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Review Article

CURRENT TRENDS IN AYURVEDIC MANAGEMENT OF CEREBRAL PALSY IN CHILDREN

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Abstract

Cerebral palsy is most common motor disability affecting a large paediatric population worldwide. Children affected with the disease presents with developmental delay and motor deficits and may have one or more associated problems like mental retardation, seizures, feeding difficulties along with ophthalmologic and hearing impairments. Currently there is no specific treatment in conventional system for the brain insults leading to motor dysfunction in cerebral palsy. The existing therapeutic options are mostly symptomatic and place cerebral palsy amid the costliest chronic childhood conditions. Ayurveda recommend multiple treatment options for cerebral palsy. Out of these treatment options herbal drugs, Panchakarma therapies and yoga are most acclaimed for this disease. This paper reviewed various clinical and experimental studies to ascertain efficacies of these modalities and found that Ayurveda can efficiently manage cerebral palsy along with its associated condition.

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

INTRODUCTION

In fact Cerebral palsy is a clinical presentation of a wide variety of cerebral cortical or sub-cortical insults occurring during the first year of life[1] which is characterized by a motor disorder resulting from a non-progressive insult to the developing brain. Its worldwide incidence is 2 to 2.5 per 1000 live births[2] while in India it is 2-4 per 1000 live birth.[3] Insults resulting in neuronal loss can be:

- Cortical (pyramidal), resulting in spasticity,
- Basal ganglia (extra pyramidal), resulting in abnormal movements such as choreoathetosis,
- Cerebellar, resulting in hypotonia,
- Mixed.

Spastic CP is the most common type accounting up to 75 % of cases.[4] Children with CP usually present with developmental delay and motor deficits. Motor deficits of CP include negative phenomena such as weakness, fatigue, in coordination and positive phenomena such as spasticity, clonus, rigidity and spasms. Currently there is no specific treatment in conventional system for these brain insults leading to motor dysfunction in cerebral palsy. The available symptomatic therapeutic options place cerebral palsy among the costliest chronic childhood conditions.[6]

Hence parents and families are always in search of better, economical and more effective alternative therapeutic options. In a survey complementary and alternative medical treatments are of great interest to families of children with CP with a usage prevalence of 56 %, among this massage therapy was most accepted. Children affected with quadriplegic CP with spasticity and those who could not walk independently are more commonly using services of alternative medicine.[7] Ayurveda, the holistic science of life offers multiple modalities for this problem, among them use of drugs, panchakarma therapies and yoga are beneficial. Cerebral palsy cannot be correlated to any single disease or symptom complex as per Ayurvedic texts. But on the basis of aetiopathogenesis, classification and clinical features it can be compared to vata vyadhi or more precisely shiromarma abhighataja vata vikara as it is caused by an insult to the growing brain. It may include pakshaghat, ekangvata, sarvagavata, pangu etc. According to Ayurveda antenatal or natal factors are involved in its etiology which can be inappropriate Ritu, Kshetra, Ambu and Bija,[8] Dauhrida avamanana[9] (abandon of pregnancy craving), presence of garbhopaghatakarabhava[10] (factors injurious to fetus) and incompatible garbhavriddhikarabhava.[11]

All these factors cause improper growth of fetus and may result in various anomalies like CP. As the aetiopathogenesis points towards involvement of mastishka and vata dosha, so medhya drugs and vata eliminating drugs and therapies are main stay of treatment. Thus drugs which have anti spasticity, muscle relaxant, nootropic, neuroprotective, neuro-regeneration and anticonvulsant properties are being employed in cerebral palsy to manage clinical features and associated conditions. Ayurvedic herbal drugs in single or compound form have all these properties.

Thus with single herb or herbal compound all the properties needed can be provided to the patients of CP along with various Panchakarma therapies and yoga which are most effective to improve motor deficits found in CP. This paper focuses on these evidence based modalities.

