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RESEARCH ARTICLE

COGNITIVE FUNCTION DEFICITS IN CEREBRAL PALSY: A COMPREHENSIVE REVIEW AND UPDATES

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ABSTRACT

Cerebral Palsy as known as the Little's disease is a collective term used to identify a group of non contagious and non progressive neuromotor conditions. According to the intensity of the disorder and the various symptoms Cerebral Palsy is divided into four categories: Spastic cerebral palsy, this type is further divided into three types depending upon the severity of the spasticity-(Hemiplegia, Diplegia and Quadriplegia), Dyskinetic, Ataxic and mixed. Cognition is the ability to perform high level brain functions which involves organization, planning, problem solving, focusing-maintaining and shifting of attention when necessary, understanding and using of language etc. These high level functioning are met in everyday life situations and any impairment or damage in the areas of the brain leads to the loss of these functioning Cognitive impairment is not the primary effect of Cerebral Palsy and may or may not accompany Cerebral palsy although research and Studies have shown that cognitive impairment is said to exist in two thirds of the reported cases, out of which one third of children with cerebral palsy are severely or moderately impaired, while the rest have mild impairment. Cerebral palsy in non progressive disorder but the effects can be held at bay with the help of various aids like surgery, counseling, therapies, medical helps etc, cognitive exercises like Cogmed are also available now to maintain and develop one's cognitive level. This article aims to do a comprehensive review of the cognitive deficits of cerebral palsy and the researches made to understand the topic.

INTRODUCTION

The human mind is a machine which is very fascinating and very complicated to understand fully. Through the help of this part of the body, one is able to think, feel, emote and perform various difficult and simple tasks at the same time. The aim of this article is to study the cognitive deficits in patients suffering from cerebral palsy. Cognition is the ability to perform high level brain functions which involves organization, planning, problem solving, focusing-maintaining and shifting of attention when necessary, understanding and using of language etc. These high level functioning are met in everyday life situations and any impairment or damage in the areas of the brain leads to the loss of these functioning. Cognitive dysfunction is a term to understand the loss of such functions (thinking, reasoning, remembering) which interferes with daily needs of functioning to respond to an information. Cognition is one such topic that many scholars have attempted to understand and still on the process of understanding, there are many theories, assessment tools and experiments to be able to get a gist of what cognition is.

Clinical manifestations and classification

Cerebral palsy (also known as Little's disease as it was described around 150years ago by Dr Little who was an orthopedic surgeon), the term denotes a wide range of disorders and developmental disabilities that may arise as a result of damage to a brain that may have occurred before, during or after birth. This condition is not progressive and non contagious, although there is no cure for this condition, the consequences can be held at bay to some extent with the aid of various treatment facilities and coping mechanisms. Cerebral palsy is classified into four types according to the severity of the damage.

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(1) Spastic cerebral palsy wherein the person suffering has either dominant or exclusive impairment in spasticity, this type is further divided into three types depending upon the severity of the spasticity-hemiplegia (where one side of the body is affected), diplegia (where lower half of the body is affected and a mild involvement of the upper arms as well) and quadriplegia(here all the four limbs are affected along with the involvement of muscles that has control over the tongue, mouth and the pharynx). (2) Dyskinetic- here the person as an abnormal muscle tone when the person tries to move, drooling, dysarthria and dysphagia accompany the main problem. (3) Ataxic-there is a loss of muscle coordination which leads to impairment in fine motor skills, dexterity and unsteadiness and dysmetria (mild tremor) while walking,(4) mixed- this type of cerebral palsy is a mixture of spasticity, dystonia along with/without athethoid movements.

