folic acid and omega- 3 failed to show any benefit in treatment of ASD.[26] HBOT (P> 0.05). As regards resperidal, there was a statistically significant difference (P< 0.05) between cases receiving resperidal compared to cases not receiving resperidal as regards ATEC total score (both before and after HBOT) being lower (better) in cases not receiving resperidal (probably these cases are less severe and hence have lower ATEC scores).

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Table (2) Descriptive and comparative statistics between ATEC subscale score, ATEC total score and and CARS before and after HBOT in children with Autism.

	Pre- HBO5T Mean Score	Post- HBOT Mean Score	Mean Diff.	Std. D	t	p	% Improved
Atec I	20	18.1	- 1.9	4.954	- 2.712	0.009	9.5%
Atec Ii	15.44	14.2	- 1.24	3.198	- 2.742	0.009	8%
Atec Iii	17.78	15.92	- 1.86	4.870	- 2.701	0.009	10.5%
Atec Iv	10.88	10.36	- 0.52	1.542	- 2.385	0.021	4.7%
ATEC Total	64.16	58.54	- 5.62	11.940	- 3.328	0.002	8.7%
CARS	34.78	32.08	- 2.7	5.797	- 3.294	0.002	7.8%

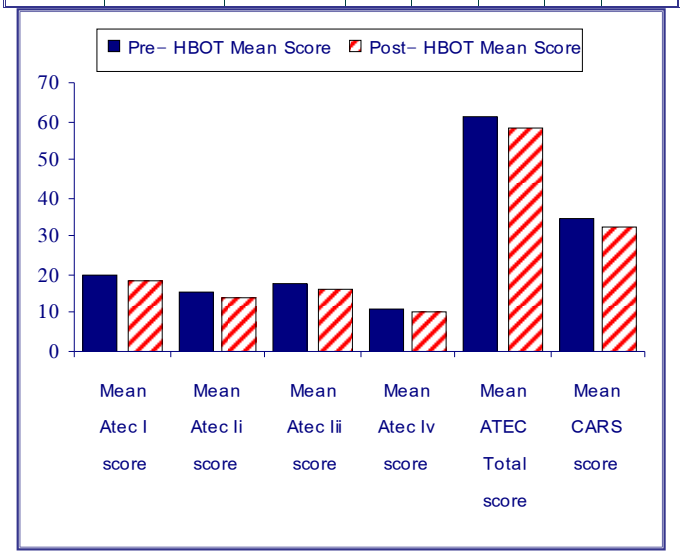

Figure (1) comparative statistics between ATEC subscale mean score, ATEC total mean score and CARS mean score before and after HBOT in children with Autism.

Discussion:

Autism Spectrum Disorders (ASDs) are characterized by the presence of impaired development in social interaction and communication and the presence of a restricted activity and interests.[1] The etiology of ASD is not currently known, which may in part explain why numerous widely divergent treatments for ASDs are in regular use.[3] Cerebral hypoperfusion in temporal regions and other brain areas in autistic children has been correlated with repetitive, self- stimulatory and stereotypical behaviors, and impairments in communication.[3] HBOT can compensate for decreased blood flow by increasing the oxygen content of plasma and body tissues.[10, 17] HBOT can overcome the effects of cerebral hypoperfusion by providing more oxygen to the brain and by causing angiogenesis of new blood vessels over time by increasing Vascular Endothelial Growth Factor (VEGF) levels.[2, 3, 9, 10, 11, 18, 19] HBOT has been shown to decrease the infiltration of polymorphnuclear leucocytes (PMN's) after an ischemic injury to the brain.[9] In addition, HBOT inhibits neutrophil attachment to blood vessel walls[13] and increases the distance that oxygen can travel in the interstitial space.[9] HBOT has been shown to possess potent anti- inflammatory properties in human studies.[2, 3, 9, 10, 11, 20] HBOT has been reported to decrease the production of pro-inflammatory cytokines (TNF- alpha, interferon- gamma, IL- 1 and IL- 6) in human studies[20, 2, 3, 9] as well as to increase counter- inflammatory IL-10 levels.[21, 2, 3, 9]

