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STUDY OF TOPOGRAPHICAL AND GMFCS PATTERN OF CEREBAL PALSY IN CHILDREN

Paediatrics

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ABSTRACT

Introduction: Cerebal Palsy is the most common childhood physical disability representing a group of conditions with heterogenous symptoms that are characterized by deficient motor control, spasticity, paralysis and other neurological disturbances that emerge before, during, or in a short time after birth. **Methodology:** A tertiary hospital based descriptive cross-sectional study among 73 subject of age group 2-12years diagnosed as cerebal palsy. The study was carried to find the topographical and GMFCS pattern of Cerebal palsy in children. **Results-** Mean age of the patients was 5.2 ± 3.2 years (Range 2 to 12 years) with male to female ratio of 1.7:1. According to Topographical Pattern, 41.1% patients had spastic diplegia, 31.5% had spastic quadriplegia, 15% had spastic hemiplegia, 4.1% had dystonic type, 2.7% had ataxic type, 2.7% had hypotonic type and 2.7% had choreoathetoid or dyskinetic type of CP. As per GMFCS Pattern, 16.4% patients were in level III,47.9% were in level IV and 35.6% were in level 5 of GMCFS. **Conclusion:** Topographical classification is helpful in detecting the limb(s) affected. GMFC System is proficient in determining in how and where a child is affected by CP and useful in ascertaining treatment protocols.

KEYWORDS

Topographical, GMFCS, Cerebral Palsy.

INTRODUCTION: -

Cerebral palsy (CP) is a physically disabling condition that affects 2-3 per 1000 live births and is considered the most common cause of serious physical disability in childhood. The classification of CP depends on the predominant motor alteration and encompasses three main types: spastic, athetoid, and ataxic. The mixed type involves characteristics of the two types at the same time. Depending on the impairment of the arms relative to the spastic legs, CP is further classified into hemiplegic CP (unilateral disorder), diplegic CP (greater impairment of the legs than of the arms), quadriplegic CP (all four limbs equally affected), monoplegic CP (one limb affected), and triplegic (three limbs affected).[1,2]

Cerebral palsy can be described or classified in different ways by involvement of gross motor movements. Spastic cerebral palsy is the most common type, affecting approximately 77-93% of people with the condition. Dyskinetic cerebral palsy affects about 2-15% of people with cerebral palsy and has two forms: athetosis (uncontrolled, slow, stormy and writhing movements) and dystonia (sustained or intermittent muscle contractions causing twisting or repetitive movement). Ataxic cerebral palsy is the least common type (2-8%) and characterized by shaky movements affecting balance and coordination.[3,4]

Topographical classification takes into account the body parts affected by cerebral palsy. Monoplegia means only one limb affected, while hemoplegia refers to both upper and lower limbs on one side of the body affected. Diplegia affects both lower limbs significantly more than the upper limbs, while trilegia indicates three limbs affected. Quadriplegia affects both upper and lower limbs, and the muscles of the trunk, face, and mouth could also be affected. [5,6]

The gross motor skills of children and young people with cerebral palsy can be categorized into five different levels using the Gross Motor Function Classification System (GMFCS). The GMFCS levels are as follows: Level I– Walks without limitations; Level II– Walks with limitations; Level III– Walks using a hand-held mobility device; Level IV– Self-mobility with limitations; may use powered mobility; and Level V– Transported in a manual wheelchair.[7]

The GMFCS has been included in several recent randomized clinical trials as part of the definition of severity, and in these trials, children with mild cerebral palsy without functional impairment were not considered to have the outcome of interest. The Western Australian Cerebral Palsy Register grades severity using the GMFCS that allows researchers to include or exclude cases without functional impairment. In an international study involving prematurely born children with cerebral palsy, "disabling" cerebral palsy was determined with greater reliability, suggesting that the exclusion of cases without functional impairment might improve the validity of observational epidemiologic studies and randomized trials in which cerebral palsy was an outcome. However, clinicians should regard with caution those studies of cerebral palsy in which information was lacking about the severity of cerebral palsy, as assessed with a reliable measure. [1-2,7]

METHODOLOGY

This descriptive cross-sectional study was conducted at Tertiary Care Hospital, Western Maharashtra.

