Clinical Profile and Vitamin D Status of Children with Cerebral Palsy

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Abstract

Cerebral palsy (CP) is a disorder of motor function and posture, due to impaired brain development. Children with CP are at risk of experiencing vitamin D deficiency due to reduced mobility, low vitamin D intake, and use of anti-epileptic drugs. Vitamin D deficiency can cause hypocalcemia and reduce bone mineral density, osteopenia, and rickets so that it can result in pathological fractures even with only minor injuries. Monitoring vitamin D levels, early identification, and appropriate vitamin D supplementation are important in reducing the risk of injury and fracture in PS children. This study aims to determine the clinical profile of children with cerebral palsy and their vitamin D status. **Methods:** A descriptive study of children with cerebral palsy aged 2 to 6 years at the Neuro-pediatric outpatient clinic at H. Adam Malik Hospital, Medan from November 2022 to April 2023. Primary data was obtained from interviews and examination of serum vitamin D levels. Secondary data was obtained from medical records. **Results:** Eighty-five CP children were included in this study, 51.8% were boys and 48.2% were girls. The mean age of the subjects was 3.48 years, 34.1% of the subjects experienced malnutrition. The etiology of CP mainly occurs in the perinatal period (66.7%). Most subjects had spastic type (75.3%), with GMFCS grade V being the most common type (34.1%). Most of the subjects (57.6%) had epilepsy and were using anti-epileptic drugs. The majority of subjects had vitamin D deficiency status (56.5%). **Conclusion:** The clinical profile of cerebral palsy children at Haji Adam Malik Hospital Medan showed that most CP occurred during the perinatal period. Spastic type is the most common type of CP, most CP children experience epilepsy and vitamin D deficiency.

Keywords: Clinical profile; Cerebral palsy; Children; Vitamin D

Cerebral palsy is a disorder of motor function and posture, resulting from impaired brain development, and is a group of neurological developmental disorders in children that are heterogeneous, non-progressive, and cause lifelong disability.(1) Recent population-based studies from around the world report prevalence estimates of CP ranging from 1 to almost 4 per 1,000 live births or per 1,000 children. In Indonesia, the incidence of PS cannot be studied with certainty, currently, there is no data on the prevalence of CP.(2-5) Cerebral palsy can be accompanied by several disorders or disorders, including perceptual, sensory, musculoskeletal, cognitive, behavioral, and communicative disabilities, epilepsy, difficulty eating, nutritional disorders, and decreased bone density due to vitamin and mineral deficiencies, especially vitamin D and calcium. (6)

Vitamin D is very important for bone growth, biomineralization, and musculoskeletal development in childhood because it facilitates the absorption of calcium and phosphate from food, and is involved in various other metabolic processes, including regulation of hormone secretion (insulin and renin), cell proliferation and differentiation, immune function as well as anti-inflammatory effects.(2,7-10) Low vitamin D levels in CP children are more common than in children without limitation of mobility. (2) Low levels of vitamin D in CP children can be caused by multifactor including low sunlight exposure due to limited movement, inadequate vitamin D intake due to eating problems, and long-term use of anti-epileptic drugs (AEDs) which interfere with vitamin D metabolism.(6,7) Various study shows that the prevalence of vitamin D deficiency in CP children is around 50-60%.(6,7) Meanwhile, in Indonesia, studies on vitamin D levels in CP children are still rarely carried out.

Vitamin D deficiency can cause hypocalcemia, metabolic bone disease due to reduced bone mineral density, osteopenia, and rickets which can result in pathological fractures even with minor injuries.(8) Monitoring vitamin D levels, early identification, and appropriate vitamin D supplementation are important in reducing the risk of injury and fractures in CP children.(9)

