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DAILY PROFILE OF BLOOD PRESSURE AND STATE OF COGNITIVE FUNCTION IN PATIENTS WITH ARTERIAL HYPERTENSION

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The article is devoted to the problem of arterial hypertension as the most important risk factor for the development of cognitive impairment. In 39 and 32 patients with arterial hypertension with cognitive dysfunctions, a significant impairment of the arterial pressure daily profile by systolic and diastolic blood pressure was found, against 19 and 16 of patients with similar indices in the group without cognitive impairment. With the decrease of the MoCA-test scores, there were correlations of the daily index of systolic and diastolic blood pressure and, as well as indices of systolic blood pressure variability per day and night. We have found that patients with hypertensive disease of stage II with the presence of cognitive impairment are characterized by a significant prevalence of the pathological types of arterial pressure daily profile: "Non-dipper" and "Night-peaker" (46.2 % and 19.2 %, respectively).

Key words: hypertensive disease, blood pressure monitoring, cognitive impairment.

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ДОБОВИЙ ПРОФІЛЬ АРТЕРІАЛЬНОГО ТИСКУ ТА СТАН КОГНІТИВНОЇ ФУНКЦІЇ У ПАЦІЄНТІВ З АРТЕРІАЛЬНОЮ ГІПЕРТЕНЗІЄЮ

Стаття присвячена проблемі артеріальної гіпертензії як найважливішому фактору ризику розвитку когнітивних порушень. У 39 і 32 пацієнтів на артеріальну гіпертензію з когнітивними дисфункціями виявлено достовірне порушення добового профілю артеріального тиску по систолічному і діастолічному артеріальному тиску, проти 19 і 16 пацієнтів по аналогічним показникам в групі без когнітивних порушень. Зі зниженням показників шкали МоСА-тесту корелювали показники добового індексу систолічного і діастолічного артеріального тиску, а також показники варіабельності систолічного артеріального тиску за день і ніч. Нами встановлено, що пацієнти на гіпертонічну хворобу II стадії з наявністю когнітивних порушень характеризуються достовірним переважанням патологічних типів добового профілю артеріального тиску "Non-dipper" і "Night-peaker" (46,2 % і 19,2 %, відповідно).

Ключові слова: гіпертонічна хвороба, моніторинг артеріального тиску, когнітивні порушення.

The work is a fragment of the research project "Changes in the structural and functional state of the heart, blood vessels in patients with arterial hypertension: provoking and restraining factors, development of complications and treatment options", state registration No. 0120U103231.

To date, hypertension (AH) is considered not only as a leading risk factor for brain stroke, coronary heart disease, heart and kidney failure, premature death, but also is an independent risk factor for cognitive dysfunction in all age groups, up to the degree of dementia [2]. Currently, more and more attention is drawn to the intermediate stage of cognitive disorders (CD) development, when they have not yet reached the degree of dementia, but are already beyond the age norm [15].

The role of AH in the formation of cognitive disorders has been shown in a number of large studies, such as Baltimore Longitudinal Study on Aging, EVA Gothenburg, Honolulu-Asia Aging Study, ARIC (Atherosclerosis Risk in Communities) [7].

The effect of AH on CD is largely determined by its duration and characteristics of changes in blood pressure (BP). Increase in blood pressure by only 10 mm Hg from the target level of systolic blood pressure (SBP), increases the risk of vascular cognitive disorders from 7–16 % to 40 % [5]. There is a direct relationship between blood pressure at the age of 50 and the state of mind at the age of 70: the better the blood pressure is controlled, the better the cognitive function is [5]. In the literature, much attention is paid to the importance of daily blood pressure monitoring (DBPM), the parameters of which have an established relationship with damage to target organs and the development of cardiovascular complications in the future [9, 15].