Study Population: Children aged 2 – 12 years old diagnosed with Cerebral Palsy, who attended the paediatric IPD.

Sample Size: Total 73 children diagnosed with cerebral palsy.

Sample Size was calculated by WinPepi.

Inclusion criteria:

- Children in the age group of 2-12 years diagnosed with cerebal palsy.
- Children with moderate to severe impairment defined by gross motor functional
- Classification system [2,6,7] who had been clinically diagnosed as cerebral palsy.

Exclusion criteria:

- Children below the age of 2 years and above 12 years.
- Children who had history of regression of milestones.
- Children investigated or known to have genetic, metabolic or other medical illnesses known to influence the growth were excluded.
- After Ethical Committee Approval the children's, parents' or guardian's written informed consent was taken after explaining them the study procedure and their approval and preparedness to participate voluntarily.
- Confidentiality of participants was maintained:
- The detailed clinical examination of all the subjects was done. The subjects were studied and then classified according to Nature of movement disorder (spasticity, ataxia, dystonia, and athetosis) and the anatomic or the topographic distribution of the motor abnormalities and also according.
- Consent forms regarding details of study were prepared in English, Hindi and to GMFCS levels. All the subjects were submitted for further management.
- Data analysis was done by SPSS Statistics Version 20:

OBSERVATIONS AND RESULTS

Table No.: 1 - Age and gender distribution

Age	Gender		Total (%)
	Male (%)	Female (%)	
2 - 5 years	27 (58.7)	14 (51.9)	41 (56.2)
5.1 - 9 years	12 (26.1)	9 (33.3)	21 (28.8)
9.1 - 12 years	7 (15.2)	4 (14.8)	11 (15.0)
Total	46 (100.0)	27 (100.0)	73 (100.0)
Chi square= 0.45, df = 2, p value = 0.765			

Table No.1 shows that among male subjects (n = 46), majority of them were in the age group of 2-5 years (58.7%), followed by 5.1-9 years (26.1%) and 9.1-12 years (15.2%). While among female subjects (n = 27), majority of them were 2 - 5 years old (51.9%), followed by 5.1 - 9 years (33.3%) and 9.1 - 12 years old (14.8%). By applying chi square test, the relationship of age and gender was found to be statistically non-significant (p>0.05).

Table No.: 2 Distribution of subjects based on Topographical classification

Topographical classification	No. subjects	Percentage
Spastic diplegia	30	41.1
Spastic quadriplegia	23	31.5
Spastic hemiplegia	11	15
Dystonic	3	4.1
Ataxic	2	2.7
Hypotonic	2	2.7
Choreoathetoid or dyskinetic	2	2.7
Total	73	100

Table no. 2 shows that according to topographical classification, more than two-fifth of the subjects (41.1%) had spastic diplegia, while 31.5% had spastic quadriplegia, 15% had spastic hemiplegia, 4.1% had dystonic, 2.7% had ataxic, 2.7% had hypotonic and 2.7% had choreoathetoid type of cerebral palsy.

Table no. 3 Distribution of subjects based on GMFCS classification

GMFCS classification	No. subjects	Percentage
Level 3	12	16.4
Level 4	35	47.9
Level	26	35.6
Total	73	100

Table no.3 shows that according to Gross motor functional classification system (GMFCS), 16.4% subjects had level 3 GMFCS, 47.9% subjects had level 4 GMFCS and 35.6% subjects had level 5 GMCFS.

Table no. 4 Distribution according to GMFCS and neuroimaging findings

GMFCS	Neuroimaging findings		Total (%)
	Normal (%)	Abnormal (%)	
GMFCS III	0	12(17.1)	12(16.4)
GMFCS IV	2(66.7)	33(47.1)	35(47.9)
GMFCS V	1(33.3)	25 (35.7)	26(35.6)
Total	3(100.0)	70 (100.0)	73 (100.0)
Chi square= 0.7, df 2, p value = 0.612			

Table no. 04 shows that among CP subjects with abnormal neuroimaging findings (n=70). 17.1% subjects belonged to gross motor functional classification system level 3 (GMFCS III), 47.1% subjects belonged to GMFCS level IV and 35.7% subjects belonged lo GMFCS level V. However, Among CP subjects with normal neuroimaging findings (n=3), 66.7% subjects belonged to GMFCS IV and 33.3% subjects belong to GMFCS level V. By applying chi square test, the relationship between GMFCS and neuroimaging was found to be statistically non-significant (p>0.05).

