ORIGINAL ARTICLE

MORPHOLOGICAL PATTERN AND FREQUENCY OF CENTRAL NERVOUS SYSTEM TUMOURS IN CHILDREN

Bilqees Fatima, Samina Khaleeq*, Mohammad Tahir, Khaleeq-uz-Zamaan*

Department of Pathology, Federal Government Polyclinic, Islamabad, *Department of Neurosurgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad-Pakistan

Background: Recent studies, including a comprehensive study by National Cancer Institute, have shown that a significant increase in the incidence of childhood brain tumours makes them the most common paediatric tumour. The objectives of this study were to determine the frequency of central nervous system tumours in paediatric age group (0–12 years), and to segregate various morphologic types according to WHO classification. **Methods:** The study included consecutive cases of central nervous system tumours diagnosed in children in the histopathology department at Federal Government Polyclinic, PGMI, Islamabad, during a period of 4.8 years (Jan 2009–Aug 2013). The initial histopathological evaluation of these lesions was performed on H&E stained sections of paraffin embedded tissues. Special stains and immunohistochemistry were performed whenever indicated. **Results:** Out of 75 cases, 34 (45.3%) were astrocytic tumours, including 16 (47.1%) Pilocytic astrocytomas (WHO Grade-I), 1 (2.9%) diffuse fibrillary astrocytoma (WHO Grade-II), 1 (2.9%) anaplastic astrocytoma (WHO Grade-III) and 16(47.1%) glioblastoma multiforme (WHO Grade-IV); 18 (24%) were embryonal tumours including 17 (94.4%) medulloblastoma (WHO Grade-IV) and 1 (5.6%) neuroblastoma (WHO Grade IV); 10 (13.3%) were craniopharyngiomas (WHO Grade-I) and 5 (6.7%) were ependymal tumours including 1 (20%) myxopapillary ependymoma (WHO Grade-I) and 4 (80%) ependymomas (WHO Grade-II). Miscellaneous entities included 3 (4%) choroid plexus tumours; 1 (2%) anaplastic oligodendroglioma (WHO Grade-III); 1 (2%) atypical meningioma (WHO Grade-II); 1 (2%) schwannoma (WHO Grade-I); 1 (2%) neurofibroma (WHO Grade-I) and 1 (2%) lipoma (WHO Grade-I). **Conclusion:** Astrocytic tumours are the most common central nervous system tumours in paediatric age group and high grade lesions (WHO Grade-IV) constitute the largest category (45.3%).

Keywords: Paediatric, Central nervous system, Astrocytoma, Medulloblastoma, Pilocytic, astrocytomas, craniopharyngiomas

J Ayub Med Coll Abbottabad 2016;28(1):44–6

INTRODUCTION

For several decades, paediatric brain tumours were reported to be the most common type of cancer in children, second only to leukaemia. But recent studies, including a comprehensive study by National Cancer Institute, have shown that an increasing incidence of childhood brain tumours makes them the most common malignancy in paediatric age group.[1] In United States, brain and CNS tumours in children younger than 15 years occurred at an annual rate of 3.45 per 100,000 person years in 1994[2], which increased to a corresponding value of 4.92 per 100,000 person years in 2004-2008[3]. This is partly attributed to the use of more sophisticated diagnostic methods including CT scan and MRI.[4] However environmental and genetic factors cannot be completely ruled out.[5] In developing countries the prevalence rate has been reported from 4.38–12.6%, while in developed countries it is only 2%.[6] Part of this may be due to the fact that children make up a large proportion of our population (Approximately 39%).[7] Morbidity and mortality caused by these tumours is a serious issue which needs to be addressed. Overall 5 year survival rate for brain and central nervous system tumours according to Central Brain Tumour Registry of United States was estimated to be 71.9%, with a wide range between low and high grade tumour types. For example, estimated 5 year survival rates for pilocytic astrocytoma (WHO grade I), medulloblastoma (WHO grade IV) and glioblastoma (WHO grade IV) were 97.1%, 61.5% and 20.5% respectively.[3] Although hospital based studies cannot give exact incidence rates, however, the information may be useful in giving patterns of these tumours in our region.[8] Keeping in view these facts and figures, the aim of this study was to provide a comprehensive data regarding the prevalence of central nervous system tumours in children in our vicinity by using an updated WHO classification, so that better management of these tumours can be planned in future.

