Histopathological Frequency of Central Nervous System Diseases

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Abstract

Objective: To determine the frequency of central nervous system diseases, both neoplastic and non-neoplastic, by methodically examining data from various age and gender groups. The goal of the research is to guide future research directions, assist public health programs targeted to certain age and gender demographics, and educate clinical practice by analyzing the demographics of patients with both neoplastic (tumors) and non-neoplastic (non-tumor) CNS diseases.

MethodS: This is a cross-sectional study that aims to examine the frequency of central nervous system diseases. A retrospective was carried out at the Basic Medical Sciences Institute of Karachi's Pathology Department between October 2019 and September 2022. The study comprised all central nervous system (CNS) tissues submitted for histological evaluation. The gender, age and histological results of the samples were taken into consideration when reviewing them in detail.

Results: 207 central nervous system cases were investigated. A total of 180 CNS tumors were identified; meningioma and astrocytoma were the most common. Patients with CNS tumors had an average age of 35.8, and they were more likely to be female. And 27 non-neoplastic lesions were received, out of which granulomatous lesion was the most frequent. Non-neoplastic lesion was most common in males and the mean age was 25.2.

Conclusion: The current study contributes to the information available about the frequency of central nervous system diseases in our region. The gold standard for diagnosing a variety of diseases remains histological examination, even with the use of contemporary imaging techniques that aid in provisional diagnosis. Immunohistochemistry's further applications help with illness diagnosis and confirmation.

Keywords: CNS, neoplastic, non-neoplastic, meningioma, tuberculosis, Astrocytoma.

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Introduction

Brain tumours affect both adults and children and 90% arises from brain and remaining 10% arises from spinal cord, nerves and meninges[1]. As per Kang et al., there are various regions that are linked to CNS tumours, including the pituitary, pineal gland, and craniopharyngeal ducts[2]. Of the several forms of CNS tumours oligodendroglioma, ependymoma and astrocytoma are the most common and account for around 80% of cases. It is possible that endogenous steroid hormones contribute to the development of gliomas. Females are generally protected from glioma during their premenopausal years, according to the descriptive epidemiology of gliomas[3].

CNS tumors are the second most prevalent type of tumor in children. The posterior cranial fossa is site to the majority of pediatric brain tum-

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ors. Of all the tumor kinds, pilocytic astroc-ytoma and medulloblastoma are the most prevalent[4].

Malignant brain tumours affect 2,058 individuals annually or 3.3 per 100,000 persons in Iran[5]. In Malaysia, there are 1.26 brain tumours for every 100,000 people annually[6].

Brain and spinal cord tumours (CNS tumours) significantly affect mortality and morbidity rates in individuals of all ages. Brain and other tumors central nervous system are histologically complex and exhibit many well-known hallmarks of cancer, including dysregulated cell growth and metabolism. Brain and other CNS cancers have only ever been linked to large doses of ionizing radiation. A number of mendelian cancer syndromes such as Li Fraumeni syndrome, neurofibromatosis types I and II, and tuberous sclerosis are also associated[7].

As to the research conducted by Louis et al., the fifth revised version of the World Health Organization's categorization system for Central Nervous System neoplasms indicates that there are over 100 distinct histological subtypes of malignancies that affect the central nervous system. This suggests that there is a great deal of variation in the cellular features, behavior and clinical results of CNS neoplasms[8].

There is a possibility that non-neoplastic mass lesions can mimic malignancies on clinical and radiographic examinations. The causes of these disorders can range from developmental to inflammatory, infectious, vascular, and treatment-related[9].

Purpose of the study **is** to assess the occurrence of different types of central nervous system neoplastic and non-neoplastic diseases. By assessing the occurrence of both neoplastic and non-neoplastic CNS diseases, we can gain valuable insights that inform clinical practice, public health strategies, and future research directions, ultimately enhancing patient care and health outcomes.

Methodology

A retrospective study was carried out at Karachi's Pathology Department, Basic Medical Sciences Institute, between October 2019 and September 2022. All central nervous tissue specimens submitted for histological assessment were included in the study period during the analysis. The Ethics Committee gave its approval to the study.

By using non-probability convenience sampling technique brain as well spinal cord specimens were preserved in 10% formalin solution and the biopsy sample was processed and embedded in paraffin. Histology's widely used staining method, hematoxylin and eosin (H&E), was applied to tissue samples to create histopathological sections. Two pathologists examined the sections under a light microscope. Patients' preliminary surgical biopsy records revealed their age, socioeconomic status, and clinical characteristics. Statistics were analyzed and presented in simple percentages.

