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Original Research Article

Histopathological Spectrum of Central Nervous System Tumours in a Tertiary Care Centre

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Abstract

Background: Central nervous system (CNS) tumours comprise a heterogenous group of neoplasms having a wide spectrum. Various factors such as carcinogenic effects of X-rays, chemotherapeutic drugs, electromagnetic radiations, from appliances like microwaves and mobile phones, have contributed to the increasing incidence of these tumours. Their diagnosis and management are well aided by the newer radiological diagnostic techniques and the neurosurgical procedures.

Methods: A prospective study was conducted which included 90 central nervous system tumour biopsies with the relevant clinical and radiological findings.

Results: The study revealed mean age of 42 years. The male to female ratio was 1.0:0.95. Out of total 90 cases of CNS tumours in the study, 83 cases (92.22%) were primary tumours and 7 cases (7.77%) were metastatic tumours Among primary CNS tumours, we encountered meningioma (23.33%) as the commonest neoplasm followed by astrocytoma (18.88%), schwannoma (10%) and pituitary adenoma (8.88%). Frontal lobe was found to be the most common site (22.22%) of brain tumours followed by fronto-parietal region (17.77%). Meningiomas showed a female predilection whereas glioblastomas and various other tumours were seen commonly in males.

Conclusion: The histopathological study anchors the diagnosis and management of central nervous system tumours.

Keywords: Astrocytoma; Glioblastoma; Meningioma; Pituitary adenoma; Schwannoma; Central nervous system tumours.

Introduction

The tumours of central nervous system (CNS) constitute about 1–2% of all malignancies and contributes 2% of all cancer deaths. CNS tumours are a group of unique and heterogenous tumours comprising of primary and secondary tumours derived from the brain and the spinal cord including cerebral and spinal meninges.[1] They show divergent lines of differentiation and thus a variable histopathological spectrum. Remarkable difference has been noted in the frequency, location and histological type of CNS tumours for specific age and sex groups.[2] The increasing incidence of CNS tumours can be attributed to various risk factors such as exposure to X-rays during investigations, carcinogenic factors such as chemotherapeutic agents, arsenic, etc. Day to day increasing exposure

to electromagnetic field generated by household appliances like microwave and mobile phones can also be a risk factor.[3]

They are associated with significant morbidity and the diminished quality of life, attributed to both the disease as well as to the treatment required. The recent diagnostic modalities like CT scan, MRI and PET scan has helped and made easier to localize the tumour. The newer neurosurgical procedures like stereotactic biopsy have made a way for an accurate diagnosis and early appropriate management. Nowadays intraoperative cytology techniques like squash preparations have aided in early and better outcomes.[4] Many times, special diagnostic techniques like immunohistochemical staining (IHC) is required for diagnosis. Even today, haematoxylin and eosin (H&E) is the mainstay for histopathological diagnosis of a central nervous system tumour.[5]

The exact frequency of various CNS tumours as well as their distribution is not known in our area. This makes it difficult to realise the magnitude of a major public health problem. The purpose of this study is to provide the current scenario of central nervous system tumours in our tertiary health care set up and to compare it with the published literature in India and all over the world.

Materials and Methods

The study was conducted in the department of pathology of a tertiary care centre. A total of 90 biopsies with the relevant clinical and radiological findings were included in the study. Ethical Committee clearance was obtained before the start of the study. These biopsy specimens were fixed in 10% buffered formalin. After overnight fixation, the sections were processed as per the routine histological processing. These tissues were dehydrated with ascending grades of alcohol, cleared with xylene, and embedded in paraffin to prepare blocks. These blocks of tissue were cut using a rotary microtome into sections of 3–5 micrometre thickness. The sections were stained with haematoxylin and eosin. Special and immunohistochemical staining was done whenever required. The histopathological typing and grading with WHO Classification was done. Finally, the results were analysed and the data was prepared to determine the relative frequencies of various histopathological patterns, the distribution of age, sex and location of various CNS tumours.

Results

In this study, age ranged from 1.5 years to 81 years. Mean age was 42 years. Majority of patients belonged to 4th and 5th decade of their life while very few patients had their age above 70 years. Out of 90 cases, 51% were male and 49% were female. The male to female ratio was 1.0:0.95 (Table 1).

Table 1: Incidence of CNS tumours in males and females.