In our study, there was a statistically significant decrease in the mean scores (i.e., improvement in) of ATEC subscales, ATEC total score and CARS after HBOT when compared to their level before HBOT ($p < 0.05$) Table (1). The average improvement of ATEC subscale I (speech, language, communication), subscale II (sociability), subscale III (sensory/ cognitive awareness), subscale IV(health, physical, behavior), total score was 10.5%, 8%, 10.5%, 4.7% and 8.7% respectively, and the average improvement of CARS score in all children was 7.7%. Table (1). These results are consistent with that obtained by a similar Egyptian study on 20 children who received 20 sessions of HBOT 1.5 ATA with 100% oxygen, each (1- 1.5) h. significant improvement was observed in the total CARS and ATEC scale in total score, subscales compared to their level before HBOT however, the average improvement of ATEC total score in all children was 32.1%, and the average improvement of CARS score in all children was 15.1%.[22] Similar conclusion was made by a multicenter, randomized controlled study and compared 33 children receiving HBOT at 1.3 ATA and 24% oxygen with 29 children in a control group who received 1.03 ATA and 21% oxygen for 40 sessions of 1 hour each over 4 weeks. the ATEC, score showed a statistically significant improvement in the HBOT group compared with the control group in terms of sensory or cognitive awareness.[23] On the contrary, our results are not in agreement with another randomized controlled trial study on 60 Thai children with autism, aged (3- 9) years who were randomly assigned to receive 20 1 hr sessions of either HBOT 100% at 1.5 ATA or sham air 21% at 1.15 ATA. Effects on behaviour were measured using the (ATEC) score. These were evaluated by parents and clinicians, both of whom were blinded to the actual exposure. Results showed that there were no statistically significant differences in average percentage changes of total ATEC score and all subscales scores when comparing the HBOT and control groups, either by parents or clinicians.[24]

As regards different age groups, we found there was no statistically significant difference when comparing younger age group (<5 yrs) with older age group (> 5 yrs) as regard the post- HBOT ATEC total score and post- HBOT CARS ($p > 0.05$). In our study There was no statistically significant difference between males and females as regards the ATEC total score and CARS either before or after HBOT ($P > 0.05$). In our study There was no statistically significant difference between cases on speech therapy or behavioral therapy compared to cases without such therapies as regards the ATEC total score and CARS either before or after HBOT ($p > 0.05$). Our results were comparable to that obtained by another study which reported that effects of HBOT were not additive to the effects of ABA.[25] However, an Egyptian study reported that cases with behavioral therapy showed significant improvement in both ATEC total score (post HBOT) and CARS (post HBOT) when compared to cases without behavioral therapy, although, the same study found no statistically significant difference between cases on speech therapy compared to cases without speech therapy as regards the ATEC total score and CARS either before or after HBOT.[22] Our results revealed no statistically significant difference between cases on methylcobalamine, or omega- 3 and cases without theses drugs as regards the ATEC total score either before or after. these results are supported by that of asimilar study which showed that

Introduction:

Autism is a neuro- developmental disorder in the category of pervasive developmental disorders, characterized by problems of social communication, inflexible language and behavior, and repetitive sensory-motor movements.[1] Numerous studies of autistic individuals have revealed evidence of cerebral hypoperfusion, neuro- inflammation, gastrointestinal inflammation, immune dysregulation, oxidative stress, relative mitochondrial dysfunction.[2.3.4.5.6.7.8] neurotransmitter abnormalities, impaired detoxification of toxins. Many of these findings have been correlated with core autistic symptoms.[2,3] HBOT has been used and can compensate for decreased blood flow by increasing the oxygen content of plasma and body tissues. HBOT has been reported to possess strong anti- inflammatory properties and has been shown to improve immune function. There is evidence that oxidative stress can be reduced with HBOT through the upregulation of antioxidant enzymes. HBOT can also increase the function and production of mitochondria and improve neurotransmitter abnormalities. In addition, HBOT upregulates enzymes that can help with detoxification problems and impaired production of porphyrins in autistic children which might affect the production of heme,[2, 3, 9, 10, 11, 12, 13, 14] HBOT has been shown to mobilize stem cells from the bone marrow to the systemic circulation. Recent studies in humans have shown that stem cells can enter the brain and form new neurons, astrocytes, and microglia. It is expected that amelioration of these underlying pathophysiological problems through the use of HBOT will lead to improvements in autistic symptoms.[3]

The aim of this study: was to study the effect of HBOT on autistic symptoms (repetitive, self- stimulatory and stereotypical behaviors, and impairments in communication) in Egyptian children.

