



# Blood pressure in the elderly: peculiarities of control and treatment

Presión arterial en el anciano: peculiaridades de control y tratamiento

422

Vladislav Sergeyeovich Osipov

Federal State Budgetary Educational Institution of Higher Education «I.N. Ulianov Chuvash State University, 428015, Volga Federal District, Chuvash Republic, Cheboksary, Moskovsky Prospekt, 15, Russia, vlad\_osipov\_2001h@mail.ru. <https://orcid.org/0009-0008-6396-9923>

Djumkhourat Abduselimovna Nazaralieva

Federal State Budgetary Educational Institution of Higher Education «Astrakhan State Medical University», 414000, Astrakhan, Bakinskaya str. 121, <https://orcid.org/0000-0002-0649-0122> djumcanaza@gmail.com

Zulfiya Shafievna Magomedova

Federal State Budgetary Educational Institution of Higher Education «Astrakhan State Medical University», 414000, Astrakhan, Bakinskaya str. 121, <https://orcid.org/0009-0007-5593-3923> magomedovazulya01@gmail.com

Madina Abaevna Badenova

Federal State Budgetary Educational Institution of Higher Education «Astrakhan State Medical University», 414000, Astrakhan, Bakinskaya str. 121, <https://orcid.org/0000-0002-8499-6890> badenova97@mail.ru

Vladislav Victorovich Petrov

Federal State Budgetary Educational Institution of Higher Education «Astrakhan State Medical University», 414000, Astrakhan, Bakinskaya str. 121, <https://orcid.org/0000-0003-0477-3310> vladvp24012002@gmail.com

Tamerlan Bashirovich Pliev

Federal State Budgetary Educational Institution of Higher Education «Maikop State Technological University Medical Institute, 385000, Republic of Adygea, Maykop, Pervomayskaya str., 191, <https://orcid.org/0009-0006-4258-8318> pliev.tamerlan.02@mail.ru

Anetta Akhsharonovna Musakhanova

Federal State Budgetary Educational Institution of Higher Education «Astrakhan State Medical University»

Pediatric faculty, 414000, Astrakhan, Bakinskaya str. 121, <https://orcid.org/0009-0000-2829-2648> anetta\_zhumakhanova@mail.ru

Received: 07/20/2024 Accepted: 08/19/2024 Published: 09/12/2024 DOI: <http://doi.org/10.5281/zenodo.14223129>

## Abstract

The paper analyses in detail the problems of blood pressure (BP) control and treatment in elderly people, who represent one of the most vulnerable categories of patients in terms of cardiovascular diseases. The incidence of arterial hypertension increases due to natural ageing processes such as decreased vascular elasticity, increased arterial stiffness and progression of atherosclerosis. The authors emphasise that these changes in the body require special attention from physicians when developing BP control strategies, as standard methods used in younger patients may be ineffective or even dangerous in the elderly.

This study also examines key physiological aspects of ageing that affect blood pressure regulation. Particular attention is paid to path physiological changes such as decreased renal function, altered sodium sensitivity,

deterioration of bar reflexes and changes in endocrine function. These factors complicate BP control and may require adjustments in both dosage and drug selection.

The authors focus on the importance of an individualized approach to the treatment of elderly patients with arterial hypertension. They discuss non-medication methods such as lifestyle modification, dietary intervention (reduced salt intake, increased potassium intake, Mediterranean diet), increased physical activity and body weight control. These measures play an important role in the primary prevention and comprehensive treatment of hypertension.

The authors of the paper give modern recommendations on target blood pressure levels for the elderly, taking into account the latest clinical studies, and also determine the need for a multidisciplinary approach in the man-

## Introduction

agement of elderly patients with hypertension, which includes close cooperation between therapists, cardiologists, nephrologists and gerontologists.

**Keywords:** blood pressure, elderly people, hypertension, blood pressure control, arterial hypertension treatment, antihypertensive therapy, age-related changes, non-pharmacological treatment, cardiovascular diseases, individualized approach.

