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BLOOD PRESSURE VARIABILITY IN ELDERLY AND MIDDLE-AGED HYPERTENSIVE PATIENTS

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Abstract. It has long been proven that risk of cardiovascular and cerebrovascular complications in hypertensive patients depends not only on absolute level of blood pressure but also on fluctuations in blood pressure over different periods of time that is blood pressure variability. Blood pressure is not a static parameter but rather undergoes continuous fluctuations over time as result of interaction between environmental factors and behavior on the one hand and internal regulatory mechanisms of cardiovascular system on the other hand. Elevated blood pressure variability may indicate cardiovascular dysregulation and itself may be a cardiovascular risk factor associated with increased all-cause and cardiovascular mortality, stroke, coronary artery disease, heart failure, end-stage renal disease and incidence of dementia.

Purpose was to improve system of prevention and diagnosis of hypertensive patients at ambulatory-polyclinic stage due to study of contribution of blood pressure variability.

Materials and methods. The group of examinees was formed taking into account 60 elderly and middle-aged hypertensive patients including with coronary artery disease. For this purpose ambulatory blood pressure monitoring was used.

Results. The frequency of high blood pressure variability in hypertensive patients of elderly age was 42.5% (n=17); in middle-aged was 30% (n=6).

In patients with high and low blood pressure variability of elderly age non-dipper group prevails over dipper group in structure of daily blood pressure rhythm (81.1% vs. 18.9% and 75% vs. 25%, respectively).

The same was true for middle-aged patients (80% vs. 20% and 76,9% vs. 23,1%).

Blood pressure variability in elderly patients was 18.6% higher than in middle-aged and amounted to 16.7±7.2 mm Hg ($p<0.05$).

The increase is in average daily systolic blood pressure by 2.4% ($p<0.01$) between high blood pressure variability in elderly and middle age in favor of middle age. The difference of average daily diastolic blood pressure between high blood pressure variability in elderly and in middle-aged was 8.3% higher in favor of middle age ($p<0.01$). This difference was also observed in maximal diastolic blood pressure and amounted to 20.4% ($p<0.05$). There was the slight increase, but it was there, in average blood pressure between high blood pressure variability in elderly and in middle age by 2.3% similarly ($p<0.05$). It was found the significant increase in maximal systolic blood pressure by 8% and 14,1% between the above groups and controls ($p<0.001$).

With regard to daily index of average blood pressure differences between control and low/high blood pressure variability in middle age were of interest, namely the decrease of 24.1% and 60.3%, respectively ($p<0.05$).

Conclusions. The percentage of hypertensive patients and high blood pressure variability in elderly is higher than in middle-aged.

In elderly and middle-aged hypertensive patients with high/low blood pressure variability non-dipper group predominates in structure of daily blood pressure rhythm.

In middle age there is an increase in many ambulatory blood pressure monitoring indicators compared to elderly which should be taken into account in treatment.

Keywords: arterial hypertension, essential hypertension, blood pressure, blood pressure variability, high blood pressure variability, low blood pressure variability, dipper, non- dipper, elderly and middle-aged hypertensive patients.

Introduction. High systolic blood pressure variability (BPV) and high systolic mean blood pressure (BP) are associated with 33% and 6% higher odds of cardiovascular disease in adults aged ≥65, respectively. High BPV (HBPV) is also related to an 18%-28% and 11% increased odds of cerebral deterioration and poor stroke recovery [2].

High day-by-day BPV in acute ischemic stroke was associated with more severe stroke independent of BP levels [4, 7].

The 85 years older age group presented a significantly greater whole-day systolic BP standard deviation (STD) of ambulatory blood pressure monitoring (ABPM) (13.2±3.19 vs. 12.47±3.05, p=.005) compared with those under the age of 85 years. In the 85 years older age group, the proportion of individuals with the reverse dipper pattern was higher (48.15% vs. 38.31%, p=.017) than under

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85 years age group. This study revealed that elderly male hypertensive patients aged over 85 years presented elevated average BP levels. The research investigated ABPM characteristics. Older hypertensive individuals are more likely to have a reverse-dipper BP pattern [5].

These findings supported that maintaining stable systolic BP (SBP) in late life helped lower the risk of Alzheimer's disease, partially by modulating amyloid pathology, cerebral metabolism, and cerebrovascular health [1, 3].

Research justification. Arterial hypertension (AH) remains one of the leading causes of cardiovascular morbidity and mortality, especially among middle-aged (MA), elderly (E), and senile individuals. In recent years, increasing attention has been paid not only to BP levels, but also to its variability and circadian rhythm, which are considered independent predictors of target organ damage and adverse cardiovascular events [6].