MATERIAL AND METHOD

The review is taken from the articles searched through Google scholar by using the key words cerebral palsy, Ayurveda, panchakarma, anticonvulsant, nootropic, muscle relaxant, ashwagandha, bacopa and centella etc. All the related research articles, clinical and experimental studies from 1988 to till date were reviewed for the required properties and activities. The selected articles are grouped into single and compound herbal drug on their effects, panchakarma therapies and yoga which are discussed as:

Ayurvedic Herbs

Antispasticity Activity

In a study standardized and phytochemically evaluated aqueous and hydro alcoholic extracts of the plant *Eclipta alba* (L.) Hassk. (Bhringraja) were assessed for sedative, muscle relaxant, anxiolytic, nootropic and anti-stress activities. The results show it has nootropic as well as stress attenuating property resulting due to induced alterations.[12]

In another study *Pueraria tuberosa* DC. (Vidarikanda) isoflavanoids and their active metabolites were studied for muscle relaxant activity in mice. Methocarbamol and dantrolene sodium which were used as positive controls. A low dose (50 mg/kg i.p.) of each test compound had no muscle relaxant activity. However, a high dose (100 mg/kg, i.p.) of equol, the reductive metabolite of daidzin, daidzein and genistein had significant muscle relaxant activity at 15, 30 and 45 minutes after administration and its potency been moderate. Potent muscle relaxant activity was observed in vivo with p-ethylphenol (100 mg/kg, i.p.), the degraded metabolite of genistein.[13]

Nootropic Activity

A double-blind placebo-controlled independent group design clinical study was conducted to assess cognitive enhancing effects of the *Bacopa monniera* Linn. (Brahmi) extracts in healthy humans for a 90 day in 107 healthy participants. 62 participants completed the study with 80 % treatment compliance. Neuropsychological testing using the cognitive drug research cognitive assessment system was conducted at baseline and after 90 days of treatment with a special extract of *Bacopa monniera* Linn.(2 × 150 mg Keen Mind) or placebo. *Bacopa monniera* Linn product significantly improved performance on the 'working memory' factor more specifically spatial working memory accuracy.[14] The results of a double blind trial of *Centella asiatica* Linn. (Mandukaparni) indicated that there was a significant increase in the general mental ability of mentally retarded children after 3 months and 6 months of drug administration. In the behavioral area, significant improvement was found in the overall general adjustment and attention and concentration after 6 months.[15]

In a study 50,100 and 200 mg/kg orally root extract of *Withania somnifera* (L.) Dunal (Ashwagandha) was administered for 6 days in mice receiving chronic electroconvulsive shock (ECS) treatment and results showed significantly improved memory consolidation. *Withania somnifera* (L.) Dunal administered on day 7 also attenuated the disruption of memory consolidation produced by chronic treatment with ECS. On the elevated plus maze *Withania somnifera* (L.) Dunal reversed the scopolamine (0.3 mg/kg) induced delay in transfer latency on day 1. On the basis of these findings it is suggested that *Withania somnifera* (L.) Dunal exhibits a nootropic like effect in naive and amnesic mice.[16] Nootropic effect of alcoholic and aqueous extracts of *Pueraria tuberosa* DC (Vidarikanda) was evaluated by using elevated plus maze (EPM). A significant reversal effect was observed on rectal temperature in CIH model, reduction of head twitches in LIH models. The results indicate that nootropic activity observed with tuber extracts of *Pueraria tuberosa* DC could be through improved learning and memory either by augmenting the noradrenalin (NA) transmission or by interfering with 5-hydroxytryptamine (5-HT) release.

Phytoconstituents like flavonoids have been reported for their nootropic effect and these are present in both alcoholic and aqueous extracts of tubers of *Pueraria tuberosa* DC and these active principles may be responsible for nootropic activity.[17]

In an experimental study ethanolic extract of *Evolvulus alsinoides* Linn (Shankhpushpi) and its ethyl acetate and aqueous fractions were evaluated for their memory enhancing and nootropic properties. Two doses (100 and 200 mg/kg p.o.) of the ethanol extract and ethyl acetate and aqueous fractions were administered in separate groups of animals. Both doses of all the extracts of drug significantly improved learning and memory in rats. Furthermore, these doses significantly reversed the amnesia induced by scopolamine (0.3 mg/kg i.p.). Nootropic activity was compared using piracetam as the standard.[18]

A study indicates that treatment during postnatal developmental stage with *Centella asiatica* Linn. (Mandukaparni) extract can influence the neuronal morphology and promote the higher brain functions of juvenile and young adult mice.[19]

Neuroprotective Activity

In a study neuro-protective effects of the root extract of *Asparagus racemosus* Willd (Shatavari) were studied both in animal models and clinical patients. Mice were subjected to 3 h unpredictable swim stress daily up to 30 days to develop region specific neurodegeneration. Separate group of animals were given 100 mg/kg BW dose of *Asparagus racemosus* Willd (Shatavari) root extract daily up to 30 days, orally. Histological and behavioral studies were carried out. For clinical study registered patients both male and female were subjected to memory retention and recall test. Result proved its neuroprotective effects.[20]

