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A HISTOPATHOLOGICAL AUDIT OF BRAIN TUMOR RECEIVED IN 3 YEARS AT A SINGLE TERTIARY CARE HOSPITAL.

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ABSTRACT

OBJECTIVE: To determine the frequency of various brain tumor subtypes in different age groups and gender. **METHODS:** This retrospective study was done at Pathology Department of JPMC Karachi. Brain tumor specimens submitted in 10% buffered formalin for histopathological evaluation between October 2019 and September 2022, from patients of any age and gender, were included. Tumors were classified according to the WHO Classification of Central Nervous System (CNS) Tumors. Data regarding tumor type, histologic grade, and distribution across age and gender were recorded and analyzed using Microsoft Excel and SPSS 26 version. **RESULTS**: There were 40.7% specimens of males and 45.8% of females. Meningiomas and astrocytomas were the most common brain tumors, each comprising 31.7% (57 cases), followed by pituitary adenomas (5.6%), medulloblastomas (5%), schwannomas (4.4%), necrotic tumors (2.8%), oligodendrogliomas (2.2%), and ependymomas (1.1%), with rare tumors like hemangioblastoma, osteoma, and undifferentiated high-grade tumors each accounting for 0.6%. Meningiomas were more common in females, while astrocytomas and pituitary adenomas were higher in males (p=0.06). Additionally, astrocytomas and meningiomas were the most common with mean ages of 34 and 41 years; medulloblastomas were more frequent in younger patients, with a significant age difference in tumor types (p=0.03). **CONCLUSION**: Brain tumors showed diverse histopathological subtypes, with meningiomas more common in females and astrocytomas in males, occurring across all ages with subtype-specific age and gender patterns.

KEY WORDS: Brain Tumor, Histopathology, Male, Female, Age

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INTRODUCTION

The majority of CNS tumors (>90%) are found in the brain[1]. According to Steponaitis et al. (2019), gliomas account for the majority of brain tumors, with Astrocytomas accounting for the majority of it[2]. Generally speaking, there are 1.6% to 2.5% new cases of brain malignant tumors and a 2.5% death rate. 15,193 primary brain cancers were reported in South East Asia in total in 2016[3]. Asia had

the highest prevalence of brain cancer (52.26%), following by the Europe (21.8%), America (19.1%), and Africa (5.7%). Because of socioeconomic differences, cancer incidence varies between different places[4]. Tumors exhibit a bimodal age distribution, with one incidence peak occurring in children and a second between the ages of 45 and 70 years. The clinical presentation of intracranial tumors varies based on factors such as the tumor's size, anatomical location, and rate of progression.[5] Brain tumors affect people of all ages and sexual orientations, accounting for 3% of all cancer in Pakistan. In 2020, Shaukat Khanum Memorial Cancer Hospital assessed 224 cases (3.2%) of brain tumors. Most of the cases of brain tumors are gliomas, the most common type.[6] The most prevalent solid tumor killer in children, malignant primary brain tumors rank third in terms of cancer-related mortality in adults and adolescents.[7] Many environmental factors have been looked into as potential risk factors for adult brain and other CNS malignancies.[8,9] Conversely, tumors of the brain and central nervous system have primarily been associated with high levels of ionizing radiation exposure. Several inherited cancer disorders, including Li-Fraumeni syndrome, neurofibromatosis types I and II, and tuberous sclerosis, also contribute to the development of these malignancies.[10]

Meningioma ranks as the leading brain tumor globally, with gliomas particularly astrocyte-originating types next in frequency, followed by tumors of the pituitary gland.[11] Regional variations exist in the distribution of these brain growths, and recent years have shown a global rise in cases of primary brain masses.[11] According to other recent study the malignant tumors were more frequently observed than benign ones. Among the various tumor types, astrocytomas were the most commonly identified, closely followed by meningiomas.[12] Based on local study the oligodendroglioma emerged as the predominant histological variant, while headache was the most frequently reported clinical symptom among patients. Based on the controversial findings regarding the most common histological types of brain tumors, this study was conducted to determine the frequency of various brain tumor subtypes across different age groups and genders, aiming to enhance current knowledge by identifying prevalent histopathological patterns that may improve diagnostic accuracy and guide more effective management in clinical neuro-oncology practice.

