

Violations of the Functional Activity of the Sympathoadrenal System in the Development of Hypertension in Young People

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Abstract Arterial hypertension is one of the main risk factors that determines the prognosis of morbidity and mortality in the population. The problem of hypertension remains very relevant in many countries of the world. The results of our studies, to some extent, can show the important role of impaired SAS activity in the formation of hypertension in young people. It has been established that individuals engaged in IT activities experience a regular increase in the activity of the sympathoadrenal system due to constant exposure to the occupational factor, which is proved by an increase in the daily excretion of catecholamines and a decrease in MAO activity. **Materials and methods.** The study included 40 men aged 25 to 44 years, with a mean age of 33.4 ± 5.6 years. Clinical, instrumental and special research methods were performed. It was revealed that in the population of young people engaged in active professional activities, there are violations of the functional activity of the sympathoadrenal system, manifested by an increase in the excretion of catecholamines, in particular epinephrine and norepinephrine, and a decrease in the content of the key enzyme of catecholamine deamination-monoamine oxidase (MAO).

Keywords Hypertension, Men, IT, Catecholamines, Epinephrine, Norepinephrine, Dopamine, Monoamine oxidase

1. Introduction

The main cause of death in economically developed and rapidly developing countries is cardiovascular diseases (CVD). According to large studies conducted in different countries of the world, diseases of the cardiovascular system occupy a leading position in the structure of mortality and by 2020 have reached global significance. According to WHO research conducted in the Republic of Uzbekistan, it has shown that it belongs to the states with the highest development of cardiovascular diseases [1]. Recently, despite state programs for the prevention, treatment and prevention of cardiovascular diseases, the problem remains not fully solved (Khuzhamberdiev M. A. 2023, Kurbanov R. D. 2023, Fozylov Kh. G. 2023) [5].

A special place in the problem of cardiovascular diseases is given to hypertension. According to WHO data from 2020, more than 30 % of the world's adult population suffers from hypertension and this is more than a billion people.

Arterial hypertension is one of the main risk factors that determines the prognosis of morbidity and mortality in the population. The problem of hypertension remains very relevant in many countries of the world, including Uzbekistan.

According to WHO experts, by the end of 2021, Uzbekistan is experiencing an increase in the number of cases in women by 9%, and in men even higher by 15%. Such a high prevalence of hypertension around the world, rightly allows us to consider it a "disease of civilization" [1].

Recently, there has been a tendency to increase the number of young people with hypertension. The widespread unfavorable lifestyle among young people in recent years has become not only a medical, but also a socio-economic problem of our time [1].

A large number of studies have been devoted to the pathogenesis, diagnosis, and treatment of hypertension in young adults (Lyamina S. V., 2010; Sundstorm J., 2012; Nechaeva G. I., 2013; Chernova I. M., 2014; Khuzhamberdiev M. A., Vakhabov B. M. 2023) [5,6,7,8]. At the same time, from the point of view of diagnosis, organization of the treatment of hypertension in young people is very important. Treatment and prevention of hypertension in this age group, many unresolved issues remain.

According to the data of Feskova A. A., Pertsev A. V. from 2020, over the past 5-7 years, an increase in blood pressure is observed in 33-42% of adolescents, while 17-26% have persistent hypertension. Features that make it difficult to diagnose hypertension in the early stages in young people are the transient nature of increased blood pressure (BP) at the beginning of the disease and the conditionality of criteria for increased blood pressure (Kotovskaya Yu. V., Kobalava Zh.

D., Kobzev R. Yu., 2012; Govorukhina A. A., Popova M. A., Vologzhanina N. A., 2015), as well as a peculiar clinical picture, in which vegetative disorders play an important role (Wein A.M., 2003; Conradi A. O., 2013), among the latter, great importance is attached to the increase in the tone of the sympathetic nervous system, which is considered to be the trigger moment for increasing blood pressure in young patients [2,3,4].