In order to determine the tumor frequency, this study included all histologically verified biopsy specimens of central nervous system tumors that were appropriately formalin-fixed and paraffin-embedded.

Tissue specimens that were not properly preserved were excluded because they could have an impact on the precision and dependability of the findings. Furthermore, cases containing insufficient material were not included, such as specimens with substantial deterioration or insufficient tissue samples.

Results

Table 1. Frequency Of All Types Of Brain And Spinal Cord Tumors

Diagnosis	Number of brain tumors (%)	Number of spinal cord tumors (%)	Total number of tumors (%)
Meningioma	57(31.7)	13(7.2)	70(38.9)
Astrocytoma	57(31.7)	3(1.7)	60(33.3)
Pituitary Adenoma	10(5.6)	-	10(5.6)
Schwannoma	8(4.4)	2(1.1)	10(5.6)
Medulloblastoma	9(5)	-	9(5)
Ependymoma	2(1.1)	3(1.7)	5(2.8)
Oligodendroglioma	4(2.2)	-	4(2.2)
Chondrosarcoma	-	1(0.6)	1(0.6)
Ganglioglioma	-	1(0.6)	1(0.6)
Hemangioblastoma	1(0.6)	-	1(0.6)

Undifferentiated High grade tumor	1(0.6)	-	1(0.6)
Metastatic neoplasia	-	1(0.6)	1(0.6)
Neurofibroma	-	1(0.6)	1(0.6)
Osteoma	1(0.6)	-	1(0.6)
Necrotic tumor	5(2.8)	-	5(2.8)
Total	155(86)	25(14)	180(100)

P<0.01 was found to be statistically significant using the Chi Square test

Table-1 shows the frequency of brain and spinal cord tumors in each morphological category. 180 CNS malignancies were found in all, of which 155 (86) were brain tumors and 25 (14) were spinal cord tumors. Meningioma 70 (38.9%) was the most common tumor among them, followed by astrocytoma 60 (33.3%). A P-value of less than 0.05 was deemed statistically significant using the Chi Square test.

Table 2. Central Nervous System Tumors Based On Gender

Diagnosis	Gender				M:F
	Male		Female		
	N	%	N	%	
Meningioma	20	11.1	50	27.6	0.4:1
Astrocytoma	34	18.8	26	14.4	1.3:1
Pituitary Adenoma	7	3.8	3	1.6	2.3:1
Schwannoma	3	1.6	7	3.8	0.4:1
Medulloblastoma	3	1.6	7	3.8	0.4:1
Ependymoma	3	1.6	2	1.1	1.5:1
Oligodendroglioma	2	1.1	2	1.1	1:1
Chondrosarcoma	0	0.0	1	0.6	0:1
Ganglioglioma	1	0.6	0	0.0	1:0
Hemangioblastoma	0	0.0	1	0.6	0:1
Undifferentiated High grade tumor	1	0.6	0	0.0	1:0
Metastatic neoplasia	0	0.0	1	0.6	0:1
Neurofibroma	0	0.0	1	0.6	0:1
Osteoma 1	0.6	0	0.0	1:0	
Necrotic tumor	2	1.1	3	1.6	1:1.5
Total 80	42.8	100	57.2	0.8:1	

p=0.038 was found to be statistically significant using the Chi Square test.

Table-2 shows the distribution of all malignancies in the brain and spinal cord by gender. With a male to female ratio of 0.8:1, CNS tumors were likewise more frequently detected in women than in males. A statistically significant P-value was defined as one that was less than 0.05 using the Chi Square test.

Table 3. Central Nervous System Tumors Based On Age

Diagnosis	N(%)	Age (years) Mean ± SD	Min - Max
Meningioma	70(38.9)	42 ± 14	(2-70)
Astrocytoma	60(33.3)	33 ± 17	(4-65)
Pituitary Adenoma	10(5.6)	40 ± 10	(22-54)
Medulloblastoma	9(4.4)	17 ± 12	(5-42)
Ependymoma	5(2.8)	22 ± 8	(11-32)
Oligodendroglioma	4(2.2)	36 ± 8	(30-45)
Chondrosarcoma	1(0.6)	30 ± 0.1	(30-30)
Hemangioblastoma	1(0.6)	35 ± 0.1	(35-35)
Undifferentiated High grade tumor	1(0.6)	6 ± 0.1	(6-6)
Ganglioglioma	1(0.6)	7 ± 0.1	(7-7)
Metastatic neoplasia	1(0.6)	62 ± 0.1	(62-62)
Neurofibroma	1(0.6)	45 ± 0.1	(45-45)
Osteoma	1(0.6)	27 ± 0.1	(27-27)
Schwannoma	10(5.6)	30 ± 14	(2-55)
Necrotic tumor	5(2.8)	40 ± 6	(32-47)
Total	180(100)	35.8 ± 15.9	(2-70)

Note: when there is (n=1) case SD cannot be computed
P<0.001 was found to be statistically significant using one-way ANOVA
*standard deviation is high due to wide range of minimum and maximum age difference.

