International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Website: https://ijmpr.in/

Original Research Article

Study of Clinico-Etiological Aspects of Cerebral Palsy & Co-Morbidities in Pediatrics at One of Largest Hospital of Asia

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OPEN ACCESS

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Received: 02-05-2026
Accepted: 12-06-2026
Published: 28-06-2026

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ABSTRACT

Background: Cerebral palsy (CP) is a group of permanent disorders of movement and posture caused by non-progressive disturbances in the developing fetal or infant brain. CP is commonly associated with sensory, cognitive, behavioral, and neurological comorbidities that significantly affect quality of life.
Objectives: To study the prevalence, clinico-etiological profile, types of cerebral palsy, and associated comorbidities among pediatric patients attending a tertiary care teaching hospital.
Methods: A prospective cross-sectional study was conducted over a period of two years at a tertiary care hospital. Ninety children aged 6 months to 12 years diagnosed with cerebral palsy were enrolled. Detailed clinical evaluation, neurological examination, assessment of comorbidities, neuroimaging, EEG, ophthalmological examination, and hearing assessment were performed wherever indicated. Data were analyzed using Microsoft Excel.
Results: Among 1,58,640 pediatric patients, 90 children were diagnosed with cerebral palsy (0.05%). Male predominance was observed (male:female ratio 1.5:1), with the majority presenting between 3–5 years of age. Perinatal asphyxia (41.11%) was the most common etiological factor, followed by low birth weight (24.44%) and prematurity (16.66%). Spastic quadriplegia was the most frequent subtype (51.11%), followed by spastic diplegia (25.55%). Common comorbidities included epilepsy (43.33%), microcephaly (42.22%), feeding difficulties (34.44%), speech delay (28.88%), hearing loss (16.66%), and visual impairment (13.33%). Periventricular leukomalacia was the most common neuroimaging abnormality (52.38%). Most assessed patients had severe functional limitation, with GMFCS Level V being the commonest category (45.65%).
Conclusion: Perinatal asphyxia remains the leading preventable risk factor for cerebral palsy. Spastic quadriplegia is the predominant clinical subtype and is frequently associated with significant neurological and developmental comorbidities. Strengthening antenatal and perinatal care, early diagnosis, multidisciplinary rehabilitation, and comprehensive management of comorbidities are essential to improve outcomes in children with cerebral palsy.

Keywords*: Cerebral palsy, Perinatal asphyxia, Spastic quadriplegia, Epilepsy, Comorbidities, Neurodevelopmental disorders..*

INTRODUCTION

Cerebral palsy is a diagnostic term used to describe a group of permanent disorders of movement and posture causing activity limitation that are attributed to non-progressive disturbances in the developing fetal or infant brain. The motor disturbances are often accompanied by disturbances of sensation, perception, cognition, communicationand behavior as well as by epilepsy and secondary musculoskeletal problems. [1,2,3,4]

Cerebral palsy has substantial effects on function and health-related quality of life of patients and their care takers. Cerebral palsy is a well-recognized neuro-developmental condition beginning in early childhood and persisting through the lifespan,

and is one of the most expensive health condition. The lifetime cost of CP was about 860,000 euro for men and about 800,000 euro for women of which the largest component was attributed to social care costs, particularly during childhood.[5]

The worldwide incidence of CP according to CDC data is 3.6/1000 live births with male to female ratio 1.4:1.The prevalence of CP has increased somewhat as a result of enhanced survival of very premature infants weighing <1000gm, who go on to develop CP at a rate of approximately 15 per 100.[6] During the past 20 years, there have been increases in the incidence and prevalence of CP which may be related to improved survival of neonates with advanced perinatal care, improved data collection and documentation of cases by national registries.[7]

Cerebral palsy can often lead to children having less than desirable interactions with others and in some cases, this can result in unfair discrimination from peers, potent employers, doctors and even members of their own family. Caregivers of children with CP suffer from a substantial psychological burden and also from a feeling of guilt about child's condition. In addition to psychological problems, parents also feel socially isolated, stigmatized and develop conflicts in their families and society. Besides, they also undergo physical stress like lack of sleep, musculoskeletal arches and pain and hypertension.[8,9,10]