Given the role of hypertension in the development of cognitive impairment and subsequent dementia, it is important to perform early diagnosis of disorders of higher brain functions, which can remain for a long time the only symptom of neurological distress. Currently, there are data from clinical studies that suggest that modification of risk factors and treatment, started at an earlier stage, may be effective and will suspend further progression of CD [14]. In this regard, early verification of CD in patients with AD permits the timely appointment of drug treatment at the stage of mild and moderate CD.

In view of the above, it is worth studying the most significant indices of DBPM as predictors of CD in patients with hypertensive disease (HD).

The purpose of the study was to examine the relationship of cognitive impairment with the indicators of “office” and daily monitoring of blood pressure in patients with hypertension.

Materials and methods. We examined 102 patients with stage II HD without comorbidities, the average age of which was 49.84 ± 0.83 years. The duration of the disease averaged 8.78 ± 0.60 years. Among the examined patients there were 72 men (70.6 %) and 30 women – 29.4 %. Grade 2 hypertension was detected in 41 (40.2 %) patients, grade 3 hypertension in 61 (59.8 %) patients. All patients did not receive regular antihypertensive therapy or were not treated appropriately (without reaching their target blood pressure levels). The diagnosis of HD was established according to the recommendations of the European Society of Cardiology (2018) [15]. Blood pressure was assessed during office measurement of blood pressure and DBPM. The exclusion criteria were stroke, transient ischemic attacks, traumatic brain injury with loss of consciousness, severe somatic diseases.

DBPM was performed in stationary conditions, using a portable device for automatic measurement of blood pressure Meditech ABPM-04, Hungary. The programming of the monitor was carried out taking into account the day and night periods. The frequency of measurements was 15 minutes during the day and 30 minutes at night. All subjects kept diaries, which recorded the time and duration of periods of physical activity, rest and sleep. Data that include at least 80 % of effective measurements were taken into account. The analysis of DBPM results was performed using a computer software. The following parameters were analyzed: mean daily values of systolic, diastolic and pulse blood pressure (SBP, DBP, PBP); double product (DP); pressure load index – time index (IR) of hypertension for 24 hours of SAT and DBP; daily index (DI), which reflects the degree of nocturnal blood pressure reduction (SBP and DBP) relative to the day; the magnitude of the morning rise in blood pressure, as well as the variability of blood pressure by standard deviation (SD) of the average daily (SD SBP and DBP day) and mean night (SD SBP and DBP night) values of SBP and DBP.

In interpreting the results of the study the normative values of blood pressure [1] and the European Society of Cardiology were used (2018) [15]. To diagnose hypertension, the threshold level for the mean daily CAT and DBP were values $\geq 130/80$ mm Hg. Pulse blood pressure was defined as the difference between CAT and DBP per day and was considered normal <46 mm Hg, elevated at values greater than 53 mm Hg. [1]. Blood pressure load hypertension was calculated as the proportion of measurements in which the blood pressure exceeds 135/85 mm Hg during the day and 120/70 mm Hg at night. It was calculated as a percentage of measurements in 24 hours [7, 15]. Blood pressure load, which did not exceed 10–25 %, was considered normal, 25–50 % – characteristic of “labile AH”, more than 50% – for stable AH.

Depending on the value of night pressure decrease (NPD) BP, the following types were distinguished: [10] “dipper” – with physiological decrease in BP at night (NPD – 10–20 %); “Non-dipper” – with insufficient decrease in blood pressure at night (NPD $<10\%$); “Night-picker” – with a steady increase in blood pressure at night (NPD <0); “Over-dipper” – with an excessive decrease in blood pressure at night (NPD $> 20\%$).

The variability of blood pressure was calculated as the standard deviation (SD, mm Hg) from the mean daily (SD SBP and DBP day) and mean night (SD SBP and DBP night) values of SBP and DAT. The critical values of variability for CAT both during the day and at night were 15 mm Hg, for diastolic blood pressure 14 mm Hg during the day and 12 mm Hg at night. [1]. Variability was considered increased in excess of at least one of the 4 critical values [12]. The index of short-term daily variability of blood

pressure was also determined, calculated with account of the actual duration of day and night periods (SDdn) [1, 10].

