

Incidence of Primary Brain Tumors: A Hospital Based Study of 200 Cases

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ABSTRACT

Object: The main objective of this study was to determine the incidence of primary brain tumors. It's a hospital based study, which was conducted in the department of Neurosurgery Nishtar Hospital, Multan between 1996 and 1999.

Methods: Patients of either sex were included in the study on the basis of history, clinical evaluation, laboratory and imaging investigations. The patients were admitted from outpatient department and by referrals from other medical units. After admission in the unit a uniform protocol of history taking, clinical and neurological examination, investigations and histopathological diagnosis was adopted for each patient. The information thus gathered was entered in a pro forma. The data analysed were age, sex, histological type, frequency and intracranial location of tumors.

Results: Among the 200 patients with primary brain tumors, there were 133 (66.5%) male and 67 (33.5%) female patients; the ratio being 1.98. The mean patient age was 33 years. The 31-40-year-old age bracket was found to be most highly represented, corresponding to 22.5% of total patients. In the younger age group, there were 34 (17%) male and 10 (5%) female patients, the ratio being 3.4 and the age mean of the patients was 7.6 years, with the range of 12 months to 15 years. The most common histological entities were; 127 (63.5%) neuroepithelial tumors, 30 (15%) meningiomas, 19 (9.5%) pituitary adenomas followed by 9 (4.5%) acoustic neuromas and 9 (4.5%) craniopharyngiomas. The remaining 6 (3%) cases were of teratoma, epidermoid cyst and haemangioblastoma. In the study, a higher ratio for supratentorial tumors was observed (155/45 cases; ratio 3.44) including 32 cases confined to sellar/ parasellar region.

Conclusion: The overall results conclude that primary brain tumors are more prevalent in males, with the age range of 31 and 50 years. Astrocytic tumors are the most frequent type of brain tumors with overall predilection for supratentorial compartment. Meningiomas and acoustic neuromas are rare in children.

Key Words: Primary Brain Tumor.

INTRODUCTION

According to published epidemiological surveys conducted in several countries, the incidence of primary intracranial tumors ranges from 4.5 to 14.5 cases per 100,000 populations per year¹. This geographic variation may be a reflection of the quality of medical care, the availability of diagnostic facilities and the level of organization of registries for data collection and coding. It has been found that socio-economically developed countries have higher incidence rate than less developed countries. When all histological types of primary intracranial tumors are combined, Sweden

has the highest rate (10/100,000/year), closely followed by the United States and Israel.² Asian and African countries report lower rates.³

It has been observed that the annual incidence rate of primary brain tumors per 100,000 population increases steadily with advancing age, as it is evident by the Rochester, Minnesota, data. This study revealed that there was an increase in the incidence with advancing age (4.0 at 12 years, 6.5 at 35 years, 18.0 at 55 years, to over 70.0 at 75 years of age.⁴

Most population-based registries report a higher brain tumor rate in males than in females. A

comparison using international data on the incidence of primary brain tumors of all histological types combined found an average male-female gender ratio of 1.4 (range 0.9 to 2.6) across geographic regions³. The gender ratio varies considerably by histological type. Gliomas are higher in males (gender ratio = 1.5) and meningiomas are higher in females (gender ratio = 0.6).⁵

In general, gliomas account for 40 percent to 67 percent and meningiomas for 9 percent to 27 percent of primary tumors in population-based studies⁶. According to Central Brain Tumor Registry of the United States⁷, meningiomas represent 33% of all primary brain tumors, making meningiomas the most common primary brain tumor, followed by glioblastoma (18%), astrocytomas (8%), nerve sheath tumors (8%), pituitary tumors (12.2%), lymphomas (2.5%), oligodendrogliomas (2.1%) and medulloblastomas/PNETs (1%). A study carried out in the department of clinical neurosciences, Western General Hospital, Edinburgh, U.K revealed the crude yearly incidence of primary brain tumors in the Lothian region of Scotland was 15.3/100,000⁸. A total of 228 cases of primary brain tumors were studied with the prevalence of neuroepithelial tumors (53.5%), meningeal tumors (19.5%) and sellar tumors (16.5%). There were 4.5% cranial nerve tumors, 4.5% primary lymphomas, and 0.5% germ cell tumors.