Table 3 shows the central nervous system tumor based on the age. CNS tumors range in age from two years old to seventy years old, with a mean age of 35.8 years. A P-value of less than 0.05 was regarded as statistically significant when using the Chi Square test.

Table 4. Non-Neoplastic Diseases Based On Gender And Age

Non neoplastic lesion	Number(%)	Gender		Mean± SD Age(years)
		Male N(%)	Female N(%)	
Granulomatous	9(33.3%)	7 (50)	2(50)	24 ± 2.5
Abscess and non-specific Inflammation	7 (25.9%)	5(71.4)	2(28.6)	31 ± 3.1
Epidermoid Cyst	7(25.9)	4(57.1)	3(42.9)	26 ± 2.1
Infectious lesions	4(14.9)	4(100)	0(0)	20 ± 1.8
Total	27(100%)	20(74%)	7(26%)	25.2 ± 2.2

Table 4: displays the all non-neoplastic diseases based on gender and age. The most common non-neoplastic diseases among CNS was granulomatous lesion followed by abscess and non-specific inflammation. CNS non-neoplastic diseases are common in males then females. The mean age of non-neoplastic CNS tumor is 25.2 years.

Discussion

The only goal of this study is to show how common CNS non-neoplastic diseases and tumours are. Between October 1, 2019 and September 30, 2022, the pathology department of the Basic Medical and Science Institute at Jinnah Postgraduate Medical Centre in Karachi received a total of 207 CNS samples.

A total of 155 (86.1%) brain biopsies, 25 (13.9%) spinal cord biopsies and 27 non-neoplastic biopsies were obtained over the course of three years. The Shaukat Khanum cancer registry reports that in a single year, 224 cases (3.2%) of brain cancer were reported across all age categories. This is a greater figure than what was reported in the study because the registry covers a 12-month period[10].

Over the period 2010 to 2017, 162 patients with CNS tumors were diagnosed in Nepalese hospitals[11]. Another study in West Bengal, India examined 96 CNS tumors retrospectively, 34 of which were non-neoplastic and 62 of which were neoplastic[12].

According to this study, females are 1.25 times more likely to develop CNS tumours than males. Similarly, a study discovered that, with a ratio of 1.70:1, women are more prone than men to acquire CNS tumours[13]. On the other hand, the Shaukat Khanum cancer registry of Pakistan 2020 indicates that men are more likely than women to have CNS tumours[10].

The study found that CNS tumours typically have an age of 35.8 years. In an Indian study that was conducted close to ours, the patients' ages were reported to be 43.28[14]. The Leece study indicates that persons over 40 have an increased risk of developing CNS tumours; these findings are consistent with our own[15].

Meningiomas and Astrocytoma rank among the most prevalent tumours, per the current study. Between 2019 and 2022, there were 130 individuals having both tumours combined. Another investigation with comparable results indicated that of all CNS tumours, meningioma and Astrocytoma were the most prevalent[16].

The most prevalent CNS tumours globally are astrocytoma, which are followed in frequency by meningiomas, mixed gliomas, and oligodendroglioma[15]. One of the most prevalent forms of brain tumours, astrocytoma occurs in every second occurrence of brain tumours[17]. Diffuse astrocytic and oligodendroglial tumours were the most frequently diagnosed conditions, followed by meningiomas, according to a study by Shrestha et al[11].

In the current analysis, meningioma was found in 70 (38.9%) of the 180 patients with CNS tumors; 20 of these patients were male (28.6%) and 50 of these patients were female (71.4%). Patients age ranges from from 2 to 70 years old. In an eight-year investigation, meningioma cases (21.56%) were discovered in India[11]. Meningiomas are more common in women, as evidenced by the 12-year retrospective study conducted in Saudi Arabia, which found 70 (30.8%) cases of meningiomas. This study is more similar to ours[18]. Likewise, meningiomas comprised 35.1% of all tumours[19].

In the current study, there were 60 (33.3%) patients with astrocytoma during the specified years; 4 was the minimum age and 65 was the maximum age. Of these, 37 (61.7%) were males and 23 (38.3%) were females. There were 66 (29.1%) cases of astrocytic tumours, according to Mohammed et al., and men were more prone to develop them (18). Since their sample was gathered over a 7-year period, the number of astrocytic tumours in their study was 54 (41.5%), which is marginally fewer than ours[20].

