 years	M	Right Frontal		Glioblastoma IDH wild type IV	GFAP, loss of nuclear expression ATRX, Mib1 30%
20	27 years	M	Left frontal lobe		Diffuse Astrocytoma Grade II	GFAP, P53-80%, ATRX, Mib1-30%
21	70 years	F	Right Parietal		Glioblastoma Grade IV	
22	55 years	F	Spinal cord	R132H mutant	Diffuse Astrocytoma Grade II	S-100, GFAP ,Mib1%
23	15 years	M	4th ventricle		Medulloblastoma	Synaptophysin, CD99, GFAP, Ki67-30%
24	70 years	M	Right frontal lobe		Angiosarcoma	Vimentin, podoplanin,
25	33 years	M	Right frontal	R132H mutant	Oligodendroglioma, Grade II	GFAP, ATRX, Mib1 - 4%
26	20 years	M	Right frontal		Glioblastoma IDH wild type IV	GFAP, Vimentin, p53, Mib1-40%

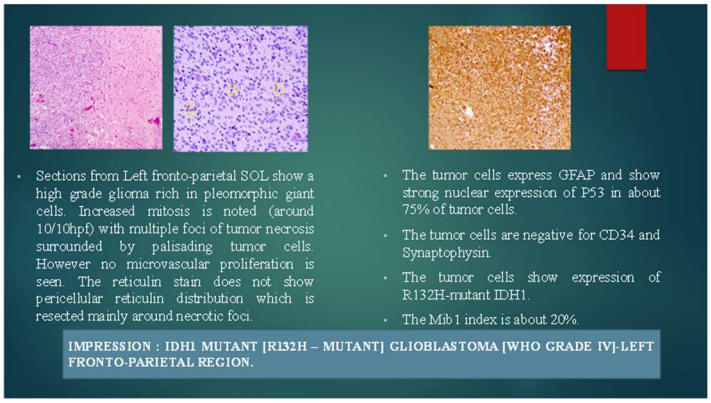

Figure 1

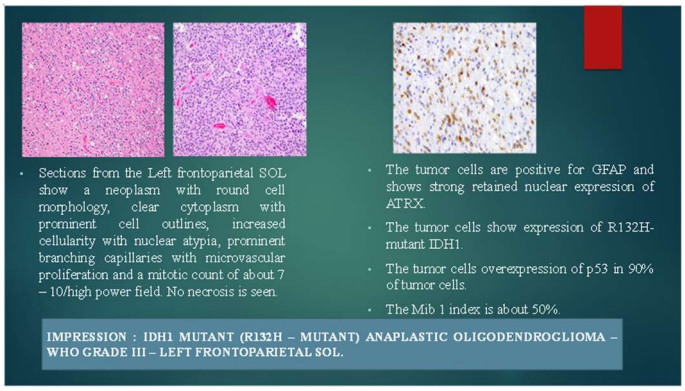

Figure 2

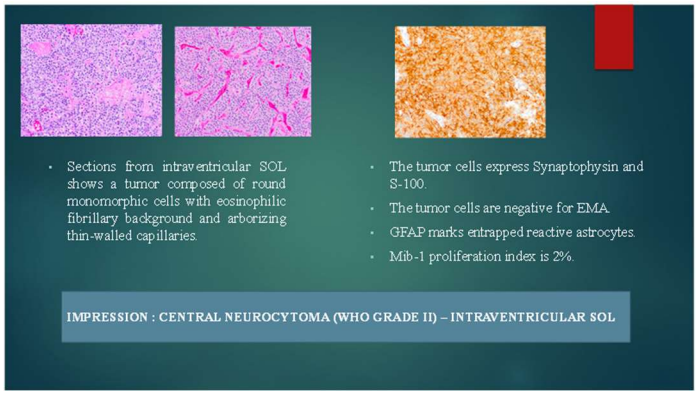

Figure 3

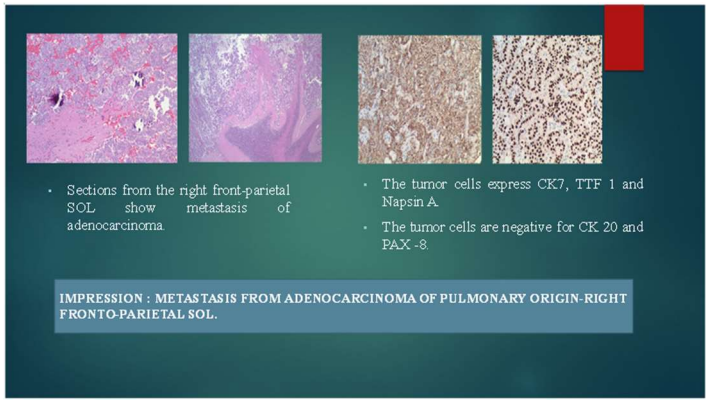

Figure 4

DISCUSSION

CNS tumors are associated with guarded prognosis. Due to morphological variations IHC was applied to distinguish between different categories of lesions. 6 cases were diagnosed with Glioblastoma (WHO Grade IV) with a frequency of 23.07% and 19.23% of astrocytic tumors. The diagnosis of glioblastoma was confirmed by positive expression of GFAP by epithelial structures.4 cases were reported as oligodendroglioma with a frequency of 15.38%. Out of 4 cases 1 case on histopathological evaluation revealed tumors arranged in clusters and nests.

Individual tumor cells were round to oval with eosinophilic cytoplasm and round to oval nuclei in a vacuolated mucinous stroma. Hence differential diagnosis included metastatic carcinoma and chordoid meningioma. IHC showed diffuse cytoplasmic staining for GFAP, p53 and Mib1 thus confirming the diagnosis. One uncommon case in 55yrs, Female with intraventricular mass was reported in our study. Histology revealed tumor cells arranged in nests and

sheets. Individual tumor cells showed monomorphic cells with round nuclei, vacuolated cytoplasm and speckled chromatin.

Differential diagnosis was oligodendroglioma and central neurocytoma. IHC showed positivity for synaptophysin which is diagnostic of central neurocytoma. Most common metastatic deposit in our study was Adenocarcinoma reported in 3 cases. In one of our case,47 years, female with mass in Right fronto-parietal region. Differential diagnosis included metastasis from adenocarcinoma of pulmonary origin or from upper GI. IHC showed positivity for CK7, TTF 1 and Napsin A thus confirming the diagnosis of metastasis from pulmonary origin.