**A**rterial hypertension is one of the most common cardiovascular diseases, especially among the elderly. With age, the risk of developing hypertension increases significantly, and by the age of 60-70 years, most people are faced with high blood pressure. This feature is associated with a complex of physiological changes occurring in the body: thickening of arterial walls, decreased elasticity of blood vessels, deterioration of kidney function and changes in hormonal regulation. Such factors complicate both the diagnosis and treatment of hypertension in elderly patients<sup>1</sup>.

Blood pressure control in the elderly is of particular importance because hypertension significantly increases the risk of developing serious complications such as stroke, myocardial infarction, chronic heart failure and renal failure. At the same time, therapy in this age group faces a number of challenges. Elderly patients often have co morbidities (e.g., diabetes mellitus, chronic kidney disease) and are taking multiple other medications, what increases the risk of drug interactions and side effects.

The aim of this article is to review the main aspects of blood pressure control and treatment in elderly patients, highlight key problems and propose modern approaches aimed at optimizing therapy. An important point is an individualized approach to each patient, taking into account their general state of health, age and co morbidities.

**Materials and Methods.** In the process of writing the study, a number of articles and monographs within the research topic were analyzed and a number of scientific methods were applied. The analysis of scientific literature made it possible to gather information about age-related changes in the body related to blood pressure, as well as the peculiarities of treatment of arterial hypertension in the elderly. In this regard, scientific articles, monographs, clinical guidelines and recommendations on the treatment of hypertension issued by international and national organizations were studied. Systematization and synthesis of data made it possible to structure the collected materials, classify approaches to the diag-

nosis and treatment of hypertension in elderly patients, identify common patterns and draw conclusions based on existing studies. This method also allowed us to summarize current recommendations for the treatment of arterial hypertension in the elderly, to identify optimal drug regimens and therapy strategies.

The comparison method made it possible to identify differences in the methods of control and treatment of arterial hypertension in the elderly and in other age groups.

The use of these methods, as well as a number of others, made it possible to comprehensively investigate the problem of arterial hypertension in the elderly, to identify the features of control and treatment, and to propose optimal solutions based on current scientific data.

## Results

**D**ue to natural aging processes such as decreased vascular elasticity, increased arterial stiffness and progression of atherosclerosis, the incidence of arterial hypertension among the elderly is increasing. This phenomenon is explained by a variety of factors associated with changes in the body that affect blood pressure regulation and vascular tone<sup>2</sup>.

With age, significant changes occur in the body regarding not only the structure but also the functionality of the blood vessels. These changes may be related to several key processes that affect blood pressure and overall cardiovascular health<sup>3</sup>.

One of the most significant changes observed in the elderly is a decrease in arterial elasticity. Vascular elasticity is provided by the presence of collagen and elastin in the vessel walls. With age, these components are lost, resulting in a reduced ability of the vessels to stretch and contract in response to pressure changes. This reduces their ability to adapt to the pulsating blood flow caused by heartbeats.

As a result, when systolic pressure rises, vessels cannot adequately dilate, which leads to its additional increase<sup>4</sup>. In turn, a decrease in vascular elasticity may contribute to the development of systolic arterial hypertension, especially in people over 60 years of age, which is the most common form of hypertension in this age group.

Arterial stiffness, or vascular stiffness, is another important aspect that increases with age. It is associated not only with changes in the composition of arterial walls, but also with the accumulation of various substances, such as calcium, which leads to their deposition and disruption of the structure<sup>5</sup>. Over time, such changes lead to

a decrease in arterial diameter and an increase in blood pressure, as the heart has to work with a greater load to pump blood through stiffer vessels. In addition, increased arterial stiffness leads to the pulse wave (pressure fluctuations in the artery that occur during cardiac contraction) travelling faster and with greater force, which may increase the risk of cardiovascular events such as myocardial infarction or stroke<sup>6</sup>.

