An epidemiological study of paediatric central nervous system (CNS) tumours in Gujarat cancer research institute, Ahmedabad

Priti P Trivedi1*, Deepak K Goel1, Shailee P Mehta1, Dhaval H Jetly1

1 Dept. of Pathology, Gujarat Cancer Research Institute, Ahmedabad, Gujarat, India

A R T I C L E   I N F O

Article history:
Received 26-01-2019
Accepted 11-04-2019
Available online 22-11-2019

Keywords:
Paediatric CNS tumours
Epidemiological study
WHO classification 2016

A B S T R A C T

Paediatric brain tumours are the most common solid tumours in children and hence, leading cause of mortality and morbidity in children in our country. Though we have enough statistical data about its epidemiology in western population, there are only a few reports from developing countries like India.

Aims: To study the epidemiological patterns of brain tumours in children in our institute.

Materials and Methods: It is a medical record based observational study in which retrospective epidemiological approach is used. The records of 50 children <18 years registered in our department suffering from primary brain malignancy over a period of one year are selected. Data regarding age, sex, site of the tumour, clinical features, histology and immunohistochemistry are collected. The World Health Organization classification 2016 of neoplasms is adopted.

Results: Male patients falling under the age group of 6-10 years is the most common age group in which these tumours are diagnosed. The most common primary paediatric brain tumours were astrocytic tumours (28%), followed by medulloblastoma (26%) and ependymoma (16%). The most common astrocytic tumour was pilocytic astrocytoma.

Conclusion: Our study is an attempt to analyse the epidemiological pattern of paediatric CNS tumours in premiere tertiary care cancer institute of western India which showed the histological profile of paediatric brain tumours in India is like that reported in the Western literature.

© 2019 Published by Innovative Publication. This is an open access article under the CC BY-NC-ND license (https://creativecommons.org/licenses/by/4.0/)

1. Introduction

In children under 15 years of age, brain tumours are second most common type of tumours after leukemia and represent around approximately twenty percent of childhood malignancies.1 According to the Indian Council of Medical Research, National Cancer Registry data, the incidence of paediatric brain tumours varies from 0% to 2.11%.2

Childhood central nervous system (CNS) tumours differ from adult brain tumours with respect to their primary sites of origin, clinical features, tendency to spread early, histological characteristics and their biological behaviour. Unlike adults, almost fifty percent of all the childhood brain tumours are in the infratentorial region. The predominant CNS tumour types in adults are metastases, glial neoplasms and meningiomas, whereas in children, major tumour include gliomas and primitive embryonal neoplasms.

Extensive tumour surgical resection and chemotherapy above radiation are advised for paediatric brain tumours.3 Fortunately, as compared to adults, brain tumours in the paediatric age group carry a better prognosis.4 Prognosis and 5-year survival depend not only on the type of tumour and its grade but only on its location, duration of symptoms, speed of growth, and infiltration into normal brain parenchyma.5

Population-based studies are required to determine the cancer burden due to paediatric CNS malignancies and for the histological typing of brain tumours in India. There are very few studies published from India describing the prevalence of paediatric brain and spinal cord tumours. This data will greatly contribute to the Indian database of
paediatric CNS tumours.

2. Materials and Methods

This study is a retrospective medical record-based observational study carried out over a period of one year in the department of pathology at a tertiary referral centre of western India.

2.1. Inclusion criteria

Only those patients were under 18 years of age and diagnosed as well as treated in our hospital in the study duration were included in the study. Exclusion criteria

1. Patients who had received chemotherapy or radiotherapy before being admitted to our hospital.
2. Patients who had any other coexistent primary malignancies elsewhere in the body.
3. Patients who had any kind of developmental malformation in CNS.
4. Patients who were a known case of malignant metastasis from other parts of the body.

The hospital records of all the patients fulfilling the inclusion criteria were analyzed, and descriptive epidemiological records were created for the patients by age, sex, and histological variables according to the WHO grading of paediatric CNS tumours 2016.

3. Results

A total of 50 cases of primary paediatric CNS tumours were analysed in our department in a period of two years.

3.1. Sex distribution

Number of male patients were slightly more than female patients and male to female patients’ ratio is 1.2:1.

3.2. Age distribution

Most common age group noted was 6-10.

3.3. Location

| Location        | Number | Percentage |
|-----------------|--------|------------|
| Posterior fossa | 18     | 36%        |
| Ventricles      | 15     | 30%        |
| Cerebrum        | 9      | 18%        |
| Suprasellar     | 7      | 14%        |
| Spinal cord     | 1      | 2%         |
| Total           | 50     | 100%       |

Posterior fossa was the most common site of these tumours followed by ventricles.

Most common clinical symptoms at time of presentation in descending order of their frequency were headache, vomiting, neurological defects, seizures, visual deficits, and fever.

4. Discussion

Though still in our country, infections are a major cause of mortality in children, with the advent of antibiotics they have largely been controlled, and malignancies have emerged as a substantial aetiology of childhood mortalities.

