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Gastrointestinal disorders in children with cerebral palsy

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***Abstract*---**Background and aim: Feeding and gastrointestinal difficulties are common in children with cerebral palsy and if not appropriately managed can result in under nutrition, poor growth and worsened general health. This study aimed to evaluate gastrointestinal disorders in children with cerebral palsy. Patients and methods This study was a retrospective observational study performed in Pediatric department in Edfo General Hospital enrolled 70 children their age ranged between 2 months and 15 years attending the Hospital with history of cerebral palsy in the period from December 2020 to June 2021. Results: There was significant correlation between types of CP and dysphagia and constipation; as Dysphagia and Constipation was more in Spastic quadriplegia and Spastic triplegia Conclusion: Regarding GIT problems related to CP; the main GIT compliant was Diarrhea, followed by abdominal pain, vomiting, drooling, constipation, Dysphagia, reflux and dysentery.

***Keywords*---**cerebral palsy, children, gastrointestinal, nutrition, feeding.

Introduction

Neurodevelopmental Disorders (NDDs) are disorders of brain function that associated with a wide variation of mental, behavioral and physical features. NDDs include cerebral palsy and autism spectrum disorders, attention deficit/hyperactivity disorders, speech disorders and genetic disorders **[1].** Cerebral palsy (CP) is a diagnostic term used to describe a group of permanent disorders of movement and function that causing activity limitation, and is attributed to a non-progressive disturbance of fetal or infant brain. CP is the most common and costly form of chronic motor disability that begins in childhood, and recent data from the Centers for Disease Control and Prevention indicate that the incidence is 3.6/1000 with a male/female ratio of 1.4/1. The prevalence of CP has increased somewhat due to the enhanced survival of very premature infants < 1,000 g, who go on to develop CP at a rate of approximately 15/100 [2].

The neurological lesion associated with CP may impact on the muscles of the jaw, cheeks, lips, tongue, palate and pharynx [3] which manifest functionally as difficulties with controlling saliva, eating, drinking, swallowing and speaking. Eating and drinking are complex sensory-motor activities, which can be described in four phases, including the oral preparatory, oral (propulsive), pharyngeal and esophageal phases of the swallow [4]. Children with cerebral palsy are sometimes prone to different digestive problems, including upset stomach, vomiting, bloating and constipation, while in some instances these aliments are minor and will go away, other times it may indicate a more serious problem. Poor feeding, poor mobility, muscle spasm, difficulty swallowing and excess drooling all can contribute to digestive problem to children with cerebral palsy. Changes in breathing, heart rate, blood pressure, and overall mood can occur with feedings and digestion, These children also may be unable to digest their food properly and/or absorb enough nutrients. If digestion disorder becomes too severe, it can become life-threatening. [5]

The type of treatment the child receives will depend upon which digestive disorder he has: For instance, children with constipation and other bowel problems may be placed on a special diet, as well as given probiotics and medications such as antispasmodics. In other instances, children may be referred to specialists who can assist them in learning new methods of swallowing and drinking, one of the easiest ways to help children with digestive problems is by eliminating foods and liquids that trigger adverse reactions. Sometimes this isn't always easy to discern without professional help, but past studies indicate that diet changes can be extremely effective in helping children with digestive problems [6]. For severe digestive problems, especially for children who cannot eat or have difficulties swallowing, a feeding tube may be recommended.

Patients and Methods

This study was a retrospective observational study performed in Pediatric department in Edfo General Hospital enrolled 70 children their age ranged between 2 months and 15 years attending the Hospital with history of cerebral palsy in the period from December 2020 to June 2021. All children attending Pediatric department in Edfo General Hospital fulfilled following criteria

Inclusion criteria: All children with history of cerebral palsy and aged from two months up to 15 years .
Exclusion criteria: Neonates less than two months, any patient with a previous history of liver, renal or heart disease and any patient with any other neurological disease
Study procedures: All patients enrolled in the study underwent:
Full history taking: Child sex, age, residence, oate of hospital admission and received treatment before arrival to Edfo General Hospital
Full physical examination: General Examination: Vital signs (heart rate, respiratory rate, blood pressure and temperature. Systematic examination: Neurological examination, chest examination, abdominal examination, cardiac examination
Laboratory investigations include : Complete blood count, blood glucose level, blood urea and serum creatinine level, serum sodium and serum potassium level and serum calcium level .
Radiological investigation: chest X-ray, abdominal ultrasound and CT & MRI Brain .

