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VEGETATIVE STATUS AND CORTISOL LEVEL IN SCHOOL AGE CHILDREN WITH NORMAL, HIGH NORMAL ARTERIAL PRESSURE AND ESSENTIAL ARTERIAL HYPERTENSION

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 NORMAL ARTERIAL PRESSURE AND ESSENTIAL ARTERIAL HYPERTENSION**

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Rezume

Introduction. Essential arterial hypertension (EAH) among teenagers is a predictor of hypertonic disease in adults, risk factor of heart ischemic disease development, atherosclerosis, cardiac failure, which are basic reasons of invalidity and mortality of adult population. In relation to that, problem of prevention and prognosis of the progression of high normal pressure and arterial hypertension in children and teenagers occupies prior position in pediatrics and children's cardiology.

The objective: to study vegetative status in relation to cortisol amount in school age children with normal, high normal arterial pressure and essential arterial hypertension

Material and methods

62 school children aged from 14 to 16 years old were studied and prospectively followed. Children were divided to 4 groups: 1st group included children with normal arterial pressure (control group n=20), 2nd group involved children with high normal AP (HNAP) (comparison group =18), two basic groups: 3rd group of children with labile arterial hypertension (LAH) =12, and 4th group of children with stable arterial hypertension (SAH) = 12.

Results

According to the results of studies of the parameters of vegetative homeostasis in relation to cortisol level in children aged 14-16 years old (average 14.65±0.19 years old) with essential arterial hypertension a reliable prevalence of hyper sympatheticotonic original vegetative tension was determined (p<0.001, AR=0.33) with little impact of humoral factors (p<0.05) in rest and expressive maladjustment reactions in orthostasis; rise of cortisol amount in blood serum with reliable correlations with cardiac intervalographic parameters at orthostatic test. Cortisol amount >402.2 nmol/L was significant in case of stabilization of arterial hypertension (RR=1.93).

Conclusion. The achieved data have prognostic importance in relation to the formation of stable arterial hypertension in children.

Key words. Essential arterial hypertension, children, school age, vegetative nerve system, vegetative homeostasis, cortisol.

**НОРМАЛ, ЮҚОРИ НОРМАЛ АРТЕРИАЛ ҚОН БОСИМИ ВА ЭССЕНЦИАЛ АРТЕРИАЛ
 ГИПЕРТЕНЗИЯЛИ МАКТАБ ЁШИДАГИ БОЛАЛАРДА ВЕГЕТАТИВ СТАТУС ВА КОРТИЗОЛ
 МИҚДОРНИНГ ҲОЛАТИ**

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Резюме

Долзарблиги. Ўсмирлардаги эссенциал артериал гипертензия (ЭАГ) катта ёшдагиларнинг гипертоник касаллигини предиктори, юрак ишемик касаллиги, атеросклероз, юрак етишимовчилигининг хавф омилли бўлиб, катта ёшдаги аҳолининг ногиронлиги ва ўлимнинг асосий сабабчиларидандир. Шунинг учун болалар ва ўсмирлардаги юқори нормал қон босими ва артериал гипертензия муаммоси педиатрия ва болалар кардиологиясининг устувор йўналиши ҳисобланади.

Тадқиқот мақсади: нормал, юқори нормал артериал қон босими ва эссенциал артериал гипертензияли мактаб ёшидаги болаларда вегетатив статус ва кортизол миқдорининг ҳолатини ўрганиши.

Тадқиқот материаллари ва усуллари. 14– 16 ёшдаги 62 нафар мактаб ўқувчиси проспектив қузатув ва текширувдан ўтказилди. Бунда болалар 4 гуруҳга бўлинди: 1 гуруҳ – артериал қон босими нормал бўлган болалар (назорат гуруҳи) (n=20), 2 гуруҳ – юқори нормал артериал қон босимига эга болалар (2-солиштирма гуруҳи) – 18, 2 та асосий гуруҳ: 3-гуруҳ – лабил артериал гипертензияси бўлган (ЛАГ) – 12 ва 4-гуруҳ – стабил артериал гипертензияси бўлган ўқувчилар (САГ) - 12.