Patients& Methods:

This prospective clinical trial study was conducted on 50 children diagnosed as autism based on DSM- IV- TR criteria (diagnostic and statistical manual of mental disorders, 4th edition criteria, text revised) who attended for HBOT at Nasser Institute for Research and Treatment. Their age ranged from (2- 8) yrs with mean age 4.6 yrs, SD± 1.9 yrs. Children were allowed to continue all current therapies during HBOT. All patients were subjected to the following: (1) Detailed history taking with onset, course, duration of the disease, age, sex of the patient, antenatal, natal, postnatal history, developmental history (both mental and motor) and accurate details of cognitive abilities and gross and fine motor function, past history and family history of similar condition or any psychological or mental disorders. Also history of major childhood illnesses, surgery, injuries, diet, and medication was taken. (2) Thorough clinical examination with special emphasis on neurological examination. (III) Psychiatric evaluation includes: Confirmation of diagnosis using DSM- IV- TR criteria.[15, 2] Childhood autism rating scale (CARS) was done before and after 40 sessions of HBOT.[21] (3) HBOT: All patients received HBOT at 1.5 ATA/100% oxygen for one course of 40 sessions of 60 minutes duration over 2months; five sessions/ week in a multiplace chamber with gradual compression over 15 minutes followed by gradual decompression over 15 minutes (4) Post- exposure evaluation: evaluation of improvement was done using Autism Treatment Evaluation Checklist (ATEC).[16]

All children were accompanied during treatment sessions by a parent or adult caregiver who signed a written consent to engage in the study.

Statistical Methodology:

Data are expressed as mean± SD (range) or as number (%) of cases. Comparison between parameters of ATEC and CARS pre and post HBOT was performed using paired t test, the relationship with other parameters was obtained by a Pearson correlation coefficient. Analysis was performed by using the Statistical Package for Social Sciences (SPSS. V.15). The level P< 0.05 was considered the cut- off value for significance.

Results:

This study included 50 patients, there were recruited from the Nasser Institute for research and treatment. They included 39 males (78%), and 11 females (22%) with male to female ratio (3.5: 1), their ages ranged from 2 to 8 years, with a mean age 4.6, SD± 1.9 years. 44 patients (88%) were diagnosed before the age of 3 years, while 6 of them (12%) were diagnosed after the age of three years. In the current study, 38 patients (76%) were classified as mild/moderate (CARS 30- 36) and 12 patient (24%) were classified as severe (CARS> 36). 17 patients (34%) of patients were on speech therapy, were 8 patients (16%) on behavioral therapy, 19 (38%) patient were on methycobalamine, while 29 (58%) patient were on omega-3. Four patient were on anticonvulsants (8%) while 15 patients (30%) were on Risperdal.

Table (1) descriptive data of patients

Variable	Pre- HBOT total ATEC score				Post- HBOT total ATEC score			
	M	SD	t	p	M	SD	t	p
1. Age Group								
<5 No. = 31	69.23	27.55	1.71	0.09	61.61	29.17	0.98	0.3
>5 No. = 19	55.89	25.22			53.53	26.27		
2. Gender								
Male no.= 39(78%)	62.05	28.05	- 1.03	0.3	56.23	28.46	- 1.09	0.2
Female no.= 11(22%)	71.64	23.73			66.73	26.46		
3. Speech Ttt								
Yes No. = 17	60.88	26.85	- 0.6	0.5	58.76	24.3	0.04	0.9
No No. = 33	65.85	27.67			58.42	30.25		
4. Behavioral Ttt								
Yes no. = 8(16%)	69.75	25.91	0.96	0.5	65.25	21.26	0.73	0.4
No no. = 42(84%)	63.1	27.64			57.26	29.27		
5. Methylcobal								
Yes no. = 19(38%)	72.74	27.26	1.78	0.08	64.95	29.38	1.26	0.2
No no. = 31(62%)	58.90	26.26			54.61	27.04		
6. Omega- 3								
Yes no. = 29(58%)	70.28	28.47	1.91	0.06	63.83	30.58	1.58	0.1
No no. = 21(42%)	55.71	23.48			51.24	23.03		
7. Anticonvulsant								
Yes no. = 4(8%)	85.75	18.50	1.68	0.09	81.50	23.61	1.73	0.08
No no. = 46(92%)	62.28	27.19			56.54	27.79		
8. Resperidal								
Yes no. = 15(30%)	81.27	27.29	0.003	3.16	75.00	27.28	2.9	0.005
No no. = 35(70%)	56.83	24.02			51.49	25.72		

Evaluation of Hyperbaric Oxygen Therapy for Patients with Autism Spectrum Disorders at Early Childhood Stage

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Summary

Background: Numerous studies of autistic individuals have revealed evidence of cerebral hypoperfusion, neuroinflammation, gastrointestinal inflammation, immune dysregulation, oxidative stress, relative mitochondrial dysfunction, and neurotransmitter abnormalities. Many of these findings have been correlated with core autistic symptoms. Cerebral hypoperfusion in autistic children has been correlated with repetitive, self-stimulatory and stereotypical behaviors, and impairments in communication. Specifically, hyperbaric oxygen therapy (HBOT) has been used and can compensate for decreased blood flow by increasing the oxygen content of plasma and body tissues..

