

Demographic, neuroradiological and neuropathological characteristics among children with central nervous system tumors in the Iranian referral center for stereotaxis

Características demográficas, neurorradiológicas y neuropatológicas de los niños con tumores del sistema nervioso central en el centro de referencia iraní para estereotaxis

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Abstract

Introduction & Background. Central nervous system (CNS) tumors are common types of malignancies in children and the recognition of these tumors and related factors can help to improve the prognosis. The purpose of the present study was to evaluate demographic, neuroradiological, and neuropathological characteristics in 1-14-year-old children with central nervous system tumors in the Department of Pediatrics of Shohada-e Tajrish Hospital. **Methods.** In this descriptive study, 96 children aged 1-14 years with central nervous system tumors in the Department of Pediatrics of Shohada-e Tajrish Hospital from 2014 to 2016 were selected by convenience sampling, and the demographic, neuroradiological, and neuropathological characteristics were determined and compared according to other variables. **Results.** 60.4% of the patients were aged 1-10 years and 55.2% of them were male. The most common types of tumors were astrocytoma (33.3%), glioma (16.7%) and medulloblastoma (10.4%). 46.9% of the tumors were supratentorial and 53.1% were infratentorial. Enhancement was observed in 53.1% of the patients in imaging. **Conclusion.** Overall, based on the obtained results, it may be concluded that the most common types of CNS tumor in children are astrocytomas and these tumors are usually infratentorial with enhancement in imaging.

Keywords: CNS Tumor, Children, Neuropathology, Neuro-radiology.

Resumen

Introducción y antecedentes. Los tumores del sistema nervioso central (SNC) son tipos comunes de neoplasias malignas en los niños y el reconocimiento de estos tumores y factores relacionados puede ayudar a mejorar el pronóstico. El objetivo del presente estudio fue evaluar las características demográficas, neurorradiológicas y neuropatológicas en niños de 1 a 14 años con tumores del sistema nervioso central en el Departamento de Pediatría del Hospital Shohada-e Tajrish. **Métodos.** En este estudio descriptivo, se seleccionaron 96 niños de 1 a 14 años con tumores del sistema nervioso central en el Departamento de Pediatría del Hospital Shohada-e Tajrish de 2014 a 2016 mediante muestreo de conveniencia, y se determinó las características demográficas, neurorradiológicas y neuropatológicas determinado y se comparó comparado de acuerdo con otras variables. **Resultados.** el 60,4% de los pacientes tenían entre 1 y 10 años y el 55,2% eran varones. Los tipos de tumores más frecuentes fueron astrocitoma (33,3%), glioma (16,7%) y meduloblastoma (10,4%). El 46,9% de los tumores fueron supratentoriales y el 53,1% infratentoriales. Se observó realce en el 53,1% de los pacientes en las imágenes. **Conclusión.** En general, con base en los resultados obtenidos, se puede concluir que los tipos más comunes de tumor del SNC en niños son los astrocitomas y estos tumores suelen ser infratentoriales con realce en la imagen.

Palabras clave: Tumor del SNC, Niños, Neuropatología, Neurorradiología.

Tumors of the brain and spinal cord are the most frequent solid malignancies and the second cause of cancer-related death in children younger than 15 years of age¹⁻³. The prevalence of brain tumors is 28 per one million and the incidence is 2 per 100,000 every year^{4,5}. These types of malignancies are significant due to their nonspecific manifestation, difficult diagnosis, side effects, and relatively high mortality rate. The majority of brain tumors arise naturally from CNS compartments, and unfortunately, they are increasing in terms of prevalence and incidence⁶. This condition has a broad range of manifestations regarding its location, type, growth rate, and age^{7,8}, although morning headache, convulsion, personality disorders, malaise, paresis as well as vertigo, visual and hearing changes, nausea, confusion, and numbness, especially in the face, are well-known problems related to brain tumors^{8,9}.

