HISTOPATHOLOGICAL SPECTRUM OF CNS TUMORS: AN OBSERVATIONAL STUDY IN A TERTIARY CARE CENTRE OF NORTH-EAST INDIA

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ABSTRACT

Introduction: Central nervous system (CNS) tumours are a diverse group of neoplasms and the most dreaded form of cancer with high morbidity and mortality comprising less than 2% of all malignancies. Not much is known about the epidemiology of CNS tumours in our population in North-East India. **Aim:** Aim of this study is to identify the age groups, gender distribution, topography and different histological types of CNS tumours and classify them. **Materials and Methods:** This retrospective histopathological analysis of brain tumours was carried out in the Department of Pathology, Agartala Government Medical College, Tripura, India, from May 2019 to June 2021. During this period, a total of 42 neurosurgical biopsies were retrieved from the department’s archives. The diagnoses in all the cases were made on histopathological examination of routinely processed tissue. The haematoxylin and eosin-stained sections in all cases were reviewed by the authors, and the diagnosis was confirmed applying the WHO classification 2016. The relative frequency of tumours and the distribution per age, sex, and location of the lesion were analyzed. A wide range of histopathological spectrum of CNS tumours was observed and was classified according to the WHO classification system of 2016. The primary CNS tumours were graded from Grade I to Grade IV. **Results and Conclusion:** 39 (92.8%) cases of primary tumours and 3 (7.2%) cases were metastatic tumours. Overall, meningioma was the most common tumour (48%), followed by glioblastoma (21.5%). Males are more affected compared to females. However, WHO grade I neoplasm was the predominant (46%). The present study helps to provide information regarding the burden of disease in our population.

KEYWORDS CNS tumours, Brain tumours, Meningioma, North East India

Introduction

Central nervous system (CNS) tumours are a diverse group of neoplasms and the most dreaded form of cancer with high morbidity and mortality. They comprise less than 2% of all malignancies.[1] In India, tumours of the CNS constitute about 1.9% of all tumours.[2]

The majority of brain tumours are sporadic lesions. To date, heritable genetic syndromes and prior ionizing radiation exposures such as computed tomography scans and X-rays are the only known risk factors accounting for <10% of all brain tumours.[3]

CNS tumours show a bimodal age distribution with one peak in children and the second peak in 45–70 years of age.[4] The signs and symptoms of intracranial tumours depend on the size of the tumour, its location and its rate of growth. However, a rising global trend in these tumours has been observed over the years, with new potential risk factors being identified for brain tumours. Recently, the International Agency for Research on Cancer also classified overexposure to low frequency, non-ionizing electromagnetic waves through mobile phones as...
possibly carcinogenic to human beings and a potential risk factor for brain tumours such as glioma meningioma and acoustic neuromas.[3] Specifically, to date, there is no published database on the profile of CNS tumours in Tripura. The present study is an attempt to identify age groups, gender distribution, tumour location and different histological types and grading of CNS tumours (WHO 2016) in the population attending our hospital, which in turn would facilitate proper planning of appropriate management.

Materials and Methods

The present study was a retrospective study conducted in the Department of Pathology, Agartala Government Medical College, Tripura, covering a period of two years from May 2019 - June 2021. The study was approved by the Institutional ethical committee.

A total of 42 biopsies of CNS tumours were retrieved from the archives of the Department of Pathology of this institute. The patient’s clinical data, including age, sex, location of the tumour, were obtained in all cases. The H&E stained slides were reviewed by the authors, and histological diagnoses were confirmed using WHO 2016 classification. The study included all biopsy specimens of primary and metastatic tumours of CNS. Non-neoplastic and inflammatory lesions were excluded. Final results were analyzed, and data was prepared to study histological patterns of CNS tumours with age and sex distribution in our area.

We have very limited resources and could not expect all the standard diagnostic procedures, including molecular studies, at our centre.

Results and analysis

A total of 42 cases of CNS tumours were analysed, covering two years. These included 39(92.8%) cases of primary tumours, and 3(7.2%) cases were metastatic.

