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The state of intracardiac hemodynamics in the elderly people with arterial hypertension, taking into account age, gender differences and geographic climatic living conditions

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Abstract

We conducted a study of the state of intracardiac hemodynamics in elderly patients with hypertension in the Kabardino-Balkarian Republic, taking into account age, gender and geographic climatic differences.

Materials and methods

In the course of the study, an echocardiographic study was used according to the standard protocol with the Aloka ultrasound machine (Japan), which included M-modal, two-dimensional and Doppler modes.

Results

The study of the criteria of intracardiac hemodynamics in elderly and middle-aged men revealed that the parameters of the end-diastolic dimension (EDD) of the left ventricle and the mass of the left ventricular myocardium (LVMM) prevailed in elderly men compared with middle-aged men. When assessing the indicators of the transmitral blood flow in elderly men, a tendency towards a decrease in the value of the E/A ratio was found that was a reflection of diastolic dysfunction, namely, a disorder in myocardial relaxation. In elderly women, large sizes of the aortic root diameter, left ventricular myocardial mass (LVMM) and the thickness of the interventricular septum (IVS) were detected compared with the middle-aged women, which might be associated with age-related changes, namely, a decrease in elasticity, an increase in the diameter and wall thickening. Our analysis of the data delivered by our echocardiographic studies revealed that elderly patients with hypertension were characterized not only by the presence of LVH, but also by various changes in the geometry of the left ventricular myocardium. In the concentric hypertrophy group, the values of the relative wall thickness (RWT) and the left ventricular myocardial mass (LVMM) were significantly higher than those identified in the eccentric hypertrophy group, where there were higher values of the EDD parameters. A correlation was found between the average blood pressure (according to the ABPM data) and the parameters of the left ventricular myocardium in elderly patients with hypertension.

Discussion

The study of the intracardiac hemodynamic parameters in elderly people (both men and women) has revealed a high prevalence of changes in the geometry of the left ventricle with a predominance of the concentric type of remodeling, which is more pronounced in elderly women.

Conclusion

Our analysis of the prevalence of hypertension in elderly patients, considering the geographic climatic conditions of their residence, has revealed that the incidence rate of hypertension is higher in those individuals, who live in the lowland zone than in those living in the mountainous regions.

Keywords

Daily monitoring of blood pressure, ABPM, Left ventricular remodeling, Left ventricular hypertrophy, Arterial hypertension, Elderly people, Intracardiac hemodynamics

Imprint

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Introduction

Among the diseases of the circulatory system in the elderly, the most common case is arterial hypertension (AH), which significantly reduces the quality and life expectancy of this category of patients [1-3]. According

to the relevant data provided by many researchers, the incidence of diseases and deaths among elderly patients correlates with an abnormal increase in their blood pressure [4-6]. The topic of studying hemodynamic changes in patients of various ages with hypertension has been sufficiently covered by the reference literature, but the dependence of these changes on sex, gender differences and geographic climatic living conditions has not been sufficiently investigated [7-9]. In connection with the above, it seems relevant to study the daily blood pressure profile in elderly people with hypertension and identify the correlation between the parameters of 24-hour blood pressure monitoring (ABPM) and their indicators of intracardiac hemodynamics.

The aim of the study is to analyze the state of intracardiac hemodynamics in elderly patients with hypertension, who reside in the Kabardino-Balkarian Republic, taking into account their age, gender and the geographic climatic factors.

Materials and methods

The material for the study covered 150 elderly patients with hypertension, who underwent inpatient treatment at the Republican Gerontological Rehabilitation Center and the Republican Clinical Hospital. The research method applied by us involved echocardiography (EchoCG) according to the relevant standard protocol, including M-modal, two-dimensional and Doppler modes, with the Aloka SSD-1700 ultrasound machine (Japan) equipped with the 3,5 MG transducer [11,12]. Analyzed parameters were as follows: anteroposterior dimension of the left atrium (LA) in diastole, end systolic dimension (ESD) and end diastolic dimension (EDD) of the left ventricular cavity, thickness of the interventricular septum (IVST) and posterior wall (LVPWT) at the end of diastole, end systolic and diastolic volumes, ejection fraction (EF), left ventricular myocardial mass (LVMM) according to the formula by R.B. Devereux: LVMM = 0,8x (1.04x ((LVPWT + IVS + EDD) i-EDDi)) + 0,6.

