

Original Research Article

Analysis of histopathological spectrum of intracranial central nervous system tumours in a tertiary care hospital

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ABSTRACT

Background: Descriptive epidemiology of intracranial central nervous system (CNS) tumours is a significant part of tumour studies which provides information on magnitude and distribution of the lesions. The objective of this study is to provide an overview of frequency of intracranial CNS tumours with comparison with national and international data.

Methods: In this retrospective study 101 intracranial CNS tumours diagnosed over a period of 4 years were included. Histological diagnosis of tumours was confirmed and they were classified according to revised WHO classification of CNS tumours 2016. Frequencies of tumours in accordance to age, gender, location, laterality and grades were evaluated.

Results: Total 101 cases including 59 (58.42%) males and 42 (41.58%) females were studied. Paediatric and adult cases accounted for 17 (16.83%) and 84 (83.17%), respectively. Most tumours were noted in the 6th decade. Out of total cases, 91 (90.1%) were primary intracranial CNS tumours and 10 (9.9%) were metastatic tumours. Most common tumours were astrocytoma followed by meningioma. Among children, astrocytoma (41.18%), medulloblastomas (41.18%), ependymomas (11.76%) and meningiomas (5.88%) were the reported lesions. In adults, astrocytoma (39.29%), meningiomas (23.81%), metastatic tumours (11.90%), ependymomas (8.33%), hemangioblastomas (5.95%) and schwannomas (4.76%) were common. Glioblastomas were the commonest astrocytoma. WHO grade I tumours were commonest followed by grade IV.

Conclusions: The study gives a glimpse of prevalence of intracranial central nervous system tumours forming a baseline profile based primarily on the histopathological diagnosis at rural tertiary care hospital.

Keywords: CNS tumours, Epidemiology, Pathological review, Astrocytoma, Glioblastoma, Meningioma

INTRODUCTION

Central nervous system tumours are unique rare neoplasms accounting for 1-2% of total malignancies.¹ As per the reports of GLOBOCAN 2020, it has ranked to 20th position among all cancers, with an estimated 308 102 new cases worldwide. It accounts for 2.5% of all cancer related deaths with ranking of 13 among all cancers.² central nervous system tumours are associated with increased morbidity and mortality. Also, there is

significant regional and geographical variation present in the incidence globally.³ Histopathological examination forms an integral and crucial part in the management of the tumours as the typing and grading of the tumours has a significant prognostic and therapeutic impact. Recent revised WHO 2016 classification of central nervous system tumours has also included use of molecular studies for specific diagnosis and prognostication of central nervous system tumours, along with the histopathological grading.

METHODS

A total of 101 cases of intracranial CNS tumours were retrieved from the archives of department of pathology, Rural medical college, Pravara institute of medical sciences (deemed to be university) over 4 years duration, January 2017 to December 2020. The inclusion criteria were all intracranial neoplasms classified and graded as per the world health organisation (WHO) 2016 classification. Tumours of the pituitary gland, cases with incomplete clinical data, inconclusive pathology, and non-neoplastic cystic lesions were excluded from the analysis. All these specimens were fixed in 10% formalin for overnight. After fixation, the sections were processed as per the routine histopathological processing in the form of dehydration, clearing and embedding to prepare formalin fixed paraffin embedded blocks. These blocks of tissue were cut into sections of 5-6-micron thickness and stained with haematoxylin and eosin stain. Special and immunohistochemical staining was utilised whenever available. All cases were reconfirmed applying revised WHO classification 2016. Finally, the results were analysed and the data was prepared to determine the relative frequencies of various histopathological diagnosis, the distribution of age, gender, location, site of lesion and side of lesions. According to CBTRUS database, cases with age range of 0-18 years were categorized as paediatric, while those 19 years and above were categorized as adults.⁴ All calculations were done using MS excel.

RESULTS

Age and gender distribution

A total of 101 cases were included in the study out which 59 were males and 42 were females with M:F ratio of 1.40:1. Paediatric cases accounted for 17 (16.83%) while adults were 84 (83.17%). Mean age at the diagnosis of all cases was 41.16 years.

Most of the cases were in the age group of 31-60 years with 6th decade being the commonest followed by 5th and 4th decades. Age range of 6 to 78 years was observed (Figure 1). Among adult cases, male preponderance noted with M:F ratio of 1:56:1 while in paediatric population slight female preponderance was noted with M:F ratio of 0.89:1.

