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Analysis of Histomorphological Spectrum of CNS Tumors in a Tertiary Care Centre

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Abstract

Background: Central nervous system (CNS) tumours vary geographically and racially in incidence and distribution. They make up 2% of all cancers, with a rising incidence. Distinguishing non-neoplastic CNS lesions from brain tumours often requires histopathological examination due to clinical and radiological similarities. Therefore, this study formulated the analysis of histomorphological spectrum of CNS tumours in a tertiary care centre. Methodology: This retrospective study comprised 60 cases and was conducted at a tertiary healthcare hospital from July 2012 to July 2016. The cases were diagnosed through histopathological examination and categorized in accordance with the world health organization (WHO) 2016 classification. Results: Out of 60 cases, 31-40 age group had the highest number of cases, with 15 individuals affected, constituting 25.00% of the total cases. As age brackets increase, the incidence of CNS lesions rises. Astrocytomas constitute the most common CNS tumor (36.6%). The breakdown of tumor grades in relation to different age groups reveals that Grade II tumors display a broader distribution, occurring in every age group and accounting for a total of 10 cases. Conclusion: Our study identifies astrocytoma as the most common CNS tumor (22 cases in ages 31-50), followed by meningioma (6 cases in ages 31-60), and various other tumors with 6 cases each. Grade II tumors are prevalent (10 cases across all age groups).

Keywords: *Histomorphology, central nervous system (CNS), tumours, non-neoplastic tumor, neoplastic tumor.*

1. Introduction

CNS tumors characterize a diverse group of neoplasms and are considered one of the most feared forms of cancer due to their high morbidity and mortality rates. These tumors account for less than 2% of all malignancies. [1] Additionally, CNS lesions exhibit significant geographic and racial variations in incidence and distribution patterns. Furthermore, the histological spectrum of CNS tumors is wide-ranging in addition to differs between different age groups.[2] The annual occurrence of CNS tumors varies, ranging from 10 to 17 per 100,000 individuals for intracranial tumours as well as 1 to 2 per 100,000 individuals for intraspinal tumors. Most of these cases constitute major tumors, with only a fraction, approximately one-fourth to half, being metastatic in nature.[3] Previously, the incidence of brain tumors in India was relatively low. However, with the advancement and widespread use of newer investigative neuroimaging techniques in the country over the past two decades, it has become evident that brain tumors are just as common in India as they are in other parts of the world. [4] Many non-neoplastic CNS lesions can mimic brain tumors both clinically as well as radiologically, necessitating histopathological examination for differentiation. Primary brain tumors can present with a range of clinical signs and symptoms, which can be broadly categorized as either general or focal. [5] Increased intracranial pressure often gives rise to general symptoms such as persistent headaches and convulsions, while tissue damage within the brain typically leads to focal symptoms like unilateral weakness, unsteadiness, expressive language disorders, and visual problems. Among the most common and initial

manifestations of primary brain tumors are headaches, which can vary in intensity, generalized seizures characterized by abnormal brain activity affecting the entire body, and weakness on one side of the body, corresponding to the tumor's location. Additionally, patients may experience difficulties with balance and coordination, expressive language difficulties, and visual disturbances, such as blurred or double vision, all of which can vary depending on the tumor's size, location, and growth rate. Early recognition of these warning signs is crucial for prompt diagnosis and the initiation of appropriate medical interventions. [5]

The progression of a brain tumor is significantly shaped by its growth patterns and location. For instance, certain low-grade glial tumors can infiltrate extensive areas of the brain, resulting in severe clinical impairments and a grim prognosis. Given their ability to infiltrate both white and gray matter extensively, complete surgical removal of such tumors may not be feasible without compromising neurological function. Furthermore, any CNS neoplasm, irrespective of its histologic grade or classification, could have fatal outcomes when located in a vital brain region. [3,6]

Treatment protocols and clinical trials for CNS tumors are typically guided by the WHO classification system. This system categorizes tumors into one of four grades, ranging from Grade I to Grade IV, based on their biological behavior. Traditionally, brain tumors have been classified according to their cell or site of origin, encompassing various categories such as those of 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.