With age, there are also changes in endothelial function, the inner layer of blood vessels. The endothelium plays a critical role in maintaining vascular tone and regulating blood flow. **In older adults**, endothelial dysfunction is common and leads to impaired production of vasodilators such as nitric oxide. This may contribute to increased vascular tone and blood pressure<sup>7</sup>.

As people age, there are also changes in the baroreceptors, sensors that help the body regulate blood pressure. Bar receptors are located in the aorta and carotid arteries and respond to changes in pressure by sending signals to the central nervous system to adjust cardiac output and vascular tone. In older people, these receptors can become less sensitive, making blood pressure regulation less effective.

Vascular health may also be worsened by co morbidities such as diabetes mellitus and dyslipidaemia. These conditions, which are common in the elderly, may contribute to more rapid progression of atherosclerosis and increased vascular stiffness, exacerbating problems with blood pressure control<sup>8</sup>.

All these changes in the vascular system make older adults more susceptible to high blood pressure. Understanding these age-related changes is important for developing effective strategies for the treatment and control of arterial hypertension, as it allows physicians to tailor their approaches to individual patient characteristics, taking into account risks and possible complications.

Atherosclerosis is one of the main factors contributing to the development of arterial hypertension in the elderly. This process is a chronic disease characterised by the deposition of lipids, calcium and other substances on arterial walls, leading to the formation of atherosclerotic plaques. The progression of atherosclerosis can significantly alter hemodynamic and increase the risk of serious cardiovascular disease.

Several factors contribute to atherosclerosis. High cholesterol, especially low-density lipoprotein (LDL), favors plaque formation. Older people often have elevated levels of cholesterol and triglycerides, which increases the risk of atherosclerotic changes<sup>9</sup>.

Chronic inflammation also plays a key role in the pathogenesis of atherosclerosis. With age, the immune system may become less effective, leading to persistent inflammation and an increased risk of plaque formation. Blood pressure itself can contribute to endothelial dam-

age and exacerbate the atherosclerotic process, creating a vicious cycle. Diseases such as diabetes mellitus, obesity and metabolic syndrome also contribute to the progression of atherosclerosis.

Atherosclerosis goes through several stages and begins with damage to the endothelium, which can be caused by high cholesterol levels, high blood pressure, smoking or inflammation. The damaged endothelium becomes permeable to lipids, which penetrate the vessel wall. Lipids accumulate in the vessel intima, leading to the formation of plaques. In response, macrophages and other cells are activated, leading to inflammation and the formation of a fibrous capsule. Plaques may remain stable or progress. Unstable plaques may rupture, leading to thrombosis and closure of the vessel lumen<sup>10</sup>.

Atherosclerosis affects blood pressure in several ways. Atherosclerotic plaques narrow arteries, which increases resistance to blood flow and, consequently, blood pressure. As arteries become stiffer and their elasticity is compromised, hemodynamic change, which can lead to higher systolic pressure and lower diastolic pressure. It becomes more difficult for the heart to pump blood through narrowed vessels, which can also lead to myocardial hypertrophy and increased risk of heart failure<sup>11</sup>.

The progression of atherosclerosis can lead to many serious consequences. Rupture of atherosclerotic plaque or thrombosis can lead to impaired blood supply to the brain. Coronary artery blockage can cause a heart attack, which is one of the leading causes of death among the elderly. Increased strain on the heart and lack of blood supply can lead to the development of chronic heart failure, which significantly impairs quality of life. Progression of atherosclerosis can lead to narrowing of the arteries supplying the extremities, causing pain and dysfunction.

Aging is accompanied by many physiological changes that affect blood pressure regulation and overall cardiovascular health. Understanding these changes is critical to the successful control of arterial hypertension in the elderly. With age, there is a decline in kidney function, which plays an important role in blood pressure regulation. The kidneys are responsible for the excretion of excess sodium and fluid from the body, which helps to maintain normal blood pressure levels<sup>12</sup>.