Sr. No.	CNS Tumours	Males	Females	Total
1	Meningioma	5	16	21
2	Astrocytoma	9	8	17
3	Glioblastoma	12	–	12
4	Oligodendroglioma	2	1	3
5	Oligoastrocytoma	1	1	2
6	Schwannoma	6	3	9
7	Pituitary adenoma	4	4	8
8	Ependymoma	1	1	2
9	Medulloblastoma	–	2	2
10	Neurofibroma	–	1	1
11	Choroid plexus carcinoma	1	–	1
12	Craniopharyngioma	1	–	1
13	Pinealoblastoma	1	–	1
14	Plasmacytoma	–	1	1
15	Haemangioblastoma	1	–	1
16	Haemangiopericytoma	–	1	1
17	Metastasis	2	5	7
	Total	46	44	90

Meningiomas and metastatic tumours were more common in females in comparison with other CNS tumours. Most frequent tumour among males was glioblastoma followed by astrocytoma.

Majority were intracranial tumours (83.33%) and rest were intraspinal tumours (16.66%). Most of the intracranial tumours were located in the right cerebral hemisphere (54.71%) while 45.28% were located in left cerebral hemisphere (Table 2).

Table 2: Location of various CNS tumours.

Sr. No.	Location	Number of Cases	(%)
1	Frontal lobe	20	22.22
2	Parietal lobe	8	8.88
3	Temporal lobe	4	4.44
4	Fronto-parietal	16	17.77
5	Fronto-temporal	1	1.11
6	Parieto-temporal	2	2.22
7	Parieto-occipital	1	1.11
8	Temporo-occipital	1	1.11
9.	Sellar/suprasellar	9	10.0
10.	Olfactory groove	2	2.22
11.	Cerebellum	3	3.33
12.	Cerebellopontine angle	8	8.88
13.	Spinal cord	15	16.66
	Total	90	100

Among intracranial CNS tumour cases, majority were supratentorial tumours (85.33%) and rest were infratentorial tumours (14.66%). Most common location of CNS tumours in our study was frontal lobe of cerebral hemisphere followed by spinal cord. Most of the astrocytic tumours were found to be located in the frontal lobe (58.82%) of the cerebrum, while the other sites were parietal and temporal lobes of cerebrum and the brainstem.

Out of all, 83 cases (92.22%) were primary whereas 7 cases (7.77%) were secondaries. Amongst all, meningiomas were in majority, followed by astrocytomas. Most of the metastatic tumours were squamous cell carcinomas (71.42%) while others were metastatic adenocarcinomas (28.57%).

Meningiomas were seen mostly after 3rd decade of life whereas astrocytomas were seen mostly before second decades (Fig. 1). Glioblastomas were more frequent in the 5th decade of life. Schwannomas and pituitary adenomas were frequent in 4th and 5th decade respectively (Fig. 2). Metastatic tumours occurred between the 4th and the 6th decade (Fig. 3). The most common paediatric CNS tumour was found to be astrocytoma while the most frequent tumour in adults was meningioma followed by astrocytoma and glioblastoma (Table 3).

Table 3: Presentation of various CNS tumours according to decades of presentation.

Sr. No.	CNS tumour	Age groups (years)							Total
		≤20	21–30	31–40	41–50	51–60	61–70	>70	
1.	Meningioma	1	1	4	5	4	5	1	21
2.	Astrocytoma	4	5	1	4	2	1	–	17
3.	Glioblastoma	–	–	2	6	2	2	–	12
4.	Oligodendroglioma	–	1	2	–	–	–	–	3
5.	Oligoastrocytoma	–	–	1	1	–	–	–	2
6.	Schwannoma	1	1	4	–	2	–	1	9
7.	Pituitary adenoma	–	1	2	3	1	1	–	8
8.	Ependymoma	1	–	–	1	–	–	–	2
9.	Medulloblastoma	1	–	1	–	–	–	–	2
10.	Neurofibroma	–	1	–	–	–	–	–	1
11.	Choroid plexus carcinoma	–	–	–	1	–	–	–	1
12.	Craniopharyngioma	1	–	–	–	–	–	–	1
13.	Pinealoblastoma	–	1	–	–	–	–	–	1
14.	Plasmacytoma	–	–	–	–	1	–	–	1
15.	Haemangioblastoma	–	1	–	–	–	–	–	1
16.	Haemangiopericytoma	–	–	1	–	–	–	–	1
17.	Metastasis	–	–	2	2	2	–	1	7
	Total	9	12	20	23	14	9	3	90