Of particular clinical significance is the variability of SBP, in particular as measured by STD, exceeding the threshold level of which (15 mm Hg during the daytime) is associated with an increased risk of progression of essential hypertension (EH). At the same time, age-related features of BPV and its relationship with diurnal profile types (dipper/non-dipper) in patients of different age groups remain insufficiently studied in clinical practice.

E and senile patients are a particularly vulnerable group due to age-related changes in the vascular wall, decreased baroreflex sensitivity, and the frequent combination of EH with other chronic diseases. At the same time, in MA patients, disturbances in BPV and circadian rhythm may be subclinical, remaining underestimated during standard office BP measurement.

Daily BP monitoring allows for a comprehensive assessment of BP levels, variability, peak values, and circadian rhythm, making it an indispensable method for detecting early hemodynamic disorders. However, the available data on the comparative characteristics of ABPM in hypertensive patients of different age groups, taking into account BPV, remain limited and contradictory.

In this regard, studying age-related characteristics of ABPM indicators, BPV, and daily profile in hypertensive patients is relevant and clinically useful, as it can contribute to the optimization of cardiovascular risk stratification and individualization of antihypertensive therapy.

Purpose of the research. To improve system of prevention and diagnosis of hypertensive patients at ambulatory-polyclinic stage due to study of contribution of BPV.

Materials and organization of the research. The study group consisted of 60 patients namely 40 E and senile patients and 20 MA patients with AH including with coronary artery disease (CAD).

A total of 17 men and 20 women of elderly age and 1 man and 2 women of senile age (mean age 67.5±5.3) were examined. 11 men and 9 women of middle age with AH including those with combined CAD (mean age 52.2±3.6) were also involved.

They were divided in 4 groups: low BPV (LBPV) in elderly/middle age and HBPV in elderly/middle age. The control group consisted of 21 people.

Instrumental method was used to solve the tasks. For this purpose ABPM was used.

ABPM indicators were determined using DiaCard portable recorder (Solvaig, Ukraine) according to the standard protocol. BP and certain other parameters were measured every 30 minutes during daytime activity (from 6:00 a.m. to 10:00 p.m.) and every hour during night sleep (from 10:00 p.m. to 6:00 a.m.). The initial measurement of BP indicators was performed on both arms of the patient and further registration was performed on the arm with higher initial pressure values. The following indicators were determined and analyzed: STD for SBP during the day (mm Hg), average daily SBP (mm Hg), average daily diastolic BP (DBP) (mm Hg), average BP (mm Hg), maximal daily SBP (mm Hg), maximal daily DBP (mm Hg). Daily index (DI) was also calculated - the percentage of decrease in night BP compared to daytime, namely: DI of SBP (%), DI of DBP (%), DI of average BP (%).

The survey results were processed using variational statistics methods by determining arithmetic mean 'M' and standard deviation "σ" for each variation series. Statistical data processing was performed using Microsoft Excel software.

Results of the research. The threshold value for STD is 15 mm Hg during the day.

The frequency of HBPV in hypertensive patients of elderly age was 42.5% (n=17); in MA was 30% (n=6).

In hypertensive patients with H/LBPV of elderly age non-dipper group prevails over dipper group in structure of daily BP rhythm (81.1% vs. 18.9% and 75% vs. 25%, respectively).

The same was true for MA patients (80% vs. 20% and 76,9% vs. 23,1%).

When comparing ABPM indicators in E and MA patients, it should be noted that there were differences between the two groups in most parameters, namely, BPV in E patients was 18.6% higher than MA and amounted to 16.7±7.2 mm Hg ($p<0.05$).

Table 1

ABPM indicators in control group, L/HBPV in E/MA hypertensive patients

Indicator	Control (n=21) -1-	LBPV E (n=23) -2-	LBPV MA (n=14) -3-	HBPV E (n=17) -4-	HBPV MA (n=6) -5-	P_{1-2}	P_{1-4}	P_{2-4}
						P_{1-3}	P_{1-5}	P_{4-5}
Average daily SBP (mm Hg)	134.1± 23.2	128.1± 11.6	129.1± 11.3	129.6± 18.7	132.7± 16.1	>0.05	>0.05	>0.05
						<0.05	>0.05	<0.01
Average daily DBP (mm Hg)	89.3± 16.3	79.2± 5.4	84.4± 9.3	77.1± 13.3	83.5± 8.4	>0.05	<0.05	<0.01
						<0.001	<0.05	<0.01
Average BP (mm Hg)	106.2±15.5	103.3±18.1	111.3± 11.1	107.0±12.8	109.5±12.6	>0.05	>0.05	>0.05
						>0.05	>0.05	<0.05
Maximal SBP (mm Hg)	156.9±27.3	156.3±19.6	155.5± 13.6	169.5±23.5	179± 30.3	>0.05	<0.001	>0.05
						>0.05	<0.001	>0.05
Maximal DBP (mm Hg)	111.3±21.2	108.6± 17.3	111.7± 12.0	107.4±19.1	129.3 ±32.1	>0.05	>0.05	>0.05
						>0.05	>0.05	<0.05
DI of SBP (%)	9.9± 5.1	5.4± 6.3	9.2± 5.5	3.5± 9.7	17.0± 10.9	>0.05	>0,05	>0,05
						>0.05	>0.05	>0.05
DI of DBP (%)	14.9± 9.7	7.3± 8.0	3.7± 4.7	7.1± 9.5	3.7± 11.3	>0.05	>0.05	>0.05
						>0.05	>0.05	>0.05
DI of average BP (%)	13.1± 7.2	7.5± 0.6	10.4± 5.8	4.2± 10.7	5.2± 10.6	<0.05	<0.05	>0.05
						<0.05	<0.05	>0.05

