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A CONCEPTUAL OVERVIEW ON BALAMOOLA IN THE MANAGEMENT OF ADHD

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ABSTRACT

Attention-deficit hyperactivity disorder (ADHD) is a neuro psychiatric condition of diminished sustained attention and hyperactivity. The Aetiology of ADHD is mostly genetic, with a heritability of nearly 75%. Many neurotransmitters are assumed to be connected with ADHD symptoms and dopamine continues to be a focus of the investigation. In Ayurveda, any disease with symptoms of ADHD is described, but some references regarding abnormal behaviours and attention deficit are explained under the features of *Unmada*. In the contemporary system, the management of ADHD mainly relies upon behavioural therapy and stimulants. PEA (β-phenethylamine), has stimulant effects that lead to the release of so-called biogenic amines, including dopamine and serotonin. This PEA is identified as one important and must-be-explored alkaloid in *Bala* (*Sida Cordifolia*). The article vies for understanding and evaluation of the action of *Bala* (*Sida cordifolia*) in neurological disorders as well as ADHD with reference to ayurvedic literature and recent research works based on prophylactic efficacy of bioactive constituents obtained from roots of *Sida cordifolia.*

Keywords: ADHD, *Unmada*, *Bala*, PEA

INTRODUCTION

Attention-deficit /hyperactivity disorder (ADHD) is a neuro psychiatric condition affecting pre-schoolers, children, adolescents, and adults around the world, characterised by a pattern of diminished sustained attention and increased impulsivity or hyperactivity. Based on family history, genotyping, and neuro-imaging studies., there is clear evidence to support a biological basis for ADHD. Although multiple regions of the brain and several neurotransmitters have been implicated in the emergence of symptoms, dopamine continues to be a focus of investigation regarding ADHD symptoms. The prefrontal cortex of the brain has been implicated because of its high utilization of dopamine and its reciprocal connections with other brain regions involved in attention, inhibition, decision-making, response inhibition, working memory, and vigilance.[1] Other than dopamine, certain other neurotransmitters namely epinephrine, and serotonin are involved in the symptoms associated with ADHD. In Ayurveda symptoms of ADHD are described imprecisely under various circumstances with references to abnormal behaviour in the section of *Unmada*, such as *Anavasthita Chittatva*(flight of thoughts)*Mano Vibhrama (*pervasion of mind), *Buddhi Vibhrama* (obliteration of intellect), *Smriti Vibhrama*(impaired memory), *Sheela Vibhrama* (behavioural changes), *Cheshta Vibhrama* (abnormal actions), and *Achara Vibhrama* (impairment in conduct) and can be correlated with ADHD.[2] There are many plants that have probable action on psycho-neurological deficits. The article makes an attempt to understand and evaluate the action of *Bala* (*sida cordifolia*) in neurological disorders as well as ADHD with regards to ayurvedic literature and recent research works based on the prophylactic efficacy of bioactive constituents obtained from roots of *sida cordifolia.*

MATERIALS AND METHODS:

Classical texts of Ayurveda along with articles, modern text books, and webpages were accessed as a source of material in the study.

DISEASE REVIEW:

ADHD has remained one of the most difficult conditions in psychiatry to diagnose and categorization as evidenced by the frequent modification of the diagnostic criteria in the recent editions of DSM.[3] According to a recent meta-analysis on the prevalence of ADHD from studies done in Europe, it revealed that 7.2% (95 % confidence interval [CI]: 6.7% - 7.8%) children and adolescents have positive symptoms of ADHD.[4]In India, few studies are done, and it is in the budding stage. However, the prevalence estimated in the number of studies is limited to certain geographical locations and wide variability of the prevalence is also observed in the studies. For example, the prevalence in individuals aged between 6 and 18 years in Kashmir was 4.31%, whereas, in individuals aged between 6 and 12 years in Bangalore, it was 2.3%, in individuals aged between 6 and 18 years in Odisha the incidence was 3.66%, in individuals aged between 10 and 16 years in New Delhi the rate was 6.4%, in individuals aged between 6 and 11 years in Assam the prevalence was 12.66%, and in individuals aged between 8 and 11 years in Tamil Nadu the incidence was 8.8%.[5] Mothers of children with ADHD are more likely to experience birth complications, such as toxaemia, lengthy labor, and complicated delivery. Maternal drug use, smoking and alcohol use during pregnancy, and lead or mercury exposure (prenatal or postnatal) are commonly linked to attentional difficulties associated with the development of ADHD. Food colourings and preservatives have inconsistently been associated with hyperactivity in previously hyperactive children.[6] In the Fifth Edition of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-5) subtypes have been replaced by the following three specifiers, which essentially denote the same groups: (1) combined presentation-Where both inattentive and hyperactive presentation is observed (2) predominantly inattentive presentation -where the child fails to give a close attention in tasks and play activities, doesn't follow instructions, and fails to finish homework's/chores/duties (3) predominantly hyperactive/impulsive presentation-often fidgets with/tap

