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Research Article

Central nervous system tumors: a histopathological study

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ABSTRACT

Introduction: Brain tumors can originate in almost any type of tissue, cell or mixture of cell types in the brain or spinal cord. Tumors in different areas of the central nervous system may be treated differently and have a different prognosis.
Methods: In the period between 2011-2015, we studied on 59 patients diagnosed with CNS tumors according to the World Health Organization's diagnostic criteria. Patient data were retrieved from the archives of the department of Pathology, Sardar Patel Medical College, Bikaner. The diagnosis in all the cases were made on hematoxylin & eosin stained slides of processed tissue.
Results: Patients ages ranged from 3.5-65 years with a mean age of 41.2 years and a male to female ratio of 1.8:1. Majority of tumors had intracranial location (55 cases, 93.23%). 91.5% tumors were solid in consistency. Frontal lobe (37.3%) was the predominant affected region. Most tumors were originated from neuroepithelium (67.8%) followed by meninges (22.03%). When examining the data pertaining to specific types of tumors, most frequent type of CNS tumors was astrocytoma (31 cases, 52.5%), followed by meningioma (13 cases, 22%).
Conclusion: The most frequent type of CNS tumours in this study was astrocytoma, followed by meningioma. Males are at much higher risk of developing CNS tumour in comparison to females (1.8:1). WHO Grade IV lesions were more common in our institutional set up. The exact histological diagnosis of CNS tumors is essential to predict the prognostic factors.

Keywords: CNS tumors, Astrocytoma, Brain tumor, Meningioma

INTRODUCTION

The annual incidence of tumors of the CNS ranges from 10 to 17 per 100,000 people for intracranial tumors and 1 to 2 per 100,000 people for intraspinal tumors; the majority of these are primary tumors, and only one fourth to one half are metastatic.[1] Tumors of the CNS account for less than 2% above all malignancies.[2] The majority of patients die within first year of diagnosis of malignant lesion and less than 3% survive more than 3 years.[2]

Site of 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 hemispheres above the tentorium.[1] The central nervous system (CNS) tumors that predominate in adults differ from those seen in children. Most pediatric neoplasms occur in the posterior fossa. In adults, the majority of CNS tumors arise in the anterior fossa.

Characterizing the different forms and range of CNS neoplasms in different regions may provide etiological clues to some tumor types. The unparalleled complexity of the central nervous system (CNS) is mirrored by the ever increasing diversity of recognizing of neoplastic entities that can afflict the organ. The major classes of

primary brain tumors to be considered here include gliomas, neuronal tumors, poorly differentiated tumors, and a group of other less common tumors. The five most common primary sites are lung, breast, skin (melanoma), kidney and gastrointestinal tract accounting for about 80% of all metastases. Some rare tumors (e.g., choriocarcinoma) have a high likelihood of metastasizing to the brain.[1]

Low-grade tumors, including low-grade astrocytomas, oligodendrogliomas and mixed tumors, have been found over time to progress to high grade tumors. The time varies depending on the genetic & morphological makeup of the tumor. The same can be determined by proper examination of surgical specimen. Prognosis of high grade tumor is grave & few of the patients may not even survive 1 year after diagnosis.

As seen among children under 14 years, and in adults 70 years and older, incidence rates for brain malignancies were significantly higher from 1991 to 1995 in comparison to what was seen from 1975 to 1979.[3] Age adjusted incidence rate for cancer of brain-nervous system in Bhopal cancer registry during 1988-2003 showed that there was an increase in the incidence of CNS tumor from 0.5 to 2.4 for males and 0.5 to 1.1 for females, respectively.[2]

In this study, the relative frequency of CNS tumors, including tumors of the cranial and paraspinal nerves, have been determined by analyzing 59 cases according to the revised WHO classification and study of histopathological findings, typing and grading of CNS tumors and to assess their distribution with regard to frequency, age and sex.[4]

METHODS

A total of 59 cases of CNS tumors were studied in department of Pathology, Sardar Patel Medical College, Bikaner from period between 2011-2015. All the sections were processed by fixation, dehydration, and clearing followed by impregnation with wax. The wax blocks were cut in 5-6 µ sections & stained by hematoxylin and eosin stain.

