International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 7; Issue 5(C); May 2018; Page No. 12419-12421
DOI: http://dx.doi.org/10.24327/ijcar.2018.12421.2183

Research Article

EFFECTIVENESS OF LOW PRESSURE HYPERBARIC OXYGEN THERAPY IN AUTISM AND HYPOXIC BRAIN INJURY (HIE) CASES MIMICKING AUTISM

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A R T I C L E I N F O

Article History:

Received 6th February, 2018
Received in revised form 20th March, 2018 Accepted 8th April, 2018
Published online 28th May, 2018

Key words:

Autism, Brian injury, cognitive impairment, hyperbaric oxygen therapy, mHBOT

A B S T R A C T

Autism is a developmental disorder caused by combination of genetic and environmental factors. It is characterized by difficulty in social interaction, communication and repetitive behavior. The signs and symptoms of autism are usually noticed by the parent in the first two to three years of the life. These signs often develop gradually, though some children with autism reach their developmental milestone at a normal pace and then regress between the ages 1 to 3 years. According to DSM-5, it comes under autism spectrum disorder along with Asperger syndrome which is less severe. Cognitive impairment and sensory issues are one of the most challenging things seen in these types of kids. In this study we selected a total 150 children and grouped in groups A (Autism), B (autism with history of Brain injury near term, labor or soon after) and C (Control unselected group). We employed mHBOT (ambient air at 1.3 atmospheric pressure) plus all standard rehabilitations (Special Education, Speech and OT/Sensory Integration Therapies) to groups A and B while group C served as control cases who received the same standard therapies but no mHBOT. Two outcome measures: VSMS and CARS result were used for pre v/s post therapy statistical data analysis. The results suggested that group B, that is autism with past brain injury, had a more significant result (p=0.02) as compared to plain autism group A (p=0.04) and group C (p=0.05). The result suggests that group A autistic group given mHBOT also, had superior significant results compared to control non-mHBOT group. We conclude from our results that mHBOT gave statistically superior cognitive changes in autism and more so in autism with hypoxic brain injury. We need to continue the study with more subdivisions of type.

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INTRODUCTION

Autism is a developmental disorder caused by combination of genetic and environmental factors[1]. It is characterized by difficulty in social interaction, communication and repetitive behavior[2]. The symptoms of autism are usually noticed by the parent in the first two to three years of the life[3]. These signs often develop gradually, though some children with autism reach their developmental milestone at a normal pace and then worse[4]. According to DSM-5 it comes under autism spectrum disorder along with Asperger syndrome which is less severe[5]. Globally autism is estimated to affect 24.8 million people as of 2015[6]. In 2000s the number of people affected was estimated at 1-2 per 1000 people worldwide[7]. The clinical features seen in autism are poor socialization, speech impairment, and repetitive pattern of behavior, stereotype behavior and hyperactivity.

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Hypoxic brain injury is a one type of injury in which brain is variably deprived of oxygen due to vascular problems or tissue edema compressing the microcirculation. It can occur in all age group and often is a complication of brain stroke, brain injury, neoplasms, and inflammations due to ongoing or persistent inflammatory lesions. A net search reveals multiple references of such inflammatory lesions in all parts of brain associated with features of autism that include cases with lesions in one or more parts in basal ganglia, temporal lobe, frontal lobe, prefrontal gyrus, anterior cerebellum, etc. The brain approximately required 3.3 ml of oxygen per 100 g of brain tissue[8] per minute. As the supply of oxygen is not adequate, it results cognitive disturbance, decreased motor control and increase hyperactivity. Classical or Regular Hyperbaric Oxygen Therapy (rHBOT) involves breathing pure oxygen in a pressurized room or tube at a pressure of 1.5 ATA or more. It is approved for decompression sickness: a hazard of scuba diving. Other conditions treated with rHBOT include serious infections and bubbles of air in blood vessels. In a rHBOT chamber, the air pressure is usually increased to 150% of the usual air pressure prevalent on the equatorial sea level

(**AT**mospheric pressure **A**bsolute or ATA), rarely higher in diving accidents or Lyme Disease, where it may be increased to 2.5 to 3 ATA. Under these conditions, air in the lungs get more oxygenated than could be possible breathing pure oxygen at normal air pressure**,** based on the well-recognized proportionately greater solubility of air in water (of tissue fluid) under increased air pressure. In mild HBOT (mHBOT), ambient air is compressed to 1.3 ATA.

