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# Study Of Pediatric Central Nervous System Tumors In A Tertiary Care Centre

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**Abstract**

**Introduction -** Pediatric central nervous tumors are most common solid tumors in children and second in frequency after leukemia.

**Aims and Objective** - This study includes the spectrum of pediatric central nervous tumors with reference to their types, subtypes, age, sex, tumor location and clinicopathological features with relevant IHC in last 5 years.

**Materials And Methods -** This is a tertiary care hospital based study of Pediatric central nervous system tumors. All specimens were fixed in 10% formalin and entire biopsy tissue was processed as per standard guidelines. IHC markers were done after H&E microscopy.

**Results -** A total of 145 cases of Pediatric central nervous system tumors were diagnosed in 5 years (2018-2022) in our tertiary hospital. Out of total,86 were males and 59 were females. Supratentorial location is more common than infratentorial and spinal. Pilocytic astrocytomas was the most common tumor followed by medulloblastoma.

**Conclusion –** The most common tumor type in our study was astrocytoma with pilocytic astrocytoma being the most common astrocytic tumor. Embryonal tumors were the second most common they include medulloblastoma and PNET.

**Keywords**: Pediatric CNS tumors, immunohistochemistry, astrocytoma, pilocytic astrocytoma, medulloblastoma.

## Introduction

Pediatric tumors of nervous system are the second most common cancers after leukemia, constituting approximately 35% of all childhood malignancies and is the leading cause of death in children.[1]

Paediatric CNS tumors differ from adult brain tumors in reference to their site of origin, clinical presentation, tendency to disseminate early, histological features and their biological behaviour.[2]

In adults the most common primary brain tumors are meningiomas[7] followed by glial tumors with High grade Astrocytomas- Glioblastoma being most common.

However, in pediatric age group the glial tumors- Pilocytic Astrocytomas are most common and the second most common tumor is medulloblastoma.[5]

Histologically, central nervous system tumors are diagnosed and graded by the World Health Organization classification 2016.

In general pediatric CNS tumors are classified on the basis of histology and location,

(A) On the basis of histology can be categorized mainly into glial tumors and nonglial tumors.

**Gliomas**

Astrocytomas

Ependymomas

Gangliogliomas

Oligodendrogliomas

**Nonglial tumors**

Embryonal tumors

Craniopharyngiomas

Pineal tumors

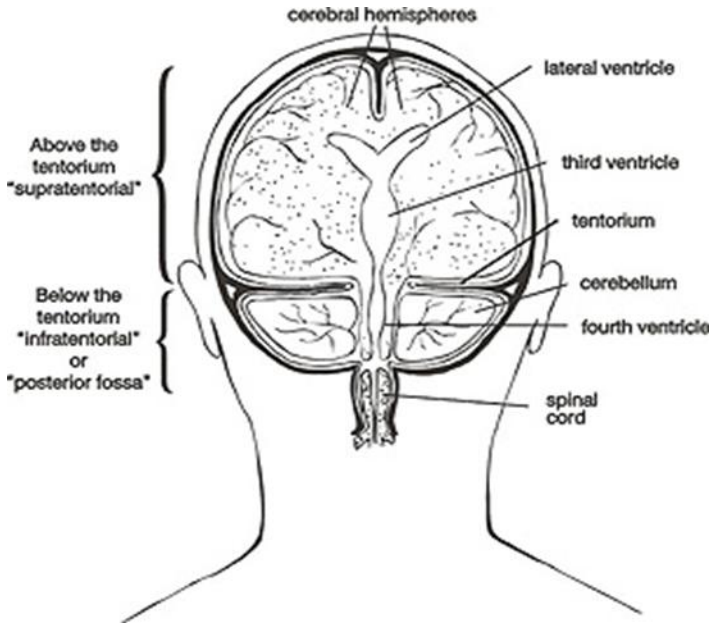
Others (i.e lymphoma, germ cell tumors, metastases)[4]

(B).On the basis of location pediatric CNS tumors are classified into

Supratentorial

Infratentorial

Spinal[3]




The most common clinical presentation in patients with brain tumors is headache followed by visual symptoms in the form of blurring or loss of vision and swaying while walking in cerebellar SOL.[3] In patients with spinal tumors the most common complaints are neurological deficits followed by sensory symptoms, limb pain and swelling.[3]

The pediatric CNS tumors pose diagnostic challenges because of varying histogenesis, histopathological differentiation ,overlapping morphological features and their differences in presentation from adults.

Immunohistochemistry in addition to the regular histopathological examination is done to confirm the diagnosis and to aid in the differential diagnosis.

The ultimate prognosis depends upon the histopathological type and grade of the tumor and thus role of a pathologist remains crucial in diagnosing and assessing the nature of the lesion.

## Material And Methods

### Study Design

This is a retrospective tertiary hospital based study of Pediatric central nervous tumors in a period of 5 years from 2018 to 2022. All specimens were fixed in 10 percent formalin and entire biopsy tissue was processed as per standard guidelines. IHC markers were done after H&E microscopy.

### Sample Size

All the Pediatric Central Nervous System specimens coming to the pathology department from 2018 to 2022.



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**Study Participants**

**Inclusion Criteria**

All the biopsies of Pediatric CNS space occupying lesions received & diagnosed on H & E as Pediatric CNS tumors were included in the study for immunohistochemical marker studies.

**Exclusion Criteria**

Cases not confirmed as neoplastic on histopathology.

Improperly fixed specimen and autolysed tissues.