The diagnoses in all the cases were made on histopathological examination of routinely processed tissue. All cases were reviewed by the authors and diagnosis was confirmed applying revised WHO classification. The relative frequency of tumors and the distribution of age, sex and location were analyzed.

Inclusion criteria

Tissue of patients of all ages with central nervous system neoplasia who have undergone histo-pathological examination following surgery was included in this study.

Exclusion criteria

Non-neoplastic lesions, Neurological lesions other than lesions of the central nervous system, Autolysed/necrosed tissue specimen, inadequate biopsy were excluded from study.

RESULTS

The distribution of 59 cases according to age, sex, consistency, site, side of CNS involved, diagnosis and their grading according WHO classification were presented in tables or bar diagram. Following results were made: As shown in Table 1, out of 59 cases, tumors are more common in male (38 cases, 64.4%) in comparison with female (21 cases, 35.6%). Male to female ratio was 1.80:1.

As shown in Figure 1, out of 59 cases, maximum incidence of tumors was found in 5th decade 16/59 (27.1%) followed by 4th decade. Both ends of age groups have tapered frequency.

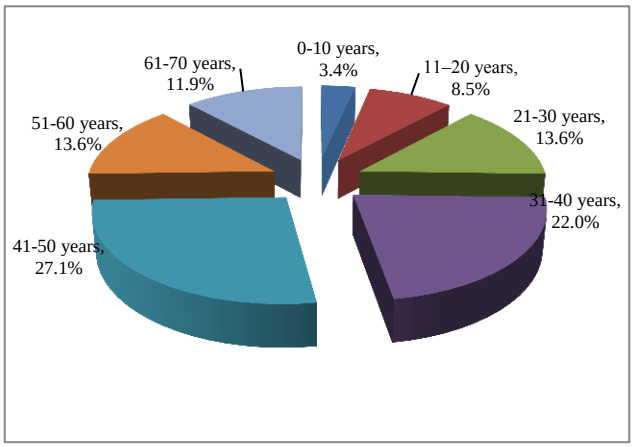

Figure 1: Distribution on case according to group.

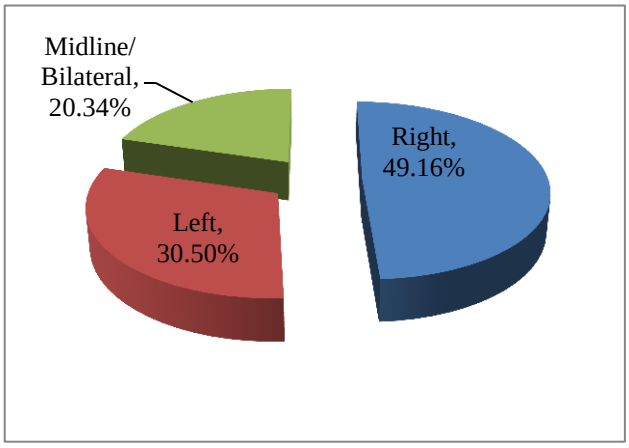

Figure 2: Distribution of cases according to the side involved.

Table 1: Distribution of cases according sex.

Histopathological diagnosis	Male		Female		Total	
	Cases	%	Cases	%	Cases	%
Astrocytoma	25	80.6	6	19.4	31	52.54
Oligodendroglioma	0	0	2	100	2	3.38
Oligoastrocytoma	2	100	0	0	2	3.38
Neurocytoma	1	100	0	0	1	1.69
Medulloblastoma	0	0	1	100	1	1.69
Primitive NET	1	100	0	0	1	1.69
Meningioma	7	53.8	6	46.2	13	22.03
Neurilemmoma	1	100	0	0	1	1.69
Neurofibroma	0	0	1	100	1	1.69
Choroid plexus papilloma	1	100	0	0	1	1.69
Papillary tumor of P.G	0	0	1	100	1	1.69
Teratoma	0	0	2	100	2	3.38
Lymphoma	0	0	1	100	1	1.69
Metastatic carcinoma	0	0	1	100	1	1.69
Total	38	64.4	21	35.6	59	100

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Table 2: Distribution of CNS tumors according origin of cell type.