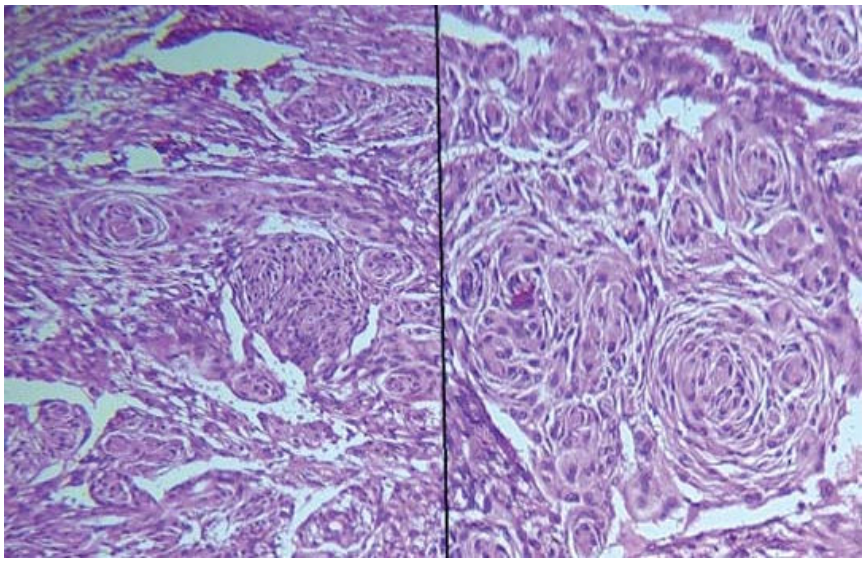

Fig. 1: Meningothelial Meningioma showing meningothelial cells arranged in whorls and lobules.

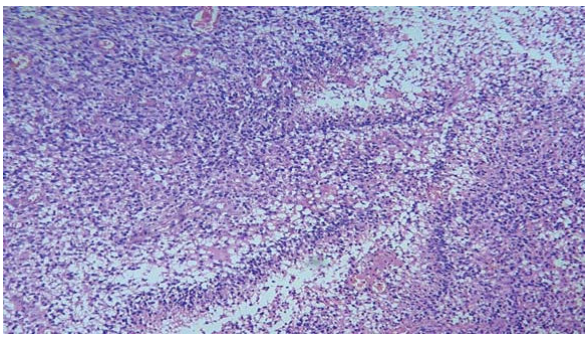

Fig.2a: Glioblastoma showing pseudo palisading of pleomorphic astrocytic cells and necrosis.

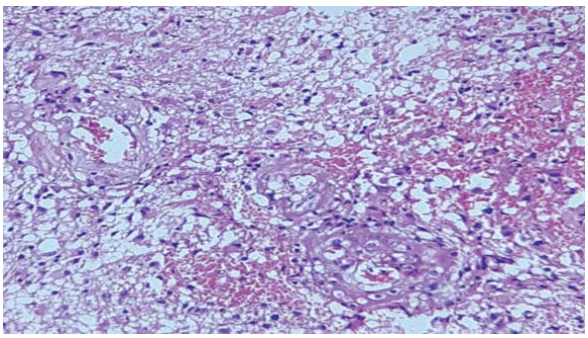

Fig 2b: Glioblastoma showing glomeruloid vascular proliferation.

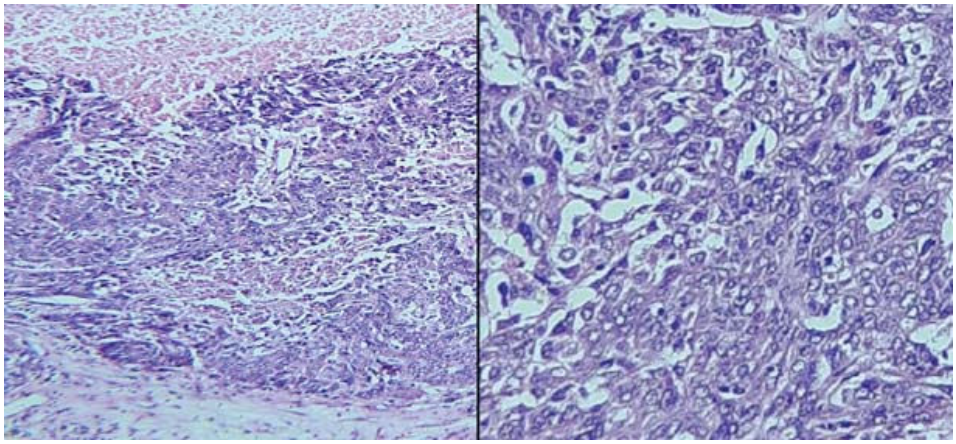

Fig 3: Metastatic deposits of Squamous cell carcinoma.