Another study on derivatives of Asiatic acid from *Centella asiatica* Linn. (Mandukaparni) was proved to be efficacious in protecting neurons from the oxidative damage caused by exposure to excess glutamate due to exerting significant neuroprotective effects on cultured cortical cells by their potentiation of the cellular oxidative defence mechanism.[21]

Neuro-Regenerative Activity

In a study *Centella asiatica* Linn. (Mandukaparni) ethanolic extract (100 μg mL^{-1}) elicits a marked increase in neurite outgrowth in human SH-SY5Y cells in the presence of nerve growth factor (NGF) while its aqueous extract found ineffective in similar dose. Sub-fractions of *Centella* ethanolic extract, obtained through silica-gel chromatography were tested (100 μg mL^{-1}) for neurite elongation in the presence of NGF. Greatest activity was found with a non-polar fraction (GKF4).

Male Sprague-Dawley rats given *Centella* ethanolic extract in their drinking water (300–330 mg kg^{-1} daily) demonstrated

more rapid functional recovery and increased axonal regeneration (larger calibre axons and greater numbers of myelinated axons) compared with controls, indicating that the axons grew at a faster rate. Taken together, findings indicate that components in *Centella asiatica* Linn. (Mandukaparni) ethanolic extract may be useful for accelerating repair of damaged neurons.[22]

In a study it was found that six of the 18 compounds isolated from the methanol extract of Ashwagandha enhanced neurite outgrowth in human neuroblastoma SH-SY5Y cells. In Withanolide A – treated cells, the length of NF-H-positive processes was significantly increased compared with vehicle treated cells, whereas, the length of MAP2-positive processes was increased by Withanosides IV and VI. These results suggest that axons are predominantly extended by Withanolide A, and dendrites by Withanosides IV and VI.[23]

Anticonvulsant Activity

It was observed that the animals treated with the methanolic extracts of stem callus, leaf callus and whole plant (200 mg/kg oral) of *Convolvulus pluricaulis* Chois (Shankhpushpi) showed significant protection against tonic convulsion induced by transcorneal electroshock, which was also comparable with that of the standard drug phenytoin.[24]

Ethanol extract of the roots of *Nardostachys jatamansi* DC. (Jatamansi) was studied for its anticonvulsant activity and neurotoxicity alone and in combination with phenytoin in rats. The results demonstrated a significant increase in the seizure threshold by *Nardostachys jatamansi* root extract against maximal electroshock seizure (MES) model as indicated by a decrease in the extension/flexion (E/F) ratio. *Nardostachys jatamansi* DC root extract also showed minimal neurotoxicity against rotarod test at doses that increased the seizure threshold. Further, pre-treatment of rats with phenytoin at a dose of 12.5, 25, 50 and 75 mg/kg in combination with 50 mg/kg of *Nardostachys jatamansi* DC root extract resulted in a significant increase in the protective index (PI) of phenytoin from 3.63 to 13.18. The dose response studies of phenytoin alone and in combination with *Nardostachys jatamansi* DC extract on the serum levels of phenytoin clearly demonstrated the synergistic action of both the drugs.[25] *Valeriana wallichii* (Tagar) possess anticonvulsant activity in maximal electroshock seizures in mice after intraperitoneal administration as indicated by reduction in duration of tonic hind limb extensor phase with a dose dependant increase in potency (450 mg/kg, 900 mg/kg).[26]

Brahmi Ghrita an Ayurvedic compound containing *Bacopa monnieri* Linn. (Brahmi) (8 g), *Acorus calamus* Linn. (Vacha) (4 g), *Evolvulus alsinoids* Linn. (Shankhpushpi) (4 g), *Saussurea lappa* C. B. Clarke (Kustha) (4 g) and cow's ghee (80 g), was screened for anticonvulsant activity (100, 300, 500 and 750 mg/kg, orally) by administering it 60 minutes before pentylenetetrazole or maximum electroshock. Four groups of mice (n = 5) were fed orally with BG (100, 300 and 500 mg/kg) or vehicle and the effect on motor coordination was assessed using rotarod apparatus. BG inhibited MES and PTZ-induced convulsions in a dose-dependent manner. This may also suggest that the anticonvulsant action of the formulation is mediated by the chloride channel of the GABA / benzodiazepine receptor complex.[27] *Ficus religiosa* Linn. (Ashvath) extract showed no toxicity, potentiated pentobarbitone induced sleep and inhibited seizures induced by MES and picrotoxin in a dose dependent manner. Anticonvulsant effect of extract was comparable to clinically used antiepileptic drugs (phenytoin and diazepam).[28] Thymoquinone is major constituent of *Nigella sativa* Linn. (Kalajaji*)* seeds, a traditional medicine claimed to be useful in convulsions.