However, in 2016, the WHO introduced a significant update to the classification of CNS tumors by incorporating molecular parameters alongside histology to define many tumor entities. This modernized approach provides a comprehensive framework for diagnosing CNS tumors in the molecular era. This integration of molecular information allows healthcare professionals to make more precise diagnoses and tailor treatment strategies to the specific molecular characteristics of each tumor, ultimately improving the management and care of patients with CNS tumors.[7] This study examined the histopathological diversity of CNS tumors, encompassing both non-neoplastic as well as neoplastic conditions. Neoplastic tumors were categorized and graded in accordance with the WHO classification.

2. Material and method

This retrospective study involved the analysis of data pertaining to CNS tumors, including lumps, histopathological slides as well as clinicopathological specifics of patients. The study encompassed 60 cases of diagnosed CNS tumors within a 5-year period, spanning from July 2012 to July 2016, conducted at a department of Pathology, chettinad hospital& research institute. The evaluation encompassed basic demographic information, tumor site as well as examination of hematoxylin and eosin (H&E) stained histopathological slides obtained from biopsies. The cases were diagnosed and classified in accordance with the WHO 2016 organization of CNS tumors and all age groups were included in the study, with non-neoplastic CNS conditions excluded.

3. Result and Discussion

Table-1: The age distribution of space-occupying lesions within the brain and spinal cord varies across different age groups

S.NO	Age group	CNS Lesions	Percentage
1	0-10	6	10.00%
2	11-20	4	6.67%
3	21-30	5	8.33%
4	31-40	15	25.00%
5	41-50	15	25.00%
6	51-60	12	20.00%
7	≥ 60	3	5.00%
Total number of cases		**60**	**100%**

In the youngest age group, 0-10 years, there are 6 reported cases, constituting 10.00% of the total cases. Moving up to the 11-20 age group, there are 4 cases, making up 6.67% of the total cases, while the 21-30 age group includes 5 cases, accounting for 8.33% of the total. As we progress to older age brackets, the incidence of CNS lesions appears to increase. The 31-40 age group reports the highest number of cases, with 15 individuals affected, representing 25.00% of the total cases. Similarly, the 41-50 age group also presents 15 cases, comprising another 25.00% of the total. In the 51-60 age group, there are 12 cases, making up 20.00% of the total instances. Lastly, the age group labeled as '≥ 60' reports 3 cases, which represents 5.00% of the total cases.

Table-2: Distribution of CNS tumors

Sr. No.	CNS TUMORS	No. of cases	Percentage
1	Astrocytoma	22	36.67%
2	Meningioma	6	10.00%
3	Neurofibroma/Schwannoma	6	10.00%
4	Oligodendroglioma	3	5.00%
5	Small round cell tumor (PNET/Ewings/Medulloblastoma)	6	10.00%
6	Ependymoma	2	3.33%
7	Pituitary adenoma	3	5.00%
8	CNS Lymphoma	2	3.33%
9	Hemangioblastoma	1	1.67%
10	Metastatic deposits	3	5.00%
11	Gliosarcoma	1	1.67%
12	Plasmacytoma	1	1.67%
13	Infective lesions	1	1.67%
14	Inflammatory Pseudotumor	1	1.67%
15	Others (AV Malformation,Ganglioglioma)	2	3.33%
	Total	60	100.00%

Astrocytoma takes the lead as the most prevalent CNS tumor, accounting for 36.67% of cases with a total of 22 instances. Following closely are Meningioma and Neurofibroma/Schwannoma, both contributing 10.00% each, representing 6 cases each. Oligodendroglioma is less common, appearing in 5.00% of cases, totaling 3 instances. Similarly, Small round cell tumors, which include PNET, Ewings and Medulloblastoma, also account for 10.00%, constituting 6 cases in the dataset. Beyond these, the dataset encompasses a variety of less frequent tumor types, including Ependymoma, Pituitary adenoma, CNS Lymphoma, Hemangioblastoma, Metastatic deposits, Gliosarcoma, Plasmacytoma, Infective lesions, Inflammatory Pseudotumor, and Others (such as AV Malformation and Ganglioglioma), each contributing percentage ranging from 1.67% to 3.33%.