1. Methods

This study is a descriptive study to determine the clinical profile and vitamin D status of children with cerebral palsy. The study was conducted at the Neuro-pediatric Outpatient Clinic at Haji Adam Malik Hospital, Medan, from November 2022 to April 2023. The subjects were children aged 2 to 6 years who were diagnosed with cerebral palsy by a neuro-pediatrician. Exclusion criteria were CP children who received vitamin D supplements of >400 IU/day in the last 1 month and CP children who received drugs that interfere with vitamin D metabolism (systemic corticosteroids, rifampicin, antiretrovirals) in the last 1 month. Data collection was carried out using consecutive sampling. The variables studied were nutritional status, etiology of CP, type of CP, epilepsy, and AED use. There are three CP categories used in this study: spastic, hypotonus, and dyskinetic. The spastic type is classified further into three subtypes which are hemiplegic, diplegic, and quadriplegic. Functional levels were evaluated using the Gross Motor Function Classification System (GMFCS). GMFCS has five classifications from I to V. Children who can walk without support are included in levels I and II, while children with assistive mobility devices and orthoses to walk are included in level III. Level IV children can function in a sitting position with limited self-mobility. Level V children cannot walk and require support to maintain their sitting position. Moreover, GMFCS levels I, II, and III are categorized as ambulatory, and GMFCS levels IV and V are categorized as non-ambulatory. Respondents' 25(OH)D levels were evaluated using Linked Fluorescent Assay (ELFA). Informed consent was gathered before the examination. Vitamin D status was divided into three categories: normal if the level ranges between 30-100 ng/mL; insufficient if it ranges from 21-29 ng/mL; and deficient if < 20 ng/mL. Categorical data is presented in the form of frequency distributions and percentages. Numerical data is presented in percentages. The data collected was processed and analyzed using the help of the Statistical Package for Social Science (SPSS) computer software version 23.0.

2. Results

A total of 101 children with cerebral palsy, only 85 children fulfilled the inclusion criteria; 8 children were excluded due to intake of vitamin D supplements and 8 children did not have parental consent. The mean age of subjects was 3,48 (SD 1,42) years and consisted of 44 male subjects and 41 female subjects. Most of the subjects (41,2%) were poor-nourished and 34.1% were malnourished. The majority of subjects are spastic type (75.3%), with spastic quadriplegia and spastic diplegia being the most common subtypes. There were 57.6% of the subjects consumed anti-epileptic drugs. Most of the subjects (67%) were non-ambulatory CP. The characteristics of the research subjects can be seen in **Table 1**.The lowest vitamin D level is 9.07 ng/mL and

the highest is 55.6 ng/mL Most of the subjects experienced a deficiency of vitamin D (56.5%), this is shown in **Table 2.**

Table 1. Demographic Characteristics of Children with Cerebral Palsy

Characteristics	**Results (n = 85)**
Age (SD), years	
Mean (SD)	3,48 (1,42)
Median (Min-Max)	2,83 (2 – 6)
Gender, n (%)	
Male	44 (51,8)
Female	41 (48,2)
Nutritional Status	
Malnourished	29 (34,1)
Poor-nourished	35 (41,2)
Well-nourished	21 (24,7)
Etiology CP, n (%)	
Prenatal	**13 (15,3)**
Congenital Malformation	4 (30,8)
TORCH Infection	9 (69,2)
Perinatal	**56 (65,9)**
Asphyxia	31 (55,4)
Prematurity	25 (44,6)
Postnatal	**16 (18,8)**
CNS Infection	15 (93,8)
Kernicterus	1 (6,2)
Type of CP, n (%)	
Dyskinetic	1 (1,2)
Hypotonic	20 (23,5)
Spastic Hemiplegic	6 (7,1)
Spastic Diplegic	29 (34,1)
Spastic Quadriplegic	29 (34,1)
Anti-Epileptic Drugs	
Yes	49 (57,6)
No	36 (42,4)
GMFCS	
I	0
II	3 (3,5)
III	25 (29,4)
IV	28 (32,9)
V	29 (34,1)

CNS: Central Neuron System; CP: Cerebral Palsy, GMFCS: Gross Motor Function Classification System

Table 2. Vitamin D Status in CP Children

Vitamin D Status, ng/mL	Results (n = 85)
Median (Min–Max)	19,5 (9,4 – 55,6)
Mean (SD)	21,92 (9,07)
Vitamin D Status, n (%)	
Deficiency	46 (54,1)
Insufficiency	25 (29,4)
Normal	14 (16,5)

3. Discussion

In this study, it was found that the majority of CP children were boys (51.8%). The results of this study in accordance with Toopchizadeh et al. study in Iran 2017 and Leonard et.al study in Belgium 2019, which also reported that the majority of PS patients were boys (56.9%). Risk factors for cerebral palsy are related to asphyxia, prematurity, infection/inflammation, and genetic disorders. These risk factors have the potential to affect brain development regardless of gender, but several studies report a higher male gender prevalence, with a male/female sex ratio of 1.3-1.4:1.2.(10,11)

The prevalence of malnutrition in this study was 75.3% (41.2% malnutrition and 34.1% malnutrition). These results are not much different from study by Nur et al in 2018, the prevalence of malnutrition was found in 77.5% of CP children (67.5% were undernourished and 10% were malnourished).(12) A Study by Adamu et al 2017 reported the prevalence of malnutrition in CP children amounting to 86%.(13) The prevalence of malnutrition in CP children in developing countries is higher when compared to developed countries as reported by Leonard et al in Belgium (34%) and Caselli et al in Portugal (22%).(10,14) This difference could be This is because most of the research subjects were children with cerebral palsy of the spastic type, where difficulty eating in CP children was more common in CP of the spastic type.