Majority of the CNS tumours were WHO grade I (51.35%), followed by WHO grade II and grade IV (20.27%), and WHO grade III (8.10%). WHO grade I tumours were more frequent among females (70.58%) as compared to males (35%). Grade III and IV tumours were found mainly in males (15% and 32.5%). Thus, grades I and II were noted more often in females while grades III and IV were frequent amongst males. Most common meningioma was found to be meningothelial (42.85%), followed by transitional (28.57%), psammomatous (14.28%) and fibrous (9.52%). Atypical meningiomas (4.76%) accounted least of all meningiomas. WHO grade I meningiomas were the commonest accounting for 95.23%.

Among the astrocytic tumours, WHO grade II and III were more frequent accounting for 47.05% and 29.41% respectively followed by grade I (23.52%). Out of 9 cases, five were cellular schwannomas (55.55%) and four were plexiform schwannomas (44.44%).

Discussion

CNS tumours are histologically and genetically classified and graded by WHO. This helps in understanding the severity of the lesion and the evolution of the disease process in terms of progression and grade. Classification and grading assists in proper management of patient with various treatment modalities like neurosurgery, radiotherapy or chemotherapy. Their distribution is variable according to geographic regions, age and sex of the patient. Across various countries, in Georgia, study done by Gigineishvili et al[6] showed meningiomas (25.91%) as the most prevalent CNS tumour, similar to our findings in India. On the contrary, most of the countries including Pakistan, England, Egypt, Nepal and China showed glial tumours astrocytoma and glioblastoma as the most frequent tumour. Pakistan[7] recorded 48% astrocytomas and China[8] recorded 38% of glioblastomas. Nepal[9] showed 38.6% prevalence of astrocytic tumours. England[10] and Egypt[11] estimated 35.2% astrocytomas in their studies.

In India, according to our study 23.33% were meningiomas and this was in accordance with the studies conducted by Ghangoria et al, Jaiswal et al and Kanthikar et al with the most frequent presenting tumour as meningioma. Ghangoria et al[12] studied 65 cases with 24.61% meningeal tumours. The study of 4,295 cases by Jaiswal et al[13] showed 23.2% meningiomas and 38 case study of Kanthikar et al[14] showed 34.2% meningiomas.

Literature also showed many studies with glial tumour as the most frequent CNS tumour. These studies were Jalali et al, Krishnatreya et al and Anadure et al. Jalali et al[15] studied 656 cases that comprised 38.7% astrocytomas. 231 cases were evaluated by Krishnatreya et al[2] comprising 37.2% astrocytic tumours. Anadure et al[4] estimated 48% cases of astrocytomas in a 50 cases study.

In the present study, majority of the cases (41%) belonged 5th decade followed by 31–40 years age group. This was in concordance with the observations of various studies done by Masoodi et al[16] and Chawla et al[17] with the most frequent age group of 31–50 years constituting 47% and 39%, respectively. Similar results were also noted in the studies of Singh et al[18], Sumathi et al[19], and Desai et al[20]. Singh et al estimated 54% cases and Sumathi et al estimated 50% cases in the age group of 31–50 years. 107 patients studied by Desai et al showed 40% of cases in the age group of 31–50 years. We observed a decline in the number of cases with the advancing age.

The mean age of 42 years with age ranging from 1.5 years to 81 years in our study is comparable with study conducted by Masoodi et al[16] with 106 cases of mean age 43.3 years in the study group of age ranging from 4–80 years. Nibhoria et al[3] studied 100 cases with the age range of 0–70 years and the mean age was 40 years. Adnan et al[21] studied 144 cases of ranging 8–75 years with the mean age of 37 years.