Table-3: The distribution of central nervous system tumors among the brain and spinal cord exhibits variability in their occurrence and location within these neural structures

Sr. No.	CNS tumors	Brain	Spinal cord
1	Astrocytoma	13	9
2	Meningioma	4	2
3	Neurofibroma/Schwannoma	3	3
4	Oligodendroglioma	3	0
5	Small round cell tumor (PNET/Ewings/Medulloblastoma)	5	1
6	Ependymoma	1	1
7	Pituitary adenoma	2	1
8	CNS Lymphoma	2	0
9	Hemangioblastoma	1	0
10	Metastatic deposits	2	1

11	Gliosarcoma	1	0
12	Plasmacytoma	0	1
13	Infective lesions	1	0
14	Inflammatory Pseudotumor	1	0
15	Others (AV Malformation, Ganglioglioma)	1	1
	TOTAL	40	20

Astrocytoma stands out as the most prevalent, with 13 brain cases and 9 spinal cord cases. Following this, Meningioma appears with 4 brain cases and 2 spinal cord cases, while Neurofibroma / Schwannoma is evenly split with 3 cases in both the brain and spinal cord. Oligodendroglioma is predominantly in the brain, accounting for 3 cases, while Small round cell tumors (PNET, Ewings, and Medulloblastoma) are mostly in the brain with 5 cases and 1 in the spinal cord. Ependymoma is fairly evenly distributed, with 1 case in both the brain as well as spinal cord.

Pituitary adenoma is found in 2 brain cases and 1 spinal cord case, while CNS Lymphoma occurs in 2 brain cases. Hemangioblastoma primarily resides in the brain with 1 case, whereas Metastatic deposits are present in 2 brain cases and 1 spinal cord case. Gliosarcoma is located in the brain with 1 case and Plasmacytoma exclusively affects the spinal cord with 1 case. Additionally, infective lesions, inflammatory pseudotumor, and other tumors (including av malformation and ganglioglioma) each have 1 case distributed in different cns locations.

Table 4: Age wise incidence of CNS neoplasms

TUMOR	0-10 yrs	11-20 Yrs	21-30 yrs	31-40 Yrs	41-50 Yrs	51-60 yrs	>60yrs	TOTAL
Astrocytoma	4	1	1	6	6	4	-	22
Meningioma	-	-	1	1	2	1	1	6
Schwannoma	-	-	-	2	3	1	-	6
Oligodendroglioma	-	-	-	2	-	1	-	3
Small Round cell tumor	2	3	1	-	-	-	-	6
Ependymoma	-	-	-	1	-	1	-	2
Pituitary adenoma	-	-	1	1	2	-	-	4
Gliosarcoma	-	-	-	-	-	-	1	1
Hemangioblastoma	-	-	1	-	-	-	-	1
Metastatic deposits	-	-	-	-	1	2	-	3
Plasmacytoma	-	-	-	1	-	-	-	1
CNS Lymphoma	-	-	-	-	1	1	-	2
Inflammatory Pseudotumor	-	-	-	-	-	1	1	2
Others (Ganglioglioma,)	-	-	-	1	-	-	-	1
TOTAL	6	4	5	15	15	12	3	60

This above table indicate that the distribution of CNS (Central Nervous System) tumors across different age groups, from 0-10 years to over 60 years, with a total of 60 cases. Astrocytoma is the most prevalent, with 22 cases in various age groups, particularly in the 31-50 years range. Meningioma is the second most common, with 6 cases, primarily affecting those aged 31-60 years. Schwannoma, oligodendroglioma and small round cell tumors each contribute 6 cases to the dataset, distributed across different age groups. Other less common tumors, such as Ependymoma, Pituitary adenoma, Gliosarcoma, Hemangioblastoma, Metastatic deposits, Plasmacytoma, CNS Lymphoma, Inflammatory Pseudotumor and others, are also present, each with their own age group distributions. This data provides insights into how various CNS tumors manifest in different age brackets within the given dataset.

