

REVIEW ARTICLE

Role of Ayurveda in the Management of Cerebral Palsy in the Children: A Critical Review

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ABSTRACT

Introduction: A group of conditions collectively known as cerebral palsy (CP) impact a person's mobility, balance, and postural stability. Children with CP are more likely to have a motor handicap. Every 1000 live births, it happens in 1.5–2.5 of them. When compared to infants born at term, the prevalence is noticeably higher in premature births.

Material and Methods: In this review, search engines such as PubMed, Ayush Research Portal, Dhara, and Scopus regarding Ayurvedic medicinal plants having Nootropic activity, Neuroprotective activity, and anticonvulsant activity were used.

Results: Different single Ayurvedic medicinal drugs were screened for having nootropic activity, neuroprotective activity, and anticonvulsant activity.

Discussion: These screened drugs may be used in the related conditions of CP, which in turn improves the quality of life in pediatric patients.

Conclusion: More intensive scientific review on CP is the need of the hour. The present review helps in day-to-day clinical practice.

1. INTRODUCTION

A group of conditions known as cerebral palsy (CP) impacts a person's mobility, balance, and posture. The most prevalent motor disability in children is CP. The word cerebral refers to brain-related matters. Palsy is a term used to describe muscle weakness or dysfunction. A person's inability to control their muscles due to improper brain development or damage to the growing brain is the cause of CP.^[1] Although it does not necessarily result in severe problems, CP is the primary cause of childhood disability in India. A person with severe CP may require lifetime care or specialized equipment, while someone with mild CP may not require any assistance or may have minor issues like trouble walking. Since the disorder is not progressive, it does not worsen with time, and in fact,

some symptoms may even alter as the kid ages.^[2] The most common cause of impairment in children is CP. 1.5–2.5 out of every 1000 live births experience it. Compared to babies born at term, the prevalence is noticeably higher in prematurely born newborns. CP is more likely to develop in infants born before 28-week gestation, with the risk increasing with decreasing gestational age. Low birth weight babies also have a higher prevalence. The highest risk group is newborns with very low birth weights (<1500 g), of which 5–15% experience CP. About 80% of cases of CP are caused by prenatal events, while 10% are caused by postnatal events.^[3]

1.1. Types^[4]

Based on where the brain injury occurred, there are many forms of CP.

- Ataxic CP: This type is caused by damage to the cerebellum, resulting in motor control and movement issues.
- Athetoid/dyskinetic CP: Caused by damage to the basal ganglia and/or cerebellum, this condition results in fluctuating muscle tone and involuntary movements.

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- Hypotonic CP: This rare type, also connected to cerebellum damage, is characterized by floppy muscles, excess flexibility, and poor mobility.
- Spastic CP: The most common type of CP, this is caused by damage to the motor cortex and characterized by tight muscles and jerking movements.
- Mixed CP: Multiple areas of brain damage can lead to patients having more than one type of CP.

1.2. Etiology^[3]

CP is brought on by abnormal brain development or injury to the developing or newborn brain. The brain damage that causes CP can happen during the prenatal, perinatal, or postnatal stages and is non-progressive (“static”). In many cases, the etiology of a single patient is complex.

1.3. Prenatal Causes

- Congenital brain malformations
- Intrauterine infections
- Intrauterine stroke
- Chromosomal abnormalities.

1.4. Perinatal Causes

- Hypoxic-ischemic insults
- Central nervous system (CNS) infections
- Stroke
- Kernicterus.

1.5. Postnatal Causes

- Accidental and non-accidental trauma
- CNS infections
- Stroke
- Anoxic insults.

One of the main risk factors for CP is premature birth. Premature birth complications that might result in CP include

- Periventricular leukomalacia
- Intraventricular hemorrhage
- Periventricular infarcts.

Other risk factors associated with CP are multiple gestation, intrauterine growth restriction, maternal substance abuse, pre-eclampsia, chorioamnionitis, abnormal placental pathology, meconium aspiration, perinatal hypoglycemia, and genetic susceptibility.

1.6. Related Conditions of CP^[5]

- Intellectual disability: Approximately 30–50% of individuals with CP have an intellectual disability.
- Seizures: Up to 50% of kids with CP experience one or more seizures. Children who suffer from both epilepsy and CP are more likely to be intellectually disabled.
- Developmental delays: Children with moderate-to-severe CP frequently experience delays in their growth and development. Smaller limbs and muscles are typically impacted by CP.
- Osteoarthritis and spinal deformities: CP is linked to kyphosis, lordosis, and scoliosis. Pain, a breakdown of joint cartilage, and an increase in bone mass (osteoporosis) can all be caused by pressure on and misalignment of the joints.
- Impaired vision: Many children with CP suffer from strabismus,

also known as “cross eyes,” which, if untreated, can impair vision and make it difficult to determine distance. Some kids with CP have trouble organizing and comprehending visual data. Some kids can be blind in one or both eyes, or they might have impaired eyesight.

