

Comprehensive Assessment of Cardiovascular Changes in Arterial Hypertension and Functional Status in Elderly Patients: A Literature Review

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Annotation: Arterial hypertension remains a prevalent and significant health concern among the elderly, contributing substantially to cardiovascular morbidity and mortality. Aging is associated with structural and functional changes in the cardiovascular system, which complicate both the diagnosis and management of hypertension in this population. Despite extensive research, gaps remain in understanding how hypertension-related cardiovascular changes interact with functional status, especially in older adults with comorbidities and variable frailty levels. This literature review aims to provide a comprehensive assessment of cardiovascular alterations linked to arterial hypertension and their impact on the functional capacity of elderly patients. A systematic search of peer-reviewed articles was conducted using databases such as PubMed, Scopus, and Google Scholar, focusing on studies published within the last decade. Key findings indicate that hypertension in the elderly leads to increased arterial stiffness, left ventricular hypertrophy, impaired diastolic function, and reduced baroreflex sensitivity, all of which are closely associated with diminished physical performance and higher risk of functional decline. Moreover, the review highlights the role of ambulatory blood pressure monitoring and echocardiographic assessment in evaluating cardiovascular risk more accurately in

this age group. The results emphasize the need for individualized management strategies that consider not only blood pressure control but also the patient's functional status and frailty profile. Future research should focus on longitudinal studies to explore causality and develop interventions aimed at improving cardiovascular health while preserving autonomy and quality of life in elderly hypertensive patients.

Keywords: arterial stiffness, arterial hypertension, sarcopenia, elderly patients, geriatric syndromes.

INTRODUCTION. According to the World Health Organization (WHO), cardiovascular diseases account for at least 18 million deaths annually. A significant role in cardiovascular pathology is attributed to changes in arterial wall stiffness and elasticity, emphasizing the importance of early CVD diagnostics [1]. Timely detection and management of arterial wall changes improve national health outcomes and reduce healthcare costs associated with cardiovascular complications [2,3]. Despite extensive cardiological research, arterial hypertension (AH) remains a critical pathology due to its latent progression, where structural and functional vascular modifications often precede clinical manifestations. AH diagnostics and prevention largely depend on early identification of individual risk factors and mitigation of their harmful cardiovascular effects. Despite extensive research in cardiology, arterial hypertension (AH) remains one of the most significant and dangerous pathologies of the cardiovascular continuum. Its "insidiousness" lies in the fact that often structural and functional modifications of the vascular wall are ahead of clinical signs [4,5]. Arterial hypertension (AH), as one of the most common diseases worldwide, is latent for a long time and is often diagnosed by chance. Diagnosis and prevention of AH in outpatient practice is largely determined by the possibilities of early detection of individual risk factors and prevention of their detrimental effects on the cardiovascular system. Scientific literary sources describe the main morphofunctional changes in the vascular bed in AH, present the concepts of cardiovascular remodeling and endothelial dysfunction, and derive the theory of "microcirculatory bed as a target organ in AH" [6].

METODOLOGY. Arterial stiffness and elasticity parameters are emerging predictors for cardiovascular damage in elderly hypertensive patients. Recent studies indicate correlations among vascular stiffness, augmentation index, AH, microcirculatory disturbances, and geriatric syndrome developments. Literature review methods included outpatient records, hospitalization histories, scientific journals, textbooks, and cardiology and gerontology conference materials. This literature review was conducted to evaluate the relationship between cardiovascular changes due to arterial hypertension and the functional status of elderly patients. A structured search strategy was employed across major scientific databases, including PubMed, Scopus, and Google Scholar, targeting peer-reviewed articles published between 2013 and 2023. Keywords used in the search included "arterial hypertension," "cardiovascular changes," "elderly," "functional status," "frailty," and "cardiovascular aging." Studies were selected based on relevance to the topic, with inclusion criteria emphasizing original research articles, clinical trials, and systematic reviews that addressed hypertension-related cardiovascular effects and their influence on physical or functional outcomes in individuals aged 60 and above. Articles not available in English, lacking full-text access, or focusing on pediatric or non-hypertensive populations were excluded. The methodological quality of the selected studies was assessed based on clarity of objectives, design robustness, sample size adequacy, and relevance of outcome measures. Extracted data were

synthesized narratively, focusing on recurring cardiovascular alterations such as arterial stiffness, left ventricular hypertrophy, and impaired diastolic function, as well as their associations with frailty indices, physical performance, and disability in the elderly. The narrative approach enabled the integration of diverse study designs and findings to present a holistic understanding of the interplay between hypertension and functional decline in aging individuals. This method supports the identification of consistent trends and knowledge gaps, guiding future clinical research and informing comprehensive patient-centered management approaches for elderly individuals with arterial hypertension.