As far as the distribution of tumors by site is concerned, the majority of tumors (32%) are located in the meninges. Twenty-four percent of tumors are located within the frontal, temporal, parietal, and occipital lobes of the brain. 61% of gliomas occur in the frontal, temporal, parietal, and occipital lobes of the brain. Cerebrum, ventricle, cerebellum, and brain stem tumors account for 2%, 1%, 3%, and 2% of all tumors, respectively. The cranial nerves account for 7% of all tumors. Together, the pituitary and pineal glands account for about 14% of tumors. Olfactory tumors of the nasal cavity account for less than 1% of tumors⁷.

METHODS

This prospective study of 200 cases of primary brain tumors was started in January 1996 till December 1999 in the department of the Neurosurgery at Nishtar Hospital. Multan.

The patients of either sex were admitted from outpatient department and through referrals from other medical units. After admission in the unit a uniform

protocol was adapted for purpose of diagnosis. Diagnosis was made by history taking, clinical and neurological examination, laboratory and radiological investigations and tumor tissue histopathology.

The criterion for choosing the appropriate surgical approach was based on the characteristics of the tumor (size, site, configuration and extent) and the status of the patient (age, state of the health and the neurological deficit). All the operations were done by the consultant neurosurgeons.

The data thus gathered was entered in a pro forma; it was tabulated and then analyzed and compared with international data.

RESULTS

The following aspects were taken into account while tabulating the results.

1. Age and sex determination.
2. Histological type and frequency of different tumors.
3. Intracranial site of tumor.

Age and Sex Distribution

Among the 200 patients with primary brain tumors, there were 133 (66.5%) male patients and 67 (33.5%) female patients the ratio being 1.98. The age of the patients ranged between 01 and 70 year. The mean age at the time of presentation was 33 years. Table 1 shows the sex distribution at different ages.

Table 1: *Gender distribution.*

Age Group (Years)	Number of Patients	Male	Female	M/F ratio
0 – 5	17	14	3	4.6:1
6 – 10	16	12	4	3:1
11 – 20	22	17	5	3.4:1
21 – 30	31	23	8	2.9:1
31 – 40	45	25	20	1.25:1
41 – 50	43	28	15	1.86:1
51 – 60	16	5	11	0.45:1
61 – 70	10	9	1	9:1
Total	200	133	67	1.98:1

The average age of the patients with most prevalent type of tumors was; neuroepithelial tumors 31.9 (range 1-70 years), meningiomas 42 (range 25-60 years), pituitary tumors 38 (range 15-60 years), Craniopharyngiomas 12.3 (range 4-40 years), acoustic neuromas 42.6 (range 22-70 years).

The highest incidence of 45 (22.5%) cases were seen in age group 31-40 years, and only 17 (8.5%) cases were seen in age group less than five years and 16 (8%) in the 6th decade of life.

Table 2: Number of Primary Brain Tumors by Major Histology Groupings, Histology and Gender.

Histology	Number	Male	Female
Tumors of Neuroepithelial Tissue			
Astrocytomas grade-1	28	23	5
Astrocytomas grade 2	45	33	12
Astrocytomas grade 3	25	20	5
Astrocytomas grade 4	12	10	2
Oligodendroglioma	3	3	
Choroid plexus	2	2	
Neuroblastoma	2	1	1
Astroblastoma	1	1	
Ependymoma	4	2	2
Medulloblastoma	5	4	1
Tumors of cranial nerves	5	4	1
Acoustic neuromas	9	2	7
Tumors of meninges			
Meningiomas	30	13	17
Hemangioblastomas	3	2	1
Germ cell tumors and cysts			
Teratoma	2	1	1
Epidermoid	1	1	
Tumors of sellar region			
Pituitary tumors	19	10	9
Craniopharyngiomas	9	5	4
Total	200	133	67

Although, in all age groups, males had a higher incidence than females, the incidence was reverse in

the 6th decade as there were 5 males and 11 females, the female-to-male ratio being 2.2. Also in cases of meningiomas, the female-to-male ratio was 1.3 (17/13 cases) and in acoustic neuromas the female-to-male ratio was 3.5 (7/2 cases) Table 2 shows number of Primary Brain Tumors by Major Histology Groupings, Histology and Gender.