**Result**

**Age and gender wise distribution** –

In this study 145 pediatric central nervous system tumor cases are included and out of total, 86 cases were males and rest 59 cases were females with male to female ratio is 1.45: 1. Age ranges from 16 weeks (foetus) to 18 years. On the basis of age group cases are divided in Foetus, 0-5 years, 6-10 years and 11-18 years. Out of total cases, one was male foetus, 18 cases in age group of 0-5 years , 35 cases in 6-10 years and 91 cases in 11-18 years, which accounts maximum 62.76% of total cases.

**Location wise distribution –**

In our study most common tumors were Supratentorial tumors(n=80/145), which are 55.17 % followed by infratentorial tumors (n=40/145) & spinal tumors (n=25/145).

The most common anatomical site was Cerebral hemisphere having 27.59 % of total cases (n=40/145), followed by spinal cord (n=25/145), cerebellum (n=19/145), ventricle (n=19/145), sellar/suprasellar (n=18/145), thalamus/hypothalamus (n=10/145).

**Histopathological distribution –**

The most common tumor type in our study was astrocytoma which was seen in 47 patients (33.10%) with pilocytic astrocytoma (13.79 %) being the most common astrocytic tumor. Embryonal tumors were the second most common constituting 12.41% cases, They include medulloblastoma (11.72 %) and PNET (0.68 %). Third most common tumor was ependymoma (10.34 %) which include myxopapillary ependymoma (0.68 %), ependymoma - WHO grade II (2.75 %) and anaplastic ependymoma- WHO grade III(6.89 %), Other less frequent tumors were schwannoma (6.89 %), ganglioglioma (4.82 %), craniopharyngioma (4.82 % ), pituitary adenoma (4.13 %),round cell tumors (4.13 %) and choroid plexus tumors (3.44 %)

So, Pilocytic astrocytoma is most common tumor followed by medulloblastoma.

In fetal age group only single case of choroid plexus papilloma was present. In 0-5yrs age group Astrocytoma (n=7/18) was most common tumor, in 6-10 yrs age group astrocytomas(n=13/35) was most common followed by ependymoma (n=6/35) and in 11-18 yrs age group astrocytomas (n=28/91) was most common tumor followed by embryonal tumors(n=12/91).

Tumors are present predominantely in 11-18 year age group which were (n=91/145) 62.75 % followed by in 6-10 year age group (n=35/145) which were 24.13 % of total tumors.

Astrocytoma, embryonal tumors, ependymomas, gangliogliomas, sellar suprasellar tumors, choroid plexus tumors, oligodendroglioma, grerm cell tumors and round cell tumors are more common in males as compare to females. Mesenchymal/non meningothelial tumors, meningiomas, schwannomas and pineal parenchymal tumor of intermediate differentiation are common in females as compared to males.

In astrocytomas, all grades had male preponderance except diffuse astrocytoma which was female dominating.

The entire spectrum of choroid plexus tumors are present as 3 case of choroid plexus papilloma,1 case of atypical choroid plexus papilloma and 1 case of choroid plexus carcinoma.

In Spinal cord most common tumor was schwannoma (n=7/25) followed by ependymoma (n=5/25) and astrocytoma(n=3/25).



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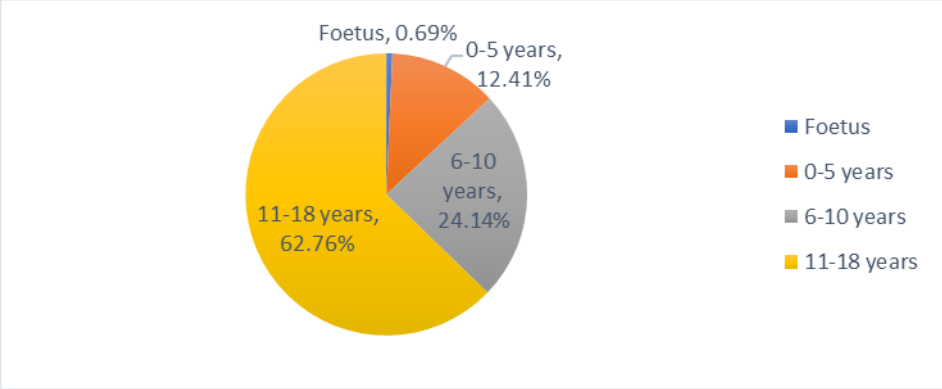
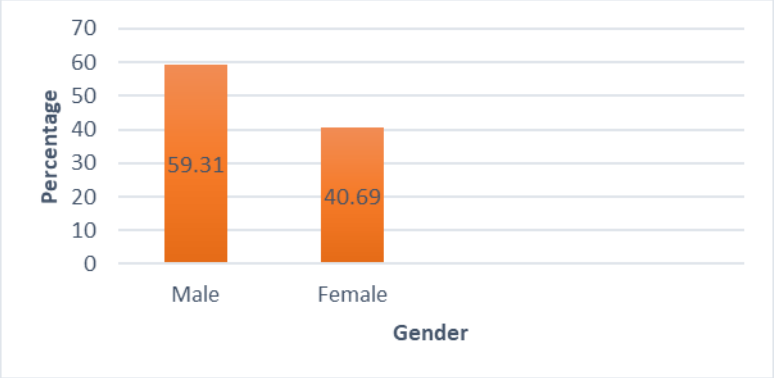
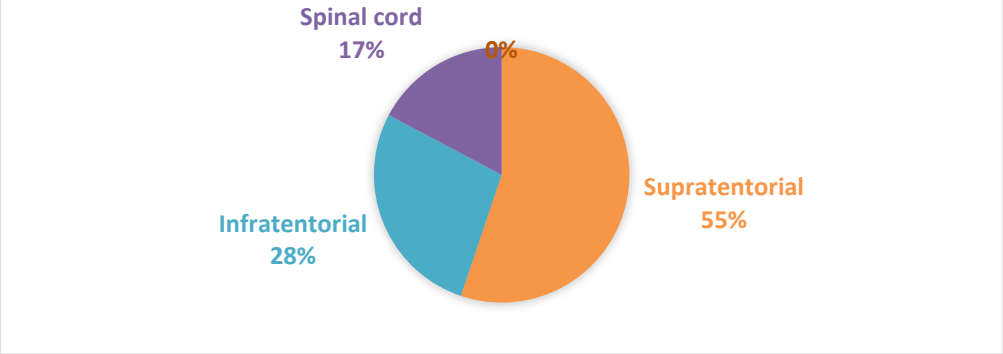
**Graph 1 : Distribution Of Cases According To Age**




