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Sympatheadrenal System and Lipid Peroxidation Processes in Young People Employed in the it Profession

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Abstract: *Despite national programs aimed at the prevention, early detection, and treatment of cardiovascular diseases, the problem remains highly relevant. In recent years, attention has been focused on the role of the sympathoadrenal system (SAS) in the pathogenesis of arterial hypertension. An acute release of catecholamines during stressful external influences is the earliest, due to stress and increased sympathetic nervous system tone, which is one of the key principles in the development of arterial hypertension in young people.*

The aim of the study was to examine the characteristics of sympathoadrenal dysfunction and lipid peroxidation processes in young individuals working in the information technology field.

Materials and methods. Ninety men aged 25–44 years were examined; the average age was 33.2±0.93 years. Safe, instrumental, and distinctive laboratory research methods were used.

Results and Conclusions. It was established that young individuals actively working in the IT sector exhibit impaired sympathoadrenal system function, leading to increased excretion of catecholamines (primarily adrenaline and noradrenaline), disruption of the circadian rhythm of catecholamine excretion, decreased activity of monoamine oxidase (MAO), a key enzyme in catecholamine deamination, increased levels of vanillylmandelic acid, a quaternary metabolite of catecholamines, and increased levels of malondialdehyde (MDA), a secondary product of lipid peroxidation.

Key words: *hypertension, men, IT, catecholamines, adrenaline, noradrenaline, dopamine, monoamine oxidase, vanillylmandelic acid, malondialdehyde.*

Introduction

Currently, hypertension is considered one of the most common pathologies in industrialized countries, affecting approximately 40% of the adult population . In recent years, there has been a trend toward an increase in the number of young patients with hypertension.

There is a growing trend in the incidence of cardiovascular diseases among young people, and in Uzbekistan, for example, among those aged 25-44, the incidence of hypertension has increased by approximately 20% over the past 5 years (WHO, 2020) . Considering that Uzbekistan is one of the countries with the largest population of young people, the problem of cardiovascular diseases is becoming increasingly pressing. Many modern researchers and authors attribute the sharp increase in hypertension to lifestyle changes, unhealthy habits such as alcohol and smoking, a sedentary lifestyle, emotional instability, high susceptibility to stress, low tolerance for adaptation, poor nutrition, and the interrelationships between cardiovascular risk factors. Recently, the role of the sympathoadrenal system (SAS) in the pathogenesis of hypertension has become increasingly important. The SAS is the link between the sympathetic nervous system and the adrenal medulla and plays a vital role in the consistent state of the body under external influences. An emergency release of catecholamines under the influence of external influences is the first effect of stress , increased tone of the sympathetic nervous system as

one of the key principles of the development of hypertension in young people (Vein A.M., 2003; Konradi A.O., 2013 , Khuzhamberdiev M.A. 2023) .

Assessing the activity of the sympathoadrenal system to optimize hypertension prevention methods in the stress-prone population and to implement preventive and corrective measures for identified manifestations is a pressing issue in modern medicine due to the high clinical manifestations of this principle. Despite the initiation of research aimed at elucidating the role of autonomic and sympathoadrenal regulation in the pathogenesis of hypertension, many unresolved questions remain in the domestic and international literature.

Early diagnosis of hypertension in young people allows for the early detection of the disease. The data obtained can serve as a basis for further development of preventive measures against hypertension in young adults.

MATERIALS AND METHODS

The study subjects were 50 young people engaged in IT activities, 40 young people from the non-organizational layer of the population not engaged in the IT profession, with identified hypertension , visible in the clinics of the city of Andijan and IT - Digital Andijan region and 20 healthy people.

All study participants were assessed strictly in accordance with current guidelines. Diagnostic testing was based on clinical and anamnestic data, physical examination, electrocardiographic parameters, and chest X-ray.

90 men were examined, depending on professional exposure (work activity) and blood pressure, the subjects were divided into 4 groups:

Group I : Young people examined, working in the IT industry, with diagnosed arterial attack (blood pressure of 140/90 mmHg and above), men aged 25-44 years, average age 33.2 ± 0.9 years, n = 22.

Group II : Young men prone to stress, engaged in the IT industry, without blood pressure (BP up to 140/90 mmHg), aged 25-44 years, average age 31.8 ± 0.9 years, n = 28.

III : Subjects included men from the unorganized population with severe arterial rhinitis (BP 140/90-159/99 mmHg), aged 29-44 years, average age 34.8±1.11 years, men, n = 40.

