



ISSN (P): 2617-7226
ISSN (E): 2617-7234
www.patholjournal.com
2024; 7(2): 33-38
Received: 06-02-2024
Accepted: 10-03-2024

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Histomorphological approach of central nervous system (CNS) tumors: A retrospective study at a tertiary teaching care center

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DOI: <https://doi.org/10.33545/pathol.2024.v7.i2a.566>

Abstract

Introduction: Tumors of CNS are rare and constitute about 1-2% with high morbidity and mortality of all malignancies. The majority of these are primary tumors, and only one fourth to one half are metastatic. The CNS tumors show bimodal age distribution with one peak in children and another peak in 45-70 year of age. The CNS tumors that predominate in adults differ from those seen in children.

Aims and Objectives: To evaluate the histopathological spectrum of various CNS tumors with relative frequency, age, site, gender and locations.

Material and Methods: A total 280 cases were retrieved from the records of histopathology section of department of pathology at B.J. Medical college, Ahmedabad from Jan 2023 to Dec 2023. Histological typing and grading was done according to the WHO 2016 classification.

Result: CNS tumors show a slight male predominance with male to female ratio was 1.03:1 with mean age group for diagnosis of CNS tumor was 40.28 years. Most predominant age group affected was between 41-50 years (19.28% cases). Meningioma was the most common tumor followed by pituitary adenoma in adult while medulloblastoma was the most common tumor in children. The primary CNS tumors were graded from grade I to grade IV. Supra-sellar region and ventricles were the most common location in adult and children respectively.

Conclusion: The present study helps to provide information regarding the burden of disease in our area. So diagnosis and grading of tumors by HPE is essential to predict the prognosis and treatment.

Keywords: CNS tumors, meningioma, histopathology

Introduction

The Central nervous system (CNS) consists of cerebrum, cerebellum, brain stem, spinal cord, meninges, twelve paired cranial nerves and blood vessels supplying these structures. There are two main types of tumors: Malignant and benign. Tumors of CNS are rare and constitute about 1-2% with high morbidity and mortality of all malignancies. In India, tumors of CNS constitute about 1.9% of all tumors.

The tumors of CNS are histologically type by the WHO as tumors of glioneuronal tumors, embryonal tumors, pineal tumor, cranial and paraspinal nerve tumors, meningiomas, mesenchymal, non-meningothelial tumors and hematolymphoid tumors, germ cell tumors, tumors of Sellar region and metastatic tumors. Overall males are affected more common than females except in meningiomas where female are more frequently involved.

The CNS tumors show bimodal age distribution with one peak in children and another peak in 45-70 year of age. Site of the lesion is important because any CNS neoplasm, regardless of histologic grade or classification, may have lethal consequences if situated in a critical brain region. Seventy percent of childhood CNS tumors arise in the posterior fossa; a comparable number of tumors in adults arise within the cerebral hemisphere above the tentorium. The CNS tumors that predominate in adults differ from those seen in children.

The exact histological diagnosis as typing and grading of CNS tumor has integral and crucial part in management of the tumor. Recent improvement in knowledge of record maintenance and improved diagnostic facilities and better health care, CNS tumors incidence seems to be on the rise in developing countries.

Aims and Objectives

1. To evaluate the histopathological spectrum of various CNS tumors

- 2. To evaluate age, site, gender and frequency of various CNS tumors

Materials and Methods

The present retrospective observational study is conducted in the Department of pathology at B. J. Medical College, Ahmedabad on biopsy samples received from the duration of Jan 2023 to Dec 2023. In Present study, total 280 cases were studied, histological typing and grading was done according to the WHO 2021 classification.

