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HISTOPATHOLOGICAL SPECTRUM AND DESCRIPTIVE EPIDEMIOLOGY OF CENTRAL NERVOUS SYSTEM TUMORS DIAGNOSED AT A TERTIARY CARE CENTER

Pathology

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ABSTRACT

Central Nervous System (CNS) tumours are rare and account for 1-2% of all malignancies.[1,2] It can present as a primary tumour or a metastatic neoplasm. Primary tumours show a bimodal peak. Objective: To provide an overview of the descriptive epidemiology and histological spectrum of CNS tumours in a tertiary care centre. Methods: This is a retrospective study, which includes all histologically diagnosed cases of CNS tumours from 2017-2020, retrieved from archives of department of Pathology in Saveetha medical college. The frequency and distribution of CNS tumours based on age, gender, histology and grades according to WHO Classification of CNS Tumours 2016 were analysed. Results: In our study, the incidence of CNS tumours was more common in the age group of 41-50 years and had a female preponderance. The most common tumour observed was meningioma followed by astrocytoma. WHO Grade I tumour was found to be most common among the primary CNS tumours. Histological examination remains the gold standard for diagnosis of CNS tumours. This study shows the incidence and distribution of CNS tumours. It helps identifying the burden of the disease in the community and can be further used for comparative studies in the future.

KEYWORDS

CNS tumours, Meningioma, Astrocytoma

INTRODUCTION:

Cancer burden continues to grow globally and is a major cause of public health concern.[3] In 2018, 18.1 million new cases of cancer was recorded.[4] Tumours of the central nervous system (CNS) account for 1-2% of all malignancies.[1,2] The annual incidence for CNS tumours is approximately 3.9-3 per 100000 and 1-2 per 100000 in males and females respectively.[1] CNS tumours include benign and malignant lesions. Those tumours for which complete surgical resection is not possible may require compromise in neurological functions. Thus, they are associated with high morbidity and mortality. CNS tumours account for approximately 20% of all cancers that occur in childhood.[5] The increasing incidence of CNS tumours can be attributed to the more frequent use of modern radiological techniques in recent times. The objective of this study is to provide an overview of the descriptive epidemiology and histological spectrum of CNS tumours in a tertiary care centre and to analyse the frequency and distribution of CNS tumours based on age, gender, histology and grades according to the WHO Classification of CNS tumours 2016.

MATERIALS AND METHODS:

This is a retrospective descriptive study done at the department of Pathology in Saveetha medical college, Thandalam, Chennai. It was done after obtaining the necessary approval from the institutional review board. The required data regarding CNS tumours was collected from the hospital's tumour registry between the period from January 2017 to January 2020. A total of 98 cases which included biopsies and resection specimens, that were histologically diagnosed as per WHO Classification of CNS tumours (2016) following proper tissue processing and staining with hematoxylin and eosin were retrieved from the archives of the department of Pathology. The tumours arising from the cranial and peripheral nerves, and the non-neoplastic and infectious brain lesions were excluded from the study. A complete enumeration sampling technique was used. Patient's clinical details including age, sex, site of lesion was collected and studied. Statistical analysis was performed using SPSS software.

The histological subtype of the CNS tumour was studied in relation to the patient's age, gender, tumour topography, frequency and their grade. The confidentiality of patient details was maintained. The histological spectrum of the CNS tumours in our tertiary care centre was analysed based on the WHO Classification of CNS tumours (2016).

RESULTS:

A total of 98 cases received between January 2017 and January 2020 were analysed. It included 90 cases of primary brain tumours and 8 cases of metastasis to brain. The study population comprised of 45 males (45.9%) and 53 female (54.1%) patients.