Control group - Relatively healthy men aged 29 to 44 years, with an average age of 36.15 ± 1.44 years, n = 20. All subjects were subject to a 24-hour urinary excretion limitation of catecholamines (CA)—adrenaline (A), norepinephrine (NA), and dopamine (DA)—using a fluorometric method on an Elisa biofluid analyzer (Germany). The circadian rhythm of catecholamine excretion was calculated, and the ratio of norepinephrine to adrenaline—the norepinephrine/adrenaline A coefficient—was calculated using computational methods.

Determination of monoamine oxidase (MAO) activity, a key enzyme in catecholamine deamination, in serum using the traditional Elisa ELISA method (Germany). Malondialdehyde (MDA) levels, the end product of lipid peroxidation, are measured using the ELISA method.

Statistical processing of research results using the Microsoft software package Excel 2010 SPSS Statistics 22.0 for Windows . Nonparametric data analysis methods were used: Fisher and Mann-Whitney tests to determine various indicators of the frequency of deviations of additional parameters from conductive norms.

Statistically significant changes with the probability of erroneous acceptance of null hypotheses -$p < 0.05$.

RESULTS AND DISCUSSIONS

The study was conducted with mandatory voluntary consent from the participants, in full compliance with the standards of the World Medical Association Declaration of Helsinki (2013 edition).

Age, duration of professional activity, presence of bad habits, activity levels, duration of sleep, body weight, hereditary predisposition to hypertension, changes in the ECG, as well as systolic and diastolic blood pressure were assessed (Table 1) .

Table 1

Comparative characteristics of age, social, behavioral, instrumental indicators in containing groups

Indicators	**I- group GB + IT (n=22)**	**III group IT no GB (n=28)**	**IV group GB without IT (n=40)**	**Control, healthy (n = 20)**
Age, years	33.2 ± 0.9	31.8 ± 0.9	34.8 ± 1.11	32.4±1.45
Professional activity, duration, years	3.8±0.6	3.7±0.5	-	-
Alcohol consumption, %				
Smoking, %	2 (9.1 %)	4 (1 4 , 3%)	5 (1 2 , 5%)	-
Sports participation, %	4 (18.3 %)	6 (21.4 %)	12 (30 %)	-
Duration of sleep, hours	4 (18.3 %)	5 (17.9%)	5 (1 2 , 5%)	11 (55%)
Body weight, %	5.6±0.4*	6.4±0.2^	6.8±0.2^	7.0±0.3
Obesity, %	3 (13.6%)	4 (14.3 %)	8 (20%)	4 (20 %)
Hereditary predisposition to hypertension, %	4 (18.3%)	7 (25%)	9 (22.5 %)	-
Systolic pressure (SBP), mmHg	1(4.6%)	net	11 (27.5%)	
Diastolic pressure (DBP) mmHg				-
ECG, changes, %	142.9 ± 3.6 *	134.2 ± 2.4 ^	146.3 ± 2.4 ^	124.0±4.2
		86.8 ± 1.7 ^	93.1 ± 1.7 ^	79.2±3.3
	93.2 ± 1.8 *			
		6 (21.4 %)	8 (20 %)	-
	8 (36.4%)			

Note : *,^ - differences in indications to the control group are significant (P<0.05).

When analyzing the average blood pressure values, it was found that both systolic and diastolic pressure values differed significantly between the 4 control values (p<0.05 according to the results of one-way analysis of variance).

In patients of the 1st group (hypertensive, IT specialists n=22), the average level of systolic blood pressure (SBP) was 143.9 ± 3.6 mm Hg, diastolic (DBP) - 93.8 ± 1.8 mm Hg.

In the second group (IT workers without signs of hypertension, n=28) SBP was 134.2±3.6, DBP -86.8±1.8 mmHg.

In group I and II (hypertension, not involved in IT, n=40) -146.3±2.4 and 93.1±1.7 mmHg, and in the control group (healthy individuals, n=20) -124.0±4.2 and 79.2±3.3 mmHg (Table 1).

The results of the analysis of variance showed significant intergroup differences in both the length of the SBP ($F=7.31$; $p=3.1 \times 10^{-5}$) and the length of the DBP ($F=6.95$; $p=5.3 \times 10^{-5}$). This confirms the influence of both professional and clinical-physiological factors on blood pressure.

Pairwise comparisons using statistical corrections revealed statistically significant differences between the control sequence and all other conditions .

In young individuals in Group I (HB+IT), SBP and DBP values significantly exceed those in the control group by 20.2 mmHg (p=0.010) and 14.6 mmHg (p=0.0058). The effect size (Cohen's d=1.18–1.21) indicates high clinical originality of the color.