- Hearing loss: Compared to the general population, those with CP are more likely to have impaired hearing. Certain children experience partial or whole loss of hearing, especially when their developing brains are not getting enough oxygen or are jaundiced.
- Speech and language disorders: Over 75% of individuals with CP experience speech and language disorders, which include issues forming words and speaking coherently.
- Excessive drooling: People with CP may drool excessively due to a lack of control over their tongue, lips, and throat muscles.
- Incontinence: Due to inadequate control of the bladder muscles, incontinence is a potential consequence of CP.
- Difficulty with perceptions and sensations: Some people with CP are painful or have trouble perceiving basic sensations like touch.
- Learning challenges: Children with CP may experience difficulties processing specific kinds of auditory and spatial information.
- Long-term diseases and infections: Adults with CP are more likely to experience pneumonia, heart problems, and lung disease.
- Contractures: In individuals with CP, the painful fixation of muscles into specific positions, known as contractures, can exacerbate muscle spasticity and joint abnormalities.
- Malnutrition: Many people with CP, especially babies, may find it challenging to obtain the right nourishment and acquire or maintain weight due to swallowing, sucking, or feeding issues.
- Dental issues: Due to inadequate dental hygiene, a large number of children with CP are at risk for cavities and gum disease.
- Inactivity: A lot of kids with CP are not able to engage in sports and other activities hard enough to build and keep up their strength and fitness. Adults with CP who are inactive frequently show worsening symptoms of their illness as well as worse general health and well-being.
- Bone health: People with CP have far decreased bone mineral density, which increases their risk of bone fractures.
- Psychological problems: Individuals with CP are more likely to experience anxiety, sadness, and social.

2. MATERIALS AND METHODS

An electronic search was done on PubMed, Ayush Research Portal, Dhara, and Scopus regarding Ayurvedic Medicinal plants having Nootropic activity, Neuroprotective activity, Anticonvulsant activity. A collected data were analyzed. Keywords used for database analysis were “Ayurveda,” with combined terminologies of “Nootropic activity,” “Neuroprotective activity,” “Anti convulsant activity,” and other specific Latin or Sanskrit names of Ayurvedic drugs.

3. RESULTS

3.1. Drugs Showing Nootropic Activity

- (i) *Brahmi* (*Bacopa monnieri* [L.] Wettst.)

The “Working Memory” element, and more specifically the accuracy of spatial working memory, is greatly enhanced by *B. monnieri*. After the treatment period, there were fewer false-positive results in the Rapid Visual Information Processing Task for the *B. monnieri* group. The results of the study confirm the claims that taking a 90-day dose of *B. monnieri* extract can improve cognitive function in healthy individuals.^[6]

Even in young, healthy people, *B. monnieri* appears to have some acutely improving benefits on cognitive functioning (a true nootropic effect). The acute neurocognitive features of Brahmi may be better understood by combining more temporally sensitive brain activity measures with fewer memory-specific cognitive tasks.^[7]

In addition, there were some impacts on mood and a decrease in cortisol levels, suggesting a physiological mechanism through which consuming *B. monnieri* reduces stress. It was determined that acute supplementation with *B. monnieri* has some adaptogenic and nootropic effects.^[8]

(ii) *Manduka parni* (*Centella asiatica* [L.] Urban)

C. asiatica at varying concentrations enhances neurite outgrowth. The effects of *C. asiatica* commenced immediately after cell seeding, as indicated by its accelerating effect on neuronal differentiation. Subsequently, *C. asiatica* significantly elaborated dendritic and axonal morphology and facilitated synapse formation. Asiatic acid also facilitated neurite outgrowth but to a lesser extent than *C. asiatica*. These findings revealed that *C. asiatica* exerted its modulatory effects in every stage of neuronal development, supporting its previously claimed neurotrophic function and suggesting that this natural nootropic and its active component asiatic acid.^[9]

Animal performance was slightly affected by the *C. asiatica* water extract, but overall performance was improved. In addition, it enhanced the expression of genes related to antioxidant response and mitochondria in the liver and brain of both young and old mice. The frontal cortex and hippocampal regions likewise showed elevated expression of synaptic markers, but not in the cerebellum. The alterations in gene expression may have an impact on mitochondrial biogenesis, which may enhance cognitive function when combined with the activation of antioxidant response genes.^[10]