Натижалар. Эссенциал артериал гипертензияси бўлган 14– 16 ёшдаги (ўртача ёши 14,65±0,19) мактаб ўқувчиларида вегетативгомеостаз параметрлари кортизол миқдори билан узвий боғлиқликда ўрганилганда бошланғич вегетатив тарангликнинг гиперсимпатикотоник ҳолати ишончли равишда устунлиги (p<0,001, AR=0,33), турғунликда гуморал факторларнинг таъсири кўйи чегарада (p<0,05) эканлиги билан ва ортастазда яққол дисадаптив реакциялари; қон зардобиди кортизол миқдорининг ошиши ва ортостатик пробада унинг кардиоинтервалография параметрлари билан ишончли равишда корреляцион боғлиқликлари аниқланди. Артериал гипертензиянинг стабил бўлишида >402,2 нмоль/л кортизол миқдори аҳамиятли бўлди (RR=1,93).

Хулоса. Олинган натижалар болаларда стабил артериал гипертензиянинг ривожланишини прогнозда муҳим аҳамиятга эга.

Калит сўзлар. Эссенциал артериал гипертензия, болалар, мактаб ёши, вегетатив нерв тизими, вегетатив го-меостаз, кортизол.

СОСТОЯНИЕ ВЕГЕТАТИВНОГО СТАТУСА И УРОВНЯ КОРТИЗОЛА У ДЕТЕЙ ШКОЛЬНОГО ВОЗРАСТА С НОРМАЛЬНЫМ, ВЫСОКИМ НОРМАЛЬНЫМ АРТЕРИАЛЬНЫМ ДАВЛЕНИЕМ И ЭССЕНЦИАЛЬНОЙ АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИЕЙ

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Резюме

Актуальность. Эссенциальная артериальная гипертензия (ЭАГ) у подростков является предиктором гипертонической болезни взрослых, фактором риска развития ишемической болезни сердца, атеросклероза, сердечной недостаточности, которые являются основными причинами инвалидизации и смертности взрослого населения. В связи с этим, проблема профилактики и прогнозирования течения высокого нормального давления и артериальной гипертензии у детей и подростков занимает приоритетное положение в педиатрии и детской кардиологии.

Цель. Изучить состояние вегетативного статуса во взаимосвязи с уровнем кортизола у детей школьного возраста с нормальным, высоким нормальным артериальным давлением и эссенциальной артериальной гипертензией

Материалы и методы. Исследованию и проспективному наблюдению были подвергнуты 62 школьника в возрасте 14-16 лет. Дети разделены на 4 группы: 1 группа – дети с нормальным артериальным давлением (АД) (контрольная группа) (n=20), 2 группа – дети с высоким нормальным АД (ВНАД) (сравнительная – 2я группа) – 18, 2 основные группы: 3 группа – дети с лабильной артериальной гипертензией (ЛАГ) – 12 и 4-я группа – дети со стабильной артериальной гипертензией (САГ) – 12.

Результаты исследования. По результатам исследований параметров вегетативного гомеостаза во взаимосвязи с уровнем кортизола у детей в возрасте 14-16 лет (средний возраст 14,65±0,19 лет) с эссенциальной артериальной гипертензией было установлено достоверное преобладание гиперсимпатикотонического исходного вегетативного тонуса ($p < 0,001$, $AR = 0,33$) с низким уровнем воздействия гуморальных факторов ($p < 0,05$) при покое и выраженные дисадаптивные реакции на ортостазе; повышение уровня кортизола в сыворотке крови с наличием достоверных корреляционных связей с параметрами кардиоинтервалографии при ортостатической пробе. Уровень кортизола $> 402,2$ нмоль/л был значимым при стабилизации артериальной гипертензии ($RR = 1,93$).

Заключение. Полученные данные имеют прогностическое значение в отношении формирования стабильной артериальной гипертензии у детей.

Ключевые слова. Эссенциальная артериальная гипертензия, дети, школьный возраст, вегетативная нервная система, вегетативный гомеостаз, кортизол.