**Graph 2 : Distribution Of Cases According To Gender**




**Graph 3 : Distribution Of Cases In Relation To Tentorium Cerebelli**



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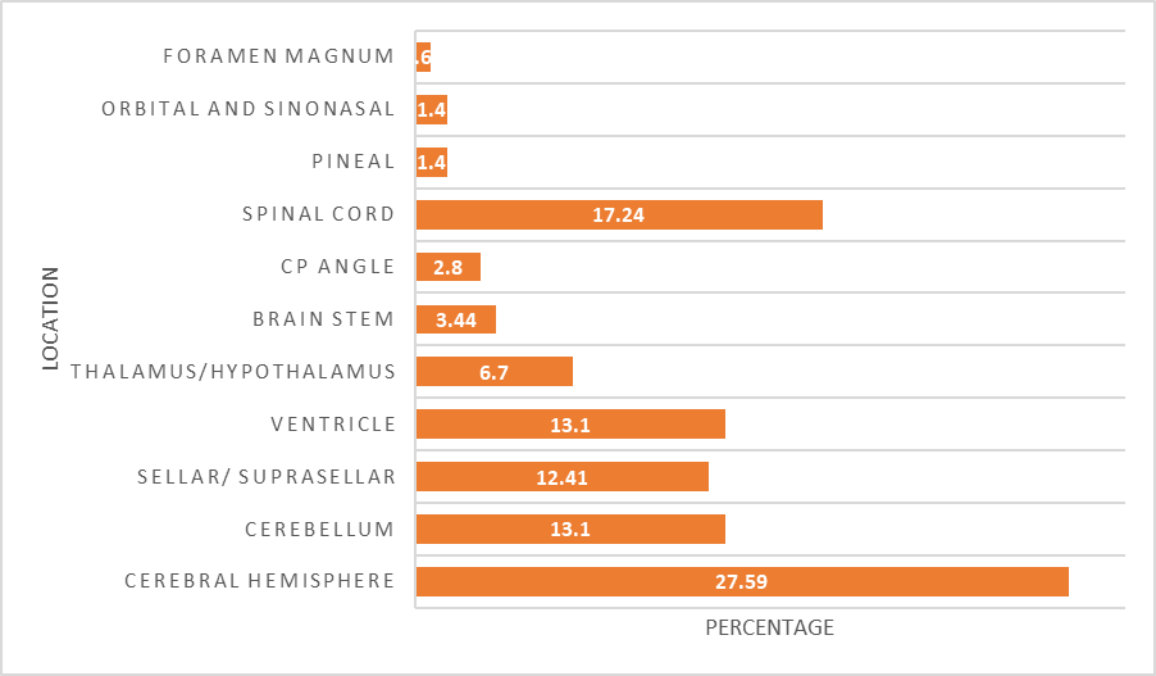
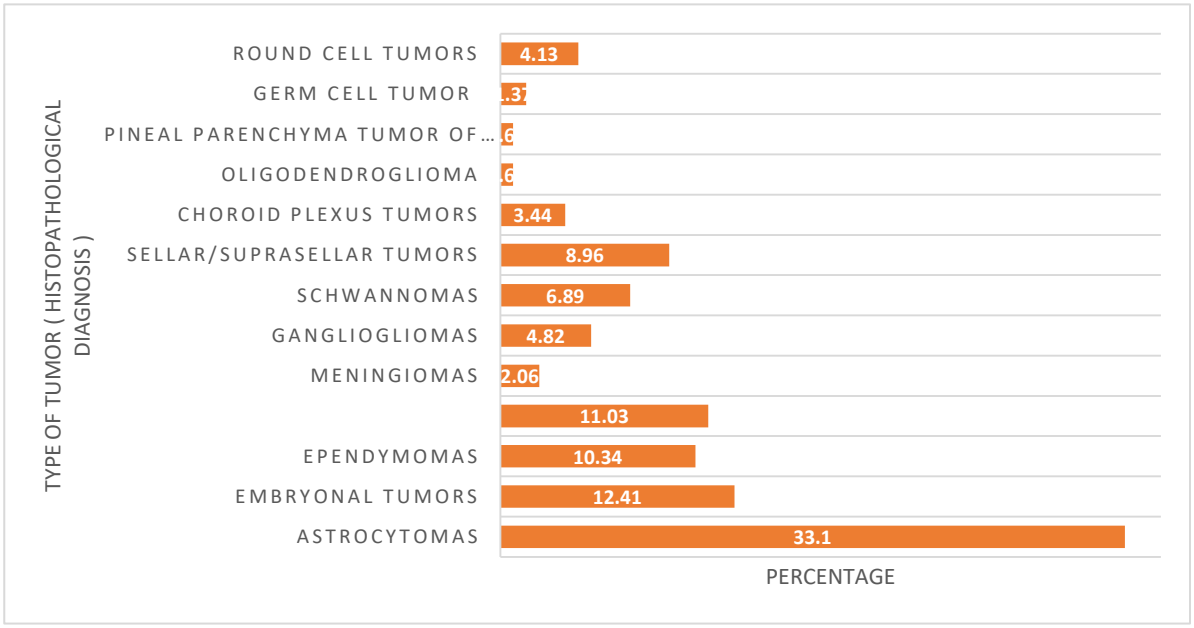
**Graph 4 : Distribution Of Cases According To Location**




