Original Article

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Histopathological Spectrum of Central Nervous System Tumors: A Single Centre Study of 100 Cases

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Abstract

Introduction: Central nervous system (CNS) tumors are not frequent tumors with primary malignant brain tumors accounting for 2% of all cancers in the U.S adults. The incidence rates are lower in developing countries like compared to the developed countries while increased rates have been observed in both.

Purpose: The aim of the present study is to study the histopathological spectrum of CNS tumors irrespective of age in single tertiary care center.

Material and Methods: The present 5 years study from a single tertiary care center, patient clinically diagnosed with CNS tumors and registered between 2009 and 2014 in pathology department were included and classified according to WHO 2007 classification along with grading of the tumor.

Results: A wide range of histopathological spectrum of CNS tumors was observed and was classified according to the recent WHO classification system. The primary CNS tumors were graded from Grade 1 to Grade 1V. Overall tumors of neuroepithelial tissue (51.7%) was the most common entity followed by the tumors of meninges (34.8%), metastatic tumors (5.6%), tumors of peripheral nerves (4.5%), tumors of the sellar region (2.3%), and lymphomas and hematopoietic neoplasm (1.1%).

Conclusion: Rising global trends in the incidence of CNS tumors, irrespective of age have been observed. The present study highlights the histological diversity in CNS tumors in both, adult as well as pediatric age groups.

Key words: Astrocytoma, Central nervous system, Meningioma, Tumors

INTRODUCTION

Though central nervous system (CNS) tumors are not as frequent as tumors of many other sites,[1] they showed a varied histopathologic spectrum. It has been revealed by International Agency for Research on Cancer that the worldwide incidence rate of CNS tumors in 2002 was 3.7/100,000 population among males and 2.6/100,000 population among females. The incidence rates were higher in developed countries (males:5.8/100,000; females:4.1/100,000) than in developing countries (males:3.0/100,000; females:2.1/100,000).[2] In 2008, the rates had risen to 3.8/100,000 in males and 3.1/100,000 in females, although the incidence rates in developed countries (males:5.8/100,000; females:4.4/100,000) still remained higher than those in developing countries (males: 3.2/100,000; females: 2.8/100,000).

In developing countries like India, due to lack of complete registration of newly diagnosed cases with local cancer registries, the exact tumor burden of such disease goes unnoticed and is underestimated. Hospital-based prevalence data, therefore, forms the basis for estimating the disease load. With increased availability of diagnostic facilities and better healthcare, the incidence of CNS tumors seems to be on the rise in developing countries.[3]

All the CNS tumors were divided into seven categories: Tumors of neuroepithelial tissue; tumors of the cranial and paraspinal nerves; tumors of the meninges; lymphomas

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and hematopoietic neoplasms; germ cell tumors; tumors of the sellar region; and metastatic tumors. The WHO classification offers a crude histological grading system, in which each CNS tumor is classified as Grades I-1V according to its degree of malignancy. This system can provide an estimate for the prognosis of a patient. In this study, age, sex and the histological tumor type and grade were systematically recorded.

The spectra of the malignant tumors were different in the pediatric and adult groups. For the adults, astrocytic tumors, tumors of meninges, and metastatic tumors occupied the top three places while astrocytic tumors took the lead in pediatric cases.

MATERIALS AND METHODS

The present 5 years study from a single tertiary care center, the patient diagnosed with CNS tumors and registered between 2009 and 2014 in the pathology department were consecutively screened. The H and E stained histopathological slides of biopsy received were evaluated. The cases were diagnosed and characterized where necessary using immunohistochemistry and categorized according to the WHO 2007 classification. The inclusion criteria were cases of CNS tumors of all age groups. The tumors of peripheral nervous system and non-neoplastic conditions of the CNS were excluded. With these criteria, a total of 100 cases of CNS tumors were studied, and their histological typing and grading was done.