Age Based Distribution:

The age of the patients included in the study ranged between 2 years to 75 years with a mean age of 38.5 years. The most predominantly affected age group in our study were in their fourth decade, between 41-50 years (29.6%) followed by 31-40 years (21.4%) (Table-1). In our study, there were 16 cases of paediatric brain tumours (patient's age less than 18 years). Adult and paediatric patients with CNS tumours accounted for 84.6% and 15.3%, respectively. Age-wise distribution of CNS tumours is given Table-1

Table 1- CNS tumours distribution based on age and gender:

Histological subtype	Age distribution								Gender distribution
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Percentage
Astrocytic tumors	1	3	1	8	4	4	3	-	Male- 28.9% Female- 20.8%
Oligodendroglial tumors	-	-	1	4	1	-	-	-	Male- 8.9% Female- 3.7%
Oligoastrocytic tumors					1	1			Male- 4.5% Female- Nil
Ependymal tumors	1	-	-	-	1	-	-	-	Male- 4.5% Female- Nil
Choroid plexus tumors	2	1							Male- 2.2% Female- 3.7%
Pineal tumors		1							Male- 2.2% Female- Nil
Embryonal tumors	2	3	-	-	-	-	-	-	Male- 11.1% Female- Nil
Meningeal tumors	-	1	1	6	17	8	3	-	Male- 22.2% Female- 49.1%
Tumours of sella	1	-	1	3	2	2	2	-	Male- 8.9% Female- 13.3%
Metastatic deposits					3	2	2	1	Male- 6.6% Female- 9.4%
Total	7	9	4	21	29	17	10	1	Male- 45.9% Female- 54%
Percentage %	7.14	9.2	4.1	21.4	29.6	17.4	10.2	1.0	

Gender Based Distribution:

Gender distribution of CNS tumours in our study, showed a slight

female preponderance. Male to Female ratio was found to be 0.8:1. In the histological subtypes, meningioma and pituitary adenoma showed an increased female preponderance, whereas oligoastrocytic tumours, ependymal tumours and medulloblastoma were exclusively seen in the males, in our study. Also, astrocytic tumours and oligodendroglioma showed a male preponderance in our study. The gender-wise distribution of CNS tumours is shown in Table-1.

Frequency Of Various CNS Tumour Subtypes And Grades:

A wide spectrum of CNS tumours were studied, and graded according to the WHO Classification of CNS tumours (2016). Grades from I to IV were assigned for the primary tumours included in our study. Meningeal tumours were the most common tumour subtype seen, followed by astrocytic tumours in the present study [Table- 2].

Table 2- CNS tumours distribution based on histological subtypes and tumour grading:

Histological Subtypes	Grade I	Grade II	Grade III	Grade IV	Total	Percentage (Subtypes)
Astrocytic tumors	2	6	3	13	24	24.4 %
Oligodendroglioma	-	4	2	-	6	6.2 %
Ependymal tumours	1	1	-	-	2	2.0 %
Oligoastrocytic tumours	-	2	-	-	2	2.0 %
Choroid plexus tumors	1	-	2	-	3	3.0 %
Pineal tumors	1	-	-	-	1	1.0 %
Embryonal tumors	-	-	-	5	5	5.1 %
Meningeal tumors	29	6	1	-	36	36.8 %
Tumors of sella	11	-	-	-	11	11.2 %
Metastatic deposits					8	8 %
Total	45	19	8	18		
Percentage (Grades)	50 %	21.11 %	6.67 %	22.22 %		

Meningiomas showed a female preponderance, with the age of patients ranging between 15 to 70 years and the median age was 42.5 years [Table-1]. The most common site where the tumour was located was the frontal and occipital lobe of cerebrum. Histological distribution of meningiomas showed meningothelial meningioma to be the most common subtype followed by transitional meningioma, in the present study [Table-1, Figure-1]