Location and laterality distribution

Location wise supratentorial cases accounted for 75.25% while 24.75% cases were infratentorial. Overall, right sided lesions (47.52%) were common followed by left sided lesions (42.57%). Three cases (2.93%) were bilateral while 7 cases (6.93%) were midline lesions.

Supratentorial cases were commonly noted in left side. Midline tumours were common in infratentorial tumours. Infratentorial cases were common in younger population (mean age 31.36 years) as compared to supratentorial

cases (mean age 44.62 years). Frontal lobe along with fronto-parietal lobe was the commonest location with 16 cases each (Table 2).

Histopathological distribution of tumours

Overall neuroepithelial tumours dominated the total cases. Astrocytoma were the commonest CNS tumours 33 cases (32.67%) followed by meningiomas 21 cases (20.79%) and metastasis 10 cases (9.90%) (Table 1). Representative images of various CNS tumours are shown in Figure 2 and 3.

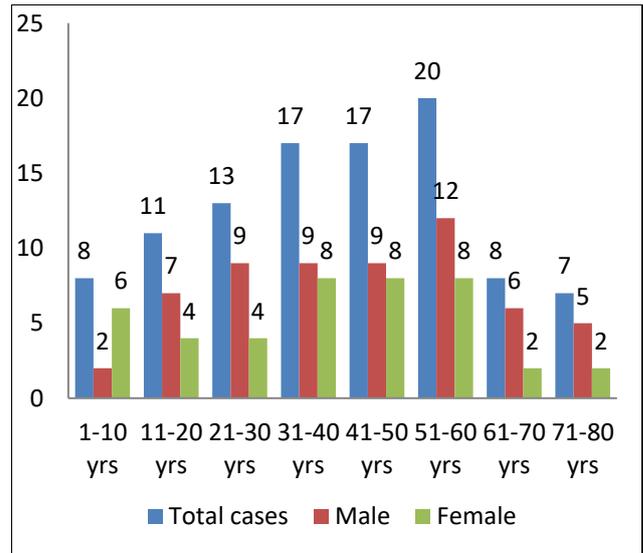


Figure 1: Distribution of intracranial CNS tumours according to age and sex (n=101).

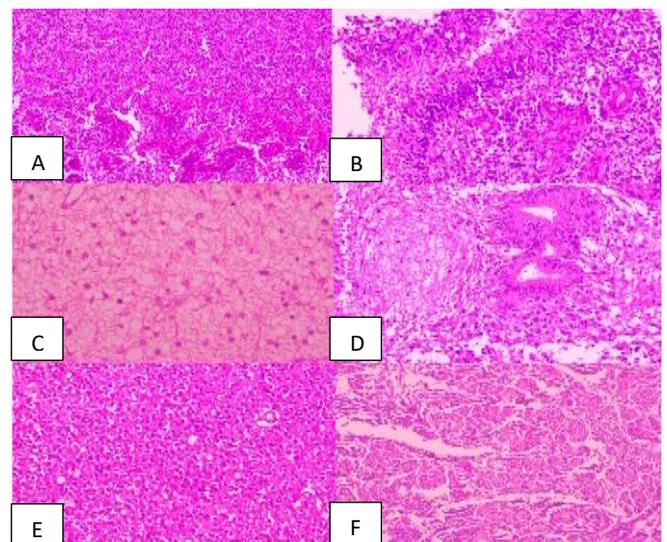


Figure 2: Glioblastoma of pseudopalisading necrosis (A), Microvascular proliferation (B), Diffuse astrocytoma (C), Ependymoma (D), Oligodendroglioma and (E), Meningothelial meningioma (F) at 200x magnification (Haematoxyline and Eosin stain).