In this study, the predominant age group affected was 21-40 years (42.8%), followed by 41-60 years (28.6%). Meningioma, which was found to be the most common CNS tumour, also belonged to 3rd to 4th decade. The second most common tumour glioblastoma multiforme (GBM) also belonged to the 3rd and 4th decades. There was one case of Medulloblastoma (age-14 years) and one case of GBM (age-82 years) [Table-1, Chart-1].

According to WHO 2016 classification, 39 primary cases were graded. The majority of the lesions belonged to Grade-I (46%) in comparison to Grade-II (28.2%) and grade IV (25.8%). Among astrocytomas, grade IV tumours were in the maximum numbers [Table-3].

Out of three metastatic tumours, two were metastatic choriocarcinomas identified in the brain, and one was male, and one was female. The third one was metastatic adenocarcinoma, presenting with a mass in the spinal region with unknown primary.

Different locations of brain tumours are shown in Table-4 and chart-4. Among the brain tumours, the most common site involved was the frontal lobe of the cerebrum, followed by the temporal lobe. The least affected site was the occipital lobe.

Chart 2 Gender wise distribution of CNS tumors.

The most common histological types found were meningioma (48%) followed by glioblastoma multiforme (21.5%) and oligodendroglioma (12%). We had two cases of ependymoma, in a 45 years old female and in a 63 years male; both located intraventricular in cerebrum. One 14 years female with medulloblastoma NOS, located in cerebellum was also found. Out of three metastatic tumours, two were located in cerebrum and one was in spinal region. The picture is depicted in Table-2.

A most common histological subtype of meningioma was found to be meningothelial (65%) and psammomatous variant (15%); both are grade-I followed by atypical variant (Grade-II) [Chart-3].

Chart 3 Pie chart showing histological types of CNS tumours.

Overall, males were affected more than females (M: F=1.5:1). However, meningioma was predominantly found in females (M: F=1:2). At the same time, Glioblastoma multiforme (Grade-IV) and oligodendroglioma (Grade-II) were predominantly found in males (M: F=2:1) and (M: F=4:1) respectively [Chart-2].
Table 1 Distribution of CNS tumors according to age group.

| Tumor type                          | Total number (%) | 0-20 years | 21-40 years | 41-60 years | 61-80 years | >80 years |
|-------------------------------------|------------------|------------|-------------|-------------|-------------|----------|
| 1. Diffuse Astrocytic and oligoden-drogial tumors | 16 (38%)         |            |             |             |             |          |
| a. Diffuse astrocytoma, NOS         | 2 (4.8%)         | 1          |             |             |             |          |
| b. Oligodendroglioma, NOS           | 5 (12%)          | 2          | 2           | 1           |             |          |
| c. Glioblastoma, NOS                | 9 (21.5%)        | 4          | 2           | 2           | 1           |          |
| 2. Ependymal tumors                 |                  |            |             |             |             |          |
| a. Ependymoma                       | 2 (4.8)          |            |             |             |             |          |
| 3. Embryonal tumors                 |                  |            |             |             |             |          |
| a. Medulloblastoma, NOS             | 1 (2.4%)         |            |             |             |             |          |
| 4. Meningial tumors                 |                  |            |             |             |             |          |
| A. Meningioma                       | 20 (48%)         |            |             |             |             |          |
| a. Meningothelial                   |                  | 7          | 3           | 2           | 1           |          |
| b. Psammomatous                     |                  | 1          | 2           |             |             |          |
| c. Angiomatous                      |                  | 1          |             |             |             |          |
| d. Microcystic                      |                  | 1          |             |             |             |          |
| e. Atypical                         |                  | 1          | 1           |             |             |          |
| 5. Metastatic tumors                | 3 (7%)           | 1          | 1           | 1           |             |          |
| Total                               | 42 (100%)        | 01 (2.4%) | 18 (42.8%)  | 12 (28.6%)  | 09 (21.4%)  | 02 (4.8%) |

Table 2 Relative frequencies of different types of CNS tumours.

