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A CRITICAL APPRAISAL OF VARIOUS AYURVEDIC TREATMENT MODALITIES IN THE MANAGEMENT OF CEREBRAL PALSY IN CHILDREN

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ABSTRACT

Cerebral palsy is the most common motor disabilitating disease affecting a vast population (paediatric) worldwide. Children affected with cerebral palsy presents with motor deficits and developmental delay and may have one or more associated problems like seizures, mental retardation, feeding difficulties along with hearing and ophthalmologic impairments. Presently, there is no specific treatment for brain injury that causes motor dysfunction such as cerebral palsy in the conventional system. Most of the existing treatment options are symptomatic and rank cerebral palsy among the most expensive chronic childhood diseases. Ayurveda recommends a variety of treatment options for cerebral palsy. Among these treatment options, Panchakarma therapy, medicinal herbs and yoga are the most acclaimed. This article reviews various clinical and experimental studies to determine the efficacy of these methods and finds that Ayurveda can effectively manage cerebral palsy and related conditions.

Keywords: Cerebral palsy, Ayurveda, Herbs, Panchakarma, Yoga.

INTRODUCTION

In fact, cerebral palsy is a clinical manifestation of various lesions of the cerebral or subcortical cortex that occur in the first year of life characterized by movement disorders caused by non-progressive damage to the developing brain [1]. The rate of incidence in India it is 2-4/1000 live births[2] while the global rate is 2-2.5/1000 live births. [3]

Amongst cerebral palsy, Spastic cerebral palsy is the most common type, accounting for 75% of cases[4]. Children with cerebral palsy usually have dyskinesias and developmental delays. The motor deficits of cerebral palsy include positive phenomena such as rigidity, spasms, clonus and spasticity as well as negative phenomena such as fatigue, weakness and incoordination. There is currently no specific treatment for these brain injuries that cause motor dysfunction such as cerebral palsy in the conventional system. Available symptomatic treatment options rank cerebral palsy as the most expensive chronic disease in childhood[5].

Injury leading to neuronal loss can be:

1. Basal ganglia (extrapyramidal), which produces abnormal movements, such as choreoathetosis,
2. Cortex (pyramid), which produces spasticity,
3. Cerebellum, which produces hypotonia,
4. Mixed.

Therefore, parents and families are always looking for better, cheaper and more effective alternative treatment options. In a survey, complementary and alternative therapies received great attention from families of children with cerebral palsy, with a prevalence of 56%, of which massage therapy was the most accepted. Children with cerebral palsy who have quadriplegia and spasticity and who cannot walk independently use alternative medicine services more frequently[6]. Ayurveda, the holistic science of life, provides many ways to solve this question, among which the use of panchakarma therapy, medicinal herbs and yoga are beneficial.

According to the Ayurvedic text, cerebral palsy cannot be correlated with a single disease or complex of symptoms. But according to the pathogenesis, classification and clinical features, it can be compared with vata vyadhi or, more accurately, with shiromarma abhighataja vata vikara, because it is caused by injury to the developing brain. It can include pakshaghat, ekangvata, sarvagavata, pangu, etc. According to Ayurveda, the cause involves prenatal or birth factors, which may be unsuitable Ritu, Kshetra, Ambu and Bija[7], Dauhrida avamanana[8] (nonfulfilment the desire during pregnancy), non-compatible garbhavriddhikarabhava[9] (factors responsible for growth of the fetus) and presence of garbhopaghatakarabhava[10] (factors harmful to the fetus).

All of these factors can lead to poor fetal development and can lead to various abnormalities, such as cerebral palsy. Since the pathogenesis points to the involvement of vata dosha and mastishka, hence, vata shamak drugs and therapies and medhya drugs (memory enhancing drugs) and are the main treatment stays. Therefore, drugs with nootropic, antispasm, neuroprotective, muscle relaxation, nerve regeneration, and anticonvulsant properties are used to treat the clinical features and related disorders of cerebral palsy.

