



Microelement provision state in patients with paroxysmal autonomic failure on the background of thyroid pathology

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Abstract. Background. The study of changes in the micronutrient content and its correlation with physical state in patients with paroxysmal autonomic failure (PAF) on the background of thyroid pathology is relevant. **Materials and methods.** The research included 44 patients aged from 7 to 17 (14.06 ± 0.18) years with PAF. All patients underwent comprehensive examination using clinical and instrumental methods. The composition of macro- and microelements in the blood plasma and the hair root zone was studied by measuring mass fraction of chemical elements in the hair and plasma using X-ray-fluorescence method with the help of portable energy-dispersive X-ray-fluorescence spectrometer ElvaX; children's individual microelement profile deviations were also evaluated. **Results.** In 100 % of patients with PAF, iodine deficiency was found after determining micronutrient content in the hair that indicate the necessity of iodine deficiency prevention in such patients. **Conclusions.** The correlation between the microelements involved in thyroid gland functioning and their content in the hair and blood plasma have been established that indicate a significant imbalance of the microelement state in patients with PAF and requires appropriate correction.

Keywords: vegetative dysfunction; thyroid gland pathology; microelements; X-ray-fluorescence spectrometer; children

Introduction

Over the last decade the stable increasing in the number of children with autonomic dysfunction symptoms observed. According to modern ideas autonomic dysfunction regarded not only as a disease that embedded in the narrow confines of a particular nosology, but as a manifestation of systemic Psycho-endocrine-immune disorders. Paroxysmal autonomic dysfunction is the clinical form of autonomic dysfunction resulting from autonomic nervous system overload and is characterized by adaptation processes disruption [1].

Recent studies have conclusively demonstrated the thyroid gland pathology influence on the autonomic nervous system functioning. It was defined that even in the early stages of thyroid dysfunction psycho-emotional field affecting, as a well as central and autonomic nervous systems action [2–4]. Recently widely studied autonomic dysfunctions in case of hypothyroidism in adults. In this researches attention is paid to the frequent mood

changes and emotional instability in patients, almost 73.1 % of them marked irritability, tearfulness, hyperactivity, anxiety, susceptibility to phobic state. The last of them in 35 % of cases occurring as a nonspecific panic attacks and resembled clinically to sympathoadrenal crisis [5].

According to the WHO, 30 % of the world's population are at the risk of iodine deficiency. Despite the Iodine key role in such cases, endemic cretinism today has mixed origin and is being a result of interaction between endogenous and exogenous factors. According to literature, important thing is not only to reduce Iodine admission to the organism, but also deficiency of related minerals.

Microelements concentration in tissues is balanced owing to homeostasis. Changes in the concentration of each microelement, distribution, metal ions depositing submit to the macroorganism's biochemical regulation. Ionic balance determination in biological substances

allows to comprehend the metabolic changes in metal-bearing molecules in the macroorganism. It is known, that human hair collect microelements, whereby their concentration may be objective indicator of organism microelement state in general [6].

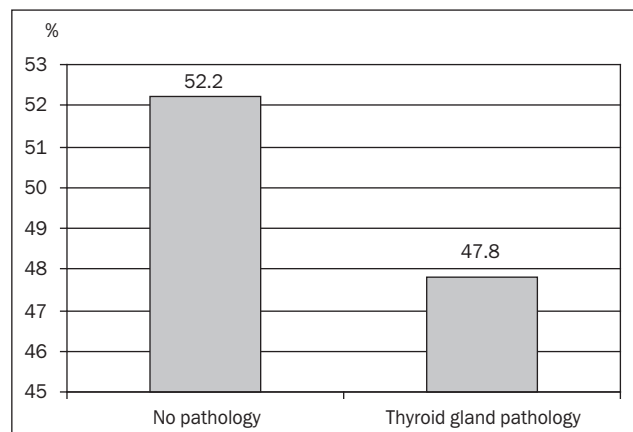
The WHO recommends to define Iodine in urine when the prevalence of Iodine deficiency among the population should be determined [7]. However, Iodine amount in urine shows current use of Iodine, therefore it doesn't represent genuine Iodine state in the body. The Iodine content in depot tissues (hair) indicates its usage for the prolonged time. A.L. Horbachev et al. conducted the comparative analysis of Iodine content with the standard determination of it in the urine with simultaneous determination in the hair to confirm the amenity of Iodine content in hair to establish the Iodine deficiency. Thus, according to the research, the Iodine determination in hair is being more sensitive method and allows to determine endogenous Iodine and other microelements deficiency [8].

