

PROFILE OF PEDIATRIC CENTRAL NERVOUS SYSTEM (CNS) TUMOR PATIENTS AT DR. SOETOMO GENERAL ACADEMIC HOSPITAL SURABAYA IN 2017-2023

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Abstract

Central nervous system (CNS) tumors are a heterogeneous group in any region of the brain and spinal cord. They causes significant morbidity and mortality. CNS tumor is diagnosed based on clinical and radiological findings, but a definitive diagnosis requires histopathology examination. However, the demographic and histopathological profile of pediatric CNS tumor is rarely studied in Indonesia. The study aims to analyze the profiles of pediatric CNS tumor patients based on demographic and histopathological characteristics. This retrospective descriptive study was conducted using secondary data from a medical records of all pediatric CNS tumor patients at Dr. Soetomo General Academic Hospital from January 2017 to December 2023. The results show a total of 165 cases were included in this study, 60% occurred in male and 40% in female. The majority of the patients aged 5-8 years old (30.3%) and tumors commonly located within posterior fossa (21.4%). WHO grade I pilocytic astrocytoma (24.2%) is the most common histopathological subtype for benign CNS tumors followed by WHO grade IV medulloblastoma (20.6%) for malignant CNS tumor. Thus, pediatric CNS tumor was found to be more frequent in males than females, with the peak occurring in 5-8 years old. The most common location was within posterior fossa. The most common histopathological subtype was WHO grade I pilocytic astrocytoma.

Keywords: CNS, Epidemiology, Pediatric, Tumor

Introduction

Central nervous system (CNS) tumors are a heterogeneous group that can develop in any region of brain and spinal cord (Louis et al., 2021). The incidence rate of children in the age group of 0-19 years with CNS tumors was 6.13 per 100,000 population (Ostrom et al., 2023). In recent years, classification of pediatric CNS tumors has changed including revisions to tumor nomenclature and molecular diagnostics have become incorporated with the histopathology (Cole, 2022). The World Health Organization (WHO) 2016 Classification of CNS Tumors had been used molecular feature and histology to define the tumor groups for the first time. There is a shift from using histopathological diagnoses by microscope to using molecular features (Louis et al., 2016). The 2021 revised fifth edition of the WHO Classification of CNS Tumors introduces a number of tumors into a specific entity by molecular information (Pollack et al., 2019).

The etiology of primary CNS tumor is unknown, but there are several risk factors including perinatal parameters as tentative risk factors (Georgakis et al., 2017). Signs and symptoms in CNS tumors can occurs generalized due to increased intracranial brain pressure, but can also be localized while involving the major structures of the CNS system (Alentorn et al., 2016).

Neuroimaging modalities and intra-operative techniques are safer for CNS tumors diagnosis, especially when tumors located in eloquent sites of the brain or spinal cord. However, surgery even along with chemoradiotherapy, is often non-curative in aggressive tumors causing some serious side effects and long-term sequelae, such as seizures and permanent neurological deficits. Advanced modality for diagnosis and targeted therapies, also novel outcome predictors are rapidly emerging in the current situation. Some of the surgical techniques including magnetic fields to control tumor progression, ultrasound for enhancing drug delivery and tumor ablation, intra-operative fluorescence and phototherapy to limit malignant tumors infiltration are currently under investigation (Delaidelli & Moiraghi, 2024).

CNS tumors epidemiology is to know the prevalence and characteristics of CNS tumors either the demography, clinical, or histopathological characteristics of the patients. There are still limited data and limited molecular test for CNS tumors in Indonesia so that authors study the epidemiology of primary CNS tumors at Dr. Soetomo General Academic Hospital, Surabaya based on the 2016 WHO classification. Presence of epidemiologic studies can help to predict cancerous CNS tumors survivability and early detection can be approached.

The study aims to analyze the profiles of pediatric CNS tumor patients based on demographic and histopathological characteristics.

Research Method

This retrospective descriptive study was conducted using secondary data from a medical records of pediatric CNS tumor patients at Dr. Soetomo General Academic Hospital, Surabaya. The total sampling technique was used in this study. The study's sample consisted of all pediatric CNS tumor patients at Dr. Soetomo General Academic Hospital from January 2017 to December 2023. The inclusion criteria in this study were Primary CNS tumor patients under the age of 18 with comprehensive medical records and histopathological diagnosis results following biopsy surgery at Dr. Soetomo General Academic Hospital. The exclusion criteria were secondary CNS tumor patients, patients with incomplete medical records, patients who did not undergo biopsy procedure at Dr. Soetomo General Academic Hospital from January 2017 to December 2023 and patients without histopathological diagnosis results. The variables in this study were age, gender, tumor location, and histopathological subtype. The collected data were processed using the Microsoft Excel 2021 software based on the research variables.

Results and Discussion

The patient's characteristics are shown in Table 1. After inclusion and exclusion processes, the total number of subjects was 165. Age classifications consisted of infants (less than 1 year) and children with age group of 1-4 years, 5-8 years, 9-12 years, and 13-17 years. Those aged 5-8 years old had the most frequent of prevalence, with 50 (30.3%) patients. The gender proportion was dominated by male with 99 (60%) patients than female with 66 (40%) patients.

Table 2 below presents the tumor characteristics including location and histopathological subtype based on 2016 WHO classification of CNS tumors. Posterior fossa (21.2%) was the most frequent sites. As the result of the histopathological examination following biopsy, the most histopathological features were pilocytic astrocytoma with 40 (24.2%) patients.