Ayurvedic herbs in simple or compound form have all of these properties. Therefore, the use of a single herb or herbal compound can provide cerebral palsy patients with all the necessary properties, as well as various Panchakarma and yoga therapies

that are most effective in improving motor deficits found in cerebral palsy. This article focuses on these evidence-based approaches.

PANCHAKARMA THERAPIES

Shastik shali pinda sweda (SSPS)

Shashtika shali pinda sweda is a type of swedan (fomentation), made from boiled Shashtika shali (a variety of rice) and Balamoola kwatha (a decoction of Sida cordifolia Linn) and milk.

A clinical study of 16 patients was conducted in 8 patients in both the group: group A (external Shashtika Shali Pinda Sweda and internal Samvardhana Ghrita) and group B (internal Samvardhana Ghrita) for 35 days. Samvardhana ghrita contains the drug Khadira (*Acacia catechu* Wild.), Prishniparni (*Pseudarthria viscida* Desv), Syandana (*Ogenia dalbergiodes* Benth), Atibala (*Abutilon indicum* Linn.), Kebuka (*Costus speciosus* Smith.), Saindhava lavana (sodium chloride), Milk (Kshira), Ghrita (ghee). Group A showed better results in improving motor system skills, Improved muscle strength and reduced hypertonia and tendon reflexes. This shows a more beneficial result of the shashtika shali pinda sweda in the motor skills improvement as major do occur in the motor system in the patients suffering from cerebral palsy. Group A observed more prominent results in the improvement of motor system components, and resulted in a more effective combination therapy[11].

Salavana Upnaha Sweda

A case report was conducted to assess the efficacy of Salavana upnaha sweda in spasticity of cerebral palsy in a 2 years 6 months old boy. 3 sittings of salavana sweda was conducted 15 days each with a gap of 15 days (total 90 days). In every sitting Abhyanga was done with Bala-ashwagandhadi taila was given daily before Salavana sweda for 15 days. The spasticity was grade 1+ before treatment ans came down to 1 after the treatment (modified Ashworth spasticity scale was used). The muscle power was also increased from grade 1 to 2[12].

Matra Basti

Matra basti is a subtype of Anuvasana basti that is discussed in panchakarma therapy, in which oil or ghee is administered in small amounts through the rectal route. In a clinical study, the effects of Samvardhana ghrita were evaluated orally and rectally. 40 children with cerebral palsy were randomly divided into 2 groups, each containing 20 cases. Group A (Samvardhana ghrita, orally) was treated with 5 grams of Samvardhana ghrita twice daily for 48 days with honey as anupana. In group B (Samvardhana ghrita, matra basti), Samvardhana ghrita in dose of 20 ml for 48 days was administered via basti. In this study, both routes of administration of showed promising results in the treatment of cerebral palsy. The basti group showed better improvements in fine and gross motor development and the oral route has been found to be more effective in language and performance[13].

Chaturbhadra Kalpa Basti

In a case study done on a 3 years old boy, yoga basti was found effective in case of cerebral palsy. Total duration of treatment was 94 days as – udvardana with horse gram and barley powder for 20 minutes (5 days) then Abhyanga with balataila for 20 minutes followed by Swedana for 20 minutes (5 days) and then Chaturbhadra Kalpa Basti for next 12 days containing 4 sneha Basti initially then 1 Asthapana Basti (120 ml, Madhutailika basti) and lastly 4 Anuvasana Basti (30 ml, Balataila). 3 cycles of the treatment protocol was done in between period for discontinuation was 14 days. Ashtanga ghrita was also given orally (not during the days of Basti) in a dose of 2.5 ml once a day. Overall improvement was observed in spasticity scale, Ashwarth scale, Elbow flexion and knee flexion[14].

