Some trace elements and oxidative status in children with Down syndrome and the effect of early intervention program

Al okali A.
Neuro-psychriatric Faculty of Medicine (Derna), Omar Amukhtar University. Libya
Amnaina A.
Pediatric Faculty of Medicine (Derna), Omar Amukhtar University. Libya
El Shourbagy O.
Community Deprtments, Faculty of Medicine (Derna), Omar Amukhtar University. Libya.

Abstract:

Our objective is to measure some plasma trace elements, oxidant and antioxidant enzymes and to compare the degrees of response to early intervention program among the intellectually disabled children due to genetic etiology (Down Syndrome).

Methodology:

This case control study included 60 children (30 cases with Down syndrome from outpatient clinics and care center for children with especial needs, Derna) and 30 controls matched for age and sex, from January to December 2007. All cases were subjected to measuring plasma selenium, copper, superoxide dismutase (SOD), glutathione peroxidase, evaluation of all the developmental fields (infant-stimulation, cognition, motor, social maturation, and language), a comprehensive program for early intervention using Portage Developmental Charts.

Results:

The mean values of plasma copper, erythrocyte SOD and blood glutathione peroxidase were significantly higher in cases with Down Syndrome than the controls (1.9± 0.2, 1.6± 0.2 mg/L, 407± 155, 133± 54 U/L, 13457± 2175, 6671± 2105 U/L), respectively, while blood selenium was significantly lower in Down Syndrome than controls (14.3± 0.9, 19.7± 1.3 ug/L, respectively)($P < 0.05$).

The mean value of social, self-help, cognition and motor developmental fields in Down Syndrome were significantly improved after the intervention program than before (77.3± 13, 78.1± 15, 61.2± 21, 66.8± 17, 66.3± 14, 73.5± 20, 44± 19, 52.6± 22, respectively)($P < 0.05$).

Conclusion:

Implementation of early comprehensive intervention programs is mandatory for the children who suffer from problems related to developmental fields and detecting any metabolic or molecular disorders could be prevented or treated by correction or replacement.

Keywords:

Down Syndrome, Mental Retardation, Early Intervention, Trace elements, Oxidative status.

Introduction:

Improving educational results for children with disabilities is an essential element of international policy of ensuring equality of opportunity, full participation, independent living, and economic self-sufficiency for individuals with disabilities. Early intervention applies to children of school age or younger who are discovered to have or be at risk of developing a handicapping condition that may affect their development. Early intervention consists in the provision of services for such children and their families aiming at lessening the effects of the condition[(1)].

Targeted interventions showed that cognitive and linguistic profiles or different slowings of development might affect early intervention services for young children with Down syndrome or other genetic disorders[(2)].

Early intervention has been shown to result in the child:

1. Enhance the developmental competence of participants and to prevent or minimize developmental delay.
2. Being retained in grade less often.
3. In some cases being indistinguishable from non-handicapped classmates years after intervention.
4. Needing fewer special education and other habilitative services later in life[(3)].

Aims:

The aim of the study is to measure some plasma trace elements, oxidant

and antioxidant enzymes and to compare the degrees of response to early intervention program among the intellectually disabled children due to genetic etiology (Down Syndrome).

Subjects And Methods:

This case control study included 60 children (30 cases with Down syndrome from outpatient clinics and care center for children with especial needs, Derna) and 30 controls matched for age and sex, from January to December 2007.

Each case was subjected to the following:

1. Comprehensive history taking and clinical examination. Investigations according to individual case (echocardiography, hearing test, fundus examination, brain C-T scan, EEG,...).
2. Laboratory investigations (Chromosomal analysis was done to all cases using the G-banding., Thyroid profile: TSH, T3 and T4, selenium, copper, superoxide dismutase, glutathione peroxidase.
3. Preliminary evaluation of developmental age (DA) of all developmental fields (infant-stimulation, cognition, motor, social maturation, and language), using the "Portage" charts.[4,5]
4. A comprehensive "Portage" program for early intervention and education of mentally disabled children and their mothers, concerned mainly with training of children inside their local environment (house).
5. A final post-evaluation of DA of all developmental fields, using the "Portage" developmental charts.

Results:

- Table (1) shows that the mean values of plasma copper, erythrocyte SOD and blood glutathione peroxidase were significantly higher in cases with Down Syndrome than the control group (1.9+ 0.2, 1.6+ 0.2 mg/L, 407+ 155, 133+ 54 U/L, 13457+ 2175, 6671+ 2105 U/L, respectively)(P<0.05). The mean values of blood selenium was significantly lower in cases with Down Syndrome than the control group (14.3+ 0.9, 19.7+ 1.3 ug/L, respectively)(P<0.05).