Perinatal complications, especially asphyxia at birth, are the most common risk factors for CP in developing countries. In this study, perinatal complications contributed 65.9% of the causes of CP, whereas asphyxia contributed the largest number of cases (55.4%). The results of this study are almost the same as Salfi's study in Surabaya, where perinatal factors were the largest cause of CP (69.5%).(15) Likewise, a study by Sharma et al in India 2018 reported that perinatal causes of asphyxia were the largest cause of CP (48%) compared to prenatal and postnatal. (16)

Most of the subjects in this study were spastic type (75.3%) with the most common spastic types being spastic quadriplegic (34.1%) and spastic diplegic (34.1%). The results of this study are not much different from the study conducted by Minocha et al 2016 which obtained an incidence of spastic type in 180 CP children of 84.4%.(17) A study by Toopchizadeh et al 2017 reported that spastic quadriplegic type was the most common type of CP (43.1%).(2) The quite large numbers in this study could be because Haji Adam Malik Hospital is a referral hospital from areas in North Sumatra so CP patients who come for treatment are already in serious condition.

Most of the research subjects were CP GMFCS IV 32.9% and GMFCS V 34.1%. A study by Nur et al. found that the majority of subjects had GMFCS V (34%).(12) This is comparable to a study by Kareem et al. in Iraq reporting 47.2% of subjects had GMFCS V.(18) A study by Delobel et al. 2021 obtained different results, only 27.4% of 252 CP children had severe GMFCS grades (GMFCS IV-V). Most CP children with GMFCS IV or V were found in treatment centers in Asia or Africa compared to Australia, Europe, or North America. (19)

Epilepsy is common in CP children and occurs in 30–40% of cases. In this study, the majority of subjects experienced epilepsy and received AEDs (57.6%). The results of this study were higher than those reported in previous studies, a study by Pavone et al. in France found that of 93 CP subjects, 49% had epilepsy. This difference may depend on case selection, where the frequency of epilepsy is greater in the group of CP subjects with spastic quadriplegic type, and with more severe motor dysfunction, as reported in the literature, which may be a reflection of the severity of damage to the brain. (20-22)

The prevalence of vitamin D deficiency in children with cerebral palsy varies throughout the world. In this study, of 85 children with cerebral palsy, 54.1% had deficiency, and 29.4% had vitamin D insufficiency. The lowest vitamin D level was 9.4 ng/mL and the highest level was 55.6 ng/mL. This is not much different from several previous studies. A study by Toopchizadeh et al. reported a prevalence of vitamin D deficiency in CP children of 44.6%.(2) In study by Le Roy et al., 30.4% of CP children had vitamin D deficiency and 47.8% had insufficiency, whereas in study by Seth et al., the prevalence of vitamin D deficiency in cerebral palsy children was quite high, namely 60%.(6,23)

There are various causes of vitamin D deficiency, including reduced synthesis in the skin, lack of food intake containing vitamin D, and acquired or hereditary vitamin D metabolism disorders. (24) Sun exposure is a determining factor in vitamin D levels. Interestingly, more than 90% of the need for vitamin D in the body is fulfilled by exposure to sunlight. Inadequate sun exposure has been cited as one of the most common factors contributing to vitamin D deficiency in CP children. The precipitating element here is loss of ambulation. Non-ambulatory CP children are often at home and lack exposure to sunlight, therefore, they are susceptible to low concentrations of vitamin D levels in serum. (7,23)

4. Conclusion

The clinical profile of cerebral palsy children at Haji Adam Malik Hospital Medan showed that most CP occurred during the perinatal period. Spastic type is the most common type of CP, most CP children experience epilepsy and vitamin D deficiency. Routine assessment of vitamin D levels and its preventive treatment are advised to avoid its deficienct and following effects.

5. References

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