Introduction

Essential arterial hypertension (EAH) as a multifactor pathology develops in case of disorders of the adaptation processes of people to the conditions of environment with background genetic predisposition and regular forming pathologic physiological processes in organism, which can affect the mechanisms of arterial pressure (AP) regulation [1, 3, 4, 5, 6]. According to various authors prevalence of EAH in childhood and adolescence represents a significant value from 2.4% to 18% [8, 10, 11, 12]. Recently there is a notable tendency for growth of EAH prevalence among school children. Arterial hypertension among teenagers is a predictor of hypertonic disease in adults, risk factor of heart ischemic disease development, atherosclerosis, cardiac failure, which are basic reasons of invalidation and mortality of adult population [13, 14, 15]. In relation to that, problem of prevention and prognosis of the progression of high normal pressure and arterial hypertension in children and teenagers occupies priority position in pediatrics and children's cardiology.

In compliance with the modern notions, health is assessed according to the degree of body adaptation to environment, while start of disease is considered to be maladjustment of functional systems. From that point of view, EAH is considered to be a manifestation of maladjustment of mechanisms regulating arterial pressure. Processes of adaptation and regulation of arterial pressure are closely interrelated with the function of vegetative nerve system; first of all it is relevant to hypothalamus-pituitary-adrenal system. Definition of heart rate is commonly accepted to be the most descriptive non-invasive method of qualitative and quantitative assessment of heart rate vegetative regulation [2, 16, 17]. Nowadays

assessment of original vegetative tension (with the help of Vein charts), Kerdo's vegetative index, cunei orthostatic test, cardiac intervalographic parameters (CIG) are widely used for the study of vegetative nerve system functional status in adolescents with arterial hypertension syndrome (CIG). CIG as a method for the assessment of VNS status does not have any age restrictions, it is safe, non-invasive, and used for healthy and sick children; it provides characteristics of the activity of sympathetic and parasympathetic parts of VNS via their influence on heart rate.

The title of "stress hormone" cortisol received due to formation of protective reactions to external threats and stress situations. It intensifies heartbeat, increases arterial pressure (AP). At the same time cortisol controls vascular tone preventing critical alteration of AP [2, 15]. In relation to that, the study of the correlation of original vegetative tone and cortisol representing vegetative and hormonal regulation of adaptation in children with EAH causes a great interest. That problem is not sufficiently studied in children with EAH and requires further study.

The objective: to study vegetative status in relation to cortisol amount in school age children with normal, high normal arterial pressure and essential arterial hypertension

Material and methods

62 school children aged from 14 to 16 years old (average 14.65±0.19) were studied and prospectively followed. Children were divided to 4 groups: 1st group included children with normal arterial pressure (control group n=20), 2nd group involved children with high normal AP (HNAP) (comparison group =18), two basic groups: 3rd group of children with labile arterial hypertension (LAH) =12, and

4th group of children with stable arterial hypertension (SAH) = 12. There were 35 boys (56.4±6.3%) and 27 girls (43.6±6.3%) respectively. Classification according to average age and gender was even. Clinical study inclusion criteria: children with essential arterial hypertension I stage (EAH, I stage with average SAP and/or DAP in three measurements equal or above 95 percentile, determined for that age group; if these exceed 99 percentiles not more than 5mmHg. When higher level of AP in dynamic follow up is not registered constantly, it is diagnosed as labile AH. The age of children 14-16 years old [9] without damage of target organs and children with normal and high normal arterial pressure, not in the exacerbation stage of chronic foci of infection within 6 months. Clinical study exclusion criteria: congenital renal abnormalities, endocrine pathology, secondary or symptomatic AH, EAH II stage. We performed complex studies using standard research methods (poll, ante and postnatal history, study of heredity, environmental and psychological factors, clinical and paraclinical tests (measurement of arterial pressure (AP); Grows graphics in compliance with WHO criteria (2009); definition of the puberty stage in compliance with Tanner's scheme (1962). Cardiac intervalographic parameters were assessed on the basis of recording of 100 consequent cardiac intervals in cunei position after 10-minutes rest and 100 cardiac intervals immediately after patient's movement to vertical position (Kuberger M.B., 1985). After R-R interval measurement with 0.02 second accuracy strip we performed analysis of the basic parameters of variational pulse-metering: mode (Mo), variation range (delta X), mode amplitude (AMo) and tension index (TI), determined according to the following formulae: $AMo/2 \times Moxdelta X$. Using cardiac intervalographic data we assessed original vegetative tone (OVT) and vegetative reactivity (VR).