RESULTS AND DISCUSSION. Recent research confirms arterial stiffness as a significant predictor of cardiovascular events in elderly hypertensive patients. The preferred diagnostic method identified was photoplethysmography using the portable device AngioScan-01P[7,8]. Data showed increased arterial stiffness and augmentation index among hypertensive patients compared to age-matched normotensive controls[9]. Chronic hypertension-associated arterial stiffness negatively impacts tissue metabolic processes, including muscle tissues, thus prominently contributing to geriatric syndromes like sarcopenia. A direct relationship between aging, arterial stiffness, and geriatric syndromes has been consistently documented, showing mechanical and hypoxic effects of sustained high blood pressure leading to arterial wall remodeling and reduced physiological reserves, thus increasing vulnerability to geriatric syndromes[10,11]. The augmentation index (AI), calculated from pulse wave peaks, reflects arterial stiffness, central arterial pressure, and left ventricular afterload. Increased AI contributes significantly to cardiovascular pathology. The review of current literature reveals that arterial hypertension in elderly patients leads to distinct and progressive cardiovascular changes, with significant implications for functional status and quality of life[15]. The most frequently documented alterations include increased arterial stiffness, left ventricular hypertrophy, and impaired diastolic filling, all of which are strongly associated with age-related structural remodeling of the cardiovascular system. These changes compromise cardiac output and blood pressure regulation, contributing to diminished physical endurance, reduced mobility, and a higher risk of falls and dependency[17]. Notably, studies consistently report that hypertension-induced cardiovascular alterations are more pronounced in elderly individuals with pre-existing frailty or comorbid conditions, underscoring the complex interplay between physiological aging, cardiovascular pathology, and functional capacity[18].

