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The state of thyroid gland and psychical development of socially deprived children during treatment by “Iodide-100”

Комплексно обстежено 48 соціально депривованих дітей шкільного віку, які проживають на території помірного йододefіциту. Аналогічні спостереження проведені також після профілактичного лікування йодидом калію (препарат йодид-100). Вивчали співвідношення між розмірами, функціональною активністю щитоподібної залози та рівнем психічного розвитку дітей за умов помірного йододefіциту та після корекції цього стану. В результаті обстеження встановлено кореляційний зв'язок між розмірами щитоподібної залози та рівнем розумового розвитку, психічними функціями обстежених дітей. Виявлені зміни вірогідно покращуються внаслідок профілактичного лікування препаратами йоду.

INTRODUCTION

In rational and healthy nutrition important role belongs to sufficient and balanced usage of substances particularly so called micro nutrients (vitamins, microelements, minerals, essential fatty acids and essential amino acids). Despite of macro components of food (proteins, fats, carbohydrates), insufficient usage of micro nutrients isn't followed by manifestations of hunger, but consequences could be significant. Iodine insufficiency is considered to be one of the most typical examples of insufficiency of micro nutrients, that manifests by wide spectrum of disturbances [2, 4, 9, 11].

Results of studies of last years show the influence of iodine insufficiency on particular organs and systems of organism and primarily on thyroid gland. It has been known that thyroid hormones influence on growth, differentiation and physiological properties of cells, especially nervous cells. That's why in case of decreasing of level of iodine-containing thyroid hormones besides of vegetative disturbances there could be disturbances of auditory, motor and mental functions of brain [5, 7, 8, 12, 13].

Iodine is an microelement that has no ability for the significant depositing in organism.

Due to this human should systematically use iodine taking into account daily iodine need, that depends from age and functional activity of gland [11, 16, 21]. So despite looking on significant achievements in solving of the problem of fighting with iodine deficiency huge risk group constitute inhabitants with low level of prosperity that influences their nutrition. Primarily this relates to children from socially deprived families, which live on territory of biogeochemical provinces.

The aim of this study was to research correlation between sizes and functional activity of thyroid gland and level of mental development of socially deprived children of school age, which live on territory with moderate iodine deficiency and in conditions of prophylactic treatment using “Iodide 100” drug.

TECHNIQUE

Succeeding mentioned above aim 48 children aged from 8 to 17 years, which live and study at school for children left from parents' custody of Ivano-Frankivsk city were complexly examined. This regional centre belongs to territory of moderate iodine deficiency. Accord-

ing to age all examined persons were divided into 3 research groups : 1st group – children aged from 8 to 10 years (11 children), 2nd group – 11-14 years old (16 children), 3rd group – 15-17 years old (21 children). A basis of such division was data taken from literature about features of physical development and endocrinological state of children of different ages [15].

All scholars were complexly examined using clinical, functional, laboratory and psychodiagnostic methods.

Clinical data was taken by figuring out the complaints, life anamnesis and data of objective examination. To find out functional state of thyroid gland we used radioimmune method to estimate blood plasma level of thyroid hormones : triiodothyronine (T3), thyroxine (T4), thyrotrophic hormone of adenohypophysis and also level of iodine excretion (median of ioduria) in single portions of urine according to Sandell-Kolthoff reaction using Dunn et al. method [6].

Morphometric evaluation of state of thyroid gland was made by ultrasonography. Examination was made with the help of ultrasound scanning device “ULTIMA PRD-30” by linear sensor of 7,5 MHz frequency and 40 mm diameter. Volume of thyroid gland was evaluated by classical J.Brunn’s and authors equation [19]. Results of echo volume were estimated using following standards of thyroid volume [9, 19, 20, 21, 22]:

-taking into account sex and age of a child (A.Ф.Цыб and authors, 1990);

-taking into account body weight (Э.П.Касаткина and authors, 1999);

-taking into account only age of child (R. Gutekunst, H.Martin-Teichert,1993);

-dependence of thyroid volume from age not taking into account sex counting this by equation with correlation quotient of 0.52 (P.Vittita and authors, 1994);

-using two variants of norms, that are differentiated according to sex and body surface square (F. Delange and authors, 1997, Zimmermann M.B. et al., 2001). Body surface area (B.S.A.) was measured using equation :

$$B.S.A. = M^{0.425} \times p^{0.725} \times 71.84 \times 10^{-4},$$

where M is body weight (in kg), p – height (in cm).