A study conducted for anticonvulsant effect of Thymoquinone using pentylenetetrazole (PTZ) and maximum electroshock induced seizures found that a dose of 40 mg/kg and 80 mg/kg prolong the onset of seizures and reduce the duration of myoclonic seizures induced by PTZ treatment.[29]

In the traditional system of medicine, roots and rhizomes of *Glycyrrhiza glabra* Linn. (Yesthimadhu) have been in use since centuries. A study reported anticonvulsant action of its ethanolic extract of roots and rhizomes. The extract significantly and dose dependently delayed the onset of clonic convulsions induced by PTZ. Moreover, the dose of 100 mg/kg offered protection to all animals.[30]

Yoga

In a case study of a nine-year-old female with diplegic CP who presented to physical therapy with deficits in balance, flexibility and strength as well as functional limitations such as difficulty in dressing, ascending and descending stairs was provided six week children's yoga program to address these deficits. The patient demonstrated improvement in balance, flexibility, strength and functional mobility.[31]

Panchakarma therapies

Shastik shali pinda sweda

Shashtika shali pinda sweda (SSPS) is the sudation performed by bolus of boiled Shashtika shali (a type of rice) with Balamoola kwatha (decoction of *Sida cordifolia* Linn.) and milk.

A clinical study was carried out in 16 patients, 8 in each group: group A (Shashtika Shali Pinda Sweda externally and Samvardhana Ghrita internally) and group B (Samvardhana Ghrita internally) for 35 days duration. Samvardhana ghrita contains drugs *Acacia catechu* Wild. (Khadira), *Pseudarthria viscida* Desv (Prishniparni), *Ougenia dalbergiodes* Benth (Syandana), *Abutilon indicum* Linn. (Atibala), *Costus speciosus* Smith. (Kebuka), Sodium chloride (Saindhava lavana), Kshira (Milk), Ghrita (Ghee). Group A showed better results in improving motor system skills by improving muscle power, and reducing hypertonia and tendon reflexes. This shows a comparatively more beneficial outcome of the SSPS procedure regarding improving motor system components. Major impairment of motor system is occurring in CP patients. More prominent outcome is observed in group A in improving the motor system components, thereby leading to a more effective protocol of combined treatment.[32]

Matra Basti

Matra basti is sub type of Anuvasana basti discussed under panchakarma therapy in which oil or ghee is given by rectal route in a small quantity.

In a clinical study effect of Samvardhana ghrita by oral and rectal route was assessed. 40 children suffering from cerebral palsy were included and randomly distributed in to two groups with 20 patients each. Group A (Samvardhana ghrita orally) was treated with 5 g of Samvardhana ghrita twice daily with honey as anupana for 48 days. In group B (Samvardhana ghrita as matra basti) 20 ml of Samvardhana

ghrita was administered through basti for 48 days. Both route of administration has shown promising results in cerebral palsy in this study. Oral route is found to be more effective in language and performance while basti group has shown better improvement in fine and gross motor development.[33]

Multiple therapies

In a clinical study on cerebral palsy multiple Panchakarma procedures like abhaynga (massage), shirodhara, pizichil, SSPS were evaluated for their efficacy. Study was conducted on sixty patients who were divided in to two groups, 30 patients in each group. The test group of 30 patients was selected for Ayurvedic treatment. 30 patients were randomly selected for physiotherapy treatments.

Ayurvedic treatment regimen was of three rounds of treatment of 45 days in each round with two months gap and six months follow up. Ayurvedic regimen consists of internal medication in the form of Decoction *Bacopa monnieri* Linn., *Centella asciatica* Linn., and *Glycyrrhiza glabra* Linn. 60 ml each twice a day, *Acorus calamus* Linn. and *Withania somnifera* Linn. *Dunal* powder ¼ tea spoon at night with bee honey and Mahadalu Anupana with Chandrakalka 250 mg twice a day with bee honey. Externally abhaynga with Naryana oil for 2 weeks followed by shirodhara by same oil for one week is given. Then one week of pizichil with same oil and in the end 2 weeks of shastik shali panda sweda. The efficacy of each therapy was evaluated by Gross Motor Function Classification System. The study pointed out that Ayurvedic treatment regimen is highly effective than physiotherapy treatment in the management of cerebral palsy.[34]

