Spectrum of pediatric brain tumors in India: A multi-institutional study

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Abstract

Background: Till date there is no published multi-institutional data regarding the epidemiological profile of pediatric brain tumors in India. Aim: The present retrospective study analyses the histological spectrum of pediatric age group brain tumors in seven tertiary care hospitals in India. Material and Methods: Data regarding frequencies of various primary brain tumors (diagnosed according to the World Health Organization (WHO) classification), in 3936 pediatric patients (<18 yrs of age), was collected from seven tertiary care hospitals in India. Results: The most common primary pediatric brain tumors were astrocytic tumors (34.7%), followed by medulloblastoma and supratentorial primitive neuro-ectodermal tumors (22.4%), craniopharyngiomas (10.2%) and ependymal tumors (9.8%). The most common astrocytic tumor was pilocytic astrocytoma. In comparison to adults, oligodendrogliomas and lymphomas were rare in children. Conclusions: Our study is the first such report on the histological spectrum of brain tumors in children in India. Except for a slightly higher frequency of craniopharyngiomas, the histological profile of pediatric brain tumors in India is similar to that reported in the Western literature.

How to cite this article:

How to cite this URL:

Full Text
Tumors of the nervous system are the second most common childhood tumor after leukemia, constituting approximately 35% of all childhood malignancies and remain the leading cause of cancer-related deaths in children. Childhood central nervous system (CNS) tumors differ significantly from adult brain tumors in reference to their sites of origin, clinical presentation, tendency to disseminate early, 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 neoplasms has led to investigations in distinct molecular and genetic pathways and therapeutic approaches for each tumor type. However, for the necessary research required in the field of pediatric brain tumors, a thorough knowledge of the worldwide incidence and distribution of the various neoplasms is essential. There are several reports regarding the epidemiology of CNS tumors in children in the Western literature. However, due to scarcity of reliable data collection and monetary resources, information on the demographic profiles of these tumors is scant in the developing world, where due to a large population load the burden of such tumors is high. Specifically, till date, there is no published database on the profile of pediatric brain tumors in India, which is indeed a difficult and marathon task. The present study therefore attempts to profile the hospital-based prevalence of pediatric CNS tumors (according to the WHO classification) at seven large centers in India having excellent neurosurgical and neuropathology facilities. The data has been compared with international statistics from population- and hospital-based series.

**Material and Methods**

Data on CNS tumors in the pediatric age group (<18 years of age) was collected from the neuropathology records of seven tertiary hospitals in India, which included GB Pant Hospital, New Delhi; Christian Medical College (CMC), Vellore; Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh; National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore; Tata Memorial Hospital (TMH), Mumbai; Chhatrapati Shahji Maharaj Medical University (CSMMU), Lucknow, and All India Institute of Medical Sciences (AIIMS), New Delhi. The time periods for which data was available differed among the institutes. Primary tumors of the brain were included, while metastatic tumors and vascular malformations were excluded. The cases were diagnosed and characterized where necessary using immunohistochemistry and categorized according to the most recent WHO classification prevalent at the time of diagnosis. With these criteria, a total of 3936 pediatric brain tumors were collected and analyzed to assess breakup of different histological types and grades and compared with available international data in tumor registries and hospital-based studies.

**Results**

Pediatric CNS tumors accounted on an average 14.8% of total intracranial tumors (ranging from 10-21%, [Table 1]). The percentage breakup of various histological subtypes from various hospitals is provided in [Table 2], and percentage breakup of histological subtypes of the most common gliomas (astrocytomas, oligodendrogliomas and ependymomas) in [Table 3]. On comparing the histological subtypes of pediatric CNS tumors, it was seen that astrocytomas averaged 34.7% (range 22.3-46.7%), and were the commonest tumors in almost all the hospitals. Embryonal tumors including medulloblastomas, supratentorial primitive neuroectodermal tumors (PNETs), Atypical teratoid rhabdoid tumors (ATRTs), etc, comprised the second largest group after astrocytomas (average 22.4%). Craniopharyngiomas (10.2%) were the third most common tumors followed by ependymal tumors (9.8%), neuronal and mixed-neuronal glial tumors (4%), nerve sheath tumors (3.6%) and meningeal tumors (3.2%).