In individuals of group II (HD without IT), the greatest deviations were observed compared to the control: an increase in SBP of -22.3 mm Hg (p = 0.0006), and in DBP of -13.9 mm Hg (p = 0.0078; Cohen's d ≈1.3).

Meanwhile, Group III (IT workers without hypertension) was characterized by more consistent SBP and

DBP values compared to the control group. However, the differences did not reach statistical significance after Louisiana, based on multiple comparisons ($p>0.05$). This may indicate a predisposition to developing hypertensive conditions in IT workers without overt hypertension.

The average values of blood pressure in patients with hypertension are significantly higher than in healthy people ($p<0.001$) (Table 1)

The most pronounced increase in blood pressure is observed in IT specialists with hypertension and a high level of stress risk (Cohen's $d>1.2$).

In IT producers without hypertension, a tendency towards increased blood pressure was revealed, reflecting possible strains of dependence on chronic stress.

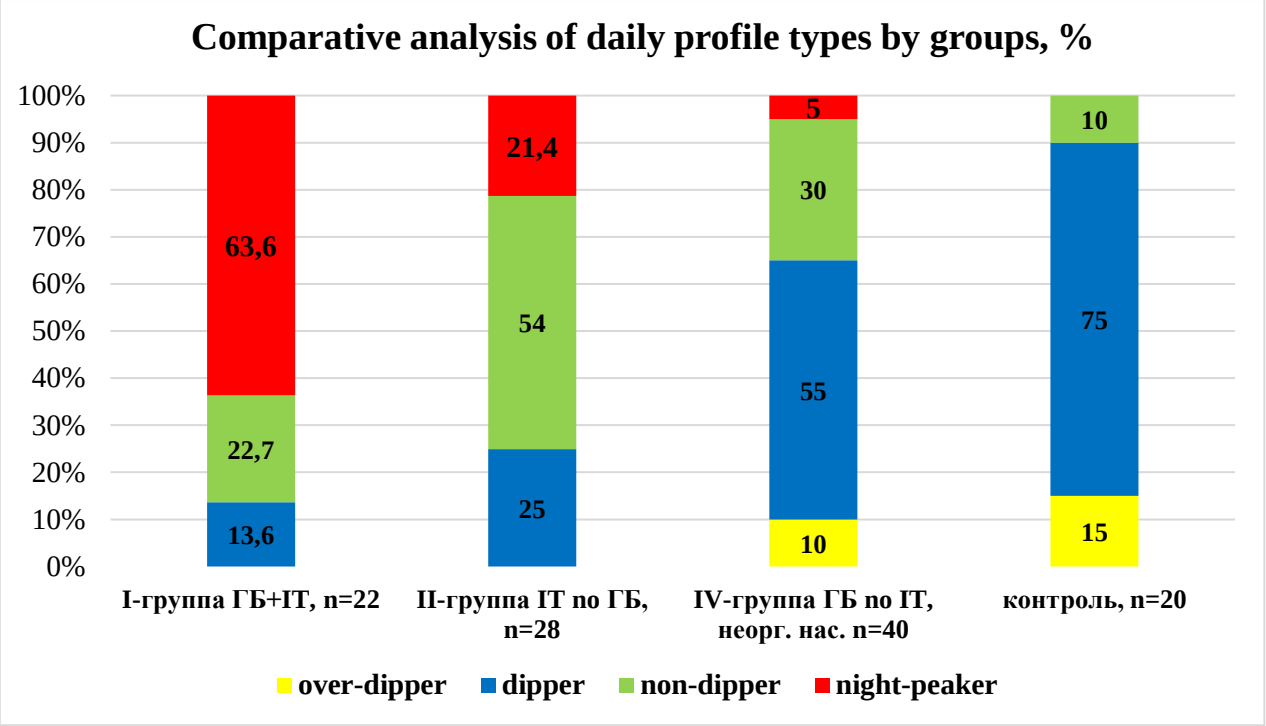

Fig. 1. Comparative analysis of the types of daily AD profile by group

An analysis of 24-hour blood pressure monitoring (ABPM) data revealed fundamental differences between the methods.

IT specialists exhibited a predominance of abnormal circadian BP profiles (night peaks and non-dippers), accounting for a total of 80% of the study groups. The most pronounced abnormal circadian BP profiles (night peaks and non-dippers) were observed in individuals in Group I — young individuals aged 25-44 years engaged in IT activities with diagnosed hypertension—accounting for a total of 86.3% (Fig. 1). Similar circadian BP profiles accounted for 75% of the total in Group II . For comparison, the proportion of this type among the unorganized population was only 35%, and in the control group, no more than 10% (Fig. 1).