Until now the situation with microelements state in patients with paroxysmal autonomic failure (PAF) on the thyroid gland pathology background is uncertain. It is relevant, because obtained results gives a chance to treat patient with regard to detected pathology.

The purpose of the study was to determine microelements state in patients with paroxysmal autonomic failure on the thyroid gland pathology background.

Materials and methods

The research included 44 patients from 7 to 17 y.o. (14.06 ± 0.18) with PAF, who underwent a complex screening in the Center of autonomic dysfunction at the Child Clinical Hospital N 6 in Kyiv, Ukraine. Working out in complains detail an survey with children and their parents was conducted. All patients were completely examined by clinical and instrumental methods. Screening involved the methods of autonomic homeostasis condition evaluation, cerebral blood flow and brain biopotential activity evaluation, thyroid ultrasound, thyroid hormones blood test and endocrinologist professional advice. The diagnosis "Paroxysmal autonomic failure" defined according to Maidannyk VG classification (2000)



Picture 1. Thyroid gland pathology in patients with PAF

[1]. The composition of macro- and microelements in the blood plasma and the hair root zone was studied by measuring mass fraction of chemical elements in hair and plasma using X-ray-fluorescence method with the help of portable energy-dispersive X-ray-fluorescence spectrometer "ElvaX". Children's individual microelement profile deviations held by means of biologically acceptable levels (BAL) of toxic chemical elements and normal limit of essential chemical elements in patients hair, defined by Skal'na MG (2009). Statistical analysis was performed using mathematical software package MS Excel and SPSS 22.0.

Results and discussion

Mostly patients with PAF complained of headache (96.9 %), loss of consciousness (47.4 %), emotional lability (57.5 %), pain in the heart (33.3 %), fear (47.4 %). Thyroid ultrasound has been carried out to all patients with PAF as well as additional T3/T4 and thyroid-stimulating hormone blood test. Among all examined patients thyroid gland disorders was found in 47.8 % of patients (pict. 1).

After endocrinologist professional advice patients were diagnosed in the following way (pict. 2).

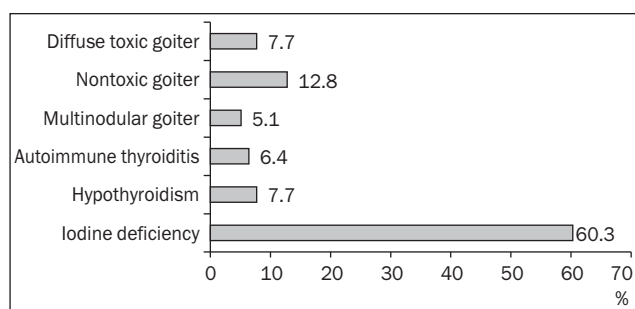
Thus, after endocrinologist professional advice next disorders were determined: nontoxic goiter in 12.8 % of patients, the Grave's disease (diffuse toxic goiter) in 7.7 %, multinodular goiter in 5.1 %, autoimmune thyroiditis in 6.4 %, hypothyroidism in 7.7 %. In other patients detected disorders were interpreted as iodine deficiency, that indicate the necessity of Iodine state determination in patients.

All patients with PAF has been carried out with microelements state evaluation and its determination in the hair and blood plasma.

The following changes in the microelements concentration in the hair and blood plasma were defined (pict. 3, 4).

As represented on the pict. 3, in all children with PAF iodine and selenium deficiency were determined. Also, half of patients had reduced zinc concentration and 63.6 % had calcium reduction. Besides, in 9.1 % of patients sulfur deficiency was revealed.

As represented on the Pic.4, the blood plasma fractionation shows reduced bromide concentration in 100 % patients with PAF, reduced calcium concentration in 61.6 %, reduced sulfur concentration in 54.5 %, reduced zinc concentration in 54.5 %.