hands & feet, unable to play or engage in leisure activities, talks excessively, runs about or climbs in situations where it is inappropriate. The diagnosis of ADHD may be elicited based on the detailed history of the child's early developmental patterns along with direct observation of the child.[7]

AYURVEDIC APPROACH TOWARDS ADHD:

Though there are numerous references to psychological disorders in Ayurveda classics, there is no precise description of the clinical condition representing ADHD. Hence, ADHD can be classified as an *Anukta Vyadhi* as per *Ayurveda* principles and upon understanding its pathophysiology, management is made based upon the involvement of *Doshas, Dushya, Dhatu, Mala, Agni, Srotas, Adhishthana, Nidana Panchaka, Doshaja Prakriti, Rogi Pareeksha, Roga Pareeksha,* and *Manasa Prakriti*. The clinical features of ADHD have a resemblance with the disease entity *Unmada* mentioned in all the major Ayurveda classics. While explaining *Pratyatma Lakshana* of *Unmada, Chakrapani Datta* has explained *Sangya Vibrama*-where the person fails to recognise place, names, and inattentiveness upon calling by name and *Chesta vibrama*- i.e., undesirable activities which are inappropriate to the circumstances. The same has been explained as an inattentive & hyperactive presentation of ADHD. Upon keen consideration of the etiopathogenesis involved in ADHD, there is a need for medications and *Panchakarma* procedures which can target the neurotransmitters in order to manage the core features of ADHD. Ayurveda systems of medicine possess a wealth of single herbs, formulations, and *Panchakarma* procedures that can efficiently address the ever-increasing prevalence of ADHD.[8]

VARIOUS *SHAMANOUSHADI*'S EXPLAINED IN AYURVEDIC CLASSICS FOR *UNMADA*, WHERE BALA IS AN INGREDIENT: -

- *Unmada bhanjana rasa* (b. r 24/41-44).[9]
- *Panchabhauthika taila* (ka.kal.4/32-40).[10]
- *Shatapaka balataila* – (bh.sam.chi.8/20).[11]
- *Ksheerabala taila* (Sahasrayogam, taila prakaranam).[12]
- *Sitakusumabaladi yoga* (y.r 22/37).[13]
- *Chaitasa ghrita* (c.d 20/31-33).[14]

DRUG REVIEW:

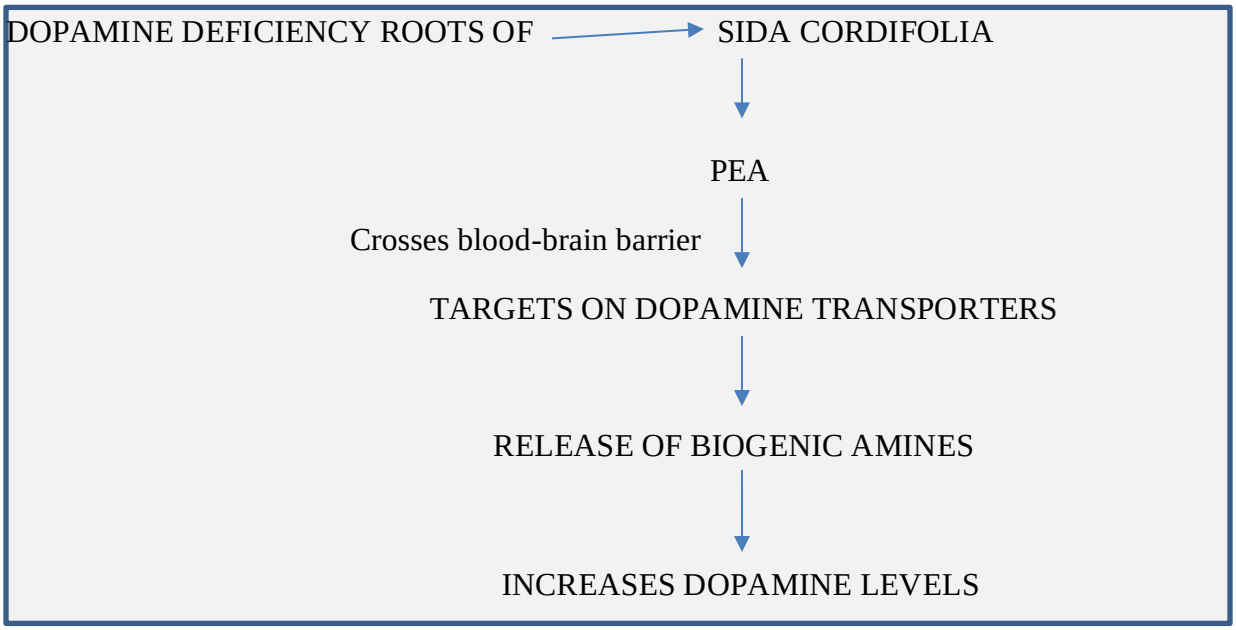
Popularly known as '*Bala*', the root of *Sida cordifolia* L. (*Malvaceae*) is regarded as a valuable drug in the Ayurvedic System of Indian Medicine. *Bala* is one of the herbs in *Brumhani dashaimani, Balya dashaimani, Madhura skandha, Vatashamaka varga, and Madhyama Panchamula*.[15]