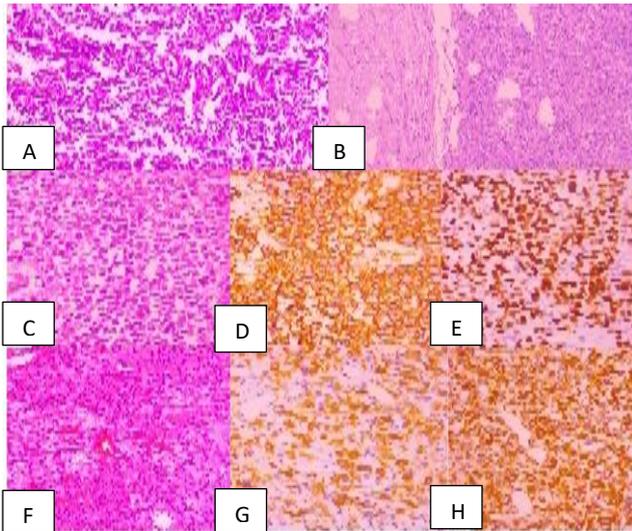


Figure 3: Medulloblastoma (A), Metastatic adenocarcinoma (B), at 200x magnification (H and E) CNS lymphoma (C), With CD 20 immunostain positivity (D), High Ki67 index (E), Haemangioblastoma (F), with inhibin (G) and vimentin (H) immunostain positivity at 400x magnification (Haematoxyline and Eosin stain).

Overall, WHO grade I tumours were commonest 29 cases (32.58%) followed by grade IV 26 cases (29.21%). Grade II and III tumours accounted for 22 cases (24.72%) and 12 cases (13.48%) respectively (Table 3). Among rest 12 cases, 10 were metastatic carcinomas while 2 were primary CNS lymphomas.

In paediatric cases, astrocytoma and medulloblastomas were commonest, accounting for 41.18% each (Figure 4).

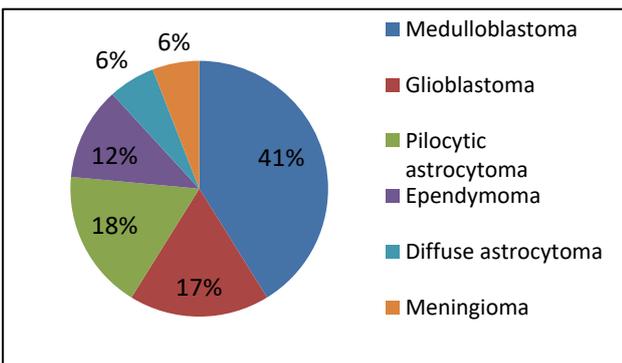


Figure 4: Distribution of intracranial CNS tumours in paediatric population (n=17).

In adults too, astrocytic tumours were common accounting for 26 cases (30.95%) followed by 20 cases of meningioma (23.81%) and 10 cases of metastasis (11.90%), 9 cases of oligodendrogliomas (10.71%), 2 cases of ependymoma (2.38%), 3 cases of oligoastrocytoma (3.57%), 5 cases of haemangioblastomas (5.95%), 4 cases of schwannoma (4.76%), two cases of

primary CNS lymphomas (2.38%) while single case each of atypical central neurocytoma, choroid plexus papilloma and haemangiopericytoma (1.19%) (Figure 5).

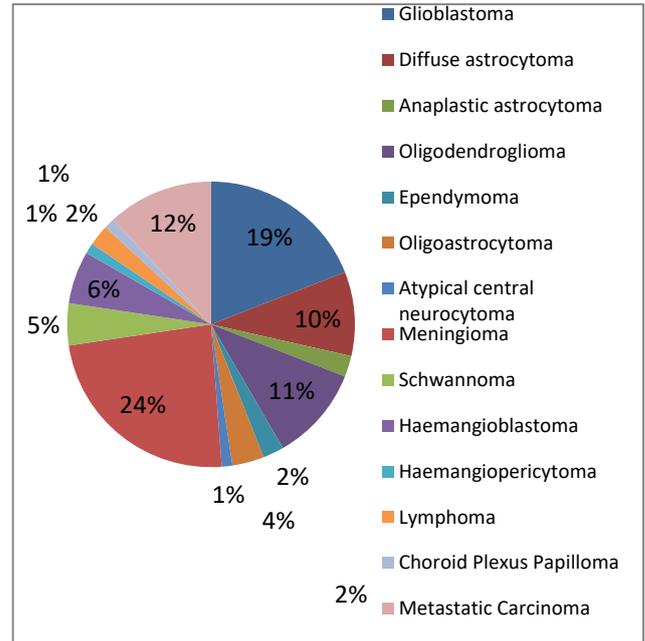


Figure 5: Distribution of intracranial CNS tumours in adult population (n=84).

Mean age of all astrocytoma cases was 38.54 years with male dominance (M:F of 2.3:1). Astrocytoma was common at supratentorial location. Glioblastoma (57.58%) was the commonest astrocytic tumour followed by diffuse astrocytoma. Glioblastomas were common in age group of 41-50 years ranging from 7 to 72 years with frontal and temporal lobe being the commonest locations.