Research results

When analyzing the EchoCG indicators in elderly patients, taking into account the influence of the geographic climatic zone of their residence, there were no significantly significant differences revealed (see Table 1 herein). In elderly patients with AH, living in the mountainous zone, the indicators of the aorta size, EDD and EF were recorded to be slightly higher com-

Table 1
Indices of intracardiac hemodynamics in elderly patients with hypertension depending on the region of their residence (X ± SD)

Indicator	Plain residence n = 24	Foothill zone residence n = 39	Mountain zone residence n = 18
Ao, mm	31,1±1,5	31,3±2,2	33,5±1,8
EDD, mm	50,6±3,2	50,4±2,3	53,4±4,9
ESD, mm	34,1±4,8	32,7±4,6	33,8±5,3
EF, %	60,9±6,4	59,1±4,8	65,4±3,5
LVPW, mm	10,5±1,8	11,2±1,2	10,8±1,5
IVST, mm	11,9±1,7	11,8±2,1	12,3±1,3

Note: *significance criterion in relation to the mountain zone (p<0,05).

Abbreviations in Tables 1-4: Ao - aorta, ESD - end-systolic dimension, EDD - end-diastolic dimension, EF- ejection fraction, LVPWT - left ventricle posterior wall thickness, IVST - interventricular septum thickness.

Table 2
Indices of intracardiac hemodynamics in elderly men and women with hypertension (X ± SD)

Indicator	Groups of examined individuals		P
	Men n=40	Women n=41	
Ao, mm (aorta)	33,0±2,9	32,6±2,7	>0,05
EDD, mm	52,3±5,9	49,9±6,5	>0,05
ESD, mm	34,1±6,3	33,6±5,5	>0,05
EF %	65,1±9,1	60,9±7,7	>0,05
LVPWT, mm	10,6±1,4	10,5±1,3	>0,05
IVST, mm	12,5±1,3	12,3±1,5	>0,05
MLVM (mass of left ventricular myocardium)	216,4±54,5	201,4±49,8	>0,05
RWT (relative wall thickness)	0,42±7,2	0,43±8,9	>0,05
E, m/s	64,3±9,2	66,7±10,3	>0,05
A, m/s	65,2±10,6	68,9±11,2	>0,05

Table 3
Indices of intracardiac hemodynamics in middle-aged and elderly men with hypertension (X ± SD)

Indicator	Groups of examined individuals		P
	Elderly age n=40	Average age n=33	
Ao, mm	33,0±2,9	31,2±1,9	>0,05
EDD, mm	52,3±5,9	48,2±2,5	<0,05
ESD, mm	34,1±6,3	31,4±4,2	>0,05
EF %	65,1±9,1	65,2±5,3	>0,05
LVPWT, mm	10,6±1,4	10,5±1,3	>0,05
IVST, mm	12,5±1,3	12±1,4	>0,05
MLVM	216,4±54,5	180,4±36,7	<0,05
RWT	0,42±7,2	0,40±6,3	>0,05
E, m/s	64,3±9,2	67,6±13,8	>0,05
A, m/s	65,2±10,6	61,9±10,4	>0,05

Table 4
Indices of intracardiac hemodynamics in middle-aged and elderly women with AH (X ± SD)

Indicator	Groups of examined individuals		P
	Elderly age n=41	Average age n=31	
A o, mm	32,6±2,7	29,1±2,2	>0,05
EDD, mm	49,9±6,5	47,1±2,9	>0,05
ESD, mm	33,6±5,5	30,7±2,5	>0,05
EF %	60,9±7,7	64,9±4,2	>0,05
LVPWT, mm	10,5±1,3	10,1±1,1	>0,05
IVST, mm	12,3±1,5	10,2±1,0	<0,05
MLVM	201,4±49,8	166±51,8	<0,05
RWT	0,43±8,9	0,41±9,8	>0,05
E, m/s	66,7±10,3	74,2±11,4	<0,05
A, m/s	68,9±11,2	59,3±9,9	<0,05