DISCUSSION

Cerebral palsy is a sequel of brain injury and a growing body of evidence demonstrates that the brain is capable of recovery after an injury because of the ability of neurons and other brain cells to alter their structure and function (plasticity) in response to external and internal pressures.[35]

Thus drugs with neuro-regenerative, neuro-protective and nootropic properties can make a micro environment in the brain for brain plasticity. Review of various clinical and experimental studies show that Ayurvedic herbal drugs are having many of these properties in single herbs. Ashwagandha (*Withania somnifera* (L.) Dunal) is a good nootropic agent and also promote neuro-regeneration. This herb is well known for its rejuvenating properties.[36] Brahmi (*Bacopa monniera* Linn.) the wonderful nervine tonic possess nootropic and memory enhancing properties. Shatavari (*A. racemosus* Willd) is having good neuro-protective properties. Mandookparni (*Centella asiatica* Linn.*)* is nootropic, neuro-regenerative and neuroprotective in action. It is found to increase the general mental ability, attention and concentration of mentally retarded children. These properties are essential in the treatment of all type of CP specially associated with poor cognitive functions and mental retardation. Vidarikanda (*P. tuberosa* DC.) a balya drug is found to have muscle relaxant and nootropic activity. Other drug with muscle relaxant activity is Bhringraja (*Eclipta alba* Hassk) which is also very good hepatoprotective and immunomodulatory drug.[37]

Both these drugs are useful in spastic type of cerebral palsy and are also useful for associated complaints like recurrent chest infections. Shankhpushpi (*Convolvulus pluricaulis* Chois) is another drug with good nootropic and anticonvulsant properties. Other anticonvulsant drug which are frequently used and also reviewed here are *V. wallichii, N. jatamansi* DC, *Glycyrrhiza glabra* Linn, *Ficus religiosa* Linn, *Nigella sativa* Linn. and Brahmi ghrita. These drugs are often used in epilepsy and are thus also useful in CP associated with seizures. Various Panchakarma procedures are shown to be beneficial in motor dysfunction of cerebral palsy. Main procedures are Abhaynga (massage), Shashtika shali panda sweda (sudation with specific rice), Shirodhara, Pizichil and Matra basti. These procedures should be performed daily for at least two weeks time and repeated after 7-14 days for three to six months for best results as shown in the clinical studies reviewed. The procedures especially SSPS, Abhyanga and Pizichil are known to normalize tone of muscles and are beneficial in spastic type of CP. Massage therapy improve circulation in the muscles, increase the flow of nutrients and eliminate waste products in the body. Massage likely involves parasympathetic activity and a relaxed physiologic state.[38] Shirodhara calms the mind and is helpful to reduce involuntary movements thus it is beneficial in chorioathetoid type of CP. Matra basti provides nutrition to whole body including muscles and thus may be used in weakness and fatigue associated with different types of CP. Various yogic exercises are helpful in avoiding contractures in spastic CP, coordination in athetoid and ataxic type of CP and balancing muscle tone in hypotonic as well as spastic type of cerebral palsy. Yoga in children is associated with improvements in mood and function, and may be especially beneficial for chronic musculoskeletal conditions.[39] Yoga has been reported as a beneficial physical activity available to individuals with severe disabilities.[40]

CONCLUSION

Cerebral palsy is a chronic motor disability affecting substantial paediatric population and costing largely on family earnings. Various recent studies show that Ayurveda through its treasure of herbal drugs, panchakarma therapies and yoga can manage different types of cerebral palsy along with its associated condition. Ayurveda can provide alternative, economical and more effective treatment option for children afflicted by cerebral palsy however more clinical double blind studies are required to establish it in scientific world.