METHODS AND MATERIALS

A retrospective was conducted at the Histopathology department of Jinnah Postgraduate Medical Center Karachi. This audit of the the histopathological spectrum of brain tumors conducted on the data of period between October 2019 and September 2022. The study included all brain tumor specimens submitted for histopathological evaluation during the study period of either age or gender. All specimens those were received in 10% buffered formalin, processed by routine paraffin embedding, and stained with Hematoxylin and Eosin (H&E) for microscopic examination were incorporated. All the non-neoplastic lesions, inadequate or autolyzed tissue samples not suitable for histopathological interpretation, duplicate entries of previously reported cases, and cases with incomplete clinical or radiological information were excluded. The samples had been preserved in 10% buffered formalin in accordance with standard histopathological protocols. Following fixation, the biopsy specimens were processed, paraffin embedded, and sectioned at 3–4 µm thickness. H&E staining was performed for histological examination. Two Pathologists looked at the sections under a light microscope to make a pathological diagnosis. The age,

socioeconomic level, and clinical characteristics of the patients were disclosed in the early surgical biopsy records. Tumors were classified according to the latest WHO Classification of CNS Tumors. Where necessary, immunohistochemical (IHC) markers were applied to confirm diagnosis and determine tumor subtype. Data regarding tumor type, histologic grade, and distribution across age and gender were recorded and analyzed. Descriptive statistics were applied using Microsoft Excel and SPSS 26 version, and findings were presented in the form of frequencies, percentages, and tabulations. Chi-square test was applied and a p-value <0.05 was considered as significant.

RESULTS

A total of 155 out of 180 brain tumor cases were successfully categorized based on their morphological types. The most commonly observed tumor types were meningioma and astrocytoma, each accounting for 31.7% of the cases (57 each), making them the most frequent histological subtypes. Pituitary adenomas followed with 5.6%, while medulloblastomas comprised 5% of the cases. Other less frequent tumors included schwannomas (4.4%), necrotic tumors (2.8%), oligodendrogliomas (2.2%), and ependymomas (1.1%). Rare tumor types like hemangioblastoma, osteoma, and undifferentiated high-grade tumors were seen in only 0.6% of cases each. **Table.1**

Meningiomas were more common in females (22.2%) compared to males (9.4%), with a male-to-female ratio of 0.42:1. Astrocytomas were more prevalent in males (20%) than females (11.7%), with a male-to-female ratio of 1.7:1. Other tumor types like medulloblastomas, schwannomas, and pituitary adenomas were observed in both genders, though pituitary adenomas had a higher male prevalence (3.9% male vs. 1.7% female, male-to-female ratio of 2.3:1). The overall male-to-female ratio for all tumors was 0.8:1, with a statistical value of P=0.06, indicating no significant gender-related difference. **Table.3**

The study of 155 brain tumor cases revealed that astrocytomas and meningiomas were the most common, each accounting for 36.8% of the cases, with mean ages of 34 and 41 years, respectively. Other tumor types, such as pituitary adenomas, medulloblastomas, and schwannomas, had varying age distributions, with medulloblastomas being more common in younger patients. The overall mean age for all tumors was 36 years, with a significant age difference observed between tumor types (p=0.03). **Table.3**

TABLE-1: HISTOPATHOLOGICAL TYPES OF BRAIN TUMORS N= 155

Diagnosis	**Frequency (%)**
Meningioma	57(31.7)
Astrocytoma	57(31.7)
Pituitary Adenoma	10(5.6)
Schwannoma	8(4.4)
Medulloblastoma	9(5)
Ependymoma	2(1.1)
Oligodendroglioma	4(2.2)
Hemangioblastoma	1(0.6)
Undifferentiated High grade tumor	1(0.6)
Osteoma	1(0.6)
Necrotic tumor	5(2.8)
Total	155(86)/180(100)

TABLE-2: HISTOPATHOLOGICAL TYPES OF BRAIN TUMORS ACCORDING TO GENDER N= 155

Diagnosis	Gender				M:F
	Male		Female		
	N	%	N	%	
Meningioma	17	9.4	40	22.2	0.42:1
Astrocytoma	36	20.0	21	11.7	1.7:1
Medulloblastoma	3	1.7	6	3.4	0.5:1
Schwannoma	3	1.7	5	2.8	0.6:1
Pituitary Adenoma	7	3.9	3	1.7	2.3:1
Oligodendroglioma	2	1.1	2	1.1	1:1
Osteoma	1	0.6	0	0	1:0
Ependymoma	1	0.6	1	0.6	1:1
Hemangioblastoma	0	0.0	1	0.6	0:1
Undifferentiated High grade tumor	1	0.6	0	0	1:0
Necrotic tumor	2	1.1	3	1.7	1:1.5
Total	73	40.7	82	45.8	0.8:1