Table-5: Grade and age wise incidence of astrocytoma

GRADE	1-10 Yrs	11-20 Yrs	21-30 Yrs	31-40 yrs	41-50 Yrs	51-60 Yrs	>60yrs	TOTAL
I	2	-	-	1	1	-	-	4
II	1	1	1	3	1	3	-	10
III	-	-	-	1	1	-	-	2
IV	1	-	-	1	3	1	-	6
OTAL	**4**	**1**	**1**	**6**	**6**	**4**	**-**	**22**

This table offers a comprehensive breakdown of tumor grades in relation to different age groups, encompassing a total of 22 cases. Grade I tumors are evident across all age categories except for individuals aged 11-20 and those over 60 years, amounting to a total of 4 cases. In contrast, Grade II tumors display a broader distribution, occurring in every age group and accounting for a total of 10 cases. Grade III tumors are confined to the age groups 31-40 and 41-50, with a cumulative count of 2 cases. Lastly, Grade IV tumors are found in age groups 1-10, 31-40, 41-50 and 51-60, collectively totalling 6 cases.

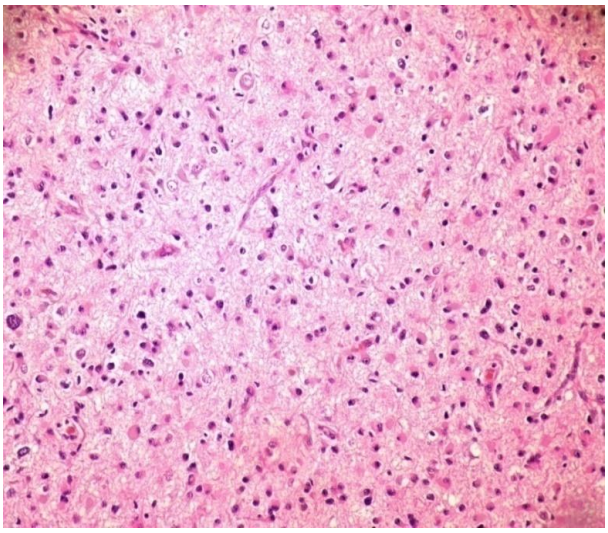

Figure 1: HISTOPATHOLOGYOF GRADE II ASTROCYTOMA (Grade II Gemistocytic Astrocytoma showing gemistocytes with ample eosinophilic cytoplasm havingeccentrically placed nucleus on a fibrillary background).

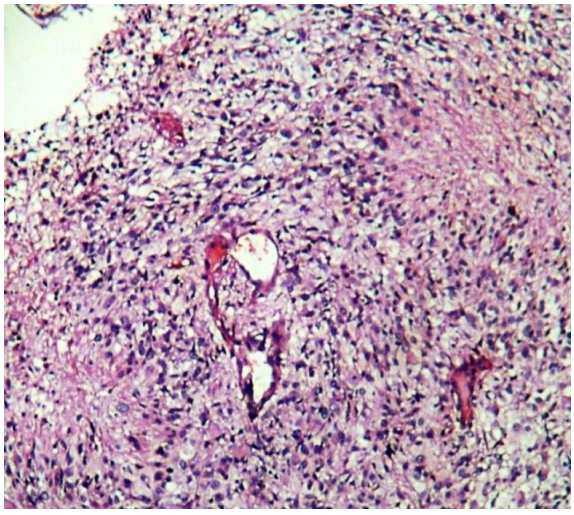

Figure 2: HISTOPATHOLOGY IN GRADE IV ASTROCYTOMA (Grade IV Astrocytoma GBM, showing pleomorphic Astrocytes, endothelial proliferation with pseudo palisading necrosis.)

