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Prevalence of primary central nervous system tumors in Iran: a retrospective study

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ABSTRACT

BACKGROUND

Tumors are the second-most common cause of death after cardiovascular diseases. Brain tumors are really different regarding location, symptoms and signs. The aim of this study was to determine the prevalence of different primary brain tumors in Iran.

METHODS

This cross-sectional study analyzed the medical records of patients with primary brain tumor referred to university hospitals between January 2016 and January 2017. By examining the hospitalization records, clinical symptoms, pathological and imaging findings, data was collected on age, sex, hand dominance, type of tumor, and the involved hemisphere. A chi-square test of independence was used to analyze the relationship between hand dominance and tumor grade. P-values less than 0.05 were considered statistically significant.

RESULTS

In total, 1113 patients with brain tumor with mean age of 41.89 ± 18.06 years, including 708 males (63.6%), were studied in Tehran, Iran. The most common brain tumors were glioblastoma with a frequency of 330 (29.6%) and astrocytoma 183 (16.4%). The rarest tumor types are ependymoblastoma with a frequency of 14 (1.3%). Overall, 551 (49.5%) patients had left hemisphere and 459 (41.2%) had right hemisphere involvement. There was no significant relationship between hand dominance and tumor grade ($p>0.05$).

CONCLUSION

Brain tumors are more common in the fourth and fifth decades of life, and glioblastoma and astrocytoma tumors are the most common brain tumors. The sex distribution of these patients in the present study shows a higher prevalence in men. There was a significant relationship between the hand dominance in patients and contralateral hemisphere involvement.

Keywords: Frequency, concussion, primary brain tumor, dominant hand, CNS

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INTRODUCTION

Although brain tumors are less common than other malignancies, they have mostly severe symptoms and poor prognoses.[1] These tumors are the most common types of solid tumors and can be divided into primary and secondary.[2,3] The best indicator of cancer survival is prevalence; however only a small number of studies focused on the prevalence of primary brain tumors, which can be explained by the limited data regarding this topic. As a result the impact of primary brain tumors on the Iranian health care system is not well known.[4]

One percent of newly diagnosed tumors are primary brain tumors, and 2% of these can lead to death. Brain tumors are the most common solid tumors in pediatrics, leading to a high morbidity and mortality. Based on cellular origin and histopathologic findings, there are 100 types of brain tumors. They are classified as benign and malignant tumors which are graded I to IV according to WHO classification.[5,6] Most of the brain tumors in the US are benign, of which meningioma is the most common. Among the malignant types, glioma is more frequent. Primary brain tumors include a combination of malignant and benign tumors which originate from the brain parenchyma and its surrounding structures. Since these tumors often cause severe disabilities and place a heavy burden on both health care system and families, they are the cause of great morbidity and mortality.[7,8]

Brain tumors in children are different from adults regarding the location of the primary tumor. In children, tumors originate more from the posterior cavity, whereas most adult tumors are located in the cerebral hemisphere and above the cerebellar tentorium.[5] In the past 20 years the incidence of brain tumors has increased by more than 40% in all age groups, especially in adults. The incidence of medulloblastoma and ependymoma in male patients is reported to be higher.[9]

Hereditary and familial syndromes are associated with an increased incidence of brain tumors in approximately 5% of cases. A history of contact with ionizing materials is also associated with an increased incidence of brain tumors.[9]

In a retrospective study involving 610 patients in northwest Iran, the prevalence rate of more invasive central nervous system (CNS) tumors was reported to have significantly increased in East Azerbaijan compared to previous decades.[10] Another study in Isfahan Province, Iran, showed that the prevalence of brain and other nervous system tumors was 1.4 times higher in males than in females, with a 35.7% increase in the incidence rate over the study period.[11]

Past studies have produced diverse and at times inconclusive results due to regional variations and different methodologies. Compared to these studies, this study was conducted at one of the largest cancer centers in Tehran, the capital city of Iran, which is a referral center for many patients from different regions. The comprehensive data from this diverse patient population provides us with a unique opportunity to study the prevalence and characteristics of primary brain tumors in a way that is representative of the broader population. The current study aimed to provide a more comprehensive understanding of primary brain tumors. A better understanding of the prevalence of these tumors can be helpful in describing the geographical differences and for more efficient planning in health resources.[12]

METHODS

Research design

This retrospective cross-sectional study was conducted using medical records of patients referred to Tehran university hospital as capital multinational and multicultural city in Iran between January 2016 and January 2017.