The male to female ratio in current study was 1.0:0.95. The sex ratio was found to be almost equal but males, 46 cases slightly outnumbered females, 44 cases. Similar findings were noted in the study done by Desai et al[20] which included 54 males and 53 females with male to female ratio of 1.0:0.98. It was also in accordance with other studies showing male preponderance in CNS tumours. These studies include Masoodi et al[16] and Chawla et al[17] with M:F of 1.12:1 and 1.6:1, Nibhoria et al[3], Kasalakshmi et al[1], Adnan et al[21] with their respective male to female ratios as 1.2:1, 1.08:1 and 1.4:1. Few studies showed slight female preponderance with a male to female ratio of 0.8:1 and 0.9:1 conducted by Sumathi et al[19] and Singh et al[18].

In the current study, most of the CNS tumours were intracranial (83.33%) in location with few being intraspinal (16.66%). These findings werei n accordance to the findings of the other studies. Masoodi et al[16] observed 86.8% intracranial and 13.2% intraspinal tumours. Kasalakshmi et al[1] observed 93.05% intracranial and 6.94% intraspinal tumours. Nibhoria et al[3] observed 95.5% intracranial and 4.5% intraspinal tumours. Pidakala et al[5] observed 86.7% intracranial and 13.3% intraspinal tumours.

In our study, 85.33% tumours were supratentorial and 14.66% tumours were infratentorial in location. These were in accordance with the study of Jalali et al[15] and Kasalakshmi et al[1]. Jalali et al estimated 83% of tumours were supratentorially located and Kasalakshmi et al estimated 58.33% of CNS tumours are supratentorial.

Anterior fossa was found to be the most common location involved by CNS tumours in adults while paediatric CNS tumours were found in the posterior fossa. This was in concordance with the studies conducted by Kasalakshmi et al[1] and Pidakala et al[5].

Frontal lobe was found to be the commonest site (22.22%) of brain tumours. Similar findings were observed in the studies of Masoodi et al[16] and Pidakala et al[5] with frontal lobe as the commonest site. 20.7% tumours were found to be located in the frontal lobe in a study conducted by Masoodi et al. Frontal lobe was the site for 18.5% of intracranial tumours as estimated by Pidakala et al. However, studies by Kasalakshmi et al[1] and Sumathi et al[19] revealed parietal lobe (23.6% and 32.5% respectively) as the commonest site followed by frontal lobe.

Out of total 90 cases of CNS tumours in the study, 92.22% were primary tumours and 7.77% were metastatic tumours. This was found to be in concordance with Jalali et al[15] and Adnan et al[21] accounting 88.5% and 91.7% primary and 11.5% and 8.3% secondary tumours.

Among various CNS tumours, we encountered meningioma (23.33%) as the commonest neoplasm followed by astrocytoma (18.88%). Almost similar results were observed by Das et al, Suh et al and Lee et al[16]. Ghanghoria et al[12] studied 65 cases of CNS tumours and found meningeal tumours as the most common tumour (24.61%) followed by glial tumours. Jaiswal et al[13] studied 4,295 cases with CNS tumour and found meningioma (23.2%) as the most prevalent CNS neoplasm. 34.2% cases were meningiomas in a study done by Kanthikar et al[14] including 38 cases.

On the contrary, Masoodi et al[16], Chawla et al[17], Kasalakshmi et al[1], Sumathi et al[19], Desai et al[20], and Adnan et al[21] reported astrocytoma as the commonest CNS tumour in their respective studies. Kasalakshmi et al studied 72 CNS tumours, out of which 41.66% were astrocytoma and 27.77% were meningioma. Desai et al included 107 CNS tumours and found astrocytoma (23.31%) as the most common tumour followed by meningioma (19.65%) in their study.

In our study, paediatric cases comprised 10%. Kanthikar et al[14] study comprised 5.26% of paediatric cases out of total 38 cases. Ghanghoria et al[12] and Anadure et al[4] evaluated 65 and 50 cases with 20% and 30% paediatric population, respectively.

Among the paediatric population, various CNS neoplasms encountered were pilocytic astrocytoma (2 cases), pilomyxoid astrocytoma (1 case), desmoplastic infantile astrocytoma (1 case), medulloblastoma (1 case), craniopharyngioma (1 case), meningioma (1 case), schwannoma (1 case), and myxopapillary ependymoma (1 case). Jalali et al[15] reported pilocytic astrocytomas commonly in children. Sumathi et al[19] found medulloblastoma (2 cases), most common tumour in paediatric cases.