The magnitude of the morning rise in blood pressure was defined as the difference between the maximum and minimum values of BP in the morning. The value of the morning rise of the SBP should not exceed 56 mm Hg, DBP – 30–36 mm Hg. [10]. The study of cognitive functions was performed in the morning and was assessed using the Montreal scale of assessment of cognitive functions (MoCA-test) [3]. The test result was determined by summing the scores for each of the items. The maximum possible number of points is 30; norm – 26 and more, the presence of CD was determined at indices less than 26 points.

Statistical processing of the study results was performed using the computer software “IBM SPSS Statistics 22”. The studied values in the paper are presented in the form: sample mean±standard error of representativeness of the sample mean. When testing statistical hypotheses, the null hypothesis was rejected at a significance level of 0.05. The degree of correlation between a pair of independent traits, expressed on a quantitative scale, was assessed using the P. Spearman rank correlation coefficient (R).

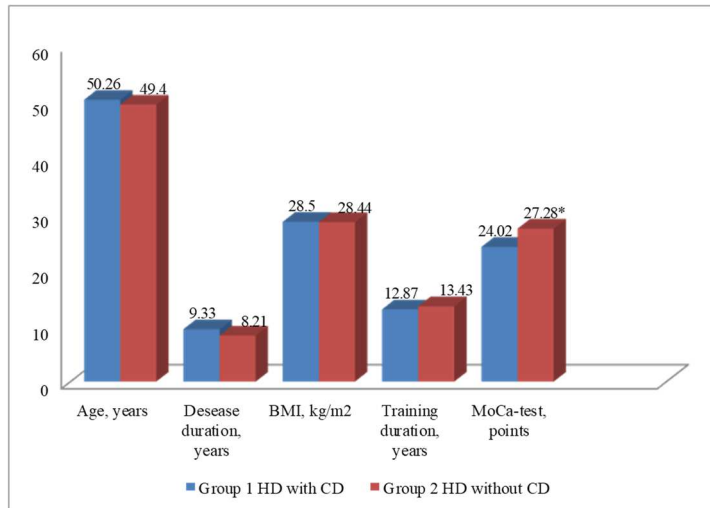


Fig.1. Clinical characteristics of patients with stage II HD depending on the level of cognitive dysfunction. Notes: * → differences in indices when comparing groups 1 and 2 were significant (p <0.05).

Results of the study and their discussions. The examined patients were divided into 2 groups depending on the level of cognitive functions. Group 1 included 52 patients with stage II HD with CD (51 %), group 2 with 50 patients with stage II HD without CP (49 %) (fig. 1).

The MoCA test scores in the groups 1 and 2 were 24.02±0.14 and 27.28±0.19 points, respectively, which is significantly less by 11.9 % in group 1 than in group 2. Age, duration of hypertension, body mass index, duration of education (training in educational institutions of different levels) in the observed groups of patients did not differ significantly (p>0.05).

During DBPM, elevated rates of SBP and DBP were detected, respectively, according to one or another hypertension degree (table 1).

□bl□1

Indices of office measurement and DBPM in patients with stage II HD with and without CD

Indices, measurement units	Group 1	Group 2
	HD patients with CD (n=52)	HD patients without CD (n=50)
Clinical SBP, mm Hg	158.6±2.28	154.8±1.53
Clinical DBP, mm Hg	93.37±1.18	92.42±0.91
Average daily SBP, mm Hg	140.62±1.04	137.92±1.09
Average daily DBP, mm Hg	86.81±0.92	86.20±0.81
Average daily PP, mm Hg	53.81±0.92	51.72±0.98
Average daily heart rate, bpm	69.58±0.82	68.80±0.85
Double product DP, mm Hg /beats *, day	97.84±1.36	94.89±1.38
CI SBP, %	8.17±1.12	11.60±0.77*
CI DBP, %	9.26±1.03	12.68±0.75*
Blood pressure load day SBP, %	69.44±1.76	62.76±3.30
Blood pressure load day DBP, %	69.94±2.22	64.25±2.56
morning surge of SBP, mm Hg	56.90±2.34	51.92±2.56
morning surge of DBP, mm Hg	39.10±1.86	36.70±2.12
SDdn SBP	16.74±0.40	14.10±0.32*
SDdn DBP	13.09±0.30	12.14±0.38