Histological Type and its Frequency

Amongst the 200 cases of primary brain tumors, the most common histological entities were; 127 (63.5%) neuroepithelial tumors, 30 (15%) meningiomas, 19 (9.5%) pituitary adenomas followed by 9(4.5%) acoustic neuromas and 9 (4.5%) craniopharyngiomas. The remaining 6 (3%) cases were of teratoma, epidermoid cyst and haemangioblastoma. Table 3 depicts the distribution of various pathological entities observed in the study. The further breakup of the neuroepithelial tumors revealed that there were 110 (55.0%) cases of astrocytic tumors, 7 (3.5%) cases of embryonal tumors, 4 (2%) cases of ependymoma, 3 (1.5%) cases of oligodendrogliomas followed by 2 (1%) cases of choroid plexus tumors, and 1 (0.5%) case of astroblastoma. Further analysis of the astrocytic tumors revealed, that there were 28 (25.45%), 45 (40.90%), 25 (22.72%), and 12 (10.98%) cases corresponding to WHO grade I, grade II, grade III and grade IV respectively.

Intracranial Site of the Tumor

In the study, a higher ratio for supratentorial tumors was observed (155/45 cases; ratio 3.44). Out of the total 155 cases in supratentorial compartment there were 32 cases confined to sellar/ parasellar region. The histological entities in the supratentorial compartment were; 92 (59.35%) cases of astrocytic tumors, 24 (15.48%) cases of meningiomas, 19 (12.25%) cases of pituitary adenomas, 9 (5.80%) cases of craniopharyngiomas, 3 (1.93%) cases of oligodendroglioma, 2 (1.29%) cases of teratoma, 2 (1.29%) cases of neuroblastoma, 1 (0.6%) case of astroblastoma, 1 (0.6%) case of choroid plexus carcinoma, 1 (0.6%) case of haemangioblastoma and 1 (0.6%) case of ependymoma. In the supratentorial compartment the distribution of astrocytic tumors was as follows;

- More than one lobe: 36 (32.72%).
- Frontal: 22 (20%).
- Temporal: 18 (16.36%).
- Parietal: 8 (7.27%).
- Bifrontal: 5 (4.54%).

- Occipital: 3 (2.27%).

In the infratentorial compartment there were 18 (40%) cases of astrocytoma, 9 (20%) cases of acoustic neuroma, 6 (13.32%) cases of meningioma, 5 (11.11%) cases of ependymoma, 2 (4.4%) cases of haemangioblastoma, 1 (2.2%) case of epidermoid cyst and 1 (2.2%) case of choroid plexus papilloma.

The distribution of astrocytomas in the infratentorial compartment was, as;

- Cerebellar hemisphere: 7 (6.36%).
- Vermian: 7 (6.36%).
- CP angle: 4 (3.63%).

Table 3: *Distribution of all primary brain tumors by histology.*

Histology	Number	% age
Tumors of Neuroepithelial Tissue	127	
Astrocytomas grade-1	28	14%
Astrocytomas grade 2	45	23%
Astrocytomas grade 3	25	13%
Astrocytomas grade 4	12	6%
Oligodendroglioma	3	1.5%
Choroid plexus	2	1%
Neuroblastoma	2	1%
Astroblastoma	1	0.5%
Ependymoma	4	2%
Medulloblastomas	5	2.5%
Tumors of cranial nerves	9	
Acoustic neuromas	9	4.5%
Tumors of meninges	33	
Meningiomas	30	15%
Hemangioblastomas	3	1.5%
Germ cell tumors and cysts	3	
Teratoma	2	4%
Epidermoid	1	0.5%
Tumors of sellar region	28	
Pituitary tumors	19	9.5%
Craniopharyngiomas	9	4.5%

Among the sellar/parasellar tumors in 32 patients, there were 19 (59.37%) cases of pituitary adenomas, 9 (28.12%) cases of craniopharyngiomas, 2 (6.25%)

cases of meningiomas, 1 (3.12%) case of haemangioblastoma and 1 (3.12%) case of teratoma.

There were total of 18 tumors in the CP angle region. In order of frequency, there were 9 (50%) cases of acoustic neuromas, (8 on the right side and 1 on the left side), 5 (27.7%) cases of meningiomas (2 on the left side and 3 on the right side), and 4 (22.2%) cases of astrocytoma, (3 on left side and 1 on the right side). The distribution of the meningiomas was as follows;

- Sphenoid wing: 10 (33.33%).
- Convexity: 7 (23.33%).
- CP angle (Petrosal): 5 (16.6%).
- Olfactory groove (Bifrontal): 2 (6.66%).
- Parasagittal: 2 (6.66%).
- Suprasellar: 2 (6.66%).
- Falx: 1 (3.33%).
- Foramen magnum: 1 (3.33%).

