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PECULIARITIES OF 24 HOUR AMBULATORY BLOOD PRESSURE MONITORING INDICES IN PATIENTS WITH ESSENTIAL HYPERTENSION, STAGE II OF DIFFERENT AGE GROUPS

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Резюме

ОСОБЛИВОСТІ ПОКАЗНИКІВ ДОБОВОГО МОНІТОРИНГУ АРТЕРІАЛЬНОГО ТИСКУ В ХВОРИХ НА ГІПЕРТОНІЧНУ ХВОРОБУ II СТАДІЇ РІЗНИХ ВІКОВИХ ГРУП

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Мета – визначення особливостей показників добового моніторингу артеріального тиску в хворих на гіпертонічну хворобу II стадії різних вікових груп.

Матеріал і методи. Показники добового моніторингу артеріального тиску визначено в 57 пацієнтів середнього (45-59 років) віку (група I) і 43 хворих похилого (60-74 роки) віку (група II), які перебували на стаціонарному двотижневому лікуванні. Контрольну групу склали по 15 хворих для кожної з обстежених категорій (відповідно III група – обстежені середнього віку та IV група – обстежені похилого віку) з порівнянним статевим складом.

Результати. Одним із чинників, що визначають зміни гемодинаміки у хворих на гіпертонічну хворобу, є вік, причому зі збільшенням віку в хворих зменшується діастолічний артеріальний тиск на тлі стабільно підвищеного систолічного, що слід враховувати в доборі антигіпертензивного лікування. З віком поступове підвищення систолічного артеріального тиску пов'язано зі збільшенням жорсткості аорти, частково – зі збільшенням вмісту колагену та зменшенням еластичних фібрил і формуванням ізольованої систолічної артеріальної гіпертензії. Доведено, що в процесі формування ізольованої артеріальної гіпертензії зростання пульсового артеріального тиску понад 60 мм рт. ст. є несприятливим щодо розвитку цереброваскулярних подій. В осіб похилого віку пульсовий артеріальний тиск виявився сильнішим чинником ризику за рівні систолічного та діастолічного артеріального тиску й середнього артеріального тиску. Нещодавно з урахуванням вікових особливостей всі три показники визнано порівнюваними предикторами у віці 50-59 років (перехідний період), а у віці 60-79 років діастолічний артеріальний тиск, негативно впливаючи на кардіоваскулярний ризик, підніс роль пульсового артеріального тиску прогностично вищим за рівень систолічного артеріального тиску.

Ключові слова: артеріальна гіпертензія, гіпертонічна хвороба, артеріальний тиск, ізольована систолічна артеріальна гіпертензія, добовий моніторинг артеріального тиску.

In the recent years, there is worsening of demographic situation in the majority of countries, due to steady growth of arterial hypertension (AH) and the aging of population [13,14]. According to the UN statistics the number of people over 60 years will exceed 1 billion to 2025, representing 15% of the world's population [12]. It

is known that AH affects 30-35 % of adult population of the industrialized countries, and its prevalence reaches 40-50 % among the elderly [7, 15].

Discussion of target levels of blood pressure (BP) in elderly patients is long. For over half a century, as a result

of adaptive response to maintain perfusion of organs was proposed by the empirical formula $(100 + \text{age})$ of systolic blood pressure (SBP) for elderly people [22,23]. The views are radically changing every year. However, according to the Framingham Heart Study independent risk factor for cardiovascular complications throughout life has been recognized level of SBP.

Search of the importance of BP with age teetered between diastolic and systolic its level. Recently revealed positive correlation between age and BP has established a leading role of SBP in the formation of AH in people over 50 years, while diastolic blood pressure (DBP) was a priority in a younger population (The Third National Health and Nutrition Examination Survey, 1991; FHS, 2002). Isolated reports indicate that diastolic hypertension spread in less than 10% of all patients with AH after 70 years. As a complement, the relationship between DBP and cardiovascular risk is bimodal, the same as when it is increasing more than 90 mm Hg, and with a decrease of about 70 mm Hg in the elderly. As a result, on any elevated levels of SBP and decreased DBP cardio-vascular risk increased (ACCF / AHA, 2011).