Notes: * – differences in indices when comparing groups 1 and 2 are significant (p <0.05).

Indices of clinical and average daily SBP and DBP in the group of patients with hypertension with CD were relatively the same as in the group of patients with hypertension without CD.

Patients in groups 1 and 2 showed a high rate of hypertension: blood pressure load for SBP and DBP per day was more than by 2 times higher than normal (p<0.05) and was relatively the same when comparing groups.

The mean values of morning surge SBP in groups 1 and 2 did not exceed the permissible level. When analyzing the value of the DBP morning rise, its normal values were noted in the group of patients with HD without CP and the tendency to increase in the group of patients with HD with CP, although intergroup differences were not statistically significant ($p>0.05$).

When analyzing the DP index, which reflects the load on the cardiovascular system per day, it was found that it was also not statistically higher in the group of HD patients with CD than in the group of HD patients without CD.

In the analysis of DBPM data, much attention was paid to assessing the variability of blood pressure. Fluctuations in blood pressure for patients are often invisible, but from the point of view of determining the prognosis for this category of patients, this index is very important because the variability of blood pressure is an independent predictor of damage to target organs such as heart and brain. The results of our study showed that in the group of patients with hypertension with CD there was a significant increase in the variability of SBP (VSBP) for day and night and a tendency to increase the variability of DBP (VDBP) for day and night compared to the group of patients with hypertension without CD (table 2).

□b□2

Indices of blood pressure variability in patients with stage II HD with CD and without CD

Indices, units of measurement	HD Patients with CD (n=52)	HD Patients without CD (n=50)
Average daily variability of SBP, Hg	17.04±0.52	14.13±0.45*
Average daily variability of DBP, Hg	13.49±0.37	12.60±0.49
Average night variability of SBP, Hg	16.16±0.60	14.06±0.45*
Average night variability of DBP, Hg	12.29±0.40	11.22±0.37

Notes: * - differences in indices when comparing groups 1 and 2 are significant ($p<0.05$).

Significant differences were found for the average 24-hour index SBP and DBP, which characterizes the degree of blood pressure reduction at night (table 1). According to the values of 24-hour index in each patient was determined by the type of daily blood pressure profile. Summary data on the frequency of occurrence of different variants of the daily profile of blood pressure are presented in fig. 2.

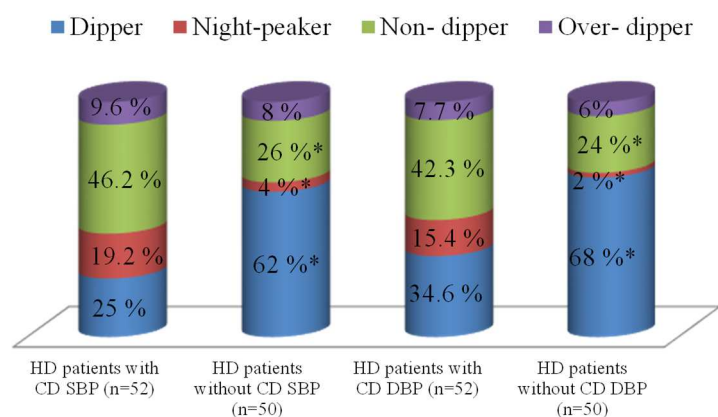


Fig.2. Distribution of HDpatients with CD and without CD according to the degree of nocturnal decrease in SBP and DBP

Notes: * - differences in indices when comparing groups 1 and 2 are significant ($p<0.05$).

