Gross Motor Function Scale Assessment in Children with Cerebral Palsy on Hyperbaric Oxygen Therapy

Thesis

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Mohamed Taha El-Sherbiny

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List of Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
ATA	Atmosphere Absolute
atm	Atmosphere
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CP	Cerebral Palsy
CT	Computed Tomography
EEG	Electroencephalogram
GMFCS	Gross Motor Function Classification System
GMFM	Gross Motor Function Measure
HBOT	Hyperbaric Oxygen Therapy
IL-1	Interleukin -1
IL-6	Interleukin -6
IN	Idling Neurons
mmHg	Millimeter mercury
MRI	Magnetic Resonance Imaging
O_2	Oxygen
pCO_2	Partial Pressure of Carbon Dioxide
pO_2	Partial Pressure of Oxygen
PVL	Periventricular Leukomalacia
TNF- α	Tumor Necrosis Factor α

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ABSTRACT

Background: cerebral palsy (CP) describes a permanent and early onset disorder of motor function in children leading to activity limitation which is assessed by Gross Motor Function Measure (GMFM) which is a standardized observational tool designed and validated to measure changes in gross motor functions over time.

Objective: to assess gross motor function in children with CP under Hyperbaric Oxygen Therapy (HBOT).

Method: In present prospective study, 60 CP children aged 3-12 years, divided into two groups, group I (40 children received HBOT assessed for GMFM scores and severity at the beginning, after 20, 40 sessions and at the end of treatment). Group II (20 children received conventional rehabilitation program assessed for GMFM scores and severity at the beginning and at the end of treatment). Statistical analysis of changes within each group and comparison between groups were done by suitable statistical tests.

Results: GMFM scores and severity significantly improved after HBOT compared to rehabilitation program.

Conclusion: HBOT has a positive effect on children with CP with meaningful improvement in GMFM scores and severity.

Key words: Cerebral palsy, GMFM, HBOT

INTRODUCTION

Cerebral palsy represents a complex and extremely varied group of developmental conditions or syndromes and certainly cannot be considered a single disorder ***(Mutch et al., 1992)***.

By definition, these conditions begin very early in a child's formation, whether during the intrauterine period or in the months after an infant's birth. The cerebral palsies commonly have impairments in the developing central nervous system that affect the development of postural and motor control.

Cerebral palsy is the most common motor disability of childhood with an early onset that occurs in about 2.1 per 1000 live births ***(Oskoui et al., 2013)***.

It affects 1 to 3 per 1,000 school-aged children, 3/4 of whom are born at term ***(Rosenbaum et al., 2007)***.

Most cases are prenatal in origin (70–80%). Perinatal etiology accounts for 10 to 20% and the rest are of postnatal etiology ***(O'Shea, 2008 and Clark et al., 2008)***.

The treatment and management of children with cerebral palsy is an ever-evolving story.

In the past twenty years, a number of exciting innovations in treatment have expanded the opportunities to help children.

At the same time, the field has experienced a remarkable proliferation of alternative therapies and approaches ***(Rosenbaum, 2003)***.

In the absence of definitive treatment for cerebral palsy, it is not surprising that alternative approaches of management arise and attract attention. One of these alternative therapies involve the use of hyperbaric oxygen for children with cerebral palsy, this form of treatment has spread worldwide, despite little scientific evidence of efficacy.

Hyperbaric oxygen therapy (HBOT) is defined as the inhalation of 100% oxygen inside a hyperbaric chamber that is pressurized to greater than 1 atmosphere (atm). The use of HBOT to treat patient with cerebral palsy is based on the theory that among the damaged brain cells there are inactive cells that have the potential to recover. These cells constitute the ischemic penumbra, the transition of dormant neurons between areas of dead tissue and unaffected healthy tissue. The theory is that improving oxygen availability to these cells stimulates the dormant cells to function normally

reactivating them metabolically or electrically ***(Harch and Neubauer, 1999 and Neubauer, 1998)***.

Clinical assessment of gross motor function in children with cerebral palsy depends on gross motor function measure (GMFM) ***(Nordmark et al., 1997 and Russell et al., 1989)***.

Gross Motor Function Measure (GMFM), is the standard tool for mobility assessment and ambulatory ability prediction for cerebral palsy. GMFM is a five-level classification that differentiates children with cerebral palsy based on the child's current gross motor abilities, limitations in gross motor function, and need for assistive technology and wheeled mobility. The Gross Motor Function Classification System (GMFCS) contains 4 age bands (under 2 years, 2-4 years, 4-6 years and 6-12 years) ***(Palisano et al., 1997)***.

The GMFM-88 is the original version of the Gross Motor Function Measure. It has 88 items that are grouped (for ease of clinical administration) into five dimensions (Lying & Rolling – Sitting – Crawling & Kneeling – Standing – Walking, Running and Jumping). Scoring is done by calculating a percent score for each of these dimensions and an overall score averaging the five dimension scores ***(Russell et al., 2003)***.

AIM OF WORK

This study is designed to clinically assess gross motor function in children with cerebral palsy on hyperbaric oxygen therapy (HBOT).

CEREBRAL PALSY

I) Historical review:

Cerebral palsy (CP) is a well-recognized neuro-developmental condition that begins in early childhood persisting through the whole life. Originally reported by ***Little*** in 1861 and was called “cerebral paresis”. In over 20 years of orthopaedic practice, ***Little*** came to the conclusion that there is a causal relationship between birth complications, asphyxia and disorders of mental and physical development after birth. He settled his opinion on approximately 200 well-documented personal cases of spasticity with birth complications in their history. This conclusion was generalized to all clinical types of CP ***(Little, 1862)***.

At the end of the 19th century, Sigmund Freud and Sir William Osler both began to contribute important perspectives on the condition.

Sigmund Freud was the first to write about cerebral palsy as a descriptive category, uniting different infantile motor deficits of brain origin ***(Freud, 1897)***.

In 1959, ***Mac Keith and Polani "Little Club"*** defined CP as a persisting but changing disorder of movement and posture, appearing in the early years of life due to nonprogressive disorder of the brain ***(Mac Keith and Polani, 1959)***.

In 1964, ***Bax*** stated that CP is a disorder of movement and posture due to a defect or lesion of the immature brain. But the concept of sensory, cognitive, behavioral and other associated impairments was not included in this definition ***(Bax, 1964)***.

An International Workshop on Definition and Classification of Cerebral Palsy was held in 2004, underlined that CP is not an etiologic diagnosis, but a clinical descriptive term ***(Ashwal et al., 2004)***.

II) Definition of CP:

Cerebral palsy describes a group of permanent disorders of development, movement and posture, causing activity limitation, that is attributed to nonprogressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, behavior, epilepsy and by secondary musculoskeletal problems ***(Eliasson et al., 2006)***.