**Graph 5: Distribution Of Cases According To Histopathological Diagnosis**



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**Graph 6: Correlation Of Gender With Histopathological Diagnosis**

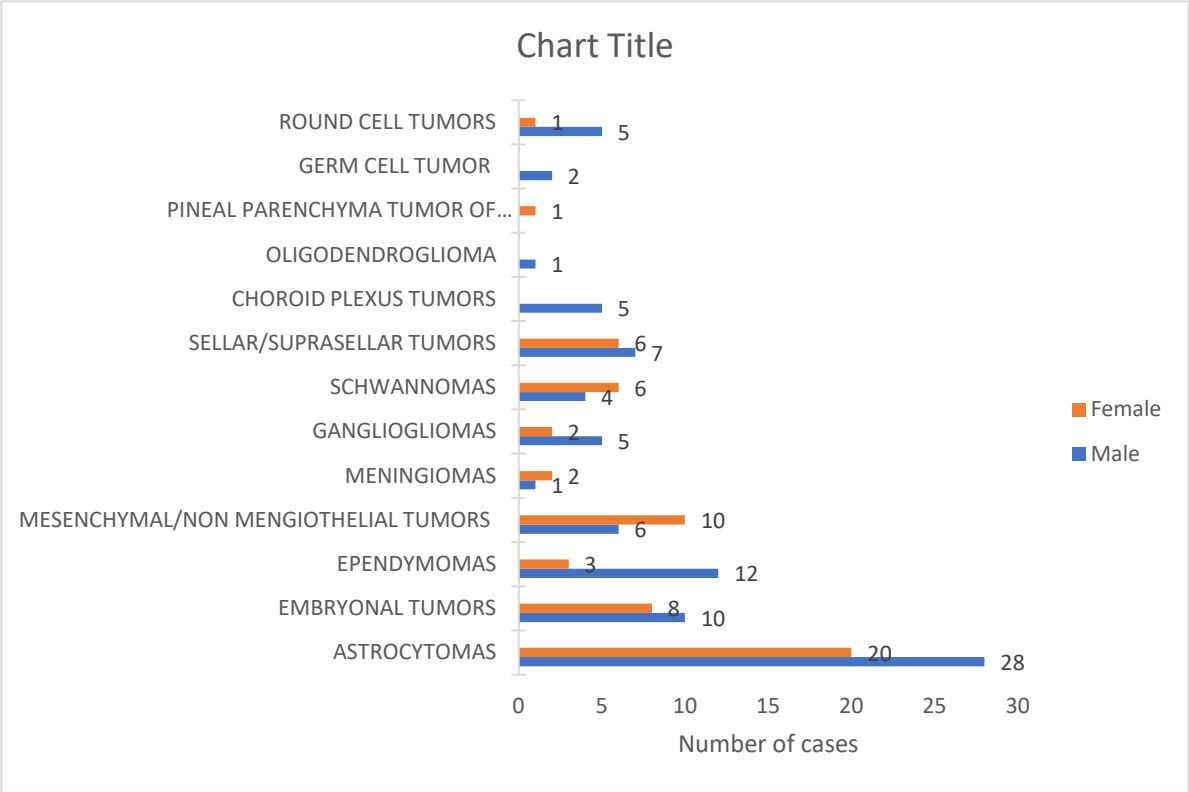


**Table 1 : Distribution Of Cases According To Location**

| Location | Number | Percentage% |
|---|---|---|
| Cerebral hemisphere | 40 | 27.59 |
| Cerebellum | 19 | 13.10 |
| Sellar/ supra sellar | 18 | 12.41 |
| Ventricle | 19 | 13.10 |
| Thalamus / Hypothalamus | 10 | 6.70 |
| Brain stem | 5 | 3.44 |
| Cp angle | 4 | 2.80 |
| Spinal cord | 25 | 17.24 |
| Pineal | 2 | 1.40 |
| Orbital and sinonasal | 2 | 1.40 |
| Foramen magnum | 1 | 0.69 |
| **Grand total** | **145** | 100 % |



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**Table 2: Distribution Of Cases According To Histopathological Diagnosis**

| Histopathological diagnosis | Number | Percentage% |
|---|---|---|
| Astrocytomas | 48 | 33.10 |
| Embryonal tumors | 18 | 12.41 |
| Ependymomas | 15 | 10.34 |
| Mesenchymal/Non mengiothelial tumors | 16 | 11.03 |
| Meningiomas | 3 | 2.06 |
| Gangliogliomas | 7 | 4.82 |
| Schwannomas | 10 | 6.89 |
| Sellar/suprasellar tumors | 13 | 8.96 |
| Choroid plexus tumors | 5 | 3.44 |
| Oligodendroglioma | 1 | 0.68 |
| Pineal parenchymal tumor of intermediate differentiation | 1 | 0.68 |
| Germ cell tumor | 2 | 1.37 |
| Round cell tumors | 6 | 4.13 |
| **Grand total** | **145** | |