With age, the gradual elevation of SBP is associated with increased aortic stiffness, partially with the increase of collagen and the decrease of elastic fibrils and formation of isolated systolic hypertension (ISH) [5, 6, 18]. Thus, it is proved that during the formation of ISH the elevation of pulse pressure (PP) more than 60 mm Hg is unfavorable due to development of cerebrovascular events [11, 19]. In the elderly PP was stronger risk factor than the level of SBP and DBP or average daily BP. Recently, three age-appropriate indices were considered comparable predictors at the age of 50-59 years as a transitional period, and at the age of 60-79 years DBP adversely affecting the cardiovascular risk raised prognostic role of PP higher than the SBP (ACCF / AHA, 2011).

During screening, in patients older than 55 years, ISH accounts for 56 % of newly diagnosed AH. The presence of ISH is associated with the growth of cardiovascular mortality in 2-5 times, the frequency of cerebral strokes – in 2,5 times, the overall mortality – by 51 %. According to the Framingham Heart Study ISH is the predictor of cardiovascular diseases in the elderly [17]. The elevation of SBP by 10 mm Hg above 140 mm Hg at the age of 60 years will inevitably lead to an increase of rate of complications by 30 % [2,3,4, 20, 21, 24].

The etiology of ISH in older age groups requires clarification. There are reasons to associate it with aging. Sclerosis of aorta and large arteries, mainly as the result of sclerosis of media leads to reducing of their elasticity. Increased stiffness of the aorta is mainly due to collagenization of media, but not atherosclerosis [6, 9,

18]. At an older age, the loss of elasticity of the arterial wall fibers and deposition of collagen, elastin, glycosaminoglycans and calcium are observed. Histological changes that occur with age in the walls of blood vessels are similar to changes due to atherosclerosis. However, the role of atherosclerosis in the pathogenesis of ISH in elderly patients is controversial. In the study of autopsy specimens of human aorta was shown that the elasticity of its walls decreases with age, but how it depends on the processes of aging and atherosclerosis is unknown. In addition, clinical practice shows that SBP remains within normal limits in many patients with severe advanced atherosclerosis. In contrast, in some populations with a low prevalence of atherosclerosis SBP elevates with age and ISH is present. Among the factors that contribute to the development of AH in general are the reduction of capillary bed, rise of renin as the indicator of activation of pressor renin-angiotensin system, lowering of kallikrein, as the index of inhibition of depressor kallikrein-kinin system, involvement of pressor renal factor in general, and its systolic character due to the main factor aortic sclerosis. Enhancement of the speed of expulsion, falling of the ratio norepinephrine/epinephrine - may contribute to systolic character of hypertension [8]. Peripheral vascular resistance increases, sensitivity of β -adrenergic receptors reduces as a result of decrease of elasticity of blood vessels and atherosclerotic changes. Heart rate (HR), stroke volume and left ventricular ejection rate are within normal limits. Aging of vessels is accompanied by loss of ability to produce vascular endothelium-dependent relaxing endothelial factors [1, 6]. Decrease of elasticity of arteries weakens pressosensitive function, accompanied by raised level of norepinephrine in plasma. The regulation of many other hormones (renin, angiotensin, aldosterone, vasopressin) changes significantly and also contributes to AH. Peculiarities of course of the disease and achieving of target levels of BP in elderly patients require further study.

THE OBJECTIVE OF THE STUDY

To determine the state of hemodynamics in patients with essential hypertension (EH), stage II of different age groups.

MATERIAL AND METHODS

Indices of ambulatory blood pressure monitoring (ABPM) were identified in 57 middle-aged patients (45-59 years) (group I) and 43 elderly patients (60-74 years) (group II), who underwent two-week in-patient treatment. The control group consisted of 15 patients for every of the surveyed groups (group III - middle-aged and group IV – elderly respectively) matched with basic by age and gender. The control group was presented with patients without AH who were hospitalized with

diagnoses of chronic gastritis, duodenitis, cholecystitis, atherosclerotic cardiosclerosis, with angina, functional class that is not above I, without cardiac arrhythmias and heart failure that is not above II A stage for Strazhesko M.D. – Vasylenko V.H.