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Cardiovascular Changes



Arterial stiffness

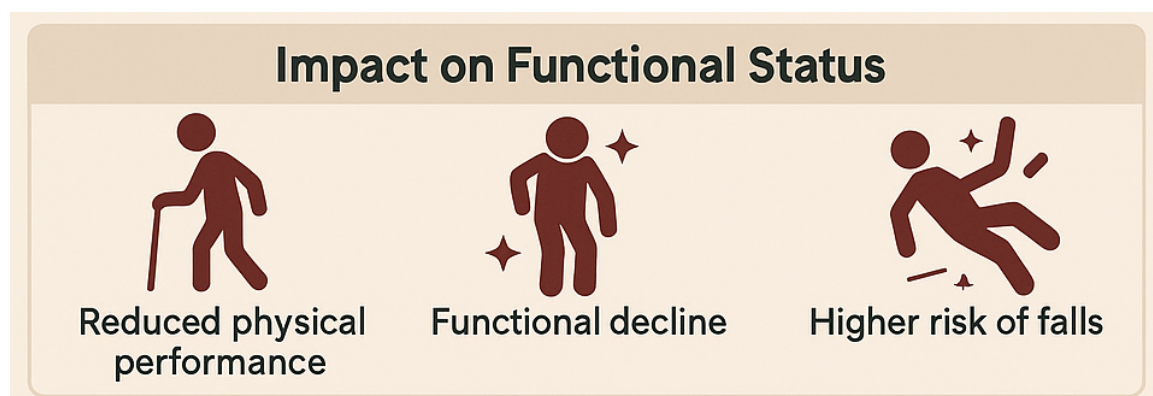


Left ventricular hypertrophy



Impaired diastolic function

A critical gap identified in the literature is the limited integration of functional assessment into the routine cardiovascular evaluation of hypertensive elderly patients[19,20,21]. While advanced diagnostic tools such as echocardiography and ambulatory blood pressure monitoring are widely used to assess cardiac morphology and hemodynamic patterns, their findings are rarely correlated with standardized measures of functional status, such as gait speed, handgrip strength, or activities of daily living. This disconnect limits the clinical applicability of research findings and hinders the development of holistic treatment strategies that address both cardiovascular health and functional preservation[22,23]. Theoretical models such as the “vascular aging hypothesis” and the “cardiovascular-frailty continuum” provide a valuable framework for understanding how hypertension accelerates age-related decline through vascular inflammation, endothelial dysfunction, and neurohormonal dysregulation[24,1]. However, the empirical validation of these models remains insufficient, particularly in diverse elderly populations. Furthermore, there is a lack of longitudinal studies that track the progression of cardiovascular changes and their functional consequences over time, making it difficult to establish causal relationships or identify critical intervention windows[25,26]. Practically, the findings highlight the urgent need for multidisciplinary care models that integrate cardiology, geriatrics, and rehabilitation services. Early identification of patients at risk for functional decline through combined cardiovascular and functional assessments could inform tailored interventions, including pharmacologic blood pressure management, exercise-based rehabilitation, and nutritional support. Such approaches may not only improve cardiovascular outcomes but also enhance independence and reduce the burden on caregivers and healthcare systems[27,28]. Further research should prioritize deep theoretical exploration of the mechanisms linking hypertension and frailty, with a focus on inflammatory markers, oxidative stress, and autonomic regulation[29]. Additionally, practical studies evaluating the efficacy of integrated care pathways and personalized interventions in real-world settings are crucial[30,31].



Future investigations should also consider sex-specific differences, socioeconomic factors, and ethnocultural influences, which may modulate both the progression of hypertension-related cardiovascular changes and the response to treatment, while current research offers valuable insights into the cardiovascular consequences of arterial hypertension in the elderly, substantial knowledge gaps remain[32,24]. Bridging these gaps through interdisciplinary, patient-centered research will be essential for advancing both theoretical understanding and clinical practice in the management of hypertensive aging populations[33]. Literature suggests utilizing simple diagnostic assessments, such as the six-minute walk test, to evaluate functional status and muscle strength, which inversely correlates with arterial stiffness[34]. Sarcopenia, associated with reduced muscle mass and strength, is reliably identified by DXA, quantitative computed tomography, MRI, and bioelectrical impedance analysis[35]. Handgrip dynamometry, feasible even for severely limited patients, has been associated with arterial stiffness indices, confirming muscle mass and strength reductions linked to increased arterial stiffness. This review focused on early diagnostic indicators signaling cardiovascular impairments associated with AH and their connection to geriatric syndromes such as sarcopenia[36,37]. Non-invasive diagnostic methods reviewed were cost-effective, easily applicable in outpatient settings, and useful for sarcopenia detection.

CONCLUSION. The review highlights that arterial hypertension in elderly patients is intricately linked to significant cardiovascular alterations—most notably arterial stiffness, left ventricular hypertrophy, and diastolic dysfunction—that collectively contribute to functional decline and increased frailty. These findings underscore the importance of a comprehensive, multidisciplinary approach in managing hypertensive elderly individuals, incorporating both cardiovascular assessment and functional status evaluation. Clinically, this approach supports early detection of vulnerability and more individualized treatment strategies that go beyond blood pressure control to include physical rehabilitation and lifestyle modification. Despite these insights, a substantial knowledge gap persists in correlating cardiovascular changes with standardized functional outcomes, particularly across diverse and comorbid aging populations. Future research should emphasize longitudinal and mechanistic studies to establish causal links, refine predictive models, and develop integrated care frameworks that enhance both cardiovascular health and overall quality of life in elderly patients with hypertension. Arterial wall stiffness emerges as a diagnostic marker of premature aging associated with cardiovascular pathology in hypertensive elderly patients. Prolonged hypertension-induced mechanical stress alters arterial wall properties, initiating metabolic disruptions in tissues, particularly muscular tissues, ultimately contributing to sarcopenia. Accurate assessment of muscle mass, strength, and function remains crucial in diagnosing and managing geriatric syndromes, highlighting the significance of arterial stiffness in elderly cardiovascular care

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