Diffuse astrocytoma was also common in males with common age group of 21-30 years commonly occurring at fronto-parietal lobe. Pilocytic astrocytoma (3) were noted exclusively in paediatric population and to right side with mean age at time of diagnosis as 12.67 years. Anaplastic astrocytoma (2) were adults with left sided lesions with mean age at time of diagnosis as 45 years.

Ependymomas showed distinct female predilection (M:F-1:3) with mean age at the time of diagnosis 28.5 years. Out of 4 cases, three were of anaplastic ependymoma. Oligodendrogliomas were also common in adults and showed male dominance (M:F 2:1). Mean age at the time of diagnosis was 47.22 yrs with most cases occurring in age group of 31-40 years (4 cases). Most common location for them included temporo-parietal lobes followed by temporal lobe. Oligoastrocytomas showed female preponderance (M:F 1:2).

Mean age of meningioma cases were 50.62 years. Most of the cases were supratentorial and common in adults. Slight female predilection seen with M:F-0.9:1. Most of the cases were seen in 6th decade followed by 4th decade.

Most common location was frontal lobe followed by frontoparietal lobe. Sixteen meningioma cases were WHO grade I followed by grade III (3 cases) and grade II (2 cases). Among grade I tumours, meningothelial meningiomas were commonest.

Medulloblastomas were also seen exclusively in children with male predilection. Two cases of primary CNS lymphoma were included, both were right sided and males having mean age of 42 years. All schwannomas were common in adults located at cerebello-pontine angle

(CP angle) with mean age of 40 years and equal sex predilection. Hemangioblastomas were common in adults with mean of 32.6 years with M:F-1.5:1. All cases were infratentorial with cerebellum being commonest site.

Metastasis was common in adults with mean age of 53.1 years with male dominance (M:F-2.33:1). Most common age group was 51-60 yrs. Most common location was frontal lobe followed by cerebellum. In metastasis, adenocarcinoma was the commonest with lung as site of primary which was proved on immunohistochemistry.

Table 1: Distribution of intracranial CNS tumours in males and females with M:F ratio and mean age at the time of diagnosis (n=101).

Types of tumour	Males	Females	Total no of cases with percentage	M:F ratio	Mean age (years)
Diffuse astrocytoma	08	1	09 (8.91)	8:1	36.67
Anaplastic astrocytoma	1	1	02 (1.98)	1:1	45
Glioblastoma	12	7	19 (18.81)	1.71:1	42.84
Pilocytic astrocytoma	2	1	03 (2.97)	2:1	12.67
Oligodendrogliomas	6	3	09 (8.91)	2:1	47.22
Ependymoma	1	3	04(3.96)	0.33:1	28.5
Oligoastrocytomas	1	2	03 (2.97)	0.5:1	46
Atypical central neurocytoma	0	1	01 (0.99)	-	45
Medulloblastomas	4	3	07 (6.93)	1.33:1	10.57
Schwannomas	2	2	04 (3.96)	1:1	37.5
Meningiomas	10	11	21 (20.79)	1:1.1	50.62
Hemangioblastoma	3	2	05 (4.95)	1.5:1	32.6
Hemangiopericytoma	0	1	01 (0.99)	-	61
Lymphoma	2	0	02 (1.98)	-	42
Metastasis	7	3	10 (9.90)	2.33:1	53.1
Choroid plexus papilloma	0	1	01(0.99)	-	27
Total	59	42	101 (100)	1.4:1	41.16

Table 2: Distribution of intracranial CNS tumours according to location (n=101).

Location	Adults	Paediatric cases	Total
Frontal	16	0	16
Fronto-parietal	13	3	16
Fronto-temporal	4	0	4
Fronto-temporo-occipital	1	0	1
Fronto-temporo-parietal	4	0	4
Parietal	5	0	5
Parieto-occipital	3	1	4
Parieto-temporal	7	0	7
Temporal	8	1	9
Temporo-parietal-occipital	1	0	1
Thalamus	0	1	1
Parasagittal	1	0	1
Lateral ventricle	3	0	3
Insular	1	0	1
4 th Ventricle	0	3	3
Cerebellum	5	4	9
Brainstem	1	3	4
Cerebello-Pontine angle	8	0	8
Others (sellar/suprasellar, Sphenoid wing, falcine dura etc)	3	1	5
Total (%)	84 (83.16)	17 (16.83)	101 (100)

Table 3: Distribution of intracranial CNS tumours according to WHO grades.