The diagnosis and stage of EH was set according to the criteria of WHO and the International Society of Hypertension (2013). Patients with significant heart rhythm disorders, angina, functional class that is above I, heart failure that is above II A stage for Strazhesko M.D. – Vasylenko V.H. were not involved in the study. Patients with symptomatic hypertension and obesity more than the second degree were also excluded.

Indices of ABPM were determined using a portable recorder ABPM -04 (company "Meditech", Hungary)

according to a standard protocol [16]. Measurements of BP and some other parameters were performed every 15 minutes during daily activity (from 6 to 22 hours) and every 30 minutes during night sleep (from 22 to 6 hours). The initial BP measurement was performed on both hands of a patient and subsequent registration was carried on the arm with higher initial pressure values. We determined and analyzed the following indices: the average daily SBP (mm Hg), the average daily DBP (mm Hg), the average BP (mm Hg), the maximal daily SBP (mm Hg), the maximal daily DBP (mm Hg), the average daily HR (/min.), daily index (DI) of SBP (%), DI of DBP (%), DI of the average BP (%).

RESULTS AND DISCUSSION

The research results are presented in table 1.

Table 1

Indices of ABPM in middle-aged and elderly patients with essential hypertension compared with control group (M±σ)

Indices	Distribution of the surveyed groups				P
	I group (n=57)	II group II (n=43)	III group (n=15)	IV group (n=15)	
The average daily SBP (mm Hg)	156,5±12,1	150,5±12,6	104,2±3,1	115,5±8,0	P ₁ >0,05 P ₂ <0,001 P ₃ <0,01
The average daily DBP (mm Hg)	99,9±6,6	92,5±1,3	64,7±3,7	71,9±8,6	P ₁ <0,001 P ₂ <0,001 P ₃ <0,05
The average BP (mm Hg)	116,2±9,9	103,3±10,9	86,4±7,5	86,4±7,5	P ₁ >0,05 P ₂ <0,05 P ₃ <0,01
The maximal daily SBP (mm Hg)	176,5±23,5	169,3±25,1	138,8±8,3	146,5±8,6	P ₁ >0,05 P ₂ <0,05 P ₃ >0,05
The maximal daily DBP (mm Hg)	115,6±21,0	100,4±18,2	89,4±9,7	93,3±7,4	P ₁ <0,05 P ₂ >0,05 P ₃ >0,05
The average daily HR (/min.)	65,5±8,4	63,0±9,1	70,7±1,9	68,9±18,4	P ₁ >0,05 P ₂ >0,05 P ₃ >0,05
DI of SBP (%)	9,6±7,4	8,9±5,5	10,8±7,0	10,8±7,0	P ₁ >0,05 P ₂ >0,05 P ₃ >0,05
DI of DBP (%)	13,8±8,1	14,1±7,1	16,8±10,4	16,8±10,4	P ₁ >0,05 P ₂ >0,05 P ₃ >0,05
DI of the average BP (%)	12,0±7,7	11,3±6,1	14,2±8,7	14,2±8,7	P ₁ >0,05 P ₂ <0,01 P ₃ >0,05

Remark: P₁ – statistical significance of difference between groups I and II, P₂ – statistical significance of difference between groups I and III, P₃ – statistical significance of difference between groups II and IV

The differences were observed between middle-aged and elderly patients in majority of indices of BP, particularly in the elderly. The average daily and the maximal DBP were significantly less by 7,4 % ($p < 0,001$) and 13,1 % ($p < 0,05$) compared to middle-aged patients.

We found a tendency of lowering of indices of ABPM in elderly patients, the average daily and the maximal SBP lowered by 3,8 % and 4,1 % respectively, the average daily HR - by 3,8 %, DI of SBP - by 7,3 % and DI of the average BP - by 5,8%, but the results were not significant compared with the data of patients of the middle age.