Major classes	Diagnosis	No. of Cases	%	Total	
				Cases	%
Neuroepithelial	Astrocytoma	31	52.54	40	67.79
	Oligodendroglioma	2	3.38		
	Oligoastrocytoma	2	3.38		
	Neurocytoma	1	1.69		
	Papillary tumor of P.G	1	1.69		
	Choroid plexus Papilloma	1	1.69		
	Medulloblastoma	1	1.69		
	Primitive NET	1	1.69		
Meningeal	Meningioma	13	22.03	13	22.03
Cranial and paraspinal nerves	Neurilemmoma	1	1.69	2	3.38
	Neurofibroma	1	1.69		
Germ cell tumor	Teratoma	2	3.38	2	3.38
Haemato-lymphoid	Lymphoma	1	1.69	1	1.69
Metastatic	Metastatic carcinoma	1	1.69	1	1.69
Total		**59**	**100.0**	**59**	**100.0**

As shown in Table 2, out of 59 cases, In case of noeplastic lesions, maximum lesion were found in right side (49.16%, 29 cases) followed by left side (30.50%, 18 cases).

As shown in Figure 3, out of 59 cases, neoplastic lesion highest incidence was found in frontal lobe 22 (37.28%) followed by temporal lobe 11 (18.64%). Majority of tumors had intracranial location (55 cases, 93.23%). Extracranial location found in 4 (6.77%) cases.

As shown in Figure 4, out of 59 cases majority 91.52% (54 cases) of lesions with solid consistency showed neoplastic nature.

As shown in Table 2, total of 59 CNS tumors were diagnosed during four year period. Of these, 58 (98.3%) were primary, and 1 (1.7%) was metastatic. On the basis of origin of cell type, neuroepithelial tumors were most common (40 cases. 67.79%) followed by meningeal tumors (13 cases, 22.03%). The most frequent type of CNS tumor was astrocytoma (31 cases, 52.54 followed by meningioma (13 cases, 22.03%).

In Table 3, according to WHO classification, 55 cases were graded, in which majority of lesions belonged to Grade I (32.7%) and IV (32.7%) followed by grade II (29.1%) and III (5.5%). Among the 40 tumors of neuroepithelial tissue, the majorities were accounted under the subgroup: astrocytomas (total astrocytomas =31). The most common tumor subtype within this group was the grade 4 astrocytomas or glioblastoma multiforme (GBM) comprising 16 cases, followed by grade 2 astrocytomas (total cases = 11), 2 cases of grade 1 & 3 each. Oligodendroglial tumors was diagnosed in two cases, both were in grade 2. Two cases were diagnosed oligoastrocytoma. Primitive neuro-ectodermal tumor (PNET), Neurocytoma, Papillary tumor of P.G, Choroid plexus papilloma, and medulloblastoma were diagnosed in one patient each accounting for 2.5% each of all tumors derived from neuroepithelial tissue. The most common type of astrocytoma was WHO grade IV type.

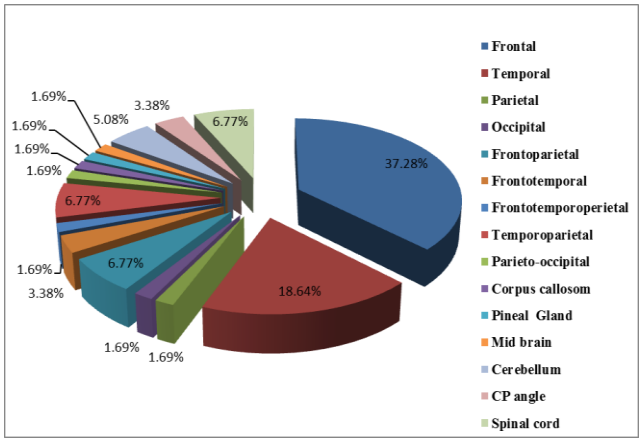

Figure 3: Distribution of cases according site involved.

Table 3: Disribution of cases according WHO grading system, 2007.