Research subjects

The study population comprised all patients diagnosed with primary cerebrospinal tumors, as

confirmed by pathology reports, between January 2016 and January 2017. These patients had their records available in the pathology centers of the university hospitals under study. The inclusion criteria were patients who had been diagnosed with primary cerebrospinal tumors during the study period and had their pathology reports available in the selected university hospitals. The exclusion criteria were patients whose diagnosis was not confirmed by a pathology report, had secondary or metastatic brain tumors originating from another primary site, were diagnosed outside the study period, or if their medical records were incomplete or inaccessible. Patients with benign or non-tumorous lesions of the central nervous system were also excluded.

Data collection

Patients' data were extracted using a checklist which included: age, sex, diagnosis, radiography findings, pathology report, location of tumor, grade of tumor, and dominant hand. The grading of the tumors was done using the fourth edition of the international classification of diseases for oncology (ICD-O), introduced by the Word Health Organization. Based on this classification, tumors are classified in 4 grades ranging from grade I representing stable or slowly growing tumors to grade IV malignant tumors. Tumors were divided into nonmalignant (WHO grades I and II) and malignant (WHO grades III and IV) categories.

Statistical analysis

The data analysis was done using the SPSS software version 22 for Windows (IBM Corp., Armonk, NY, USA). Patients' data were compared and analyzed using the chi-squire test and T- test. The descriptive data of the patients were compared using their frequency, mean and standard deviation. A two-tailed p-value of less than 0.05 was considered as statistically significant.

Ethical clearance

Confidentiality of patients' data was maintained and no data regarding patients' personal information was disclosed. The study protocol was approved by the institutional review board of Shahid Beheshti University of Medical Sciences (IR.SBMU.MSP.REC.1396.250).

