# Child India

October 2021

Monthly e-Newsletter of Indian Academy of Pediatrics


## IAP EXECUTIVE COMMITTEE - 2021

| | |
|---|---|
| PRESIDENT | DR PIYUSH GUPTA |
| PRESIDENT-ELECT | DR REMESH KUMAR R |
| IMM. PAST PRESIDENT | DR BAKUL JAYANT PAREKH |
| VICE-PRESIDENT (CENTRAL ZONE) | DR N RAVI KUMAR |
| VICE-PRESIDENT (EAST ZONE) | DR ATANU BHADRA |
| VICE-PRESIDENT (NORTH ZONE) | DR SANGEETA YADAV |
| VICE-PRESIDENT (SOUTH ZONE) | DR MAJ K NAGARAJU |
| VICE-PRESIDENT (WEST ZONE) | DR JAYANTKUMAR V UPADHYE |
| SECRETARY GENERAL | DR G V BASAVARAJA |
| TREASURER | DR PURNA A KURKURE |
| EDITOR-IN-CHIEF, IP | DR DEVENDRA MISHRA |
| EDITOR-IN-CHIEF, IJPP | DR S THANGAVELU |
| JT. SECRETARY - LIAISON | DR HARISH KUMAR PEMDE |
| JT. SECRETARY - ADMIN | DR SAMIR HASAN DALWAI |

### Executive Members

DR BATCHU RAJSEKHAR (AP)
DR P ANIL KUMAR (AP)
DR DEVAJIT KUMAR SARMA (Assam)
DR BIRENDRA KUMAR SINGH (Bihar)
DR SUJIT KUMAR SINHA (Bihar)
DR ARUN BANSAL (Chandigarh)
DR ARVIND PRAKASH SAVANT (Chhattisgarh)
DR ANURAG AGARWAL (Delhi)
DR PEEYUSH KHANNA Delhi)
DR AJAY KUMAR GUPTA Delhi)
DR SHIVANAND Y GAUNS (Goa)
DR CHETAN G TRIVEDI (Gujarat)
DR YOGESH N PARIKH (Gujarat)
DR SANDIP K TRIVEDI (Gujarat)
DR SATISH KUMAR SHARMA (Haryana)
DR NARENDER S YADAV (Haryana)
DR RAVINDER K GUPTA (J & K)
DR JOY BHADURI (Jharkhand)
DR MALLESH GOWDA GS (Karnataka)
DR PREETI M GALAGALI (Karnataka)
DR SUMITHA NAYAK (Karnataka)
DR RAJAKUMAR N MAROL (Karnataka)
DR RIAZ I (Kerala)
DR JEESON C UNNI (Kerala)
DR MK NANDAKUMAR (Kerala)
DR JAYAKUMAR C PANICKER (Kerala)
DR KEWAL KISHORE ARORA (MP)
DR MAHESH MAHESWARI (MP)
DR ANAND S DESHPANDE (Maharashtra)
DR ANIL SHRIRAM RAUT (Maharashtra,)
DR NARENDRA R NANIVADEKAR (Maharashtra)
DR PRASHANT B JADHAV (Maharashtra)
DR PARAMANAD G ANDANKAR (Mumbai)
DR BISHWAJIT MISHRA (Odisha)
DR NARAYAN P MODI (Odisha)
DR HARPREET SINGH (Punjab)
DR MANMEET KAUR SODHI (Punjab)
DR DEVENDRA SAREEN (Rajasthan)
DR RAKESH KUMAR JORA (Rajasthan)
DR SUDIP DUTTA (Sikkim)
DR JANANI SHANKAR (Tamil Nadu)
DR R PALANI RAMAN (Tamil Nadu)
DR R SOMASEKAR (Tamil Nadu)
DR A JALEEL AHAMED (Tamil Nadu)
DR A YASHOWANTH RAO (Telangana)
DR K NARAHARI (Telangana)
DR UPPIN NARAYAN REDDY (Telangana)
DR PARTHASARTHI CHAKRABARTI (Tripura)
DR RAJEEV KRASHAK (UP)
DR SANJAY NIRANJAN (UP)
DR OM SHANKAR CHAURASIYA (UP)
DR UTKARSH SHARMA (Uttarakhand)
DR ASOK KUMAR DATTA (West Bengal)
DR SUBROTO CHAKRABARTTY(West Bengal)
DR SWAPAN KUMAR RAY (West Bengal)
DR SHEILA S MATHAI (Services)
DR RUCHIRA GUPTA (Chief Org. Secretary)

# CONTENT

## Editor's Note

Dear Colleagues,

The October issue of Child India is dedicated to Cerebral Palsy, the most common childhood impairment affecting approximately 3/1000 live births in our country. Research has proved that most cases of this neurodevelopmental disorder are due to multiple causes operating together to bring about a cascade of events that result in brain cell death during the rapid & vulnerable phase of development from 5th month of pregnancy to the first two years of life.

This brain disorder affects all aspects of brain functions. Mobility is the predominant casualty. But it could also impair vision, speech, sensation, bladder control, hearing, learning and behavior. Some children have convulsive disorder. The resultant abnormal biomechanics leads to progressive muscle and bone lesions even though there is no progression of the brain lesion. And since nerves do not regenerate, there are no curative solutions. But early diagnosis and interventions by multi or trans disciplinary professionals from fields of pediatrics, developmental pediatrics, pediatric neurology, physiotherapy, speech and language pathology, OT, psychology, special education, assistive technology and psychosocial sciences, can lessen the limitations and improve the quality of life of persons with cerebral palsy and their families. Neuroplasticity results in optimal compensation in the early years of life when brain growth is maximal and hence earlier the diagnosis and earlier the appropriate intervention, the less the impairments in later years. However, they need a system of health care throughout their life and that would They also need inclusive policies at all levels of governmental and societal action in all spheres of life.

On October 6th, World Cerebral Palsy Day, we IAPians join the world in celebrating and supporting those living with CP. We need to ensure that children and adults with Cerebral Palsy (CP) have the same rights, access and opportunities as anyone else in our society. It is only together, that we can make that happen.

We thank members of the IAP Neurodevelopment Chapter for their contributions to this issue of Child India.

Jai IAP!

**Dr Jeeson C Unni**
**Editor-in-Chief**

# President's Address

Dear friends,

Greetings.

Let us dwell on what we as an Academy could do for the multitude of children with cerebral palsy

50-60% of children with cerebral palsy have normal intelligence and can be educated in normal schools and pursue a wide range of careers like any other person in spite of their mobility limitations and become contributory members of society. But this is only possible if the societal discrimination, disparities and attitudinal barriers are minimized.

It is disheartening to note that differently abled children, like those with cerebral palsy, are subject to multiple deprivations and limited opportunities in our country. These include denial of disability, physical restraints, social boycott, denial of property rights, decreased marital life prospects due to a child with special needs in the family, implications on sexuality of people with disability, women with disability, discrepancies in state welfare programs, and problems in measuring disabilities. Their families and caregivers also go through a lot of stress and challenges which ultimately leads to grave discriminatory practices towards these children.

The awareness needs to be created through our members about how to popularise govt schemes conducted by The National Trust - like DISHA (Early Intervention and School Readiness Scheme), VIKAAS (Day Care), SAMARTH (Respite Care), NIRAMAYA (Health Insurance Scheme), SAHYOGI (Caregiver training scheme), GYAN PRABHA (Educational support), PRERNA (Marketing Assistance) and SAMBHAV (Aids and Assisted Devices)..

There is evidence for family-centered care for service delivery as the best practice for early intervention of pediatric rehabilitative care. The family of the child is the key for continuity of care. Strengths and limitations of the family unit need to be assessed and an effective team created to support the requirements.to improve patient-centric and population-based care practices.

Regards,

**Piyush Gupta**
National President, IAP 2021

# Secretary's Message

Dear All

**"Not all of us can do great things.**
**But we can do small things with great love."**
**– Mother Teresa."**

Greetings! It has been an eventful month at the IAP Child India in September 2021.

Firstly, it gives me immense pleasure to inform you all that, the process of IAP Election for the year 2022 has begun from the 10th September 2021. A healthy democracy requires a decent society; it requires that we are honourable, generous, tolerant and respectful. Therefore, on behalf of IAP, I urge all esteemed eligible members of IAP to participate in this process of democracy.

We had a very successful IAP Office Bearers Meeting via Video Conferencing on 12th September 2021. My heartfelt thanks to everyone for participating in this meeting.

Early Childhood Development (ECD) is one of the precious and flagship programs of Indian Academy of Pediatrics under the presidential action plan.

Following are some of the major milestones towards the progress of the said program: -

- IAP – UNICEF – WHO Collaborative session on 'Primary Care Interventions for Early Childhood Development' was conducted during on 5th Feb, 2021 at IAP Pedicon program in Mumbai
- Steering committee was made for plan and process of ECD program at country level with Chairpersons as Dr Piyush Gupta (President IAP 2021) and Dr Digant Shastri (President IAP 2019) and Dr Remesh Kumar R (IAP President 2022).
- National consultative meeting along with all partners was conducted from 22nd to 24th March, 2021 at Delhi.
- Virtual launch of the program was conducted on 25th July, 2021 with Dr Rajesh Mehta, Regional Adviser- New born, Child and Adolescent Health, World Health Organization (WHO), Regional Office for South-East Asia as a 'Chief Guest' and was participated by around 70 delegates / partners.
- Zone wise Training of Trainers were conducted under the proactive leadership of respective Vice President of particular zone.
- After successful creation of Master trainers across the country, it is proposed to conduct a total of 200 District Level workshops.

## Secretary's Message

We have other committees that met this month like The Meeting of IAP Task Force for School Reopening Guidelines (2.0) on 1st September 2021, and we are happy to inform you that we have published IAP ADVISORY ON SCHOOL REOPENING (Sept 2021) on our official IAP website.

We also had the Periodic Virtual Review Meeting of CIAP staff on 20th September 2021.

We have conducted the South Zone Early Childhood Development ToT physically at Chennai on 5th September 2021. National ToT on Dysbiosis- PG on 15th September 2021via video conferencing. We also conducted 4 Physical NTEP workshops at Ranchi, North Delhi, Rohtak & Chandigarh and 1 Virtual workshop in the month of September 2021.

Mission School Uday is also one of the precious and flagship program of Indian Academy of Pediatrics under the presidential action plan. We have conducted 12 workshops. also we have also conducted 7 Virtual workshops of the CADE Module, 3 Workshops of Immunization Dialog Module across India in the month of September 2021.

Finally sharing the updates on the NRP Projects, we have successfully conducted IAP –NNF Collaborative meeting on 5th September 2021 at Mumbai. IAP NRP Steering Committee Meeting at Delhi on 19th September 2021 as well as meeting of newly appointed Zonal Coordinators along with SAC on the same day at Delhi.

The demand for hybrid Courses is increasing day by day. We have conducted overall 40 NRP courses (Basic, Hybrid and Advance) in the month of September 2021.

Overall, the month of September 2021 has been very fruitful and focused on academic growth for their members and we look forward to having more such activities in the coming months.

Jai IAP!! Jai Hind!!

Sincere Regards,

**Dr G V Basavaraja**
Hon. Secretary General 2020 & 21

# Cerebral Palsy in the 21st Century - What has changed

**Wg Cdr (Dr) KS Multani**
Pediatrician, 11 AF Hospital
National Secretary, IAP Chapter of Neurodevelopmental Pediatrics
Lead Expert- WHO-NBHSP South East Asia

## Introduction

Cerebral palsy (CP) is a clinical condition similar to epilepsy in that it is a clinical diagnosis. At the same time , it results from a wide variety of causes again making it similar to epilepsy. Since it was first described in the 19th century by Dr William Little who described it as a condition of spastic rigidity of limbs of newborn children, CP has come a long way with major advances in diagnosis, management as well as prevention frontiers.

