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Nutritional Status of Children with Cerebral Palsy

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ABSTRACT

Objective: This study examined the nutritional parameters of children diagnosed with cerebral palsy who have lost their physical and mental function for various reasons.

Methods: A total of 130 children aged 2-18 years, diagnosed with cerebral palsy were included in the study. The nutritional characteristics of all patients were recorded, and nutritional problems were assessed. Body weight, height, and serum levels of total protein, albumin, ferritin, folic acid, alkaline phosphatase, calcium, phosphorus, magnesium, vitamin-D, and parathormone were measured.

Results: Of the 130 patients included in the study, 50% were female, and the median age was 10 (range 2-18) years. The median interquartile range (IQR) height was 130 (110-148) cm, and the median (IQR) weight was 24 (16-38) kg. In laboratory examinations, the median (IQR) vitamin-D level was 18.4 (10.5-24.9) ng/mL, with 23% (n=30) of the cases having levels below 10 ng/mL, 32% (n=42) having levels between 10-20 ng/mL, and 45% (n=58) having levels above 20 ng/mL. Albumin levels were significantly higher in female patients (p=0.002).

Conclusion: Careful monitoring of iron and vitamin-D deficiencies is necessary in children with cerebral palsy who are fed enteral formulas.

Keywords: Cerebral palsy, dysphagy, nutrition, spasticity

INTRODUCTION

Cerebral palsy (CP) is a chronic condition of movement and posture development caused by non-progressive damage to the developing fetal or infant brain, resulting in limited activity (1). Oral intake disorders and malnutrition are frequently observed in these patients because of spastic movement disorders and oropharyngeal dysphagia (2,3). In addition, due to the development of contractures and posture disorders, objective and standard measurement of parameters used in nutritional evaluation, such as height and weight, has become difficult. In these patients, protein and energy malnutrition and micronutrient deficiencies due to oral intake disorders may be observed (4,5). The frequency of increased fracture risk due to decreased bone mineral density and minimal trauma is reported to be 5-60% (2,6). In this study, the nutritional parameters of children diagnosed with CP who have lost their physical and mental function for various reasons were examined.

METHODS

A total of 130 children aged 2-18 years, diagnosed with CP, who were brought to the Pediatric Gastroenterology outpatient clinic between June 2016 and June 2017 for nutritional management were included in the study. Our study was conducted in accordance with the Declaration of Helsinki and was approved by the Health Sciences University Türkiye, Şişli Hamidiye Etfal Training and Research Hospital Ethics Committee (decision no: 1420, date: 28.01.2020). All patients were bedridden and required care from their families. The nutritional characteristics of all patients were recorded, and nutritional problems were assessed using the Waterlow classification. No additional pathology was detected in any of the patients beyond their current condition. Body weight and height were measured using the same height meter and weighing equipment. Laboratory examinations were used to measure serum levels of total protein, albumin, ferritin, folic acid, alkaline phosphatase, calcium, phosphorus, magnesium, vitamin-D, and parathormone (PTH) using Roche AutoAnalyzer systems. The study did not include a control group.

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Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences® version 22.0 (IBM Corp., Armonk, NY, USA). Numbers, percentages, means, medians, etc., were used to summarize the results. The normal distribution of numerical data was assessed using the Shapiro-Wilk test. For normally distributed data, the mean and standard deviation (SD) were reported, whereas the median and interquartile range (IQR) were used for non-normally distributed data. Numerical data were compared using Student's t-test or Mann-Whitney U test according to normality. All p-values were two-tailed and were considered significant at $p<0.05$, with a confidence interval of 95%.

RESULTS

Of the 130 patients included in the study, 50% were female, and the median age was 10 (range 2-18) years. The median (IQR) height was 130 (110-148) cm, and the median (IQR) height SDs was -1.63 [-2.10-(-1.16)]. The median (IQR) weight was 24 (16-38) kg, and the median (IQR) weight SDs was -3.7 [-4.17-(-3.23)]. According to the Waterlow classification, 45 patients (34.7%) were classified as mildly malnourished. There were no significant differences in age, height, height SDs, weight, weight SDs, and Waterlow classification values between male and female patients ($p>0.05$) (Table 1).