Tumour	Grade I	Grade II	Grade III	Grade IV	Total
Astrocytoma	3	9	2	19	33
Oligodendroglioma	0	6	3	0	9
Ependymoma	0	1	3	0	4
Oligoastrocytoma	0	2	1	0	3
Central Neurocytoma	0	0	0	1	1
Meningioma	16	2	3	0	21
Hemangioblastoma	5	0	0	0	5
Hemangiopericytoma	0	1	0	0	1
Schwannoma	4	0	0	0	4
Medulloblastoma	0	0	0	7	7
Choroid plexus papilloma	1	0	0	0	1
Total	29	21	12	27	89

DISCUSSION

CNS tumours are unique and heterogenous lesions and they have variable distributions in age, gender as well as show geographical variations. Histopathology plays a pivotal role in the diagnosis and classification of CNS tumours. According to WHO classification, CNS tumours are mainly graded according to the histomorphology alone. However, certain drawbacks associated with this include, subjective variation and less reproducibility. These drawbacks can be minimized using use of other ancillary techniques such as immunohistochemistry, molecular pathology, etc. Understanding of epidemiology of the lesions also gives better insight when approaching to the specific diagnosis.

Our study showed astrocytoma as the most frequent intracranial CNS tumour accounting for 32.67% with glioblastoma being the commonest. Similar results were noted by many of studies including Mehta (38.2%, 752 out of total 1967 cases), Mondal (41.5%, 92 out of total 130 cases), Mohammad (29.1%, 66 out of total 227 cases), Lakshmi et al (41.66%, 30 out of total 72 cases), Khonglah et al, Jalali et al, Hema et al and Masoodi et al.⁵⁻¹² In contrast, other Indian studies like Vimal, Hamdani, Kanthikar, Jaiswal and Ghangoria et al showed meningiomas as the commonest CNS tumours.^{13,17}

In our study, most of the cases were from 6th decade followed by 5th and 4th decades. As compared to our study, Jaiswal et al, Mondal et al, Vimal et al and Kanthikar et al showed most cases from 5th decade while Mehta et al found 4th decade as commonest.^{5,6,13,15,16} Most cases were in the age group of 30-60 years in our study. This finding was consistent with studies by Jaiswal and Vimal et al.^{13,16}

Overall male dominance observed in this study with M:F ratio being 1.4:1. Similar results were recorded by Thakur (M:F-1.05:1), Mohammad (M:F-1.2:1), Mehta (M:F-1.23:1), Hamdani (M:F-1:0.8), Mondal (M:F-1.28:1), Masoodi (M:F-1.12:1), Adnan (M:F-1.4:1), Nibhoria

(M:F-1.2:1) and Lakshmi et al (M:F-1.08:1).^{5-8,12,14,18-20} While Sumathi et al noted slight female dominance with M:F of 0.9:1. Vimal et al and Desai et al showed near equal M:F ratio with M:F of 1:0.95 and 1:0.98 respectively.^{13,21,22}

In present study, most of the cases were grade I tumours followed by grade IV. These finding were consistent with Mehta et al and Vimal et al found grade I tumours commonest followed by grade II tumours.^{5,13}

Frontal and the fronto-parietal lobe (16 cases each) were the commonest location for the tumours in our study. This finding is supported by studies conducted by Vimal et al, Hamdani et al, Massodi et al, Pidakala et al, Mehta et al and Khonglah et al, where frontal lobe was the commonest location.^{5,9,12-14,23} Sumathi et al and Lakshmi et al found parietal lobe being common followed by frontal lobe.^{21,8}

Out of total cases, supratentorial tumours were common (75.25%). These findings are consistent with studies conducted by Vimal et al, Jalali et al and Lakshmi et al.^{8,10,13}

Paediatric cases accounted for 17 (16.83%) while adults were 84 (83.17%). Similar distribution was noted by Jaiswal and Vimal et al accounting for 83.8 and 90% adult cases respectively.^{16,6}

The mean age at the time of diagnosis for intracranial CNS tumours was 41.16 years. Similar findings were noted by Vimal et al (42 years), Massodi et al (43.3 years), Nibhoria et al (40 years), Mohammad et al (42.9 years) and Adnan et al (37 years).^{7,12,13,19,20}