RESULTS

The present study was conducted during 2009-2014 in which 100 cases of clinically diagnosed CNS tumors received in the department of pathology were studied. Out of the 100 clinically diagnosed CNS tumors, neoplasm was seen in 89% of the cases and 07% showed reactive gliosis while biopsy was inadequate or inconclusive in 04%. Among the CNS tumors, the majority (95.5%) presented as space occupying lesion in the brain and only 4.5% were intra-spinal tumors. The CNS tumors showed a slight male predominance (Male: Female = 1.2:1) and a broad range was found, i.e. 0-70 years with the mean age of 40. The pediatric tumors contributed 12.3% of all CNS tumors (Table 1).

A wide range of histopathological spectrum of CNS tumors was observed and was classified according to the recent WHO classification system. The primary CNS tumors were graded from I to IV. Overall tumors of neuroepithelial tissue (51.7%) was the most common entity followed by the tumors of meninges (34.8%), metastatic tumors (5.6%), tumors of peripheral nerves (4.5%), tumors of the seller region (2.3%), and hemolymphoid neoplasm (1.1%)(Figure 1) respectively (Table 2).

The tumors of neuroepithelial tissue comprised mainly of astrocytic tumors (39.32%) followed by oligodendroglial tumors (4.50%), (Figure 2) mixed gliomas (2.25%), ependymal tumors (2.25%), choroid plexus tumors (2.25%), and embryonal tumors (1.12%). Male predominance was seen in the ratio of 1.8:1.0 and the mean age was found to be 36.4 years. Among the astrocytic tumors, anaplastic

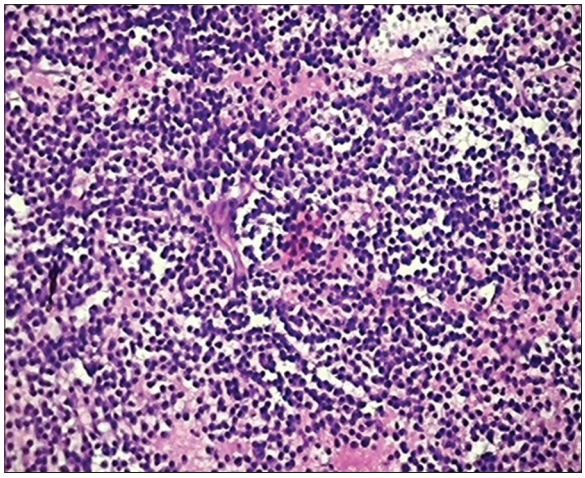

Figure 1: Plasmacytoma (H&E X400)

Table 1: Depicting the age, sex, histological subtypes and WHO grading of meningiomas

Age	Sex	Histologic subtypes	WHO grade
45	Female	Transitional	I
55	Male	Transitional	I
31	Female	Fibroblastic	I
50	Female	Meningotheliomatous	I
50	Female	Transitional	I
48	Male	Meningotheliomatous	I
50	Female	Transitional	I
35	Female	Transitional	I
49	Female	Transitional	I
35	Female	Meningotheliomatous	I
70	Male	Fibroblastic	I
21	Female	Transitional	I
45	Female	Meningotheliomatous	I
42	Female	Meningotheliomatous	I
55	Female	Fibroblastic	I
60	Female	Transitional	I
19	Female	Fibroblastic	I
71	Male	Meningotheliomatous	I
65	Female	Meningotheliomatous	I
24	Female	Atypical meningioma	II
28	Male	Atypical meningioma	II
32	Female	Atypical meningioma	II
58	Male	Meningotheliomatous	I
30	Male	Meningotheliomatous	I
62	Female	Meningotheliomatous	I
49	Female	Transitional	I
50	Male	Meningotheliomatous	I

astrocytomas Grade III (45.7%) was the commonest type followed be diffuse astrocytoma Grade II (34.3%) and glioblastoma multiforme Grade IV (20.0%).