Referring to the laboratory testing, the median (IQR) serum total protein was 7.1 (6.8-7.4) g/dL, albumin was 4.2 (3.9-4.5) mg/dL, and ferritin was 30.9 (21-48) mg/L. The median (IQR) vitamin-B12 level was 584 (422-962) pg/mL, with levels above 800 pg/mL in 13% (n=13) of the cases. The median (IQR) folic acid level was 9.1 (7-11.6) ng/mL, phosphorus was 4.4 (4-4.9) mg/dL, calcium was 9.6 (9.27-9.9) mg/dL, magnesium was 2 (1.9-2.2) mg/dL, and PTH was 35 (24.3-48.7) pg/mL. The median (IQR) vitamin-D level was 18.4 (10.5-24.9) ng/mL, with 23% (n=30) of the cases having levels below 10 ng/mL, 32% (n=42) having levels between 10-20 ng/mL, and 45% (n=58) having levels above 20 ng/mL. Albumin levels were significantly higher in female patients ($p=0.002$) (Table 2).

DISCUSSION

Feeding problems are frequently observed in children with CP. Spastic motor disorders and oropharyngeal dysphagia are common causes of these feeding issues. Enteral feeding methods, such as percutaneous endoscopic gastrostomy (PEG), can be employed, particularly in cases where dysphagia and motility disorders restrict oral intake (7). Monitoring nutrition

Table 1. Demographic features of the study population

Variables	All patients (n=130)	Female patients (n=130)	Male patients (n=130)	p-value
Age (Years, median, range)	10 (2-21)	10 (2-21)	10 (3-15)	0.909[a]
Height (Cm, median, IQR)	130 (110-148)	135 (110-149)	122 (110-148)	0.554[a]
Height SDs (median, IQR)	-1.63 [-2.10-(-1.16)]	-1.61 [-2.05-(-1.1)]	-1.66 [-2.14-(-1.2)]	0.582[a]
Weight (Kg, median, IQR)	24 (16-38)	27 (16-40)	23 (16-36)	0.452[a]
Weight SDs (median, IQR)	-3.7 [-4.17-(-3.23)]	-3.6 [-4.1-(-3.15)]	-3.8 [-4.2-(-3.27)]	0.368[a]
Waterlow classification (n, %)				
Normal	36 (27.7%)	19 (14.7%)	17 (13%)	0.923[b]
Mild	45 (34.7%)	21 (16.2%)	24 (18.5%)	
Moderate	31 (23.8%)	14 (10.8%)	17 (13%)	
Severe	18 (13.8%)	9 (6.9%)	9 (6.9%)	

[a]Mann-Whitney U test, [b]Chi-square test
cm: Centimeter, IQR: Interquartile range, kg: Kilogram, SDs: Standard deviations

Table 2. Laboratory parameters

Variables	All patients (n=130)	Female Patients	Male Patients	p-value
Total protein (g/dL, median, IQR)	7.1 (6.8-7.4)	7 (6.8-7.5)	7.1 (6.8-7.3)	0.578[a]
Albumin (mg/dL, median, IQR)	4.2 (3.9-4.5)	4.3 (4.1-4.6)	4.1 (3.7-4.4)	0.002[a]
Ferritin (mg/L, median, IQR)	30.9 (21-48)	28.1 (23-44.6)	31.3 (17.5-55)	0.665[a]
Folic acid level (ng/mL, median, IQR)	9.1 (7-11.6)	9.08 (7.15-11.88)	9.4 (6.23-11.66)	0.809[a]
Phosphore (mg/dL, median, IQR)	4.4 (4-4.9)	4.4 (3.8-5.05)	4.4 (4-4.8)	0.580[a]
Calcium (mg/dL, median, IQR)	9.6 (9.27-9.9)	9.66 (9.28-9.95)	9.58 (9.3-9.9)	0.683[a]
Magnesium (mg/dL, median, IQR)	2 (1.9-2.2)	2 (1.9-2.2)	2 (1.9-2.2)	0.166[a]
Vitamin-D (ng/mL, median, IQR)	18.4 (10.5-24.9)	17.8 (7.8-24.8)	19 (12.45-25.2)	0.355[a]
Parathormon (pg/mL, median, IQR)	35 (24.3-48.7)	36.13 (24.3-48.6)	34 (24.1-50)	0.743[a]