Overall, 40% of IT professionals reported a nighttime increase in blood pressure (a nighttime peak), indicating hyperactivation of the sympathoadrenal system at night and circadian rhythm disruption .

Forty percent of young people with IT professions exhibited a non-dipper type with no consistent nocturnal effect of blood pressure.

Conversely, bear encounters were significantly more common in the disorganized population influence group (55%), while in the control group , they occurred in 75% of subjects (Fig. 1) . A χ^2 analysis revealed significant differences between the results ($\chi^2=18.7$; $p<0.01$), confirming the influence of professional factors in the IT sphere on the circadian rhythm of blood pressure.

The identified changes lead to disorganization of the daily regulation of blood pressure in IT specialists,

which can be considered an early predictor of the development of hypertension in this professional group. Table 1 presents a comparative assessment of age, social, behavioral, and instrumentally confirmed characteristics among the main subgroups. Analyzing these data, it can be concluded that the first, second (IT specialists), and third (unorganized society) study groups exhibit different behavioral characteristics, which, ultimately, influence the functional activity of the sympathoadrenal system (SAS). However, the expression of these factors appears limited, and for a more thorough understanding of the functional state of the sympathoadrenal system, it was necessary to study the daily excretion of catecholamines in urine, as well as the activity level of the main enzyme responsible for the deamination of catecholamines, monoamine oxidase (MAO), in the blood serum, and the level of the end product of methacholamines, vanillylmandelic acid (VMA), in urine.

The results of the assessment of daily excretion of catecholamines (CA), including dopamine and DOPA, are presented in Table 2.

Table 2

Daily excretion of CA relative to healthy and normal groups, P < 0.05

Groups	**A, mcg/day**	**HA, mcg/day**	**YES, m to g/day**	**DOPA, mcg/day**
I - group GB + IT (n=22)	31 , 3 ±0.16	231.1 ± 0.9	939.1 ± 1.6	66.9±1.2
II - IT group no hypertension (n=28)	28.1 ± 0.2	212.2 ± 1.04	912.5 ± 1.9	62.4 ±1.0
III- GB without IT (non-organic population) , n=40	25.2 ± 0.23	190.15 ± 1.04	817.0 ± 1.95	58.4±0.9
Control, n = 20	16.8±0.3	78.2 ± 0.8	416.2 ± 1.69	42.4 ±0.8
R	$p_1 < 0.05$ $p_2 < 0.05$ $p_3 < 0.001$	$p_1 < 0.05$ $p_2 < 0.05$ $p_3 < 0.001$	$p_1 < 0.05$ $p_2 < 0.05$ $p_3 < 0.001$	$p_1 < 0.05$ $p_2 < 0.05$ $p_3 < 0.001$

When studying the daily excretion of CA (A, NA, dopamine) and DOPA in young people with hypertension engaged in it, we noted a statistically stable increase on the first day of the study. Thus, the content of daily excretion in urine of free A was 14.4 ± 0.3 μg / day, conjugated A - 17.0 ± 0.5 μg / day., total A - 31.4 ± 0.4 μg / day, which is respectively 54.5% (2.2 times), 39.7% (1.66 times), 46.5% (1.87 times). times) higher than the control indicators (P<0.001) and 24.3% (1.3 times), 16.0% (1.18 times), 19.7% (1.25 times) (P<0.05) higher than similar indicators of group III (young people from the unorganized population with hypertension without IT activities) (Table 3)

In the subjects of the second group (young people engaged in IT activities without hypertension) , a statistical increase (p<0.001) in the level of daily excretion of free adrenaline (A) in urine 43.0% higher (1.7-4 times), conjugated A by 39.0% (1.6-4 times), and total A by 41.5% (1.6-8 times), higher than the control values (P<0.001) and averaged 11.4±0.3 μg /day, 16.8±0.4 μg/day, 28.2 ±0.3 μg/day, μg/day (Table 3) .

In the control group with the preservation of daily urinary excretion, free A was 6.55±0.2 μg/day, conjugated A was 10.25 ± 0.3 μg/day, and total A was 16.4±0.3 μg/day (Table 3).