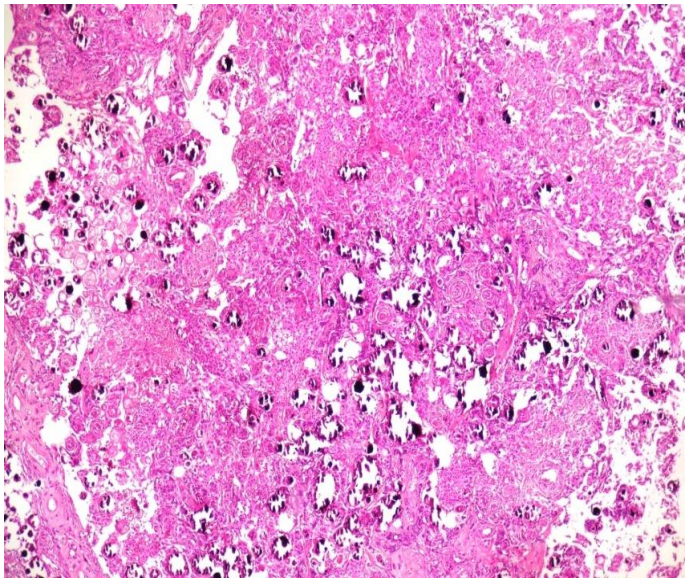

Figure 3: Histopathology in psammomatous meningioma (Histopathology in Grade I Psammomatous meningioma showing intact cellular whorls & psammomatous calcifications)

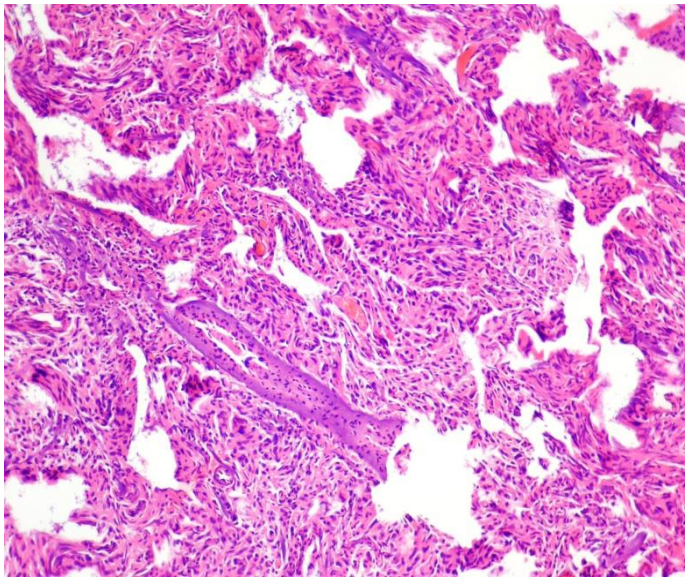

Figure 4: Histopathology in anaplastic meningioma (Grade III Anaplastic meningioma showing pattern less arrangement of anaplastic cells with increase in mitosis)

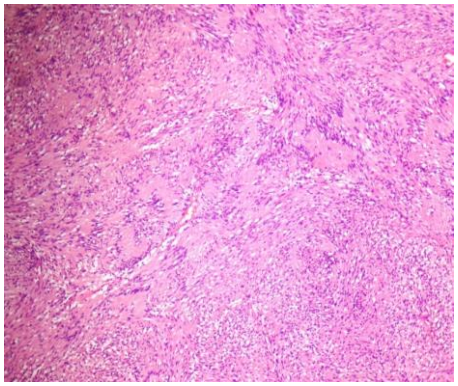

Figure 5: Histopathology in schwannoma (Schwannoma showing swirls of compact Antoni A & loose Antoni B areas with charecteristical verucay bodies)

CNS tumors encompass a wide range of neoplasms and are the most feared type of cancer due to their elevated morbidity and mortality rates. They constitute less than 2% of all malignancies globally. In India, CNS tumors make up around 1.9% of all tumors. [8] Hence, in the current study, we conducted an analysis of the histomorphological spectrum of CNS lesions in hospital.

In the present study, as we progress into older age brackets, the incidence of CNS lesions appears to increase. The 31-40 age group reports the highest number of cases, with 15 individuals affected, representing 25.00% of the total cases. Similarly, the 41-50 age group also presents 15 cases, comprising another 25.00% of the total. The outcomes of our study are similar to the study conducted by *Bhattacharya S et al*. [6] their findings indicated that the highest incidence of affected individuals was in their sixth decade of life, followed by those in the fifth decade, with an average age of 50 years. Likewise, research conducted by *Yeole* [9] and *Ghanghoria et al.* [10] demonstrated that the predominant age group affected was individuals in their sixth decade, followed by those in the fifth decade, with an average age of 50 years. This observed correlation is consistent with another study conducted in North India by *Hamdani et al.* [11]

In the present study, astrocytoma takes lead as the most prevalent CNS tumor, accounting for 36.67% of cases, with a total of 22 cases. Following closely are Meningioma and Neurofibroma/Schwannoma both contributing 10.00% each, representing 6 cases each. This finding is in concordance with the studies conducted by *Patty* [12] plus *Das et al.* [13], noted that astrocytomas were the most frequently encountered tumors. Differences in relative frequency and tumor distribution among populations in different countries may be affected by various genetic as well as ecological issues.