Tumors	Grading			
	Grade 1	Grade 2	Grade 3	Grade 4
Astrocytoma	2 (6.5%)	11 (35.5%)	2 (6.5%)	16 (51.5%)
Oligodendroglioma		2 (100%)		
Oligoastrocytoma		2 (100%)		
Neurocytoma		1 (100%)		
Choroid plexus Papilloma	1 (100%)			
Papillary tumor of P.G	1 (100%)			
Medulloblastoma				1 (100%)
Primitive NET				1 (100%)
Meningioma	12 (92.3%)		1 (7.7%)	
Neurofibroma	1 (100%)			
Schwannoma	1 (100%)			
Total	18 (32.7%)	16 (29.1%)	3 (5.5%)	18 (32.7%)

Out of 31 astrocytic tumour, two cases of pilocytic astrocytoma, eight cases fibrillary astrocytoma, three cases gemistocytic astrocytoma, two cases anaplastic astrocytoma (Figure 5), sixteen cases glioblastoma multiforme were diagnosed. One case giant cell glioblastoma variant was also included in sixteen cases of GBM.

Tumors derived from the meninges were the second most frequently occurring group of intracranial tumors. Within this group, all cases were meningiomas. A total of 13 cases of Meningioma were diagnosed in the study period. 7 cases were male and 6 cases were female. Age was ranging from 40 years to 65 years. The most common histological subtypes of meningiomas were meningothelial 8 (61.6%) followed by transitional 2 (15.4%), fibroblastic 1 (7.7%), angiomatous 1 (7.7%). These all were present in grade I. One case of anaplastic (7.7%) was in grade III.

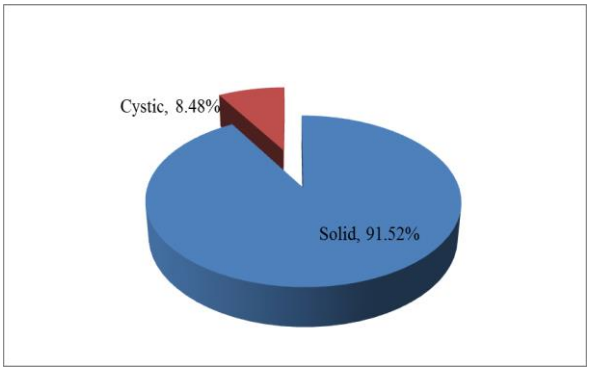

Figure 4: Distribution of cases according to consistency of lesions.

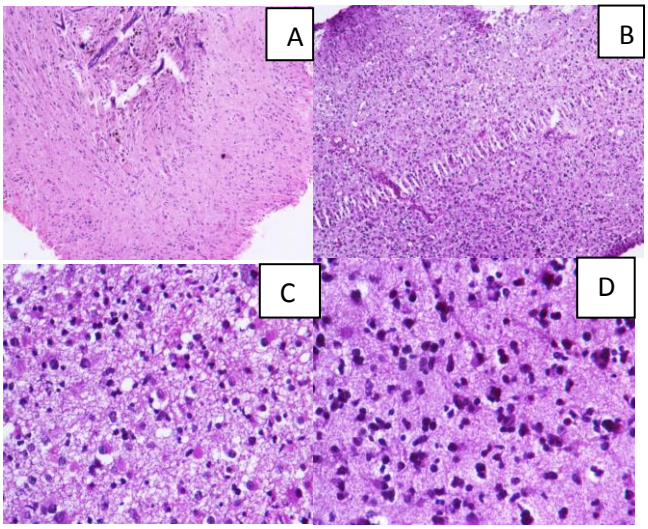

Figure 5: (A) Pilocytic astrocytoma (H &E 100 x); (B) Fibrillary astrocytoma (H &E 100 x); (C) Gemistocytic astrocytoma (H &E 100 x); (D) Anaplastic astrocytoma (H &E 100 x).

DISCUSSION

It has been noted that substantial differences exist between countries, geographic areas and ethnic groups for incidence of malignancies of the nervous system.[5]

The age distribution of all CNS tumors showed a gradual increase in tumor cases with increasing age, peaking in the age group 41-50 years and tapering off thereafter.