Ethical consideration

Approval of the ethical committee of Edfo General Hospital to the final protocol was obtained. Verbal & written consent was obtained from all cases or case's parents before getting them involved in the study. The steps of the study, the aim of the study, the potential benefit and hazards, all were discussed with the cases parents .

Statistical analysis

All statistics was performed using SPSS version 23. Continuous data such as age and weight were presented as mean ± SD and range. Qualitative variables such as sex was expressed as percentages Analysis of continuous data with normal distribution was analyzed by student t test and non- normally distributed data by Mann-Whitney U test. Categorical data was analyzed by chi-square test and Fischer exact where applicable. P value of <0.05 was defined as statistically significant .

Results

The mean± SD of age was 5.2 ± 4.7 years old ranged between (2months and 15 years), male represented51.4% and females 48.6%, 41.4% of participants had positive consanguinity. Table (1) Prenatal history in table (2) illustrated that 5 participants (7.1%) suffered from IUGR, 4 (5.7%) their mothers had history of teratogenic drugs, 2 (2.9%) mothers exposed to irradiation or chronic illness. Mother's anemia or abdominal trauma, each of them reported by only one participant (1.4%) For Natal history; Preterm, Obstructed labor and Bleeding were reported in (n=12; 17.1%, n=8; 11.4% and n=4; 5.7%) respectively. Table (2) GIT problems were illustrated in table (7) as the main GIT compliant were mainly Diarrhea (60%), abdominal pain(52.9%) ,vomiting (47.1%) , drooling (45.7%), and constipation (35.7%) , Dysphagia , reflux and dysentery were mentioned by (28.6%,21.4% and 7.1%) respectively. Table (3)

Neurological symptoms and signs were mainly; Seizure (70.0%), Bulbar nerve affection (60.0%), Eyes problems (18.6%) and Hearing difficulties (11.4%) for muscle tone; Hypertonic was found in (72.9%) and Hypotonic in (27.1%) Delayed motor development was reported in all participants (100%) and Delayed mental development was reported in 58.6%. Table (4) Types of CP of the studied group were ordered as illustrated in table (9) : in the following order; Spastic diplegia(27.1%), Spastic quadriplegia (20.0%),Hypotonic (17.1%) , Ataxic spasti (12.9%), Mixed CP (8.6%), Spastic hemiplgia (7.1%),Spastic triplegia (4.3%) and Spastic monoplegia (2.9%). Table (5) There was significant correlation between types of CP and dysphagia and constipation; as Dysphagia and Constipation was more in Spastic quadriplegia and Spastic triplegia. Table (6)

Table (1): Baseline and demographic data of the studied group

Variable		Descriptive (n=70)
Age (years)	Mean ± SD	5.2 ± 4.7
	Min.-Max.	2 months -15 years
	Median	4.25
	IQR	8.1
Sex	Male	36 (51.4%)
	Female	34 (48.6%)
Consanguinity	-ve	41 (58.6%)
	+ve	29 (41.4%)

Quantitative data were presented as mean ± SD (range). Qualitative data were presented as No. (%).
IQR (interquartile range)

Table (2): Prenatal, natal and post-natal history of the studied group

Variable		Descriptive (n=70)
Prenatal history	Teratogenic drug	4 (5.7%)
	Uterine bleeding	3 (4.3%)
	Irradiation	2 (2.9%)
	Chronic illness	2 (2.9%)
	Abdominal trauma	1 (1.4%)
	Anemia	1 (1.4%)
	Intra uterine growth retardation (IUGR)	5 (7.1%)
Natal history	Preterm	12 (17.1%)
	Obstructed labor	8 (11.4%)
	Bleeding	4 (5.7%)
Post-natal history	Convulsion	30 (42.9%)
	Head trauma	4 (5.7%)
	CNS neonatal infection	13 (18.6%)
	Severe neonatal Jaundice	3 (4.3%)

Quantitative data were presented as mean ± SD (range). Qualitative data were presented as No. (%).