The task of reducing the burden of disability due to CP would involve two steps. First to reduce the occurrence of CP and second to maximize the functional potential of the children with CP by providing necessary support and rehabilitation services to the child. These steps can be addressed in an organized way through a multidisciplinary rehabilitationprograms.[11]

The purpose of doing this study is to know the current status of the disability and its rising prevalence and also to create awareness about the condition and its shortcomings in developing country like India.

STUDY HYPOTHESIS

The correlation between clinico-etiological aspects of cerebral palsy and associated co-morbidities in patients presenting to the apex hospital of the stateof developing country and comparison to the established data.

AIMS AND OBJECTIVES

To study the prevalence of patients diagnosed with cerebral palsy out of total cases presenting to hospital.To study etiological and clinical profile of the cerebral palsy patients&classify the types of CP and assess the spectrum of sensory, motor, functional and behavioral disabilities also evaluate co-morbid conditions associated with cerebral palsy and their changing patterns.

MATERIALS AND METHOD

- Children diagnosed with cerebral palsy attending the pediatric department of the hospital over 2 Year period were enrolled in this study.Data was collected using a predesigned proforma to obtain necessary information. Detailed CNS examination was done in each participant & allpatients were assessed for other co-morbid conditions.Detailed ophthalmological evaluationand Hearing assessment by BERA was performed to evaluate deafness.Necessary investigations like neuro-imaging studies & EEG were done as per the requirement of the case.
- Obtained data was analysed and compared with established data.

INCLUSION CRITERIA

Patients meeting the standard definition of cerebral palsy, falling in age group between 6 months to 12 years, who were admitted in the hospital and attending the outdoor patient department and having static brain insult to the developing brain were included in our study.

EXCLUSION CRITERIA

Children of age group less than 6 months and more than 12 years, having progressive neurological disorder like neurodegenerative disorders, de-myelinating disorders, etc; not having motor involvement, having congenital CNS malformations, having peripheral nervous system disorders were excluded from study.

STUDY DESIGN

Prospective cross sectional study was done in tertiary care hospital at Civil Hospital, Ahmedabad, Gujarat over period of 2 years.

Data of this study was recorded and analysed in Microsoft Excel.

The study has been conducted with the ethical permissions from the Institute for which the ethical permission document has been attached in the annexure.

RESULTS

Out of 1,58,640 patients (OPD = 1,50,000 & IPD = 8460)there were 90 children (OPD = 25 & IPD = 65) with cerebral palsy over 2 years enrolled in our study. This contributes to 0.05% to total patients. There was relatively higher proportion of CP amongst hospitalized patients(0.75%) as compared to OPD patients (0.01%) as seek for medical emergency.

As chart 1 & 2 suggestive of male and female ratio of 1.5:1 with the most common age group of presentation was 3-5 years (44.40%) whereas infantile age group was least common amongst all (6.6%).

As mentioned in table 1, we observed maximum number of CP patients in first birth order child (42.2%) and the proportion was gradually decreasing with increasing parity.As awareness of general population increase in developing nation most delivery conducted at hospital (85.5%)and much less were home delivered(14.4%).61.11% (n=55) patients among the total were born by vaginal delivery, 34.44% (n=31) by caesarean section and only 4.44% (n=4) were delivered by instrumental vaginal delivery.

Table 1- Sample distribution based on birth order.

Birth order	No. of children (n=90)	Percentage
1st	38	42.2%
2nd	22	24.4%
3rd	18	20%
4th and above	12	13.3%

As mentioned in table 2, the most common antenatal risk factor was PIH (17.77%) followed by gestational diabetes mellitus & extreme maternal age each in 5.55%. Perinatal asphyxia was the most common perinatal risk factor found in 41.11% followed by low birth weight (24.44%) and prematurity (16.66%).