## Definition

The term 'Cerebral palsies' was actually coined first by William Osler who used it for a heterogenous group of disorders resulting in characteristic neurological findings in the child. The definition of cerebral palsy has stood the test of time. As per the 2007 consensus definition, CP is a "spectrum of permanent disorders of development of movement and posture, causing activity limitation, that are attributable to non-progressive disturbances in the fetal or infant brain. The motor disorders of CP are often accompanied by disturbance of sensation, perception, cognition, communication and behaviour, by epilepsy and secondary musculoskeletal problems" Though it is a static condition, the presentation changes with age. Also, a number of co-morbid conditions like epilepsy, intellectual disability, vision and hearing impairments etc are seen in cases of CP. Fifty percent of the cases with CP have associated intellectual disability and more than thirty percent may have speech issues, epilepsy in addition to the motor disability component.

## Prevalence

With improvements in the field of healthcare, there has been a change in the pattern of cerebral palsy that we encounter in our clinics. The improved healthcare for normal deliveries, increased survival of extremely premature neonates and the increasing trend of multiple gestation secondary to infertility treatments, there has been a shift in the way we approach these children who are at high risk of suffering from neurodevelopmental disorders. The prevalence estimates in population based studies range from 1.5-4 per 1000 live births from around the world. The average birth prevalence of CP is approximately 2 per 1000 live births. Based on gestational age of child at birth, children born extremely premature run the maximum risk of developing CP (114 per 1000 live births) followed by moderately-late preterm babies (34 per 1000 live births) and least risk in term babies. The risk of CP is higher in cases with low birth weight (50 per 1000 live births) and multiple gestation (7 per 1000 live births). Common risk factors for CP include - prematurity, multiple gestation, low birth weight, congenital

malformations, birth asphyxia, intrauterine infections, perinatal stroke, postmaturity, etc. Spastic CP remains the commonest type of CP world over (85%) followed by dyskinetic CP (7%) and ataxic CP(4%). Prediction of severity of CP can be done using the well established methods of Gross Motor Function Classification System (GMFCS) and CP motor development curves.

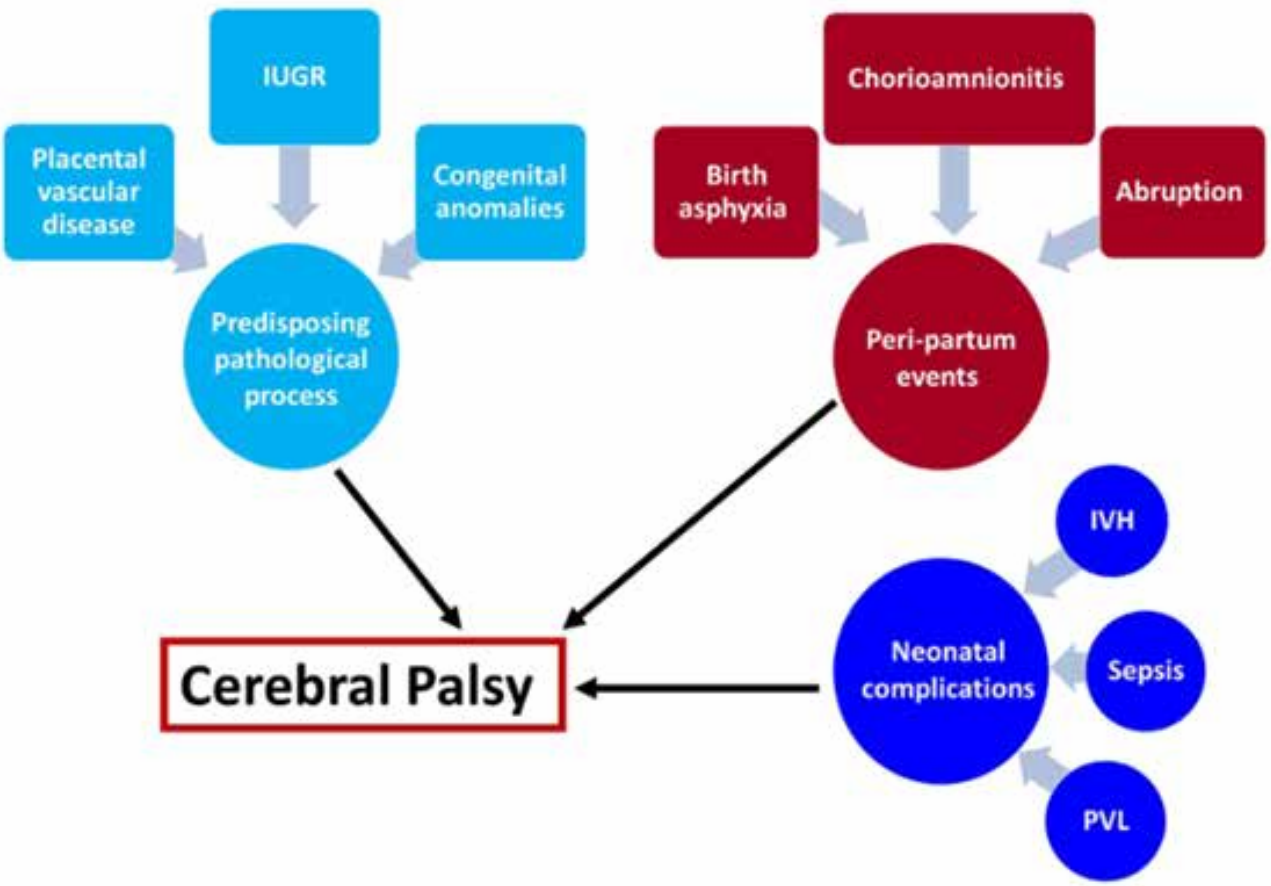
## Etiology of CP

**Early diagnosis of CP**

Diagnosis of a case of cerebral palsy remains clinical even today based on a good clinical history and examination. Laboratory investigations aid in localization of damage to brain and also provide a clue to the likely etiology. The average age at diagnosis remains around 1-2 years ( as early as 6-8 months in developed countries and as late as 5 yrs in low income countries). Though there has been an increasing trend to diagnose the condition 'early', it needs to be understood that this emphasis on early diagnosis of CP/at risk for CP is aimed more at starting intervention early in order to maximize the available period of neuro plasticity for intervention. As mentioned in a 2017 clinical practice guideline, the earliest age of diagnosis is 3 months with the a combination of Pretchl's General Movements (GMs), advanced neuroimaging (MRI) and standardized neurological movements like Hammersmith Neurological examination (HINE). Early diagnosis allows early initiation of intervention programs and improves chances of best possible functional outcomes.

## Neuroimaging & CP

MRI and cranial ultrasound have seen major advances in the field of CP with characteristic findings with MRI at 3 months having a sensitivity of 86-100% and a specificity of 89-97%. Cranial ultrasound has lower sensitivity (74%) as compared to MRI but similar specificity (92 %) as compared to MRI. The predominant lesions seen on neuro imaging are heterogenous



cerebral white matter injuries. An MRI based classification system (called MRICS) for white matter injuries of the preterm brain has also been developed for uniformity of description and clinical correlations and has been found reliable.

## GM & CP

Pretchl's general movements assessment has a 98% sensitivity and 91% specificity at 3 months of age and are also helpful in early diagnosis of conditions like autism. As GM assessment is very observer dependent, some centres are trying to develop mobile app based GM assessments using AI software to analyze pre-recorded videos of infants.

## Genetics in CP

With wide availability of genetic testing available these days, many cases of CP are found to have significant genetic findings. A potential genetic etiology may be seen in 10-30% of cases of CP with genes like TUBAIA and LICAM especially in children with CP without any significant risk factors in history and normal neuro imaging. However, one should refrain from changing the diagnosis of CP in these cases if the condition is non progressive and these should be labelled as CP (subtype - metabolic) as these cases will benefit from genetic counseling for future pregnancies.

## Management of CP

Early initiation of multidisciplinary therapy has been shown to result in best possible outcomes. Constraint induced movement therapy (CIMT), botulinum injections, assistive movement and communication devices as well as disabled friendly buildings and transports have led to improved quality of life of children with CP. The role of telemedicine in management of CP during Covid 19 pandemic has highlighted the impact that this method can have on a large number of cases living in remote areas and needs to be promoted.

## Prevention of CP

As the etiological factors of Cp can be preconceptional, periconceptional and postconceptional, there is a role of preventive strategies in CP. Use of magnesium sulfate in premature birth, prevention of preterm birth and postnatal head cooling in cases with birth asphyxia are some of the methods being advocated for preventing CP later in life.

## References

Moshe S, Omer M, Salvatore AM, et al. Cerebral Palsy - Trends in epidemiology and recent developments in prenatal mechanisms of disease, treatment and prevention. Frontiers in Neurology. Feb 2012 (Vol 5) Article 21.

Maria H, karin K, Fredrik S, et al. Cerebral palsy in extremely preterm infants. Pediatrics Vol 141(1) Jan 2018;e20171433.

Catherine A, Virginie E, Malika DA, et al. Trends in prevalence and severity of pre/perinatal cerebral palsy among children born preterm from 2001-2010: A SCPE collaboration study. Frontiers in neurology. May 2021 (Vol 12), Article 624884.

Alastair HM, Sara L, Andres M, et al. Genetic or other causation should not change the clinical diagnosis of Cerebral palsy. J of Child Neuro 2019, vol 34(8), 472-476.

Steven JK, Jaime S, Madeliene L, et al. The complex nature of Cerebral Palsy. Nature Reviews neurology Sep 2018, Vol 14, 528-543.

Bernard Dan. New ethical issues in CP. Frontiers in Neurology. March 2021, Vol 12, article 650663

Antigone P, Hilla B, Sotiria M et al. Cerebral Palsy : new developments (editorial). Frontiers in Neurology Aug 2021, vol 12, article 738921.

Anna TV, Catherine M, I Novak, et al. Early diagnosis and classification of CP : A historical perspective and barriers to early diagnosis. J of Clin Med. 2019, 8, 1599.

# Innovation in Management of Cerebral Palsy

Sayoni Roy Chowdhury*
Sheffali Gulati#

## Background

Cerebral palsy (CP) is a group of permanent disorders affecting the development of movement and posture, resulting in activity limitation, which is attributed to the non-progressive disturbances that occurred in the developing fetal or infant brain (1). Cerebral palsy is the leading cause of childhood disabilities and affects 2.95 children per 1000 born in India (2). A child with cerebral palsy faces tremendous lifetime challenges such as physical disabilities, neurobehavioural concerns, sensory impairment, epilepsy and secondary musculoskeletal problems. The management goals in CP are directed toward a multimodality strategy that focuses on improving functionality and capacities in order to achieve independence. In the modern era, technology-based interventions offer such an opportunity to facilitate assessment, diagnosis, real-time monitoring and management of children with cerebral palsy. In the last decade, there has been a substantial rise in the application of technology-based advancements in the treatment of various neurodevelopmental disorders including CP. This can be attributed to robust engineering research and commercial neurorehabilitation devices availability. The use of assistive technology and its application for neurorehabilitation is based on the theory of neuroplasticity, the restoration of neural networks through behavioral training. Currently, adaptive technology is being used to enhance mobility, optimize communication, provide assistance with activities of daily living (ADLs), self care, and improve education in children with CP.

## Mobility Technology

Assistive and adaptive mobility devices such as mobility robots, neuromuscular stimulation aided gait training, walkers and orthotic devices help cerebral palsy patients achieve greater independence and self-confidence.