Multiple therapies

In a clinical trial conducted on the cerebral palsy, to assess efficacy of various Panchakarma procedures such as Udvartana (herbal powder massage) (5 days), Abhyanga (therapeutic oil massage) and Sarvanga Swedana (whole body sudation therapy) (5 days) followed by YogaBasti (classical therapeutic enema regimen) (8 days). The regimen was repeated for 3 times with the time gap of 14 days. The procedure was done on 8 patients in total. For internal medication Ashtanga ghrita was used. The Udvartana was done using lukewarm Kullattha and Yava churna for 20 minutes. Abhyanaga was performed by lukewarm Bala taila for 20 minutes followed by Sarvanga Nadi Sweda for 20 minutes. In Yoga Basti, Anuvasana Basti (oil enema therapy) was given by Bala Taila and Asthapana Basti (decoction enema therpay) was given as Madhutailika Basti. It shows a significant result in limb spasticity[15].

In a clinical study of cerebral palsy, the efficacy of various Panchakarma procedures such as shirodhara, shashtika shali pinda sweda, abhaynga (massage), pizichil was evaluated. studies were conducted in 60 patients, divided into two groups with 30 patients in each group. of the 30 patients in the test group were selected for Ayurvedic treatment. 30 patients were randomly selected patients for physiotherapy. The Ayurveda treatment program consists of three treatment rounds, each 45-day round, two months apart and of 6-month follow-up. Ayurvedic therapy consists of internal medicines in the form of Decoction of *Bacopa monnieri* Linn., *Glycyrrhiza glabra* Linn. and *Centella asiatica* Linn. Twice a day, 60 ml each time, *Withania somnifera* Linn. Dunal and *Acorus calamus* Linn. ¼ teaspoon powder with anupana of honey, and Mahadalu and Chandrakalka 250 mg twice a day (with honey). Abhaynga and Naryana oil were administered externally for 2 weeks, followed by shirodhara from the same oil for a week. Then use of same oil for 1 week of pizichil, and finally use shastik shali panda sweda for 2 weeks. The efficacy of each therapy is evaluated using the Gross Motor Functional Classification System. Studies have shown that Ayurvedic treatment is more effective than physiotherapy in treating cerebral palsy[16].

AYURVEDIC HERBS

Nootropic Activity

In a study, 50, 100 and 200 mg/kg of Ashwagandha (*Withania somnifera* (L.) Dunal) were used in mice treated chronically with electroconvulsive shock (ECS) for 6 days. The results showed significant improves in memory consolidation. Ashwagandha on the 7th day also reduced the impaired memory consolidation caused by chronic ECS treatment. In the elevated maze, L. Dunal reversed the scopolamine-induced delay on transfer latency (0.3 mg/kg) on day 1. Based on the findings of, it is recommended that L. Dunal has nootropic effects on naive and forgetful mice[17].

An independent group design double-blind placebo-controlled clinical study was conducted to evaluate the cognitive enhancement effects of Brahmi (*Bacopa monniera* Linn.) extract among 107 healthy participants for a period of 90 days. 62 participants completed the study, and compliance with treatment was 80%. Cognitive Drug Research Cognitive Evaluation System

was used for Neuropsychological testing, it was performed at the beginning of and after 90 days of treatment with a special *Bacopa monnieri* extract (150 mg × 2 Keen Mind) or placebo. *Bacopa monniera* Linn product significantly improves the performance of the "working memory" factor, more specifically the accuracy of spatial working memory[18]. Mandukaparni (*Centella asiatica*) in a Double-blind test results showed that children with mental retardation had a significant increase in general intelligence after 3 and 6 months of administration of Mandukaparni. In terms of behaviour, 6 months later, it was found that general adjustment and attention were significantly improved, and concentration was significantly improved[19].

In an experimental study, ethanol extract from *Pueraria lobata* root evaluated the nootropic and memory enhancing properties of Shankhpushpi (*Evolvulus alsinoids* Linn) and its ethyl acetate and aqueous components. Two doses (100 and 200 mg / kg p.o.) of ethanol extract and ethyl acetate and aqueous solution were administered to different groups of animals. All drug extracts at both doses significantly improved learning and memory in rats. Furthermore, these doses of significantly reversed the amnesia caused by scopolamine (0.3 mg / kg i.p.). Piracetam was used as a standard to compare nootropic activity[20].