Table 2- Distribution based on etiology and risk factors.Antenatal& perinatal factors

Antenatal factors	No. of patients (n=90)	Percentage	Perinatal factors	No. of patients (n=90)	Percentage
Maternal age <20 yrs and > 35 yrs	5	5.55%	Prolonged labor	1	01.11%
Consanguinity	4	4.44%	Prolonged rupture of membranes	3	03.33%
Multiple pregnancies	3	3.33%	Breech	2	02.22%
Pregnancy induced hypertension	16	17.77%	Instrumental delivery	4	04.44%
Gestational diabetes mellitus	5	5.55%	Prematurity	15	16.66%
TORCH infection (CMV)	1	1.11%	Low birth weight	22	24.44%
Antepartum haemorrhage	3	3.33%	Perinatal asphyxia	37	41.11%
Uterine malformation	2	2.22%	Intracranial haemorrhage	1	01.11%

Among 90 patients, the most common postnatal risk factor was neonatal septicemia (18.88%) followed by hypoglycemia and CNS infection in 13.33% and 10.00% respectively.

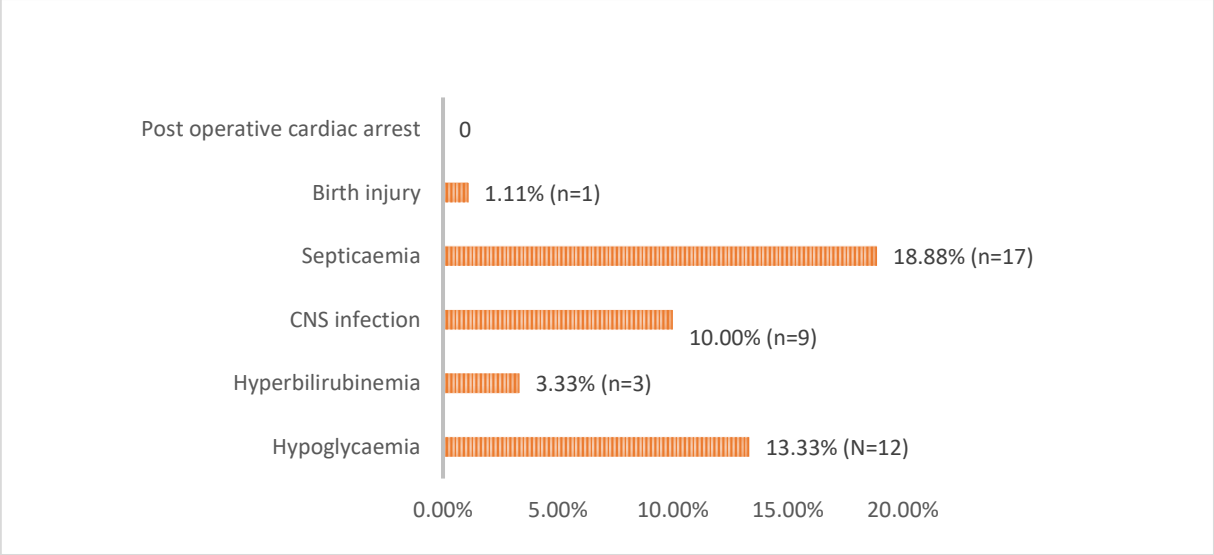


Chart 3: Post-natal factors

In observation we see that 69% patient of CP had global developmental delay and rest with isolated motor delay
In the present study, the patients were categorized as per age. In children with age less than 5 years, all the patients had various grades of protein energy malnutrition with grade 2 being the most common (46.25%). In children greater than 5 years, 70% were moderately undernourished and 30% patients were severely undernourished most due to neglected by care given and frequent inter current illness. Also we noticed, only 36.66% (n=33) children were completely immunized for their age.

Table 3- Sample distribution based on nutritional status.