Degree of the impact of vegetative nerve system (VNS) on cardiovascular system (CVS) was assessed by means of Kerdo's index calculation: $VI = (1 - DP/HBR) \times 100\%$, where VI is vegetative index measured in %, DP is diastolic pressure, mmHg, HBR is heart beat rate, beats/min. the value from -10 to +10% indicates balanced impact of VNS on CVS. In case of >+10 there is dominance of sympathetic impact, with > - 10 there is dominance of parasympathetic one. Tension rate in the regulation of CVS can be evaluated by means of express diagnostic method for the type of circulation self-regulation: $CSR = DP/HBR \times 100$, where CSR is index of the type of circulation self-regulation in %, DP is diastolic pressure, HBR is heart beat rate in beats/min. values of CSR from 90 to 110% reflect cardiovascular type, when values are >110 it is vascular, and with <90 it is cardiac type of self-regulation. Alteration of circulation regulation to the side of vascular component dominance testifies economizing, and increase of functional reserves. For the quantitative definition of cortisol amount in blood serum we applied Siemens sets (Germany) using Immulite 2000 XPi, Siemens, Germany. 138-690 nmol/L were accepted to be reference values of cortisol. Statistic processing of the material was done by means of calculation of arithmetic means (M), standard mistake (m). Statistical significance of differences was evaluated according to Student's t criterion for dependent and independent samples, where difference was considered to be reliable with $p < 0.05$. We calculated the values of attributive risk (AR) and relative risk (RR) [7].

Results of the study and discussion

Analysis of average quantitative and qualitative parameters of CIG in children revealed the following regularities of alterations of heart rate variability values: in the group of children with SAH in rest compared to the children from the control group there was reliable decrease of Mo ($p < 0.05$) with parallel decrease of delta X to 17.3%. as a result, there was increase of AMo to 15%, with reliable rise of TI1. Average values of TI1 in children with HNAP and control group testified original sympathicotonia and eutonia, respectively. Eutonic variant was rarely registered among the children with arterial hypertension compared to the control. Though original hypersympathicotonia in the group of children with SAH was registered 2.5 times more often ($RR = 2.5$), than among the children with HNAP, with absence of the original OVT with normal values of AP ($p < 0.05$). among the children of basic groups 30% cases of stable AH were linked with isolated hypersympathicotonia ($AR = 0.3/30\%$ or in 30 children out of 100 with AH) (table 1). In the position of orthostasis children with SAH compared to those from the control group had decrease of delta X ($p < 0.01$) and increase of Mo ($p < 0.05$) and AMo by 23.9%. parameters of TI2 in children with LAH and VR index turned out to be higher than the values of similar integral values of the children with normal AP to 93.2%, 45.2%, HNAP to 55.6% and $p < 0.05$, and SAH to 18.6% and 34.9%, respectively. Consequently, a large number of children with hypersympatheticotonic type of VR were in the group of children with LAH (58.3%), than in the control group (40%), comparison group (22.2%, $p < 0.05$), and the second basic group (33.3%). Asympatheticotonic type of VR was more often registered in the first basic group, i.e. children with LAH (41.7%), than among the children of the control group (15%), comparison group (38.9%), and second basic group (25%) without reliable differences. Sympatheticotonic (normotonic) type of VR prevailed among the children of the control group (45%) compared to basic groups (25% and 16.7%, respectively in the first and second basic groups).