REFERENCES

1. Shevell MI, Bodensteiner JB. Cerebral palsy: defining the problem. Semin Pediatr Neurol 2004; 11(1): 2-4. http://www.ncbi.nlm.nih.gov /pubmed/15132247 assessed on dated 25/09/2013 http://dx.doi.org /10.1016/j.spen.2004.01.001 PMid:15132247
2. Rosen MG, Dickinson JC. The incidence of cerebral palsy. Am J Obstet Gynecol 1992; 167(2): 417-23. http://www.ncbi.nlm.nih.gov /pubmed/1497045 assessed on dated 25/09/2013 http://dx.doi.org/ 10.1016/S0002-9378(11)91422-7
3. D Nagarajappa, Rana Laxmi. Home management of the child with cerebral palsy. Nursing journal of India 2003; 94(10): 234-6. http://www.i-md.com/docsearch/doc/16e9f10c-ae96-493d-8eca-107f17bc2026 assessed on dated 25/09/2013 PMid:15310095
4. Matthews D, Wilson P. Cerebral Palsy. In: Molnar G, Alexander M (eds). Pediatric Rehabilitation 3rd edition. Philadelphia: Hanley and Belfus, Inc; 1999. p. 193.218. http://www.scribd.com/doc/ 164659416/Cerebral-Palsy assessed on dated 25/09/2013
5. Mohammed MS. Jan Cerebral Palsy: Comprehensive Review and Update. Ann Saudi Med 2006; 26(2): 123-132 http://www.scribd.com /doc/115107842/11821-Cerebral-Palsy assessed on dated 25/09/2013
6. Papavasiliou AS. Management of motor problems in cerebral palsy: a critical update for the clinician. Eur J Paediatr Neurol 2009; 13(5): 387-

96. Epub 2008 Sep 7. http://www.ncbi.nlm.nih.gov/pubmed/18778959 assessed on dated 25/09/2013 http://dx.doi.org/10.1016/j.ejpn. 2008.07.009 PMid:18778959