Age	Grade of malnutrition	No. of patientsb(n=90)	Percentage
Less than or equal to 5 years	PEM 1	19	23.75%
	PEM 2	37	46.25%
	PEM 3	24	30.00%
>5 years	Moderate under-nutrition	7	70%
	Severe under-nutrition	3	30%
	Total	10	

In the present study, spastic quadriplegic CP was the most common type observed in 51.11%, followed by spastic diplegic (25.55%) and spastic hemiplegic CP (13.33%).
In the current study, Epilepsy was the most common morbidity observed in 43.33%. Microcephaly (42.22%) & feeding difficulties (34.44%) were also common in these children.
Attention deficit disorder was diagnosed in 4 whereas one child was suspected to have autistic spectrum disorder and was kept under follow up for further evaluation.

Table 4- Sample distribution based on type of cerebral palsy.

Type of CP	No of patients (n=90)	Percentage
Spastic diplegic	23	25.55%
Spastic quadriplegic	46	51.11%%
Spastic hemiplegic	12	13.33%
Dystonic	6	06.66%
Hypotonic	3	03.33%

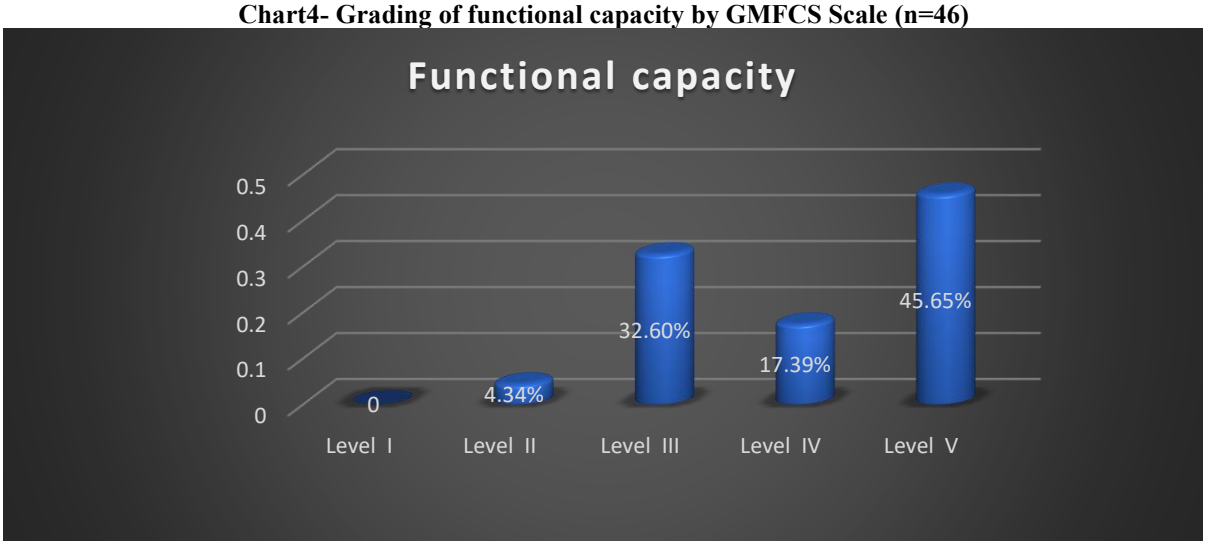
Table 5- Sample distribution based on associated co-morbidities.

Associated Co-morbidities	No. of patients	Percentage
1) Epilepsy	39	43.33%
2) Speech delay	26	28.88%
3) Hearing loss	15	16.66%
4) Visual impairment	12	13.33%
5) Feeding difficulties	31	34.44%

6) Microcephaly	38	42.22%
7) Cranial nerve deficit	9	10.00%
8) Behavioural problems	5	05.55%

In the present study, we could do GMFCS grading in 46 patients as this assessment was included later in the study after neuro-physician advice as an expert. We observed Level 5 motor disability as most common in 45.65% followed by Level 3 in 32.6%.