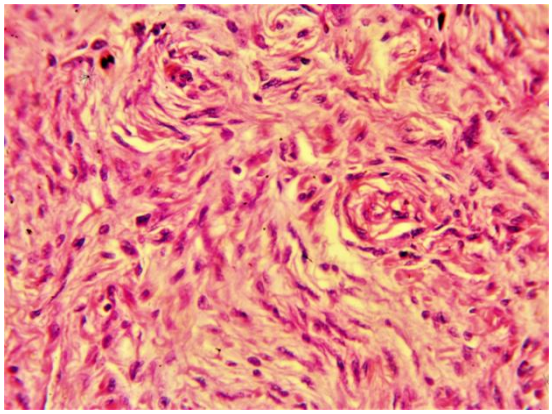
P=0.06 was found to be statistically insignificant using the Chi Square test

TABLE-2: HISTOPATHOLOGICAL TYPES OF BRAIN TUMORS ACCORDING TO GENDER N= 155

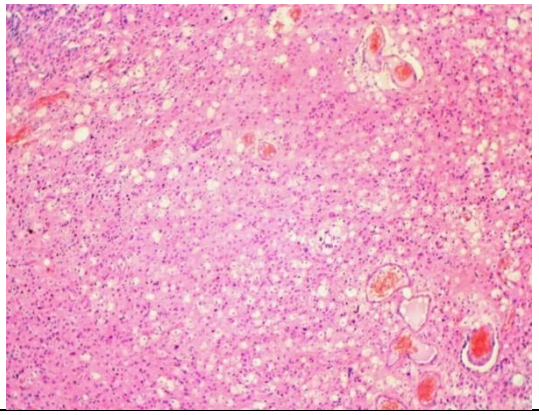
Diagnosis	N	%	Age in years			
			Mean	SD*	Minimum	Maximum
Astrocytoma	57	36.8	34	17	4	65
Meningioma	57	36.8	41	15	2	70
Pituitary adenoma	10	6.5	41	10	22	54
Medulloblastoma	9	5.8	17	12	5	42
Schwannoma	8	5.2	31	15	2	55
Oligodendroglioma	4	2.6	36	8	30	45
Necrotic tumor	5	3.2	40	6	32	47
Ependymoma	2	1.3	29	5	25	32
Hemangioblastoma	1	0.6	35	--	35	35
Undifferentiated High grade tumor	1	0.6	6	--	6	6
Osteoma	1	0.6	27	--	27	27
Total	**155**	**100**	**36**	**16**	**2**	**70**

P=0.03 was obtained by one way ANOVA and found to be statistically significant.

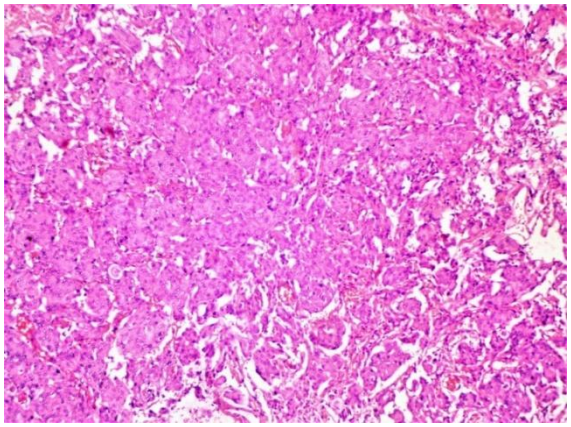
Photomicrograph 1: SP NO 20/19: Meningioma (H&E X40)



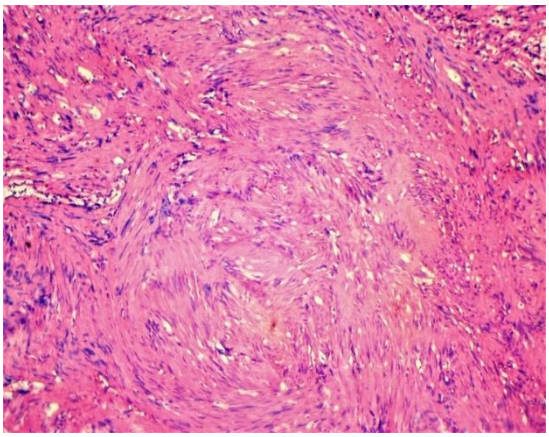
Photomicrograph 2: SP NO 21/3651: Oligodendroglioma (H&E X10) showing closely packed cells with small round nuclei and perinuclear halos