1. Mobility Robots: Robotics can be identified as a branch of technology integrating robots with computer systems to simulate complex human actions by providing control, sensory feedback and information processing (3). The fundamentals of motor learning and neuroplasticity can be addressed using mobility robots to enhance movement quality in the field of neurorehabilitation. Mobility robots can perform high-quality, supervised movements while also providing joint support and real-time feedback. Mobility robots are classified according to the design (grounded exoskeletons, wearable exoskeletons, and end effector devices) or functional tasks (augmentation or assistance, upper extremity or lower extremity function) they enable to achieve. The various mobility robotic devices used either commercially or in

* DM Pediatric Neurology Resident, Center of Excellence & Advanced Research on Childhood Neurodevelopmental Disorders, Child Neurology Division, Department of Pediatrics, All India Institute of Medical Sciences, New Delhi, India

# MD Pediatrics, FRCPCH (UK),FAMS, FIAP, FIMSA
Coordinator, DM Paediatric Neurology Programme, Faculty in-Charge, Center of Excellence & Advanced Research on Childhood Neurodevelopmental Disorders;
Chief, Child Neurology Division, Department of Pediatrics, All India Institute of Medical Sciences, New Delhi, India
www.pedneuroaiims.org,Sheffaligulati@gmail.com; sheffalig@yahoo.com

research are enlisted as follows:

- **Gait training robots (4,5):** The design is based on treadmill training that integrates grounded exoskeleton designs with partial body weight supported training. This acts by simulation of the gait cycle and facilitation of gait quality, efficiency by providing visual and auditory feedback. It primarily improves walking speed, endurance, and motor function, especially in CP with GMFCS (Gross motor functional classification scale) levels II and I. NF-walker and Lokomat are examples of such mobility robotic platforms. Despite the widespread use of treadmill training in rehabilitation settings, the evidence on the efficacy of gait training robots in enhancing gait function is still limited across randomised controlled trials. This could be due to lack of well-established rehabilitative protocols as well as a diversified research environment.
- **Extremity robotics (upper and lower extremity) (6,7):** These robots use end effector and grounded exoskeleton designs to offer movement with more than one degree of freedom at individual joints. These robotic devices target specific joint and muscle functions such as range of motion, muscle strength, muscle length, and spasticity. The most explored lower extremity robotic platform is ankle robotics. Armeo-spring and You-grabber are examples of robotic devices designed for the upper extremities.
- **Wearable Exoskeletons (8):** These are wearable units that integrate motors, pneumatics, levers, and hydraulics and are controlled by a microprocessor and powered by batteries to provide support to movement at individual joints. Most such designs target gait efficiency.
- **Robotic crawler (9) :** As compared to typically developing infants, infants at risk for cerebral palsy have a significant disadvantage in learning to crawl. SIPPC (Self-Initiated Prone Progression Crawler) is an assistive technology developed at the University of Oklahoma (Stillwater, United States) to help infants improve their crawling ability. The infants are fitted with an outfit that allows for kinematic remodeling of their movement parameters as well as EEG monitoring of their neural responses. They are placed in an assistive robot that can boost the effectiveness of their crawling efforts and minimize the level of weight bearing required for optimal prone locomotion.

2. Neuromuscular stimulation assisted gait analysis and walking technology: Using wearable-wireless surface electrodes, multichannel neuromuscular stimulation-assisted gait training allows for the proper activation of lower-limb muscles, resulting in a more functional gait pattern (10). This can help children with spastic CP gain muscle strength and reduce spasticity by targeting certain specific lumbar-sacral sensory roots. Similarly, the Walk-Aide System is a self-contained device designed to provide comfortable and effective transcutaneous stimulation to the peroneal nerve in children with hemiplegic cerebral palsy to improve dorsiflexion of the ankle during the swing phase of gait, eliminating foot drop and normalising gait pattern (11).
3. Walkers with or without wheels, standers, canes and power wheelchairs: These mobility aids can be useful tools in helping children with CP achieve mobility.

## Communication Technology

Up to 40% of children with CP with GMFCS levels IV and V have communicative difficulties. Communication aide designs can range from manual signs, graphic symbols and communication boards to more complex devices that synthesize speech.

1. **Electronic Communication boards:** An electronic communication board is a device that allows children to select letters, words,

and phrases from a screen to verbally convey their thoughts and feelings. These boards look similar to electronic tablets/ipads and contain letters, images and photos that a child can point to. The chosen words or symbols are then turned into phrases that are read aloud to the audience. Communication boards may often create 8-12 words per minute. Communication boards are of two basic types.

- High-tech board includes speech generation and eye-tracking technology to assist children with limited upper extremity mobility.
- Low-tech boards provide a basic sheet of paper that allows children to point to letters or words to display what they want to communicate

2. **Augmentative and alternative communication systems (AAC):** Recent technological advancements have resulted in lightweight, cost-effective, and precise input sensors for speech-generating devices. This innovation has made it possible to integrate various types of user interfaces into AAC devices, serving the needs of people with differing levels of physical ability. Eye-tracking or eye gaze control devices and the Brain-computer interface (BCI) are the best examples of commercially available AAC devices; details of such devices have been summarized in the table below. Cost and slow language output remain the main drawbacks of such AAC devices.
3. Auditory devices: Hearing impairment, regardless of severity, bears a significant impact on how a child with CP matures and communicates with their peers and family. Deafness can make physical and cognitive abilities even more challenging for children with CP. It may be difficult to communicate using sign language or braille letters for children with CP with restricted upper limb function. This drastically restricts the linguistic options for CP children with impaired hearing ability. Children with CP and hearing impairment hence will benefit from auditory devices such as cochlear implants.

## Table 1: AAC systems

| | | |
|---|---|---|
| **Devices with Active Inputs** (12) | a) **Inputs requiring eye-gaze control**<br>People with reliable eye movements can communicate information through an access pathway that is controlled with eye gaze. Eye gaze captures eye movement through an infrared camera mounted on a computer or a tablet. Letters or pictures can be selected by holding the eye gaze on a specific object or letter or by blinking. These can be combined with speech-generating devices for providing communication opportunities. | **b) Inputs requiring controlled movements**<br>User interfaces can vary from standard designs like a joystick, mice to more complicated adapted setups like mechanical switches, head control inputs for individuals with significant motor impairments. |
| **Devices with Passive Inputs** (13) | a) **Physiologic inputs:**<br>Access pathways can decode signs or clues that indicate feelings or needs; as for example use of facial expressions & vitals signs to indicate an emotional state. | b) **Brain–computer interface (BCI):**<br>Brain–computer interfaces are able to detect thought-induced changes in the brain and convert this information in a processing unit to produce communication output. Icon and letter-based access pathways to produce speech have recently been incorporated into BCI systems for individuals with restricted motor function. |

## Virtual reality technologies for sensorimotor training

Virtual reality (VR) systems use interactive, real-time simulations to promote multi-sensory feedback and user interaction with the help of a user-computer interface. It allows the user to practice good quality movements of whole body/ individual limbs and high number of repetitions by simulating a real-life task (14). The VR systems that have been investigated include a wide range of designs. Researchers have used either commercial interactive video games or custom-engineered technology that includes real-time movement analysis and feedback. Most studies targeted gait, upper extremity movement, and balance. VR had a medium to large effect on the rehabilitation of gait and a large effect on the rehabilitation of balance as per literature evidence.

## Brain stimulation

Brain stimulation can play a role in remedying CP. Non-invasive novel approaches such as direct brain stimulation (TCDS) and especially Transcranial magnetic stimulation (TMS) reported satisfying results across various studies for treatment of cerebral stroke, spasticity and patients with hemiplegic cerebral palsy. In TMS, a figure of eight conductive coil was used to conduct electrical current to the neural cells. This magnetic stimulation induces local electrical variations in cortical neural cells based on Faraday's Law. Cortical excitability and eternal modifications in neural behavior can be regulated via monotonous stimulation with TMS (15).

## Other Assistive technology

- **Adaptive writing and typing aids:** Children with cerebral palsy often have restricted hand function due to tonal abnormalities and reduced muscle strength; which prevents them from using a traditional writing pad or keyboard. Commercial writing aids are available in form of pencil or pen grips, weighted pens or pencils and slanted writing pad. Assisted typing aids have a velcro or elastic brace that wraps over the hand and a metal or steel "pointer" that extends out of the brace to press down keys on the keyboard. Such adaptive technologies can aid children with CP and are crucial in ensuring their academic achievements.
- **Assistive devices for daily life:** Children with cerebral palsy often have considerable difficulty performing activities of daily living like eating, bathing, getting dressed or brushing their teeth. Using assistive technology to help with daily tasks can help children with CP get a step closer to self-sufficiency. Examples of such innovative technologies include adaptive dressing aids, power brushes, adaptive bath benches, raised or lowered toilet seats, safety grab bars in rooms, weighted cups/bowls/ plates, manual house key turners, non-slip mats, pull-out tables next to bed, couch, chairs and bed positioning aids and pillows.
- **Drooling scarf:** The drooling scarf is another form of textile-based innovation for CP children.
- **Self-care robots:** Personal use robots can help older children with a restricted range of motion of upper extremities. These robotic systems can be designed as mounted devices that are placed on a surface such as a table, desk, or lap tray, or as autonomous robotic systems with driving and navigation capabilities9. Examples of task-specific robots include those that can pour water from a bottle, push calculator buttons and aid in feeding/brushing, etc.
- **Social robots :** Socially assistive robots focus on helping users by engaging them in social interactions such as helping in conducting therapy sessions by providing motivation by quoting phrases and instructions by physical demonstration of exercises.

### Mobile applications

There has been a rapid growth of mobile applications addressing the health care needs of CP children in the last decade. Apps intended specifically for people with CP and their caregivers can help guide motor, linguistic and cognitive exercises. Examples: Crazy copy games, See.Touch.Learn, iComm, etc.

## Conclusions

Mobility robots, augmentative and alternative communication devices, virtual reality systems and mobile applications have all shown promising results in offering a systematic rehabilitation strategy for children with cerebral palsy.

## References

1. Rosenbaum P et al. A report: the definition and classification of cerebral palsy. Dev Med Child Neurol. 2007;49(6):480
2. Chauhan A et al. Prevalence of Cerebral Palsy in Indian Children: A Systematic Review and Meta-Analysis. Indian J Pediatr. 2019 Dec; 86(12): 1124-1130.
3. Reyes et al. Technological Advancements in Cerebral Palsy Rehabilitation. Phys Med Rehabil Clin N Am. 2019.
4. Bayon C et al. Robotic therapies for children with cerebral palsy: a systematic review. Transl Biomed 2016; 7 (1): 1–10.
5. Carvalho I et al. Robotic gait training for individuals with cerebral palsy: a systematic review and meta-analysis. Arch Phys Med Rehabil 2017; 98 (11): 2332–44.
6. Sukal-Moulton T et al. Clinical application of a robotic ankle training program for cerebral palsy compared to the research laboratory application: does it translate to practice? Arch Phys Med Rehabil 2014; 95 (8): 1433–40.
7. Wu YN et al. Combined passive stretching and active movement rehabilitation of lower-limb impairments in children with cerebral palsy using a portable robot. Neurorehabil Neural Repair 2011; 25(4): 378–85.
8. Gorgey AS. Robotic exoskeletons: the current pros and cons. World J Orthop 2018; 9(9): 112–9.
9. David P.Miller et al. Robotic Crawling Assistance for Infants with Cerebral Palsy. Artificial Intelligence Applied to Assistive Technologies and Smart Environments: Papers from the 2015 AAAI Workshop
10. Rose et al. Artificial Walking Technologies to Improve Gait in Cerebral Palsy: Multichannel Neuromuscular Stimulation. Artif Organs, Vol. 41, No. 11, 2017
11. El-Shamy and Abdelaal et al. WalkAide Efficacy on Gait and Energy Expenditure in Children with Hemiplegic Cerebral Palsy . Am. J. Phys. Med. Rehabil. 2016
12. Karlsson P et al. Eye-gaze control technology for children, adolescents and adults with cerebral palsy with significant physical disability: findings from a systematic review. Dev Neurorehabil 2018; 21(8): 497–505.
13. Ahani A et al. Language-model assisted and icon based communication through a brain-computer interface with different presentation paradigms. IEEE Trans Neural Syst Rehabil Eng 2018; 26(9): 1835–44.
14. Galvin J et al. Facilitating clinical decision-making about the use of virtual reality within paediatric motor rehabilitation: describing and classifying virtual reality systems. Dev Neurorehabil 2011; 14(2): 112–22.
15. Ramezani et al. A Novel Intervention Technology for Cerebral Palsy: Brain Stimulation. Iran J Child Neurol. Spring 2019; 13(2): 17-28

# Management considerations - Co-morbidities in Cerebral Palsy

**Dr Leena Srivastava**
Developmental Pediatrician
Bharati Vidyapeeth, Pune

Samarth, a three year boy, with spastic quadriplegic Cerebral Palsy came to the developmental clinic for the first time. The parents had consulted various doctors earlier and the boy was on treatment for the seizures. The seizures were now controlled with the latest anti-epileptic medications that the child was prescribed. The parents were slowly starting to wake up to the fact that the child was not sitting and walking and something needed to be done. The doctor had told them earlier that they needed to go for physiotherapy but with the seizures ongoing, their focus was primarily on the seizure control.