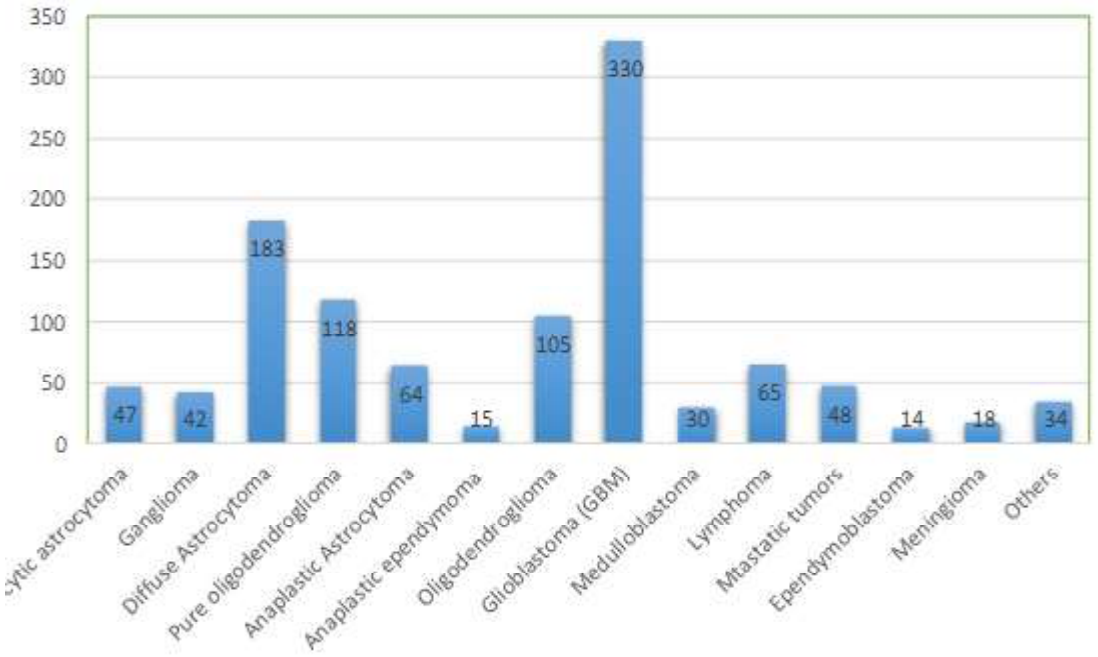

Figure 1. Frequency distribution of types of brain tumors

RESULTS

The frequency of different primary brain tumors among 1113 patients, including 405 (36.4%) females and 708 (63.6%) males in the period of 2011 to 2016 were reviewed (Figure 1). The mean age of the patients was 41.89±18.06. The most common type of tumor was glioblastoma [(GBM)(330) (29.6%))] which was more frequent among men (62.7%). The other common type of tumor were diffuse astrocytoma [(183)(16.4%)] which was also more frequent among men (65%). However, these differences among different genders were not significant (p=0.096).

Table 1 provides information regarding the distribution of brain tumors based on age. Pilocytic astrocytoma (61.7%), anaplastic ependymoma (53.3%) and medulloblastoma (46.7%) were more common in the age group of <20 years.

Table 1 shows the prevalence of different types of brain tumors based on the involved hemisphere (left, right, bilateral). The left hemisphere was the most commonly involved hemisphere [551 (49.5%)] which was followed by the right hemisphere [459 (41.2%)].

The prevalence of involved brain hemispheres based on hand dominance is shown in the Table 2. Most of the patients who had left hemisphere brain tumor were right-handed (93.8%), and 94% of cases with bilateral brain tumors were also right-handed. And there was a significant relationship between brain hemisphere and hand dominance (p<0.001).

Table 3 shows the prevalence of different grades by hand dominance. The majority of the patients had high grade tumors (598, 53.7%). However, there was no significant correlation between the tumor grade and hand dominance (p=0.386).

DISCUSSION

The findings of this study were consistent with the results of a study by de Robles et al.,[12] which was a consensus on the epidemiology of brain tumors which indicated the annual global incidence of primary malignant brain tumors was 10.82 per 100,000 person-years indicating no significant difference between men and women. In addition, they reported that meningioma is more common in women, which was also in line with our results. However, the results of the present study were inconsistent with the results of Dho et al.,[14] which was conducted in South Korea. They reported that the incidence of CNS tumors in women is more than in men, in ratios of 1.70:1 (female to male). In a study conducted on a pediatric group by Mehrvar et al.,[15] out of 1517 children referred to Mahak Children's Research and Treatment Center in Tehran, 198 (13.1%) had brain tumors, of whom 124 were boys (62.6%) and the ratio of boys to girls was 1.67 to 1. The mean age of onset in children was 11.6±3.65 years (ranging from 1-14 years).

According to the present study, the most common brain tumor was glioblastoma with a frequency of 29.6 percent (330 people) and the second most common was astrocytoma, which affected 183 patients (13%), followed by anaplastic oligodendroglioma (105 patients - 9.4%), lymphoma (65 patients, 5.8%), and metastatic tumors in a total of 48 patients (4.31%).

In the study of Garcia et al.[16] the most common tumors were meningiomas (43.6%) and in the second place glioblastoma (22%) and nerve sheath tumor (10.6%). Araghi et al.[17] also found that the most common tumor was glioblastoma. In the systematic review article by Jazayeri et al.,[18] the ratio of benign to malignant tumors was 1.07 and the most common tumors were meningioma, astrocytoma and ependymoma. In another study in Iran done by Beigi et al.,[19] the most common of these tumors among children were astrocytic, followed by embryonic and ependymal tumors.

In our study findings on the sex distribution of the tumors were not statistically significant. The present study was therefore inconsistent with the systematic review and meta-analysis study by de Robles et al.[12] They stated that there is a

Table1. Prevalence of different types of brain tumor by gender, age group and hemisphere (n=1113)