Table 3

Indicators of daily excretion of free, conjugated, and total adrenaline (A) in the observed groups (M±m, μg/day)

Survey groups	Adrenaline, mcg/day.		
	free	conjugated	total
GB + IT , n = 22	14.4±0.3	17.0±0.5	31.4 ±0.4
THIS no GB , n=28	11.4±0.3	16.8±0.4	28.2±0.3
GB without IT, n=40	10.9±0.3	14.3±0.3	25.2±0.23
Control, n=20	6.55±0.2	10.25±0.3	16.8±0.3
P 1-2	<0.05	n. v.	<0.0 5
P 1-3	<0.05	<0.05	<0.0 5
pp. 1-4	<0.001	<0.001	<0.0 01
P 2-3	n. v.	<0.05	<0.0 5
P 2-4	<0.001	<0.001	<0.0 01
P 3-4	<0.001	<0.001	<0.0 01

When calculating the daily urinary excretion of norepinephrine , we obtained the following results: the content of free NA was 108.0±0.8 μg/day, conjugated - 112.5±0.9 μg/day, total NA - 220.5±0.8 μg/day, which was 75.4% (4.1 times), 54.6% (2.2 times), 64.3% (2.8 times) higher than the control values (P<0.001) (Fig. 2).

In the subjects of the second group (young people engaged in IT activities without hypertension) , a statistical increase (p<0.001) in the level of daily excretion of free norepinephrine (FNA) with urine-on 72.3% higher (3.7 times), conjugated HA by 50.6% (2.02 times), and total HA by 60.7% (2.5 times), higher than the control values (P<0.001) and averaged 96.0± 0.8 μg/day, 104.5±0.9 μg/day, 200.5 ±0.8 μg/day (Fig. 2) .

In a study of young people from the unorganized population with hypertension, not engaged in IT , a characteristic feature of an increase in the level of daily excretion of free norepinephrine (FNA) with urine on 66.7% (3.0 times), conjugated HA by 53.2% (2.1 times), and total HA by 58.5% (2.4 times) higher than the control values (P<0.001) and accordingly total average 79.8 ±1.0 mcg /day, 110.3 ±1.0 mcg/day, 190.5 ±1.04 mcg/day (Fig. 2) .

In the control group , the daily urinary excretion rates of free NA averaged -26.6±0.6 μg/day, conjugated NA - 51.6±1.0 μg/day, and total NA - 78.8±0.8 μg/day (Fig. 2).

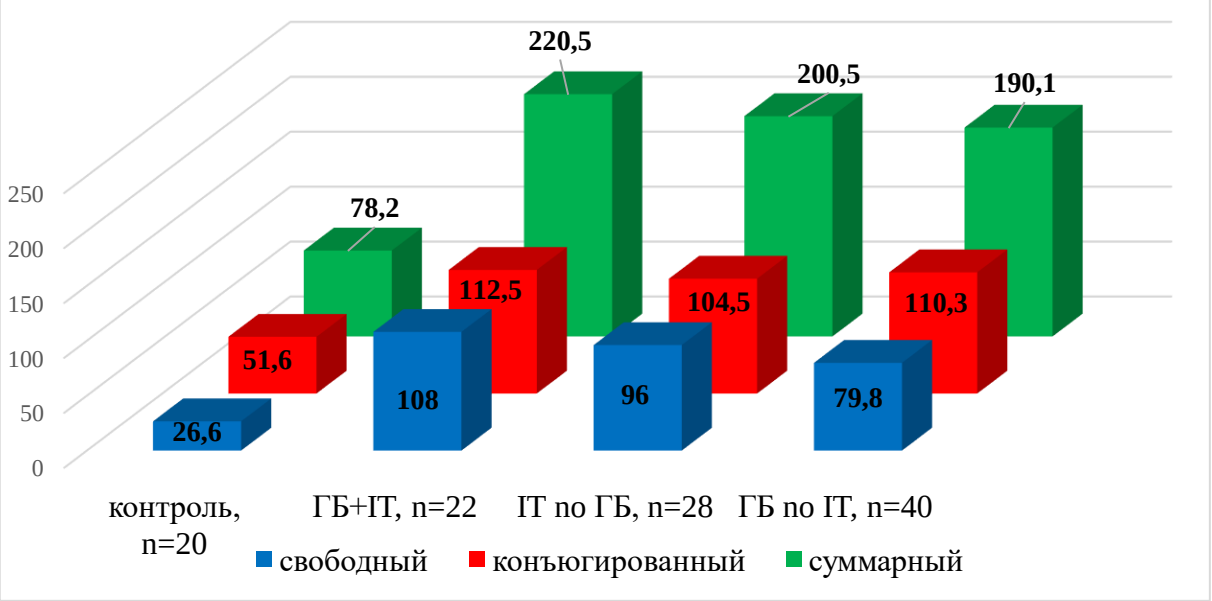

Fig.2. Daily excretion rates of free, conjugated,
total norepinephrine in the observed groups (M±m , μg/day)

When excreted, the daily excretion with urine was free DA–443.6±1.5 µg/day, conjugated DA–480.6±1.6 µg/day, total DA–924.2±1.54 µg/day, which corresponds to 70.0% (3.3 times), 41.1% (1.7 times), 55.0% (2.2 times) higher than the control indicators (P<0.001), (Table 4). The indicators of daily excretion of free DA, total statistics are significantly higher than similar indicators of group III by 20.8% (1.26 times) and 11.6% (1.13 times) (P<0.05). The daily excretion rates of conjugated DA did not differ from those in group III (Table 2). The daily urinary excretion rate of free DA in group III was 351.3±1.9 µg/day, conjugated DA - 465.7±2.0 µg/day, and total DA - 817.2±1.95 µg/day (Table 4).