[a]Mann-Whitney U test, IQR: interquartile range, g: gram, mg: milligram, ng: nanogram, pg: picogram, L: liter, dL: desiliter, mL: milliliter

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in these patients is challenging due to difficulties in measuring parameters such as height and weight, as well as limitations in transporting these patients to the hospital. Additionally, some studies reported that even with optimal nutritional management, the growth rate in this patient group is slower compared to that of healthy children (8).

Civan et al. (7) reported that nutritional parameters improved and the rate of major morbidity was low following PEG in children with CP. Similar findings were reported in a prospective study by Sullivan PB et al. (9). All patients in our study were fed orally and were followed up regularly. Given that their nutritional parameters remained stable, adequate nutrition can be provided orally in suitable patients. However, patients with oral intake problems can benefit from enteral nutrition methods such as PEG.

Children with CP may become underweight and suffer from protein-energy malnutrition. In addition, micronutrient deficiencies, which can exacerbate existing neurological damage, may also be observed (10). In our study, the nutritional parameters were maintained within normal limits in children who were appropriately monitored and fed enteral formulas. However, caution should be exercised in these patients due to the challenges associated with their care.

Paker et al. (11) evaluated vitamin-D levels in patients with CP. The study found that 42.9% of children with CP had low vitamin-D levels, and older patients and those on a regular diet were at higher risk of vitamin-D deficiency. Other studies on children with CP have reported that the use of anticonvulsants can also lower vitamin-D levels. Additionally, geographical regions with a high number of sunny days may have a positive effect on vitamin-D levels (12). Akpinar et al. (13) emphasized that children with CP who have high mobility limitation scores have lower vitamin-D levels, and they stressed the importance of monitoring vitamin-D levels in this patient group. In a study published by Le Roy et al. (14) in 2021, low levels of vitamin-D and ferritin were observed in children with CP, and the study emphasized the importance of micronutrient supplementation. In our study, although vitamin D levels were not compared by age among patients with CP, overall vitamin-D levels were found to be low. This deficiency may be attributed to limited sunlight exposure and the use of anticonvulsants in some patients. Additionally, the average ferritin level in our study was 14 mg/L, highlighting the importance of iron supplementation and nutritional recommendations for these children. Papadopoulos et al. (15) demonstrated that inadequate iron intake is the primary cause of iron deficiency anemia in patients with CP. According to their findings, patients are advised to undergo procedures such as endoscopy and colonoscopy following iron supplementation. In our study, ferritin levels were low in many patients, suggesting that iron supplementation should be recommended before performing invasive procedures.

Although our study's retrospective design and lack of a control group are limitations, the larger sample size compared with other studies in the literature represents a notable strength.

Study Limitations

The limitations of this study include its retrospective nature, small number of patients, and absence of a control group.

CONCLUSION

It is essential to monitor iron and vitamin-D levels in children with CP who are fed enteral formulas and to provide supplementation as needed.

Ethics

Ethics Committee Approval: Our study was conducted in accordance with the Declaration of Helsinki and was approved by the Health Sciences University Türkiye, Şişli Hamidiye Etfal Training and Research Hospital Ethics Committee (decision no: 1420, date: 28.01.2020)

Informed Consent: Since it was a retrospective study, patient consent was not required.