CONCLUSION

Histopathologic examination plays a significant role in diagnosis and grading of CNS tumors. Diagnostic challenges in CNS tumors can be resolved by application of IHC.

BIBLIOGRAPHY

1. Frosch M P, Anthony D C, Girolami U D. 9th ed. Philadelphia, PA: Elsevier; 2015. Robbins and Cotran Pathologic Basis of Disease.
2. Rathod V, Bhole A, Chauhan M, Ramteke H, Wani B. Study of clinico-radiological and clinico-pathological correlation of intracranial space occupying lesion at rural center. *The Int J Neurosurgery.* 2009;7(01) doi: 10.5580/ba1.
3. Louis D N, Perry A, Reifenberger G. The 2016 World Health Organization classification of tumors of the central nervous system: a summary. *Acta Neuropathol.* 2016;131(06):803–820.
4. Wohrer A. Epidemiology and brain tumours: practical usefulness. *Eur Assoc Neurooncol Mag.* 2013;3:56–60.
5. Lantos P L, Louis D N, Rosenblum M K, Allelic L M. 7th ed. London, United Kingdom: Arnold; 2002. Tumours of the nervous system.
6. Rosemberg S, Fujiwara D. Epidemiology of pediatric tumors of the nervous system according to the WHO 2000 classification: a report of 1,195 cases from a single institution. *Childs Nerv Syst.* 2005;21(11):940–944.
7. Preeti Agarwal, Rashmi Monterio, Indu Choudhary *et al.* Histopathological Spectrum of Brain Tumors in Tertiary Care Teaching Hospital in Southern Rajasthan. Indian J Pathol Res Pract.2020;9(1):65-70.
8. Grech N, Dalli T, Mizzi S, *et al.* (May 19, 2020) Rising Incidence of Glioblastoma Multiforme in a Well-defined Population. Cureus 12(5): e8195.DOI 10.7759/cureus.8195.
9. Jayapradeep DP, Pai MR. Clinicopathological study of primary central nervous system tumours – a descriptive study in a tertiary care center hospital of Dakshina Kannada. J Evolution Med Dent Sci 2021;10(36):3109-3114,DOI:10.14260/jemds/2021/634.
10. Debadrita Sen *et al.* Histopathological Spectrum of CNS Tumors: An observation Study in a Tertiary Care Centre of North –East India. International Journal of Medical Reviews and Case Reports 2022;6(3):1-6.
11.

Source of Support: None Declared
Conflict of Interest: None Declared