7. Edward A Hurvitz, Christina Leonard, Rita Ayyangar, Virginia Simson Nelson. Complementary and alternative medicine use in families of children with cerebral palsy. Developmental Medicine and Child Neurology 2003; 45: 364–370. http://journals.cambridge.org/action/ displayAbstract 150305 assessed on dated 25/09/2013
8. Sushruta Samhita Sharira Sthan vol. 1 Chaukhamba Surabharati Prakashan. Varanasi; India, translated by Sharma Ananat Ram, verse No. 2/33; 2007. p. 21.
9. Charaka Samhita Sharira sthana, vol. 1 Chaukhambha Surabharati Prakashan, Varanasi, India, Commented by Tripathi BN. Verse No. 4/15; 1999. p. 881.
10. Charaka Samhita Sharira sthana, vol. 1 Chaukhambha Surabharati Prakashan, Varanasi, India, Commented by Tripathi BN. Verse No. 4/15, 4/18; 1999. p. 884.
11. Charaka Samhita Sharira sthana, vol. 1 Chaukhambha Surabharati Prakashan, Varanasi, India, Commented by Tripathi BN. Verse No. 4/15,4/28; 1999. p. 887.
12. Thakur VD and Mengi SA. Neuro pharmacological profile of *Eclipta alba* (L.) Hassk. (Linn.) Hassk Journal of Ethnopharmacol 2005; 102(1): 23-31. http://www.ncbi.nlm.nih.gov/pubmed/16054316 assessed on dated 25/09/2013
13. Takaaki Yasuda, Miwa Endo, Toshiyuki Kon No, Tomoko Kato, Mariko Mitsuzuka and Keisuke Ohsawa *et.al*. Antipyretic, Analgesic and Muscle Relaxant Activities of *Pueraria* Isoflavonoids and Their Metabolites from *Pueraria lobata* Ohwi—a Traditional Chinese Drug; Biol. Pharm. Bull. 2005; 28(7):1224-8. http://www.ncbi.nlm.nih.gov /pubmed/15997103 assessed on dated 25/09/2013 http://dx.doi.org/ 10.1248/bpb.28.1224 PMid:15997103
14. Con Stough, Luke A Downey, Jenny Lloyd, Beata Silber, Stephanie Redman. Chris Hutchison examining the nootropic effects of a special extract of *Bacopa monniera* Linn. on human cognitive functioning: 90 day double-blind placebo-controlled randomized trial. Phytother Research 2008; 22(12): 1629-34. http://www.ncbi.nlm.nih.gov/ pubmed/18683852 assessed on dated 25/09/2013 http://dx.doi.org/ 10.1002/ptr.2537 PMid:18683852
15. Late Rao Appa MVR, Kanchana Srinivasan, T Koteswara Rao. The effect of *Centella asiatica* on the general mental ability of mentally retarded children, Indian J. Psychiat 1977; 19(4): 54-59 http://www. globalresearchonline.net/journalcontents/.../Article%20003.pdf assessed on dated 25/09/2013
16. Dhuley JN. Nootropic like effect of Ashwagandha (*Withania somnifera* L) in mice. Phytother Res 2001; 15(6): 524-8. http://www.ncbi.nlm .nih.gov/pubmed/11536383, assessed on dated 25/09/2013
17. Rao NV, Pujar B, Nimbal SK, Shantakumar SM, Satyanarayana S. Nootropic activity of tuber extract of *Pueraria tuberosa* (Roxb)., Indian Journal of Experimental Biology 2008; 46(8): 591-8. http://www.ncbi.nlm.nih.gov/pubmed/18814488, assessed on dated 25/09/2013
18. Nahata A, Patil UK, Dixit VK. Effect of *Evolvulus alsinoides* Linn. on learning behavior and memory enhancement activity in rodents, Phytotherapy Research 2010; 24(4): 486-93. http://www.ncbi.nlm. nih.gov/pmc/PMC2996570/ assessed on dated 25/09/2013
19. Rao SB, Chetana M, Uma Devi P. *Centella asiatica* treatment during postnatal period enhances learning and memory in mice. Physiol behave 2005; 86(4): 449-57. http://www.ncbi.nlm.nih.gov/pubmed/16214185 assessed on dated 25/09/2013
20. Saxena Garima, Singh Mamta, Meena Prahlad, Sharma Durgesh, Jain Ayushi and Bhatnagar Maheep *et al*. Neuroprotective effects of *Asparagus racemosus* linn root extract: an experimental and clinical study. Journal of Herbal Medicine and Toxicology 2010; 4(1): 69-76 http://hmtjournals.com/vol4_1/012.pdf assessed on dated 25/09/2013
21. Lee MK, Kim SR, Sung SH, Lim D, Kim H, Choi H, *et al*. Asiatic acid derivatives protect cultured cortical neurons from glutamate-induced excite toxicity. Res Commun Mol Pathol Pharmacol 2000; 108(1-2): 75-86.http://www.ncbi.nlm.nih.gov/pubmed/11758977 assessed on dated 25/09/2013 PMid:11758977
22. Soumyanath A, Zhong YP, Gold SA, Yu X, Koop DR, Bourdette D, Gold BG *et al*. *Centella asiatica* accelerates nerve regeneration upon oral administration and contains multiple active fractions increasing neurite elongation *in vitro*. J Pharm Pharmacol 2005; 57(9): 1221-9. http://www.ncbi.nlm.nih.gov/pubmed/16105244/ assessed on dated 25/09/2013
23. Kuboyama T, Tohda C, Zhao J, Nakamura N, Hattori M, Komatsu K *et al*. Axon or dendrite predominant outgrowth induced by constituents from Ashwagandha. Neuroreport 2002; 13(14): 1715-20. http://www. ncbi.nlm.nih.gov/pubmed/12395110 assessed on dated 25/09/2013 http://dx.doi.org/10.1097/00001756-200210070-00005 PMid:12395110
24. Ahmad S, Zafar RU, Sahid M. Anticonvulsant potential of callus cultures of *Convolvulus* microphyllus Sieb. OPEM 2007; 1: 46-50. assessed on dated 25/09/2013