At their visit to the child development centre, the Developmental Pediatrician explained to them that there are various aspects of Samarth's development that needed to be focussed on. She explained that not only the motor but the feeding, nutrition, bone health, communication, cognition, behaviour and play along with activities of daily living and social skills needed to be enhanced. She also explained to the parents that early intervention in these areas has best results when worked in the first five years of the child's life as the neuroplasticity of the brain and capacity to learn is better. They were advised to follow up with a Pediatric Neurologist on a regular basis for their difficult to manage seizures was a must and they should not stop the medication without medical advice. They discussed the MRI Brain picture that had been done earlier and were told about the chances of the child gaining motor skills like sitting and the chances of trying to make him an assisted/ independent walker.

Management of Cerebral Palsy, just like most neurodevelopment disorders ,warrants a multidisciplinary team work. A good history and examination is important to make an accurate diagnosis of Cerebral Palsy. Ruling out of CP mimics where traditional risk factors are not reported is essential.

The care approach itself has to consider all the aspects of impairment or delays and also the co-morbidities that the child has.

**Sensory impairments -** Almost 50% of children with Cerebral Palsy will have some form of visual impairment. This may be in the form of impairment in eye movements (Squint) , refractive errors and/or problems of eye function like ROP, cortical visual impairment, visual field defects.

Hearing impairments occur in 1 in 10 children with CP.

Given that the critical periods of these domains are early it is imperative that they are identified and stimulation and habilitation offered early.

**Epilepsy -** Overall prevalence of epilepsy in these children is reported in around 20-40 %. Good control of seizures is part of good intervention to ensure better response and participation.

## Feeding, nutrition, general health:

**Dysphagia -** Almost half of the children with CP have dysphagia which hampers their feeding and thereby leading to malnutrition, vitamin deficiencies.

**Nutrition -** Studies have shown around 51% of children to be malnourished. Malnourished children with limited energy reserves will obviously not be able to optimise their motor outcomes even with proper training.

**Drooling -** Spasticity with poor jaw stability, lip closure and lack of coordinated swallowing movements may increase drooling.

**Constipation -** has been reported as high as 59% in one registry. Thus advice on fibre rich diet with good practices for toilet training cam be included.

Dysphagia, GERD, drooling all contribute to the feeding issues and proper evaluation with positioning advice and guidance on food texture and consistency and if needed gastrostomy may help the parents manage these issues better.

**Oral hygiene and dental health -** Brushing of teeth may be difficult with the spasticity, drooling and sensory issues that these children may additionally have and needs to be part of the management plan.

**Bone health -** Fragile fractures may be seen in about 20% of these children at some point of their lives. It is thus important to supplement Vitamin D adequately and also ensure weight bearing exercises.

Physical activity is essential for better health, mobility , participation and quality of life; but designing a good exercise program in individual cases may be complex.

**Hip surveillance** - One in three children may suffer from hip displacement leading to pain and mobility impairment and may require orthopaedic surgical intervention in cases of dislocation. Thus comprehensive and regular hip surveillance is advisable for early identification with multidisciplinary care for prevention of dislocation.

**Motor interventions -** Motor impairments are an inevitable part of CP and the focus of management for most parents. Motor interventions when using evidence based techniques which are mostly training based and goal directed interventions. Constraint based methods like CIMT have proven to be much more effective in recent years and studies are showing encouraging reports that three in four children will walk. Child-active motor learning early interventions appeared to result in improved movement and cognition.

**Tone management -** 85 % of children with CP may have spasticity and 7 % dyskinesia or many have a mixed presentation. These postures may affect motor control and may also be painful. Appropriate use of pharmacological drugs like Baclofen or Trihexyphenidyl or surgical procedures for Botulinum toxin etc may be used for the same.

Contracture prevention and management- Comprehensive multidisciplinary approach with step at the right time for contracture prevention along with serial casting in few cases along with strength training and goal directed training may be used. Functional orthoses, Orthopedic surgical intervention to maintain alignment and optimise biomechanics may be used in children with contractures.

**Communication -** Communication difficulties may be found in around 60-80% of these children, with around 24% of those affected being non verbal. Literacy and communication using devices is gaining support and use of alternative and augmentative communication AAC devices for children who do not attain verbal abilities can be explored.

**Cognitive interventions -** About half of these children will have intellectual disability.

Recent studies do show a declining trend in these figures and evidence for early intervention and stimulation for improving cognitive outcomes in typical children in the long term is encouraging. Specific studies of cognitive interventions in children with CP are awaited though few infant programs like GAME (a combination of motor training, environmental enrichment and coaching) has shown better cognition at 1 year of age.

School guidance and academic adaptations to ensure their participation in school settings may be necessary as children with average intellectual capability also may have learning difficulties.

**Behaviour -** Behavioral problems can be a common hinderance to interventional practices and thus parent training in behavioural management becomes an inevitable part of management in many children.

Parental and family support to help coping, mental health and quality of life forms the backbone of any good intervention plan.

**Facts suggest** - A large chunk of these children with CP are not offered proven interventions and few receive harmful or ineffective interventions.

There is a conservative approach of late diagnosis of Cerebral Palsy even in high risk groups following failed milestones.

Key points to remember

- Cerebral Palsy is a common physical disability of childhood.
- Early and evidence based intervention is the key to better outcomes.
- Multidisciplinary approach offers better holistic development and progress.
- Medical , neurological and musculoskeletal co-morbidities should be included in the management plan.
- The comprehensive management plan should include all the developmental domains, co-morbidities to ensure optimal functioning, activity, participation and environmental adaptation to help the child.
- Parents may be counselled on the importance of regular holistic intervention plan with realistic expectations.

**Table 1. Follow up plan for high risk infants (ref - AIIMS- NICU protocols 2008)**

| Assessment | Age in months |
|---|---|
| Assessment of feeding and dietary counseling | 1 2 3 6 9 12 15 18 24 .....8years |
| Growth monitoring | All visits |
| Immunization | As per schedule (based on postnatal age) |
| Neurological examination | • • • • • • • |
| Developmental assessment and DQ | • • ¶ • ¶ ¶ • |
| Hearing (BERA) | • ¶ ¶ ¶ ¶ ¶ ¶ |
| Ophthalmic evaluation | • ¶ ¶ ¶ ¶ ¶ |
| USG/CT brain | As indicated |
| | ¶ if previous test abnormal |

## Further reading:

1. Novak, I., Morgan, C., Fahey, M. et al. State of the Evidence Traffic Lights 2019: Systematic Review of Interventions for Preventing and Treating Children with Cerebral Palsy. Curr Neurol Neurosci Rep 20, 3 (2020). https://doi.org/10.1007/s11910-020-1022-z.

2. National Guideline Alliance (UK). Cerebral palsy in under 25s: assessment and management. London: National Institute for Health and Care Excellence (UK); 2017 Jan. (NICE Guideline, No. 62.) 27, Other comorbidities in cerebral palsy. Available from: https://www.ncbi.nlm.nih.gov/books/NBK533230/.

3. Minocha P, Sitaraman S, Sachdeva P. Clinical Spectrum, Comorbidities, and Risk Factor Profile of Cerebral Palsy Children: A Prospective Study. J Pediatr Neurosci. 2017;12(1):15-18. doi:10.4103/1817-1745.205622.

4. Duke, R.E., Torty, C., Okorie, U. et al. Pattern of comorbidities in school-aged children with cerebral palsy in Cross River State, Nigeria. BMC Pediatr 21, 165 (2021). https://doi.org/10.1186/s12887-021-02637-9.

5. Pradeep Kumar, M.Jeeva Sankar, Savita Sapra, Ramesh Agarwal, Ashok Deorari and Vinod Paul. Follow-up of High Risk Neonates. AIIMS- NICU protocols 2008.

# Early Detection and Prevention of Cerebral Palsy

**Anjan Bhattacharya; FRCPCH, UK**
Locum Consultant in Community Paediatrics, St. Helens and Konwsley Teaching Hospitals NHS Trust, UK

Consultant Developmental Paediatrician and Head
Child Development Center
Apollo Multispeciality Hospital, Kolkata, India

## David's Story

Let us start with a real life story to describe a clinical case to highlight this article's main moto.

Currently, I am working for a short term contract as a Consultant Developmental Paediatrician in Prescot, near Liverpool in the UK and 12 year old David walks in with his father and mother in my clinic called Lowe House Community Clinic, in clutches!

He has Cerebral Palsy that was eventually detected when, following his premature birth at around 34 weeks of gestation, he failed to sit independently by 8 months of age. He was referred to Neurodisability Services and at the age of 4 years, a final diagnosis of Cerebral Palsy was made firmly, since no other cause behind his motor disability could be established.

He receives regular support locally and his parents receive Disability Benefits. David has no brothers and sisters and parents seem to be devoted to him. David goes to a mainstream school, where he is supported by his SENCO and School Nurse. School Doctor never needed to be involved with him so far, since everything seemed to be on board.

He is referred to Developmental Paediatric Clinic by his GP upon parental request to figure out why David is having bouts of self-hitting behaviour over last 6 months. School Counsellor has sat with him a few times. David says, he does not know why he hits himself but he does! He has not admitted to any bullying, any problem with any teacher or peer, he has always been okay with studies and he continues to do so. School has also not seen him in any situation, where his behaviour or performances in any other area seemed to be problematic. David says he is happy at home and parents seem to be going on steadily without any information on domestic disturbances.

David on examination does not demonstrate any signs or symptoms that will direct me to any physical ailments, which might have spurred this on. I however, kept the following differential diagnoses in mind: (1) Brain Tumor, (2) Depression with psychotic episodes or (3) Newly emerging Epilepsy. I have therefore, requested routine bloods, an EEG and a Brain MRI Scan along with a referral to the Paediatric Mental Health Team.

I will review him with all the results. But I was left thinking that, if David was born in today's day and age, especially somewhere in Queensland, Australia or such places where they routinely practice early detection tool using General Movement (Prechtl) Assessment, may be David could have been spared all these agonies of a child who had to grow up with a disability!

## So, what is GM (Prechtl) Assessment Tool?

GMA is Clinical Assessment Tool from birth till 3 to 4 months of life. It can detect risk of Cerebral Palsy! The detection rate of this

JAMA Pediatrics | Review

# Early, Accurate Diagnosis and Early Intervention in Cerebral Palsy

## Advances in Diagnosis and Treatment

Iona Novak, PhD; Cathy Morgan, PhD; Lani Adde, PhD; James Blackman, PhD; Roslyn N. Boyd, PhD; Jenica Brunstrom-Hernandez, MD; Giovanni Cioni, MD; Diane Damiano, PhD; Johanna Darrah, PhD; Ann-Christin Eliasson, PhD; Linda S. de Vries, PhD; Christa Einspieler, PhD; Michael Fahey, PhD; Darcy Fehlings, PhD; Donna M. Ferriero, MD; Linda Fetters, PhD; Simona Fiori, PhD; Hans Forssberg, PhD; Andrew M. Gordon, PhD; Susan Greaves, PhD; Andrea Guzzetta, PhD; Majna Hadders-Algra, PhD; Sophie Harbourne, PhD; Angeline Kakooza Mwesiga, PhD; Petra Kastner, PhD; Lena Krumlinde Sundholm, PhD; Beatrice Latal, MD; Alison Laughton Fowlds, PhD; Nathalie Maitre, PhD; Sarah McIntyre, PhD; Gang Nanbo, MD; Lindsay Pennington, PhD; Domenico M. Romeo, PhD; Roberta Shepherd, PhD; Alicia J. Spittle, PhD; Marcella Thornton, DipEd; Jane Valentine, MRCP; Karen Walker, PhD; Robert White, MSW; Nadia Badawi, PhD

**IMPORTANCE** Cerebral palsy describes the most common physical disability in childhood and occurs in 1 in 500 live births. Historically, the diagnosis has been made between age 12 and 24 months but now can be made before 6 months' corrected age.

**OBJECTIVES** To systematically review best available evidence for early, accurate diagnosis of cerebral palsy and to summarize best available evidence about cerebral palsy–specific early intervention that should follow early diagnosis to optimize neuroplasticity and function.