Table 5
Variants of LV remodeling in elderly men and women with hypertension

LV remodeling variant	Men	Women
Normal LV geometry	35,6%	32,8%
Concentric remodeling	19,7%	20,6%
Concentric hypertrophy	23,8%	28,1%
Eccentric hypertrophy	20,9%	18,5%

Table 6
Structural and functional characteristics in elderly patients with hypertension depending on the type of LV remodeling

Indicator	Concentric remodeling	Concentric hypertrophy	Eccentric hypertrophy
EDD	34,5±2,7	33,1±3,2	35,2±2,9
ESD	48,7±1,9	49,3±2,6*	53,6±2,4
LVPWT	10,6±1,7	11,7±2,9	10,3±1,8
IVST	12,0±1,5	12,5±1,9	11,9±1,3
EF	64,5±2,4	67,5±3,1	65,6±2,7
RWT	0,45±3,2	0,48±3,9*	0,42±2,6
MLVM	215,4±18,5	238,3±17,2*	198,6±19,7

Note: *p<0,05 compared with eccentric hypertrophy group

pared to the similar indicators in patients, who resided on the plains, but the reported differences were considered as not statistically significant (p>0,05).

When comparing the parameters of intracardiac hemodynamics in elderly patients taking into account gender differences, the difference in indicators turned out to be statistically insignificant (p> 0.05, see Table 2 herein).

When comparing the indices of intracardiac hemodynamics in elderly and middle-aged men, it was found that in elderly men the parameters of the left ventricular EDD and the value of MLVM were predominant as against the middle-aged men that could be explained by the prolonged course of hypertension and might be attributed not only to hypertrophy, but also to the left ventricular dilatation formed (p<0,05; see Table 3 herein).

When assessing the transmitral blood flow in elderly men, a tendency towards a decrease in the value of the E/A ratio was revealed that was associated with diastolic dysfunction: a disorder in the myocardial relaxation (see Table 3 herein).

In elderly women, larger values of the diameter of the aortic root, MLVM and the thickness IVS were found in comparison with the middle-aged women that might be associated with age-related changes, namely, a decrease in elasticity, an increase in the diameter and thickening of the walls (Table 4, p<0,05).

Our comparison of the parameters of the transmitral blood flow in elderly women revealed lower peak blood flow rates in the phase of passive filling of the left ventricle and higher peak blood flow rates in the active filling phase compared to the middle-aged women, that might be attributed to the severity of the diastolic dysfunction in elderly patients with hypertension (p<0,05; see Table 4 herein).

In the study of the structural and functional state of the myocardium, depending on the type of remodeling in elderly patients with hypertension, a high prevalence of changes in the LV geometry was revealed. Our analysis of the obtained echocardiographic data showed that elderly patients with hypertension were characterized not only by the presence of LVH, but also by various changes in the geometry of the left ventricular myocardium (see Table 5 herein).

Among elderly men, 35,6% of them had the normal LV geometry, while among elderly women we recorded 32,8% of the normal LV geometry cases. The eccentric LV hypertrophy was detected in 20,9% of the elderly men and in 18,5% of the elderly women. The LV concentric hypertrophy and concentric remodeling were more common in the group of elderly women. Among women, the LV concentric hypertrophy was recorded in 28,1% of the cases, in the group of men it was reported to be detected in 23,8% of the individuals (see Table 5 herein).

Our analysis of remodeling variants in elderly patients with hypertension showed that the variant of the normal LV geometry was more common among the elderly men, and among the women in the same age group with hypertension, the concentric variants of LV remodeling were more often found.