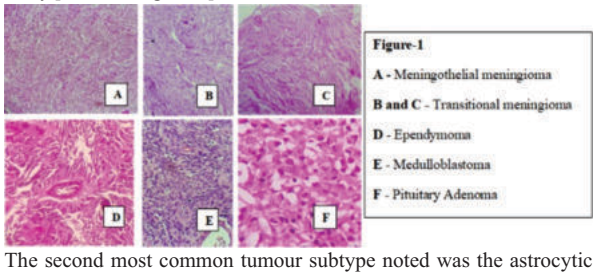

Figure-1
A - Meningothelial meningioma
B and C - Transitional meningioma
D - Ependymoma
E - Medulloblastoma
F - Pituitary Adenoma

The second most common tumour subtype noted was the astrocytic tumours [Table- 2], with age of the patients in the range between 10-65 years and thus had a median age of 37.5 years [Table- 1]. Astrocytic tumours in the present study showed a slight male predilection [Table-1], and the most common tumour subtype noted was Grade IV-glioblastoma NOS [Figure-2]. This was followed by Grade II – diffuse astrocytoma NOS [Table-2].

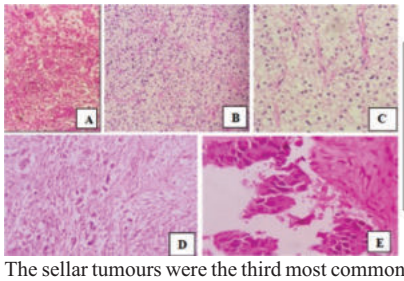

Figure- 2:
A - Glioblastoma
B and C - Oligodendroglioma
D - Gliosarcoma
E - Metastatic deposits

The sellar tumours were the third most common tumour subtype noted in the study, it included 1 case of craniopharyngioma and 10 cases of pituitary adenoma [Table- 2, Figure-1].

DISCUSSION:

Tumours arising from the CNS are a group of heterogeneous neoplasms, including both benign and malignant tumours. They account for approximately 1-2% of all tumours in adults,[1,6,7] and it was found that this incidence does not change markedly in people from different geographical regions.[8] However, in the past few decades, owing to the rise in usage of imaging techniques, an increasing trend is noted in detecting the brain tumours.[9] The most frequently encountered brain tumour in adults include metastasis, meningioma and glial neoplasms.[1]

The incidence of tumours arising from the CNS is about 3 per 1 lakh/ year in females and 3.9 per 1 lakh/ year in males respectively.[1] Tumours of the CNS are comparatively rare, however the various national and international studies show an overall increase in the occurrence of brain tumours, both in males and in females in the recent times.[10] CNS tumours are usually diagnosed using non-invasive radiological techniques and due to difficult access, surgical interventions are often limited and hence they have a guarded prognosis.[11,12] The primary tumours of the CNS often show a bimodal peak, one in the paediatric age group, and the other over 45-75 years.[12] Based on the 3 years data from our hospital , the predominantly affected age group was between 41-50 years followed by 31-40 years. This was comparable with the findings in the study conducted by Thambi R et al,[1] where the predominant age group affected was between 40 to 60 years. This finding is comparable with many other studies conducted worldwide.[1,2,13] Similarly, In the study conducted by Mehta J et al, with increasing age there was a gradual increase in the number of brain tumour cases up to the 5th decade, and thereafter the incidence showed a declining trend, with the maximum number of cases seen in the 31-50 years age group.[9]

In our study, the incidence of CNS tumours in adults was 84.6% and that of the paediatric age group was 15.3%. Out of the 16 cases of paediatric brain tumours, the most commonly encountered type was embryonal tumours (5 cases), followed by astrocytic tumours (4 cases) and choroid plexus tumours (3 cases). Similarly, in a study done by Zalata KR et al, of the total brain tumours in children less than 15 years of age, embryonal tumours and choroid plexus tumours were the most frequently encountered tumours in the children.[11]