Footnotes

Author Contributions: Surgical and Medical Practices - B.T.D., N.U., İ.K.; Concept - B.T.D., N.U., İ.K.; Design - B.T.D., N.U.; Data Collection and/or Processing - B.T.D.; Analysis and/or Interpretation- B.T.D., N.U., İ.K.; Literature Search - B.T.D.; Writing - B.T.D., N.U., İ.K.;

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REFERENCES

1. Rosenbaum P, Paneth N, Leviton A, Goldstein M, Bax M, Damiano D, et al. A report: the definition and classification of cerebral palsy April 2006. Dev Med Child Neurol Suppl. 2007 Feb;109:8-14. Erratum in: Dev Med Child Neurol. 2007 Jun;49(6):480.
2. Apkon SD, Kecskemethy HH. Bone health in children with cerebral palsy. J Pediatr Rehabil Med. 2008;1(2):115-21.
3. Benfer KA, Weir KA, Bell KL, Ware RS, Davies PSW, Boyd RN. Oropharyngeal Dysphagia and Cerebral Palsy. Pediatrics. 2017 Dec;140(6):e20170731.
4. Schoendorfer N, Boyd R, Davies PS. Micronutrient adequacy and morbidity: paucity of information in children with cerebral palsy. Nutr Rev. 2010 Dec;68(12):739-48.
5. Carman KB, Aydın K, Kilic Aydin B, Cansu A, Direk MC, Durmus S, et al. Evaluation of micronutrient levels in children with cerebral palsy. Pediatr Int. 2022 Jan;64(1):e15005.
6. Lingam S, Joester J. Spontaneous fractures in children and adolescents with cerebral palsy. BMJ. 1994 Jul 23;309(6949):265.
7. Civan HA, Bektas G, Dogan AE, Ozdener F. Percutaneous Endoscopic Gastrostomy Feeding in Children with Cerebral Palsy. Neuropediatrics. 2021 Aug;52(4):326-332.
8. Jesus AO, Stevenson RD. Optimizing Nutrition and Bone Health in Children with Cerebral Palsy. Phys Med Rehabil Clin N Am. 2020 Feb;31(1):25-37.
9. Sullivan PB, Juszczak E, Bachlet AM, Lambert B, Vernon-Roberts A, Grant HW, et al. Gastrostomy tube feeding in children with cerebral palsy: a prospective, longitudinal study. Dev Med Child Neurol. 2005 Feb;47(2):77-85.
10. Hariprasad PG, Elizabeth KE, Valamparampil MJ, Kalpana D, Anish TS. Multiple Nutritional Deficiencies in Cerebral Palsy Compounding Physical and Functional Impairments. Indian J Palliat Care. 2017 Oct-Dec;23(4):387-392.
11. Paker N, Yavuz Mollavelioglu T, Bugdaycı D, Ones K, Bardak AN, Karacan I, Yıkıcı I, et al. Vitamin D levels in children with cerebral palsy. J Pediatr Rehabil Med. 2023;16(1):163-169.
12. Vijayakumar M, Bk A, George B, Bhatia V. Vitamin D Status in Children on Anticonvulsant Therapy. Indian J Pediatr. 2022 Jun;89(6):541-545. doi: 10.1007/s12098-021-03853-y. Epub 2021 Jul 28.

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13. Akpinar P. Vitamin D status of children with cerebral palsy: Should vitamin D levels be checked in children with cerebral palsy? North Clin Istanb. 2018 Aug 8;5(4):341-347.
14. Le Roy C, Barja S, Sepúlveda C, Guzmán ML, Olivarez M, Figueroa MJ, et al. Vitamin D and iron deficiencies in children and adolescents with cerebral palsy. Neurologia (Engl Ed). 2021 Mar;36(2):112-118. English, Spanish.
15. Papadopoulos A, Ntaios G, Kaiafa G, Girtovitis F, Saouli Z, Kontoninas Z, et al. Increased incidence of iron deficiency anemia secondary to inadequate iron intake in institutionalized, young patients with cerebral palsy. Int J Hematol. 2008 Dec;88(5):495-497.