Type of tumor	Gender			Age group (years)					Hemisphere			
	Female	Male	Total	<20	20-34	35-60	>60	Total	Right	Left	Bilateral	Total
Pilocytic astrocytoma	19(40.4%)	28 (59.6%)	47	29(61.7%)	11(23.4%)	5(10.6%)	2(4.3%)	47	19(40.4%)	21(44.7%)	7(14.9%)	47
Craniopharyngioma	1(100%)	0 (0.0%)	1	0	1(100%)	0	0	1	0	1(100%)	0	1
Gangliocytoma	0(0.0%)	3(100%)	3	1(33.3%)	1(33.3%)	0	1(33.3%)	3	2(66.7%)	1(33.3%)	0	3
Ganglioglioma	13(31%)	29(69%)	42	8(19%)	12(28.6%)	2(52.4%)	0(0%)	42	22(52.4%)	17(40.5%)	3(7.1%)	42
Diffuse astrocytoma	64(35%)	119(65%)	183	24(13.1%)	72(39.3%)	75(41%)	12(6.6%)	183(100%)	82(44.8%)	94(51.4%)	7(3.8%)	183
Pineocytoma	1(33.3%)	2(66.7%)	3	1(33.3%)	0(0%)	1(33.3%)	1(33.3%)	3	0	1(33.3%)	2(66.7%)	3
Pure oligodendroglioma	45(38.1%)	73 (61.9%)	118	45(38.1%)	40(33.9%)	65(55.1%)	10(8.5%)	118	45(38.1%)	64(54.2%)	9(7.6%)	118
Anaplastic astrocytoma	22(34.4%)	42(65.6%)	64	5(7.8%)	20(31.3%)	33(51.6%)	6(9.4%)	64	20(31.3%)	38(59.4%)	6(9.4%)	64
Anaplastic ependymoma	6(40%)	9(60%)	15	8(53.3%)	2(13.3%)	4(26.7%)	1(6.7%)	15	5(33.3%)	7(46.7%)	3(20%)	15
Anaplastic Oligodendroglioma	31(29.5%)	74(70.5%)	105	9(8.6%)	19(18.1%)	61(58.1%)	16(15.2%)	105	48(45.7%)	54(51.4%)	3(2.9%)	105
Glioblastoma multiforme	123(37.3%)	207(62.7)	330	23(7%)	39(11.8%)	166(50.3%)	102(30.9%)	330	139(42.1%)	159(48.2%)	32(9.7%)	330
Medulloblastoma	14(46.7%)	16(53.3%)	30	14(46.7%)	8(26.7%)	8(26.7%)	0(0%)	30	13(43.3%)	13(43.3%)	4(13.3%)	30
Ependymoblastoma	5(35.7%)	9(64.3%)	14	5(35.7%)	4(28.6%)	4(28.6%)	1(7.1%)	14	5(35.7%)	8(57.1%)	1(7.1%)	14
Meningioma	7(38.9%)	11(61.1%)	18	3(16.7%)	2(11.1%)	7(38.9%)	6(33.3%)	18	5(27.8%)	11(61.1%)	2(11.1%)	18
Lymphoma	26(40%)	39(60%)	65	1(1.5%)	17(26.2%)	33(50.8%)	14(35.4%)	65	20(30.8%)	35(53.8%)	10(15.4%)	65
Metastatic tumors	20(41.7%)	28(58.3%)	48	3(6.3%)	2(11.1%)	26(54.2%)	17(35.4%)	48(100%)	18(37.5%)	17(35.4%)	13(27.1%)	48
Others	8(29.6%)	19(70.4%)	27	4(14.8%)	5(18.5%)	13(48.1%)	5(18.5%)	27	16(59.3%)	10(37%)	1(3.7%)	27
Total	405(36.4%)	708(63.6%)	1113	141(12.7%)	255(22.9%)	523(47%)	194(17.4%)	1113	459	551	103	1113
p value		0.967				0<001				0<001		

Table 2. Prevalence of involved brain hemispheres and location of brain tumors based on dominant hand (n=1113)

Dominant hand	Hemisphere			Tumor location										
	right	left	bilateral	Rt Diencephalon	Lt Diencephalon	Bilateral Diencephalon	Brain Stem	Rt Cerebellum	Lt Cerebellum	Bilateral Cerebellum	Rt Cerebral	Lt Cerebral	Bilateral Cerebral	Brain Ventricles
Right	345 (75.2%)	517 (93.8%)	97 (94.2%)	33 (82.5%)	517 (93.8%)	15 (100%)	47 (85.5%)	21 (67.7%)	25 (100%)	15 (100%)	269 (74.3%)	269 (74.3%)	53 (91.4%)	24 (88.9%)
Left	114 (24.8%)	34 (6.2%)	6 (5.8%)	7 (17.5%)	2 (4.1%)	0	8 (14.5%)	10 (32.3%)	0	0	93 (25.7%)	26 (6%)	5 (8.6%)	3 (11.1)
p value		<0.001							<0.001					

significant difference in the incidence of primary brain tumors in terms of gender, so that the incidence of meningioma in women is significantly higher than the incidence in men.