**Table 3 : Distribution Of Tumors In Spinal Cord**

| Tumor type | Number |
|---|---|
| Pilocytic astrocytoma | 1 |
| Glioblastoma | 2 |
| Myxopapillary ependymoma | 1 |
| Ependymoma | 2 |
| Anaplastic ependymoma | 2 |
| Schwannoma | 7 |
| Lymphoma | 2 |
| Ganglioglioma | 1 |
| Meningioma | 1 |
| Osteoblastoma | 1 |
| Lipoma | 1 |
| Ewing sarcoma | 1 |
| Teratoma | 2 |
| Round cell tumor | 1 |
| **Total** | **25** |



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**Table 4: Distribution Of Cases According To Histopathological Type And Subtype**

| **Astrocytomas (n=48)** | **Number** | Percentage |
|---|---|---|
| Pilocytic astrocytoma | 20 | 13.79% |
| Pleomorphic Xanthoastrocytoma | 2 | 1.37% |
| Diffuse astrocytoma | 9 | 6.20% |
| Anaplastic astrocytoma | 4 | 2.75% |
| Glioblastoma | 13 | 8.96% |
| **Embryonal tumors (n=18)** | | |
| Medulloblastoma | 17 | 11.72% |
| PNET | 1 | 0.68% |
| **Ependymomas (n=15)** | | |
| Myxopapillary ependymoma | 1 | 0.68% |
| Ependymoma | 4 | 2.75% |
| Anaplastic Ependymoma | 10 | 6.89% |
| **Mesenchymal/Non Meningothelial tumors(n=16)** | | |
| Embryonal rhabdomyosarcoma | 2 | 1.37% |
| Ewing's sarcoma | 1 | 0.68% |
| Fibrous dysplasia | 2 | 1.37% |
| Hemangioblastoma | 1 | 0.68% |
| Lipoma | 1 | 0.68% |
| Osteoblastoma | 1 | 0.68% |
| Chordoma | 3 | 2.06% |
| Osteoma | 1 | 0.68% |
| Hemangioma | 2 | 1.37% |
| Hemangiopericytoma | 1 | 0.68% |
| Lymphangioma | 1 | 0.68% |
| **Pineal parenchyma tumor of intermediate differentiation** | 1 | 0.68% |
| **Germ cell tumor (n=2 )** | | |
| Teratoma | 2 | 1.37% |
| **Sellar/Suprasellar tumors (n=13)** | | |
| Craniopharyngioma | 7 | 4.82% |
| Pituitary adenoma | 6 | 4.13% |
| **Choroid plexus tumors (n=5)** | | |



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| | | |
|---|---|---|
| Choroid plexus papilloma | 3 | 2.06% |
| Atypical choroid plexus papilloma | 1 | 0.68% |
| Choroid plexus carcinoma | 1 | 0.68% |
| **Oligodendroglioma** | 1 | 0.68% |
| **Gangliogliomas** | 7 | 4.82% |
| **Meningiomas** | 3 | 2.06% |
| **Schwannoma** | 10 | 6.89% |
| **Round cell tumors (n=5)** | | |
| Lymphoma | 4 | 2.75% |
| Others | 2 | 1.37% |
| **Total** | **145** | **100%** |

**Table 5: Correlation Of Age With Histopathological Diagnosis**

| | **Foetus** | **0 –5 years** | **6-10 years** | **11-18 years** | **Total** |
|---|---|---|---|---|---|
| **Astrocytomas (n=48)** | **0** | **7** | **13** | **28** | **48** |
| Pilocytic astrocytoma | 0 | 2 | 7 | 11 | 20 |
| Pleomorphic Xanthoastrocytoma | 0 | 0 | 0 | 2 | 2 |
| Diffuse astrocytoma | 0 | 2 | 1 | 6 | 9 |
| Anaplastic astrocytoma | 0 | 0 | 2 | 2 | 4 |
| Glioblastoma | 0 | 3 | 3 | 7 | 13 |
| **Embryonal tumors (n=18)** | **0** | **2** | **4** | **12** | **18** |
| Medulloblastoma | 0 | 2 | 4 | 11 | 17 |
| PNET | 0 | 0 | 0 | 1 | 1 |
| **Ependymomas (n=15)** | **0** | **1** | **6** | **8** | **15** |
| Myxopapillary ependymoma | 0 | 0 | 0 | 1 | 11 |
| Ependymoma | 0 | 1 | 0 | 3 | 4 |
| Anaplastic Ependymoma | 0 | 0 | 6 | 4 | 10 |
| **Mesenchymal/Non Meningothelial tumors(n=16)** | **0** | **5** | **2** | **9** | **16** |
| Embryonal rhabdomyosarcoma | 0 | 2 | 0 | 0 | 2 |
| Ewing’s sarcoma | 0 | 0 | 0 | 1 | 1 |
| Fibrous dysplasia | 0 | 0 | 0 | 2 | 2 |
| Hemangioblastoma | 0 | 1 | 0 | 0 | 1 |
| Lipoma | 0 | 0 | 0 | 1 | 1 |