In present study, metastatic tumours accounted for 9.9% (out of 101 cases) with male dominance. Metastatic cases were about 5% out of 5147 cases by Jaiswal et al, 1.2% out of 269 cases by Thakur et al, 7.7% out of 90 cases by Vimal et al, 2.3% out of 205 cases by Khonglah et al, 5.1% out of 34140 cases by Chen, 5.6% out of 100 cases

Nibhoria et al, 4% out of 62 cases by Hema et al, 7% out of 227 cases by Mohammad, 5.2% out of 38 cases by Kanthikar, 1.53% out of 130 cases by Mondal et al, 11.5% by Jalali et al and 8.3% by Adnan et al.^{6,7,9-11,13,15,16,18-20,24}

Our study revealed, male dominance in metastatic cases which is in contrast to findings of Vimal et al where metastasis was common in females.¹³ In metastatic lesions, most cases were adenocarcinoma mostly from lung similar to that of studies by Mondal et al, Aryal et al and Mohammad et al.^{6,7,25} While Vimal et al found most cases of squamous cell carcinomas with common origin from lung.¹³

Among paediatric population, astrocytoma and medulloblastomas were commonest with 7 cases each. In our study, Pilocytic astrocytoma was commonest astrocytoma. Studies conducted by Vimal, Jalali and Jaiswal et al showed astrocytoma as the commonest tumours while Sumathi et al found medulloblastomas as commonest paediatric tumours.^{10,13,16,21}

In present study, two cases of CNS lymphomas were noted accounting for 1.98% of all cases. Both were males. Similar findings noted by Thakur et al, Mehta et al, Khonglah et al, Jaiswal et al, Mondal et al, Mohammad et al and Hamdani et al with range of 0.76 to 1.95% of total cases.^{5-7,9,14,16,18}

In present study, four cases of schwannomas noted accounting for 3.96% with most common location being CP angle. Similar prevalence was noted by Mohammad and Hamdani et al with 3.9 and 4.37% cases respectively.^{7,14} However, other studies by Mondal, Vimal et al, Hema et al, Kanthikar et al, Khonglah et al, Mehta et al, Pidakala et al showed higher percentage of schwannomas ranging from 6.1 to 18.05%.^{5,6,9,11,13,16,23}

In our study meningiomas showed slight female preponderance similar to that of studies by Vimal, Jaiswal et al, Khonglah et al, Mohammad et al and Mehta et al while Hamdani et al showed male dominance.^{5,7,9,13,14,16} Meningothelial meningioma was the commonest type in this study as previously noted by Vimal et al.¹³

Glioblastoma were commonest astrocytoma with 57.58% of total astrocytoma. Mondal et al, Hamdani et al, Khonglah et al and Thakur et al showed similar findings with 42.5, 51.2, 47.3 and 45.4% cases respectively.^{6,9,14,18}

In our study medulloblastomas accounted for 6.93% of total cases as compared to 2.22% by Vimal et al, 3.8% by Masoodi et al, 7.6% by Mondal et al, 4% by Hema et al, less than 4% by Jaiswal, 5.36% by Khonglah et al, 4.4% by Mehta et al and 6.6% by Mohammad et al.^{5-7,9,11-13,16}

CONCLUSION

The study shows prevalence of intracranial central nervous system tumours based on histopathological diagnosis at rural tertiary care hospital in Maharashtra. Such hospital-based brain cancer registries can help in generating data which can be utilised for large scale national studies to determine spectrum of CNS tumours in Indian population. Also, such data can give help in better understanding of CNS tumours and formulation of policies at local or national level for better management of CNS tumours.