In older people, the glomerular filtration rate (glomerular filtration rate (GFR) often decreases. This can lead to sodium and water retention, which in turn contributes to high blood pressure. The kidneys produce renin, which regulates levels of aldosterone and angiotensin, which are responsible for vascular tone. Changes in these hormones can lead to high blood pressure.

Age-related changes can lead to left ventricular hypertrophy due to the constant strain associated with increased blood pressure, which can impair cardiac function and increase the risk of cardiovascular disease. There may

also be a decrease in maximal cardiac rate and myocardial contractility. This means that the heart may not be able to cope with the increased workload, which also affects blood pressure<sup>13</sup>.

With age, changes in the conduction system of the heart can occur, including slowing of atrioventricular conduction, which increases the risk of arrhythmias. Also in old age, there are changes in the levels of various hormones, which can also affect blood pressure. Cortisol levels increase, which can also contribute to high blood pressure by increasing blood volume and activating the sympathetic nervous system. Baroreceptors, which are responsible for regulating blood pressure, may become less sensitive, reducing the body's ability to respond adequately to changes in pressure. In the elderly, hyperactivation of the sympathetic nervous system may occur, resulting in increased heart rate and vasoconstriction, increasing blood pressure.

With age, there is often an increase in fat mass and a decrease in muscle mass, which can lead to insulin resistance and metabolic syndrome, and this in turn increases the risk of arterial hypertension. In addition, older adults may experience a decrease in total fluid volume, which can disrupt electrolyte balance and affect blood pressure.

**Discussion.** The management of arterial hypertension in the elderly requires an individualized approach, as ageing involves many changes that can significantly influence the choice of treatment strategy<sup>14</sup>. Individualized features include age-related changes, co morbidities, gender, genetic predisposition and lifestyle factors. Let us take a closer look at the key aspects that need to be considered when developing blood pressure control strategies in the elderly.

Ageing is accompanied not only by changes in vascular structure and function, but also by changes in the pharmacokinetics and pharmacodynamics of drugs. In the elderly, the metabolism and excretion of drugs are slower, which may increase their concentration in the blood and the risk of side effects. For example, elderly patients may experience a decrease in liver and kidney function, which requires adjustments in drug dosage. The body's response to medications changes with age. This means that drugs that were effective at a young age may be less effective or cause unexpected side effects in the elderly<sup>15</sup>.

Co-morbidities play an important role in the management of arterial hypertension. Older adults often have co morbid conditions such as diabetes, chronic lung disease, heart failure, atherosclerosis and others. Older adults with diabetes may have special requirements for blood pressure control, as high blood pressure increases the risk of cardiovascular disease. In such cases, it may be appropriate to use drugs that not only lower blood pressure but also have a protective effect on the kidneys.

Patients with heart failure should have their blood pressure monitored carefully to avoid excessive blood pressure lowering and worsening of the condition. If the patient is diagnosed with atherosclerosis, it is important to control both blood pressure and cholesterol levels to reduce the risk of cardiovascular events.

Genetic predisposition also plays an important role in the development of arterial hypertension and may influence response to treatment. Genetic factors can predetermine sensitivity to different drugs as well as predisposition to co morbidities. For example, some patients may have genetic mutations that affect drug metabolism, which requires the selection of more individualized therapy regimens<sup>16</sup>.

Lifestyle factors such as diet, physical activity level, smoking and alcohol consumption also play a significant role in controlling blood pressure. Proper diet can significantly reduce blood pressure levels. A diet rich in fruits, vegetables, whole grains and low in sodium is recommended. Regular exercise helps in maintaining a normal weight and controlling blood pressure levels. In older adults, it is recommended to choose physical activities that are safe and accessible, such as walking, swimming or yoga.

Lifestyle changes, such as quitting smoking and reducing alcohol consumption, are also important for controlling blood pressure. Smoking increases the risk of cardiovascular disease, and alcohol can increase blood pressure. Psychosocial factors such as stress, level of social support and psychological well-being can also affect blood pressure. Chronic stress can contribute to high blood pressure, so stress management techniques (e.g. meditation, relaxation and psychological support) may be helpful.