Inclusion criteria: CNS tumors of all age group

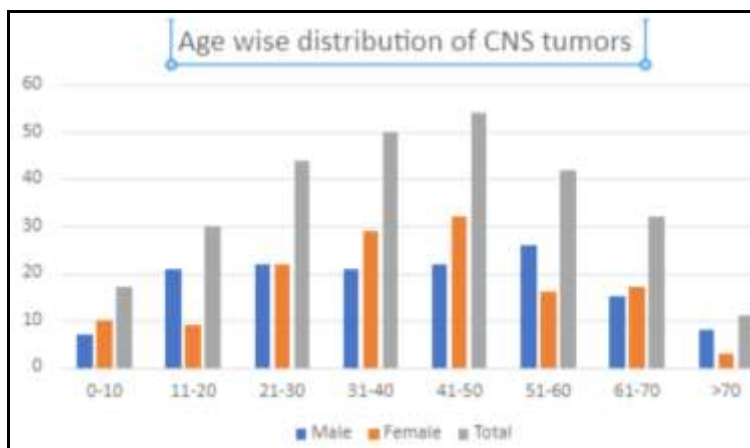
Exclusion criteria

- Non neoplastic conditions
- Tumors of peripheral nervous system

- Tumors with incomplete data
- Inadequate and poorly preserved biopsy samples

Results

The present study was conducted on 280 cases of CNS tumor during Jan 2023 to Dec 2023 in the Department of pathology. In our study the CNS tumors show a slight male (n=142) predominance with male to female ratio was 1.03:1 with mean age group for diagnosis of CNS tumor was 40.28 years. Most predominant age group affected was between 41-50 years (19.28% cases) followed by 31-40 years (17.85% cases). Out of 280 cases of CNS tumors, 258 cases were from adult age group (91.78%) whereas 23 cases were from pediatric group (8.21%). Graph 1 shows the age wise distribution of CNS tumors.



Graph 1: The age wise distribution of CNS tumors

In the present study out of 280 cases of CNS tumors, 239 cases were of intracranial origin (85.36%) and 41 cases were of spinal origin (14.64%). In our study CNS tumors were most frequently seen in intracranial regions comprising 239 cases out of which Sellar suprasellar region (n=48) were the

most common site followed by frontal (n=25), CP angle (n=25) and temporal lobe (n=15) respectively. Distribution of CNS tumors according to their locations was described in Table 2.

Table 1: Distribution of CNS tumors according to their location in Adult population

Location	No. of cases
Sellar suprasellar	45
Spinal	37
Frontal	24
Cp angle	23
Temporal	15
Ventricles	09
Parietal	12
Parasagittal	10
Temporo-parietal	08
Fronto-temporal	10
Posterior fossa	06
Fronto-parietal	9
Sphenoid	9
Clival	7
Parieto-occipital	6
Cerebellar	6
Occipital	5
Parafalcine	5
Trigeminal	3
Insular	4
Corpus callosum	2
CV junction	1
Olfactory groove	1
Total	257

Table 2: Distribution of CNS tumors according to their location in Pediatric population

Location	No. of cases
Ventricles	5
Spinal	4
Sellar suprasellar	3
Posterior fossa	3
Cp angle	2
Temporo-parietal	2
Frontal	1
Optic	1
Trigeminal	1
Corpus callosum	1
Total	23

Among 280 CNS tumors, the most common tumor in adults was meningioma (n=62) constitutes 22.14% followed by pituitary adenoma (n=34) constitutes 12.14% and schwannoma (n=31) constitutes 11.07% respectively.

In the present study out of 62 cases of meningioma, there were 20 male and 42 female cases showing female preponderance with male to female ratio 1:2.1. The mean age of meningiomas was 48.25 years. Most of the cases were supratentorial and common in adults. Out of 62 cases of meningiomas, 48 were grade I followed by 14 cases of grade II (Atypical meningioma).

The second most common tumor was pituitary adenoma comprising 34 cases with male predominance having M:F ratio was 1.83:1. Out of 31 cases of Schwannoma, 19 were female and 12 were male showing female predominance. In our study, out of 26 cases of astrocytoma, 3 were pilocytic (WHO grade I), 3 were anaplastic (WHO grade III) and 1 was diffuse astrocytoma (WHO grade IV) and others 19 were low grade (WHO grade II). In present study, Ependymoma, glioblastoma and craniopharyngioma show male predilection with M: F ratio 1.8:1, 2.33:1 and 1.6:1 respectively.

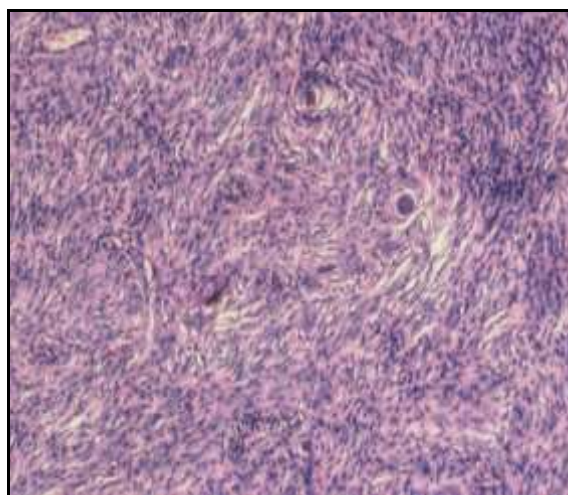


Fig 1: Psammomatous Meningioma (H & E: 20x)