Discussion

Our analysis of the above mentioned structural and functional changes in the heart depending on the type

of LV remodeling showed statistically significant differences found in the groups with the concentric hypertrophy and eccentric hypertrophy. In the concentric hypertrophy group, the RWT and MLVM values were significantly higher than those detected in the eccentric hypertrophy group, where the EDD parameters were recorded to be higher (see Table 6 herein).

We conducted an analysis of the correlation dependence between the averaged values of the day- and night-time BP values and the indicators characterizing the structural and functional state of the heart. In the group of elderly men, a correlation was identified between the indicators of the "hypertensive load" SBP in the day-time and IVS (r = 0.5, p <0.05), as well as between night-time DBP and IVS. A significant correlation was revealed between the indicators of the "hypertensive load" SBP during sleep with the LVPW value (r = 0.4, p <0.05) as well as with the RWT value (r=0,3, p<0,05). A weaker correlation, which was treated as not significant, was identified between the day- and night-time values of the indicators. When analyzing the correlation between the MLVM values and the ABPM indicators, a significant correlation with the daily SBP values was found (r=0,3, p<0,05). In general, a combination of higher correlation coefficients between the MLVM values and the averaged SBP values and the weakening relationship of MLVM with similar DBP values was identified (see Table 7 herein).

When analyzing the correlation dependence in the group of women, a significant relationship was detected between the characteristics of ABPM (day-time SBP, night-time DBP) and the IVS indicators (r = 0.5; r = 0.3, p <0.05, respectively), between SBP during sleep and LVPWT (r = 0.4, p <0.05), between the day-time SBP and MLVM (r = 0.3, p <0.05), and between the sleep SBP and RWT (r = 0.3, p < 0,05; see Table 8 herein).

Table 7
Correlation dependences between averaged blood pressure indicators (according to ABPM data) and LV myocardial parameters in elderly men with AH

	IVS	LVPW	MLVM	RWT	EF
SBP day systolic blood pressure	0,5*	0,23	0,3*	0,07	0,23
DBP day diastolic blood pressure, day time	0,21	0,12	0,17	0,08	0,26
SBP night systolic blood pressure, night time	0,2	0,4*	0,02	0,3*	0,01
DBP night diastolic blood pressure, night time	0,3*	0,2	0,05	0,2	0,05
HBP twenty-four hours per day	0,2	0,02	0,15	0,1	0,04

Note: *p<0,05

Table 8
Correlation dependences between averaged blood pressure indicators (according to ABPM data) and LV myocardial parameters in elderly women with hypertension

	IVS	LVPW	MLVM	RWT	EF
SBP day systolic blood pressure	0,3	0,04	0,4*	0,2	0,12
DBP day diastolic blood pressure, day time	0,07	0,04	0,2	0,1	0,1
SBP night systolic blood pressure, night time	0,2	0,2	0,3*	0,3	0,02
DBP night diastolic blood pressure, night time	0,2	0,04	0,05	0,16	0,01
HBP twenty-four hours per day	0,2	0,06	0,2	0,1	0,02

Note: *p<0,05

Conclusion

The given study of the intracardiac hemodynamic parameters in the elderly has revealed a high prevalence of changes in the geometry of the left ventricle with a predominance of the concentric type of remodeling, which is more pronounced in elderly women. When studying the prevalence of hypertension depending on gender, it has been found that in elderly men the incidence rate of hypertension is 49,8%, while that in women is recorded to be 54,3%. Some gender characteristics of blood pressure have been identified: among men, hypertension becomes widespread at their earlier age, while in women, the prevalence of hypertension can be detected in the sixth decade of their life span. Our analysis of the prevalence of hypertension in elderly patients, depending on the geographic climatic conditions of their residence, has shown that the incidence rate of hypertension is higher in those who reside in the plain zone as against those living in the mountainous regions. The incidence rate of hypertension in the elderly is 47,9% in the mountainous regions, while this parameter reaches 50,6% for the foothill area elderly and 57,8% in the elderly on the plain.

Statement on ethical issues

Research involving people and/or animals is in full compliance with current national and international ethical standards.

Conflict of interest

None declared.

Author contributions

The authors read the ICMJE criteria for authorship and approved the final manuscript.

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