Ten people (5.6%) in the current study had a diagnosis of pituitary adenoma. Of the ten individuals, seven (seventy percent) were males and three (30 percent) were females. The ages of the youngest and oldest were 22 and 54, respectively. Similar to the findings of this investigation, the (Lim et al.,) study discovered that 11.8% of patients had pituitary adenomas[19].

According to this study, out of the 10 patients with a diagnosis of Schwannoma, 3 (30%) were men and 7 (70%), women, ages 2 to 55. Additionally, nine patients with medulloblastoma are shown in this paper; of these, six (66.7%) were female and the remaining three (33.3%) were male. The age range of the patients was five to forty-two. Comparably, a Saudi Arabian study reports nine (3.9%) and fifteen (6.6%) cases of Schwannoma and medulloblastoma respectively. This is less than our study because theirs includes retrospective data spanning a 12-year period[18].

According to the current study, 2.8 patients between the ages of 11 and 32 were identified as having ependymoma. Of these 5 patients, 3 (or 60%) were male and the remaining 2 (or 40%) were female. Similar to our research, Mondal et al.'s study found that the frequency of ependymoma tumours in his research is 5 (2.3%) (20). The incidence of ependymoma tumours is 3.92%, according to Shrestha et al., while seven (3.1%) cases of ependymoma were reported by Mohammed et al. in their investigation[11,18].

The current study reported that a total of 4 patients (2.2%) with ages ranging from 30 to 45 years old, 2 (50%) of whom were male and 2 (50%) of whom were female, had an oligodendroglioma diagnosis. The research investigation that was closest to ours found that 2.2% of cases had oligodendroglioma[19]. Mondal et al. have reported on 11 (8.46%) occurrences of oligodendroglial tumours, and a 12-year research conducted in Saudi Arabia has reported on 13 (5.7%) cases of oligodendroglial tumours[11,18].

In our study one (0.6%) of the 35-year-old female patients had a diagnosis of hemangioblastoma. The journal (Mohammed et al.,2019) describes four hemangioblastoma cases in his study[18] (18). In their 5-year analysis, Das et al. reported 13 (2.2%) cases of hemangioblastoma, which is a somewhat larger number than what we discovered[19].

This study also included one (0.6%) case of metastatic neoplasia, which was a female 62-year-old. Over the course of the study's eight years, 3.38% of participants had metastatic tumours, according to Shrestha et al., 2020[11].

Less than 0.16% of all intracranial tumours are mesenchymal chondrosarcomas, according to Fu et al[21]. Only one (0.6%) chondrosarcoma was found in spinal cord tumors. Histopathology diagnoses only based on histopathological findings because clinical or radiological data were not provided. Tumors are rare, so no research material was found.

A rare and severely epileptic tumour, ganglioglioma (GG) accounts for around 1.3% of primary brain tumors[22]. One (0.6%) ganglioglioma in the spinal cord was discovered in this investigation. Gangliogliomas account for 3.8% of all cancers of the central nervous system, and 1.7% of them affect the spinal cord[23]. The quantity of rare tumors varies.

One instance of Osteoma (0.6%) and one case of high-grade undifferentiated tumor of mesenchymal origin were identified among the brain tumors. These two patients were included in the research as SOL due of the location of the tumor. Information on radiography and clinical conditions was not given.

Our investigation discovered 5 (2.8%) examples of necrotic tissue. Possibly as a result of the tumor being mostly necrotic and biopsy is taken from non-representative site.

We discovered 27 examples of non-neoplastic lesions in our investigation. A study conducted nearby discovered 34 (35.4%) non-neoplastic lesions[12]. There were 15 non-neoplastic lesions, which is less than our study[24]. In our investigation, granulomatous inflammation 9 (33.3%) was the most frequent lesion. On the other hand, the study[11,24] discovered that cystic lesions were the most common.

Our analysis reveals that, with a mean age of 25.2, non-neoplastic lesions are more numerous in males 20(74%) than in females 7(26%). In accord-

ance to our study, an Indian study, the patients' ages ranged from 5 days to 80 years, with a male to female ratio of 1.66:1 (11). In contrast, 8 female participants had a higher risk of developing non-neoplastic lesions[24].

Conclusion

The study found that brain biopsies were the most commonly performed procedures, with the majority of patients under 50 years old and a higher prevalence among women. Meningioma was identified as the most common tumor, followed by astrocytoma. Additionally, 27 non-neoplastic lesions were noted, with granulomatous inflammation being the most frequent, primarily affecting males in their third decade of life. These findings underscore the importance of age and gender in the occurrence of CNS tumors and non-neoplastic lesions.

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