DISCUSSION

The analysis of the present study largely conforms to the findings of others series reported in the literature.

The age of the patients in our study ranged from 1 to 70 years. The mean age at the time of diagnosis was 33 years. The highest incidence of tumors was seen in the age group of 31 to 40 years. Most of the international studies report a higher incidence of brain tumors in males than females, but the gender ratio varies considerably by histological type. In our study the male to female ratio is 1.98, which is comparable to a study by Valema JP and Walker ANA, who reported the ratio of 1.4 (range 0.9 to 2.6)³. A study in Japan revealed male to female ratio to be 0.77, which is in contrast to the general trend across the globe¹.

Out of the total 200 cases, 155 were located in the supratentorial compartment and 45 cases were in the infratentorial compartment, the ratio being 3.4:1. Thirty two cases occupied the sellar/parasellar compartment. Astrocytic tumors were the most prevalent tumors both in the supratentorial and infratentorial compartment and pituitary adenomas were the predominant tumors of the sellar/parasellar region. A total of 18 cases were detected in the cerebellopontine angle, acoustic neuromas being the most prevalent tumor in this site.

In our study neuroepithelial tumors were the most prevalent type of tumor. According to a study reported by S B Tatter et al,⁹ 50 to 60 percent of the total primary intracranial tumors are neuroepithelial tumors.

In our series the incidence is 63.5%. A study by Carl E Counsell⁸ has quoted the incidence of 53.5%. In case of children astrocytomas accounted for 56.8% of all the primary brain tumors, while the incidence reported by Kuratso J¹⁰ is 41.8% for astrocytic tumors in children.

Meningiomas accounted for 15% of the total cases, while different studies reveal its incidence to range between 9% and 27%.¹¹⁻¹⁶ Walker et al¹² has reported the incidence of meningiomas to be 20% while a study in Japan revealed that 31.2% of all the primary brain tumors were meningiomas.⁶

Different studies has revealed the low incidence of intracranial meningiomas, in children (incidence being 0.85% to 2.3%)¹⁷ and in the first two decades of life (incidence being 1% to 4%).¹⁸ The youngest patient in our study was 25 years old.

Most studies reveal a female predominance in meningiomas. According to international data, female to male ratio is about 2:1,^{1,14,19} which is also true in our study, the female to male ratio being 1.3:1.

In adults 90% of the intracranial meningiomas occupy the supratentorial compartment, while in our study 80% of the meningiomas occupied the supratentorial compartment, the commonest locations being sphenoid wing and convexity, which is comparable to other international studies. Only one case (3.3%) of foramen magnum meningioma was detected; the international survey reports the incidence being 4-9%.²⁰

Out of the 200 cases of primary brain tumors, pituitary adenomas were 9.5%, the incidence comparable to a study by George Kontogeorgos et al²¹ who has quoted the incidence to range from 10% to 20%, while Walker et al has quote the incidence of pituitary adenomas to be 14%.¹²

Acoustic neuromas accounted for 4.5% of all the primary brain tumors which is comparable to the study by Carl E Counsell et al⁸ who has also reported the incidence of 4.5% in a study of 228 cases of primary brain tumors.

Craniopharyngiomas constituted 4.5% of the total cases in this study and the incidence revealed by Stiller and Nectoux ranges from 1.5% to 11.6% in different regions of the world.²² Craniopharyngioma constitute 8.2% to 13% of the intracranial tumors in children²³. The present study showed that the incidence of these tumors was 15.90% of all the primary brain tumors unto the age of 15 years. In a study in United States it has been revealed that there is maximum incidence of craniopharyngiomas in children with the age ranging

between 5-14 years. This observation is true in our study also, as out of the total 9 cases; seven patients were below the age of 10 years.

According to PB Dirks et al²⁴ 0.5% to 2.5% of all primary brain tumors are germ cell tumors. According to a study in Scotland⁸ out of 225 cases of primary brain tumors, 0.5% was germ cell tumors; in our study the incidence is 1%. Hoffman et al²⁵ have stated that 85% of intracranial germ cell tumors occur before the second decade of life. In this present study the age of the two patients was 5 years and 8 years.