Notes: P_{1-2} – statistical significance of difference between control and LBPV E groups, P_{1-4} – statistical significance of difference between control and HBPV E groups, P_{2-4} – statistical significance of difference between LBPV E and HBPV E groups, P_{1-3} – statistical significance of difference between control and LBPV MA groups, P_{1-5} – statistical significance of difference between control and HBPV MA groups, P_{4-5} – statistical significance of difference between HBPV E and HBPV MA groups.

Among the significant ABPM indicators in MA patients that are of practical interest are the following: the increase in average daily SBP by 2.4% (p<0.01) (table 1) between HBPV E/MA in favor of middle age.

The difference of average daily DBP between HBPV E/MA was 8.3% higher in favour of middle age (p<0.01).

This difference was also observed in maximal DBP and amounted to 20.4% (p<0.05).

There was a slight increase, but it was there, in average BP between HBPV E/MA by 2.3% similarly (p<0.05).

It was found the significant increase in maximal SBP by 8% and 14,1% between the above groups and controls (p<0.001).

With regard to DI of average BP differences between control and LBPV/HBPV MA were of interest, namely a decrease of 24.1% and 60.3%, respectively (p<0.05).

Discussion of the results. In accordance with the accepted STD limit for SBP during the daytime (15 mm Hg), the study found the high frequency of BPV in hypertensive patients. In particular, HBPV was more common in E and senile patients (42.5%) than in MA patients (30%). This indicates the age-related increase in the instability of BP regulation, which is probably associated with a decrease in vascular elasticity, disruption of baroreflex mechanisms, and the accumulation of comorbid pathology.

Analysis of the daily BP rhythm showed that patients with SBP and DBP, regardless of age, predominantly had non-dipper type. This is especially pronounced in E and senile age (81.1% in SBP and 75% in DBP), which is of important clinical significance, since it is known that non-dipper profile is associated with a higher risk of target organ damage and cardiovascular complications. A similar trend was observed in MA patients, indicating an unfavorable daily BP profile already in the early stages of EH [5].

When comparing ABPM indicators between age groups, significant intergroup differences were found for most parameters. In particular, BPV in E and senile patients was 18.6% higher than in MA patients and amounted to 16.7±7.2 mm Hg (p<0.05). This confirms the hypothesis of progressive impairment of daily BP regulation with age [2].

At the same time, a number of indicators of practical interest were recorded in MA patients with HBPV. Thus, the average daily SBP was 2.4% higher compared to the elderly SBP group (p<0.01), and the difference in the average daily DBP reached 8.3% in favor of MA patients (p<0.01). This may indicate greater role of the diastolic component of BP in the formation of increased variability in MA patients.

A slight but statistically significant increase in mean BP by 2.3% between HBPV E/MA groups (p<0.05) also confirms the presence of age-related features of hemodynamics. In addition, the maximal SBP values significantly exceeded the control values — by 8.4% and 14.1%, respectively (p<0.001), and the maximal DBP — by 20.4% (p<0.05), which emphasizes the dangerous nature of peak BP rises in SBP.

Changes in the DI of mean BP in MA patients deserve special attention: a decrease of 24.1% was observed in LBPV MA group and 60.3% in HBPV MA group compared to control group (p<0.05). This indicates the significant disturbance in the circadian rhythm of BP and can be considered early marker of an unfavorable course of EH.

Conclusions. The percentage of hypertensive patients and HBPV in E is higher than in MA.

In E and MA hypertensive patients with HBPV/LBPV non-dipper group predominates in structure of daily BP rhythm.

In middle age there is an increase in many ABPM indicators compared to E which should be taken into account in treatment.