Thus, statistical processing of CIG data helped to reveal regularities in the alterations of VNS parameters in children with HNAP and AH: definition of original vegetative tone in children with SAH revealed reliable increase of TI1, reflecting intensification of sympathetic regulation; over-tension of the system functioning is confirmed by the prevailing hypersympatheticotonic OVT (41.7%, $p < 0.05$ in children with SAH versus 0,0% in the control); reliably low value of Mo in children with SAH ($p < 0.05$) and comparison group, 1st basic testifies little influence of humoral factors. That type of mechanism of cardiac regulation is not perfect. It is dangerous due to over tension and adaptation failure [2, 16].

Orthostatic test is one of descriptive methods to reveal hidden alterations in regulation mechanisms [7, 61]. Children with SAH, moving to vertical position

Table 1

Average quantitative values of cardiac intervalography and cunei-orthostatic test in children of the studied groups

Parameter	Control group (n=20)	Comparison group HNAP (n=18)	Basic groups	
			LAH (n=12)	SAH (n=12)
Mo, s	0.79±0.037	0.76±0.016	0.75±0.038	0.73±0.015*
AMo, %	24.5±1.7	27.0±1.8	24.0±2.5	29.17±1.7
delta X, s	0.29±0.11	0.24±0.019	0.27±0.049	0.21±0.047
TI ₁ , rel.u	62.4±8.05	98.02±17.3	100.6±25.8	118.4±23.9*
In orthostasis: Mo, s	0.66±0.002	0.61±0.024	0.58±0.03*	0.59±0.03*
AMo, %	27.45±2.2	2.0±3.09	32.4±4.1	34.0±3.6
delta X, s	0.23±0.02	0.28±0.03	0.23±0.03	0.17±0.01**
TI ₂ , rel.u.	150,8±40.03	140.7±39.9	184.7±60.9	219.0±58.4
Original vegetative tone (OVT)	abs./%	abs./%	abs./%	abs./%
eutonic	13/65.0±10.7	11/61.1±11.5	4/33.3±13.6	4/33.3±13.6
sympatheticotonic	3/15.0±7.9	3/16.7±8.8	2/16.7±10.8	1/8.3±7.9
hypersympatheticotonic	-	3/16.7±8.8	3/25.0±12.5	5/41.7±14.2*
vagotonic	4/20.0±8.9	1/5.5±5.3	3/25.0±12.5	2/16.7±10.8
Vegetative reactivity (VR) TI₂/TI₁	2.22±0.35	1.44±0.3	3.18±1.3	4.29±1.3
sympatheticotonic, abs./%	9/45.0±11.1	7/38.9±11.5	2/16.7±10.8	2/16.7±12.5
hypersympatheticotonic, abs./%	8/40.0±10.9	4/22.2±9.8	4/33.3±13.6	7/58.3±14.2^
asympatheticotonic, abs./%	3/15.0±7.9	7/38.9±11.5±	5/41.7±14.2	3/25.0±12.5

Note: reliability of differences with *- p<0.05; ** - p<0.01 compared to the control;
^ - p<0.05 in relation to comparison group

Table 2

Average parameters of cardiovascular system functioning, Kerdo's index, circulatory self-regulation type (CSR) and cortisol amount in children of the studied groups

Parameter	Control (n=20)	Comparison HNAP (n=18)	Basic groups	
			LAH (n=12)	SAH (n=12)
Heartbeat, beat/min	80.3±1.08	80.7±1.5	85.9±1.9*	87.9±1.7**
SAP, mmHg	115.0±1.4	120.6±1.09**	130.7±1.5***	138.7±1.01***
DAP, mmHg	74.5±1.4	79.6±1.8*	80.4±1.9*	85.0±1.7***
Kerdo index, %	6.3±2.03	7.2±2.3	9.2±2.1	11.7±2.1
Balanced effect (abs./%)	13/65.0±10.7	11/61.1±11.5	6/50.0±14.4	2/16.7±10.8*
sympathetic (abs./%)	3/15.0±7.9	4/22.2±9.8	4/33.3±13.6	10/83.3±10.8**
parasympathetic (abs./%)		3/16.7±8.8	2/16.7±10.8	
Circulatory self-regulation type (CSR), %	98.8±2.9	93.6±2.0	93.8±2.1	86.7±2.1
cardiovascular	13/65.0±10.7	11/61.1±11.5	8/66.7±13.6	2/16.7±10.8*
vascular	4/20.0±8.9	3/16.7±8.8	2/16.7±10.8	-
cardiac	3/15.0±7.9	4/22.2±9.8	4/33.3±13.6	10/83.3±10.8***
Average amounts of cortisol in blood serum, nmol/L	291.25±33.9	353.5±22.8	364.8±15.8*	402.2±25.4**