Table (1): Comparison between Mean Blood Selenium, Copper, Super oxidase mutase and Glutathione Peroxidase Levels in Down Syndrome group and the control group.

	Total DS (n=30)	Control (n=30)
SE Ug/L	14.3± 0.9*	19.7± 1.3
Cu Mg/L	1.9± 0.2*	1.6± 0.2
Sod U/L	407± 155*	133± 54
Gpx U/L	13457± 2175*	6671± 2105

* Statistically significant at P<0.05.

- Table (2) shows that the mean value of social, self-help, cognition and motor developmental fields in Down Syndrome were significantly improved after the intervention program than before (77.3+ 13, 78.1+ 15, 61.2+ 21, 66.8+ 17, 66.3+ 14, 73.5+ 20, 44+ 19, 52.6+ 22, respectively)(P<0.05).

Table (2): Comparison between Mean Values of Developmental fields Pre and Post-program in Down S. group.

Ds (N=30)	Pretest					Post-Test				
	Social	Self-Help	Cognition	Motor	Language	Social	Self-Help	Cognition	Motor	Language
Mean ± SD	66.3 ±14	73.5 ±20	44 ±19	52.6 ±22	42.5 ±22	77.3* ±13	78.1* ±15	61.2* ±21	66.8* ±17	48.2 ±20

* Statistically significant at P<0.05.

Discussion:

In the present study, there was an increase in the whole blood GPx activity of patients with complete trisomy and translocations. Patients with mosaic trisomy 21 had the typical clinical phenotype of DS, but their GPx activity statistically insignificantly increased, while their SOD activity at the high normal range. Estimation GPx catalytic activity may be a better indicator of the unbalanced antioxidant system than SOD. The SOD and GPx activities in patients with translocation 21 was statistically significantly higher than in patients with free trisomy 21. In vitro studies reported an elevated SOD/GPx in DS tissues of all organs.[6]

The Se concentrations in whole blood were significantly lower in DS patients. This finding confirms and agrees with the presence of low whole blood Se or plasma Se concentrations in DS cases reported by researchers. It has been suggested that the low Se levels in DS patients may reflect the relative Se deficiency owing to a less adaptive elevation response in GPx activity, which is a consequence of the over expressed SOD activity.[7]

Plasma Cu concentrations were significantly higher in the DS cases, which agrees with most previous studies.[8]

An overarching issue addressed in many studies is to determine whether the developmental processes of infants and young children with Down syndrome are similar to those of typically developing children but slower in rate or whether there are some qualitative differences in the behavioral expression, patterning, and organization of development.[9]

Social developmental field showed a statistically significant improvement in all DS cases (from a mean of 66.3± 14 to 77.3± 13). Before the beginning of the program, social activity showed a strong positive correlation with both motor and cognition fields and a positive correlation with self-help field. This could be explained by the fact that many social skills need a well developed gross motor (imitate praying movements, hold familial persons, play with other children, discover the surrounding environment, help his parents in home tasks ...etc.) and fine motor (grasp an object put in his hand, hold a small object, turn pages over, shake a toy producing sounds ...etc.) systems. They showed also atypical responses related to a lack of wariness or distress when presented with a still face from an adult.

Studied DS children showed a more focused style of attention, whereas, in the play alone with toys situation, they smiled less and rejected the toys more often. That could be due to presenting learning materials in a more passively rather than live format to young children with Down syndrome in order to engage attention maximally to the materials. DS cases showed a tendency to maintain high interest in the mirror than usual, perhaps indicating a failure to habituate in a situation in which such a response is common. DS patients were very adept at distracting us when they were challenged with a difficult task. They were less engaged in the motivation tasks, with shorter sequences of goal-directed behavior and more frequent toy rejection and with less causality pleasure when exploring objects (not as much positive affect associated with seeing how a toy works or discovering cause-effect relationships). This could be explained by a number of studies of learning in infants with Down syndrome[10, 11], that indicated differences in acquiring and consolidating basic developmental tasks as object concept. Findings suggest that, as early as 6 months of age, infants with Down syndrome engage in specific search and exploration behaviors that she described it as"Counterproductive"to learning.

The intersection of developed social maturation with self-help one, and cognition could be explained by the fact that cognition is considered as the master key of information processing and learning for all of the social tasks, and the delayed social responses correspondent to delays in cognitive development, reported by previous studies, could be explanations for these developmental fields correlations.[12]

Self-Help developmental field showed a statistically significant

improvement in DS cases with increase from mean of 73.5± 20 to 78.1± 15.