MATERIAL AND METHODS

The study was conducted in the histopathology department of Federal Government Polyclinic, PGMI Islamabad. Most of the cases were received from Neurosurgery department, Pakistan Institute of Medical Sciences (PIMS) hospital, Islamabad, while a few cases were from private hospitals. The time span was 4.8

years starting from January 2009 till August 2013. It was a retrospective study. All the relevant data was retrieved from archives of histopathology department. All the central nervous system tumours of children aged 0–12 years were included in the study. The histologic typing and grading of these tumours were done according to WHO classification.

RESULTS

A total of 75 cases were studied during the study period, 46 in males and 29 in females with a male to female ratio of 1.6. Mean age was 7±3.3 years (age range 07 months-12 years).Cases were divided into three age groups, 0–4 years, 5–8 years and 9–12 years, with the number of cases in each age group being 18, 26 and 31 respectively. Distribution of the common tumour types in these age groups is given in table-1.

Out of 75 cases, astrocytic tumours made up the largest category, 34 cases (45.3%), including 16 (47.1%) pilocytic astrocytomas (WHO Grade-I), 1 (2.9%) diffuse fibrillary astrocytoma (WHO Grade-II), 1 (2.9%) anaplastic astrocytoma (WHO Grade-III) and 16 (47.1%) glioblastoma multiforme (WHO Grade-IV). Embryonal tumours comprised the second most common category, 18 cases (24%), including 17 (94.4%) medulloblastoma (WHO Grade-IV) and 1 (5.6%) neuroblastoma (WHO Grade-IV). Craniopharyngioma (WHO Grade-I) was the third most common tumour, 10 cases (13.3%). Miscellaneous entities included 5 (6.7%) ependymal tumours; 3 (4%) choroid plexus tumours; 1 (2%) anaplastic oligodendroglioma (WHO Grade-III); 1 (2%) atypical meningioma (WHO Grade-II), 1(2%) schwannoma (WHO Grade-I), 1 (2%) neurofibroma (WHO Grade-I) and 1 (2%) lipoma (WHO Grade-I). Details are given in table-2. Overall, high grade (WHO Grade-IV) lesions were most common (45.3%). These include glioblastoma, medulloblastoma and neuroblastoma. Low grade (WHO Grade-I) lesions ranked the second most common category (41.3%), including pilocytic astrocytoma, craniopharyngioma, myxopapillary ependymoma, schwannoma, neurofibroma and lipoma. Grade-II and grade-III lesions were uncommon. Figure 2 shows percentages of different tumour grades.

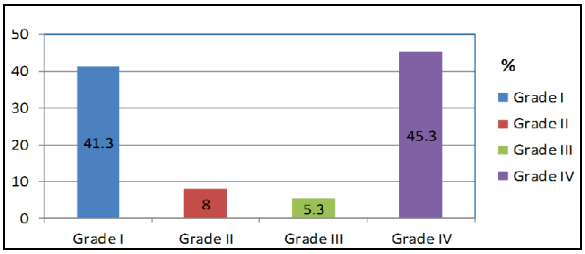

Figure-2: Percentage by tumour grade

Table-1: Histologic tumour types according to age groups

Histologic types	0–4 years	5–8 years	9–12 years
Pilocytic astrocytoma	4	4	8
Glioblastoma multiforme	5	3	8
Medulloblastoma	3	10	4
Craniopharyngioma	1	2	7
Ependymoma	0	3	2