Elevation Maze (EPM) was used to evaluate the nootropic effects of Vidarikanda (*Pueraria lobata* DC) water and alcohol extracts. A significant inversion of rectal temperature was observed in the CIH model and head twitches was reduced in the LIH model. The results showed that by improving the transmission of norepinephrine (NA) or by interfering with the release of 5-hydroxytryptamine (5HT).

The nootropic effects of plant ingredients such as flavonoids, which are reported found in alcohol and water extracts from the root tubers of vidarikanda. These active ingredients may be responsible for the nootropic activity[21].

A study showed that Mandukaparni (*Centella asiatica*) was used for treatment during the postpartum developmental stage, Mandukaparni extract can affect the morphology of neurons and promote advanced brain functions in young and young adult mice[22].

Antispasticity Activity

In another study, Vidarikanda (*Pueraria lobata* DC.) isoflavones and their active metabolites in mice were studied for their muscle relaxation activity. Mesopalmol and dantrolene sodium were used as positive controls. Each test compound at a low dose of (50 mg/kg i.p.) did not have muscle relaxant activity. However, reductive metabolite of daidzein, daidzein and genistein which is equol, when given in high doses (100 mg/kg, ip) had significant muscle relaxant result at 15, 30, and 45 minutes after administration. Effective muscle relaxation activity was observed in vivo using's degraded genistein metabolite p-ethylphenol (100 mg/kg, i.p.)[23].

In a standardized study, the water and hydroalcoholic extracts of species of Bhringraja (*Eclipta alba* (L.) Hassk.) were evaluated for phytochemistry. Bhringraja is assessed for muscle relaxation, sedation, nootropic, anti-anxiety and antistress activities. The results of show that it has nootropic and stress-reducing properties, which are caused by induced changes[24].

Anticonvulsant Activity

The methanolic extracts of leaf callus, stam callus and whole plant of Shankhapushpi (*Convolvulus pluricaulis* Chois) in animal (200 mg/kg orally) showed resistance to the onset of tonic convulsions induced by transcorneal electric shock, the effect was also comparable with the standard drug phenytoin[25].

Tagar (*Valeriana wallichii*) has the highest anticonvulsant activity as shown in maximal electroshock seizures after intraperitoneal administration in mice, such as, the duration of the hind limb extensor tonic phase is reduced and potency increases in dose-dependent manner (450 mg / kg, 900 mg / kg)[26].

The anticonvulsant activity and neurotoxicity of Jatamansi (*Nardostachys jatamansi* DC) alone and with combination of phenytoin was studied in rat model. The results showed that the root extract of jatamansi significantly increased the epilepsy threshold compared to the maximal electroshock seizure (MES) model, as shown by, the extension/flexion (E/F) ratio decreased. In the rotarod test jatamansi root extract also showed minimal neurotoxicity at a dose that increased the seizure threshold of. In addition, pretreatment of rats with phenytoin at a dose of 12.5, 25, 50, and 75 mg/kg along with jatamansi root extract 50 mg/kg resulted in improvement in the protection index (PI) of phenytoin from 3.63 to 13.18. The single dose response study of the combination of phenytoin and with jasmine extract on phenytoin serum levels clearly demonstrated the synergistic effect of the two drugs[27].

Ashvath extract (*Ficus religious* Linn.) showed no toxicity, improved pentobarbital-induced sleep, and inhibited seizures induced by picrotoxin and MES in a dose-dependent manner. On comparing the anticonvulsant effect of the extract of Ashvath is comparable to most clinically used antiepileptic drugs (diazepam and phenytoin)[28].