Table no. 05 Summary table of age group 2 – 5 years old (n=41)

Gender	Risk factors	GA	Topographical classification	MRI findings	GMFCS Level
Male n=27	Prematurity (n=8)	Full term (n=24)	Spastic Quadriplegia (n-15)	Normal (n=2)	III (n=5)
Female: n=14	Perinatal asphyxia (n=13)			Cortical atrophy (n-4)	
	Prematurity, neonatal sepsis (n=3)		Spastic diplopia (n=16)	Focal gliosis (n=3)	IV (n=21)
	Neonatal seizures (n=1)			PVI (n=12)	
	Neonatal sepsis (n=2)	Preterm (n=17)	Spastic Hemiplegia (n-4)	Post HI	V (n=15)
	GDM (n=2)			changes (n=2)	
	PIH (n=6)			Infarcts (n=2)	
	Toxoplasmosis (n-1)			Cystic	
	Post meningitis sequalae (n- 1)			Degeneration (n=7)	
	Neonatal hyperbilirubinemia (n=1)		Dystonic (n=2)	Demyelination (n=4)	
	CMV (n-1)		Choreoa thetoid (n=2)	Malformation (n-4)	
	Congenital anomaly of brain (n=1)			Basal ganglia lesions (n=2)	

Table no. 06 Summary table of age group 5 – 9 years old (n=21)

Gender	Risk factors	GA	Topographical classification	MRI findings	GMFCS level
Male n = 12	Perinatal asphyxia (n=7)	Full term (n=13)	Spastic diplegia (n=9)	Cystic degeneration (n=2)	III (n=6)
Female n = 9	Prematurity (n=7)		Spastic Quadriplegia (n=5)	Cortical atrophy(n=4)	IV (n-8)
				Focal gliosis (n=2)	
	Neonatal sepsis (n=2)	Preterm (n=8)	Spastic Hemiplegia (n-5)	PVL(n=7)	(n=7)
				Post changes (n=2)	
	PIH (n-2)			Mal formation (n-4)	
	GDM (n=1)		Ataxic (n=1)	Infarcts (n=4)	
	Congenital anomaly of brain (n=1)			Basal ganglia lesions (n-2)	
			Dystonic (n=1)	Demyelination (n=1)	
				Normal (n=1)	

Table no. 07 Summary table of age group 9 – 12 years old (n=11)

Gender	Risk factors	GA	Topographical	MRI	GMFCS
Male n=7 Female: n=4	Perinatal asphyxia (n=2)	Full term (n=6)	Spastic Quadriplegia (n=3)	Cortical atrophy (n=1)	III (n=1)
	Prematurity (n=3)			Focal gliosis (n=2)	
	Neonatal sepsis (n=2)		Spastic diplegia (n=5)	PVL (n=4)	IV (n=6)
	Toxoplasmosis (n=1)	Preterm (n=5)	Spastic Hemiplegia (n=2)	Cystic degeneration (n=1)	V (n=4)
	Developmental (n=1)		Ataxia (n=1)	Post HI changes (n=1)	
	Neonatal seizures (n=1)			Malformation (n=1)	
				Calcification (n=1)	
	Congenital anomaly of brain (n=1)			Demyelination (n=1)	
	GDM (n=1)			Basal ganglia lesions (n-2)	

DISCUSSION

In present study, Mean age of the patients was 5.2 ± 3.2 years (range 2 to 12 years), while 56.2% patients were 2 –5 years old, 28.8% were 5.1 – 9 years and 15% were 9.1 – 12 years old. Singhi et al.,[11] had found that mean age was 3.1 ± 2.6 years (range 2 months to 16 years), while about half of the patients (50.2%) were less than 2 years age, 34.2% were 2 – 5 years age, 15.6% were more than 5 years age. A Japanese study by Yoshida et al.,[8] had found that mean age in athetotic CP was 4.14 years, while mean age in spastic CP was years. A study by Nazar et al.,[9] had found commonest age group was 2 – 5 years age (78.9%).