“non-dipper”. Increase in SBP at night (type of daily curve “night-peaker”) was observed in 10 patients (19.2 % of patients with hypertension with CD) and DBP in 8 patients (15.4 %). In some patients in the group of patients with hypertension with CD there was an excessive decrease in SBP and DBP - in 5 (9.6 %) and 4 (7.7 %) at night (type of daily curve “over-dipper”) without significant difference with the group of patients with hypertension without CP 4 (8 %) and 3 (6 %), respectively.

Normal daily profile with sufficient nocturnal decrease in SBP (type of “daily curve” dipper) was found only in 13 patients and DBP – in 18 patients (25 % and 34.6 % of patients with HD with CD, respectively) against 31 (62 %) and 34–68 %) on SBP and DBP of patients in the HD group without CD.

The correlation analysis revealed a relationship between the indices of the daily blood pressure profile and the degree of CP. We obtained the results of the correlation between the number of points on the MoCA test scale and the indices of the average daily SBP and pulse blood pressure PBP of weak strength in the opposite direction ($r=-0.29$; $p=0.003$, $r=-0.25$; $p=0.01$, respectively). The direct direction of communication of CD with indices of SI SAT and 24-hour BP index of DBP $r=0.24$ was also revealed; $p=0.02$ and $r=0.36$; $p=0.002$, respectively. Correlated with a decrease on the MoCA test scale indices of SBP variability for day and night $r=-0.28$; $p=0.005$ and $r=-0.26$; $p=0.01$, respectively, and the DBP variability per night $r=0.21$; $p=0.03$. The SDdnSBP index correlated with the severity of CD $r=-0.36$; $p=0.001$.

The results of the MoCA test in our work showed a high prevalence of CD in patients with HD: CD was observed in 51 % of patients with HD. The data of our study on the occurrence of CD in patients with hypertension are consistent with the previously obtained results of other authors [4].

The results of a number of studies confirm the relationship between hypertension and structural changes in the brain (leukoareosis, lacunar infarction and subcortical atrophy of the brain), which is the morphological substrate of CD in such patients [8]. In a recent cohort study by Avet J. et al., The dependence of the leukoareosis severity on the daily level of SBP, DBP and night SBP was demonstrated [8]. In our work in the analysis of DBPM data in the group of patients with hypertension with CD, there were no significantly higher average daily SBP, DBP indices.

24-hour index of systolic and diastolic pressure in the group of hypertension with CD was significantly reduced, indicating a violation of autonomic regulation at night. There are data in the literature that circadian rhythm disorders with insufficient blood pressure at night correlate with a higher frequency of strokes, more frequent development of left ventricular myocardial hypertrophy, more frequent and severe microalbuminuria [13].

The DBPM profile “non-dipper” and “night-peaker” 24-hour index for SBP and DBP is a significant predictor of the development of cognitive decline, especially for patients younger than 50 years [5, 11]. In our work, when analyzing the data of the on DBPM in the study groups in 39 patients with hypertension with CD (75 %) initially revealed a violation of the daily profile of BP on SBP, in 32 (61.5 %) patients - on DBP. It should be noted that a high level of pulse blood pressure PBP is an indicator of increased rigidity of large arterial vessels and acts as an independent risk factor for cardiovascular complications [6].

To date, there is sufficient evidence for a relationship between high blood pressure variability and target organ damage in HD. It was found that with increasing variability of blood pressure during the day the risk of cardiovascular complications grows, accompanied by a significant thickening of the main arteries walls and an increase in the degree of left ventricular hypertrophy. The results of our study showed that in the group of patients with hypertension with CD there was a significant increase in VSBP during the day and night with an increase in short-term variability of blood pressure and the predominance of pathological types of daily blood pressure profile. In other words, the obtained results suggest that pathological circadian rhythms of blood pressure of the type “night-peaker”, “non-dipper” are associated with CD. And indicators of short-term daily variability of blood pressure and variability of average day and night SBP, in addition to the absolute values of blood pressure can serve a therapeutic purpose to prevent a decrease in cognitive function.