25. RaoVidya S, Rao Anjali, K Karanth Sudhakar. Anticonvulsant and neurotoxicity profile of *Nardostachys jatamansi* in rats**.** Journal of Ethnopharmacology 2005; 102(3): 351–356. http://www.sciencedirect. com/science/journal/03788741/102/3, assessed on dated 25/09/2013
26. Lovelyn Joseph, Rejeesh EP, Rao Sudarshanram Narayan. Supra additive effect of hydroethanolic extract of *Valeriana wallichii* (Indian valerian) root and phenobarbitone against maximal electroshock seizure in mice. Int. J. Bioassays 2013; 02(08): 1158-1161. assessed on dated 25/09/2013
27. Achliya GS, Wadodkar SG, Dorle AK. Evaluation of CNS activity of Bramhi Ghrita. Indian J Pharmacol 2005; 37: 33-6. http://www.ijp-online.com/article, assessed on dated 25/09/2013
28. Singh D, Goel RK. Anticonvulsant effect of *Ficus religiosa*: Role of serotonergic pathways. J Ethnopharmacol 2009; 123(2): 330-4. Epub 2009 Mar 9. http://www.ncbi.nlm.nih.gov/pubmed /19429380?dopt=Abstract assessed on dated 25/09/2013 http://dx. doi.org/10.1016/j.jep.2009.02.042 PMid:19429380
29. Hosseinzadeh H, Parvardeh S. Anticonvulsant effects of thymoquinone, the major constituent of *Nigella sativa* seeds, in mice. Phytomedicine. 2004; 11(1): 56-64. http://www.ncbi.nlm.nih.gov /pubmed/14971722 assessed on dated 25/09/2013 http://dx.doi.org/ 10.1078/0944-7113-00376 PMid:14971722
30. Ambawade SD, Kasture VS and Kasture SB. Anticonvulsant activity of roots and rhizomes of *Glycyrrhiza glabra.* Ind. J. Pharmacol 2002; 34(4): 251- 255. http://www.ijp-online.com/article. assessed on dated 25/09/2013
31. Bugajski S, Christian A, O Shea RK, Vendrely AM. Exploring Yoga's Effects on Impairments and Functional Limitations for a Nine-Year-Old Female with Cerebral Palsy: A Case Report. J Yoga Phys Ther 2013; 3: 140. http://www.omicsonline.org/ assessed on dated 25/09/2013
32. Vyas Apexa G, Kori Virendra Kumar, Rajagopala S, Patel Kalpana S. Etiopathological study on cerebral palsy and its management by Shashtika Shali Pinda Sweda and Samvardhana Ghrita. AYU 2013; 34(1): 56-62. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3764881/ assessed on dated 25/09/2013
33. Shailaja U, Rao Prashana N, Arun Raj GR. Clinical study on the efficacy of Samvardhana ghrita orally and by matrabasti in motor disability of cerebral palsy in children; Int. J. Res. Ayurveda Pharm 2013; 4(3): 373-377. http://www.ijrap.net/admin/php/uploads/ 1017_pdf.pdf assessed on dated 25/09/2013
34. Saroja Weerakoon1, APG Amarasinghe. Study of the efficacy of an Ayurvedic treatment regimen on Balaka Pakshaghatha with special reference to cerebral palsy. SLJIM 2011; 01(02): 55-58. http://iim.cmb.ac.lk/wp-content/uploads/2012/03/SLJIM-Vol1No2-December-2011.pdf assessed on dated 25/09/2013 assessed on dated 25/09/2013
35. Laura L Tosi, Nancy Maher, D Winslow Moore, Murray Goldstein, Mindy L Aisen *et al*. Adults with cerebral palsy: a workshop to define the challenges of treating and preventing secondary musculoskeletal and neuromuscular complications in this rapidly growing population. Developmental Medicine and Child Neurology 2009; 51(Suppl.4): 2–11. http://onlinelibrary.wiley.com/doi/10.1111/j.1469-8749.2009.03462.x/pdf assessed on dated 25/09/2013
36. Venkataraghavan S, Seshadri C, Sundaresan TP, *et al*. The comparative effect of milk fortified with aswagandha, aswagandha and punarnava in children – a double-blind study. J Res Ayur Sid 1980; 1: 370-385. http://www.altmedrev.com/publications/5/4/334.pdf assessed on dated 25/09/2013
37. Jayathirtha MG, Mishra SH. Preliminary immunomodulatory activities of methanol extracts of *Eclipta alba* (L.) Hassk. and *Centella asiatica.* Phytomedicine 2004; 11(4): 361-65. http://www.phytomedicine journal.com/article/S0944-7113(04)70341-4/abstract assessed on dated 25/09/13 http://dx.doi.org/10.1078/ 0944711041495236 PMid:15185851
38. Ireland M, Olson M. Massage therapy and therapeutic touch in children: state of the science. Altern Ther Health Med 2000; 6(5): 54-63. http://www.ncbi.nlm.nih.gov/pubmed/10979162?dopt=Abstract PMID: 10979162 [PubMed - indexed for MEDLINE] assessed on dated 25/09/2013
39. Kuttner L. Favorite stories: a hypnotic pain-reduction technique for children in acute pain. Am J Clin Hypn 1988; 30(4): 289-95.

http://www.ncbi.nlm.nih.gov/pubmed/3364392?dopt=Abstract assessed on dated 25/09/2013 assessed on dated 25/09/2013 http://dx.doi.org/10.1080/00029157.1988.10402752 PMid:3364392

40. Neubert DA, Moon MS and Grigal M. Activities of students with significant disabilities receiving services in post secondary settings. Educ. Train. Dev. Disabil 2004; 39(1): 16–25. downloads.hindawi.com/journals/tswj/2007/371790. Pdf assessed on dated 25/09/2013

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