MATERIALS AND METHODS

Participants

A total 150 children with standard cases of autism or autism with pre-, peri- or post-partum hypoxic brain injuries were selected for the study among those attending rehabilitation of center UDAAN (FSMHP-UDAAN), a project of Foundation for Spastic and Mentally Handicapped Persons, in Delhi, India. After selection of 150 subject, all the patients according to their diagnosis given by a pediatric neurologist /psychologist were divided into three groups: Group A autism, Group B hypoxic brain injury and Group C mixed cases of both types. In each group, we recruited about 50 subjects. All the selected subjects had to meet the following Inclusion criteria: age group 2 - 15 years, either sex, Exclusion criteria include uncontrolled epilepsy, and genetic disorders such as overt Cerebral Palsy, any type of muscular dystrophy, Fragile-X or Down syndrome. After obtaining voluntary informed parent consent, children were recruited in their subsequent groups.

METHODS

This study was conducted after approval for HBOT usage in children from the Ethics committee of Apollo Hospital, New Delhi. A total of 150 subjects selected and divided into three groups: Group A (autism), Group B (hypoxic brain injury mimicking autism) and group C (control group of all types of autism). In group A and B, we provided additional mHBOT for 40 sessions (6 sessions per week for 1 ½ hours daily) along with 6 months of standard rehabilitation, whereas group C received 6 months of standard rehabilitation only. Pretest and after completing the 6 months study, post-test, data was collected and analyzed using the Childhood Autism Rating Scale (CARS) and Vineland Social Maturity Scale (VSMS) as outcome measure for statistical purpose.

Outcome measures

The outcome measures used in this study were Childhood Autism Rating Scale (CARS) and Vinland Social Maturity Scale (VSMS). VSMS has total eight domains such as self-help, self-help dressing, occupation, socialization, communication and locomotion. VSMS is a descriptive based assessment tool designed to evaluate cognition, independency, communication and social skills[9]. Another outcome measure used was Childhood Autism Rating Scale (CARS) for diagnosis for autism and its severity. It is a gold standard rating scale in among scale available for autism diagnosis purpose.

Statistical analysis

The pre v/s post data was analyzed using SPSS 20.0 (Armonk, N.Y, IBM Corp., USA) and Microsoft Excel 2010. The pre and post CARS and VSMS scores for each group were analyzed with a paired-sample t-test to determine statistical significance. The p-value less than 0.05 were considered statistically significant.

RESULTS

The paired t-test between pre and post CARS scores of all the three groups revealed significant results. In group A (autism - HBOT) the mean score change was -0.88%; similarly in group B (autism + brain injury - HBOT) showed mean change score of about -1.25% and in control group that is group C (control non-mHBOT) showed mean score change of about -0.34%. The result also suggested significant result in their p value that is 0.04, 0.02 and 0.05 in group A, B and C respectively. Although all 3 groups showed significant improvement in the p value, group B showed more significant result as compared to other group such as group A and group C (See Table-1.

Table 1 Pre v/s post mean change value of CARS Score

GROUPS	Mean + standard deviation			Mean		Change in Mean values	p-Value
	Age (years)	Height (cm)	Weight (kg)	*Pre*	*Post*		
HBOT in Autism (A)	8.9+ 1.6	102.1+23.5	12.4+5.1	46.00	45.12	-0.88	0.04
HBOT in brain injury cases (B)	8.98+5.4	103+ 20.45	26+9.04	51.23	49.9817	-1.25	0.02
Control group (C)	8.86 15.4	102 21.74	24.1 8.1	45.20	44.8611	-0.34	0.05

It also suggested that HBOT may have a beneficial effect in improving cognition in autism as well as in hypoxic brain injury case. But as compared to pure autism, results in patients who show features of autism but also have a background of brain injury as shown in figure-1, fare better.