Table-2: Distribution of brain tumours by morphological subtypes

Tumour categories according to 2007 who classification	No of Cases	M	F	M/F	%
Astrocytic Tumours	**34**	**19**	**15**	**1.3:1**	**45.2**
i. Pilocytic astrocytoma(WHO grade I)	16	9	7	1.3:1	47.1
ii. Diffuse fibrillary astrocytoma. (WHO grade II)	01	1	0	1:0	2.9
iii. Anaplastic astrocytoma(WHO grade III)	01	0	1	0:1	2.9
iv.Glioblastoma multiforme(WHO grade IV)	16	9	7	1.3:1	47.1
• Gliosarcoma (WHO grade IV)	2	2	0	2:0	12.5
Embryonal Tumours	**18**	**13**	**5**	**2.4:1**	**24**
i. Medulloblastoma (WHO grade IV)	17	12	5	2.4:1	94.4
• Classic	14	9	5	1.8:1	82.4
• Desmoplastic	03	3	0	3:0	17.6
ii. Neuroblastoma (WHO grade IV)	01	1	0	1:0	5.6
Tumours of sellar region	**10**	**5**	**5**	**1:1**	**13.3**
Craniopharyngioma (WHO grade I)	10	5	5	1:1	100
Ependymal Tumours	**05**	**5**	**0**	**5:0**	**6.7**
i. Ependymoma (WHO grade II)	03	3	0	3:0	80
ii. Myxopapillary ependymoma (WHO grade I)	02	2	0	2:0	20
Choroid Plexus Tumours	**03**	**2**	**1**	**2:1**	**04**
i.Choroid plexus papilloma (WHO grade I)	01	1	0	1:0	33.3
ii.Choroid plexus carcinoma (WHO grade III)	02	1	1	1:1	66.7
Tumours of cranial /para spinal nerves	**02**	**2**	**0**	**2:0**	**2.7**
i. Schwannoma (WHO grade I)	01	1	0	1:0	50
ii. Neufibroma (WHO grade I)	01	1	0	1:0	50
Meningeal Tumours	**01**	**0**	**1**	**0:1**	**1.3**
Atypical meningioma (WHO grade II)	01	0	1	0:1	100
Oligodendroglial Tumours	**01**	**0**	**1**	**0:1**	**1.3**
Anaplastic Oligodendroglioma (WHO grade III)	01	0	1	0:1	100
Mesenchymal tumours	**01**	0	1	0:1	**1.3**
Lipoma (WHO grade I)	01	**0**	**1**	**0:1**	100

Table-3: Paediatric CNS tumours, comparison of current study and other published studies

Tumour Types Author/Period of study	Astrocytic tumours %	Medulloblastoma %	Ependymoma %	Craniopharyngioma %	Oligodendroglioma %
Sajid *et al*[14] (1995–97)	39	18.6	13	0	7.5
Ghazala *et al*[5] (1999–2002)	44.8	15.5	10.3	3.4	1.7
Naseem *et al*[16] (1989–98)	34.6	45.7	10	0	1.2
Jacqueline *et al*[15] (1935–1973)	38.1	24	10	8.6	1.2
Present (2009–13)	45.3	24	6.7	13.3	2

DISCUSSION

Brain tumours are the most frequent solid neoplasms of childhood.[9] Starr was the first to publish a large series of intracranial mass lesions, 300 cases.[10] Since then, a number of large series have been published.[11–13]

WHO system is used worldwide for classification and grading of central nervous system tumours. To the best of our knowledge, our study is the first in the region to use an updated 2007 WHO classification and grading of central nervous system tumours. The histopathological distribution of cases in our series was compared with four other series, three of them from Pakistan. Astrocytoma was the most common tumour followed by medulloblastoma in our series as well as in majority of other series.[5,14,15] Ependymoma was the third most common tumour in all of the comparison studies[5,14–16], followed by craniopharyngioma in only two of them[5,15]. Sajid *et al*[14] and Naseem *et al*[16] did not report any case of craniopharyngioma. Our study ranked craniopharyngioma as the third most common tumour, while ependymoma was at fourth place. One possible cause might be that we have included sellar tumours in our study, while some of the above mentioned studies addressed brain tumours only. Overall, grade-IV lesions were most common in our study. An increased incidence of high grade lesions was also reported by other series.[5,14–16] Table-3 gives a brief comparison of our study and the other published studies. The male to female ratio in our study was 1.6:1, showing a male predominance. This is in agreement with most of the previously published studies.[5,8,15–17] We hope that this study will provide a comprehensive data about prevalence of paediatric central nervous system tumours in our region. However, it is a single institution based study and needs a cautious interpretation. Unfortunately there are no population based registries in Pakistan except Karachi Cancer Registry.[17] Population based studies along with national cancer registries are required to determine the precise cancer burden in younger population.