Note: reliability of differences with *- p<0.05; ** - p<0.01; *** - p<0.001 compared to the control

have dominance of hypersympatheticotonic reactivity indicating certain instability of vegetative neural activity and sudden tension of compensation mechanisms. Prevalence of asympatheticotonic reactivity in children with LAH (41.7%) was higher than in the control, comparison, and the second basic groups (15.0%, 38.9%, 25.0%, respectively).

Increase of asympatheticotonic reactivity manifestation frequency in children indicates the vegetative dysfunction expression degree (exhaustion of functional reserves) mostly on CVS (hidden failure of circulation) confirmed clinically and in references [2, 16, 17]. Sympatheticotonic reactivity type is a marker of favorable tendencies in the prognosis for the observed children. The least frequency (16.7%) was registered in the second basic group and gradually inclining in the first basic, comparison, and control groups (25%, 38.9%, 45%, respectively).

A dynamic value, such as heart beat rate, is greatly dependent on the status of VNS. According to the results of the study average heartbeat parameters in the studied groups tended to intensify gradually inclining from the group of children with HNAP, then with LAH, ($p < 0.05$) and SAH ($p < 0.01$) with statistically reliable differences in relation to the control group (table 2). These changes were conditioned by the intensification of sympathetic impact, while according to anatomical physiological characteristics of that age there should be decrease of the heartbeat frequency due to prevailing activity of parasympathetic branch of VNS [2]. Average values of Kerdo's index in the studied groups were determined in the normal limits (from -10 to +10%), though a little exceed of normal values was noted in the group of children with SAH (11.7 ± 2.1) without reliable differences. In compliance with Kerdo's index the greatest frequency of VNS balanced effect on CVS was revealed among the children of the control group ($13/65.0 \pm 10.7\%$) and, respectively, there was the least frequency of sympathetic impact ($3/15.0 \pm 7.9\%$). Four children from that group had intensification of parasympathetic impact ($20.0 \pm 8.9\%$). In the group of children with HNAP and LAH there was a tendency for decrease of the frequency of VNS balanced effect with a parallel increase of the frequency of sympathetic effect on CVS. Intensification of sympathetic impact on CVS was reliably more often registered in the group of children with stable AH ($p < 0.01$), than in the control group and, respectively, with the least frequency of balanced impact ($p < 0.05$). Here the frequency of parasympathetic effect in the groups of children with SAH was not noted. There is quite regular noticeable similar tendency in relation to CSR (circulatory self-regulation) parameters, where changes of blood circulation regulation to the side of cardiac component dominance were registered in the group of children with SAH ($p < 0.001$) with statistically reliable difference in relation to the control. These changes in children with EAH characterize decrease of active functioning of parasympathetic and humoral mechanisms in the system of vegetative regulation. In compliance with the principle of "functional synergy" there is tension of sympathetic adrenal mechanisms characterized by the increase of AMo in the 1st and 2nd groups of children with EAH compared to the control one.

Comparative analysis of average parameters of cortisol amount in blood serum of the children with various values of AP is represented in table 2. In compliance with the presented data we can conclude that compared amounts of cortisol did

not exceed normal range. However average values of cortisol concentration in blood serum of the children with stable AH ($p < 0.001$) and labile AH ($p < 0.05$) were reliably higher compared to healthy children. Frequency of detection of cortisol level > 402.2 nmol/L in children increased the ratio of chances for formation of labile arterial hypertension to 2.3 folds ($RR = 1.7$) and stabilization of arterial hypertension to 3.3 folds ($RR = 1.93$), preserving high normal AP 1.2 folds ($RR = 1.1$), respectively. We determined regular interrelations between cortisol amount in blood serum and the parameters of CVS functioning and constant values of CIG in children with various values of AP.