| Histologic types                           | Total | Percentage |
|--------------------------------------------|-------|------------|
| 1. Meningioma                              | 20    | 48%        |
| a. Meningothelial                          | 13    | 31%        |
| b. Psammomatous                            | 3     | 7%         |
| c. Angiomatous                             | 1     | 2.4%       |
| d. Microcystic                             | 1     | 2.4%       |
| e. Atypical                                | 2     | 4.8%       |
| 2. Glioblastoma multiforme(GBM)            | 9     | 21.5%      |
| 3. Oligodendroglia                         | 5     | 12%        |
| 4. Astrocytoma                             | 2     | 4.8%       |
| a. Diffuse                                 | 1     | 2.4%       |
| b. Gemistocytic                            | 1     | 2.4%       |
| 5. Medulloblastoma                         | 1     | 2.4%       |
| 6. Ependymoma                              | 2     | 4.8%       |
| 7. Metastatic                              | 3     | 7%         |

Table 3 WHO Grading of primary tumors.

| Grade   | Number(%) | Male(%) | Female(%) |
|---------|-----------|---------|-----------|
| WHO I   | 18 (46%)  | 6 (15.4%)| 12 (30.6%)|
| WHO II  | 11 (28.2%)| 7 (18%)  | 4 (10.2%) |
| WHO III | Nil       |         |           |
| WHO IV  | 10 (25.8%)| 6 (15.3%)| 4 (10.5%) |
Table 4 Location-wise distribution of CNS tumors.

| Site          | Number | Percentage(%) |
|---------------|--------|---------------|
| Frontal       | 18     | 43%           |
| Temporal      | 7      | 17%           |
| Parietal      | 4      | 9.5%          |
| Occipital     | 1      | 2.4%          |
| Inter ventricular | 2   | 4.8%          |
| Cerebellum    | 3      | 7%            |
| Spinal        | 7      | 16.3%         |

Figure 1 A) Meningothelial meningioma(400x). B) Psammomatous meningioma(400x)

Figure 2 Ependymoma (400x) True rosettes- collarette of tumor cells around clear central lumen.

Figure 3 Medulloblastoma(400x) small undifferentiated oval or round cells.

Figure 4 A) Glioblastoma Multiforme,400x showing marked cellular pleomorphism. B) Glioblastoma Multiforme,400x showing necrosis.
Discussion

Brain tumours are a heterogeneous group of neoplasm with large variations in the trends of brain tumours, different histological subtypes, interpretation criteria, different newer diagnostic modalities, therapeutic approaches and registries practiced in different countries. GLOBOCAN Project (2012) reported incidence of CNS tumours 1.8% and mortality rate 2.3% worldwide.[6]

In this study, we noted that meningioma was the most common brain tumour 48% (20/42), followed by diffuse astrocytic tumours 38%(16/42) and metastatic tumours 7%(3/42) in our population. A similar picture was found by Surawicz et al.[7] in the USA and Lee et al.[8] in Korea, also reported that the most common tumour was meningioma.

The most common histological variant of meningioma was meningothelial 13/20 (31%), followed by psammomatous 3/20(7%) and atypical 2/20(4.8%)—location-wise meningioma was mostly observed in the frontal lobe followed by the temporal and spinal region.

In our analysis, males were affected more than females (M:F=1.5:1). However, meningioma was predominantly found in females (M:F= 1:2).

A similar female preponderance was observed by Yeole[9] and Ghanghoria et al.[10].

The present study showed predominant age group affected by CNS tumours was between 21-40 years (42.8%), followed by the age group 41-60years(28.6%).

Ghanghoria et al.[10], India, reported the most common tumour as meningioma in the age group between 31-40 years, and the findings are similar to this study.

However, when compared with data reported from the central brain tumour registry of the United States(CBTRUS) between 2010 -2014, the age group affected by brain tumours were older; 14% <20 years, 28% from 20-49 years, 31% from 50-69 years and 27% over 70 years.[11]

Regarding the adolescent population (<20years) in our study, there was only one case of medulloblastoma in a 14-year-old female (2.4%).

Medulloblastoma had male predominance in the CBTRUS study.[11] As the total number of tumours classified in this group is small firm conclusion cannot be made.

Fan et al. also reported a proportionately low frequency of CNS tumours at both extremes of the age spectrum (below 10 years and greater than 70 years). The highest frequency was noted in 50-59 years age group.[12]

The 2nd most common CNS tumour was the diffuse astrocytic tumour, among which glioblastoma multiforme was the most common (21.5%). Astrocytomas were seen in 68.75% of males. According to Surawicz et al.,[7] gliomas affect males than females predominantly.