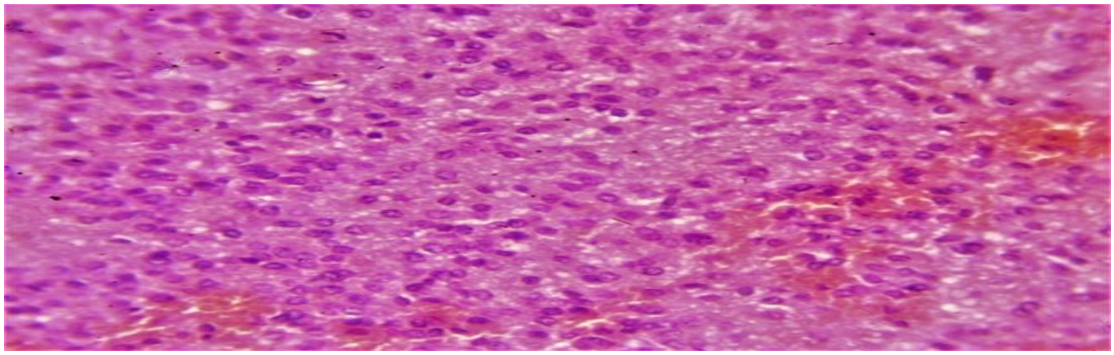
Photomicrograph 3: SP NO 22/2057: Pituitary Adenoma (H&E X10) showing monotonous cell of single cell type



Photomicrograph 4: SP NO 21/3083: Schwannoma (H&E X10) showing Antoni A and Antoni B areas with nuclear palisading



Photomicrograph 5: SP NO 21/3043: Medulloblastoma (H&E X40) showing closely packed small round cells.



DISCUSSION

This study analyzed 155 brain tumor cases from September 2019 to October 2022 at the Pathology Department of the Basic Medical and Sciences Institute, JPMC, Karachi. The most common histopathological subtypes in this study were meningioma and astrocytoma, each constituting 31.7% of cases. These findings align with the results of a study by Sen D et al[13] where meningioma was identified as the most common tumor, accounting for 48% of cases, followed by glioblastoma at 21.5%. The study also noted a higher prevalence of these tumors in males, with WHO Grade I neoplasms being the most frequent, comprising 46% of cases. A similar pattern was observed in a study by Khan J et al[12] which reported that medulloblastoma was the most common tumor in children (48%), followed by astrocytoma (25%) and ependymoma (19%). The remaining 8% included other histopathological types. Additionally, an Indian study by Yadav et al[14] found that astrocytoma was the most prevalent brain tumor, making up 35.2% of cases. This study also consistent with findings from a three-year study conducted in Eastern India, where meningioma and astrocytoma were also identified as the most common brain tumors in patients presenting at tertiary care institutions.[15] However Chaudhary P et al[16] reported that the neuro-epithelial-origin tumors were the most prevalent, accounting for 54 cases (38.9%) of CNS tumors, followed by meningiothelial tumors, which made up 36 cases (26.0%).

The findings of our study indicate that brain tumors are more commonly observed in women than in men, with a male-to-female ratio of 0.8:1. This is consistent with a previous study that reported a female preponderance, with a male-to-female ratio of 1:1.1.17 However, other studies have found a higher incidence of brain tumors in men, with male-to-female ratios of 1.4:1, 1.55:1, and 1.2:1, respectively.[6,18,19] These variations could be attributed to differences in geographical locations, demographic factors, or sample sizes across the studies. In terms of age, our research found the average age of brain tumor patients to be 36 years. This is comparable to the mean ages reported by Sajjad et al[18] in Pakistan, Mohammed et al[19] in Saudi Arabia, and Mondel et al[15] in India, which were 43, 37, and 42.9 years, respectively.[18,19] These findings suggest that while there may be some regional differences in the age distribution of brain tumor patients, the average age remains relatively consistent across various populations.

Regarding the histopathological types of brain tumors, our study identified 57 cases (31.7%) of meningiomas, with 40 (22.2%) cases in females and 17 (9.4%) in males. The age range of meningioma patients in our study was from 2 to 70 years. A retrospective study conducted in Saudi Arabia also reported a similar finding, with 70 cases (30.8%) of meningioma, which closely aligns with the results of our research.[19] This further supports the prevalence of meningiomas as one of the most common types of brain tumors across different regions.