Table (3): GIT problems of the studied group

Variable		Descriptive (n=70)
GIT problems	Vomiting	33 (47.1%)
	Diarrhea	42 (60.0%)
	Dysphagia	20 (28.6%)
	Reflux	15 (21.4%)
	Constipation	25 (35.7%)
	Abdominal pain	37 (52.9%)
	Drooling	32(45.7%)
	Dysentery	5(7.1%)

Table (4): Neurological signs and symptoms of the studied group

Neurological symptoms and signs			Descriptive (n=70)
Seizure			49 (70.0%)
Bulbar nerve affection			42 (60.0%)
Hearing difficulties			8 (11.4%)
Eyes problems			13 (18.6%)
Muscle tone	Hypertonic		51 (72.9%)
	Hypotonic		19 (27.1%)
Development	Motor	Normal	0
		Delayed	70 (100.0%)
	Mental	Normal	29 (41.4%)
		Delayed	41 (58.6%)

Table (5): Types of CP of the studied group

Types of CP	Descriptive (n=70)
Spastic diplegia	19 (27.1%)
Spastic quadriplegia	14 (20.0%)
Spastic triplegia	3 (4.3%)
Spastic hemiplgia	5 (7.1%)
Spastic monoplegia	2 (2.9%)
Ataxic spastic	9 (12.9%)
Mixed CP	6 (8.6%)
Hypotonic	12 (17.1%)

Table (6): Correlation between types of CP and GIT symptom in the studied group

GIT symptom		Types of CP								P. value (Sig.)
		Spastic diplegia (n=19)	Spastic quadriplegia (n=14)	Spastic triplegia (n=3)	Spastic hemiplgia (n=5)	Spastic monoplegia (n=2)	Ataxic spastic (n=9)	Mixed CP (n=6)	Hypotonic CP (n=12)	
Vomiting	No	10 (52.6%)	8 (57.1%)	1 (33.3%)	3 (60.0%)	2 (100.0%)	5 (55.6%)	4 (66.7%)	4 (33.3%)	0.68^{NS}
	Yes	9 (47.4%)	6 (42.9%)	2 (66.7%)	2 (40.0%)	0	4 (44.4%)	2 (33.3%)	8 (66.7%)	
Diarrhea	No	9 (47.4%)	5 (35.7%)	0	2 (40.0%)	1 (50.0%)	6 (66.7%)	2 (33.3%)	3 (25.0%)	0.48^{NS}
	Yes	10 (52.6%)	9 (64.3%)	3 (100.0%)	3 (60.0%)	1 (50.0%)	3 (33.4%)	4 (66.7%)	9 (75.0%)	

Dysphagia	No	14 (73.7%)	6 (42.9)	1 (33.3%)	5 (100%)	2 (100.0%)	8 (88.9%)	5 (83.3%)	9 (75.0%)	0.04*
	Yes	5 (26.3%)	8 (57.1%)	2 (66.7%)	0	0	1 (11.1%)	1 (16.7%)	3 (25.0%)	
Reflux	No	16 (84.2%)	9 (64.3%)	2 (66.7%)	4 (80.0%)	1 (50.0%)	7 (77.8%)	5 (83.3%)	11 (91.7%)	0.71NS
	Yes	3 (15.8%)	5 (35.7%)	1 (33.3%)	1 (20.0%)	1 (50.0%)	2 (22.2%)	1 (16.7%)	1 (8.3%)	
Constipation	No	13 (68.4%)	5 (35.7%)	1 (33.3%)	4 (80.0%)	2 (100.0%)	9 (100.0%)	5 (83.3%)	6 (50.0%)	0.03*
	Yes	6 (31.6%)	9 (64.3%)	2 (66.7%)	1 (20.0%)	0	0	1 (16.7%)	6 (50.0%)	
Abdominal pain	No	9 (47.4%)	6 (42.9)	0	1 (20.0%)	1 (50.0%)	7 (77.8%)	3 (50.0%)	6 (50.0%)	0.26NS
	Yes	10 (52.6%)	8 (57.1%)	3 (100.0%)	4 (80.0%)	1 (50.0%)	2 (22.2%)	3 (50.0%)	6 (50.0%)	
Drooling	No	10 (52.6%)	4 (28.6%)	1 (33.3%)	3 (60.0%)	2 (100.0%)	7 (77.8%)	4 (66.7%)	7 (58.3%)	0.29NS
	Yes	9 (47.4%)	10 (71.4%)	2 (66.7%)	2 (40.0%)	0	2 (22.2%)	2 (33.3%)	5 (41.7%)	
Dysentery	No	17 (89.5%)	13 (92.9%)	3 (100.0%)	5 (100%)	2 (100.0%)	9 (100.0%)	5 (83.3%)	11 (91.7%)	0.91NS
	Yes	2 (10.5%)	1 (11.1%)	0	0	0	0	1 (16.7%)	1 (8.3%)	