Conclusions

1. Neuropsychological examination of 102 patients with stage II HD, who do not regularly receive antihypertensive therapy, showed the presence of CD in 51 %.
2. Arterial hypertension in patients with stage II HD with the presence of CD is characterized by a steady significant increase in VSBP during the day and night ($p < 0.05$) and SDdnSBP ($p < 0.05$).
3. In patients with stage II HD with the presence of CD, in contrast to the group of patients with stage II HD without CD, there is a predominance of pathological types of daily BP profile of “non-dipper” and “night-peaker” types (46.2 % and 19.2 %, respectively).

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THE TRANSFORMATION OF PSYCHOPHYSIOLOGICAL FUNCTIONS OF MILITARY PILOTS WITH DIFFERENT PROFESSIONAL QUALIFICATION AND AGE

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The paper presents the results of the investigations related to revealing the transformation peculiarities of a complex of psychophysiological functions of military pilots of supersonic, subsonic, transport and helicopter aviation with due respect to their qualification level and age. The authors outline the descriptive list of psychophysiological characteristics that change regularly because of improving professional competence. They also specify the regular decrease in the level of significance of the correlation relationship between qualification and a complex of psychophysiological functions in pilots of supersonic, subsonic and transport aviation. As far as helicopter pilots are concerned, the increase in the body compensatory abilities under carrying out less intensive work results in the natural increase in such relationships. Moreover, the availability of trustworthy correlation relationships between the qualification of pilots and their age is shown. Furthermore, this relationship in supersonic aviation pilots is manifested much stronger than in other categories.

Key words: aviation medicine, psychophysiological functions, military pilots.

В.В. Кальниш, К.В. Шепітько, І.С. Трінька, В.В. Кравчук, С.М. Пашковський ТРАНСФОРМАЦІЯ ПСИХОФІЗІОЛОГІЧНИХ ФУНКЦІЙ ВІЙСЬКОВИХ ЛЬОТЧИКІВ З РІЗНОЮ ПРОФЕСІЙНОЮ КВАЛІФІКАЦІЄЮ ТА ВІКОМ

У статті представлено результати досліджень щодо виявлення особливостей трансформації комплексу психофізіологічних функцій військових льотчиків надзвукової, дозвукової, транспортної та вертолітної авіації з урахуванням рівня їх кваліфікації та віку. Виділено перелік психофізіологічних характеристик, що закономірно змінюються у результаті удосконалення професійної підготовленості. Встановлено закономірне зменшення рівня значимості кореляційного зв'язку між кваліфікацією та комплексом психофізіологічних функцій льотчиків надзвукової, дозвукової та транспортної авіації. У вертольотчиків зростання компенсаторних можливостей організму під час реалізації менш напруженої праці призводить до закономірного збільшення кількості таких зв'язків. Крім того, показано наявність достовірних кореляційних зв'язків між кваліфікацією пілотів та їх віком. Причому цей зв'язок у льотчиків надзвукової авіації проявляється значно сильніше, ніж у інших.

Ключові слова: авіаційна медицина, психофізіологічні функції, військові льотчики.

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Solving the problem of the human factor in aviation medicine is closely connected with determining the effects of psychophysiological abilities and the state of health of pilots [0]. References intensively highlight the role and importance of a pilot's flying hours and physical training for preventing flight accidents [0]. With the aim of lessening the effects of human factor the model and the technique of the automated diagnostics of a military pilot state of health are suggested [0].

In their paper D.A. Nikiforov et al. [0] maintain that the most significant factors of the pilot's professional activities are as follows: the organization of the processes of professional training (including the