Primary brain tumors are a group of cancers that occur in the brain tissue and compartments including glial and non-glial cells. In children, brain tumors usually derive from different parts of the organ and, in comparison with adults, radiotherapy would cause more damage to normal brain growth in the first 5 years of age.

The most common brain tumors in children are medulloblastoma, low-grade astrocytoma, ependymoma, craniopharyngioma, and brain stem glioma. In 2006, Shuangshoti et al. claimed that the prevalence of brain central tumors was twice as high in boys as in girls¹⁰. In a study by Jahan et al., the frequency and histomorphological spectrum of CNS tumors in children and their relationship with age, sex and tumor distribution in Bangladeshi children were investigated between 2006 and 2007. The results of the study showed that there were 55 cases of pediatric tumors in this period. The Patients' ages ranged from 2 months to 15 years and the mean age at diagnosis was 10.1 years. The location of the tumor was infratentorial in 59% of cases, and the most common tumor was medulloblastoma with a rate of 23%¹¹. Relatively similar findings were reported about the location by Kardi et al. Their results showed that 53% of brain tumors were infratentorial, although sex was not named as an effective factor in the prevalence of the studied tumors by them¹².

Reporting astrocytomas followed by medulloblastomas as the most frequent brain tumors, Mehdizadeh et al. showed that brain tumors were slightly more common in boys, especially in children older than 10 years¹³, and most tumors were located in the supratentorial region, although the prevalence of supratentorial and infratentorial tumors was similar in children under 10 years of age. On the other hand, Hjalmarsson et al. concluded an 80% malignancy rate of brain tumors among 1223 children between 1973 and 1992¹⁴⁻¹⁶.

However, given that there is not enough information about childhood brain tumors in children in our country, the current study was performed on children with brain tumors, who were referred to a University hospital in Tehran as a referral center for stereotaxis in Iran, in order to determine the characteristics of brain tumors in children and compare their pattern with what has been described in other countries. It also aimed at achieving optimal solutions for faster diagnosis and timely treatment and ultimately improving patients' condition.

Through a descriptive cross-sectional study, all 1- to 14-year-old children with brain tumors who were referred to Shohada-e Tajrish hospital in Tehran between 2014 and 2016 participated in this study considering the inclusion and exclusion criteria. Patients with leukemia, lymphoma and metastatic cases as well as vascular malignancies quit the study.

Initially, the records of the referrals with CNS tumors were evaluated to find individuals who were diagnosed through radiology and pathology. The patients with CNS involvement and metastasis secondary to the named exclusion criteria were excluded from the study. The type of tumor was extracted from pathologic reports, and the data including demographics, symptoms and signs, a history of cerebral trauma and infections besides first symptoms (headache, nausea, vomiting, visual problems, convulsion, ataxia and paresis) were recorded in a relevant questionnaire. MRI (brain and spinal cord with/without contrast), MRS and fMRI (for some) were done and post-operative occurrence was also recorded.

Statistics: The quantitative and qualitative data were analyzed through an independent t-test and a Chi-square test respectively considering 95% confidence interval, 0.05 type one error, and 0.05 significance level using SPSS software version 24.

Ethics: Keeping the private data safe, the investigators did not impose any extra charge or unnecessary visit or hospitalization or even non-relevant tests on the participants.

Ninety-six patients enrolled in the current study. 53 (55.2%) of them were male and 43 (44.8%) female and the majority of the participants (60.4%) were between 1 and 10 years of age. 35.4% of them were aged more than 10 years and the rest were younger than one year of age (4.2%). The most frequent problem was visual disorders (27.1%) followed by imbalance and headache (24% each) in addition to nausea and vomiting (22.9%). Through physical examination, paresis (24%) and cerebellar signs (22.9%) were the most frequent signs as (Table 1) shows. The interval between the onset of symptoms and tumor diagnosis was less than 12 months in 90.6% of the patients, 12 to 24 months in 7.3% and more than 24 months in 2.1%.