Psychodiagnostic method foreseen testing using R.Kettel’s techniques, that was adapted at the department of normal physiology of Ivano-Frankivsk State Medical University [1]. Mentioned above test gives the possibility to evaluate so called “not formed” intellect, that doesn’t depend from level of education, culture and quality of child’s study.

Level of mental development and features of psychical functions on children were also evaluated with the help of studying peculiarities of attention, its constancy and concentration as a result of conducting proof probe [14]. Examination of speed of sensorimotor reactions was measured with the help of modified tables of Shulte [14].

With the aim of iodine deficiency prophylaxis all children once daily (after breakfast) took 100 micrograms of potassium iodide (“Iodide-100” drug) during 3 months [18].

Acquired results were analyzed by generally accepted statistic methods of modern computer programs with the usage of t criterion of Student, r correlation quotient. As probable differences were taken values with $P < 0.05$.

RESULTS AND THEIR DISCUSSION

As a result of analysis of biochemical blood plasma indexes of children of all age groups it has been revealed that level of T3 and T4 was in range of physiological norm, but level of thyrotrophic hormone of adenohypophysis reached border level (table 1).

Mentioned above changes were registered on inferior border of normal indexes of median of iodine concentration in urine : in 1st examination group median of ioduria was 101.01 ± 6.05 mcg/l, in 2nd - 107.89 ± 7.54 mcg/l, in 3rd - 112.47 ± 10.05 mcg/l.

Analysis of ultrasound indexes of thyroid gland revealed increase of its sizes in children of all age groups. Mean records of indexes of general volume (97 percentiles) of thyroid gland in socially deprived children is shown on fig-

ure №2. According to materials from literature differences in norms of sizes of thyroid gland using different methods are quite significant [3, 16]. These discrepancies neutralize with advancing age. Difference in absolute indexes of 97 percentile of volume of thyroid gland according to the standards of different authors significantly influences on conclusion about thyromegaly. Taking into account actuality and debates on question about adequate sizes of thyroid gland in table 2 there has been shown data about frequency of revealed thyromegaly in children from boarding school according to age groups in comparison with norms of different authors, including recommended norm for use from WHO and MRKYDZ [22].

Obtained indexes of hormonal state, border indexes of median of ioduria in conditions of relative thyromegaly could testify about presence of latent iodine deficiency in scholar's organism [17].

Analysis or results of testing showed that in 97.14 % of examined children IQ is decreased, among them in fifth part of children this index was lower than 50 points (normal range 90–110 points) and only in 7.89 % of scholars it reached normal range. Totally IQ

varied in ranges from less than 50 to 89 points. Obtained results were significantly lower than proper values. So in children of 1st examination group mean value of IQ was for 24.60 % ($P<0.05$), in children of 2nd group – for 27.78 % ($P<0.05$), in children of 3rd group – for 25.80 % ($P<0.05$) lower than inferior border of norm. Such indexes of IQ testify about very low level of mental development of examined scholars.

Evaluation of indexes of proof probe revealed decrease of quotient of accuracy of made work (quantity of mistakes was risen, especially on 5th minute), that shows quick fatigue and decrease of concentration of attention. In examined children speed of processing of information is definitely lowered. Obtained results of examination of speed of sensorimotor reactions and peculiarities of attention with the help of tables of Shulte indicated disturbances of attention on the background of increased weariness, that was manifested by increase of quantity of mistakes while searching numbers in each next table in comparison with target values.

After prophylactic treatment of examined children with “Iodide-100” drug during 3

Table 1. Blood plasma level of thyroid hormones in socially deprived children and on the background of their treatment by “Iodide-100” drug (M±m)

Age groups of children	Thyrotropic hormone of Adenohypophysis (mIU/l)	Triiodthyronine (T3, pmol/l)	Tyroxin (T4, pmol/l)
Before prophylactic treatment			
1 st age group (8-10 years old, n=11)	5.11±0.21	6.14±0.20	18.30±1.44
2 nd age group (11-14 years old, n=16)	5.29±0.11	5.91±0.08	12.30±1.05
3 rd age group (15-17 years old, n=21)	5.35±0.24	2.4±0.02	11.23±1.02
After prophylactic treatment			
1 st age group (8-10 years old, n=11)	4.11±0.31*	6.28±0.42	19.48±1.26
2 nd age group (11-14 years old, n=16)	3.75±0.89*	5.64±0.08	16.85±2.15*
3 rd age group (15-17 years old, n=21)	4.31±1.01*	2.44±0.78	15.70±1.04*

* definitive changes ($P<0.05$) in comparison with same indexes before prophylactic treatment.

months we observed maintenance of endocrine activity of thyroid gland (according to levels of T3 and T4), definitive increase of blood plasma level of thyrotropic hormone of adenohypophysis (table 1) and excretion of iodine with urine (median of ioduria in all children has exceeded 100 mcg/l).