The incidence of epidermoid cysts is 0.2% to 1.8% as reported by Yoshizato K et al²⁶ which is quite comparable to the incidence (0.5%) found in the present study.

Hemangioblastomas constituted 1.5% of all the primary brain tumors in our study, the same incidence of 1.5% to 2.5% as stated by Setti S Rengachary.²⁷ These tumors occur mainly during the third through fifth decade²⁸ as is the case in our study, where the age ranged between 20 to 50 years. Hemangioblastomas are most commonly found in the posterior cranial fossa.²⁷ Supratentorial hemangioblastomas are exceedingly rare tumors. Only 83 cases have appeared in literature.²⁹ In our study, two cases were found in the infratentorial compartment and one was in the suprasellar/parasellar region, a rarity.

CONCLUSION

The overall results conclude and suggest that is our setting:

Primary brain tumors are more prevalent in males than females, but there are exceptions to this rule as is evident by the following observations,

In case of meningiomas, there were more females as compared to male patients, the ratio being 1.30.

There is a female preponderance in case of acoustic neuromas, the female to male ratio being 3.5.

The study revealed that most of the patients were in the range of 31 and 50 years. Only ten patients were detected below the age of 5 years and ten cases were detected in the 7th decade of life.

Astrocytic tumors accounted for the most frequent type of brain tumors. Grade-II astrocytomas had the highest incidence, which was true in both the adults and the children, and the least frequent were the grade-IV tumors.

Astrocytomas involved nearly every area of the brain, the most frequent single region being the temporal area. More than half of these tumors occupied

the right hemisphere. 84% of all the astrocytic tumors occupied the supratentorial compartment, and in younger age group 60% occupied the said compartment.

Meningiomas were the second most common tumors, and were more prevalent in females as compared to males. The commonest age of incidence was the 5th decade of life, and not even a single case was detected in the younger age group and neonates. The most favourite site for meningiomas in the supratentorial compartment was the sphenoid ridge, and in the infratentorial compartment, the inferior aspect of the petrous temporal bone at the cerebellopontine angle.

All the cases of neurilemmomas were found to arise from the eighth cranial nerve.

In the younger age group upto the age of 15 years, the second most common tumor was craniopharyngioma after astrocytomas. Maximum number of cases was detected in the 5th year of life.

Overall distribution revealed that tumors predominantly occupied the supratentorial compartment, both in adults and in children.

Cerebellopontine angle was dominated by the acoustic neuromas followed by the meningiomas and astrocytomas.

Among the intraventricular tumors, ependymomas were the predominant tumors followed by choroid plexus tumors.

There was no marked difference in the general trend in the incidence of primary brain tumors as compared to the international data, except a few of the following:

- The incidence of malignant astrocytic tumors is more prevalent in older age group, which is not the case in our study.
- Although the incidence of meningioma is a rarity in childhood, they have been detected in this age group upto 1.5% to 2.5%. No case was detected in our series.
- Most of the studies reveal that in younger age group there is predominance of primary brain tumors in the infratentorial compartment, but this is not the case in our study.
- There was a marked difference in the male to female ratio as compared to other studies.

Keeping in view the above facts, I would like to give few suggestions;

There is no cancer registry in our setup, where all the patients could be registered from the teaching hospitals and patients operated in the private sector. I would suggest that all brain tumors should be included

in the cancer registry. This aspect would give a more accurate picture of the total burden of the disease for planning health care, would improve the epidemiological studies, and would remove the inconsistencies that presently exist. This shall also help us in the follow-up of the patients and provide us with the idea about the prevalence of cancer in different regions and in different periods. Secondly it shall be helpful for the comparison and statistical analysis. Currently we can just analyze the hospital-based data and not the population based data.

Due to low literacy rate, low socioeconomic status and certain cultural taboos and influence, the patients are brought very late to the proper institutions and also the females are not given the due protocol. I would suggest that health care should be expanded; proper knowledge of the disease and its symptomatology should be provided both to the general public and paramedical staff working in the rural areas.

It is a proven fact that the use of modern technology is beneficial both for the clinician and the patient. Due to economic constraints and lack of will, the facilities like CT scanner, MRI, authentic laboratories are not available to the large masses. There should be an extensive expansion of these facilities.

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