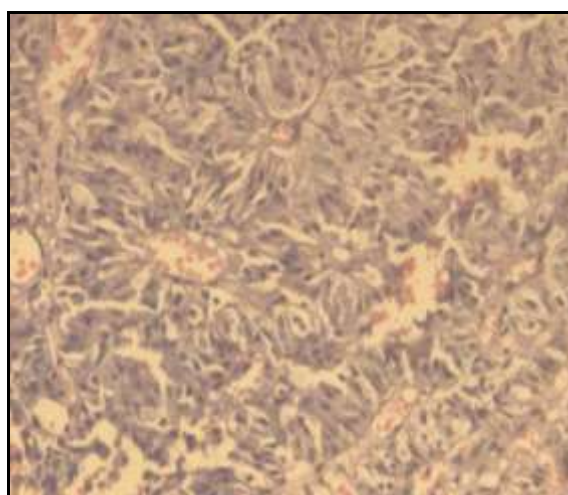


Fig 2: Monomorphic uniform tumor cell- pituitary adenoma (H & E: 20x)

Table 3: Distribution of CNS tumors in relation to gender in Adult population

Diagnosis	Gender				Total	
	Male		Female			
	N	%	N	%	N	%
Meningioma	19	14.61	42	32.81	61	23.64
Pituitary adenoma	22	16.92	12	9.37	34	13.18
Schwannoma	11	8.46	19	14.84	30	11.63
Glioblastoma	21	16.15	09	7.03	30	11.63
Astrocytoma	13	10.00	09	7.06	22	8.53
Ependymoma	09	6.92	04	3.12	13	5.04
Craniopharyngioma	06	4.61	04	3.12	10	3.87
Metastatic	05	3.84	03	2.34	08	3.10
Oligodendroglioma	04	3.07	03	2.34	07	2.71
Medulloblastoma	01	0.77	00	00	01	0.39
Hemangioblastoma	01	0.77	04	3.12	05	1.93
Neurofibroma	01	0.77	02	1.56	03	1.16
Chordoma	01	0.77	03	2.34	04	1.55
Teratoma	01	0.77	01	0.78	02	0.77
Pleomorphic xanthoastrocytoma	01	0.77	02	1.56	03	1.16
Pineal tumor	03	0.31	00	00	03	1.16
Hemangiopericytoma	02	1.53	01	0.78	03	1.16
Hemangioma	00	00	03	2.34	03	1.16
Ganglioglioma	02	1.53	00	00	02	0.77
AV malformation	01	0.77	02	1.56	03	1.16
Lymphoma	02	1.53	00	00	02	0.77
Langerhans cell histiocytosis	00	00	01	0.78	01	0.39
Cavernoma	01	0.77	01	0.78	02	0.77
Paraganglioma	00	00	01	0.78	01	0.39
Myxoid Chondrosarcoma	01	0.77	00	00	01	0.39
Angiofibroma	01	0.77	00	00	01	0.39
High grade synovial sarcoma	00	00	01	0.78	01	0.39
Mixed glioma	01	0.77	01	0.78	02	0.77
Total	130	100	128	100	258	100

In our study, each one rare case like paraganglioma, ganglioglioma, Atypical teratoid/ rhabdoid tumor and Embryonal tumor with multilayered rosettes was noted.

Metastases was common in adults with mean age of presentation 45.62 years with male preponderance. Most

common location was parietal lobe followed by frontal lobe. Most common primary was colon adenocarcinoma.

Among pediatric tumors medulloblastoma was the most common histological diagnosis. The mean age in pediatric tumors was 6.65 years with female predominance.

Table 4: Distribution of CNS tumors Based on histological subtype in Pediatric population

Histological type	Male	Female	Total
Medulloblastoma	3	2	5
Craniopharyngioma	2	1	3
Embryonal Tumor with Multilayered Rosette, NOS	0	1	1
Undifferentiated Malignant tumor-Atypical Teratoid/Rhabdoid tumor	1	0	1
Astrocytoma	1	3	4
Ependymoma	0	1	1
Optic Glioma	1	0	1
Mature Teratoma	0	1	1
Langerhans cell Histiocytosis with Xanthomatous change	1	0	1
Malignant Round Cell Tumor- NOS	1	0	1
Meningioma	1	0	1
Ganglioglioma	0	1	1
Neurofibroma	0	1	1
Schwannoma	1	0	1
Total	11	12	23

According to WHO 2021 classification 174 primary cases were graded. Most of the lesion belong to grade I (n=73) in

comparison to grade II (n=55) and grade IV (n=35). Grade III (n=11) tumors were the least common of all.