Among the astrocytomas [Table 3], WHO Grade I tumors (pilocytic astrocytomas and subependymal giant cell astrocytoma (SEGA) were the commonest (average 23%). Grade IV astrocytomas (glioblastoma multiforme (GBM) comprised on an average 4.46%. In ependymal tumors, anaplastic ependymoma (Grade III) was relatively more common and comprised one-thirds to half of ependymal tumors. Oligodendrogliomas were
very rare in the pediatric age group (1.1%). CNS lymphomas also formed a rare diagnosis in children.

[Table 4] compares the frequency of various CNS tumors reported in different countries, including developed countries such as Canada, Sweden, Japan and Germany as well as developing ones like Brazil, China and Morocco. [1],[5],[6],[7],[8],[9],[10],[11] The frequency of tumors in India fell between the ranges formed by the international data. (Table 4)

**Discussion**

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 diseases goes unnoticed and is underestimated. Hospital-based prevalence data therefore forms the basis for estimating the disease load. This data is essential for ascertaining the required healthcare infrastructure in the management of these diseases, and for assessing geographical differences in their molecular and genetic profiles. With increased availability of diagnostic facilities and better healthcare, the incidence of CNS tumors seems to be on the rise in developing countries. Due to the high incidence and mortality of childhood CNS tumors, they form the most demanding group of tumors for neuro-oncologists. In contrast to the Western literature, there is to date no report exclusively profiling pediatric CNS tumors in India. We assessed the hospital-based prevalence of such tumors by collecting data (categorized according to the most recent WHO classification [4] ) from seven centers with first-rate neurosurgical facilities in different geographical locations in India, in an attempt to represent the profile of the entire country.

In our study, the most common brain tumors in the pediatric age group in descending order are astrocytoma, medulloblastoma, craniopharyngioma followed closely by ependymoma. However, in a large meta-analysis by Rickert and Paulius, [3] it was seen that internationally, ependymomas are the third most common tumors followed by craniopharyngioma occupying the fourth place. This trend can be seen in [Table 4] in the data from Canada, [7] Germany, [6] Sweden, [9] and Morocco [10] while figures from Korea [5] and Brazil [1] are similar to Indian data. Data from a single institute in Beijing, China, however, showed craniopharyngiomas to be the second commonest tumor. [8] Rickert and Paulius found germ cell tumors to be the fifth most common type, [3] but as can be seen from [Table 4], the frequency of germ cell tumors varies markedly in different countries ranging from just 0.9% in Morocco [10] to 14.3% in Japan. [11] In particular, all the three oriental Asian countries included i.e. Korea, China, and Japan, show higher frequency for germ cell tumors and craniopharyngiomas, suggesting environmental and/or genetic differences. As can be seen from [Table 4], except for a marginally higher frequency of craniopharyngiomas, the spectrum of brain tumors in Indian children seems to resemble Western studies.

The primary limitation of our study was variation in the time duration of data collected from different institutions starting from 1990-2006 till 2007. This highlights the requirement of uniform and structured cancer registries in developing countries like India and the recent awareness of the importance of gathering data for epidemiological purposes by hospitals. In spite of this limitation, this study serves an important purpose as an initial attempt to profile brain tumors in Indian children, on a multi-institutional level, across different geographic regions, in an effort to represent the entire patient population. Also, the tumor frequencies differed between different hospitals, as all are tertiary level referral hospitals. The incidence of various CNS tumors in the current study falls well within the range seen in the international studies for every tumor category. This can have important connotations in the field of pediatric brain tumor research in India, particularly when analyzing differences in their molecular and genetic pathways, which could aid in the development of targeted, individualized therapies and planning treatment protocols and strategies.

To conclude, there is a rising global trend in the incidence of pediatric CNS tumors. Based on large hospital series of pediatric patients, the present survey revealed the histopathological diversity of childhood neurological neoplasms, and provides the first profile of the spectrum of CNS tumors in children in India.

**References**

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