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REFERENCES

- Gupta T, Epari S, Moiyadi A, Shetty P, Goda JS, Krishnatry R et al. Demographic profile, clinicopathological spectrum, and treatment outcomes of primary central nervous system tumors: Retrospective audit from an academic neuro-oncology unit. *Indian J Cancer.* 2017;54:594-600.
- Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.* 2021;0:1-41.
- 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):376-93.
- Ostrom QT, Gittleman H, Farah P, Ondracek A, Chen Y, Wolinsky Y et al. CBTRUS statistical report: Primary brain and central nervous system tumors diagnosed in the United States in 2006-2010. *Neuro Oncol* 2013;15(2):ii:1-56.
- Mehta J, Bansal B, Mittal A, Mathur K, Vijay R. Histological Analysis of Primary Brain Tumors in a Tertiary Care Hospital: A Retrospective Study of 5 Years. *Int J Med Res Prof.* 2017;3(5):14-8.
- Mondal S, Pradhan R, Pal S, Biswas B, Banerjee A, Bhattacharyya D. Clinicopathological pattern of brain tumors: A 3-year study in a tertiary care hospital in India. *Clin Cancer Investig J.* 2016;5:437-40.
- Mohammed AA, Hamdan AN, Homoud AS. Histopathological profile of brain tumors: A 12-year retrospective study from Madinah, Saudi Arabia. *Asian J Neurosurg.* 2019;14:1106-11.
- Lakshmi K, Hemalatha M, Tamil Arasi DS, Lingeswara Rao B. Histopathological Study of Spectrum of the Lesions of Central Nervous System in a Tertiary Care Hospital. *J of Evolution of Med and Dent Sci* 2015;4(7):1145-50.

9. 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;9:175-81.
10. Jalali R, Datta D. Prospective analysis of incidence of central nervous tumours presenting in a tertiary cancer hospital from India. *J Neurooncol.* 2008;87:111-4.
11. Hema NA, Ravindra RS, Karnappa AS. Morphological Patterns of Intracranial Lesions in a Tertiary Care Hospital in North Karnataka: A Clinicopathological and Immunohistochemical Study. *J Clin Diagn Res.* 2016;10(8):EC01-5.
12. Masoodi T, Gupta RK, Singh JP, Khajuria A. Pattern of central nervous system neoplasms: A study of 106 cases JK-practitioner. 2012;17(4).
13. Vimal S, Dharwadker A, Vishwanathan V, Agarwal N. Histopathological Spectrum of Central Nervous System Tumours in a Tertiary Care Centre. *Indian J Pathol Res Pract.* 2020;9(2 Part I):103-10.
14. Hamdani SM, Dar NQ, 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(8):673-6.
15. Kanthikar SN, Nikumbh DB, Dravid NV. Histopathological overview of central nervous system tumours in North Maharashtra, India: a single center study. *Indian J Pathol Oncol.* 2017;4(1):80-4.
16. Jaiswal J, Shastry AH, Ramesh A, Chickabasaviah YT, Arimappamagan A, Santosh V. Spectrum of primary intracranial tumours at a tertiary care neurological institute: A hospital-based brain tumor registry. *Neurol India.* 2016;64:494-501.
17. Ghanghoria S, Mehar R, Kulkarni CV, Mittal M, Yadav A, Patidar H. Retrospective histological analysis of CNS tumors-A 5-year study. *Int J Med Sci Public Health.* 2014;3:1205-7.
18. Thakur AS, Gahine R, Kulkarni V. A study on morphologic and histological pattern of the central nervous system tumors. *Int J Res Med Sci.* 2018;6:3879-82.
19. Adnan HA, Kambhoh UA, Majeed S. Frequency of CNS lesions in a tertiary care hospital-A 5-year study. *Biomedica.* 2017;33(1):4-8.
20. Nibhoria S, Tiwana KK, Phutela R, Bajaj A, Chhabra S, Bansal S. Histopathological Spectrum of Central Nervous System Tumors: A Single Centre Study of 100 Cases. *Int J Sci Stud.* 2015;3(6):130-4.
21. Sumathi V, Balakrishnan K, Krishna MSS, et al. Histopathological spectrum and grading of CNS tumours in tertiary centre: Case study of 83 cases. *J Evid Based Med Healthc.* 2016; 3(45): 2240–2243.
22. Desai RI, Soni NS, Desai IM. Retrospective study of CNS tumours in tertiary care hospital. *Int J Cur Res Rev.* 2017;9(2):1-4.
23. Pidakala P, Inuganti RV, Boregowda C, Mathi A, Lakhineni S. A five-year histopathological review of CNS tumours in a tertiary centre with emphasis on diagnostic aspects of uncommon tumours. *J Evid Based Med Healthc.* 2016;3(51):2605-12.
24. Chen L, Zou X, Wang Y, Mao Y, Zhou L. Central nervous system tumors: a single center pathology review of 34,140 cases over 60 years. *BMC Clin Pathol.* 2013;13(1):14.
25. Aryal G. Histopathological pattern of central nervous system tumor: A three-year retrospective study. *J Pathol Nepal.* 2011;1:22-5.

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