PHYTOCONSTITUENTS OF *BALA*:

Roots contain C28 phytoecdysones, viz., sidasterone A, sidasterone B, carboxylated tryptamines, asparagine, quinazoline alkaloids, sympathomimetic amines, β-phenethylamine, ψ ephedrine, choline, betaine, rutin, phytosterol, resin acids. β-sitosterol, acylsteryglycoside sitoindoside, ephedrine, S- (+)-Nb methyltryptophan methyl ester, hypaphorine, vasicinone, vascicine, and vasicinol. The roots contain 0.06% of alkaloid.[16] The pharmacological and other biological effects of Sida cordifolia have been extensively elucidated to include actions on the cardiovascular system, CNS, anti-inflammatory, analgesic effect, hypoglycaemic effect, anti-pyretic, anti-ulcerogenic activity, anti-HIV-1 activity, and hepatoprotection. In a recent animal study on rats, to investigate the action of ethanolic extract of S. cordifolia root on quinolinic acid-induced neurotoxicity, S. cordifolia exhibited neuroprotective, anti-inflammatory, and antioxidative effects comparable to the standard drug deprenyl.[17]

Among the phytoconstituents of *Bala*, an important and must-be-explored alkaloid is β-phenethylamine (PEA). PEA has also been found in the brains of humans and other mammals, which is facilitated by its high solubility in plasma and its ability to cross the blood-brain barrier. Like its α-methylated derivative, amphetamine, PEA has stimulant effects that lead to the release of so-called biogenic amines, including dopamine and serotonin. Unlike amphetamine, PEA has difficulties maintaining high concentrations in the human body, due to its oxidative deamination to phenylacetic acid by the enzyme B monoamine oxidase (MAO). Phenylacetic acid has an effect that is similar to the activity of the natural endorphins, an effect that is known as a "runner's high".[18]

ACTION OF PEA, BIOCONSTITUENT OF SIDA CORDIFOLIA ON ADHD: -



PEA IN ADHD:

ADHD is a chronic child hood disorder that is characterized by a number of behavioural symptoms, including a small attention span, increased frustration, distractibility, and often depression and anxiety. ADHD often is paralleled by co-existing psychiatric disorders and patients can have problems that are attributable to ADHD way into their adulthood. While the diagnosis of ADHD is usually done by the analysis of the symptoms (American psychiatric association 2000)[19], PEA was recently described as a biomarker for ADHD. This novel discovery will improve confidence in the diagnostic efforts, possibly leading to reduced misdiagnosis and overmedication. Specifically, the urinary output of PEA was lower in a population of children suffering from ADHD, as compared to the healthy control population, an observation that was paralleled by reduced PEA levels in ADHD individuals. In a consecutive study, children suffering from ADHD were treated with methylphenidate, also known as Ritalin. Patients whose symptoms improved in response to treatment with methylphenidate had a significantly higher PEA level than patients who did not experience such an improvement in their condition.[20]