Out of the 98 specimens received during our study, 90 were primary tumours arising from the CNS, and 8 were metastatic brain tumours [Figure-2]. Of the primary CNS tumours in our study, meningiomas were the most noted brain tumour, accounting for 36.8%. This was followed by astrocytic tumours accounting for 24.4%. This was concordant with the studies done by Thambi R et al, Kanthikar SN et al, Hamdani SM et al, Ghanghoria S et al, Surawicz et al, Lee et al, and also with a number of other worldwide studies, where meningioma was included among the CNS tumours studied.[1,12,14-17] However, in the studies conducted by Mehta J et al and Zalata KR et al, the most common sub-type observed in their was the astrocytic tumours followed by meningioma.[9,11]

In the study done by Thambi R et al, among the meningiomas seen, the most common subtype noted was transitional meningioma followed by meningiothelial meningioma.[1] However, in our present study, the most common subtype of meningioma encountered was meningothelial meningioma [Figure-1] followed by transitional meningioma [Figure-1], among the different variants of meningioma seen.

Among the astrocytic tumours, grade 4 glioblastoma [Figure-2] was the predominant type seen in the present study, which was similar to the findings observed in the studies conducted by Mehta J et al and Hamdani SM et al.[9,14] The higher incidence of grade 4 glioblastoma could be due to patients presenting late to the hospital.[9] And hence, this shows the need for imaging and neurology consultation at a grass root level, so that these tumours can be picked up early.[15]

In the present study, brain tumours were more commonly seen in females, with a male to female ratio of 0.8:1. This is in contrast to the studies done by Jaiswal J et al, Mehta J et al, and Hamdani SM et al all of which showed an inverse observation.[2,9,14] But our findings were concordant with Lee et al, who had reported that CNS tumours showed a female preponderance with a male: female ratio of 1:1.43.[17]

In the present study a female preponderance was seen in meningioma and pituitary adenoma [Figure-1], and a male preponderance was seen in astrocytic tumours and oligodendroglioma [Figure-2]. Also, oligoastrocytic tumours, ependymal tumours [Figure-1] and medulloblastoma [Figure-1] were exclusively seen in male patients.

The male preponderance of astrocytoma was also reported by Hamdani SM et al, in which 53.65% of astrocytomas seen were in male patients, with a male: female ratio of 1:0.8.[14] However contrary to our study, Hamdani SM et al had reported that there was a male preponderance for meningiomas as well.[14] Our findings were concordant with Surawicz et al, who had reported that meningiomas were encountered more frequently in females,[16] and with the study done by Zalata KR et al, according to which, the four CNS tumours which showed a female preponderance were, meningiomas, pituitary adenoma, schwannoma and cystic lesions in the brain.[11]

Site of the lesion in the brain is of great significance because, it determines accessibility for remedial surgeries and if the tumour is situated in a critical region in the brain, they can be fatal, irrespective of the histologic grade or classification of the tumour. The most common site where the CNS tumours were seen in our study was the frontal lobe, which was comparable to all the national data used for comparison. Frontal lobe as the commonest site of brain tumour was also reported by Thambi R et al and Trabelsi S et al in the studies conducted by them.[1,13]

CONCLUSION:

The histological examination of the tumours remains the gold standard investigation for diagnosis of tumours arising from the CNS. This study shows the incidence and distribution of various tumours arising from the CNS. It helps identifying the burden of the disease in the community and can be further used for comparative studies in the future.

This study was done based on the WHO classification of tumours of the CNS- 2016. The new edition of WHO classification of tumours of the CNS- 2021 has integrated molecular data into the typing, sub-typing and the grading of the major central nervous system tumour groups, as they aid in diagnostic, therapeutic, and prognostic purposes. However, the many challenges of the newer edition of WHO classification of tumours of the CNS-2021 include, availability of more widespread and faster molecular testing, and the cost involved for the same. With the current shift towards molecular basis of diagnosing CNS tumours, the 5th edition recommends the use of NOS [Not Otherwise Specified], when the diagnostic test required is not performed.

Conflict Of Interest : There is no conflict of interest.

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Declaration Of Patient Consent:

The authors certify that they have obtained all the appropriate patient consent forms. The presented patients had given their written informed consent, for publication of data and images.

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