The male: female ratio in our study is 1.2 :1 which is almost comparable to the study by Yeole et al.\(^6\) and Nasir et al.\(^7\) and is little more than the study done by seven premiere institutes of our country which was 1:1.2.\(^8\) Male preponderance in India is likely due to the cultural factors wherein boys get more attention and are brought to the hospital more often for management. The mean age of paediatric brain tumours in our study is 8 years, higher than that observed in the study by Nasir et al.\(6,7\)
Table 2: Histological subtype and grading of paediatric CNS tumours (According to WHO classification of paediatric CNS Tumours 2016)

| Type of tumour (no of cases) | Subtype (no of cases) | Grade (no of cases) | Percentage |
|-----------------------------|----------------------|---------------------|------------|
| Embryonal tumours (18)     | Medulloblastoma (13) | Grade IV (13)       | 26%        |
|                             | Embryonal tumour (2) | Grade IV (2)        | 4%         |
|                             | PNET-(3)             | Grade IV (3)        | 6%         |
|                             |                      | Grade I (8)         |            |
| Diffuse astrocytic and      | Astrocytoma (14)     | Grade II (4)        | 28%        |
| oligodendrogial tumours (17)| Oligodendroglioma (1)| Grade II (1)        | 2%         |
|                             | Glioblastoma (2)     | Grade IV (2)        | 4%         |
|                             |                      | Grade I (1)         |            |
| Ependymal tumours (8)       | Ependymoma (8)       | Grade II (5)        | 16%        |
| Meningioma (3)              | Meningioma (3)       | Grade I (1)         | 6%         |
| Tumour of the sellar origin (3) | Craniopharyngioma (3) | Grade I (3) | 6% |
| Neuronal and mixed neuronal glial tumour (1) | Ganglioglioma (1) | Grade I (1) | 2% |

Table 3: Astrocytoma subclassification

| Astrocytoma subtype          | No of cases |
|------------------------------|-------------|
| Pilocytic astrocytoma        | 5           |
| Diffuse astrocytoma          | 4           |
| Pilomyxoid astrocytoma       | 3           |
| Anaplastic astrocytoma       | 2           |
| Total no of cases            | 14          |

Table 4: Embryonal tumour sub-classification

| Embryonal tumour subtype     | No of cases |
|------------------------------|-------------|
| Teratoid type                | 1           |
| Multilayer rosette type      | 1           |
| Total                        | 2           |

Table 2: Histological subtype and grading of paediatric CNS tumours (According to WHO classification of paediatric CNS Tumours 2016)

| Type of tumour (no of cases) | Subtype (no of cases) | Grade (no of cases) | Percentage |
|-----------------------------|----------------------|---------------------|------------|
| Embryonal tumours (18)     | Medulloblastoma (13) | Grade IV (13)       | 26%        |
|                             | Embryonal tumour (2) | Grade IV (2)        | 4%         |
|                             | PNET-(3)             | Grade IV (3)        | 6%         |
|                             |                      | Grade I (8)         |            |
| Diffuse astrocytic and      | Astrocytoma (14)     | Grade II (4)        | 28%        |
| oligodendrogial tumours (17)| Oligodendroglioma (1)| Grade II (1)        | 2%         |
|                             | Glioblastoma (2)     | Grade IV (2)        | 4%         |
|                             |                      | Grade I (1)         |            |
| Ependymal tumours (8)       | Ependymoma (8)       | Grade II (5)        | 16%        |
| Meningioma (3)              | Meningioma (3)       | Grade I (1)         | 6%         |
| Tumour of the sellar origin (3) | Craniopharyngioma (3) | Grade I (3) | 6% |
| Neuronal and mixed neuronal glial tumour (1) | Ganglioglioma (1) | Grade I (1) | 2% |

Table 3: Astrocytoma subclassification

| Astrocytoma subtype          | No of cases |
|------------------------------|-------------|
| Pilocytic astrocytoma        | 5           |
| Diffuse astrocytoma          | 4           |
| Pilomyxoid astrocytoma       | 3           |
| Anaplastic astrocytoma       | 2           |
| Total no of cases            | 14          |

Table 4: Embryonal tumour sub-classification

| Embryonal tumour subtype     | No of cases |
|------------------------------|-------------|
| Teratoid type                | 1           |
| Multilayer rosette type      | 1           |
| Total                        | 2           |

years) and comparable with the study done by Mehrazin and Yavari (8.7 years). Even though some tumours tend to occur more frequently at certain specific ages, age itself is of no particular importance in diagnosing tumour type. All the tumours are known to occur at any age throughout childhood. Our series had more children in the second hemicraniopharyngioma (6%) which is similar to large meta-analysis done by Rickert and Paulius, and little different from a study done by seven institutes of our country in which third most common tumour was craniopharyngioma followed by ependymoma.

Symptoms and signs depend on the type of tumour, but also on its growth rate, location in the CNS, and age of the child. Neurological symptoms produced by brain tumours are divided into general or local manifestations. General symptoms are due to increased intracranial pressure, which results directly from progressive enlargement of the tumour within the limited volume of the cranial vault and secondly causing blockage of the flow of cerebrospinal fluid; local symptoms are because of the pressure caused by tumour on contiguous areas of the brain. The most common presenting complaint for brain tumours in our study was headache, vomiting, seizures while ataxia was the most common clinical feature in spinal cord tumours.