Children of the control group had direct correlations between the amount of cortisol and heartbeat values, Kerdo's index, AMo, TI1 and TI2 ($r = +0.25$, $p > 0.05$, $r = +0.44$, $p < 0.01$, $r = +0.53$, $p < 0.001$, $r = +0.51$, $p < 0.001$, $r = +0.50$, $p < 0.001$, respectively). Feedback correlations were determined between cortisol amount and the values of CSR and AMo in orthostasis ($r = -0.45$, $p < 0.01$, $r = -0.25$, $p > 0.05$, respectively). Children with HNAP were characterized by the decrease of the power of diverse correlation links between cortisol amount and the figures of Kerdo's index and CSR ($r = +0.21$, $p > 0.05$, $r = -0.21$, $p > 0.05$, respectively); disappearance of the links with AMo, TI1 and TI2, but appearance of direct average intensity link with Mo in orthostasis ($r = +0.50$, $p < 0.001$). In children with labile AH coefficient of correlation between cortisol amount and heartbeat, Kerdo's index, AMo, TI2 and CSR was not determined. Low intensity interrelations without statistical reliability with TI1, delta X, AMo in orthostasis and VR ($r = 0.23$, $p > 0.05$, $r = -0.29$, $p > 0.05$, $r = -0.26$, $p > 0.05$, $r = -0.25$, $p > 0.05$, respectively) were characteristic for the children with LAH. Completely different correlation links were revealed in the group of children with stable AH. We determined reliable direct correlations between cortisol amount and heartbeat, AMo parameters in orthostasis, and TI2 ($r = 0.52$, $p < 0.01$, $r = 0.44$, $p < 0.05$, $r = 0.46$, $p < 0.05$, respectively), and feedback between Mo in orthostasis ($r = -0.43$, $p < 0.05$). Only in that group of children there was notable dependence of DAP values on the cortisol amount ($r = 0.28$, $p > 0.05$).

Conclusions

1. It was determined that children with AH were characterized by tense functioning of VNS compared to the children with normal AP. Reliable prevalence of hypersympatheticotonic OVT ($p < 0.001$, $AR = 0.33$) with low level of humoral factors impact ($p < 0.05$) in rest; expression of maladjustment reactions in orthostasis (hypersympatheticotonic VR 45.8%, ($RR = 1.2$) and asympatheticotonic VR 33.3%, ($RR = 2.2$)). herein vegetative provision of orthostatic test was performed mostly due to humoral-metabolic effects, indicating decreased adaptation probability and stress instability of an organism.

2. Cortisol status in children with AH was characterized by stress-activation of adjustment reactions, manifested by the increase of cortisol amount in blood serum with reliable correlations with CIG parameters in orthostatic test. Frequency of detection of cortisol amount > 402.2 nmol/L in children increase the ratio of the chances for formation of labile arterial hypertension to 2.3 folds ($RR = 1.7$), stabilization of arterial hypertension to 3.3 folds ($RR = 1.93$), and preserving high normal AP to 1.2 folds ($RR = 1.1$), respectively.

3. Detection of the interrelation between cortisol and parameters of CVS functioning, and CIG constant values testified preservation of internal systemic regulatory mechanisms providing physiological state of CVS in the children with normal AP. Children with HNAP were characterized by more compensated status of neural humoral regulation of heart and AP via vascular system.

4. Disorder of correlation interrelations in the children with LAH might be considered to be non-specific stress-reaction of an organism: transfer from eustress to distress. Herein there is no complete adaptation of body to stress effect or activation of anti stress adaptation turns to be insufficient for the elimination of stress' negative influence, later leading to chronic uncontrolled process and tension of neural humoral interrelations.

5. Intensification of cortisol secretion in the group of children with stable AH and setting out of other correlations indicates alteration in stress-realizing system with over-tension of neural endocrine regulation line. These alterations are, probably, characteristic for chronic stress and serve to be protective-adaptation reaction of an organism. The data achieved have prognostic value in relation to formation of stable arterial hypertension in children.

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