Picture 2. Nosological forms of thyroid gland disorders in patients with PAF

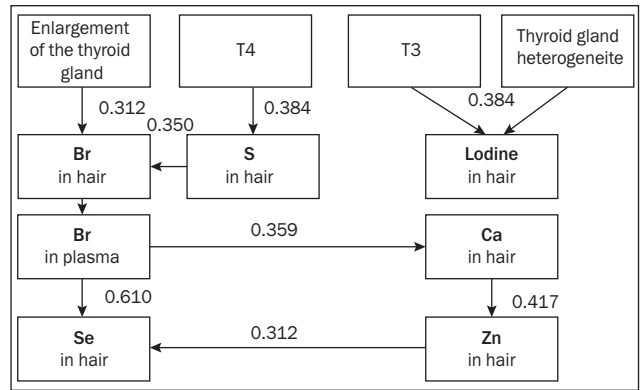
reduced selenium and zinc concentration in 86.3 and 29.5 % accordingly. Iodine concentration in blood plasma was not measured due to his minimal concentration and insufficient sensitivity of the X-ray fluorescence method test-systems.

Interestingly, the microelements parameters comparing in patients with PAF on the thyroid gland pathology background and without it, a statistically significant difference was found only in the concentration of sulfur in plasma (61.5 versus 29.0 %, $p < 0.05$). All other microelements were found almost in the same amount in both groups.

The correlation analysis was performed between the microelements content in hair and blood plasma and thyroid gland indexes (pict. 5).

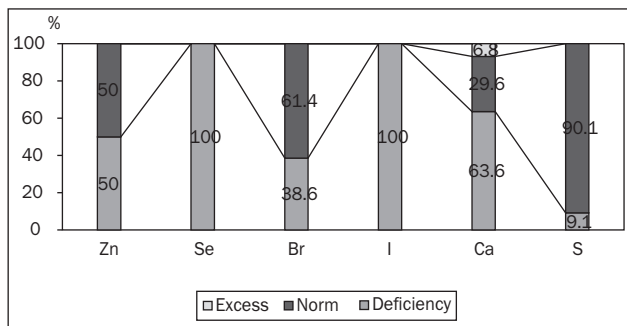
Enlargement of the thyroid gland has a positive statistically significant correlation with the content of bromide in hair ($r = 0.312$, $p < 0.05$) is to be noted, while thyroid gland heterogeneity correlates with the iodine content in the hair ($r = 0.384$, $p < 0.05$). In addition, changes in the T4 hormone range correlate with the sulfur content insufficiency in the hair ($r = 0.384$, $p < 0.05$), and T3 — with iodine content ($r = 0.384$, $p < 0.05$). The fact is that the microelements content in plasma (Br, Se, Zn, Ca) has a positive mutual statistically significant correlation.

There are a lot of reliable facts about iodine necessity for the thyroid gland functioning and human organism as a whole, but its competitive interactions with the microelement of bromide, similar in chemical group (halogen), are also important. It is also known that selenium and zinc are directly involved in the formation of thyroid gland and its hormones. Thus, selenium is an integral

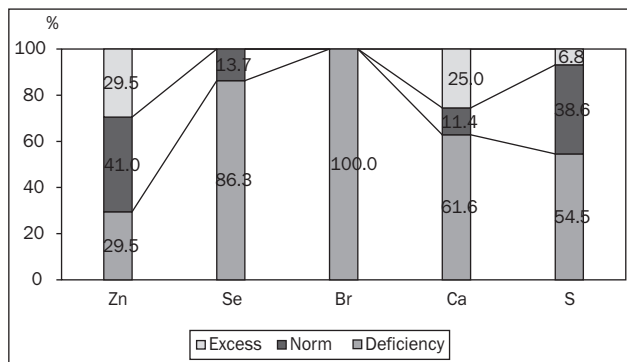


Picture 5. The correlation connections between the microelements content in hair and blood plasma and thyroid gland properties in patients with PAF on the thyroid gland pathology background

part of the enzyme Iodotyrosine deiodinase, responsible for the peripheral transformation of the T4 (thyroxine) hormone into active T3 (triiodothyronine), while zinc, as a part of more than 200 metalloproteinases, is part of the nuclear receptor of triiodothyronine. It is important that the T4 hormone breakdown leads to increased calcium loss in the urine and to the bone resorption. At the same time, calcium range lowering is associated with calcitonin hormone concentration decreasing, while sulfur is known as a constituent part of calcitonin. As a result, the concentration of parathyroid hormone grows and resorption of bone tissue increases with the subsequent development of osteopenia. Consequently, the disorders in the microelement provision state in patients with PAF on the thyroid gland pathology background have great significance and require appropriate correction.