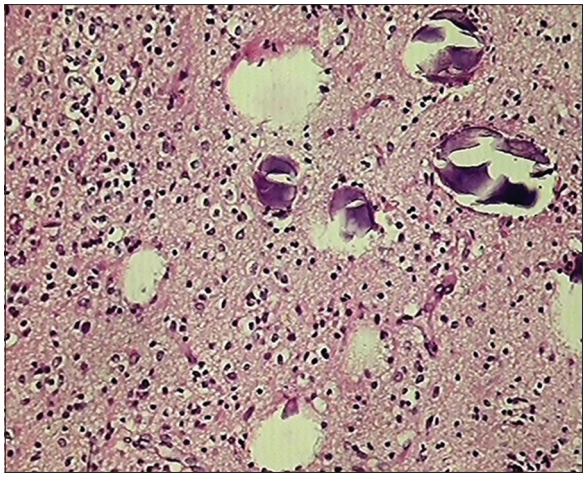

Figure 2: Oligodendroglioma (H&E X100)

Table 2: Percentage breakup of CNS tumors with histologic subtypes and WHO grading

Tumor types	WHO grading	Percentage
Tumor of neuroepithelial tissue		39.3
Astrocytic tumors		
Diffuse astrocytoma	Grade II	
Anaplastic astrocytoma	Grade III	
Glioblastoma multiforme	Grade IV	
Oligodendroglial tumors		4.5
Oligodendroglioma	Grade II	
Anaplastic oligodendroglioma	Grade III	
Mixed gliomas		2.3
Oligoastrocytoma	Grade II	
Anaplastic oligoastrocytoma	Grade III	
Ependymal tumors		2.3
Ependymoma	Grade II	
Choroid plexus tumors		2.3
Choroid plexus papilloma	Grade I	
Choroid plexus carcinoma	Grade IV	
Embryonal tumors		1.1
Medulloblastoma	Grade IV	
Tumors of peripheral nerves		4.5
Neurofibroma	Grade I	
Tumors of meninges		
Meningiomas		34.8
Meningiomas	Grade I	
Atypical meningiomas	Grade II	
Mesenchymal, non-meningothelial tumors		3.4
Lipoma	Grade I	
Haemangioma	Grade I	
Tumors of uncertain histogenesis		1.1
Hemangioblastoma	Grade I	
Lymphomas and haemopoietic neoplasm		1.1
Plasmacytoma	Grade IV	
Tumors of the sellar region		2.3
Craniopharyngioma	Grade I	
Metastatic tumors		5.6

CNS: Central nervous system, WHO: World Health Organization

Meningiomas (Figure 3) dominated the tumors of meninges contributing 30.3% of the total 34.8% followed by mesenchymal, not meningeal tumors (3.4%) and occasional tumors of uncertain histogenesis (1.1%).

The mean age in meningiomas was found to be 45.5 years, and family preponderance was seen in the ratio of 1:1.2.

Atypical meningiomas constituted 3.34% of the total meningiomas and occurred in the younger age group with a mean age of 28 years. A wide range of histologic subtypes was observed in meningiomas, and WHO grading system was applied to them (Table 3).

This was followed by metastatic tumors (Figure 4) that constituted 5.6% of the total tumors with a mean age of 61 years and slight male preponderance (3:2).

The pediatric tumors were peculiar by their histologic diversity with astrocytic tumors (25% of pediatric tumors) taking a lead. The median age in pediatric tumors was found to be 9.4 years with equal male to female ratio (1:1). (Table 4)

DISCUSSION

The incidence of CNS tumors is quite low in adults while they form the second most common childhood tumors after leukemia.[4] Adult CNS tumors differ