Among adults, meningioma (23.33%) was found to be the most common CNS tumour. Similarly, Gigineishvili et al[6] showed meningioma (25.91%) as the most common adult tumour. In this study, meningiomas showed a female predilection whereas glioblastomas and various other tumours were seen commonly in males. This corresponds with the recordings of Jaiswal et al[13] that showed female predominance of meningiomas. According to WHO grading of various selected CNS tumours, the present study revealed grade I tumours (51.35%) were more common followed by grade II and grade III tumours (20.27%). Among grade I tumours, most of them were meningiomas and were found predominantly in females (70.58%) which was in accordance with Sumathi et al (64%). Grade III tumours were found predominantly in males (15%). Majority of grade IV tumours were glioblastoma (12 cases) followed by medulloblastoma (2 cases) and pinealoblastoma (1 case). Grade IV tumours were mainly encountered in males (13 cases). Ghanghoria et al[12] and Anadure et al[4] also noted that the majority of the tumours were grade I. Ghanghoria et al found that out of 65 cases, 41 cases were WHO grade I tumours followed by grade III tumours.

In our study, meningiomas (21 cases) were the commonest tumours of all CNS neoplasms. Amongst various meningiomas, meningothelial meningioma, WHO grade I, represented 42.85%. Majority of the meningiomas were WHO grade I tumours (95.23%). Meningiomas showed female preponderance (16 cases). Similar findings were noted in most of the studies in literature including Masoodi et al, Pidakala et al and Gadgil et al[22]. Masoodi et al noted that out of 21 cases of meningiomas under study, 17 were female patients. Pidakala et al estimated 130 female patients amongst the total of 194 meningioma cases. Gadgil et al studied 313 cases of meningioma and found the female to male ratio was 2.2:1.

Astrocytomas were the second most frequently encountered CNS neoplasms in our study with the incidence of 18.88%. These included diffuse (29.41%), gemistocytic (17.64%), anaplastic (29.41%), pilocytic (11.76%), pilomyxoid (5.88%) and desmoplastic infantile astrocytoma (5.88%). Most of the astrocytic tumours were WHO grade II tumours (47.05%). Das et al[23] reported an incidence of 9.2% of astrocytic tumours. Frontal lobe (58.82%) was the commonest site of involvement of astrocytic tumours followed by fronto-parietal region (11.76%) of cerebral hemisphere and cerebellum (11.76%).

In present study, glioblastomas comprised 13.33% of all CNS tumours, whereas Javaria et al[24] showed a high incidence of 22.6% in their study. Pidakala et al observed an incidence rate of 8.4% glioblastomas of all CNS tumours. Glioblastomas are WHO grade IV tumours. We found males were frequently associated with glioblastoma.

Schwannomas, which are WHO grade I tumours, comprised of 10% (9 cases) of all CNS tumours in our study. Out of these, 55.55% were cellular and 44.44% were plexiform schwannomas. However, schwannomas constituted 17.2% of all CNS tumours and were the second most common tumour after astrocytomas in a study done by Pidakala et al.

We encountered with 8.88% of pituitary adenomas in our study, while Das et al and Masoodi et al reported an incidence of 11.8% and 11.3% in their respective studies.

Metastatic tumours were seen in patients between 31–80 years of age with female preponderance. Pidakala et al observed metastatic tumours between 51–70 years. Most of the metastatic tumours were squamous cell carcinoma, 5 cases (71.42%) with the primaries being in the lung. 2 cases (28.57%) of adenocarcinoma metastatic deposits were observed with primaries in the lung and prostate. On the contrary, Aryal et al conducted a study in Nepal and found adenocarcinoma (7 cases, 87.5%) as the most common histological type of metastatic tumours. It was also observed that all the cases of metastatic deposits of squamous cell carcinoma lung were females.

Among the embryonal tumours, 2 cases (2.22%) of medulloblastomas which are WHO grade IV tumours were noted in 1.5 year and 34 year old female. Similarly, medulloblastomas constituted 3.8%, 4.4% and 3.2% of all CNS neoplasms as reported by Masoodi et al, Ahmed et al and Patty

et al, respectively. Oligodendroglioma constituted 3.33% of all CNS neoplasms which can be compared to Jalali & Datta and Masoodi et al.

Conclusion

Few CNS tumours show characteristic clinical and radiological presentation. But many of the cases pose a diagnostic challenge necessitating the cytological and histological evaluation of the tumour. Thus, the routine histopathological examination of biopsy specimens has become very important with clinical and radiological correlation. The knowledge about the histopathological spectrum of various CNS tumours may help to identify various etiological factors, to understand the neoplastic process and to predict the prognostic factors that help in the management.

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