The findings of the present study largely align with those reported in regional and international literature, while also highlighting some variations in tumor frequency, age distribution, and gender predominance. Among the CNS tumors observed, astrocytic tumors, meningiomas, and pituitary adenomas were among the most frequently diagnosed, consistent with previous studies that also reported astrocytomas and meningiomas as the most prevalent types. For instance, other studies have shown astrocytic tumors to comprise approximately 29.1% of brain tumors, with a higher incidence in males, a trend also noted in our data.[16] Pituitary adenomas accounted for 5.6% of cases in our study, which is slightly lower than the 11.8% reported in a five-year study. Nonetheless, both studies found a male predominance, although the reason for this

remains unclear. Similarly, Schwannomas represented 4.4% of cases, closely aligning with the 3.9% reported by Mohammed et al., suggesting a stable prevalence across regions.[19]

Medulloblastomas in our study represented 5% of tumors, which is comparable to rates reported by Patel et al. (4.42%) and other studies (up to 6.6%).This consistency across studies supports the classification of medulloblastoma as a significant pediatric and young adult brain tumor. Ependymomas and oligodendrogliomas were relatively rare in our data (1.1% and 2.2%, respectively), with other studies reporting slightly higher rates ranging from 2.3% to 8.46%.[16,17,19] These differences may stem from population differences, diagnostic practices, or referral patterns.

In the current investigation, 10 (5.6%) of the brain tumors had a diagnosis of pituitary adenoma. Of these ten, three (1.7%) were women and seven (3.9%) were men. The eldest was fifty-two years old, and the youngest was twenty-two. In a 5-year research, a study discovered that 11.8% of pituitary adenomas were received, which is higher to the results of our study. Similar to our study, they discovered that males were more likely to have pituitary adenomas than females. It is unknown why males are more likely than females to have pituitary adenomas.[16]

In the present study, eight (4.4%) Schwannoma were discovered in the brain, aged two to fifty-five (3 men and 5 females, respectively). Our study's results are in line with those of Mohammed et al.'s (2019) investigation, which found 9 (3.9%) incidences of brain Schwannoma over their 12-year study period.[19] A total of 9 medulloblastoma cases (5%) were identified among brain tumors, with 6 cases (3.4%) in females and 3 cases (1.7%) in males. The age range was 5 to 42 years. In aligns to this study, Patel et al also found 22(4.42%) of Medulloblastoma.[20] A study reported fifteen cases of Medulloblastoma, or 6.6% of all cases reported. This is greater than what we found in our study.[19]

According to the current study, 2 (1.1%) ependymomas were received in brain tumors; 1 (0.6%) male and 1 (0.6%) female, with minimum and maximum ages of 25 and 32, respectively. Over a three-year period, there were five (2.3%) cases of brain ependymoma tumorsy.[16] Compared to what we looked at in our study, it is rather greater. According to Mohammed et al the brain included seven (3.1%) ependymomas,[19] which is also more than what we have concluded. The current investigation found that a total of 4 (2.2%) oligodendrogliomas were found in brain tumors; the ages of the patients varied from 30 to 45 years, with 2 (1.1%) of the men and 2 (1.1%) of the females. Findings of this study also comparable to those of Das et al who found that 2.2% of cases of oligodendroglioma in the brain were related to the condition,[17] Compared to our analysis, 11 (8.46%) oligodendroglial tumors have been identified in 3 years.[16] Over a 12-year period, 13 (5.7%) cases of oligodendroglial tumors were documented in Saudi Arabia.[19] Based on certain limitations this study was limited by its single-center, retrospective design and relatively small sample size, which may affect the generalizability of results. Incomplete clinical and radiological data, as well as possible biopsy sampling errors, may have impacted diagnostic accuracy. The absence of molecular analysis also restricted detailed tumor classification. However further larger scale, multicenter studies with complete clinical and radiological data are recommended to validate these findings and accurately determine the most common histopathological types of brain tumors. Such research would contribute to improved diagnostic precision and aid in developing more effective and targeted management strategies.

CONCLUSION

It is evident that brain tumors possess diverse histopathological subtypes with varying prevalence across different age groups and genders. Meningiomas and astrocytomas were the most frequently diagnosed tumors, with meningiomas more common in females and astrocytomas predominantly affecting males. The age distribution revealed that brain tumors can develop at any stage of life, with certain subtypes more prevalent in specific age groups. Findings emphasize the need for age- and gender-based profiling to improve diagnostic accuracy and guide tailored management in neuro-oncology; further multi-center studies are recommended to validate and expand these observations to enhance neuro-oncological care.

ETHICS APPROVAL: The ERC gave ethical review approval.

CONSENT TO PARTICIPATE: written and verbal consent was taken from subjects and next of kin.

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AUTHORS' CONTRIBUTIONS:

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated in the work to take public responsibility of this manuscript. All authors read and approved the final manuscript.

CONFLICT OF INTEREST: No competing interest declared

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