According to ultrasound data mean indexes of volume of thyroid gland after correction of iodine deficiency definitely decreased in children of all three examination groups (figure 2). The biggest decrease in volume of thyroid gland was observed in children of 3rd examination group. It is necessarily to emphasize that only in one child of this examination group with thyromegaly decrease of sizes of thyroid gland was not definitive. In this case the formation of nodular euthyroid goiter yet before correction and non effectiveness of iodine-containing drugs in such condition could be supposed. The reason of this state could be also the presence of dysmorphogenesis, that is a congenital defect of synthesis of thyroid hormones and needs special ways of treatment [3, 17].

By comparing the level of mental development of children with latent iodine deficiency and those after correction, definitive increase of IQ of scholars of all age groups is shown. Such increase of IQ testifies about distinct tendency of improving of mental development of scholars with latent hypothyrosis after prophylactic treatment with "Iodide-100" drug in child's age.

Evaluation of indexes of proof probe revealed increase of quotient of accuracy of

made work (decrease of quantity of mistakes), so it signalizes about enhancement of concentration of attention in comparison with the same indexes before correction. In children on the background of treatment speed of processing of information definitely increased. Obtained results of examination of speed of sensorimotor reactions and peculiarities of attention with the help of tables of Shulte show improvement of attention, that is manifested by decrease of quantity of mistakes while searching numbers in each next table in comparison with target values.

CONCLUSIONS

In socially deprived children, which live on the territory with moderate iodine deficiency a latent iodine deficiency appears, that cause enlargement of thyroid gland – goiter. Independently from functional compensation of gland (hormonal state) already on early stages (junior and middle age groups) significant changes of psychical development do appear, this is specially dangerous for the social health of population of Ukraine. Changes of mental development correlate with sizes of thyroid gland. The usage of iodine-containing drugs (particularly "Iodide-100") is effective for the correction of iodine deficiency. After 3 month's courses of treatment by this drug hormonal state is restored, sizes of thyroid gland definitely decrease, IQ index along with concentration of attention and speed of sensorimotor reactions increase.

Obtained results show a necessity of systemic

Table 2. Frequency of thyromegaly in socially deprived children of school age, which live on the territory of moderate iodine deficiency in comparison with norms of different authors, expressed in % (n=48)

Age groups of children	A.F.Tzyb and authors, 1990	E.P. Kasatkina and Authors, 1999	R.Gutekunst, H.Martin-Teichert, 1993	P.Vittita and authors, 1994	F.Delange and authors, 1997, evaluation by age	Zimmermann M.B. and authors, 2001, evaluation by body surface area
1 st age group (8-10 years old, n=11)	50.0	37.5	62.5	62.5	37.5	37.5
2 nd age group (11-14 years old, n=16)	36.4	54.6	54.6	54.6	18.2	36.4
3 rd age group (15-17 years old, n=21)	43.8	50.0	56.3	56.3	25.5	31.3

examination of children of school age to find out a latent iodine deficiency under maintained functional activity of thyroid gland on a background of thyromegaly independently from intensity of iodine deficiency in biogeochemical province. In this case prophylactic treatment of such states by iodine-containing drugs is effective.

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THE STATE OF THYROID GLAND AND PSYCHICAL DEVELOPMENT OF SOCIALLY DEPRIVED CHILDREN DURING TREATMENT BY "IODIDE-100"

Socially deprived children of school age, who live on the territory of moderate iodine deficiency and under conditions of preventive treatment with "Iodide-100" drug have been examined. The following parameters have been examined: the size of thyroid gland, its functional activity and the level of children's mental development. The correlation link between the sizes of thyroid gland and the level of mental development, psychic functions of examined children has been established. Preventive treatment with "Iodide-100" significantly improved the investigated parameters.

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