Aim: was to study effects of HBOT on symptoms of Autism Spectrum Disorder (ASD), including social communication problems, stereotypical and repetitive and challenging behavior.

Patients and Methods: This study was conducted on 50 children diagnosed as ASD based on DSM- IV- TR criteria (diagnostic and statistical manual of mental disorders, 4th edition criteria, text revised), their age ranged from 2- 8 yrs with mean age 4.6 yrs, SD±1.9 yrs. All patients received 40 sessions of HBOT 1.5 ATA (atmosphere absolute) with 100% oxygen for 1 h in multiplace chamber. Patients were evaluated before and after HBOT using Autism Treatment Evaluation Checklist (ATEC) Childhood Autism Rating Scale (CARS).

Results: The study revealed a statistically significant decrease (i.e., improvement) in the mean scores of ATEC subscale, ATEC total score and CARS post HBOT compared to their level before HBOT ($p < 0.05$).

Conclusion: HBOT is a potentially effective treatment for children with ASD but further studies are recommended to determine which ASD individual subgroups would benefit from treatment with HBOT.

دراسة تقييم العلاج بالأكسجين المضغوط
فى المرضى الذاتويين فى مرحلة الطفولة المبكرة

الخلفيه: أشارت دراسات عديدة أجريت فى الآونة الأخيرة، إلى إختلالات معينة فى العديد من الوظائف فى مرضى التوحد مثل نقص التروية الدماغية، والإلتهاب، الإضطراب المناعى، إضطراب فى الموصلات العصبية، وخلل فى وظائف الميتوكوندريا. وقد كشفت العديد من الدراسات على الأفراد المصابين بالتوحد دليلا على نقص انسياب الدم الدماغي، والتهاب الأعصاب، والتهاب المعدة والأمعاء، الاضطراب المناعي، والإجهاد التأكسدي، الخلل النسبى فى وظائف الميتوكوندريا، خلل فى الموصلات العصبية، وخلل فى إزالة السموم، وضعف إنتاج البورفيرين. وقد ارتبطت العديد من هذه النتائج مع أعراض التوحد الأساسية فعلى سبيل المثال، ارتبط نقص انسياب الدم الدماغى فى الأطفال المصابين بالتوحد بالسلوكيات المتكررة والنمطية وسلوكيات تنبيه الذات، وضعف فى التواصل والإدراك الحسي، والتفاعل الاجتماعى. ولذلك فإن العلاج بالأكسجين ذوالضغط فوق الجوى قد يكون قادر على تحسين كل هذه الأختلالات فى الأفراد المصابين بالتوحد. ويمكن أن يتم تعويض انخفاض تدفق الدم عن طريق زيادة محتوى الأوكسجين فى البلازما وأنسجة الجسم.

الهدف: تحديد ما إذا كان العلاج بالأكسجين المضغوط يحسن أعراض داء الذاتوية، بما فى ذلك مشاكل التواصل الاجتماعي، والسلوكيات النمطية والمتكررة.

المرضى والأساليب: تم اجراء الدراسة على ٥٠ طفلا من المرضى الذاتويين الذين تم تشخيصهم طبقا للمعايير التشخيصية لداء الذاتوية للدليل التشخيصى والإحصائى للاضطرابات العقلية، الطبعة الرابعة (جمعية الطب النفسى الأمريكية، ٢٠١٣). تم اعطاء العلاج بالأكسجين النقى ١٠٠%- ١,٥ ضغط جوى مطلق لمدة ٤٠ جلسة كل جلسة ٦٠ دقيقة. مع تقييم مدى التحسن باستخدام القائمة المرجعية لتقييم علاج داء الذاتوية (ATEC) قبل وبعد العلاج.

النتائج: اظهرت وجود انخفاض (تحسن) ذو دلالة احصائية فى معدل القياس الكلى ومعدلات القياسات الفرعية لإستبيان القائمة المرجعية لتقييم علاج داء الذاتوية (ATEC) بعد العلاج بالأكسجين بالمقارنة بالقياسات المقابلة لها قبل العلاج بالأكسجين ذوالضغط فوق الجوى.

الخلاصة: تستنتج الدراسة أن العلاج بالأكسجين ذو الضغط فوق الجوى هو علاج آمن ومبشر للمرضى الذاتووين لكنه يحتاج الى مزيد من الدراسة والتقييم لنتائجه لاستكشاف مجموعات فرعية من المرضى الذاتووين الذين يمكن ان يستفيدوا من العلاج.