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| | | | | | |
|---|---|---|---|---|---|
| Osteoblastoma | 0 | 0 | 1 | 0 | 1 |
| Chordoma | 0 | 0 | 0 | 3 | 3 |
| Osteoma | 0 | 0 | 0 | 1 | 1 |
| Hemangioma | 0 | 1 | 1 | 0 | 2 |
| Hemangiopericytoma | 0 | 0 | 0 | 1 | 1 |
| Lymphangioma | 0 | 1 | 0 | 0 | 1 |
| **Pineal parenchyma tumor of intermediate differentiation** | **0** | **0** | **1** | **0** | **1** |
| **Germ cell tumor (n=2 )** | **0** | **0** | **1** | **1** | **2** |
| Teratoma | 0 | 0 | 1 | 1 | 2 |
| **Sellar/Suprasellar tumors (n=13)** | **0** | **1** | **3** | **9** | **13** |
| Craniopharyngioma | 0 | 1 | 3 | 3 | 7 |
| Pituitary adenoma | 0 | 0 | 0 | 6 | 6 |
| **Choroid plexus tumors (n=5)** | **1** | **1** | **2** | **1** | **5** |
| Choroid plexus papilloma | 1 | 1 | 0 | 1 | 3 |
| Atypical choroid plexus papilloma | 0 | 0 | 1 | 0 | 1 |
| Choroid plexus carcinoma | 0 | 0 | 1 | 0 | 1 |
| **Oligodendroglioma** | **0** | **0** | **0** | **1** | **1** |
| **Gangliogliomas** | **0** | **0** | **2** | **5** | **7** |
| **Meningiomas** | **0** | **0** | **0** | **3** | **3** |
| **Schwannoma** | **0** | **0** | **0** | **10** | **10** |
| **Round cell tumors (n=5)** | **0** | **1** | **1** | **4** | **6** |
| Lymphoma | 0 | 0 | 1 | 3 | 4 |
| Other | 0 | 1 | 0 | 1 | 2 |

**Table 6: Correlation Of Gender With Histopathological Diagnosis**

| | Male | Female | Total |
|---|---|---|---|
| **Astrocytomas (n=48)** | **28** | **20** | **48** |
| Pilocytic astrocytoma | 11 | 9 | 20 |
| Pleomorphic Xanthoastrocytoma | 2 | 0 | 2 |
| Diffuse astrocytoma | 4 | 5 | 9 |
| Anaplastic astrocytoma | 3 | 1 | 4 |
| Glioblastoma | 8 | 5 | 13 |
| **Embryonal tumors (n=18)** | **10** | **8** | **18** |
| Medulloblastoma | 10 | 7 | 17 |



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| | | | |
|---|---|---|---|
| PNET | 0 | 1 | 1 |
| **Ependymomas (n=15)** | **12** | **3** | **15** |
| Myxopapillary ependymoma | 1 | 0 | 1 |
| Ependymoma | 4 | 0 | 4 |
| Anaplastic Ependymoma | 7 | 3 | 10 |
| **Mesenchymal/Non Meningothelial tumors(n=16)** | **6** | **10** | **16** |
| Embryonal rhabdomyosarcoma | 2 | 0 | 2 |
| Ewing's sarcoma | 1 | 0 | 1 |
| Fibrous dysplasia | 0 | 2 | 2 |
| Hemangioblastoma | 0 | 1 | 1 |
| Lipoma | 0 | 1 | 1 |
| Osteoblastoma | 0 | 1 | 1 |
| Chordoma | 1 | 2 | 3 |
| Osteoma | 0 | 1 | 1 |
| Hemangioma | 2 | 0 | 2 |
| Hemangiopericytoma | 0 | 1 | 1 |
| Lymphangioma | 0 | 1 | 1 |
| **Pineal parenchyma tumor of intermediate differentiation** | **0** | **1** | **1** |
| **Germ cell tumor (n=2 )** | **2** | **0** | **2** |
| Teratoma | 2 | 0 | 2 |
| **Sellar/Suprasellar tumors (n=13)** | **7** | **6** | **13** |
| Craniopharyngioma | 5 | 2 | 7 |
| Pituitary adenoma | 2 | 4 | 6 |
| **Choroid plexus tumors (n=5)** | **5** | **0** | **5** |
| Choroid plexus papilloma | 3 | 0 | 3 |
| Atypical choroid plexus papilloma | 1 | 0 | 1 |
| Choroid plexus carcinoma | 1 | 0 | 1 |
| **Oligodendroglioma** | 1 | 0 | 1 |
| **Gangliogliomas** | **5** | **2** | **7** |
| **Meningiomas** | **1** | **2** | **3** |
| **Schwannoma** | **4** | **6** | **10** |
| **Round cell tumors (n=5)** | **5** | **1** | **6** |
| Lymphoma | 4 | 0 | 4 |
| Others | 1 | 1 | 2 |



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**Table 7: Percentage Breakup Of Various Histological Subtypes Of Pediatric CNS Tumors In Indian Studies.**

| Tumor | AIIMS [21] | NIMHANS [21] | GB PANT[21] | TMH [21] | CSMMU [21] | CMC [21] | PGIMER [21] | SHAH [18] | PRESENT STUDY |
|---|---|---|---|---|---|---|---|---|---|
| Astrocytoma | 33.7 | 44.1 | 22.3 | 28.6 | 30.6 | 46.7 | 37 | 40.8 | 33.43 |
| Mb & PNETs | 16.8 | 19.7 | 32 | 29 | 27.7 | 10.3 | 21.6 | 29.0 | 12.41 |
| Ependymoma | 8.5 | 8.5 | 12.2 | 19.1 | 9.4 | 4.8 | 6.3 | 6.6 | 10.34 |
| Oligodendroglioma | 0.7 | 0.9 | 2.9 | 1.4 | 1.5 | 0 | 0 | 2.6 | 0.68 |
| Craniopharyngioma | 12.7 | 7.7 | 13.5 | 4.5 | 13.1 | 8.5 | 11.5 | 11.8 | 4.82 |
| Schwanomma | 7 | 4.3 | 1.3 | 2.4 | 2.2 | 4.6 | NA | 2.6 | 6.89 |
| Meningioma | 5.6 | 4.3 | 0.3 | 3.4 | 2.2 | 3.5 | NA | 1.3 | 2.06 |
| Neuronal & Mixed neuronal glial | 4.1 | 2.8 | 5.2 | 2.1 | 0 | NA | NA | 1.3 | 4.82 |
| Germ cell tumor | 2.2 | 2.2 | 3.3 | 1.7 | 2.2 | NA | NA | 0 | 1.37 |
| Chroid plexus tumor | 1.5 | 2.6 | 1.6 | 1.7 | 1.5 | NA | 3.5 | 2.6 | 3.44 |
| Pineal tumors | 0.7 | 1.4 | 1.3 | 1 | 3 | NA | NA | 1.3 | 0.68 |
| Lymphoma | 1 | 0.5 | 0.3 | 0 | 0 | 1.1 | NA | NA | 2.75 |