**EVIDENCE REVIEW** This study systematically searched the literature about early diagnosis of cerebral palsy in MEDLINE (1950-2016), EMBASE (1980-2016), CINAHL (1982-2016), and the Cochrane Library (1988-2016) and by hand searching. Search terms included cerebral palsy, diagnosis, detection, prediction, identification, predictive validity, accuracy, sensitivity, and specificity. The study included systematic reviews with or without meta-analyses, criteria of diagnostic accuracy, and evidence-based clinical guidelines. Findings are reported according to the PRISMA statement, and recommendations are reported according to the Appraisal of Guidelines, Research and Evaluation (AGREE) II instrument.

**FINDINGS** Six systematic reviews and 2 evidence-based clinical guidelines met inclusion criteria. All included articles had high methodological Quality Assessment of Diagnostic Accuracy Studies (QUADAS) ratings. In infants, clinical signs and symptoms of cerebral palsy emerge and evolve before age 2 years; therefore, a combination of standardized tools should be used to predict risk in conjunction with clinical history. Before 5 months' corrected age, the most predictive tools for detecting risk are term age magnetic resonance imaging (80%-89% sensitivity), the Prechtl Qualitative Assessment of General Movements (98% sensitivity), and the Hammersmith Infant Neurological Examination (90% sensitivity). After 5 months' corrected age, the most predictive tools for detecting risk are magnetic resonance imaging (80%-89% sensitivity) (where safe and feasible), the Hammersmith Infant Neurological Examination (90% sensitivity), and the Developmental Assessment of Young Children (93% C index). Topography and severity of cerebral palsy are more difficult to ascertain in infancy and magnetic resonance imaging and the Hammersmith Infant Neurological Examination may be helpful in assisting clinical decisions. In high-income countries, 2 in 3 individuals with cerebral palsy will walk, 3 in 4 will talk, and 1 in 2 will have normal intelligence.

**CONCLUSIONS AND RELEVANCE** Early diagnosis begins with a medical history and involves using neuroimaging, standardized neurological, and standardized motor assessments that indicate congruent abnormal findings indicative of cerebral palsy. Clinicians should understand the importance of prompt referral to diagnostic-specific early intervention to optimize infant motor and cognitive plasticity, prevent secondary complications, and enhance caregiver well-being.

JAMA Pediatr. doi:10.1001/jamapediatrics.2017.0690
Published online July 17, 2017.

Supplemental content

**Author Affiliations:** Author affiliations are listed at the end of this article.

**Corresponding Author:** Iona Novak, PhD, Cerebral Palsy Alliance, The University of Sydney, PO Box 180, Hornsby Forest, New South Wales, Australia 2080 (inovak@cerebralpalsy.org.au).

clinical tool is around 98%, which is higher than any other methods around. For example, the combined detection rate of MRI/USG Brain Scans and Clinical Developmental Assessments come to around 97% at best but later in life!

According to published date in JAMA 2017, Iona Novak et. al. has mentioned clearly that the average age for Early Detection of Cerebral Palsy (CP) is 12 – 24 months now-a-days and that CP is the commonest physical disability (1 in 500 approx.). It of course feels wonderful, that I have an upcoming publication where Iona Novak is the Lead Author and I am one of the co-authors.

Therefore, if David was born in Queensland or Kolkata today with prematurity, he had a chance of getting assessed by GMA and with 98% sensitivity (true positive rate of a test) his CP risk could have been picked up.

## GMA (Precthl)'s importance

Iona Novak, with her expert team of about 30 international experts, have clearly stated in the JAMA article, that techniques with lesser and later detection tools (MRI brain or Hammersmith/HINES) are still very useful in high income countries. But GMA being easy to administer, clinical, non-invasive risk stratification tool should do wonders in resource-crunched countries like India and many more!

## Advantages

1. Detects risk earliest possible time (0-3 months) while Neural Plasticity is intact
2. Clinical
3. Non-invasive (trained expert observational only)
4. Human Resource intensive
5. No gadgets are necessary
6. Easy to do
7. Utterly cheap

## Disadvantages

1. Human Resource scarcity
2. Interrater variability
3. New tool

## Discussion

GM training is available in India. The training is given by none other than Dr. Christa Einspieler, Ex-Professor from Graz University and colleague of Professor of Hans Prechtle, who is no more.

Training is imparted on behalf of GM Trust International based in Austria. All bona fide GM Trained professionals are trained by GM Trust International.

There are regular courses held in many countries. For example, it is conducted by Betty Hutchons at the University College of London. Betty Hutchon is one of the two Baileys III Trainer in the British isles and I have been trained by her. I, amongst few others, conduct GM training in India, where Prof, Chista Einespiler or one of her accredited colleagues train professionals internationally, including India. The courses at UCL, London is nearly GBP1000. In India, it costs between GBP150 (Basic) and GBP 250 (Advanced), when delivered by Graz University/ GM Trust International Trainers.

It is very important that we salvage boys and girls like David, so that they do not have to face what David is facing today!

Anecdotal experience from Child Development Centre in Kolkata is that, if we detect At Risk by 3 months of birth, using GMA (we do Advanced GMA, with Optimality Scores to monitor progress), use of Early Intervention with GM based interventions as well as NDT (Neuro-Developmental Therapy) seems to have completely normalized infants! We had about 6 infants detected At Risk, so far! All of them have gone back to living normally, not needing any further intervention now!

It is difficult to say with such small numbers but, if we trust science, it is possible that we have salvaged at least 6 Davids born in Kolkata.

This is the take home message for the CP Month of October. I expect IAP to lead this endeavour.

## Conclusions

1. GMA is a cheap, expertise dependent clinical non-invasive tool to detect risk of CP when Neural Plasticity is intact or near intact
2. Use of GMA saves lots of costs and agony in the life course of a child with CP
3. GMA trained professionals should be ubiquitous. It should not be a lottery of birth
4. There are excellent Early Interventional tools, which in expert hands, have potential to normalize children thus detected to be at risk.

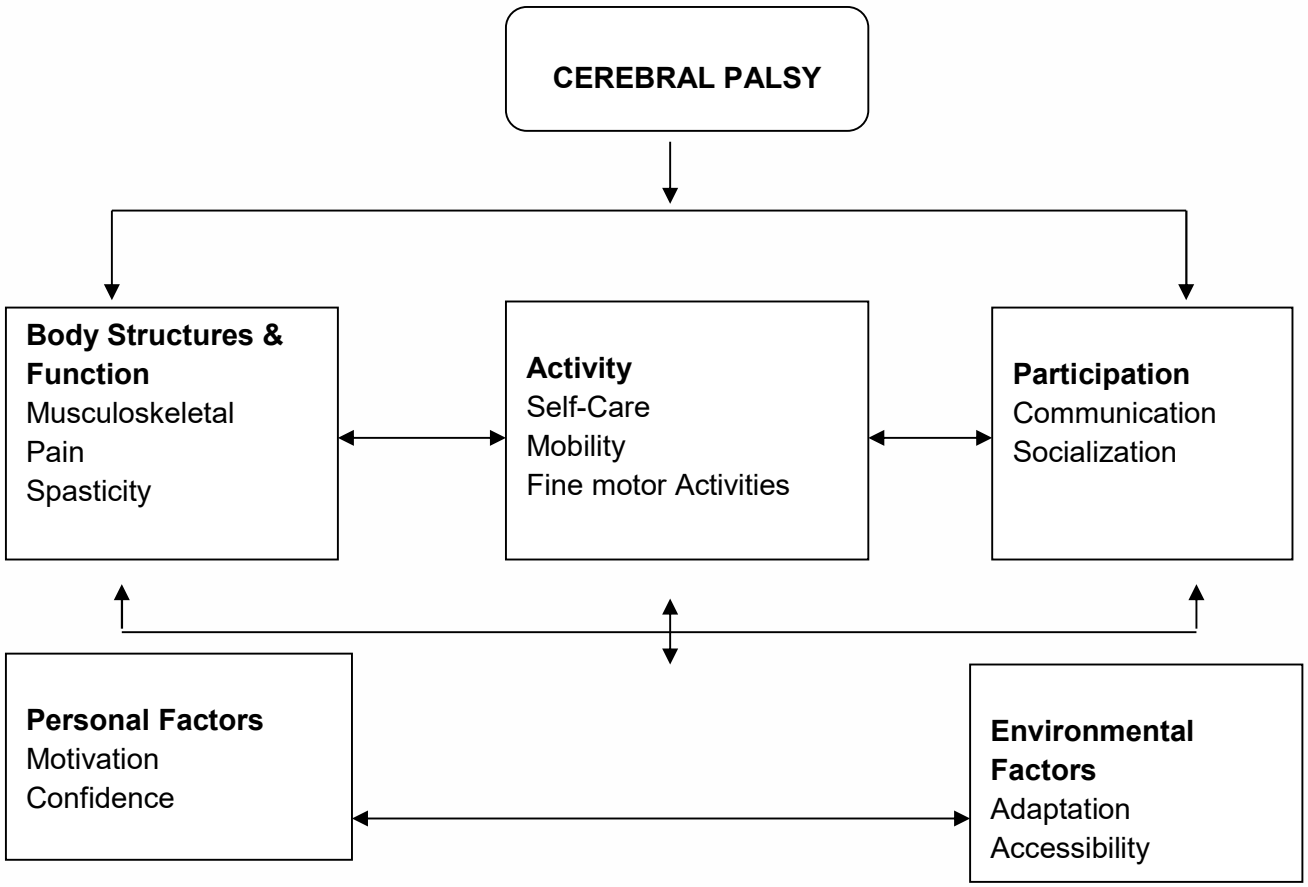
## References

1. Novak I et al. Early Accurate Diagnosis and Early Intervention in Cerebral Palsy: Advances in Diagnosis and Treatment. JAMA. 2017:E6-11

# Cerebral Palsy Rehabilitation - A Holistic Approach

**Dr Sreeja K.S**
MBBS, DNB PMR (gold Med.al), MNAMS
Specialist, Dept of PMR, Aster Medcity, Kochi, Kerala

"Cerebral palsy (CP) describes a group of disorders of the development of movement and posture, causing activity limitations, which are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behaviour, and/or by a seizure disorder". ICF is a classification system developed by WHO, an integrated bio-psychological model of health, where the individual's functioning is determined by complex interaction of the impairment, activities and participation within the environmental and personal context. Use of ICF in management of CP enables a guide to selection of measurement tools, to inform goal setting, decision making processes and determine outcomes meaningful to the children and their families.



## Goals of rehabilitation

1. Improve mobility level of child
2. Prevent deformity and contractures
3. Educate parents regarding home management of child
4. To train child in activities of daily living (ADL)
5. To improve social participation of affected child.

## Classification tools used in CP

**Functional motor ability- GMFCS**

Gross Motor Function Classification System (GMFCS)

1) Walk independently
2) Walk independently with limitations
3) Use assistive devices such as elbow crutches or walking frames
4) Require a wheelchair but may have some form of independent mobility such as a powered wheelchair or may assist with transfers
5) Require a wheelchair and are fully dependent in their mobility

**Upper limb classification- MACS**

Communication Function Classification System (CFCS) Levels

1) Effective sender and/or receiver with familiar and unfamiliar partners
2) Effective but slower paced sender and/or receiver with familiar and unfamiliar partners
3) Effective sender and/or receiver with familiar partners
4) Inconsistent sender and/or receiver with familiar partners
5) Seldom effective sender and/or receiver even with familiar partner

**Communication classification- CFCS**

Communication Function Classification System (CFCS)

1) c Effective sender and/or receiver with familiar and unfamiliar partners
2) Effective but slower paced sender and/or receiver with familiar and unfamiliar partners
3) Effective sender and/or receiver with familiar partners
4) Inconsistent sender and/or receiver with familiar partners
5) Seldom effective sender and/or receiver even with familiar partners

## ASSESSMENT

Body structure and function

**A. Physical assessment**

ROM

Spasticity- Modified Ashworth scale, Modified Tardieu scale

Tone- Hypertonia assessment tool

## Gait classification

| Spastic diplegia | Spastic hemiplegia | Crouch |
|---|---|---|
| Scissoring gait pattern- hips flexed and adducted<br>Knee flexed with valgus | Weak hip flexion and ankle dorsiflexion<br>Overactive posterior tibial is<br>Hip hiking or hip circumduction<br>Supinated foot in stance phase<br>Upper extremity posturing | Tight hip flexors<br>Tight hamstrings<br>Weak quadriceps<br>Excessive dorsiflexion in both diplegic and quadriplegics |

Dystonia

Strength

Selective motor control

**B. Functional eating and drinking assessment-**

Dysphagia disorder survey

Drooling impact scale

VFSS

**C. Sensation**

**D. Pain**

FACES pain scale- revised.