Concerning the pathologic study, the most common types of tumors were astrocytoma (42.7%), glioma (21.3%)

and medulloblastoma (13. %), as shown in (Table 2) and (Figure 1). Six of the participants had a family history of malignancy, but 90 (93.8%) of them did not report any similar experience before.

The tumor location was supratentorial in 46.9% of the cases while 53.1% were infratentorial (Figure 2). However, the results of radiology showed enhancement in 51 (53.1%) of the cases, but the rest did not show the sign.

In terms of the mortality rate, 36 (37.5%) of our participants deceased and 60 (62.5%) of them survived through the period we followed them up. For the frequency of postoperative complications, 52 (54.2%) of the patients experienced them including 5% postoperative infections, although the details are not reported in the current study. The type of tumors strongly correlated with age (P-value=0.003) and astrocytoma was more frequent in patients less than one year of age (75%) or above 10 years old (63%) while glioma was more prevalent at ages 1-10 (34.1%). The tumor location did not correlate with patients' age (P-value=0.577).

Table 1. The frequency of found problems during physical examination among the patients

	Row	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	17	17.7	17.7	17.7
	Papilledema	12	12.5	12.5	30.2
	Cerebellar signs	22	22.9	22.9	53.1
	Paresis	23	24.0	24.0	77.1
	Cranial Nerve Involvement	9	9.4	9.4	86.5
	Visual signs	13	13.5	13.5	100.0
	Total	96	100.0	100.0	

Table 2. The frequency of neuropathologic findings among the participants

	Row	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Glioma	16	16.7	21.3	21.3
	Astrocytoma	32	33.3	42.7	64.0
	Medulloblastoma	10	10.4	13.3	77.3
	Meningioma	2	2.1	2.7	80.0
	PNET	1	1.0	1.3	81.3
	Ependymoma	9	9.4	12.0	93.3
	Germinoma	2	2.1	2.7	96.0
	Glioblastoma	1	1.0	1.3	97.3
	Craniopharyngioma	2	2.1	2.7	100.0
	Total	75	78.1	100.0	
	Missing data	21	21.9		
Total		96	100.0		

Fig. 1. The distribution of pathologic findings regarding the patients' age

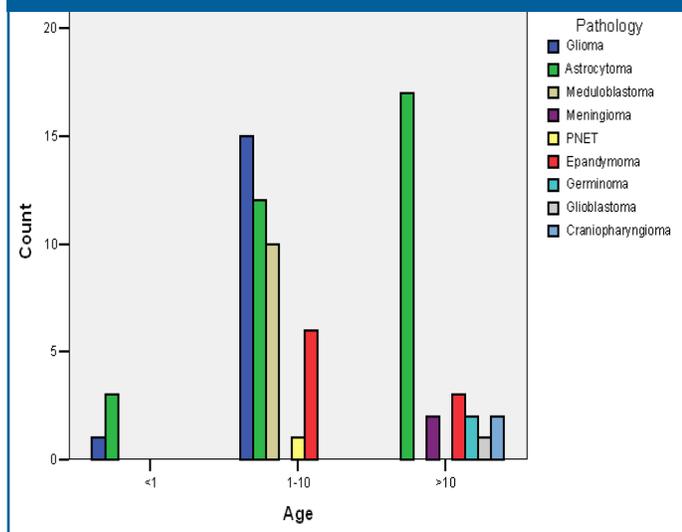
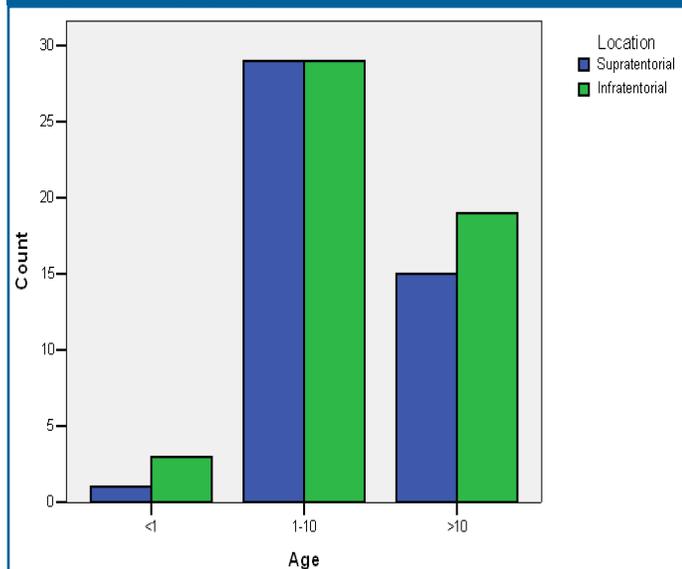