Having the support of family and friends can have a positive impact on the health and well-being of older people, helping them to manage chronic conditions. It is important to ensure that the patient's blood pressure and health status are regularly monitored so that changes in therapy can be made if necessary<sup>17</sup>. Older people may have problems in comprehending information or following recommendations, so health care providers should pay attention to educating and informing patients about the importance of blood pressure control.

An individualized approach to the management of hypertension in the elderly takes into account many factors, including age-related changes, co morbidities, gender, and genetic predisposition and lifestyle factors. This approach allows more effective blood pressure control strategies to be developed, minimizing risks and improving patients' quality of life. Successful management of arterial hypertension requires comprehensive communication between physicians, patients and their families, as well as ongoing monitoring and adaptation of therapy to changes in health status.



Blood pressure control in the elderly requires a comprehensive approach, including both non-medication and medication methods. This is due to the peculiarities of the age-related organism, increased sensitivity to drugs and the presence of co morbidities<sup>18</sup>. Effective management of arterial hypertension is aimed not only at reducing blood pressure levels, but also at reducing the risk of cardiovascular disease and improving the quality of life. Non-drug methods are an important part of blood pressure control strategies and can often be effective as stand-alone measures, especially in the early stages of hypertension.

As already mentioned, diet plays a key role in controlling blood pressure. Regular physical activity can help lower blood pressure and improve overall health. At least 150 minutes of moderate physical activity per week such as walking, swimming or yoga is recommended. Physical activity not only promotes weight loss, but also improves cardiovascular function and overall health.

Overweight and obesity are important risk factors for the development of arterial hypertension. Older people are advised to maintain a healthy weight, which can be achieved through proper diet and regular physical activity. Older people are advised to use relaxation techniques such as meditation, deep breathing and yoga. These practices help to reduce stress levels and improve overall psycho-emotional well-being<sup>19</sup>. Having social support and being active in the community can help reduce stress levels. Participating in interest groups, volunteering, and socializing with friends and family can have a positive impact on mental health.

If non-pharmacological measures are not effective enough, medication may be required. The selection of medications should be tailored to the individual patient, including co morbidities, age and response to treatment. Diuretics (e.g. hydrochlorothiazide) help to lower blood pressure by reducing blood volume by removing excess fluid and sodium. This is the first step in the treatment of arterial hypertension, especially in the elderly.

Beta-blockers reduce cardiac output and lower heart rate. They are particularly useful in patients with cardiovascular disease and heart rhythm disorders. ACE inhibitors block the formation of angiotensin II, which leads to a decrease in vascular tone and therefore blood pressure. They also have a protective effect on the kidneys and the cardiovascular system.

Elderly patients often take multiple medications to treat different conditions, which can lead to polypharmacy. It is important to avoid overprescribing to minimize the risk of side effects and drug interactions. It is important to ensure that the patient adheres to the medication regimen.

Effective blood pressure control requires regular monitoring and adjustment of treatment approaches. It is recommended that older people monitor their blood pressure at home using automatic tonometers. This allows

changes in blood pressure to be detected and steps to be taken to correct them. Regular check-ups with a physician are necessary to assess the effectiveness of treatment, monitor possible side effects and adjust therapeutic approaches<sup>20</sup>.

Every patient is unique, so it is important to approach the treatment of arterial hypertension on an individual basis. Taking into account the patient's characteristics, lifestyle, preferences and responses to treatment will allow the development of an optimal blood pressure control strategy. Physicians should actively involve patients in the decision-making process regarding their treatment by discussing with them the advantages and disadvantages of different methods and medications. This helps to increase patient compliance and satisfaction with therapy. As a patient's health status, age and co morbidities change, the treatment approach should be adjusted, which may include changing dosages, changing medications or adding new medications.

The selection of methods to control blood pressure in the elderly requires a comprehensive approach that takes into account both non-medication and medication. It is important to remember that effective management of arterial hypertension is not just about lowering blood pressure, but also includes improving quality of life and reducing the risk of cardiovascular disease. Collaboration between physicians and patients, regular monitoring and individualization of therapy are key aspects of successful blood pressure control in the elderly.