**E. Nutritional assessment**

Anthropometry

Biochemical marker

GERD

Bone health

Dietary assessment

## Activity and participation assessment

**A. Gross motor and mobility assessment**

GMFM

3D gait analysis

**B.Fine motor and upper limb assessment**

Quality of upper extremity skills test (QUEST)

**C. Speech and language assessment**

**D. Quality of life assessment-**

Cerebral palsy Quality of life Questionnaire (CP QOL)

Paediatric evaluation of Disability Inventory (PEDI)

## Environmental assessment

School function assessment (SFA)

Functional Independence Measure for children (WeeFIM)

## Specific management issues in Cerebral Palsy

- Spasticity and dystonia
- Seizures 35-45%
- Pain- musculoskeletal, spasms, reflux, constipation
- Sleep disturbances
- Musculoskeletal changes- contractures, joint instability, scoliosis
- Intellectual disabilities 40-60%
- Visual impairment 20-60%
- Hearing issues 30%
- Oral/motor deficits- dysarthria, apraxia, aphasia
- Feeding/nutrition
- Gastrointestinal issues-GERD, Constipation
- Emotional support

## Interventions

**Body structure and function**

**1. Hip surveillance**

All children with cerebral palsy should be referred for hip surveillance. Initial referral should occur between 12-24 months of age or at diagnosis. All children should get a baseline pelvis x-ray. The need for ongoing hip surveillance is determined by the child's GMFCS level, age and their hip migration percentage. As GMFCS level increases the risk of progressive hip displacement also increases.

**2. Stretch intervention**

■ Manual stretch program

Key muscles to stretch:

- Hip adductors , Hip flexors, Hamstrings, Calves (with knee bent and straight)
- Shoulder – extensors and internal rotators, Elbow flexors, Forearm pronators, Wrist flexors, finger flexors, Thumb adductor

■ Casting

It gains or restore the muscle length and provide soft tissue elongation. Serial casting is indicated when soft tissue contracture is interfering with function or causing potential biomechanical misalignment. Continuous stretch increase muscle fibre length due to increase in number of sarcomeres.

■ Orthoses

Used to prevent contractures, joint alignment, provide a stable base, assists with biomechanics.

a. Lower limb orthosis

Solid AFO – Holds ankle at fixed angle to prevent plantarflexion, also helps to prevent knee hyperextension.

Hinged AFO – Allows dorsiflexion but blocks plantarflexion. Need to have full knee extension

Posterior leaf spring – used to control foot drop, allows some ankle dorsiflexion due to flexibility of the splint.

b. Upper limb orthosis

Thumb abduction wraps – holds the thumb in a slightly abducted position, gives the child sensory feedback with regards to thumb positioning.

- Wrist supports/brace – Supports the wrist in a neutral position, can be reinforced to make the splint stronger if the child has high tone.
- Night resting splint – Full forearm, wrist and finger splint that maintains muscles and joints in an optimal position for night-time positioning. Is made from thermoplastic material.

## Medical Interventions and Medications

**Medications**

1. Baclofen – start with 5-10 mg TDS and titrate after monthly interval for spasticity.
2. Tizanidine – Start with 2 mg TDS and titrate for spasticity
3. Diazepam – start with low doses and at night, useful for patients with seizure disorders and hyperactivity in spasticity.
4. Sodium valproate, carbamazepine and gabapentin – DOC in seizures or dyskinetic CP
5. Trihexyphenydyl (anticholinergics) – Drooling and dystonia.
6. Glycopyrrolate – Can be used for severe drooling, short term management
7. Scopolamine patch - may be used for drooling for short term.

## Interventions

**1. Botulinum toxin A (BoNT-A) injection (spasticity)**

Injection of BoNT-A into muscles with spasticity blocks the release of acetylcholine

In NMJ. Effects of the BoNT-A typically last from 3-6 months maximum.

Injection of BoNT-A is therefore often combined with serial casting.

Common muscles injected are

• Hip adductors, Hamstrings, Gastrocnemius

**2. Adductor release/tenotomy**

Performed to lengthen tight hip adductors and help positioning of femoral head in the acetabulum to prevent subluxation.

### 3. Single event multi-level surgery (SEMLS)

Surgical intervention for the lower limb in the older age group is often combined into one surgical sitting, known as single event multi-level surgery. The goal of surgical intervention is to correct any deformities at each level (hip, knee, ankle/ foot) and treat them as one rather than individual joints. Each joint in the lower limb is connected to and affects the others. This approach means there is only one period of rehabilitation. It is usually carried out when the child of 9-12 years of age.

**a. Tendon lengthening/release(s)**

- Lower limb- Tendo achilles, hamstrings or adductors where there is a fixed contracture.
- Upper limb- Pronators or thumb abductors

**b. Tendon transfer**

- Upper limb-at the wrist and/or thumb but need to have some voluntary grasp and release for this to be successful.
- Lower limb - at the foot/ankle level (tibialis anterior or posterior) but is also performed at the knee on the quadriceps or hamstring muscles. These are performed to improve muscle function/balance and can also be done where there is a contracture.

**Bony surgery**

- Osteotomy – for increased femoral anteversion
- Epiphysiodesis – at knee for mild fixed flexion contractures.
- Lateral column lengthening – to correct a valgus foot deformity (severe flat foot)
- Subtalar fusion – to correct a valgus foot deformity (severe flat foot).
- Varus derotation osteotomy (VDRO) – for hip displacement

## Therapautic Excercise Methods

(i) Bobath (Neurodevelopmental therapy NDT)- Normalises tone, inhibit abnormal primitive reflex patterns, facilitate automatic reactions with subsequent normal development

(ii) Sensory integration

Approach using therapeutic activities to organise sensation from body and environment to facilitate adaptive responses

(iii) Hydrotherapy

It provides stimulation to a body, enhance or facilitate relaxation, strength, balance and coordination. Method in CP is Halliwick method. The warmth and buoyancy of water support and relieve pain. Heat assist relaxation, helps reduce spasms, improves ROM, walking, fitness, endurance and respiratory function.

(iv) Vojta

It is based on automatic responses and reflex movements to specific stimuli. Stimulation lead to automatic and involuntarily complex movements such as reflex creeping in prone and reflex rolling from supine to side lying.

(v) Conductive education

It's a holistic educational approach where intensive and repetitive practice of motor skills are given in daily basis

(vi) Hippotherapy

Horseback riding use horse's movements which has an individual and variable gait, tempo, rhythm, repetition and cadence. Improvements in trunk control and balance and motor function.

(vi) Play therapy

Major key to child's cognitive and physical development.

Activity and participation interventions

Upper limb specific interventions

### 1. Modified Constraint induced movement therapy

Constraint of intact limb lead to learned reuse of the affected limb. It is done with slings, mitts, splints and casts applied for a set period of weeks upto 2 hours a day.

<4yrs - shorter periods of daily practice at home and/or preschool over an 8-10 week period is effective

>4yrs -2-3 week camps or group based

intervention appears more effective.

**2. Bimanual therapy**

Practice bilateral activities with improved use of both hands. Indicated for >12 m, have spontaneous use of affected hand, selective motor control, have basic skills such as grasp, hold and cognitive skills to respond to cues

**3. Fine Motor Function**

Activities that specifically target fine motor tasks including grasp, transfer, release and reach. May consider adaptations and modification for fine motor tools

**Lower limb training**

1. Gait training
2. Treadmill training-

Partial body weight support training is based on motor learning theories, child walks repetitively, increasing speed and weight bearing.

Speech/ language and oral motor interventions

Augmentative and alternative communication (AAC) - They supplement or replace speech. They improve expressive and receptive language

a. Aided- low technology- communication boards, alphabet boards, timetables and communication diaries
b. High technology- speech generating devices (single message switches, static display devices and dynamic display devices with additional functions, Environmental control unit and access to the internet and social.

## Enviornmental Interventions

Standing frames

Walking frames

Wheel chairs- manual and power chairs

Seating systems

Bathing aides

Car modifications

Hoists (Freestanding and ceiling track)

Common options for external access include:

- Ramp access
- Easy steps (wide, shallow steps made by a builder)
- . Widening of doorways
- Stair lift
- Handrails

## Conclusion

Effective health care for children with cerebral palsy should be family centred, competent, comprehensive, compassionate, continuous, community based and culturally appropriate.

## References

Cerebral palsy in under 25s: assessment and management. NICE guideline (NG 62) published:25 January 2017.

Nickel,RE, (2000) Cerebral palsy.The physicians guide to caring for children with disabilities and chronic conditions.

IAPMR guidelines to manage a child/ adult with cerebral palsy 2017

## Acknowledgments

**Dr KM Mathew**, Senior consultant and lead, Physical Medicine and Rehabilitation, Aster Medcity, Kochi, Kerala

**Dr Zachariah T Zachariah**

Consultant

Physical medicine and rehabilitation

Aster Medcity, Kochi, Kerala

# Pharmacotherapy of spasticity in children and adolescents with cerebral palsy

**Dr Jeeson C. Unni**
Editor-in-chief, IAP Drug Formulary
Chairperson, IAP Neurodevelopment Chapter
Senior Associate Consultant in Pediatrics
Aster Medcity, Kochi, Kerala, S India
jeeson1955@gmail.com

## Spasticity Medications

- Skeletal muscle relaxants (dantrolene sodium, baclofen)
- Benzodiazepines (diazepam)
- Alpha2-adrenergic agonists (clonidine, tizanidine)
- Botulinum toxins (onabotulinumtoxinA, abobotulinumtoxinA, incobotulinumtoxinA, rimabotulinumtoxinB)
- Phenol and alcohol injections

Because tolerance can occur with medications, drug dosages should regularly be reviewed and implantable devices (pumps, stimulators) should be checked Gabapentin, clonazepam, progabide, piracetam, lamotrigine, and cyproheptadine may potentially affect spasticity. They are currently are under investigation, have undergone little clinical evaluation and are therefore not yet 'recommended' for management of spasticity.

## Skeletal Muscle Relaxants

### Dantrolene Sodium

Dantrolene is the only oral antispasticity medication approved by the US Food and Drug Administration that works peripherally. It is often used in the field of anesthesiology to reverse malignant hyperthermia after delivery of anesthesia. As an antispastic drug it acts on the muscles themselves, uncoupling excitation and contraction by inhibiting calcium release at the sarcoplasmic reticulum. 1 Caution should be taken because there have been reports of liver failure with the use of the drug. [1,2] Because dantrolene does not selectively target specific muscles, it may lead to the adverse effect of general muscle weakness.[3] In some rare cases it has been fatal in high doses and is therefore not considered a first-line drug.[4] It may be tried in cerebral-origin spasticity - traumatic brain injury (TBI), stroke and cerebral palsy; especially as an adjunct in spasticity refractory to other treatments.

**Conclusion:** There is conflicting evidence regarding the effectiveness of dantrolene in reducing spasticity in children with CP. Dantrolene frequently causes side effects in children with spastic CP, such as weakness, drowsiness, and irritability.

Recommendation: There is insufficient evidence to support or refute the use of dantrolene for the treatment of spasticity in children with CP.

## Baclofen

Baclofen is widely used in clinical practice to treat spasticity in children with CP. Experts recommend starting baclofen at the lowest possible dose (5-10 mg/day divided into three doses a day) 5 to minimize AEs like drowsiness and sedation. It works pre- and postsynaptically as a gamma aminobutylic acid (GABA) B agonist at the spinal level 14 and binds to its receptors, leading to membrane hyperpolarization. This restricts calcium influx, which subsequently (1) restricts endogenous excitatory neurotransmitters from being released and (2) inhibits mono- and polysynaptic spinal reflexes. [5,6]

Adverse effects include systemic muscle relaxation, sedation, and fatigue. [7,8,9] Because of potential hepatotoxicity, there is a need to monitor liver function with baclofen use.[10]

Conclusion: There is conflicting evidence regarding the effectiveness of oral baclofen in reducing spasticity and improving function in children with CP. Systemic toxicity was found in some patients.