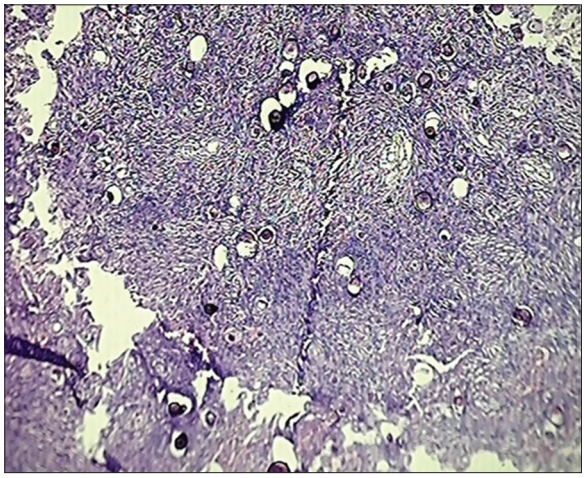

Figure 3: Meningioma (H&E X100)

Table 3: Percentage split of astrocytic tumors

Type of astrocytic tumor	WHO grade	Percentage
Diffuse astrocytoma	Grade II	34.3
Anaplastic astrocytoma	Grade III	45.7
Glioblastoma multiforme	Grade IV	20

WHO: World Health Organization

Table 4: Distribution of CNS tumors with histologic subtypes among children and teenagers (age 0-19 years)

Age	Sex	Histologic subtype	WHO grade	Percentage
18 years	Female	Cavernous hemagioma	Grade 1	8.3
10 months	Male	Choroid plexus carcinoma	Grade IV	8.3
8 years	Male	Medulloblastoma	Grade IV	8.3
17 years	Female	Craniopharyngioma	Grade I	8.3
5 years	Male	Choroid plexus papilloma	Grade I	8.3
10 years	Male	PNST-neurofibroma	Grade I	8.3
15 years	Male	Diffuse fibrillary astrocytoma	Grade II	8.3
6 months	Male	Inadequate biopsy		8.3
14 years	Female	Anaplastic oligodendroglioma	Grade III	8.3
19 years	Female	Meningioma-fibroblastic	Grade I	8.3
11 years	Female	Glioblastoma multiforme	Grade IV	8.3
5 years	Female	Anaplastic astrocytoma	Grade III	8.3

CNS: Central nervous system, PNST: Peripheral nerve sheath tumors, WHO: World Health Organization

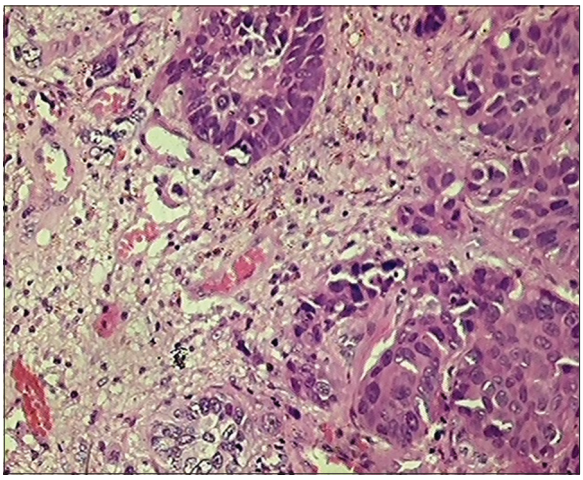

Figure 4: Metastatic carcinomatous deposits (H&E X100)

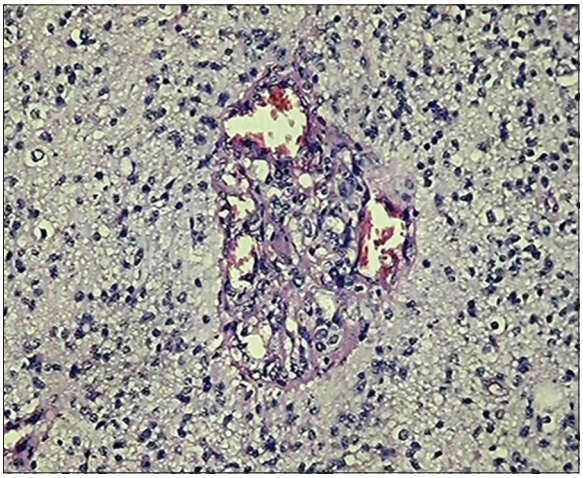

Figure 5: Anaplastic Astrocytoma exhibiting vascular proliferation. (H&E X400)