The research- excretion of free dopamine (DA) with urine-on 67.0% higher (3.3 times), conjugated DA by 34.0% (1.5 times), and total DA by 50.0% (2.0 times), higher than the control values (P<0.001) and averaged 403.8±2.5 mcg/day, 428.6±1.6 mcg/day, 832.4 ±2.5 mcg/day. (Table 4).

In the control group with retention of daily urinary excretion of free DA - 133.2±1.56 µg/day, conjugated DA - 283.0±1.8 µg/day, total excrement DA - 416.2±1.69 µg/day (Table 4).

Table 4

Daily excretion rates of dopamine (DA) free, conjugated, total (M±m , µg/day)

Survey groups	Dopamine, mcg/day.		
	free	conjugated	total
GB+IT, n=22	443.6 ±1.5	480.6 ±1.6	924.2 ±1.54
IT +GB , n=28	403.8 ±2.5	428.6 ±1.6	832.4 ±2.5
GB without IT, n=40	351.3±1.9	465.7±2.0	817,0 ±1,95
Control, n=20	133.2 ±1.56	283.0±1.8	416.2±1.69
P_{1-2}	<0.05	<0.05	<0.0 5
P_{1-3}	<0.05	<0.05	<0.0 5
$pp._{1-4}$	<0.001	<0.001	<0.0 5
P_{2-3}	<0.05	<0.05	<0.0 5
P_{2-4}	<0.001	<0.001	<0.0 01
P_{3-4}	<0.001	<0.001	<0.0 01

When conducting the daily excretion of DOPA, we obtained the following results: the daily excretion of DOPA in the 1st group was 64.2±1.2 µg/day , which is statistically significantly higher than the indicators of the control group by 34.0% (1.5 times) (P<0.05). (Table 2) . Daily excretion of DOPA in In the II group, the level of DOPA was 60.1±1.1 µg/day , which was statistically significantly higher than the control group values by 29.5% (1.4 times) (P<0.05) . The daily excretion of DOPA in the group of young people with hypertension without IT - liver activity was 58.4 ±1.0 µg /day , which was statistically significantly higher than the control group values by 27.4% (1.37 times) (P<0.05) . Daily excretion of DOPA in The indicators in group I were 9.0% higher than those in group III (Table 2) .

Analysis of the enzymatic activity of the key enzyme of catecholamine deamination, monoamine oxidase (MAO), with blood serum showed a statistically stable decrease in its level in all studies with arterial hypertension compared to the control sequence (Fig. 3). In the control group, the average MAO activity in the blood serum was 7.0±0.3 U /ex. In normal I , II , III groups , the enzyme activity was reduced by 38.6%, 37.1 %, 35.7% relative to the control group indicators and increased by 4.3±0.03 U/ex , 4.4±0.03 U/ex , 4.5±0.03 U/ex . (p<0.05). No statistically significant signals of MAO activity were noted between I , II , III groups (p>0.05), (Fig . 3)