Discussion

A research study search was conducted from PubMed database showed that primary infantile CNS represent less than 10% of pediatric CNS tumors (Simone et al., 2021). This study consistent with our findings that infants had 6.7% incidence of CNS tumors. Previous studies on the pediatric CNS tumor at several hospitals showed diverse findings about which age is the highest (Larouche et al., 2020; Steliarova-Foucher et al., 2017). One of those studies indicated 5-9 years as the most prevalent age group, while the other found it to be 0-4 years. In this research, based on the age of their initial diagnosis, subjects were separated into five age groups: less than a year, 1–4 years, 5–8 years, 9-12 years, and 13–17 years. The peak incidence of age group was 5-8 years (24.2%), which was different from other older references from the study at Hasan Sadikin General Hospital, Bandung from 2012-2018 that 6-12 years with 66 (41%) patients was the most represented age group (Dewi et al., 2023).

Gender

In this research, male incidence was more common than female, i.e. 60% male and 40% female, comparable to the older references from the study in India, Korea and China which the frequency of male was higher than female, i.e. 55.3%, 57.1%, and 63.1 %, respectively, while the 2023 CBTRUS statistical report showed that female survivor was more than men with 6.27 vs 6.00 per 100.000 populations (Cheong Soon et al., n.d.; Ostrom et al., 2023; Shah et al., 2015; Yu et al., 2022).

Tumor Site

Based on a study in Saudia Arabia and 2023 CBTRUS Statistical Report, the majority of tumor location was meninges and meningiomas being the most histopathological feature in all age groups. However, there was different epidemiological data in pediatric population than adult. 2023 CBTRUS Statistical Report claimed that pituitary and craniopharyngeal duct (18.8%) was the most frequent tumor sites, followed by the cerebellum (13.6%) (Mohammed et al., 2019; Ostrom et al., 2023).

In this research, mostly pediatric primary CNS tumors were within posterior fossa (21.2%), followed by the sellar region (15.2%) and cerebellum (14.6%). Spinal cord, ventricle, and thalamus accounted for 7.3%, 6%, and 4.8%, respectively. Mesencephalon, Cerebropontine Angle, cranial nerve, brainstem, and pons each accounted for 1.2%. Frontal, temporal, parietal, and occipital lobes of the brain accounted for 1.8%, 3.1%, 1.2%, and 1.2%, respectively. Temporoparietal, parietoccipital, and temporooccipital lobes of the brain accounted for 3%, 1.2%, and 0.6%. Frontotemporoparietal and temporoparietoccipital accounted for 2.4% and 1.2% of all pediatric primary CNS tumors.

Yang et al. from China showed that there were significantly site distribution differences between benign and malignant tumors. Sellar region (40.0%) and cerebellum or the fourth ventricle (52.7%) were the most common sites in benign and malignant tumors group, respectively (Yang et al., 2023). Our findings also revealed that sellar region (30.5%) was the most common site in the benign tumor group, but in malignant brain tumors group, posterior fossa (41.1%) was the most common sites.

Tumor Histopatology

A retrospective study at RSHS showed that the most common histopathological types was medulloblastoma, while Saket et al. from Iran claimed that the most common types of CNS tumors among children were astrocytoma (Dewi et al., 2023; Saket et al., 2021). In this research, the highest groups of tumors were astrocytic tumors (33.3%), followed by embryonal tumors (26.1%), germ cell tumors (10.3%), ependymal (7.3%),

and tumors of the cranial and paraspinal nerves (3.7%). Meningiomas, choroid plexus tumors, neuronal and mixed neuronal-glial tumors, and tumors of sellar region each accounted for 3.1%. Tumors of pineal region and mesenchymal, non-meningothelial tumors each accounted for 1,2% of all pediatric primary CNS tumors.

In term of distribution of tumors by histopathology, Canadian pediatric cohort reported that in children less than 15 years, the incidence rates of low grade gliomas (36.4%), high grade gliomas (22.3%), and embryonal tumors (18.7%) as the majority of the brain tumors were 1.41, 0.86, and 0.72 per 100 000 person-years, respectively. This distribution is comparable to our findings that CNS tumor grade 1 pilocytic astrocytoma (24.2%) was the most histopathological feature, followed by CNS tumor grade 4 medulloblastoma (20.6%) (Larouche et al., 2020).

Pilocytic astrocytoma can develops in any region of brain and spinal cord, also affects the optic nerve pathway. Various size and tumor sites resulting in difference clinical features (Resende & Alves, 2021). In this research, the most common histopathology subtypes from astrocytic tumors were pilocytic astrocytomas (72,7% of all astrocytic tumors) with suprasellar and fossa posterior fossa as the common sites.

Histologically, classification of medulloblastomas include classic, desmoplastic/nodular, medulloblastoma with extensive nodularity and anaplastic with the worst prognosis (Mohammed et al., 2019; Ostrom et al., 2023). In this research, the most common histopathology types were medulloblastomas (79.1% of all embryonal tumors) with fossa posterior and cerebellum as the common sites. Based on medulloblastoma histologically defined, classic medulloblastomas, desmoplastic medulloblastomas, and anaplastic medulloblastomas accounted for 73.5%, 17.7%, and 8.8%, respectively.

Conclusion

In this research, the majority of pediatric CNS tumor patients were males aged 5-8 years old and tumors commonly located within posterior fossa. WHO grade I pilocytic astrocytoma was the most common histopathological subtype. Subsequent researchers can use this study to do comparable research with longer period of time in order to better reflect the population. These findings suggest that further research needs to be done regarding the risk factors and clinical characteristics of pediatric CNS tumors.

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