Cognition field showed a a statistically significant improvement from a mean of 44± 19 to 61.2± 21. DS had significant difficulty making transitions from stage to stage, even when their slower developmental pace is taken into account. They showed different patterns of performance over a series of trials suggesting that their object concept knowledge was not well consolidated.

Regarding Motor field, studied DS cases showed significant improvement from a mean of 52.6± 22 to 66.8± 17.

Results of the present study, agree with previous studies[13,14,15,16] for early motor and physical therapy and intervention, which succeeded to minimize the development of the compensatory movement patterns that children with DS are prone to develop due to ligamentous laxity, hypotonia, and muscle weakness (i.e. hip abduction and external rotation, hyperextension of the knees, and pronation and eversion of the feet). They also made a beteer difference in the long-term functional outcome of children with DS.[17,18]

Conclusion:

In conclusion, the implementation of early comprehensive intervention/ stimulation programs is mandatory for early detection of the children who suffer from problems that relate to the developmental fields and their inclusion within the society as early as possible during early childhood period. Detecting any metabolic or molecular disorders of children that could be prevented or treated by correction or replacement with the suitable multivitamins and trace elements. An individualized interventional program (Portage Developmental Charts Program) for each child that suits developmental demands.

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الملخص

بعض العناصر النادرة وحالة التأكسد عند الأطفال المصابين بمتلازمة داوون وأثر برنامج للتدخل العلاجى المبكر

يهدف البحث إلى قياس بعض العناصر النادرة بالدم وأنزيمات الأكسدة والأنزيمات المضادة للأكسدة ومقارنتها بمدى الإستجابة لبرنامج تدخل علاجى مبكر عند الأطفال ذوى الإعاقة العقلية وذلك وفق الأسباب المرضية الوراثية (متلازمة داون).

المنهجية:

تناولت هذه الدراسة ستين طفلاً تم تقسيمهم الى ثلاثين طفلاً من ذوى متلازمة داون من المترددين على العيادات الخارجية ومركز رعاية الأطفال ذوى الإحتياجات الخاصة فى درنة، وأيضاً ثلاثين حالة ضابطة ممن يتوافقون فى العمر والجنس وذلك فى الفترة من يناير وحتى ديسمبر ٢٠٠٧ جميع الحالات خضعت لقياس نسب العناصر التالية فى الدم: السلينيوم، النحاس، فوق أكسيد الدسيوتاز) (بروكسيد آز الغلوتاثيون، بالاضافه الى تقييم جميع المجالات التنموية (تنبيه الرضيع- المعرفة- الحركة- النضج الإجتماعى، واللغة)، ضمن برنامج شامل للتدخل العلاجى المبكر بإستخدام جداول بورتاج البيانية.

وأظهرت النتائج: متوسط قيم النحاس فى الدم، وأنزيم آز بروكسيد الغلوتوثيون مرتفعاً وذو دلاله إحصائية فى الحالات المصابة بمتلازمة داوون بالمقارنة بالمجموعة الضابطة (١,٩±٠,٢، ١,٦±٠,٢mg/L، ٤٠٧±١٥٥، ١٣٣±٥٤U/L، ١٣٤٥٧±٢١٧٥، ٦٦٧١±٢١٠٥U/L، بالتتابع)، بينما جاء عنصر سلينيوم منخفضاً وذو دلالة إحصائية فى حالات متلازمة داوون بالمقارنة بالمجموعة الضابطة (١٤,٣±٠,٩, ١٩,٧±١,٣ug/Lعلى التوالى) (P<٠,٠٥). وجاء متوسط درجات المساعدة الإجتماعية ومساعدة الذات أفضل بشكل دلالى وأيضاً فى مجالات الحركة والمجالات التنموية وذلك فى الحالات المصابة بمتلازمة داوون بعد تطبيق برنامج التدخل العلاجى.

الخلاصة:

يعد تنفيذ وتطبيق برنامج التدخل العلاجى المبكر أمر حتمى وضرورى للأطفال الذين يعانون من مشكلات ترتبط بالمجالات التنموية وتكشف عن الاضطرابات الأيضية أو الجزيئية الممكن تجنبها أو معالجتها بالتنقيح أو الإحلال.

الكلمات المفتاحية:

متلازمة داوون- التأخر العقلى- التدخل المبكر- العناصر التتبعية- الحالة الأكسدية.