**Recommendation:** There is insufficient evidence to support or refute the use of oral baclofen for the treatment of spasticity or to improve motor function in children with CP.

## Intrathecal Baclofen(ITB)

A weight-adapted dose of ITB has been used for children, but only if they are heavier than 15 kg. 6 However, it has been noted there are more complications seen in children using ITB than in adults. 11 Furthermore, there are mixed results in studies assessing the effectiveness of baclofen in children with cerebral palsy. 1 Thus, further investigation regarding the efficacy of ITB for children is warranted.

**Conclusion :** Data are inadequate concerning the use of continuous ITB as an antispasticity treatment in children with CP. CSF leaks, seromas, catheter-related complications, and wound infection occur frequently, and other, milder complications occur less frequently.

Recommendation:There is insufficient evidence to support or refute the use of continuous ITB for the treatment of spasticity in children with CP.

## Benzodiazepines

Diazepam works postsynaptically on GABA A receptors, depressing the action of the CNS. Along with clonazepam, another benzodiazepine, diazepam induces significant sedation. Because of this sedation, a potential benefit is the reduction of spasticity at night, permitting uninterrupted sleep.

Diazepam has a tendency to act primarily on flexor refexes, 12 but it can work on extensors in higher doses. Because spinal spasticity has a propensity toward flexor reflexes, diazepam is better suited for spinal spasticity than for cerebral spasticity. 12 However, these drugs also produce tolerance and dependence, drowsiness, sedation, hypersalivation, and weakness, limiting their long-term use. 13 Due to development of dependence on prolonged use, abrupt cessation of medication is not recommended.

**Conclusion** : Diazepam is probably effective for the short-term treatment of spasticity in children with CP. None of the studies formally addressed whether diazepam improved motor function.

Ataxia and drowsiness were identified in the side-effect profile of most studies.

**Recommendations :** Diazepam should be considered as a short-term antispasticity treatment in children with CP. There is insufficient evidence to support or refute the use of diazepam to improve motor function in this population.

## Alpha2-adrenergic Agonists

**Tizanidine -** It's antispasticity effect has been demonstrated in adults with multiple

sclerosis and spinal cord injury. Very few studies available regarding its effectiveness in treating spasticity in children. Because tizanidine is extensively metabolized by the liver, hepatic impairment may have a significant effect on its pharmacokinetics. Side effects related to tizanidine use in adults include hypotension, sedation, asthenia, dry mouth, dizziness, hallucinations, and hepatotoxicity.

Their incidence in pediatric patients has not been studied. One study on combined use of botulinum toxin A and a low dose of tizanidine in treating children with cerebral palsy suffested it to be more effective and has fewer side effects versus baclofen with adjuvant botulinum toxin A. 14 There are very few small studies suggesting efficacy of tizanidine decreasing the spastic hypertonia associated with cerebral palsy in children. [15,16.]

**Conclusion :** Tizanidine is possibly effective to treat spasticity in children with CP. No toxicity was found in this small studies available.

**Recommendations :** Tizanidine may be considered for the treatment of spasticity in children with CP. There is insufficient evidence to support or refute the use of tizanidine to improve motor function in this population.

## Botulinum Toxin

Botulinum toxin, commonly referred to as Botox, is produced by the bacteria Clostridium botulinum and was originally used to treat strabismus. It is currently the most widely used treatment for focal spasticity and avoids the generalized weakness and sedation accompanying oral medications. 17 Botulinum works by inhibiting the release of vesicular acetylcholine from presynaptic nerve terminals at the neuromuscular junction. 18 This causes temporary calming of muscle contractions by blocking the transmission of nerve impulses. There are 8 different subtypes of botulinum toxin. The two, botulinum toxin A (BoNT-A) and botulinum toxin (B BoNT-B), which differ in their level of purification and immunogenicity are used for therapy. 6 BoNT-B has a tendency to cause more side effects, which is why BoNT-A is preferred. 19 Unlike other neurolytic drugs, the effects of Botox are reversible as the toxin begins to degrade, and effects last for 3–4 months.

A thorough knowledge of muscle anatomy is required, and the use of electromyography and ultrasound to localize the targeted nerve is recommended. 6 It should be administered only by those adequately trained and experienced in assessment, execution and follow up of the program.

Muscles commonly treated with Botox include the gastrocnemius-soleus complex (mostly), hamstrings, hip adductors and flexor synergy muscles of the upper extremity. Muscle relaxation is evident within 48 to 72 hours and persists for a period of 3 to 6 months and may be repeated according to the advice of the specialist/ experienced pediatric neurologist.

Use of botox helps improve a child's ability to walk or use hands and allow for a better fitting orthotics by reducing spasticity. Therapists could take advantage of the time when an overly powerful muscle is weakened to work on strengthening the muscle on the opposite side of the joint (antagonist). 20 Sometimes, casting of the involved extremity is done after the injection to increase the stretch of the tight muscle.

A major side effect is possible dissemination to other areas of the body, which can lead to dysphagia if it is being used in the upper limbs or neck muscles. These effects have been reported as early as 1 day and as late as several weeks after treatment. Patients and caregivers need to be adequately counseled and educated and their informed consent be obtained before initiating therapy and they should thus be able to identify the signs and symptoms of systemic effects after receiving an injection of BoNT. Immediate medical attention should be instituted if the child

or adolescent develops worsening or unexpected difficulty swallowing or talking, trouble breathing, or muscle weakness. The development of immunoresistance to the toxin can also be a potential problem. Some experts recommend using the smallest dose of BoNT-A and avoiding injecting more frequently than every 3 months to minimize the risk of antibody resistance. 21 As with all injections, this procedure is to be used with caution in patients receiving anticoagulation therapy.

Conclusion: For children with CP, BoNT-A is established as an effective treatment to reduce spasticity in the upper and lower extremities, but there is conflicting evidence regarding functional improvement. The available evidence suggests that BoNT-A is generally safe in children with CP. However, severe generalized weakness may occur.

## Recommendations

For localized/segmental spasticity in the upper and lower extremities of children with CP that warrants treatment, BoNT-A should be offered as an effective and generally safe treatment.

There is insufficient evidence to support or refute the use of BoNT-A to improve motor function in this population.

There is insufficient evidence to support or refute the use of BoNT-B.

## Phenol, and alcohol injections

There is insufficient evidence to support or refute the use of phenol, and alcohol injections as a treatment for spasticity in children with spastic CP.

## Summary

None of the oral medications used to treat spasticity in children has been adequately tested for safety and efficacy. There are minimal or no data regarding the pharmacokinetics or appropriate dosing parameters to treat children. These critical questions deserve serious research efforts.

Although there is sufficient evidence to recommend BoNT-A as an effective antispasticity treatment in children with CP, its beneficial effects on function, ease of caregiving, activity, and participation need to be established. More data about safety and long-term effects are also needed.

The efficacy and safety of BoNT-B, phenol, and alcohol chemodenervation as treatments for spasticity in children with CP need to be determined.

The efficacy and safety of oral baclofen and the long-term continuous intrathecal pump administration of this medication need to be determined in children with CP.

There is an urgent need to find safer and more effective treatments to help children affected by generalized spasticity due to CP.

## References

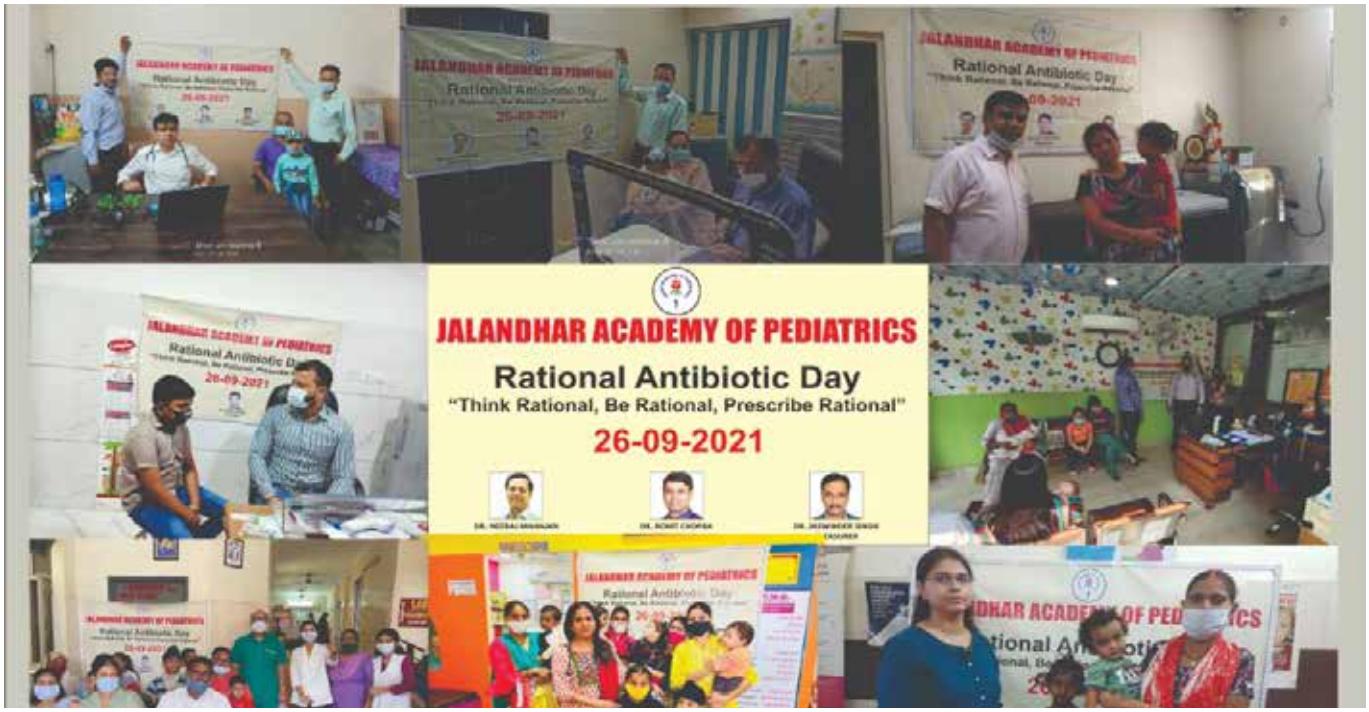
1. Tilton A, Vargus-Adams J, Delgado MR. Pharmacologic treatment of spasticity in children. SeminPediatr Neurol. 2010;17:261–7.
2. Chou R, Peterson K, Helfand M. Comparative efficacy and safety of skeletal muscle relaxants for spasticity and musculoskeletal conditions: a systematic review. J Pain Symptom Manage. 2004;28:140–75.
3. Keenan E. Spasticity management, part 2: choosing the right medication to suit the individual. Br J NeurosciNurs. 2009;5:419–24.
4. Kischka U. Neurological rehabilitation and management of spasticity. Medicine 2008; 36: 616–9.
5. Awaad Y, Rizk T, Siddiqui I, Roosen N, Mcintosh K, Waines GM. Complications of intrathecal baclofen pump: prevention and cure. ISRN Neurol. 2012;2012:575168.
6. Simon O, Yelnik AP. Managing spasticity with drugs. Eur J PhysRehabil Med. 2010;46:401–10.