CONCLUSION

Astrocytic tumours are the most common central nervous system tumours in paediatric age group, and high grade (WHO GRADE-IV) lesions constitute the largest category (45.3%).

AUTHOR'S CONTRIBTION

BF: Study Design, Write-up, SK, KUZ: Provided surgical specimens with bio-data, MT: Made the histopathological diagnosis of all cases and provided guidance regarding article writing.

REFERENCES

1. Bleyer WA. Epidemiologic impact of children with brain tumours. Childs Nerv Syst 1999;15:758–63.
2. Smith MA, Friedlin B, Ries LA, Simon R. Trends in reported incidence of primary malignant brain tumours in children in the United states. J Natl Cancer Inst 1998;90(17):1269–77.
3. Dolecek TA, Propp JM, Stroup NE, Kruchko C. CBTRUS Statistical Report: Primary Brain and Central Nervous System Tumors Diagnosed in the United States in 2005-2009. Neuro Oncol 2012;14:v1–49.
4. Birch JM, Hartley AL, Teare MD, Blair V, McKinney PA, Mann JR, *et al*. The inter-regional epidemiological study of childhood cancer (IRESCC): Case control study of children with central nervous system tumours. Br J Neurosurg 1990;4(1):17–25.
5. Hanif G, Shafqat S. Morphological pattern and frequency of intracranial tumours in children. J Coll Physician Surg Pak 2004;14(3):150–2.
6. Starling KA, Shepherd DA. Symptoms and signs of cancer in the school age child. J Sch Health 1997;47(3):144–6.
7. Young G, Torestsky JA, Campbell AB, Eskenazi AE. Recognition of common childhood malignancies. Am Fam Physician 2000;61(7):2144–54.
8. Memon F, Rathi SL, Memon MH. Pattern of Solid Paediatric Malignant Neoplasm at Lumhs, Jamshoro, Pakistan. J Ayub Med Coll Abbottabad 2007;19(4):55–7.
9. De la Torre Mondragón L, Ridaura Sanz C, Reyes Mujica M, Rueda-Franco F. Central nervous system tumours in Mexican children. Childs Nerv Syst 1993;9(5):260–5.
10. Starr MA: Tumours of the brain in childhood. Their variety and situation with special reference to their treatment by surgical interference. Med News 1889;54:29–37.
11. Low NL, Correll JW, Hammill JF. Tumours of the cerebral hemispheres in children. Arch Neurol 1965;13(5):547–54.
12. Mackay EN, Sellers AH. Malignant neoplasms of the central nervous system, Ontario Cancer Foundation Clinics, 1950-1964. Can Med Assoc J 1968;99(25):1245–53.
13. Davis CH, Odom GI, Woodhall B. Brain tumours in children-Clinical analysis of 164 cases. Pediatrics 1956;18(6):856–69.
14. Shah SH, Soomro IN, Hussainy AS, Hassan SH. Clinico Marphological Pattern of Intracranical Tumours in Children. J Pak Med Assoc 1999;49(3):63–5.
15. Farwell JR, Dohrmann GJ, Flannery JT. Central nervous system tumours in children. Cancer 1977;40(6):3123–32.
16. Ahmed N, Bhurgri Y, Sadiq S, Shakoor KA. Pediatric Brain Tumours at a Tartiary care hospital in Karachi. Asian Pac J Cancer Prev 2007;8(3):399–409.
17. Saleem MZ, Zaid ul Haq M, Badsha S. Pattern of Chilhood Malignancies at Combined Military Hospital, Rawalpindi. Pak Armed Forces Med J. 2012;62(4).

Address for Correspondence:

Mohammad Tahir, Pathology Department, Federal Government Polyclinic, PGMI, Islamabad-Pakistan
Email: mtahirtk@yahoo.com/dr.fatiema@gmail.com