Thymoquinone is the main component of Kalajaji (*Nigella sativa* Linn.) Seed, which is a traditional drug said to be helpful for seizures. A study on the anticonvulsant effect of thymoquinone using maximum electric shocks and pentylenetetrazole (PTZ) induced seizures found that doses of 40 mg / kg and 80 mg / kg can reduce the duration of myoclonus seizures and prolong the duration of seizures when treated with PTZ[29].

In the traditional medical system, the rhizome and root of Yasthimadhu (*Glycyrrhiza glabra* Linn.) has been used for centuries. One study reported on the anticonvulsant effects of ethanol extracts from its rhizome and root. Extract significantly and dose-dependently delayed the occurrence of PTZ-induced clonic seizures. In addition, the dose of 100 mg / kg provides protection for all animals[30].

Brahmi Ghrita (100, 300, 500 and 750 mg / kg, oral) is an Ayurvedic composition containing Brahmi (*Bacopa monnieri*) (8 g), Vacha (*Acorus calamus* Linn.*)* (4 g), Shankhpushpi (*Evolvulus alsinoids* Linn.) (4 g), Kustha (*Saussurea lappa* C. B. Clarke) (4 g) Cow's ghee (80 g), evaluated for anticonvulsant activity by administration of brahmi ghrita 60 minutes before pentylenetetrazole or maximum electroshock. Four groups of mice (n = 5) received oral brahmi ghrita (100, 300, and 500 mg / kg) or vehicle, and the rotarod device was used to assess the effect on motor coordination. BG inhibits the PTZ-induced and MES seizures in a dose-dependent manner. This may also indicate that the anticonvulsant effect of the preparation is mediated by the chloride channel of the GABA / benzodiazepine receptor complex[31].

Neuro-Regenerative Activity

In the study of Mandukaparni (*Centella asiatica* Linn.*)* ethanol extract (100 μg mL^{-1}) in the presence of nerve growth factor

(NGF) caused a significant increase in the growth of neurite in human SH-SY5Y cells, while its aqueous extract found ineffective at a similar dose. In the presence of NGF, the neurite elongation of the sub-fraction of *Centella asiatica* ethanol extract obtained by silica gel (100 µg mL^{-1}) chromatography was tested. The highest activity was found in with a non-polar part (GKF4).

Male SpragueDawley rats received ethanol extract of Mandukaparni (300-330 mg / kg / day) in drinking water and showed faster functional recovery and increased axon regeneration(larger diameter axons and a greater number of axons are myelinated) compared with the control, indicating that axons grow faster. In summary, the research results show that there are components in Mandukaparni ethanol extract can be used to accelerate the repair of damaged neurons[32].

In one trial, 6 of the 18 compounds which were isolated from methanolic extract of Ashwagandha were found to increase the growth of neurite in human neuroblastoma SHSY5Y cells. In cells treated with Withanolide A, the length of the NFH positive bumps was significantly increased compared to the carrier treated cells, while the length of the MAP2 positive bump increased with Withanosides IV and VI. These results indicate that the axons extend mainly through Withanolide A, and the dendrites extend mainly through Withanosides IV and VI[33].

Neuroprotective Activity

In one study, the neuroprotective effect of the root extract of Shatavari (*Asparagus racemosa* Willd) was studied in clinical patients and animal models. Mice were subjected to unpredictable swimming pressure for 3 hours per day for up to 30 days to develop specific regional neurodegeneration. Shatavari root extract was taken orally at a dose of 100 mg / kg body weight in a separate group of animals daily for a maximum of 30 days. Performance of histological and behavioral studies was done. Male and female patients enrolled in the clinical study, received memory retention and recall tests. The results show that has neuroprotective effects[34].

In another study on Asian acid derivatives of Mandukaparni (*Centella asiatica* Linn.) proved to be effective, which can effectively protect neurons from oxidative damage caused by exposure to excess glutamate, as they exert significant neuroprotection on cultured cortical cells through the effect of the defense mechanism improved cellular oxidative[35].