The frontal lobe (43%), followed by the temporal and spinal region, was the most common site of involvement in CNS tumours. This agrees with the findings of the study conducted by Trabelsi S et al. and Jalali and Dutta. [13,14]

In this series, metastatic spread from a distant primary to the brain is 7%(3/42), frequency of metastasis is lower than that of various previous studies. Bangash from Saudi Arabia has reported a very high rate of metastatic tumours (28.5%) in his study.[15]

It is difficult to compare these different studies due to the lack of uniformity in case of numbers and study methodologies.

Conclusion

The present study helps provide information regarding the burden of disease in our population. Despite the use of modern imaging technique that helps in the provisional diagnosis of disease, histological examination is the gold standard in diagnosing varied types of brain tumours. Further utility of immunohistochemistry aids in confirmation of the disease.

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Conflict of interest

There are no conflicts of interest to declare by any of the authors of this study.

References

1. Stewart BW, Kleihues P. Tumors of the Nervous System. In: World Cancer Report. Lyon, France: IARC Press; 2003.
2. Iyenger B, Chandra K. The pattern of distribution of tumors in the brain and spinal cord. Ind J Cancer 1974;11:134-8.
3. Wohrer A. Epidemiology and brain tumors : practical usefulness. Eur Assoc Neurol Mgr Mag 2013;3:56-60
4. Thakkar JP, Dolecek TA, Horbinski C, Ostrom QT, Lightner DD, Barnholtz-Sloan JS, et al. Epidemiologic and molecular prognostic review of glioblastoma. Cancer Epidemiol Biomarkers Prev 2014;23:1985-96
5. Louis DN, Perry A, Reifenberger G, von Deimling A, Figarella Branger D, Cavenee WK, et al. The 2016 World Health Organization classification of tumors of the central nervous system: A summary. Acta Neuropathol 2016;131:803-20.
6. Ferlay J, Soerjomataram I, Ervik M, Dikshit R, , Eser S, Mathers C, et al. Globocan 2012, Cancer Incidence and Sci( Turkish)2007;24:212-18.

7. Surawicz TS, McCarthy BJ, Kupelian V, Jukich PJ, Bruner JM, Davis FG, et al. Descriptive epidemiology of primary brain and CNS tumors: Results from the central brain tumor registry of the united states, 1990-1994. Neuro Oncol 1999;1:14-25.

8. Lee CH, Jung KW, Yoo H, Park S, Lee SH. Epidemiology of primary brain and central nervous system tumors in Korea. J Korean Neurosurg Soc 2010;48:145-52.

9. Yeole BB. Trends in the brain cancer incidence in India. Asian Pac J Cancer Prev 2008;9:267-70.

10. Ghanghoria S, Meher R, Kulkarni CV, Mittal M, Yadav A, Fatidar H. Retrospective histological analysis of CNS tumors- A 5 year study. Int J Med Sci Public Health 2014; 3:1205-7.

11. Ostrom QT, Gittleman H, Xu J, Kromer C, Wolinsky Y, Kruchko C et al. CBTRUS statistical report: Primary brain and other central nervous system tumors diagnosed in the united states in 2009-2013. Neuro Oncol 2016;18:v1-v75

12. Fan K, Pezeshkpour GH. Ethnic Distribution of Primary Central Nervous system tumors in Washington, DC 1971 to 1985. J Natl Med Assoc.1992;84(10):858-63.

13. Trabelsi S, H'mida-Ben Brahim D, Ladib M, Mama N, Harrabi I, Tilli K, et al. Glioma epidemiology in the central Tunisian population: 1993-2012. Asian Pac J Cancer Prev. 2014;15(20):8753-57.

14. Jalali R, Datta D. Prospective analysis of incidence of central nervous tumors presenting in a tertiary cancer hospital from India. J Neurooncol 2008;87:111-4.

15. Bangash MH. Incidence of brain tumors at an academic centre in western Saudi Arabia. East Afr Med J 2012;88:138-42.