The distribution of CNS (Central Nervous System) tumors is observed across the 31-50 year age groups, comprising a total of 22 cases. The majority of these cases are found within the age range of 31-50 years in this study. This outcome of the study is similar to the findings of *Aryal G. et al.* [14] which indicated a prevalence among individuals aged 41-60 years, and *Desai et al.* [15] where the majority of cases fell within the 41-50-year age range.

According to the WHO grading system, the astrocytomas in our present study showed that grade II tumors were the most common at 45.45%, followed by grade IV at 27%. However, diagnostic accuracy varied with tumor grade. This finding is consistent with the study conducted by *Shah HK et al.* [16] which revealed that grade 4 tumors were the most common at 33%, subsequently grade 1 and grade 2 with 29.6% each.

4. Conclusion

Our study found that astrocytoma is the most common CNS tumor, with 22 cases primarily in the 31-50 age group. Meningioma is the second most prevalent, affecting those aged 31-60, with 6 cases. Schwannoma, oligodendroglioma, and small round cell tumors each contribute 6 cases across different age groups. Grade II tumors are widely distributed, with 10 cases across all age groups.

References:

1. Stewart BW, Kleihues P. Tumors of the Nervous System. In: World Cancer Report. Lyon, France: IARC Press; 2003.
2. Khonglah Y, Shangpliang D, Mishra J, Mustafa A, Kakoti A, Phukan P. Histological spectrum of central nervous system lesions at a tertiary care center in India. Clin Cancer Investig J. 2020;9(5):175-81.
3. Frosch MP, Anthony DC, Girolami UD. Robbins and Cotran Pathologic Basis of Disease. 9th ed. Philadelphia, PA: Elsevier; 2015
4. 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
5. Allen P, Liu G. Primary brain tumors in adults: diagnosis and treatment. Am Acad Fam Phys. 2016;93(3):211-7.
6. Bhattacharya S, Maiti B, Konar K. Histopathological Profile of Central Nervous System Tumors in a Peripheral Tertiary Care Centre of West Bengal. J Lab Physicians. 2022 Aug 17;15(1):38-44.
7. 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.

8. Debadrita Sen et al. Histopathological spectrum of cns tumors: an observational study in a tertiary care centre of north-east india. International Journal of Medical Reviews and Case Reports .2022;6(3):1-6.
9. Yeole B B. Trends in the brain cancer incidence in India. Asian Pac J Cancer Prev. 2008;9(02):267–270.
10. Ghanghoria S, Mehar R, Kulkarni C V. Retrospective histological analysis of CNS tumors a 5 year study. Int J Med Sci Public Health. 2014;3:1205–1207.
11. Hamdani S M, Dar N Q, Reshi R. Histopathological spectrum of brain tumors: A 4-year retrospective study from a single tertiary care facility. Int J Med Sci Public Health. 2019;8(08):673–676.
12. Patty I S. Central nervous system tumors: A clinicopathologic study. J Dohuk Univ. 2008; 11:173–179.
13. Das A, Chapman C A, Yap W M. Histological subtypes of symptomatic central nervous system tumours in Singapore. J Neurol Neurosurg Psychiatry. 2000; 68(03):372–374.
14. Aryal G. Histopathological pattern of central nervous system tumor: a three-year retrospective study. J Pathol Nepal. 2011; 1:22-5.
15. Desai RI, Soni NS, Desai IM, Rajput K. Retrospective study of CNS tumors in tertiary care hospital. In Int J Cur Res Rev. 2017; 9(2).
16. Shah HK et al. Histomorphological spectrum of central nervous system lesions in a tertiary care hospital. Int J Res Med Sci. 2022; 10(1):86-91.