**Table 8: Frequency Of Various Types Of Pediatric CNS Tumors Reported In Different Countries (In Percentage).**

| Tumor | Brazil [8] | Korea [27] | Germany [16] | Canada [15] | Bejing [9] | Sweden [16] | Morocco [17] | Japan [22] | Present Study |
|---|---|---|---|---|---|---|---|---|---|
| Astrocytoma | 32.5 | 27.8 | 41.7 | 39.4 | 30.5 | 51 | 37.1 | 35.7 | 33.43 |
| Mb & PNETs | 13.9 | 19. | 25.7 | 15.4 | 14.6 | 17 | 28.9 | 10 | 12.41 |
| Ependymoma | 7.4 | 8.1 | 10.4 | 7 | 5.6 | 8 | 12 | 4.8 | 10.34 |
| Oligodendroglioma | 0.9 | 2.6 | 1.1 | 1.7 | 6.2 | 0 | 1.7 | 0 | 0.68 |
| Craniopharyngioma | 11 | 9.2 | 4.4 | 6.8 | 18.4 | 4.6 | 6.6 | 10.5 | 4.82 |
| Chroid plexus tumor | 3 | 2.2 | Na | 2.3 | 1.8 | 1.9 | NA | 0 | 3.44 |
| Neuronal & Mixed neuronal glial | 7.6 | 6.2 | 3.2 | <2 | 3.1 | 0 | 1.3 | 0 | 4.82 |
| Meningioma | 3 | 2.6 | 1.2 | <2 | 3.1 | 1.6 | 2.2 | 1.9 | 2.06 |
| Schwanomma | NA | 0.4 | NA | 3.1 | 2.8 | 1.1 | NA | 0 | 6.89 |
| Germ cell tumor | 3.6 | 8.1 | NA | 3.1 | 7.9 | 1.5 | 0.9 | 14.3 | 1.37 |
| Pineal tumors | NA | NA | 1.3 | 0.5 | 0.6 | 2.7 | 0.7 | 0 | 0.68 |



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**Table 9: Comparison Of Various Indian Studies On Pediatric CNS Tumor**

| Characteristics | Rinu D et al[3] (Tirupati) | Madhvan R et al[28], (Chennai) | Suresh SG et al[29], (Chennai) | Shah HC et al[18], (Gujrat) | Sangita RM[2] et al, (Mumbai) | Jain[21] et al, (AIIMS Delhi) | Present study (Jaipur) |
|---|---|---|---|---|---|---|---|
| No of patients | 64 | 250 | 52 | 76 | 239 | 819 | 145 |
| Duration of study | 2012-2018 | 2006-2011 | 2012-2016 | 2012-2013 | 2001-2015 | 2002-2007 | 2018-2022 |
| Mean Age | 13.2 yrs. (0-18yrs.) | NA (0-18yrs.) | 4yrs. | 10.69 yrs. (0-19yrs.) | NA (0-18yrs.) | NA (0-18yrs.) | 11.57 yrs (0-18 yrs) |
| Gender | M=24 F=40 | M=111 F=139 | M=37 F=17 | M=42 F=34 | M=131 F=101 | NA | M=86 F=59 |
| Common Tumor type | | | | | | | |
| Astrocytoma | 19(29.6%) | 52% | 28.8% | 40.8% | 46.8% | 33.7% | 33.43% |
| Medulloblastoma and PNET | 7(10.9%) | 21.6% | 34.6% | 29% | 18.4% | 16.8% | 12.41% |
| Craniopharyngioma | 8(12.5%) | 3.6% | NA | 11.8% | 9.2% | 12.7% | 4.82% |
| Oligodendroglioma | 5(7.85) | 6% | NA | NA | 10% | 0.7% | 0.68% |
| Ependymoma | 4(6.2%) | 10.4% | 9.6% | 6.6% | 12.5% | 8.5% | 10.34% |
| Germ cell tumor | 2(3.1%) | 1.6% | 9.6% | NA | 1.3% | 2.2% | 1.37% |

## Discussion

In our study we have included cases ranging from foetus to 18 years and studied them according to their age, gender, location and their relation with the histopathological diagnosis.

### Comparison of Age and Gender:

On the basis of age group cases are divided in Foetus, 0-5 years, 6-10 years and 11-18 years. Out of total 145 cases, one was foetus, 18 cases in age group of 0-5 years, 35 cases in 6-10 years and 91 cases (62.76 %) was found in 11-18 year age group which was maximum and consistent with findings of Rinu Dwivedi, P Sudhapriya, P Padmavathi et al.

A higher proportion of brain tumors were found in males as compared to females in this study with male to female ratio of 1.45:1, consistent with findings of Avinash Gupta, Sukhpreet kaur, Hanni G Vasudev and Sangita Ramulu Margam, Nitin Maheshwar Gadgil, Ganesh Ramdas Kshirsagar et al, Whereas study by Rinu Dwivedi, P Sudhapriya, P Padmavathi et al, shows female preponderance with male to female ratio of 0.75:1 contrary to our findings.