Picture 3. Microelements concentration in the hair in patients with PAF



Picture 4. Microelements concentration in the blood plasma in patients with PAF

Conclusions

1. Thyroid gland disorders were found in 47.8 % of patients, that proves the necessity of obligatory thyroid gland screening in such patients with help of ultrasound and thyroid hormones blood test.
2. In 100 % of patients with PAF iodine deficiency was found after microelements determination in the hair, that denote the necessity of iodine deficiency prevention in such patients.
3. The correlation connections between the microelements, participated in thyroid gland functioning (Ca, Br, Se, S, Zn) and theirs content in the hair and blood plasma have been established, that indicates a significant imbalance of the microelement state in patients with PAF and requires appropriate correction.

Conflicts of interests. Authors declare the absence of any conflicts of interests that might be construed to influence the results or interpretation of their manuscript.

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Стан мікроелементного забезпечення в пацієнтів із пароксизмальною вегетативною недостатністю на фоні патології щитоподібної залози

Резюме. Актуальність. Вивчивши зміни в концентрації мікроелементів в організмі в пацієнтів із пароксизмальною вегетативною недостатністю (ПВН) на фоні патології щитоподібної залози, можна встановити їх взаємозв'язок із змінами у фізичному стані. **Матеріали та методи.** Було обстежено 44 дитини віком 7–17 років ($14,06 \pm 0,18$) із ПВН. Усім хворим був проведений комплекс клініко-інструментальних досліджень. Склад макро- та мікроелементів у плазмі крові та прикорневої зоні волосся вивчався за допомогою методики виконання вимірювань масової частки хімічних елементів у волоссі та плазмі крові рентгенофлуоресцентним методом із використанням портативного енергодисперсійного рентгенофлуоресцентного спектрометра ElvaX.

Відхилення індивідуального мікроелементного профілю дитини також фіксувалися. **Результати.** У 100 % пацієнтів із ПВН встановлено йододефіцитний стан за результатами визначення мікроелементів у волоссі, що вказує на необхідність профілактики йододефіциту в таких хворих. **Висновки.** Установлено кореляційні зв'язки між мікроелементами, що беруть участь у функціонуванні щитоподібної залози, та визначено порушення їх вмісту у волоссі та плазмі крові, що свідчить про значний дисбаланс мікроелементного стану у хворих на ПВН і потребує відповідної корекції.

Ключові слова: вегетативна дисфункція; патологія щитоподібної залози; мікроелементи; рентгенофлуоресцентний спектрометр; діти

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Состояние микроэлементного обеспечения у пациентов с пароксизмальной вегетативной недостаточностью на фоне патологии щитовидной железы

Резюме. Актуальность. Определив изменения в концентрации микроэлементов в организме у пациентов с пароксизмальной вегетативной недостаточностью (ПВН) на фоне патологии щитовидной железы, можно установить их взаимосвязь с изменениями в физическом состоянии. **Материалы и методы.** Были обследованы 44 ребенка в возрасте 7–17 лет ($14,06 \pm 0,18$) с ПВН. Всем больным был проведен комплекс клинико-инструментальных исследований. Состав макро- и микроэлементов в плазме крови и прикорневой зоне волос изучался с помощью методики измерения массовой частицы химических элементов в волосах и плазме крови рентгенофлуоресцентным методом с использованием портативного энергодисперсионного рентгенофлуоресцентного спектрометра ElvaX. Отклоне-

ния индивидуального микроэлементного профиля ребенка также фиксировались. **Результаты.** У 100 % пациентов с ПВН встановлено йододефіцитное состояние по результатам определения микроэлементов в волосах, что указывает на необходимость профилактики йододефицита у таких больных. **Выводы.** Установлены корреляционные связи между микроэлементами, участвующими в функционировании щитовидной железы, и определены нарушения их содержания в волосах и плазме крови, что свидетельствует о значительном дисбалансе микроэлементного состояния у больных ПВН и требует соответствующей коррекции.

Ключевые слова: вегетативная дисфункция; патология щитовидной железы; микроэлементы; рентгенофлуоресцентный спектрометр; дети