Arterial hypertension in the elderly is a complex problem that requires a multidisciplinary approach to ensure effective control and improve the quality of life of patients. This is due to many factors such as age-related changes in the body, co morbidities and response to therapy. In this context, close co-operation between different medical specialists and regular monitoring of the patient's condition play a key role.

The management of elderly patients with hypertension requires the integration of the knowledge and skills of specialists from different areas of medicine. General practitioners play a central role in the initial assessment and prescription of initial therapy. Therapists also provide general follow-up, monitor blood pressure levels and identify co morbidities.

Cardiology specialists are needed to assess the cardiovascular system, identify possible complications and adjust antihypertensive therapy. Cardiologists may prescribe special examination methods such as ECG or echocardiography to assess heart function.

Given the high incidence of renal disease among elderly patients, nephrologists play an important role in the management of arterial hypertension, especially in patients with diabetes and chronic kidney disease. They help in identifying appropriate therapeutic strategies considering the renal status of the patient. Gerontology special-

ists are important to consider all aspects of the aging body. They help to tailor treatment approaches, taking into account the changes in metabolism, pharmacokinetics and pharmacodynamics that occur with age.

A multidisciplinary approach in the management of elderly patients with hypertension is essential for successful treatment outcomes. Close collaboration between general practitioners, cardiologists, nephrologists and gerontologists provides a comprehensive approach to patient management, improving quality of life and reducing the risk of complications. Regular monitoring and adjustment of therapy in response to changes in health status become key aspects of effective management of arterial hypertension in the elderly.

**A**rterial hypertension is a common and serious disease among the elderly, requiring careful attention to diagnosis and treatment. Age-related changes, such as decreased vascular elasticity and increased arterial stiffness, contribute to the increased incidence of hypertension. Given the diversity of clinical presentations and the individual characteristics of each patient, it is important to adopt a flexible and personalized approach to blood pressure control. This includes setting target BP levels adapted to the patient's state of health and lifestyle.

Target blood pressure levels for older people, especially those over 80 years of age, should take into account the risks associated with hypotension, such as orthostatic hypotension and cognitive impairment. It is recommended to aim for values below 140/90 mmHg, but higher target levels may be appropriate for some patients.

The need for a multidisciplinary approach in the management of elderly patients with hypertension emphasizes the importance of collaboration between different specialists: internists, cardiologists, nephrologists and gerontologists. This allows for comprehensive examination, diagnosis and treatment that takes into account all aspects of the patient's health. Continuous monitoring of blood pressure and general health of patients is necessary for timely detection of changes and correction of treatment. This includes monitoring of co morbidities, assessment of cognitive functions and regular review of the treatment regimen. Education programmes and patient participation in decision-making about their treatment help to improve compliance and satisfaction with therapy. It is important to inform patients about the risks and benefits of different approaches to BP control.

The management of arterial hypertension in the elderly requires a comprehensive and multidisciplinary approach that takes into account the individual characteristics and needs of each patient. Effective treatment should be based on modern clinical guidelines and include active co-operation of various specialists to ensure high quality medical care and improve the quality of life of the elderly.