### Comparison of location:

In our study out of total Pediatric central nervous tumors, Intracranial tumors were 82.75% while spinal tumors were 17.24%. Intracranial tumors were more frequent than spinal, showing resemblance with study by Zhi-ming Liu, Chih-yi Liao, Heng Zhang et al, Rong Zhang, Wen-gian Shen, Liang-fu and Hosein aghayan golkashani ,Hossein hatami ,Abdonaser farzan et al.

Our study shows a preponderance of supratentorial tumors , Similar findings were published by Rosemberg et al[(8)], Zhou et al[(9)], Asirvatham et al[(10)], Pinho et al[(11)] respectively from China, South Korea, India and Brazil

Other studies of Margam S *et al*., (2016), Suresh SG *et al*., (2017) , Govindan A *et al*., (2018) , Zhi-ming Liu, Chih-yi Liao, Heng Zhang et al, (2022) and Rong Zhang, Wen-gian Shen, Liang-fu Zhou ( (2007) also shows a preponderance of supratentorial tumors.



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Infratentorial and spinal tumors were more common than supratentorial tumor in study by Ahmed et al[12] and Sapna Gandhi , Anita Meena, Anita Harsh et al, However Kaatsch et al[13] (Germany) and Gabriel Olabiyi Ogun et al[14] (Nigeria) found Equal ratio between supra- and infra-tentorial tumors.

In our study cerebral hemisphere was most common tumor location similar to the studies by Swathi Chilukuri, Ramesh Teegala , Sai Bandarupalli et al, Mohan Rao et al (2014)[19] and Vinay kumar et al (2014)[20].

**Distribution on the basis of histopathological diagnosis:**

In our study the predominant tumor type was Astrocytoma followed by medulloblastoma which was consistent with other studies of Sangita Ramulu Margam, Nitin Maheshwar Gadgil, Ganesh Ramdas Kshirsagar et al, and Hosein aghayan golkashani ,Hossein hatami ,Abdonaser farzan et al.

Embryonal tumors (Medulloblastoma) are second most common tumor entity in our study similar to study by Avinash Gupta, Sukhpreet Kaur, Hanni G Vasudev.In western population also it was found that astrocytomas and medulloblastoma are two most common tumors in childrens and ependymomas were third most common childhood brain tumor in various western studies from Germany[13], Canada[15], Sweden[16] and Morocco[17], this is in concordance with our study.

In our study pilocytic astrocytoma is most common astrocytic tumor[1,2].

In Fetal age group only one case presented which as diagnosed as choroid plexus papilloma. Astrocytoma was the most common tumor type in all other age groups, similar results are also present in study of Ricardo Silva Pinho,MD, Solange Andreoni, PhD, Nasjla Saba Silva et al. In 0-5yrs age group Astrocytoma was most common tumor, in 6-10 yrs age group astrocytomas was most common followed by ependymoma and in 11-18 yrs age group astrocytomas was most common tumor followed by embryonal tumors.

In our study, Astrocytomas, embryonal tumors, ependymomas, ganglioglioma, sellar / suprasellar, choroid plexus tumors, oligodendroglioma, germ cell tumor and round cell tumor were more common in males as compared to females whereas female preponderance is present in Mesenchymal / Non meningothelial tumors, meningioma, Schwannoma and pineal parenchymal tumor of intermediate differentiation pediatric central nervous tumors.Male preponderance in ependymal tumors were also found in Dhruv Pankaj mehta, Asha S Anand, Dipak patel et al and Quinn T. Ostrom, Mackenzie Price, Katherine Ryan et al.

In study of Quinn T. Ostrom, Mackenzie Price, Katherine Ryan et al and Keun-Tae Cho, Kyu-Chang Wang, Seung-Ki Kim et al incidence of pituitary tumors were higher in females than males

One case was diagnosed as atypical choroid plexus papilloma, which again presented after about 7 months, and on this biopsy this time, it was diagnosed as choroid plexus carcinoma (WHO grade III),with MIB1 LI of 16 to 22 %. Brain invasion was also seen in this case.

In the spinal cord, the glial tumors and Schwannomas were present in nearly equal numbers. Amongst the glial tumors, most common was ependymoma followed by astrocytoma.

**Conclusion**

In our study, Pilocytic Astrocytomas were the major histological type of pediatric central nervous tumors followed by medulloblastomas. The incidence of majority of the tumors in our institute is within range of international and national study data.

In our present study, Spectrum of pediatric Central nervous system tumors were studied and diagnosed according to the WHO 2016 classification. However, the latest CNS WHO 2021 classification lays a huge emphasis on the paediatric gliomas with the updated classification based on newly found molecular alterations. There is inclusion of some novel tumor entities based on these updated molecular and genetic studies which affect the treatment, prognosis & survival of these patients. These molecular diagnostics also help in targetted therapy to the patient thereby changing the prognostic effect remarkably rather than the treatment given by chemotherapy alone.

Though the histopathological diagnosis remains the main stay, further workup is done by immunohistochemical marker studies. The clinical



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and radiological details should be noted for integrated diagnosis.

The role of the pathologist here is to remain updated with the rapidly upcoming molecular and genetic changes in the CNS tumors and the latest updated WHO classifications to provide prompt and precise diagnosis.

In our study, we found that IHC served as an advantageous tool for accurate diagnosis in our centre, though our study is limited by the fact that we could not get the molecular & genetic workup due to its non availability at our centre and loss of close follow up of our patients.

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