Hypertension at a young age contributes to the increasing actualization of the problem, conducting research in this category of patients. In recent decades, it has consistently occupied one of the leading places in the structure of access, disability and mortality in cardiovascular diseases.

Early diagnosis of arterial hypertension in young people will allow timely detection of the disease at the earliest stage of the process. The obtained data may serve as a basis for further development of preventive measures for the development of hypertension in young people.

2. Material and Research Methods

The study included 40 male patients with arterial hypertension aged 25 to 44 years, with an average age of 32.8 ± 3.6 years, and 15 relatively healthy male patients aged 20 to 44 years, with an average age of 32.4 ± 4.5 years. Blood pressure (BP) was measured after 5 minutes of rest twice on both hands according to the accepted standard method at intervals of 5 minutes, in parallel, blood pressure was measured using automated electronic (oscillometric) devices, model Omron M6 ("Omron" Japan), according to the established protocol. The main blood pressure indicator included the average of two measurements, if there was a difference in blood pressure between the measurements of more than 5 mm. pt. st., then blood pressure was re-measured for the third time. Arterial hypertension was determined according to the WHO criteria adopted in 2023: systolic blood pressure (SBP) is greater than or equal to 140 mm.pHg, diastolic blood pressure (DBP) is equal to 90 mm Hg. The study was conducted after obtaining the participants informed consent, all the requirements of the Helsinki Declaration of the World Medical Association on Ethical Principles of conducting the study were observed. medical research from 2013.

Depending on their professional activity, the study participants were divided into 2 groups: I-group I-20 men with hypertension who are engaged in IT at the age of 25 to 40 years, the average age of which was 31.4 ± 3.2 years, II-group II-men who were diagnosed with hypertension as a result of preventive examinations at the place of residence those who do not have a certain type of professional activity, aged from 25 to 44 years, with an average age of 34.2 ± 4.1 years, in the number of 20 people. The control group consisted of 15 relatively healthy male volunteers aged 20 to 44 years, whose average age was 32.4 ± 4.5 years. Two days before the study, all participants were advised not to consume certain foods in their diet, such as strong tea and coffee, alcohol, cheese, and some fruits such as bananas and grapes.

96 hours before the study, exclude the use of antibiotics, beta-blockers, MAO inhibitors, exclude increased physical and neuropsychiatric overexertion.

The daily urinary excretion of catecholamines (CA)-epinephrine (A), norepinephrine (HA), and dopamine (DA)-was determined by the fluorimetric method an Elisa bioliquid analyzer (Germany), and the ratio of norepinephrine to epinephrine-the norepinephrine-HA/epinephrine-A ratio was calculated using calculation methods.

Determination of monoamine oxidase (MAO), akey catecholamine deamination enzyme, in blood serum was performed by Elisa (Germany).

Static processing of the study results was performed packets using Microsoft Excel 2010 SPSS Statistics 22.0 application software packages Statistics for Windows. Nonparametric methods of data analysis were used: Fischer and Mann-Whitney criteria to identify various indicators of the occurrence of deviations of the studied parameters from physiological norms.

Changes in the probability of erroneous acceptance of the null hypothesis ($p < 0.05$) were considered statistically significant.

3. Results and Discussions

Comparative characteristics of age, social, behavioral, and instrumental indicators in the studied groups are presented in table 1.

Table 1. Comparative characteristics of age, social, behavioral, and instrumental indicators in the study groups