NS= Not significant * = Significant ($p<0.05$)

Discussion

Gastrointestinal problems are encountered in at least one third of children with Cerebral palsy. These include feeding and swallowing disorders (with associated chronic pulmonary aspiration), regurgitation and vomiting, abdominal pain and constipation, Sullivan and Andrew, [7]. In the current study, we aimed to evaluate the children with cerebral palsy and their gastro intestinal disorders. This study was a retrospective observational study enrolled 70 children with CP their mean± SD age was 5.2 ± 4.7 years old ranged between (2months and 15 years), male represented 51.4% and females 48.6%. 41.4% of participants had positive consanguinity.

In the current study; Prenatal history reported was IUGR (7.1%) mothers had history of teratogenic drugs (5.7%) and (2.9%) mothers exposed to irradiation or chronic illness. Mother's anemia or abdominal trauma, each of them reported by only one participant (1.4%). In differ with Minocha et al., [8] study that found maternal anemia contributed for 17.7% cases followed by antepartum hemorrhage (5.5%), hypertension (4.4%), and infections (3.3%) ,also with Gedam et al.,[9] described probable etiological factors of CP children and found that antepartum hemorrhage and hypertension contributed 10% and 6%, respectively, and Pattar and Yelamali, [10] described similar results with equal frequency of maternal anemia, PIH/toxemia, and APH (in 6% cases each) as risk factors of CP. Other natal factors were mentioned in the present study; obstructed labor and bleeding were reported in (11.4% and 5.7%) respectively Post-natal history of convulsion was reported by 42.9%, CNS neonatal infection by (18.6%) and severe neonatal Jaundice (4.3%)

On other side, Minocha et al., [8] showed asphyxia (45.5%) as the most common risk factor of CP. Anwar et al., [11] observed that majority (53.6%) of the CP cases were reported to had perinatal asphyxia. They also observed that mothers of 43.6% CP children had history of prolonged labor Gedam et al., [9] found 2% mothers of CP children had history of prolonged labor. The most common topographical type observed in this study was Spastic diplegia (27.1%), followed by Spastic quadriplegia (20.0%), Hypotonic (17.1%) and Ataxic spastic (12.9%) The current results in differ with other studies as Spastic quadriplegia (56.6%) was the most common topographical type observed in Minocha et al., [8] study ;Spastic diplegia, hemiplegia, and triplegia are other topographical types. Hypotonic and dyskinetic types contributed for equal cases (5.5% each case) also Pattar and Yelamali, [10] found Spastic CP is the commonest physiologic type as

observed in most studies from developing countries. Among the spastic group quadriplegia was the commonest topographical type (54.54%) followed by diplegia (31.81%).

In the current study neurological symptoms and signs were mainly; Seizure (70.0%), bulbar nerve affection (60.0%), and Delayed mental development were reported in (58.6%). Eyes problems (18.6%) and Hearing difficulties (11.4%) for muscle tone; Hypertonic was found in (72. 9%) and Hypotonic in (27.1%) Gowda et al., [12] mentioned that Intellectual sub-normality was observed in 55% of cases in line with ours percent for mental abnormality. Other co-morbidities observed were, speech abnormalities in 38%, visual problems in 26%, hearing impairment in 11%, seizures in 46%, feeding problems in 19%, and undernutrition in 47% of cases.

The majority of our participants (95.4%) were underweight, This percent is, higher than saudia Arabia study by Almuneef et al., [13] as only 41.3% children with CP were underweight. also higher than those reported in Uganda (42%) Silva et al., [14], Greece (38.1%) Karagiozoglou-Lampoudi et al., [15]. Regarding a recent study by Mushta et al., [16] among CP in Arabic-Speaking Countries ; underweight was 7%–84.9% within CP children: Such differences, may be attributed to differences in methodological approaches and using different standard growth charts for comparison. Pathologies were classified into white matter anomalies, basal ganglia and thalamus, cortex and lobes, lateral ventricles, cysts, corpus callosum and cerebellar anomalies as well as other findings Ekanem et al., [17] in our study CT finding was normal in 50 % ; main abnormal findings were Diffuse brain atrophy (22.8%), Mild brain atrophy (18.6%), Affected basal ganglia (12.8%),and Cerebellar agenesis (10.0%)by MRI scan; abnormal finding were Gray matter injury (14.3%), White matter injury (10.0%) ,Focal vascular insult(5.7%) and Malformation (7.1%)