In the present study, majority of the patients were males (63%) with male -female ratio of 1.7:1. Among males (n = 46), 58.7% were 2 – 5 years old, while among females (n =27) also, 51.9% were 2 – 5 years old and relationship of age and gender was statistically non significant. Similarly male predominance was found in a study conducted by Agarwal et al., [10] (4.1:1), Singhi et al., [11] (2.1:1), Bax et al.,[12] (1.6:1), Yoshida et al.,[8] (2.5:1) and Nazar et al.,[9] (1.85:1).

In the present study, based on topographical classification, it was found that 87.5% had spastic CP (41.1% had diplegia, 31.5% had quadriplegia, 15% had hemiplegia), 4.1% had dystonic type, 2.7% had ataxic type, 2.7% had hypotonic and 2.7% had choreoathetoid or dyskinetic type of CP. Similarly, a study by Agarwal et al.,[10] had found that spastic CP was the most common, found in 92.9% patients (where, 69.4% had quadriplegia, 12.2% had hemiplegia and 11.2% had diplegia), others were hypotonic (2.04%), dystonic (2.04%) and mixed types (3.1%). Spastic cerebral palsy was also the most common type in Singhi et al., [11] study found in 70% of CP patients, followed by mixed type (13.9%), dyskinetic or athetoid type of CP (8.4%) and hypotonic or ataxic type (7.7%). Among Spastic CP type, 61% had quadriplegia, 22% had diplegia and 17% had hemiplegia. An Australian systemic review by Robinson et al.,[13] had found that spastic CP was found in 88% patients, where hemiplegia seen in 33.5%, diplegia in 28.5%, and quadriplegia in 37.6%, while 11.8% had non-spastic CP. In China, Hou et al.,[14] had found the most common type of CP was spastic (68.3%), 22.2% had athetosis and 10.6% had ataxia. However, among Spastic CP patients (n=71), 66.2% had diplegia,12.75 had tetraplegia and 21.1% had hemiplegia.

In current study, categorization based on GMFCS found that 16.4% patients in level 3 GMFCS, 47.9% in level 4 GMFCS and 35.6% in level 5 GMCFS. However, Agarwal et al.,[10] in their study had found that 21.4% were in level 1, 17.3% were in level 2, 23.5% were in level 3, 37.8% were in level 4. A study by Robinson et al., [13] had found that 28.5% patients were belongs to GMFCS level 1, 28.1% were in level 2, 13.1% were in level 3, 12.2% were in level 4 and 18.1% were in level 5. Nazar et al.,[9] had found that commonest type of CP in their study was spastic diplegia (49.1%), followed by spastic quadriplegia (19.3%), spastic hemiplegia (19.3%), choreoathetoid (7.01%) & mixed (5.3%). Among CP patients with abnormal neuroimaging findings (n=70) in present study, 17.1% patients were in GMFCS level III, 47.1% were in GMFCS level IV and 35.7% were in GMFCS level V, relationship of GMFCS with neuroimaging was statistically non-significant. Similarly, Agarwal et al.,[11] had found that types of neuroimaging abnormality significantly did not di er with gestation, birth asphyxia, microcephaly and types of CP (p>0.05). A Chinese study by Hou et al.,[14] had found that different abnormal rates of MRI in topographical classification such as spastic diplegia (89.4%), tetraplegia (100%), hemiplegia (100%), athetosis (54.5%), and ataxia (90.9%).

CONCLUSION: -

Topographical classification was helpful in detecting the limb(s) affected. GMFC System was proficient in determining in how and where a child was affected by CP and useful in ascertaining treatment protocols. On MRI, most common findings were periventricular leukomalacia and cystic degeneration. Earlier recognition of an injury before the establishment of noticeable motor defects provides an occasion for neuroprotection. MRI is the 'Gold Standard' technique for imaging in children with cerebral palsy.

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