Cognitive Deficits

Among the important known causes of cerebral palsy are congenital brain malformations including malformations of cortical development. According to KragelohMann *et al*., 1995, Steinlin *et al*., 1993 and Truwit *et al*., 1992, modern imaging techniques enable more children with these conditions to be identified and knowledge about the cortical dysplasias of which some have a genetic basis is increasing rapidly. Nelson and Leviton (1991) described Neonatal encephalopathy is a syndrome of disturbed neurological function in the earliest days of life in the term infant, manifested by difficulty with initiating and maintaining respiration, depression of tone and reflexes, subnormal levels of consciousness and often, seizures. Accidental injuries such as motor vehicle accidents and near-drowning episodes, and non accidental injuries may result in cerebral palsy. Other causes of cerebral palsy include apparent life-threatening events, cerebrovascular accidents and following surgery for congenital

malformations. Meningitis, septicaemia and other conditions such as malaria remain extremely important causes of cerebral palsy in developing countries. People suffering from cerebral palsy face problems pertaining to motor skills but cognitive deficits might accompany a person suffering from cerebral palsy as the trauma might affect several areas of the brain. Cognitive disturbance leads to mental retardation and learning disability. The prevalence of moderate, severe and profound mental retardation is 30% to 65% in all cases of Cerebral Palsy. Visual and hearing impairments prevent the physician from accurately assessing the degree of intellectual impairment. Children with intellectual impairment need special education and resources to stimulate the senses for optimal mental function. "Executive functions are the higher order functions that are present to regulate cognitive, behavioral and emotional domains. The behavior associated with disruption of the executive system depends on which particular circuits have been affected; resulting in for example distractibility, working memory impairment, or disinhibited and impulsive behavior (Powell and Voeller, 2004) according to Alexander and Struss, 2000, Lesions of one or more subcortical segments of the system can also cause impairment in executive subdomains.

The integrity of the white matter and of the dopaminergic pathways is considered important to the development and normal functioning of both executive and attentional functions, which rely on an extensive and complex interconnectivity with other brain areas. As one or more of these areas are often compromised in children with spastic CP, impairments in the mentioned cognitive areas could be expected. Moreover, studies so far have found that these cognitive areas are only partially plastic; understood as able to be reorganized to other neural areas (Thomas, 2003), which possibly causes problems to continue or even to grow as the child grows older." Louise Bottcher, *children with spastic cerebral palsy, their cognitive functioning, and social participation: a review,* pg 211,218. Other symptoms like dysarthria and impairment in the communication skills may be the reason that a child may not able to perform up to his potentiality during his assessment or scholastic level leading to a miscalculation of the cognitive ability of the child. There has been many other researches pertaining to the cognitive functioning of children with cerebral palsy, one such study was made by Fennell and Dikel, 2001, department of clinical and health psychology, university of Florida, his article reviewed the intellectual functioning of different subtypes of cerebral palsy concluding that more studies needed to be conducted to study the significant impact of cerebral palsy on intellectual, motor and neuropsychological functioning and that neuropsychological assessment could provide the necessary tool for the studies.

Relative studies of cognition and motor variables with arithmetic performance to have a better understanding of the cognitive impairment and cerebral palsy, This study which was the first to show the influence of word decoding and fine motor skills on arithmetic performance of children with cerebral palsy was done by Van Rooijen M, Verhoeven L, Smits DW, Ketelaar M, Becher JG, Steenbergen B, they conducted a research on a group of group of primary school children suffering from cerebral palsy. Structural equation modeling was used to examine the relative influence of non verbal intelligence, working memory, word coding capacities, gross and fine motor skills on arithmetic performance. The results showed that cognitive and motor predictors were all positively correlated to each other. The cognitive model, non verbal intelligence and word decoding were related to arithmetic, the combined model of motor and cognitive variables showed that word decoding and fine motor skills were the strongest predictors of arithmetic performance. Expert Studies have shown that cerebral palsy is detected in every2-4 thousand live birth and has remained constant in India for the past 20 years and the incidence occurred mostly on babies with low birth weight. According to Dr Deepak Sharan and his team in 2002-2003, 75% out of approximately 1000 cases of locomotor disabilities evaluated were found to be suffering from cerebral palsy.