We have shown that one of the factors that determines the change in hemodynamics in patients with essential hypertension is age, the increasing of age of patients is accompanied by decrease in DBP with steadily increased SBP, that should be considered in the prescription of antihypertensive treatment. This is consistent with the literature, which indicates that even healthy people with age elevate mainly SBP fixing on boundary ISH in 12% of the elderly [10].

Our data coincide with the data of other researchers, such as the average daily SBP and DBP in 39 middle-aged patients with EH, that were $153,5 \pm 1,5$ mm Hg and $94,4 \pm 0,6$ mm Hg respectively. In 22 patients with EH they were respectively $154,3 \pm 1,4$ mm Hg and $95,3 \pm 0,9$ mm Hg. The average daily SBP and DBP, the average BP, the maximal daily SBP and DI of the average BP in our examined middle-aged patients were $156,5 \pm 12,1$ mm Hg and $99,9 \pm 6,6$ mm Hg, $116,2 \pm 9,9$ mm Hg, $176,5 \pm 23,5$ mm Hg and $11,9 \pm 7,7$ mm Hg respectively.

However, some indices of ABPM (the maximal daily DBP, DI of SBP and DBP), although similar trends were not significantly different in middle-aged patients and control group. The maximal daily DBP was higher by 29,3 % and was $115,6 \pm 21,0$ mm Hg but DI of SBP and DBP were lower by 11,1 % and was $9,6 \pm 7,4$ and 17,9 % and amounted $13,8 \pm 8,1$ % respectively.

Only the average daily SBP, DBP and the average BP were significantly higher in elderly patients by 30,3 % ($p < 0,01$) and was $150,5 \pm 12,6$ mm Hg, 28,7 % ($p < 0,05$) and amounted $92,5 \pm 1,3$ mm Hg and 19,6 % (p

$< 0,01$) and was $103,3 \pm 10,9$ mm Hg compared with the control group. Other indices of ABPM (the maximal daily SBP and DBP) exceeded the parameters of the control group by 15,6 % and was $169,3 \pm 25,1$ mm Hg and by 7,6 % and amounted $100,4 \pm 18,2$ mm Hg, but were not significant.

Some indices of ABPM (the average daily HR, DI of SBP, DI of DBP, DI of the average BP) tended to decrease: respectively – by 8,6 % and was $63,0 \pm 9,1$ / min., 17,6 % and amounted $8,9 \pm 5,5$ %, by 16,1 % and was $14,1 \pm 7,1$ % and by 20,4 % and amounted to $11,3 \pm 6,1$ %, but were not significant.

Thus, the increasing of age of patients is accompanied by decrease in DBP with steadily increased SBP, that should be considered in the prescription of antihypertensive treatment. This is consistent with the literature, which indicates that even healthy people with age can experience elevated BP [10].

During the analysis of the results, comparing indices of ABPM in patients of surveyed groups, we found that in elderly patients with EH, stage II are lower the average daily and the maximal daily DBP by 7,4 % ($p < 0,001$) and 13,1 % ($p < 0,05$) respectively than in patients of middle age. The maximal daily DBP in middle-aged patients was higher by 29,3 % and amounted to $115,61 \pm 21,0$ mm Hg and DI of SBP and DBP were lower by 11,1 % and amounted to $9,6 \pm 7,4$ % and 17,9 % and was $13,8 \pm 8,1$ % respectively.

It is found that with the age DBP decreases with steadily increased SBP, that is consistent with literature [5, 12, 14], and that should be considered in the prescription of antihypertensive treatment in order to avoid hypoperfusion of vital organs. Discovered peculiarities of indices of ABPM once again confirmed the isolated nature of EH and its prevalence in the elderly.

CONCLUSION

The average daily and the maximal daily DBP are significantly less by 7,4 % ($p < 0,001$) and 13,1 % ($p < 0,05$) accordingly against a constantly increased SBP background in elderly patients with EH, stage II compared with the middle-aged.