Fan et al, also reported proportionally low frequencies of CNS tumors at both ends of the age spectrum (below 10 years old and greater than 70 years). The highest frequency was noted in the 50-59 year age group.[6] The rise in incidence of brain tumors is consistent with virtually all other adult tumors.[7] Cancers in late adulthood are often associated with environmental, occupational or lifestyle risk factors and can be ascribed to the cumulative effect of exposures over a prolonged period of time.[8]

In addition, the mean age of French patients with CNS tumors was 57.0 years, patients in Georgia, USA was 58.6 years while that parameter observed in our study was 41.2 years. A possible explanation for this discrepancy may lie in the aging populations in developed countries.[9]

The mean age of patients with neuroepithelial tumors in our study was 39.38 years, compared to that measured in Korea, 43.5 years.[10]

The mean age of patients diagnosed with meningiomas in one European report was 57.6 years, in an American report: 59 years and in an Asian report : 58.1 years.[9-11] By comparison, the mean age of patients with meningiomas at the Chris Hani Baragwanath Hospital was 45.65 years. Barker et al found a peak incidence of meningiomas in the age group 60-69 years.[12]

The peak age group for this tumor type in our study was considerably younger, 50-54 years. The average age of meningioma in our study was 49.23years, with cases of these tumors increasing in the third decade and with the vast majority occurring between the ages of 35-59 years.

In our study 4 cases were diagnosed in paediatric age groups, which were primitive neuroectodermal tumor, teratoma and grade 4 astrocytoma (giant cell type). International literature reports the most common tumors as being pilocytic astrocytomas, medulloblastomas, ependymomas, craniopharyngiomas and germ cell tumors in varying numbers in different regions.[7,10,13,14] The absence of low occurrence or absence of paediatric tumors in our study population is certainly notable, however, as the total number of paediatric patients in the sample group was relatively small, no firm conclusions can be drawn in this matter.

Rachet et al proposed that brain tumors are 20-50% more common in men in western nations.[15] The life-time risk of being diagnosed with a CNS malignancy is estimated to be 0.67% for men and 0.52% for women.[16] In separate studies performed on two continents, McKinney et al, and Fan et al found comparable results suggesting a male-to-female ratio of 1.5:1.[6,7]

Ghanghoria S et al, 2014, were found that astrocytoma was more common in males than females 68.75% of astrocytoma was seen in males and male to female ratio was 1: 0.86.[17] According to Surawicz et al (1999) gliomas affect about 40% more males than females.[13] According to Yeole BB et al, brain – nervous system cancer were more common in male than female.[2] The male-to-female ratio in our study was 1.80:1. The male predominance was evident at all ages and in particular at the extreme of age. These findings are consistent with those of western countries but are in opposition to those from Asia.

Tumors of neuroepithelial origin were more frequent in male patients.[12,13,18] Our data supports this finding as a relative risk of 3 (male/female) was found in patients with tumors of neuroepithelial origin. Barker et al found the incidence of malignant gliomas to be especially higher among male patients.[12]

Provost et al, suggested the possible explanation for a higher frequency of gliomas in males may be due to specific occupational exposures.[9] Possible reasons for the observed gender variations may arise as a result of possible variabilties in the susceptibility of X and Y chromosomes to tumorigenic stimuli, while others postulate a protective effect of female sex hormones against brain tumors.[19]

A review of data obtained from the SEER program suggested a higher incidence of meningiomas in females

across all ages, while Wiemels et al found that the previously described two-fold predominance of female meningioma cases may be inverted in the rare cases of prepubertal meningiomas.[20] In contrast, in our study, Tumors of meningeal origin (comprised primarily of meningiomas) were found more in male patients, with a recorded relative risk (male/female) of 1.16.

Medulloblastomas & PNET's had male predominance in the CBTRUS study.[13] while in our study, one patient of each was diagnosed & both were male. Our data mirrored this finding with above study.[13] However, as the total number of tumors classified into this group is small, so firm conclusions may not be made.

According to WHO classification, 55 cases were graded, in which majority of lesions belonged to grade I (32.7 %) and IV (32.7%) followed by grade II (29.1%) and III (5.5%).

It is difficult to compare these different studies due to the lack of uniformity in the case material, along with differences in the study methodologies. This study may not represent an accurate incidence of CNS tumors in west India (Rajasthan) due to the limited number of cases. Furthermore, the study was based on a single center analysis.

CONCLUSION

The most frequent type of CNS tumors in this study was astrocytoma, followed by meningioma. This study may provide the representative incidence of various types of CNS tumors. Thus, from the point of view of treatment of the different lesions of central nervous system, mostly presenting with common clinical symptoms, there is a direct need for a histopathological study in order to arrive at a correct diagnosis, as for instance in the present study to know the type of neoplastic and their further typing and also in the case of latter its histological grade from the point of view of prognosis. A nationwide multicenter study is necessary in the future.

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