significantly from childhood brain tumors in relation to their sites of origin, clinical presentation, tendency to disseminate, histological features and their biological behavior. Whereas in adults the predominant CNS tumor types are metastases, glial neoplasms, and meningiomas, in children, besides gliomas, other major tumor types including primitive embryonal neoplasms are also common. In recent times, an enhanced understanding of these biological differences between adult and childhood CNS tumors has led to investigations in distinct molecular and genetic pathways and therapeutic approaches for each tumor type.

It has been observed worldwide that the incidence of CNS tumors is on a rise. Moreover due to the high mortality seen in CNS tumors, they form the most challenging group of tumors for neurooncologists.

In the present study comprising of 100 CNS tumors irrespective of age, from a single center, have been categorized according to the recent WHO classification.[5] In our study, the most common CNS tumors in the descending order are tumors of neuroepithelial tissue (51.7%) followed by tumors of meninges (34.8%) and metastatic tumors (5.6%). This was in concordance with the nationwide database in France which revealed the proportion of tumors of neuroepithelial tissue and the

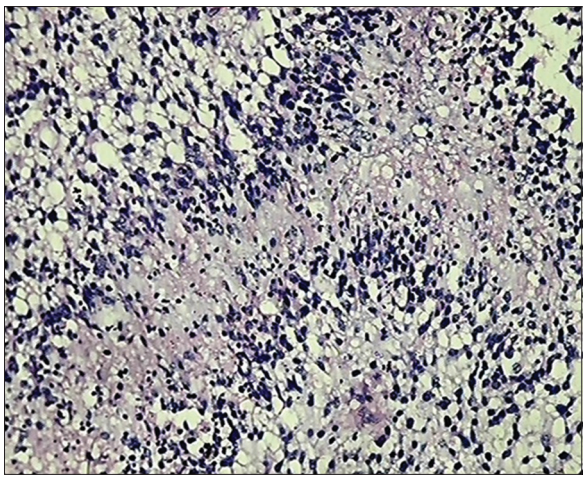

Figure 6: Glioblastoma Multiforme (H&E X400)

meninges were 53.9% and 28.8%, respectively, from 2004 to 2008.[6] Another population-based report from Central Brain Tumor Registry of the United States (CBTRUS) recorded rates of 33.7% and 35.5%, respectively, from 2004 to 2007.[7] The reason for this variation remains unknown and requires further investigation.[8] For the tumors of the meninges, increasing trends were observed around the world,[9-15] and improvements in the diagnostic technologies are still considered to be the major causal factor. Worldwide studies have also demonstrated an apparently increased incidence of metastatic tumors,[16] supporting their third position in our study.

The tumor spectra varied from adults to children and teenagers as well as from males to females. In our study, astrocytic tumors (45.7%) were the major tumor entity with anaplastic astrocytoma (Figure 5) topping the list followed by diffuse astrocytoma (34.3%). This was contrary to CBTRUS data, in which glioblastoma (Figrue 6) and anaplastic astrocytoma were the most common malignant tumors in adults.

The CNS tumors in children and teenagers showed a great histologic diversity. The most common CNS tumor in our study was astrocytic tumors comprising 25% of all tumors in this age group. This was in concordance with the study did by Chen *et al.* who found astrocytomas to be leading tumors (29.2%) in this age group in their 60 years review of cases.[8] While in a multi-institutional study did by Jain *et al.* find a slight higher proportion of astrocytoma (34.7%) as compared to our study.[3]

The incidence of various CNS tumors in the current study falls well within the range seen in the international studies for every tumor category.

CONCLUSION

Rising global trends in the incidence of CNS tumors, irrespective of age have been observed. The present study highlights the histologic diversity in CNS tumors in both, adult as well as pediatric age groups.

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