Multimodality approach including surgery, chemotherapy, and radiotherapy is the cornerstone in the management of childhood brain tumours.
### Table 5: Relation between tumour type and location

| Tumour type (no of cases) | Site of origin (no of cases) | Percentage |
|--------------------------|-----------------------------|------------|
| Medulloblastoma (13)     | Posterior fossa (8)         | 16%        |
|                          | Fourth ventricle (4)        | 8%         |
|                          | Lateral ventricle (1)       | 2%         |
| Embryonal tumour (2)     | Posterior fossa (2)         | 4%         |
|                          | Occipital lobe (1)          | 2%         |
| PNET (3)                 | Partial lobe (1)            | 2%         |
|                          | Spine (1)                   | 2%         |
|                          | Posterior fossa (5)         | 10%        |
|                          | Suprasellar (4)             | 8%         |
| Astrocytoma (14)         | 3rd ventricle (2)           | 4%         |
|                          | Temporal lobe (2)           | 4%         |
|                          | Intramedullary (1)          | 2%         |
| Oligodendroglial tumour (1) | Frontal lobe (1)         | 2%         |
| Glioblastoma (2)         | Frontal lobe (2)            | 4%         |
|                          | 4th ventricle (4)           | 8%         |
| Ependymoma (8)           | 3rd ventricle (3)           | 6%         |
|                          | Lateral ventricles (1)      | 2%         |
|                          | Frontal lobe (1)            | 2%         |
| Meningioma (3)           | Posterior fossa (1)         | 2%         |
|                          | Parietal lobe (1)           | 2%         |
| Craniopharyngioma (2)    | Suprasellar (2)             | 4%         |
| Ganglioglioma (1)        | Suprasellar (1)             | 2%         |
| Germ cell tumour (1)     | Posterior fossa (1)         | 2%         |

5. Conclusion

This study is an attempt to map the epidemiology of paediatric brain tumours from western India, which revealed the histopathological diversity of childhood neurological neoplasms based on large hospital series of paediatric patients. The major limitation of the present study is that it is a single institution study and hence may not reflect the national statistics. More and more studies like this from various cancer centres across India help to project an epidemiological profile of Indian paediatric brain tumours and thereby aid in developing national treatment protocols. The study also reflects the need to strengthen the follow-up practices for providing the best possible care to our children. This may also result in adjustment of health programs.

6. Source of funding

None.

7. Conflict of interest

None

References

1. Rosenberg S, Fujiwara D. Epidemiology of paediatric tumours of the nervous system according to the WHO 2000 classification: A report of 1,195 cases from a single institution. *Childs Nerv Syst*. 2005;21:940–994.

2. Consolidated Report of Population Based Cancer Registries 2001-2004. National Cancer Registry Programme, Indian Council of Medical Research, Bangalore, India; December 2006.

3. Albright AL. Brain tumours in neonates, infants and toddlers. *Contemp Neurol Surg*. 1985;7:1–8.

4. Hutter A, Schwertye KE, Bierhals AJ, McKinstry RC. Brain neoplasms: Epidemiology, diagnosis, and prospects for cost-effective imaging. *Neuroimaging Clin N Am*. 2003;13:237–250.

5. Pathology and Genetics of Tumours of the Nervous System. Lyon, France: International Agency for Research on Cancer; 2000; p. 314.

6. Yeole BB, Advani SH, Sunny. Epidemiological features of childhood cancers in greater Mumbai. *Indian Pediatr*. 2001;38:1270–1277.

7. Nasir S, Jamila B, Khaleeq S. A retrospective study of primary brain tumours in children under 14 years of age at PIMS, Islamabad. *Asian Pac J Cancer Prev*. 2010;11:1225–1227.

8. Jain A, Sharma MC, Suri V, Kale SS, Mahapatra AK, et al. Spectrum of paediatric brain tumours in India: A multi-institutional study. *Neural India*. 2011;59:208–211.

9. Mehrazin M, Yavari P. Morphological pattern and frequency of intracranial tumours in children. *Childs Nerv Syst*. 2007;23:157–162.

10. Cushing H. The intracranial tumours of pre-adolescence. *Am J Dis Child*. 1927;33:551–584.

11. Rickert CH, Paulus W. Epidemiology of central nervous system tumours in childhood and adolescence based on the new WHO classification. *Childs Nerv Syst*. 2001;17:503–511.

12. Packer RJ, Macdonald T, Vezina G. Central nervous system tumours. *Pediatr Clin North Am*. 2008;55:121–145.

13. Bhat S, Yadav SP, Suri V, Patir R, Kurkure P, Kellie S. Management of childhood brain tumours. *Indian J Pediatr*. 2011;78:1510–1519.

Author biography

Priti P Trivedi Associate Professor

Deepak K Goel Resident Doctor
Cite this article: P Trivedi P, K Goel D, P Mehta S, H Jetly D. An epidemiological study of paediatric central nervous system (CNS) tumours in Gujarat cancer research institute, Ahmedabad. Indian J Pathol Oncol. 2019;6(4):642-646.