Indicators	Control group, healthy (n=15)	I-group AH+IT (n=20)	II- group AH nIT (n=20)
Age, years	32.4 ± 4.5	31.4 ± 3.2	34.2 ± 4.1
Professional activity, duration, years	-	3.8 ± 0.6	-
Smoking, %	-	6 (30%)	9(45%)
Alcohol, use, %	-	2 (10%)	5(25%)
Sports, %	8 (53%)	4 (20%)	3(15%)
Sleep duration, hours	7.0 ± 0.3	$5.6 \pm 0.4^*$	$6.4 \pm 0.2^{\wedge}$
Weight gain, %	2 (13%)	4 (20%)	6 (30%)
Obesity	-	2 (10%)	3 (15%)
Hereditary predisposition to hypertension, %	Not	Not	3 (15%)
ECG, changes, %	-	4 (20%)	5 (25%)
Systolic pressure (SBP), mm.Hg.	124.0 ± 4.2	$144.2 \pm 3.6^*$	$143.3 \pm 2.4^{\wedge}$
Diastolic pressure (DBP), mm.Hg.	79.2 ± 3.3	$92.4 \pm 1.8^*$	$93.1 \pm 1.7^{\wedge}$

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

Table 1 shows that the subjects in I-groups I and II have certain behavioral changes that can some affect the activity of the sympathoadrenal system, but these hypotheses are minimal and for a complete understanding of the functional state of the sympathoadrenal system, it was necessary to

study the daily excretion of catecholamines in the urine and the level of the key protein in the blood. catecholamine deamination enzyme-monoaminoxidase (MAO) in blood serum.

When studying the daily excretion of CA and dopamine, the following changes were observed (Table 2). In I-Group I, there was a statistically significant ($p<0.05$) increase in the daily excretion of epinephrine (A) by 7.6.22% compared to the control group and averaged 29.6 ± 0.4 mcg/day. There was also 185.6% increase in the concentration of norepinephrine (NA) compared to the control group ($p<0.05$) and amounted to 223.4 ± 0.7 mcg/day. Daily dopamine excretion (DA) was increased by 123.5% compared to the control and amounted to 925.7 ± 12.3 mcg/day ($p<0.05$). In II group, there was also an increase in the daily excretion of catecholamines, in particular epinephrine (A), by 50.0% compared to the control group ($p<0.05$) and amounted to 25.2 ± 0.3 mcg/day. Daily norepinephrine (NA) excretion was increased by 143.3% compared to the control group and amounted to 190.15 ± 8.6 mcg / day ($p<0.05$). There was also an increase in DA excretion by 96.4% compared to the control and amounted to 817.2 ± 10.3 mcg / day ($p<0.05$).

The study of MAO activity revealed a significant decrease in the activity of the enzyme in all study groups compared to the control group (Table 2). In the control group, MAO activity was 7.0 ± 0.3 ng/l. In I-group, MAO activity was 4.3 ± 0.2 ng/l, which is 89.2% lower than the control ($p<0.05$). In group II, there was also a significant decrease in the

activity of the enzyme by 75.1% compared to the control group and amounted to 4.5 ± 0.3 ng/l. ($p<0.05$).

A comparative analysis of the daily catecholamine excretion parameters (A, NA, DA) and the activity of the key catecholamine deamination enzyme (MAO) in the blood serum showed that there were significant changes in the studied groups. Thus, in the I- group of male subjects involved in professional activities, it is their daily excretion of epinephrine (A) that is increased by 17,4% in relation to the second group, we study from the unorganized population with hypertension. There was also a 17.5% increase in the level of norepinephrine (NA) compared to II group. The daily excretion of dopamine (DA) in group I was increased by compared to group -II 13.3%, it was 925.7 ± 12.3 mcg/day ($p<0.05$). In I-group MAO activity was 4.65% lower group II (Table 2, Figure 1.).

Thus, the problem of the functional state of the SAS in the studied young people who are engaged in professional activities due to the constant influence of the professional factor remains the subject of discussion. Long-term activation of SAS, with its multifaceted effect on a number of structural changes, primarily in the vascular wall and myocardium, can lead to the formation of persistent irreversible changes. Sympathicotonia, being the main efferent pathway of vascular tone regulation, contributes to the development of hemodynamic, metabolic and rheological changes leading to a complex cascade of hypertension development and structural remodeling of target organs.