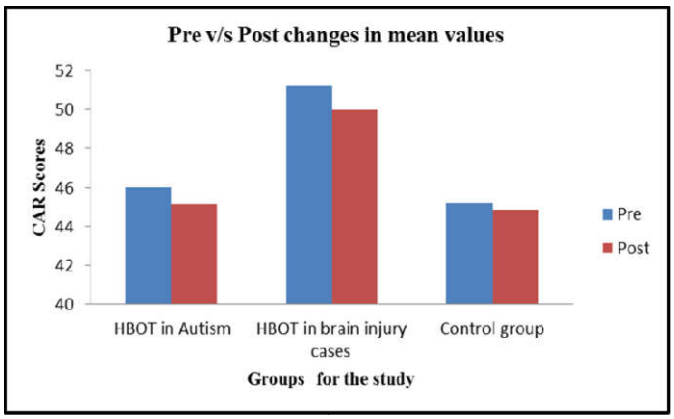

Figure 1 pre v/s post changes in mean score of CARS

Similarly in VSMS scale the result show significant changes in all group but group B that is HBOT in brain injury result more better result as compare to other groups such as group A and C as shown in table -2

Table 2 Pre v/s post changes in VSMS score values

Groups	Min		Max		Median		mean+SD		p value
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre
HBOT in Autism (A)	1.34	2.11	63.7	63.7	16.7	17.5	25.25+24.80	26.5+24.85	0.03
HBOT in brain injury cases (B)	1.76	2.51	56.4	83.07	16.31	33.21	25.33+21.06	37.26+25.82	0.003
Control group (C)	1.89	3.01	45.23	45.23	18.7	18.5	23+22.01	25.12+22.34	0.05

DISCUSSION AND CONCLUSION

Autism and brain injury are both causes of developmental disorders. In SPECT 3D Fusion Scan or Quantitative PET scan of brain, we can usually identify the type of injury to the child who came for the HBOT treatment. But physically observations may interferewith the diagnosis if the child has many sensory issues. On behalf of CARS scores and VSMS score given by clinical psychologist we had differentiated subject in this study. According to Bryan Jepson[10] *et al*, 2011, HBOT is an effective treatment modality for the core behavior

symptoms of autism. In this study he suggested mHBOT at 1.3 atmosphere pressures can have good results in subsiding the inflammation and HIE, and thus increase healing in autism. In another study by Granpeesheh[11] *et al*. 2010, he suggested HBOT delivered at 24% oxygen and 1.3 ATA many not be effective therapy for the treatment of behavioral symptoms in autism. From our finding we concluded that mHBOT at 1.3 atmosphere pressure gave significant benefit in features and quality of life in brain injury case who have clinical feature similar to autism but it does not mean it is not effective in autism. Our results in autism and as well as in brain injury suggest mHBOT shows significant result but it have more better result in brain injury associated patients. In future mHBOT can be an affordable boon to heal many neurodevelopmental cases as well as many age related secondly changes also. Based n these data, we are now enhancing the period on mHBOT to 60 to 80 sessions depending on the extent of lesions picked up by the modern colored high resolution SPECT/PET scans.

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How to cite this article:

Arun Mukherjee *et al* (2018) 'Effectiveness of Low Pressure Hyperbaric Oxygen Therapy in Autism and Hypoxic Brain Injury (Hie) Cases Mimicking Autism', *International Journal of Current Advanced Research,* 07(5), pp. 12419-12421.
DOI: http://dx.doi.org/10.24327/ijcar.2018.12421.2183

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