Prospects for further research. A promising area for further research is an in-depth study of prognostic role of BPV and disturbances in daily BP profile in hypertensive patients of different age groups. It is advisable to determine their impact on the development of target organ damage, in particular left ventricular hypertrophy, chronic kidney disease and cerebrovascular complications.

Thus, further research in this area could significantly expand our understanding of the pathophysiological mechanisms of BP regulation disorders and contribute to improving the effectiveness of prevention and treatment of EH.

Conflict of interest. The author declares that she has no conflict of interest regarding this study, including financial, personal, authorship or other nature, which could affect the study and its results presented in this article.

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ВАРІАБЕЛЬНІСТЬ АРТЕРІАЛЬНОГО ТИСКУ У ХВОРИХ НА АРТЕРІАЛЬНУ ГІПЕРТЕНЗІЮ ПОХИЛОГО ТА СЕРЕДНЬОГО ВІКУ

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Резюме. Давно доведено, що ризик кардіо- і цереброваскулярних ускладнень у пацієнтів з артеріальною гіпертензією залежить не лише від абсолютного рівня артеріального тиску, а й від коливань артеріального тиску протягом різних проміжків часу, тобто варіабельності артеріального тиску. Артеріальний тиск не є статичним параметром, оскільки зазнає безперервних коливань з часом в результаті взаємодії між факторами навколишнього середовища та поведінкою, з одного боку, і внутрішніми механізмами регуляції серцево-судинної системи, з іншого боку. Підвищена варіабельність артеріального тиску може свідчити про порушення серцево-судинної регуляції та власне може бути серцево-судинним фактором ризику, пов'язаного зі збільшенням смертності через інсульт, ішемічну хворобу серця, серцеву недостатність, термінальну ниркову недостатність та захворюваність на деменцію.

Мета дослідження – удосконалити систему профілактики та діагностики хворих з артеріальною гіпертензією на амбулаторно-поліклінічному етапі за допомогою вивчення варіабельності артеріального тиску.

Методи. Група обстежених була сформована з 60 хворих на артеріальну гіпертензію похилого та середнього віку, у тому числі з ішемічною хворобою серця. З цією метою використовували добовий моніторинг артеріального тиску.

Результати. Частота виявлення високої варіабельності артеріального тиску у хворих з гіпертонічною хворобою похилого віку становила 42,5% (n=17); середнього 30% (n=6).

У хворих на гіпертонічну хворобу з високою та низькою варіабельністю артеріального тиску похилого віку в структурі добового ритму артеріального тиску переважає група non-dipper над dipper (81,1% порівняно з 18,9% та 75% порівняно з 25%, відповідно), у середньому віці також (80% порівняно з 20% і 76,9% порівняно з 23,1%).

Варіабельність артеріального тиску у хворих похилого віку була на 18,6% вища за середній і становила 16,7±7.2 мм рт. ст. ($p<0.05$).

Різниця за показником середньодобового систолічного артеріального тиску між високою варіабельністю артеріального тиску у людей похилого і середнього віку була на 2,4% вищою з перевагою для людей середнього віку ($p<0.01$). Різниця за середньодобовим діастолічним артеріальним тиском між високою варіабельністю артеріального тиску людей похилого і середнього віку була на 8,3% вищою з перевагою для людей середнього віку ($p<0.01$). Ця відмінність простежувалася і за показником максимального діастолічного артеріального тиску і складала 20,4% ($p<0.05$). Спостерігалося невелике збільшення показників за середнім артеріальним тиском між високою варіабельністю артеріального тиску людей похилого і середнього віку на 2,3% аналогічно ($p<0.05$). Показник максимального систолічного артеріального тиску на 8,4% і 14,1% значно перевищував контрольне значення між вищезазначеними групами ($p<0.001$).

Щодо добового індексу середнього артеріального тиску спостерігалася різниця між контролем і низькою/

високою варіабельністю артеріального тиску у середньому віці, а саме зниження на 24,1% та 60,3% відповідно ($p<0.05$).

Висновки. Відсоток наявності пацієнтів із гіпертонічною хворобою з високою варіабельністю артеріального тиску похилого віку вищий, ніж у пацієнтів середнього віку.

У хворих на гіпертонічну хворобу і високу/низьку варіабельність артеріального тиску похилого та середнього віку в структурі добового ритму артеріального тиску переважає група non-dipper.

У середньому віці відбувається збільшення багатьох показників добового моніторингу артеріального тиску, порівняно з похилим, що слід враховувати у лікуванні.

Ключові слова: артеріальна гіпертензія, гіпертонічна хвороба, артеріальний тиск, варіабельність артеріального тиску, висока варіабельність артеріального тиску, низька варіабельність артеріального тиску, dipper, non- dipper, похилий і середній вік.

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