Fig. 2. The frequency of tumor location regarding the patients' age group



Discussion

The current study aimed at evaluating the pattern and characteristics of brain tumors in Iranian children in comparison with other countries and races, especially in demographic, pathological and radiological findings, to obtain optimum approaches to get a fast and appropriate treatment or even cure. Through our research work, just more than 60% of the evaluated tumors were in male children between 1 and 10 years of age. Likewise, Shuangshoti et al. disclosed similar age distribution to ours¹⁰. The prevalence of brain central tumors in their study was twice as high in boys as in girls whilst the sex ratio was about 1:2 in our study. They claimed that

neuroepithelial tumors such as astrocytoma and ependymoma formed the majority of tumors, which is similar to the results of our study. The incidence of germ cell tumors in that study was 12.9%, which is higher than the figures reported in Western countries and our study^{17,18}. This study found astrocytoma followed by glioma and medulloblastoma as the most common brain tumors while the locations were supratentorial and infratentorial in 46.9% and 53.1% of the cases respectively.

Jahan et al. found medulloblastoma as the most common brain tumor in children in Bangladesh between 2006 and 2007, but it was the third frequent one in our study, and like the current work, they reported a higher rate of infratentorial tumors¹¹. Claiming similar location and sex distribution to ours, Kardi et al. named medulloblastoma followed by astrocytoma and craniopharyngioma as the most common tumors in 367 children in Syria from 1993 to 2002^{19,20}.

Although the current study showed changes in sex distribution of brain tumors, Hjalmars et al. explained an increase in the female population in terms of the condition, especially the astroglial category during 20 years in Sweden (1973-1992)^{21,22}.

Like the present work, studies in Japan and Germany mentioned astrocytoma as the most frequent intracranial tumor, the rate of which was more than 33%^{15, 16}. Besides, the study by Makino et al. examined the epidemiology of early childhood intracranial tumors in Japan and the ratio of boys to girls stood at 1:3, which is relatively similar to our findings. However, they indicated that the highest incidence was among boys aged 10 to 14 years, which is not comparable with our claim.

Concerning the manifestation, this study disclosed headache as the chief problem which was doubled in a study in England among 200 children with brain tumors by Wilne et al.¹⁷ They also reported convulsion in 9% of their patients, but it was found in 17.7% of ours. Except for the headache, other symptoms and signs occurred absolutely more in our research work in comparison to Wilne et al.'s study. The time interval between the onset of clinical symptoms and definitive diagnosis in their study was 2.5 months, which was much less than what we found²⁰.

The mortality rate we concluded was 37.5%, which is comparable with 66% five-year survival by CBTRUS in the United States in people who were younger than 19 years and suffering from brain tumors⁶.

It seems that astrocytoma is the most frequent CNS tumor in children and the majority of it is infratentorial. It is worth focusing on genetics and similar basic sciences in future researches to identify more individual characteristics of brain tumors as well as providing systematic and national health policies and guidelines to reduce brain tumor occurrence and its complications among children.

Study limitations

This research study was retrospective, and finding the families to schedule medical visits was the only challenge throughout the follow-up period.

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Conflict of interest

The authors declare that there is no conflict of interest.

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