7. Chou R, Peterson K, Helfand M. Comparative efficacy and safety of skeletal muscle relaxants for spasticity and musculoskeletal conditions: a systematic review. J Pain Symptom Manage. 2004;28:140–7.
8. Abbruzzese G. The medical management of spasticity. Eur J Neurol. 2002;9:30–4.
9. Keenan E. Spasticity management, part 2: choosing the right medication to suit the individual. Br J NeurosciNurs. 2009;5:419–24.
10. Brashear A,Lambeth K. Spasticity. Curr Treat Options Neurol. 2009;11:153–61.
11. Kolaski K, Logan LR. A review of the complications of intrathecal baclofen in patientswith cerebral palsy. NeuroRehabilitation. 2007;22:383–95.
12. Lapeyre E, Kuks JBM, Meijler WJ. Spasticity: revisiting the role and the individual value of several pharmacological treatments. NeuroRehabilitation. 2010;27:193–200.
13. Verrotti A, Greco R, Spalice A, Chiarelli F, Iannetti P. Pharmacotherapy of spasticity in children with cerebral palsy. Pediatr Neurol. 2006;34:1–6.
14. Dai AI, Aksoy SN, Demiryürek AT. Comparison of Efficacy and Side Effects of Oral Baclofen Versus Tizanidine Therapy with Adjuvant Botulinum Toxin Type A in Children With Cerebral Palsy and Spastic Equinus Foot Deformity. J Child Neurol. 2016 Feb; 31(2):184-9.
15. Vasquez-Briceno A, Arellano-Saldana ME, Leon-Hernandez SR, Morales-Osorio MG. [The usefulness of tizanidine. A one-year follow-up of the treatment of spasticity in infantile cerebral palsy]. Rev Neurol 2006;43:132-136.
16. Nikkhah A, Mohammadi M, Ashrafi MR, Zamani G. The Efficacy and Safety of Tizanidine in Treating Spasticity in Children with Cerebral Palsy. Iranian Journal of Child Neurology 2011;5(3): 19-22.
17. Kheder A, Nair KP. Spasticity: pathophysiology, evaluation and management. Pract Neurol. 2012;12:289–98.
18. Burchiel KJ, Hsu FP. Pain and spasticity after spinal cord injury: mechanisms and treatment. Spine (Phila Pa 1976) 2001;26(24 Suppl):S146–60.
19. Dressler D, Eleopra R. Clinical use of non-A botulinum toxins: botulinum toxin type B. Neurotox Res. 2006;9:121–5.
20. Wallen M, O'Flaherty SJ, Waugh MC. Functional outcomes of intramuscular botulinum toxin type a and occupational therapy in the upper limbs of children with cerebral palsy: a randomized controlled trial. Arch Phys Med Rehabil 2007;88:1-10.
21. Tilton AH. Management of spasticity in children with cerebral palsy. Semin Pediatr Neurol 2004;11:58-65.

# IAP Jalandhar

## JALANDHAR ACADEMY OF PEDIATRICS CELEBRATES "ANTIMICROBIAL AWARENESS WEEK"

# IAP Jalandhar

# IAP Jalandhar

## JALANDAHR ACADEMY OF PEDIATRICS
## DEPT. OF PEDIATRICS,
## PIMS MEDICAL COLLEGE, JALANDHAR
## CONDUCTED
## BASIC NRP ON 06-10-2021

# IAP Navi Mumbai

# IAP Navi Mumbai

# IAP Navi Mumbai

Original Article

## Multisystem Inflammatory Syndrome in Children: Experience from October 2020 to January 2021 at a tertiary hospital in Navi Mumbai, India

Priyanka S. Amonkar[1] Suhas N. Kharche[1] Amol A. Madave[1] Jeetendra B. Gavhane[1]

[1]Department of Pediatrics, MGM Medical College and Hospital, Navi Mumbai, Maharashtra, India

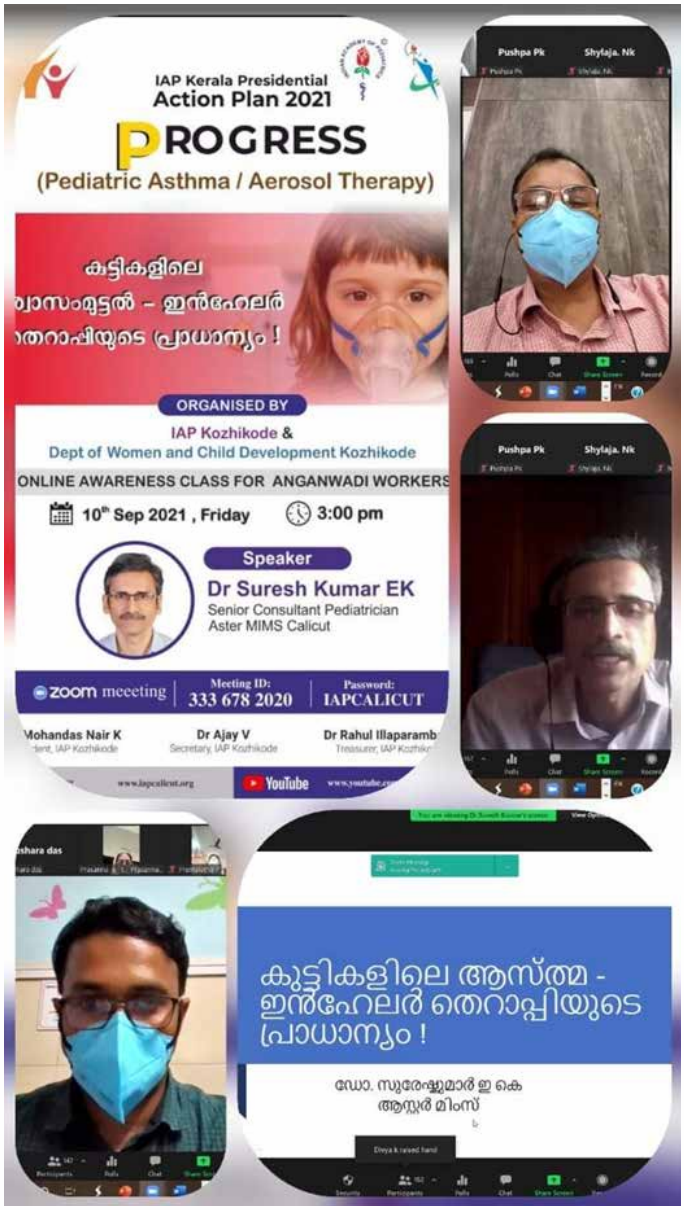
**Address for correspondence** Jeetendra B. Gavhane, DNB, Department of Pediatrics, MGM Medical College and Hospital, Plot no. 1 and 2, Sector-1, Kamothe, Navi Mumbai 410209, Maharashtra, India (e-mail: drjeetendra@gmail.com).

J Pediatr Intensive Care


# IAP Navi Mumbai

# IAP Kerala


IAP Kerala Presidential
Action Plan 2021
PROGRESS
Rational Antibiotic Therapy in Office Practice.
Antibiotic awareness week
Topic 1
Rational antibiotic use - from Fleming's days.
Topic 2
Antibiotics in PICU - Step Up or Step Down ?
Dr. Liz Mary Paul
Dr. K. Sathishkumar
zoom meeting
Meeting ID: 333 678 2020
Password: IAPCALICUT
29th Sep 2021, Wednesday
8:00 pm
Dr Shivaprasad PS
Dr Mohandas Nair K
Dr Ajay V
Dr Rahul Illaparambath
YouTube


IAP Kerala Presidential
Action Plan 2021
PROGRESS
(Pediatric Asthma / Aerosol Therapy)
കുട്ടികളിലെ
ആസ്തമ - ഇൻഹേലർ
തെറാപ്പിയുടെ പ്രാധാന്യം !
ORGANISED BY
IAP Kozhikode &
Dept of Women and Child Development Kozhikode
ONLINE AWARENESS CLASS FOR ANGANWADI WORKERS
10th Sep 2021 , Friday
3:00 pm
Speaker
Dr Suresh Kumar EK
Senior Consultant Pediatrician
Aster MIMS Calicut
zoom meeting
Meeting ID: 333 678 2020
Password: IAPCALICUT
Mohandas Nair K
Dr Ajay V
Dr Rahul Illaparamb
YouTube
Pushpa Pk
Shylaja. Nk
കുട്ടികളിലെ ആസ്തമ - ഇൻഹേലർ തെറാപ്പിയുടെ പ്രാധാന്യം !
ഡോ. സുരേഷ്കുമാർ ഇ കെ
ആസ്റ്റർ മിംസ്


TP Jayaraman
Dr Sindhu TG
Praveen KS

# IAP Kerala

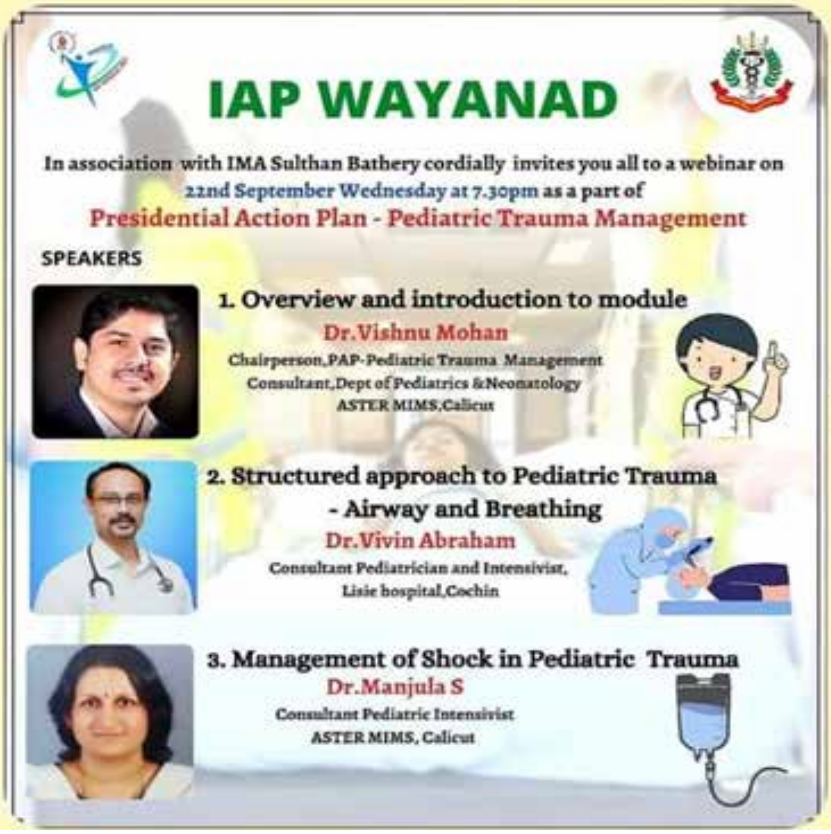

Ped Heart '21
Ped Heart '21
Ped Heart '21
Ped Heart '21
Ped Heart '21
Ped Heart '21


Department of Clinical
Nutrition and Dietetics
September
Nutrition Month
പോഷക ആഹാരമാസാചരണം സമാപനവും
എക്സിബിഷനും
വടകര സഹകരണ ആശുപത്രിയിൽ
Association with IAP Vadakara


മാതൃകാ പ്ലേറ്റ്

# IAP Kerala


Sreechand
PAEDIATRIC CRITICAL CARE NURSING WORKSHOP INAUGURAL CEREMONY


IAP WAYANAD
In association with IMA Sulthan Bathery cordially invites you all to a webinar on
22nd September Wednesday at 7.30pm as a part of
Presidential Action Plan - Pediatric Trauma Management
SPEAKERS
1. Overview and introduction to module
Dr.Vishnu Mohan
Chairperson,PAP-Pediatric Trauma Management
Consultant,Dept of Pediatrics &Neonatology
ASTER MIMS,Calicut
2. Structured approach to Pediatric Trauma
- Airway and Breathing
Dr.Vivin Abraham
Consultant Pediatrician and Intensivist,
Lisie hospital,Cochin
3. Management of Shock in Pediatric Trauma
Dr.Manjula S
Consultant Pediatric Intensivist
ASTER MIMS, Calicut


JAYARAMAN THRIKKOVIL PISHARAM


Dr Johnny Sebastian

# IAP Kerala


IMA KASARAGOD
IAP KASARAGOD
IMA KASARAGOD
(Reg No KSR/CA/182/2020)
IAP KASARAGOD
(KSR/CA/592/2015)


കൗമാരക്കാരിൽ
വ്യായാമത്തിന്റെ
പ്രാധാന്യം
ദേശീയ പോഷകാഹാര വാരം 2021


ith Kumar K C