Chart4- Grading of functional capacity by GMFCS Scale (n=46)



CP is a clinical diagnosis although neuro-imaging was performed in 42 children for etiological evaluation and prognostic purpose &EEG was performed in 35.55% patients.In the present study, neuroimaging was done in 42 patients out of which, periventricular leukomalacia was the most commonly observed finding (52.38%) followed by gliosis (16.66%).

Table 6- Sample distribution based on neuro-imaging findings.

Finding	No. of patients (n=42)	Percentage	Kasundra M et al[50](n=59) 2020
Periventricular leukomalacia	22	52.38%	13
Gliosis	07	16.66%	9
Cortical atrophy	06	14.28%	8
Agenesis or dysgenesis of corpus callosum	05	11.90%	4
Hydrocephalous	04	9.52%	6
Infarction	03	7.14%	10
Cystic encephalomalacia	03	7.14%	7
Basal ganglia involvement (hyperintensity in thalamus and putamen)	03	7.14%	5
Cortical dysplasia	02	4.76%	1
Dandy walker malformation	02	4.76%	1
Hydrancephaly	01	2.38%	-
Periventricular calcification	01	2.38%	-
Lissencephaly	-	-	1
Delayed myelination	-	-	1

Table 7- Sample distribution based on treatment.

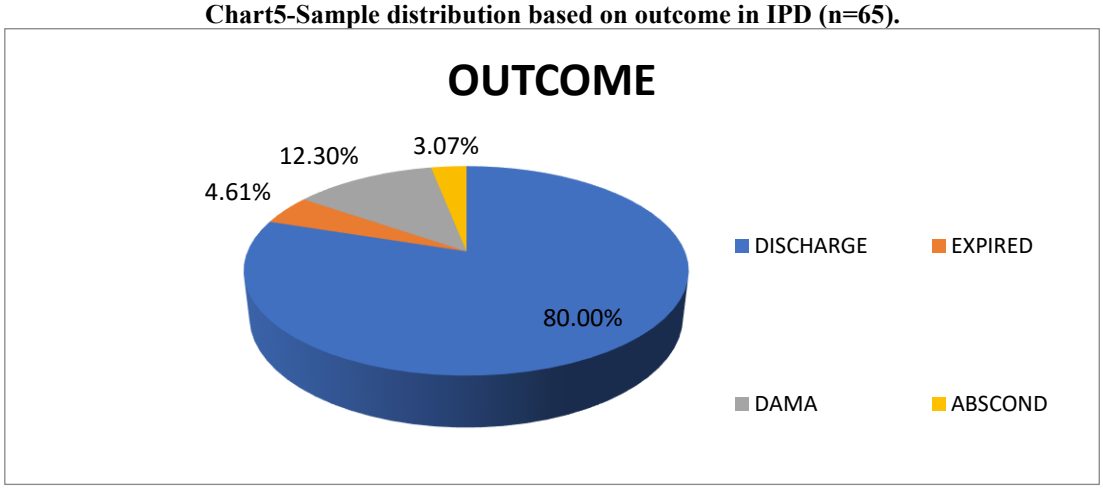
Type of treatment	No. of patients (n=90)	Percentage
Rehabilitation therapy	90	100%
Limb physiotherapy	90	100%
Behavioural therapy	4	4.44%
Foot prosthesis	2	2.22%
Hearing aid	1	1.11%
Spectacles	6	6.66%
Anti-seizure medication	39	43.33%

Antipsychotic drugs	4	4.44%
Muscle relaxant drugs	14	15.55%
Ventriculo-peritoneal shunt	3	3.33%

In the current study, all the patients(100%) were receiving rehabilitation therapy in form of neuro-developmental stimulation and speech therapy at DEIC, 100% patients were receiving physiotherapy ,43.33% patients were taking anti seizure medication.

Limb physiotherapy plays the most important role in preventing the contractures and thus motor disabilities.

Chart5-Sample distribution based on outcome in IPD (n=65).