The hippocampal acetylcholine esterase activity was elevated by *C. asiatica*. At 1 month and 6 months, there was an increase in the dendritic arborization of hippocampal CA3 neurons in terms of intersections and branching points. It demonstrates that giving *C. asiatica* extract to mice throughout their postnatal developmental stage can affect the shape of their neurons and encourage improved brain function in their juvenile and young adult brains.^[11]

(iii) *Ashwagandha* (*Withania somnifera* [L.] Dunal)

In healthy young adults, acute supplementation with 400 mg of ashwagandha root and leaf extract enhanced certain executive function measures, supported attention retention, and increased short-term/working memory.^[12]

In addition to boosting executive function, attention span, and information processing speed, ashwagandha is also useful for augmenting both immediate and general memory in individuals with MCI.^[13]

(iv) *Shatawari* (*Asparagus racemosus* Willd.)

Well known as an Ayurvedic rasayana, *A. racemosus* has been used historically to treat neurological diseases and delay aging. Its ethanol root extract has been shown in a trial to help with learning and memory problems. The mechanisms underlying a neuroprotective property involve upregulating the estrogen receptor (ER) and brain-derived neurotrophic factor (BDNF)^[14]

(v) *Shankhpuspi* (*Convolvulus pluricaulis* Choisy)

Memory was found to be enhanced in a dose-dependent manner when *C. pluricaulis* was used. During retention experiments, the injection of

C. pluricaulis extract showed a substantial reduction in latency time. Treatment with *C. pluricaulis* resulted in a dose-dependent increase in AChE activity in the CA3 area of the hippocampal areas linked to learning and memory functions. The antioxidant, neuroprotective, and cholinergic qualities of *C. pluricaulis* may be the fundamental mechanism behind these effects.^[15]

3.2. Drugs Showing Anticonvulsant Activity

(i) *Jatamansi* (*Nardostachys jatamansi* [D. Don] DC.)

A considerable rise in the seizure threshold against the maximal electroshock seizure (MES) model was exhibited by an ethanol extract of the roots of *N. jatamansi* DC. (Valerianaceae), as evidenced by a decrease in the extension/flexion (E/F) ratio. At doses that raised the seizure threshold, the root extract of *N. jatamansi* likewise showed little neurotoxicity in the rotarod test.^[16]

(ii) *Nirgundi* (*Vitex negundo* L.)

Standard medications have not been proven to be equally effective with *Vitex negundo*'s anticonvulsant efficacy. These results imply that *Vitex negundo* has anticonvulsant properties, especially when it comes to convulsions brought on by PTZ. Furthermore, *Vitex negundo*'s potentiation of valproic acid and diphenylhydantoin suggests that it might be helpful as an adjuvant therapy in addition to conventional anticonvulsants and may be able to reduce the need for diphenylhydantoin and valproic acid.^[17]

(iii) *Shankhpuspi* (*C. pluricaulis* Choisy)

Methanolic extract of *C. pluricaulis* was evaluated for anticonvulsant activity and experimental results have shown that *C. pluricaulis* did not abolish the hind limb extension but reduced the mean recovery time from convulsion.^[18]

4. DISCUSSION

Being an old traditional science, Ayurveda is able to manage most of new emerging clinical conditions in a better manner; the only need is to decode that science. All basic fundamental principles are referenced very well in Classical texts, the need is to crack idea where to use which one. In this review, effort has been made to screen the Ayurvedic medicinal plants that can be used to treat the related conditions of CP such as intellectual disability, seizures, and speech and language disorders. Panchkarma is also very useful to relieve muscle stiffness, contractures, etc. The present review is about the drugs having nootropic, neuroprotective, and anticonvulsant activity. The screened single drugs may be used to deal with the related conditions of CP which in turn improve quality of life in pediatric patients.

5. CONCLUSION

CP is a chronic motor disability influencing a significant pediatric population and costing to a great extent on country's GDP. Different clinical studies show that Ayurveda through its treasure of natural herbal medications, panchakarma, and yoga can oversee various type of CP along with its related condition. The present review helps in day-to-day clinical practice. More intensive scientific review on CP is the need of the time.

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7. AUTHORS' CONTRIBUTIONS

All the authors contributed equally in the design and execution of the article.

8. FUNDING

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9. ETHICAL APPROVALS

This study is not required ethical clearance as it is a review study.

10. CONFLICTS OF INTEREST

Nil.

11. DATA AVAILABILITY

This is an original manuscript and all data are available for only review purposes from principal investigators.

12. PUBLISHERS NOTE

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