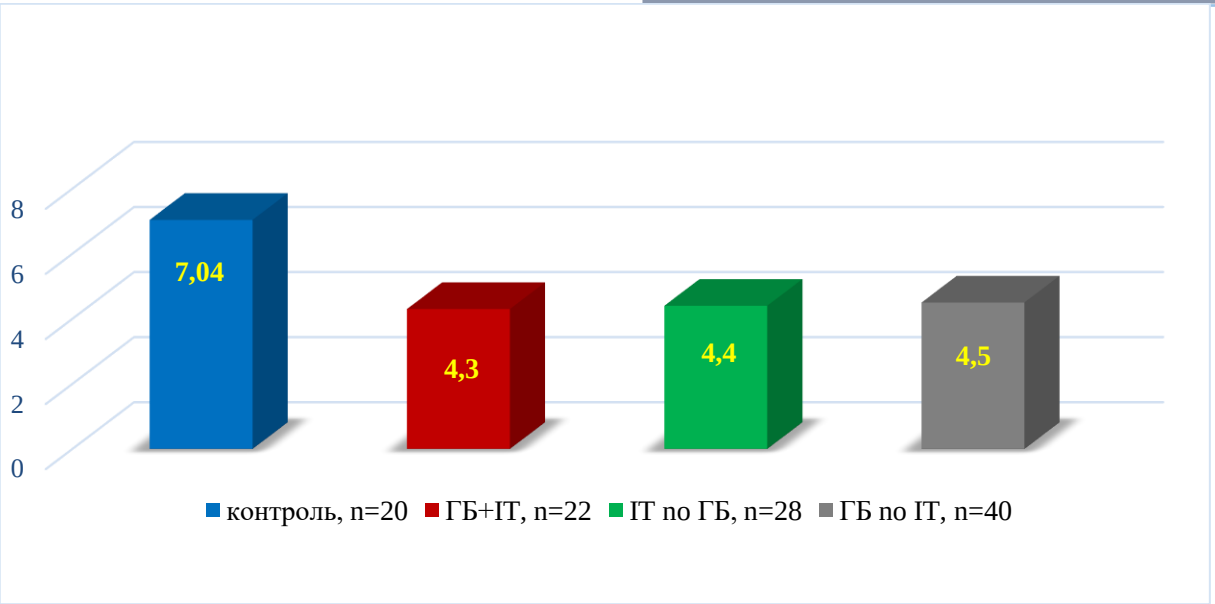

Fig.3. Serum monoamine oxidase (MAO) activity , in support groups, units/act.

In addition , a place for a comprehensive measurement of the activity of the sympathoadrenal system is provided by measuring the daily excretion in urine of the end product that produces catecholamines - vanillylmandelic acid - VMA.

In our studies, the daily urinary excretion of any catecholamine metabolism product, vanillylmandelic acid (VMA), showed a significant improvement in the subsequent groups compared to the control group. In Group I , the daily urinary excretion of VMA was 15.4 ± 0.1 ng / ml, which slightly increased the daily excretion rates in Group II , and the daily excretion of VMA in In the II group, the value was 14.6 ± 0.1 ng / ml. The daily excretion rates in the I group were higher than those in the III and control groups by 11.0 % (1.1 times) and 27.9% (1.39 times), respectively ($p < 0.05$, CI 95%). Thus, the average daily excretion of VMC with urine in the III group was 13.7 ± 0.1 ng / ml. In the control group, the daily excretion of VMC with urine was 11.09 ± 0.31 ng/ml.

Thus, an elevated VMC level indicates functional hyperactivation of the sympathoadrenal system, which occurs in patients with early-stage hypertension, especially in young adults. This may aid in the differential diagnosis of various forms of hypertension with a pronounced neurogenic component. Measuring VMC will allow us to assess the level of stress reactivity in patients, especially in those with occupational overload (IT specialists, long-haul drivers, and medical workers).

It is now reliably known that the activation of free radical peroxidation processes underlies the pathogenesis of many internal organ diseases, including the progression of atherosclerosis and the development of cardiovascular diseases. Specifically, lipid peroxidation processes lead to the accumulation of oxidized atherogenic LDL, which leads to impaired microcirculation and the development of metabolic disorders in the body.

A comparison of the MDA content in the blood serum of healthy individuals and those engaged in the IT profession leads to the latter exhibiting a stable increase in lipid peroxidation products in the blood serum.

Thus, the MDA content in the group of individuals with hypertension not engaged in IT professional activities averaged 27.5 nmol/l, which was 36.4% (1.57 times) ($P<0.01$) higher than the control group indicators , a more pronounced intensification of young people is observed with hypertension engaged in the IT profession , in this group this indicator was 32.6 nmol/l, which is 46.2% (1.86 times) and 15.6% (1.18 times) higher than the indicators of the control group and the group of young individuals with hypertension without the IT profession ($p <0.05$) (Table 5) . The indicators of malondialdehyde (MDA)

in the blood serum were on average 17.5 nmol/l.

Table 5

Average levels of malondialdehyde (MDA) in blood serum in study groups, M ± m , **(nmol/l.)**

№	Groups	Malondialdehyde (MDA), nmol/L
1	I- th GB + IT , n=22	32.6±0.6
2	II- th IT no GB, n=28	30.0±0.6
3	III -rd GB no IT , n=40	27.5 ± 0.5
4	Control, n=20	17.5 ± 0.4
5	P $_{1-2}$	<0.05
6	P $_{1-3}$	<0.05
7	pp. $_{1-4}$	<0.05
8	P $_{2-3}$	<0.05
9	P $_{2-4}$	<0.001
10	P $_{3-4}$	<0.001

Presumably, the cause initiating the decrease in MAO activity in this case is also the accumulation of lipid peroxidation products. There is evidence that, under combined conditions, qualitatively modified MAO activity occurs, caused by the stimulation of lipid peroxidation processes.