In the present study, amongst the patients admitted, 80% patients got discharged, 12.3% of the patients were discharged against medical advice, 4.61% patients got expired and 3.07% patients got absconded from the health facility.

The reason for the significant no. of DAMA could be because of the mental and the physical stress to the parents or the caregivers of the patients and poor prognosis.
In the present study, there are 3 expiries out of which all are due to septicemia.
Septicemia could be attributed to-

- Malnutrition
- Covid19 pandemic
- Increased risk of infections due to poor hygiene and lack of immunization as well.

DISCUSSION

The proportion of cerebral palsy in present study was 0.05% whereKasundra M et al[12] observed 97 patients of CP out of 12468 admitted children which constituted 0.78%.The CDC mentions the incidence of 3.6 per 1000 live birth (0.36%).The Textbook by Vykuntaraju KN and VeenaKalramentions incidence of 2-2.5/1000 live births.[13]

In present study, male to female ratio was 1.5:1. Johnson et al[14] and Kasundra M et al[12] have also observed male preponderance in their study with ratio of 1.3:1 and 1.48:1 respectively.The Centre for Disease Control and Prevention also mentions ratio of 1.4:1.The reason for this could be that the male admissions are overall more as compared to female due to more priority being given to male to seek health care during any illness as in developing country gender discrimination. Secondly, it could also be due to relatively more genetic vulnerability in males as compared to females to sustain neuronal insult.

The most common age at diagnosis was 3-5 years in our study whileKasundra M et al has 63.82% patients in the age group of 1-3 years.The CDCalso mentions that CP is typically diagnosed during the first or second year of birth.Although previous studies and journals mention that the most common age at diagnosis is 1-3 years. Late diagnosis in present study could be due to lack of awareness regarding physical abnormality in the child amongst their parents. It may also be due to primary care being received at peripheral centre and delayed referred at the end for more comprehensive care at apex by locally treating physician as low resources of developing country.

42.2% children were born first in order. Increased chance of CPD leading to difficult and prolonged labor resulting into perinatal asphyxia in primi mother and early age pregnancy, low education, malnutrition, low height in developing country like India could be the reason.But the Textbookby Vykuntaraju KN and VeenaKalra mentioned that the risk of CP increases with parity due to shorter gestation & slower intrauterine growth.

85.5% patients were hospital borne as compared to 14.4% who were born at home. Although overall risk of developing CP is more in home delivered babies due to lack of evaluationespecially for asphyxia. Monitoring and resuscitative measures also premature, low weight baby survival increase as gradual increase resources at periphery lead increase prevalence at hospital delivery.Kasundra M et al observed 86.6% of CP patients to be hospital delivered.

In the current study, most f delivery done by vaginal similar toKasundra M et al reported 73.19% patients to be delivered vaginally. As government hospital has more workload compared to doctor in India lead overall higher proportion of vaginal deliveries to prevent CS lead more complication like prolong, obstructed labour and assisted delivery may be cause for this.Standard literature however does not mention about association of mode of delivery & chance of CP but planned and emergency CS in presence of various maternal as well as fetal risk factors and signs of fetal distress respectively can decrease the magnitude of hypoxic damage to fetus and thus to some extent can prevent CP by reducing neuronal insult due to intra-partum asphyxia.

The most common antenatal risk factor was PIH (17.77%) followed by diabetes mellitus & maternal age in extremessame asKasundraM et also observed PIH as the most common antenatal risk factor in 14.43%.

Birth asphyxia was the most common peri-natal risk factor found in 41.11% followed by low birth weight and prematurity.Perinatal asphyxia was also reported in 24.5% and 22.68% respectively by Srivastava et al and Kasundra M et al as the commonest perinatal risk factor in their studies. Low birth weight (38.14%) and prematurity (23.71%) were also other common risk factors observed by Kasundra M et al.

