

## **STRUCTURAL AND FUNCTIONAL CHANGES OF THE HEART AND VASCULATURE DURING AGING:**

### **CLINICAL SIGNIFICANCE OF DIASTOLIC DYSFUNCTION AND ARTERIAL STIFFNESS**

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#### **Abstract**

Aging of the cardiovascular system is accompanied by progressive structural and functional changes in the heart and blood vessels, which substantially contribute to cardiovascular risk in older populations. Among the most clinically significant manifestations of cardiovascular aging are increased arterial stiffness and the development of left ventricular diastolic dysfunction. This article examines the pathophysiological mechanisms underlying age-associated changes in the vascular wall and myocardium, analyzes their interrelationship and clinical significance, and discusses current diagnostic approaches and preventive

perspectives. Particular attention is given to arterial stiffness as an integrative marker of vascular aging and its impact on left ventricular diastolic function.

**Keywords:** cardiovascular aging, arterial stiffness, diastolic dysfunction, left ventricle, biological age, cardiogerontology.

## **Introduction**

Population aging represents one of the most significant demographic trends of the modern era. This process is associated with a growing burden of cardiovascular diseases, which remain the leading cause of morbidity and mortality in older age groups. In clinical practice, cardiologists increasingly encounter elderly patients who lack significant coronary artery obstruction yet present with symptoms of heart failure and reduced exercise tolerance.

In recent years, the concept of cardiovascular aging has emerged as an important framework for understanding age-related cardiovascular vulnerability. Within this paradigm, age-associated changes are considered independent risk factors that contribute to adverse cardiovascular outcomes. Two central features of cardiovascular aging—arterial stiffness and myocardial diastolic dysfunction—often develop concurrently and exert synergistic effects on clinical prognosis.

### **1. Arterial Stiffness as a Manifestation of Vascular Aging**

Arterial stiffness is an integral characteristic of the mechanical properties of the vascular wall and reflects its elastic and structural integrity. With advancing age, the arterial wall undergoes progressive remodeling characterized by elastin degradation, collagen accumulation, calcification, and alterations in vascular smooth muscle cells. These changes reduce arterial compliance and impair the buffering function of large arteries.

Clinically, increased arterial stiffness leads to elevated systolic blood pressure, widened pulse pressure, and increased left ventricular afterload. Numerous studies have demonstrated that arterial stiffness is independently associated with cardiovascular events and all-cause mortality, underscoring its value as a prognostic marker.

### **2. Diastolic Function of the Myocardium and Age-Related Cardiac Changes**

Left ventricular diastolic function reflects the ability of the myocardium to relax and fill during diastole. Aging is associated with myocardial fibrosis, reduced cardiomyocyte elasticity, and disturbances in calcium homeostasis, all of which contribute to impaired relaxation and increased chamber stiffness.

Diastolic dysfunction often precedes systolic impairment and may remain clinically silent for extended periods. However, in the presence of increased arterial stiffness and additional risk factors, diastolic dysfunction becomes a key pathogenic mechanism in the development of

heart failure with preserved ejection fraction, a condition particularly prevalent among elderly patients.

### **3. Interaction Between Arterial Stiffness and Diastolic Dysfunction**

Accumulating evidence indicates a close pathophysiological interaction between vascular and myocardial aging. Increased arterial stiffness augments left ventricular afterload and disrupts ventricular–arterial coupling, promoting myocardial hypertrophy and impaired diastolic relaxation.

Conversely, diastolic dysfunction contributes to elevated left ventricular filling pressures and altered hemodynamics within the pulmonary circulation. Together, vascular and cardiac aging form a self-perpetuating cycle that exacerbates clinical manifestations of cardiovascular dysfunction in older individuals.

## **4. Diagnostic Approaches to Assessing Age-Related Cardiovascular Changes**

### **4.1 Instrumental Assessment of Arterial Stiffness**

Measurement of pulse wave velocity is widely regarded as the gold standard for assessing arterial stiffness. This noninvasive method provides quantitative information on the elastic properties of large arteries and is increasingly incorporated into both research and clinical practice.

### **4.2 Echocardiographic Evaluation of Diastolic Function**

Echocardiography remains the primary modality for diagnosing diastolic dysfunction. Analysis of transmitral flow patterns, tissue Doppler imaging, and indices of left ventricular filling pressure allows early detection of diastolic abnormalities and assessment of their severity.

## **5. Clinical and Prognostic Implications**

The coexistence of increased arterial stiffness and diastolic dysfunction is associated with an unfavorable cardiovascular prognosis, particularly in elderly populations. Early identification of these changes enhances risk stratification and enables timely initiation of preventive and therapeutic strategies.

## **6. Perspectives for Prevention of Cardiovascular Aging**

Prevention of cardiovascular aging requires a comprehensive approach that integrates lifestyle modification, optimal management of blood pressure and metabolic disorders, and

targeted pharmacological interventions. Evidence suggests that interventions aimed at reducing arterial stiffness may have beneficial effects on myocardial diastolic function.

## **Conclusion**

Arterial stiffness and diastolic dysfunction represent key clinical manifestations of cardiovascular aging and play a central role in shaping cardiovascular risk in older adults. Their interrelationship highlights the importance of an integrated diagnostic and preventive approach to age-associated cardiovascular disorders. Advances in cardiogerontology and personalized cardiovascular care offer promising avenues for improving outcomes and quality of life in aging populations.

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