## References

1. Beckett NS, Peters R, Fletcher AE, et al.: Treatment of hypertension in patients 80 years of age or older. *N Engl J Med*. 2008;358(18):1887–98.
2. Bavishi C, Bangalore S, Messerli FH: Outcomes of Intensive Blood Pressure Lowering in Older Hypertensive Patients. *J Am Coll Cardiol*. 2017;69(5):486–93.
3. Gottesman RF, Albert MS, Alonso A, et al.: Associations Between Midlife Vascular Risk Factors and 25-Year Incident Dementia in the Atherosclerosis Risk in Communities (ARIC) Cohort. *JAMA Neurol*. 2017;74(10):1246–54.
4. Supiano MA, Williamson JD: Applying the Systolic Blood Pressure Intervention Trial Results to Older Adults. *J Am Geriatr Soc*. 2017;65(1):16–21.
5. Tinetti ME, Han L, Lee DSH, et al.: Antihypertensive medications and serious fall injuries in a nationally representative sample of older adults. *JAMA Intern Med*. 2014;174(4):588–95.
6. Wei Y, Jin Z, Shen G, et al.: Effects of intensive antihypertensive treatment on Chinese hypertensive patients older than 70 years. *J Clin Hypertens (Greenwich)*. 2013;15(6):420–7.
7. Weiss J, Freeman M, Low A, et al.: Benefits and Harms of Intensive Blood Pressure Treatment in Adults Aged 60 Years or Older: A Systematic Review and Meta-analysis. *Ann Intern Med*. 2017;166(6):419–429.
8. Takami Y, Yamamoto K, Arima H, Sakima A. Target blood pressure level for the treatment of elderly hypertensive patients: a systematic review and meta-analysis of randomized trials. *Hypertens Res* 2019;42:660–668.
9. Dallaire-Theroux C, Quesnel-Olivo MH, Brochu K, Bergeron F, O'Connor S, Turgeon AF, et al. Evaluation of intensive vs standard blood pressure reduction and association with cognitive decline and dementia: a systematic review and meta-analysis. *JAMA Netw Open* 2021;4: 445-452
10. Juraschek SP, Hu JR, Cluett JL, Ishak A, Mita C, Lipsitz LA, et al. Effects of intensive blood pressure treatment on orthostatic hypotension: a systematic review and individual participant-based meta-analysis. *Ann Intern Med* 2021;174:58–68.
11. Muller M, Smulders YM, de Leeuw PW, Stehouwer CD. Treatment of hypertension in the oldest old: a critical role for frailty? *Hypertension* 2014;63:433–41.
12. Forman DE, Maurer MS, Boyd C, Brindis R, Salive ME, Horne FM, et al. Multimorbidity in older adults with cardiovascular disease. *J Am Coll Cardiol* 2018;71:2149–61
13. Materson BJ, Garcia-Estrada M, Preston RA: Hypertension in the frail elderly. *J Am Soc Hypertens*. 2016;10(6):536–41.

14. Verdecchia P., Staessen J.A., Angeli F. Usual versus tight control of systolic blood pressure in non-diabetic patients with hypertension (Cardio-Sis): an open-label randomised trial. *Lancet*. 2009;374(9689):525–533.
15. Attar A., Sayadi M., Jannati M. Effect of intensive blood pressure lowering on cardiovascular outcomes based on cardiovascular risk: a secondary analysis of the SPRINT trial. *Eur J Prev Cardiol*. 2019;26(3):238–245.
16. Sakima A., Satonaka H., Nishida N., Yatsu K., Arima H. Optimal blood pressure targets for patients with hypertension: a systematic review and meta-analysis. *Hypertens. Res*. 2019;42(4):483–495.
17. Wang J., Chen Y., Xu W., Lu N., Cao J., Yu S. Effects of intensive blood pressure lowering on mortality and cardiovascular and renal outcomes in type 2 diabetic patients: a meta-analysis. *PloS One*. 2019;14(4)
18. Zhang Y., Liang M., Sun C. Effect of intensive lowering of systolic blood pressure treatment on heart failure events: a meta-analysis of randomized controlled studies. *J. Hum. Hypertens*. 2019;33(9):648–657.
19. Takami Y., Yamamoto K., Arima H., Sakima A. Target blood pressure level for the treatment of elderly hypertensive patients: a systematic review and meta-analysis of randomized trials. *Hypertens. Res*. 2019;42(5):660–668.
20. Weiss J., Freeman M, Low A, Fu R, Kerfoot A, Paynter R, et al. Benefits and harms of intensive blood pressure treatment in adults aged 60 years or older: a systematic review and meta-analysis. *Ann Intern Med* 2017;166:419–29.