Table 2. Daily excretion of CA and MAO activity in relatively healthy and studied groups, $P<0.05$

Groups	A, mcg /day	NA, mcg /day	DA, mcg/day	MAO, ng/l
I-AG+IT, n=20	$29.6\pm0.4^*$	$223.4\pm10.7^*$	$925.7\pm12.3^*$	$4.3\pm0.2^*$
II-AG nIT (non-org. us.), n=20	$25.2\pm0.33^{\wedge}$	$190.15\pm8.6^{\wedge}$	$817.2\pm10.3^{\wedge}$	$4.5\pm0.3^{\wedge}$
Control, n=15	16.8 ± 0.4	78.2 ± 5.9	416.2 ± 8.4	7.0 ± 0.3

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

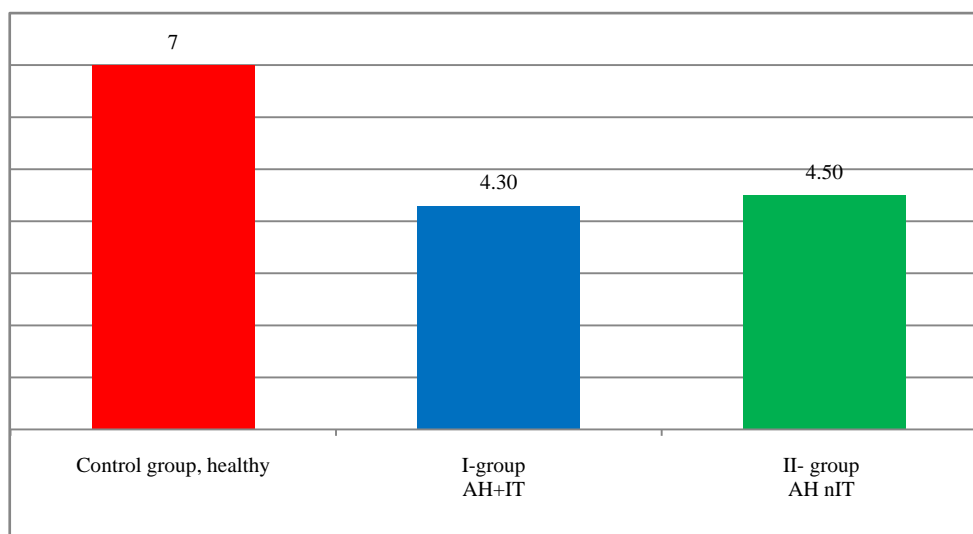


Figure 1. Daily excretion MAO activity in relatively healthy and studied groups

The results of the conducted studies showed that people with hypertension engaged in professional activities in the field of IT, there is an activation of SAS associated with an increase in the excretion of catecholamines: A, NA, DA in relation to healthy people.

Thus, the obtained data revealed that the development and progression of hypertension in individuals actively engaged in professional activities in the field of IT technologies, committed to more frequent stressors, are accompanied by impaired functioning of the CAC. As a result of the study, multidirectional changes in the content of epinephrine and norepinephrine were found depending on professional activity; male individuals engaged in IT have the maximum level of the hormonal and mediator components of the sympathoadrenal system. Increased sympathetic tone leads to a whole range of metabolic, trophic and hemodynamic changes, which is accompanied by an increased risk of cardiovascular disasters in this category of individuals.

The results of our studies, to some extent, can show the important role of impaired SAS activity in the formation of hypertension in young people.

4. Conclusions

There were multidirectional changes in the daily excretion of catecholamines: epinephrine, norepinephrine and dopamine, depending on their professional activity; male individuals engaged in IT showed the maximum level of the hormonal and mediator components of the sympathoadrenal system. It has been established that individuals engaged in IT activities experience a regular increase in the activity of the sympathoadrenal system due to constant exposure to the occupational factor, which is proved by an increase in the daily excretion of catecholamines and a decrease in MAO activity. The results of the study can serve as a scientific basis for assessing and predicting the risk of cardiovascular diseases with the development of specific preventive measures to prevent violations of the functional state of the sympathoadrenal system in this category of subjects.

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