Assessing the functional state of the sympathoadrenal system (SAS) in young patients professionally involved in information technology remains relevant due to the impact of chronic stress factors associated with their work. Prolonged hyperactivation of the SAS negatively impacts the morphofunctional characteristics of the vascular wall and myocardium, contributing to the development of persistent, often irreversible, pathological changes. Sympathicotonia, as a key effector mechanism regulating vascular tone, triggers a cascade of hemodynamic, metabolic, and rheological phenomena, accelerating the development of arterial hypertension and target organ remodeling.

The obtained data confirm the presence of pronounced activation of the sympathoadrenal system in patients with arterial hypertension involved in professional activities in the information technology field . A progressive pattern of excretion of the sympathoadrenal neurotransmitters epinephrine, norepinephrine, and dopamine was detected, compared to the control group. Disturbances in the circadian rhythm of their daily excretion also indicate persistent sympathicotonia. Specifically, IT specialists exhibited prolonged intervals of increased catecholamine release, which was observed in healthy subjects and continued to a lesser extent in individuals without professional employment.

Thus, according to the results of the study, individuals with arterial hypertension actively involved in professional IT activities and experiencing gradual, regular psychoemotional stress exhibit persistent dysfunction of the sympathoadrenal system. Opposite changes in adrenaline and norepinephrine levels were identified depending on the nature of their occupation, with men working in the IT sector exhibiting the highest levels of the hormonal and neurotransmitter components of the sympathoadrenal system. Chronically elevated sympathetic tone leads to the progression of metabolic, hemodynamic, and trophic conditions, increasing the risk of cardiovascular disease in this context.

The obtained results suggest a significant role of sympathoadrenal activity in the pathogenesis of arterial hypertension in young people, especially under conditions of professional stress.

CONCLUSIONS

1. It was found that the total adrenaline excretion in the HD+IT group was 86.9% (1.87 times) higher than in the control group, and 24.6% (1.25 times) higher than in the HD without IT. A similar trend was not found for norepinephrine, dopamine, and DOPA when applying IT to the HD group: norepinephrine excretion was 16.0% (1.16 times) higher; dopamine - 13.1% (1.13 times), DOPA

- 9.9% (1.10 times) - the reliability is statistically significant ($p<0.05$) and reflects pronounced hyperactivation of the sympathoadrenal system (SAS) in young people with HD, especially in IT specialists.

2. Statistically significant changes in the activity of monoamine oxidase (MAO), a key enzyme responsible for catecholamine dominance, were detected in the blood. The average MAO activity in the serum of patients with hypertension and IT was 4.3 U/exc, compared to 4.5 U/exc in patients without IT and 7.0 U/exc in the control group. MAO activity in patients with hypertension and IT decreased by 38.6% (1.63 times lower) compared to the control group. The decrease in MAO activity indicates a slowdown in the inactivation of catecholamines, contributing to their accumulation and enhancing the pressor effect.
3. An increase in the daily excretion of vanillylmandelic acid (VMA) was revealed. The daily excretion of VMA in the GB+IT group was 15.4 ng/ml, in the GB without IT - 13.7 ng/ml, in the control group - 11.1 ng/ml. Compared with the control, VMA in the GB+IT group was 38.7% (1.39 times) higher, and compared with the GB without IT - 12.4% (1.12 times) higher ($p < 0.05$, CI 95%).

The increase in the level of VMC reflects the method of catabolism of biogenic amines against the background of hyperactivation of the sympathoadrenal system.

4. Malondialdehyde (MDA) levels in the HD+IT group were 86.3% (1.86 times) higher than in the control group, and 18.5% (1.18 times) higher than in the HD without IT ($p < 0.05–0.001$). These data confirm the significant oxidative stress in young people with HD, especially in IT specialists, which may contribute to preliminary vascular remodeling.

The average daily blood pressure in the hypertension + IT group was SBP - 143.9 mmHg, DBP - 93.8 mmHg, hypertension without IT - 146.3/93.1 mmHg, in the control group - 124/79.2 mmHg. In the group of young individuals with arterial hypertension, which occupies the nature of IT activity, the proportion of pathological daytime types of night peakers and non-peakers is high (86%) versus 35.0% in hypertension without IT and 10.0% in the control group (χ^2, $p<0.01$). This indicates a violation of nocturnal recovery, weakening of parasympathetic activity and the preservation of long-term hypersympathicotonia.

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