Table 5: WHO grading wise distribution of CNS tumors

WHO grade	Male	Female	Total	Percentage
I	26	47	73	41.95%
II	31	24	55	31.62%
III	07	04	11	6.32%
IV	23	12	35	20.11%
Total	87	87	174	100%

Discussion

The effect that CNS cancer has on health care system is out of proportion with incidence due to high rates of mortality and inherently disabling effect has on patients, often preventing independent functioning. The present study enlightened the changing trend in the incidence of neoplastic lesions of brain also it is helpful in further medical research. In our study male predominance was seen which shows concordance with the findings of Ghanghoria *et al.* [6], Nibhoria *et al.* [3] and Hamadani *et al.* [4] In contrast to other study female predominance was notes in studies conducted by Sihora *et al.* [1]. In the present study, the common age group affected was

41-50 years, which was like Ghanghoria *et al.* [6], Mondal *et al.* [9] and Kakshapati *et al.* [12].

In our study meningiomas was the commonest tumor with female preponderance like that of studied by Vimal *et al.* [8] and Thambi *et al.* [11]. In contrast, studies done by Deshpande *et al.* [10] and Mondal *et al.* [9] show astrocytic tumor was the most common tumor.

The mean age at the time of tumor diagnosis for intracranial CNS tumors was 40.15 years, similar findings were noted by Nibhoria *et al.* [3] (40 years), Masoodi *et al.* [5] (43.3 years).

In the present study most of cases were grade I tumors followed by Grade II. These findings were consistent with Mehta *et al.* [7] and Vimal *et al.* [8] found grade I tumor commonest followed by Grade II tumors.

The Sellar suprasellar region was the most common location for the tumors in our study. This finding was contrasted with studies conducted by Vimal *et al.* [8], Hamadani *et al.* [4], Masoodi *et al.* [5], where frontal lobe was the commonest site. Table 4 shows the comparison of various CNS tumors studies in different colleges which are located in different states of India.

Table 6: Comparison of data on CNS tumors with other studies from India

Variable	Present study	Deshpande <i>et al.</i> [10]	Thambi <i>et al.</i> [11]	Mondal <i>et al.</i> [9]	Hamadani <i>et al.</i> [4]
Geographic location	Gujarat	Maharashtra	Kerala	West Bengal	Jammu & Kashmir
No. of cases	280	101	510	130	117
M: F	1.03:1	1.4:1	0.9:1	1.3:1	1:0.8
Most common age groups	41-50	51-60	40-60	41-50	51-60
Most common site	Sellar-suprasellar region	Frontal-60 cases (59.40%)	Frontal-80 cases (15.5%)	Frontal-44 cases (33.84%)	Frontal- cases (23.2%)
Histological diagnosis	Meningioma (22.14%), Pituitary adenoma (12.14%)	Astrocytoma (32.67%), Meningioma (20.79%)	Meningioma (34.7%), Astrocytoma (25.1%)	Astrocytoma (41.5%), Meningioma (15.3%)	Meningioma (41.02%), Astrocytoma (35.04%)

The metastatic tumors accounted for 8 cases (2.85%) out of 280 cases with male predilection. Metastatic cases were about 1.96%, 6.25% and 6.9% by studies done by Sihora *et al.* [1], K. Anantha Sahitya *et al.* [2] and Thambi *et al.* [11] respectively.

Among pediatric population, in present study medulloblastoma was the most common tumor which was similar to study done by Sumathi *et al.* [14], while pilocytic astrocytoma was common in study done by Vimal *et al.* [8].

In the diagnosis of CNS tumors histopathology is the gold standard in diagnosing and grading of CNS tumors. The prognosis of CNS tumor varies depending upon the location, histologic grade and metastasis. Most of the higher grade neuroepithelial tumors had bad prognosis.

Conclusion

Present study determines the disease burden in our area. As CNS neoplasms are subjected to considerable geographical and racial variation, exact histopathological diagnosis is essential to predict the prognosis and treatment. In present study meningiomas, pituitary adenomas and astrocytomas were the most common tumors in their descending order. Males are mostly affected, 41-60 years age group was most commonly involved. Thus this present study provides an insight into the incidence and emphasizes on vast varieties of CNS tumors.

Although there is availability of advanced imaging techniques at present, still histopathological examination is gold standard in their diagnosis.

Acknowledgement

Not available

Author's Contribution

Not available

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How to Cite This Article

Amipara MG, Shah AM, Goswami H. Histomorphological approach of central nervous system (CNS) tumors - A retrospective study at a tertiary teaching care center. *International Journal of Clinical and Diagnostic Pathology* 2024; 7(2): xx-xx.

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