DISCUSSION

Attention-deficit/hyperactivity disorder(ADHD) is the most common neuro behavioural disorder of childhood and one among the prevalent chronic health conditions characterized by inattention, including increased distractibility and difficulty sustaining attention, poor impulse control, and decreased self-inhibitory capacity, motor overactivity, motor restlessness.[21] Researchers have hypothesized networks within the brain for promoting components of attention including focusing, sustaining attention, and shifting attention. They describe neuroanatomical correlations for the superior and temporal cortices with focusing attention, external parietal and corpus striatal regions with motor executive functions, the hippocampus with the encoding of memory traces, and the prefrontal cortex with shifting from one stimulus to another. The further hypothesis suggests that the brainstem which contains the reticular thalamic nuclei function is involved in sustained attention.[22] *Acharya Charaka* stated that it is really difficult and not necessary to name every disease owing to its mul-

tifactorial etiology and complex pathogenesis and therefore with a clear understanding of vitiated *Doshas, Nidana, and Vyadhi Adhisthana* (site of disease manifestation), a physician is able to successfully initiate the *Chikitsa Karma* (management).[23]Balanced state of *Vata Dosha* is said to be the controller of all the motor and sensory actions in the body. *Vata* controls and coordinates the mental faculties. It enables proper breathing movements and circulation of *nutrition* all over the body.[24]Because of these reasons in *Ayurveda Vata* is considered the controller of the nervous system. In ADHD the *Prakupita Vata Dosha* (*Prana, Udana, and Vyana*) affects *Manoarthas* and *Manokarmas* and in turn leads to inattention, hyperactivity, and impulsivity. So, the main mode of treatment is to bring *Prakupita Vata Dosha* back to normalcy and proper maintenance of *Agni*.[25] *Bala* is a highly valuable drug in Ayurveda and the fact that it is one of the three most utilized raw drugs by Ayurvedic pharmaceutics. Presently many species of Sida are recognized as Bala throughout the country. Sida cordifolia Linn. is proposed as a source plant in the Ayurvedic Formulary of India. *Bala*, as the name itself, suggests a drug providing energy or strength. It is abundantly mentioned in *Ayurveda* and has been largely used in neurological as well as heart diseases. Sida cordifolia contains alkaloids to extent of 0.085 per cent. The main portion of the alkaloid is identified to be ephedrine by virtue of which it possesses psycho-stimulant properties on CNS. It is kept among *Balya Mahakashaya* and *Madhura Skandha* by *Charaka*. *Susruta* has kept it among *Vatashamaka Gana*, hence it is best for promoting strength and alleviating *Vata*. The root possesses *Madhura Rasa, Guru, Snigdha Guna, Sheeta Veerya,* and *Madhura Vipaka.* It is *Balya, Rasayana, Brimhaniya, Oojavardhaka, Raktapittahara, Vrishya, Vatahara, Kshayanashaka, Prajastapana, Grahi*. It is useful in neurological disorders like hemiplegia, facial paralysis, sciatica, general debility, headache, dysuria, leucorrhoea, tuberculosis, diabetes, fever, and uterine disorders as evidenced through various research articles. Sida cordifolia has been reported to possess analgesic, anti-inflammatory as well as hepato-protective activity. One more important action that can be credited to *Bala* is that it has a profound soothing and relaxing effect on the mind. Recent research has shown that it reduces oxidative stress in rat brains and hence proven effect on neurotoxicity. Oxidative stress is the most important mechanism in the development and progression of epilepsy and other diseases including Alzheimer's disease, chronic degenerative disorders, stroke, rheumatoid arthritis, diabetes, and cancer. The presence of flavonoids in Sida cordifolia has been confirmed by phytochemical analysis and these as well as their glycosides exert anxiolytic, sedative, and anticonvulsant effects on the central nervous system thereby may assist in controlling features of ADHD. The presence of antioxidants prevents possible damage to neurons.[26]

CONCLUSION

ADHD is a neurological disorder, characterised by inattention and hyperactivity which has been astutely pointed out as *sangya vibrama and chesta vibrama* in *Ayurveda* ages before. *Bala (Sida Cordifolia*) is a plant *that* has been highly reputed for its neurological actions and has been placed as a major constituent in many formulations of *Unmada*, a neuropsychiatric disorder. Recent analysis and studies by contemporary science have taken up PEA as a biomarker in ADHD subjects and *Bala* is found to have a significant fraction of PEA and has become an optimistic contender in the management of ADHD.

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