Regarding GIT problems in the present study; the main GIT compliant were mainly Diarrhea, abdominal pain, vomiting, drooling, and constipation, also Dysphagia, reflux and dysentery were mentioned. For drooling it was reported in (45.7%) in this study; in accordance with Speyer et al., 2019 meta-analysis as a pooled prevalence for Drooling estimate of 44.0% , but lower values reported by Erkin et al., [18] as sialorrhea was reported in (30.8%). In our study constipation was among (35.7%) ;in disagree with other studies as Erkin et al., [18] that constipation was (25%) also caramico-Favero et al., [19] study as approximately 60% of the sample exhibited constipation, and Del Giudice et al., [19] who identified constipation and prolonged colonic transit time in the left colon and rectum in 74% of the children with CP

Dysphagia was reported in the current study in 28.6%, in differ with Erkin et al., [18] study as swallowing difficulty was reported in (19.2%) , Speyer et al., [21] study as swallowing problems was 50.4%. also with Asgarshirazi et al., [22] where oropharyngeal dysphagia OPD was estimated 82% and with Benfer et al., [5] as the Prevalence of OPD reduced from 62% to 59% between ages . Abdominal pain was found in (52.9%) among our patients ,higher than Del Giudice et al., [19] as the abdominal pain was reported in 32% . Regarding vomiting it was (47.1%) in the present study , higher than that found in Del Giudice et al., [19] 32% and in

Sullivan et al., [23] 22% had significant problems with vomiting, GERD was found in 21.4% of our patients ,in other side Prevalence of GERD was higher 66% in Asgarshirazi et al., [22] study

Aspiration of food, either during or after swallowing, commonly results in chronic lung disease (recurrent wheezing, bronchitis, atelectasis, and need for supplemental oxygen) rather than acute aspiration pneumonia. Erkin et al., [18] In current study crepitation was the main finding in 45.7% , distress came next 42.9% and wheeze chest was found in 17.1% of participants . In differ with Erkin et al., [18] study, 8.3% of the children developed wheezing, 2.5% developed bronchopneumonia, and 0.8% developed both in the past year.

For diarrhea we found it in 60% of participants; infantile acute diarrhea is one of the often encountered diseases in pediatric clinics, especially in 0-2 year's old children with infantile cerebral palsy (ICP). Due to the immature digestive system and a delicate organic protective function, infants are liable to get various types of diarrhea. In ICP infants, the even slower and worse growth and development of their digestive and immune functions would make it easier for patients to suffer the disease, and affect their recovery severely. Moreover, the special characteristics of children, especially ICP children (like difficulties in giving them drug medication), adverse effects of drugs, and so on. Zhang et al., [24] Diarrhea may occur in children with impaired gut function, and may also be caused by microbial contamination Bell and Samson-Fang, [26].

There was significant correlation between types of CP and dysphagia and constipation; as Dysphagia and Constipation was more in Spastic quadriplegia and Spastic triplegia.In accordance with A Brazilian study carried out in Santos (São Paulo, Brazil) included 90 children with quadriplegic cerebral palsy aged between 2 and 13 years showed high prevalence difficult to chewing (41%) and swallow (12.8%) Lopes et al., [26]. In the same line Erkin et al., [18] concluded that In those with spastic quadriplegic CP, the incidence of a severe neurological involvement is higher, thus increasing the risk of GIT dysfunction Children with more extensive motor involvement that is, quadriplegia and dyskinesia, are most likely to have difficulties with swallowing and articulation. Children unable to walk or who required an aid and helper to walk were much more likely to have problems eating and swallowing lumpy food and needed food mashing or liquidizing.

Conclusions

In conclusion, our results indicate that; The main antenatal factors for development of CP including IUGR ,and history of teratogenic drugs and regarding natal factor ; Preterm was the main factor ,followed by obstructed labor and bleeding. The most common topographical type was Spastic diplegia, followed by Spastic quadriplegia, Hypotonic and Ataxic spastic. The main Neurological symptoms and signs were; seizure, bulbar nerve affection, and delayed mental development, eyes problems and hearing difficulties. Regarding GIT problems related to CP; the main GIT compliant was Diarrhea, followed by abdominal pain, vomiting, drooling, constipation, Dysphagia, reflux and dysentery

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