Yoga

In a case study, a 9-year-old female baby with cerebral palsy (diplegic) received physical therapy for six weeks due to balance, flexibility and strength, and functional limitations (for example, difficulty dressing, difficulty walking up and down stairs). Children provide yoga plans to solve these flaws. The patient showed improvement in balance, flexibility, strength, and functional mobility[36].

DISCUSSION

Cerebral palsy is a sequel to a brain injury and a growing body. Evidence shows that the brain can recover after injury due to the ability of neurons and other brain cells to change their structure and function (plasticity) in response to internal and external pressures[37].

Therefore, medicines with neuroprotective, nerve regenerative and nootropic action can form a microenvironment in the brain for brain plasticity. A review of several clinical and experimental studies shows that the Ayurvedic herbs do have many of these properties in a single herb.

Ashwagandha (*Withania somnifera* (L.) Dunal) is a good nootropic agent and also promotes nerve regeneration. This herb is famous for its rejuvenating properties[38].

Brahmi (*Bacopa monniera* Linn.) is a wonderful nerve tonic with nourishing and memory enhancing properties. Shatavari (*A.Racemosus* Willd) has good neuroprotective properties. Mandookparni (*Centella asiatica* Linn.) is nootropic, nerve regenerative and neuroprotective action. It has been found that it can improve the general mental capacity, concentration and attention of children with intellectual disabilities. These properties are essential for the treatment of all types of cerebral palsy, especially those related to poor cognitive function and mental retardation.

Vidarikanda (*P. Tuberose* DC.) is a balya drug is, which is found to have muscle relaxant and nootropic activity. Another drug with muscle relaxation activity is Bhringraja (*Eclipta alba* Hassk), which is also a very good hepatoprotective and immunomodulatory drug[39].

Both drugs can be used for spastic cerebral palsy, and they can also be used to treat related conditions, such as recurrent chest infections. Shankhpushpi (*Convolvulus pluricaulis* Chois) is another drug with good nootropic and anticonvulsant properties.

Other commonly used anticonvulsants are *V. wallichii, Glycyrrhiza glabra* Linn*, N. jatamansi* DC*, Nigella sativa* Linn*., Ficus religion* Linn and Brahmi ghrita. These drugs are commonly used for epilepsy, so they can also be used for cerebral palsy associated with seizures. Several Panchakarma procedures have been shown to be beneficial for cerebral palsy motor dysfunction. The main procedures are Abhaynga (massage), Matra basti, Shashtika shali panda sweda (sweat with specific rice), Pizichil and Shirodhara. These procedures should be done every day for at least 2 weeks and 1-2 weeks after to be repeated for three to six months for best results, as is in the clinical study reviewed.

Procedures in particular Abhyanga, Shashtika shali pinda sweda and Pizichil are known to normalize muscle tension and in beneficial in the spastic cerebral palsy. Massage therapy promotes blood circulation in the muscles, increases the flow of nutrients and removes junk products on. Massage may involve parasympathetic nerve activity and a relaxed physiological state[40]. Shirodhara is helpful in chorioathetoid cerebral palsy as it reduces involuntary movements and calms the mind. Matrabasti provides nutrition to the entire body, including muscles, so can be used for the weakness and fatigue associated with different types of cerebral palsy. Various yoga exercises help prevent contracture and ataxia of spastic cerebral palsy, coordination of cerebral palsy and balance muscle tension of hypotonic and spastic cerebral palsy. Yoga for kids is linked to improving mood and function, and may be particularly beneficial for chronic musculoskeletal diseases[41]. Yoga is reportedly a beneficial physical activity that can be used for people with severe disabilities[42].

CONCLUSION

Cerebral palsy is a chronic movement disorder that affects a large number of pediatric populations of and greatly cost the family income of people. Several recent studies have shown that Ayurveda can treat different types of cerebral palsy and related conditions through its herbal treasure house, panchakarma therapy and yoga. Ayurveda can provide alternative, economical

and more effective treatment options for children affected by cerebral palsy. However, to establish it in the scientific world, double-blind clinical studies are needed.

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