Septicaemia was the most common amongst the postnatal risk factors (18.88%) followed by hypoglycaemia(13.3%) and CNS infections (10%).Kasundra M et al observed CNS infection (17.52%) and septicemia (15.46%) as common postnatal risk factors. CNS infection was also reported in 17.1% by Srivastava et al [15] as the most common postnatal risk factor.

According to study of Singhi et al[16], birth asphyxia is the most common cause of CP (45.3%).[49]The most common amongst all antenatal, perinatal and postnatal risk factors was birth asphyxia(41.11%).Textbook by VykuntarajuKN and VeenaKalra mentions that the birth asphyxia is the most common cause of cerebral palsy amongst all the antenatal, perinatal and postnatal risk factors causing CP.[38]

In current study, 68.89% of the patients were having global developmental delay and in 31.11% patients, there was isolated motor delay. The delayed development is most commonly associated with quadriplegic CP which is the most common type in the present study. According to Nelson Textbook of Paediatrics, the quadriplegic CP which is the most severe form of CP is likely to be associated with mental retardation & developmental delay as compared to other types of CP. The prognosis for normal intellectual development for these patients is good.

46.25% of patients under 5 years of age were having grade 2 PEM and in 70% of more than 5 years of patients, there was moderate under-nutrition. This may be attributed to the associated co-morbidities like feeding difficulties and recurrent infections and disuse atrophy of skeletal muscles.Kasundra M et al observed 29.89% of patients to be having grade 2 PEM.

Malnutrition is common in CP patients due feeding difficulties, recurrent infections like aspiration and hypostatic pneumonia. Unawareness of caretaker regarding the nutritional requirement and to some extent neglect may also contribute to it. Disuse atrophy of the skeletal muscles may also add to the same.

51.11% patients were of spastic quadriplegic type of CP followed by spastic diplegic (25.55%) and spastic hemiplegic (13.3%). Kasundra M et al and Singhi et al have also reported spastic quadriplegic CP as the most common type of CP respectively in 53.57% and 61% in their study.

According to Nelson Textbook of Paediatrics, 21st edition, the spastic diplegic CP is the most common form i.e. 35% followed by spastic hemiplegia (25%), spastic quadriplegia (20%) and dyskinetic to be the least i.e. 15%.[7]
Epilepsy was the most common co-morbid condition present in 43.33% followed by microcephaly and feeding difficulties in 42.22% and 34.44% respectively.Kasundra M et al study has reported microcephaly to be the most common co-morbid condition (80.41%) associated with CP followed by epilepsy (54.63%) & feeding difficulties (21.64%). Speech delay (28.6%) and visual impairment (21.65%) were common higher function disability in their study. In higher functions, speech delay was observed in 28.88% as the most frequent abnormality.

46 children were evaluated for motor and functional capacity by GMFCS Score out of which 45.65% patients had GMFCS mobility score V. This could be attributed in few patients due to delay in initiation of physiotherapy.Kasundra M et al reported Level 4 motor disability as most common in 40.2% followed by Level 3 in 27.83%.

MRI was performed in 35 patients (38.88%), NCCT in 7 patients (7.77%) and EEG was done in 32 patients (35.55%). Periventricular leukomalacia was the most common neuro-imaging abnormality found in 52.38% followed by gliosis in

16.66%. Kasundra M et al also observed periventricular leukomalacia as the most common neuro-imaging finding in 13 patients out of 59 in his study.

Amongst the admitted patients, 80% patients got discharged. The most common cause of expiry was septicaemia with septic shock.

All of the patients (100%) were undergoing limb physiotherapy and rehabilitation therapy which are the most important modalities of the supportive treatment to prevent the contractures and disability and thus immobility and dependence.

CONCLUSION

Cerebral palsy is a group of disorder which can be prevented by appropriate antenatal and perinatal care. Long term prognosis of cerebral palsy patients was poor.Complications can be prevented by tertiary prevention. But India is still developing country and has developing nature of health care facility in urban & rural area and lack of technology used in Indian government health facility and by general population lead to cerebral palsy is still problem in India like developing country.

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