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Резюме

ОСОБЕННОСТИ ПОКАЗАТЕЛЕЙ СУТОЧНОГО МОНИТОРИНГА АРТЕРИАЛЬНОГО ДАВЛЕНИЯ У БОЛЬНЫХ ГИПЕРТОНИЧЕСКОЙ БОЛЕЗНЬЮ II СТАДИИ РАЗНЫХ ВОЗРАСТНЫХ ГРУПП

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Цель – определение особенностей показателей суточного мониторинга артериального давления у больных гипертонической болезнью II стадии различных возрастных групп.

Материал и методы. Показатели суточного мониторинга артериального давления определены у 57 пациентов среднего (45-59 лет) возраста (группа I) и у 43 пожилого (60-74 года) возраста (группа II), которые находились на стационарном двухнедельном лечении. Контрольную группу составили по 15 больных для каждой из обследованных категорий (соответственно III группа – обследованные среднего возраста и IV группа – обследованные пожилого возраста), сопоставимых по половому составу.

Результаты. Одним из факторов, определяющих изменения гемодинамики у больных гипертонической болезнью, является возраст, причем увеличение возраста у больных сопровождается уменьшением диастолического артериального давления при стабильно повышенном систолическом, что следует учитывать при назначении антигипертензивного лечения. С возрастом постепенное повы-

шение систолического артериального давления связано с увеличением жесткости аорты, частично – с увеличением уровня коллагена и уменьшением эластичных фибрилл и формированием изолированной систолической артериальной гипертензии. Доказано, что при формировании изолированной артериальной гипертензии рост пульсового артериального давления более 60 мм рт. ст. является неблагоприятным относительно развития цереброваскулярных событий. У лиц пожилого возраста пульсовое артериальное давление оказалось более сильным фактором риска, чем уровни систолического и диастолического артериального давления или среднего артериального давления. Недавно с учетом возрастных особенностей все три показателя были признаны сопоставимыми предикторами в возрасте 50-59 лет (переходный период), а в возрасте 60-79 лет диастолическое артериальное давление, негативно влияя на сердечно-сосудистый риск, преподнесло роль пульсового артериального давления прогностически выше уровня систолического артериального давления.

Ключевые слова: артериальная гипертензия, гипертоническая болезнь, артериальное давление, изолированная систолическая артериальная гипертензия, суточный мониторинг артериального давления.

Summary

PECULIARITIES OF 24 HOUR AMBULATORY BLOOD PRESSURE MONITORING INDICES IN PATIENTS WITH ESSENTIAL HYPERTENSION, STAGE II OF DIFFERENT AGE GROUPS

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The aim of the study was to determine peculiarities of 24 hour ambulatory blood pressure monitoring indices of patients with essential hypertension, stage II of different age groups. Indices of ambulatory blood pressure monitoring were identified in 57 middle-aged patients (45-59 years) (group I) and 43 elderly patients (60-74 years) (group II), who underwent two-week in-patient treatment. The control group consisted of 15 patients for every of the surveyed categories (group III - middle-aged and group IV – elderly respectively) matched with basic by age and gender. We have shown that one of the factors that determines the change in hemodynamics in patients with essential hypertension is age, with the age patients experience the decrease in diastolic blood pressure with steadily increased systolic blood pressure, that should be considered in the prescription of antihypertensive treatment. With age, a gradual increase in systolic blood pressure is associated with the increased aortic stiffness, partially with the increase in collagen and the decrease in elastic fibrils and the formation of isolated systolic hypertension. Thus, it is proved that in the formation of isolated hypertension the growth of pulse blood pressure for more than 60 mm Hg is unfavorable in a development of cerebrovascular events. Pulse arterial blood pressure was stronger risk factor than systolic blood pressure and diastolic blood pressure or average arterial pressure in the elderly. Recently, taking into account age characteristics, all three indices were recognized as comparable predictors at the age of 50-59 years as the transitional period, and at the age of 60-79 years diastolic blood pressure adversely affecting the cardiovascular risk, increased pulse blood pressure prognostically above the level of systolic arterial pressure.

Keywords: arterial hypertension, essential hypertension, blood pressure, systolic blood pressure, diastolic blood pressure, isolated systolic hypertension, pulse pressure, ambulatory blood pressure monitoring

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