According to the findings of the present study, pilocytic astrocytoma tumor appeared more in childhood and 61.7% of its cases were less than 20 years old. However, of the 313 people with glioblastoma (GBM), the highest rate (50.3%) was in the 35-60-year age group. Distributed astrocytoma was observed with the highest frequency (41%) in the age group of 35-60 years and the lowest frequency (6.6%) in people older than 60 years. Patients with a pure oligodendroglioma tumor were 55.1% in the 35-60 age group and 33.9% in the 20-34 age group. In a study conducted in Brazil, 27 children were examined with pilocytic astrocytoma, in which 60.9% were boys with mean age of 26 years, which is consistent with our study.[20] Other sources indicate that having a first-degree family member (including parents, children, and full siblings) that has been diagnosed with a brain tumor has been shown to increase risk of malignant glioma approximately two-fold.[21]

Our findings show that brain tumors are more common in the left hemisphere of the brain (49.5%). In 9% of cases, the brain tumors were bilateral. However, on the right hemisphere the percentage of gangliogliomas (52.4%) was higher, and the presence of metastatic tumors on both sides was equal. In the study of Zahir et al.,[22] most of the tumors were in the right hemisphere (46%) (frontal and parietal were 26% and 12%, respectively), which was similar to our study.

In the study of Brazilian children, cystic astrocytoma was more common in the temporal and parietal lobes.[20] In the study of Huang et al.[23] glioblastoma also was seen more in the temporal lobe than in the frontal lobe and equally in both hemispheres, which is inconsistent with our study.

The present study also collected and interpreted the findings of the involved cerebral hemisphere, hand dominance and tumor grade in these patients, which have been mentioned in a

few previous studies. In the study by Garcia et al.,[16] 55.9% of patients were diagnosed with grade I, 5.9% were grade II, 4.4% grade III, and 24.3% grade IV, while in our study 53.7% of patients were high grade and 37.3% of them were low grade with 9% of uncertain grade, and inferential statistics of these findings showed a significant relationship between hand dominance in the patients and hemisphere involvement on the opposite side, while there was no such relationship between hand dominance and tumor grade.

In interpreting our study findings, it is crucial to consider several limitations. Our research, being retrospective in nature, is reliant on pre-existing medical records, which introduces potential biases due to the quality and completeness of these records. Moreover, our study did not consider potential confounding variables such as other medical conditions, lifestyle factors, or genetic predispositions of the patients, which may have influenced our results.

Despite these limitations, our study carries important clinical implications. It provides clinicians a better understanding of the frequency distribution of primary central nervous system tumors in Iran, which may guide diagnostic processes and treatment strategies. From a broader perspective, this research could assist in resource allocation and public health planning for the management of brain tumors in Iran.

As we consider future research directions, studies designed to mitigate the current limitations are essential. These include enrolling a more diverse sample from multiple regions of Iran and accounting for potential confounding variables to provide a more comprehensive understanding of the factors associated with brain tumor development and progression. Longitudinal studies are also encouraged to track the evolution and outcomes of these tumors over time. Furthermore, delving into the molecular genetics and pathophysiology of these tumors could uncover potential targets for therapeutic intervention, enriching our understanding and offering hope for improved management of brain tumors in the future.

CONCLUSION

Brain tumors are more common in the fourth and fifth decades of life, and the sex distribution of these patients in the present study shows a higher prevalence in men. Glioblastoma and astrocytoma tumors are the most common brain tumors. There was a significant relationship between the hand dominance in patients and hemisphere involvement on the opposite side.

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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AUTHOR CONTRIBUTIONS

All authors contributed to this work equally. Concept and design: AAH. Assembly of data and statistical analysis: EZ. Manuscript writing: AAH and EZ. Manuscript revision: MRS. All authors have read and approved the final manuscript.

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