Treatment and Management

Cerebral palsy is not curable and is preventable to an extent although there are ways and measures to cope with the various problems that a patient with cerebral palsy faces. Good prenatal care helps decrease the risk of cerebral palsy by preventing premature births, low birth weights and infections affecting the mother. Cerebral palsy treatment focuses on making the best of the situation through the means of therapy, drugs, surgery and mechanical measures. Physical therapy helps strengthen muscles and improves walking and keeps the joints from forming contractures, there are various facilities that provide physiotherapy. Occupational therapy helps children to learn to perform daily tasks like throwing balls, feeding, dressing themselves etc. Speech therapy helps improve speech, understanding and swallowing, drugs or medicines are used to control seizures and muscle spasms. Braces are available which helps to compensate for muscle imbalance. Surgery and mechanical aids can help to overcome impairments which include orthopaedic surgeries to adjust tendon or fuse joints. Counselling for emotional and psychological needs and behavioural therapy and cognitive training techniques to help with the cognitive disabilities is present to help the child. Neuro developmental paediatricians, paediatric neurologists, paediatric rehabilitation medicine specialists (for children), and physical medicine and rehabilitation physicians (for adults) work with psychologists, neuropsychologists and therapists to gauge various abilities in the patients.

Cognitive exercise is the way to help maintain and develop one's cognitive abilities. This can be done with the help of education, active mental engagement, cognitive skill exercises and games. According to Jean Piaget (1896-1980) a contributing scholar towards the field of developmental psychology, the age where the child starts grasping knowledge and utilizing it to the various demands of daily life situations starts at 7yrs to 11yrs which he called the concrete operational stage. He developed theories on the basis of exercises that he gave to his own children and studied them. The cognitive level at this stage is such that the child starts to understand the logistics, reasoning, planning and problem solving abilities. He gave various cognitive exercises and games like tying knots from a basic level to a difficult one, Joseph Tracy, Adam Flanders, Saussan Madi, Joseph Laskas, Eve Stoddard, Ayis Pyrros, Peter Natale and Nicole DelVicchio. Departments of Neurology and Radiology, Thomas Jefferson University/Jefferson Medical College, Philadelphia, PA 19107 and Medical College of Pennsylvania/Hahnemann University, PA, *Regional Brain Activation Associated with Different Performance Patterns during Learning of a Complex Motor Skill* have studied the active involvement of the same brain region through the various stages of complex motor task learning study.

The Norwegian Institute of science and technology with Dr Gro Lohaugen, Professor Jon Skranes, Professor Anders Dale have studied *the neuropsychological status and effect of cognitive training in children with cerebral palsy,* they worked on 115 children of ages 7-15years, born at term with unilateral or bilateral cerebral palsy, (with step by step process of test and retest method with a 6months follow up) they introduced Cogmed (computerized working memory training program) to improve the working memory and improve learning abilities and behavior, they assessed to see if the intervention was effective and to increase the understanding of the mechanisms underlying a potential plasticity in the developing and the injured brain. Neuropsychological batteries give an extensive knowledge about the various areas neuropsychological functions, some of the available neuropsychological tests include the Luria Nebraska neuropsychological battery, Nimahns neuropsychological battery2004, Cambridge neuropsychological test automated battery (CANTAB), etc. Although there are various researches done on the link between cognition and cerebral palsy, there is a lack of understanding in this topic as the comprehensive study based on the various domains of cognition is yet to be studied on. Cognitive impairment is secondary effect that accompanies cerebral palsy but researches have been made

that most of the patients suffering from cerebral palsy are accompanied by cerebral palsy and is most common in spastic quadriplegia. Studies have shown that cognitive impairment is said to exist in two thirds of the reported cases, out of which one third of children with cerebral palsy are severely or moderately impaired, while the rest have mild impairment. Cerebral palsy a neuro-motor condition is not curable but with the help of various aids one can reduce the associated challenges faced.

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