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Orthostatic hypotension and cardiovascular events: An underestimated relationship in geriatrics

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Abstract

Orthostatic hypotension is a common and underestimated condition in the geriatric population, characterized by a significant decrease in blood pressure upon standing. Its pathophysiology centers on dysfunction of the baroreflex system, affected by neurodegeneration and arterial stiffness, which impedes an adequate autonomic response to postural changes. This impairment is aggravated by decreased intravascular volume, common in older adults due to dehydration, malnutrition, and diuretic use. Clinically, it manifests with symptoms such as dizziness, blurred vision, and syncope, increasing the risk of falls, fractures, and cardiovascular events.

Diagnosis is based on standardized criteria, which require serial blood pressure measurements in the supine and standing positions, as well as complementary tools such as the tilt test and ambulatory monitoring. Orthostatic hypotension has been associated with an increased risk of myocardial infarction, stroke, cognitive decline, and functional frailty. Comorbidities such as type 2 diabetes mellitus and Parkinson's disease contribute significantly to its prevalence and severity.

Therapeutic management begins with non-pharmacological interventions, such as adequate hydration, physical exercises, and the use of compression garments. Adjustment of antihypertensive medications is essential, and in resistant cases, pharmacological treatments such as fludrocortisone, midodrine, or droxidopa are used. Geriatric follow-up should be comprehensive and multidisciplinary, considering comorbidities and risk factors. Early detection and a personalized approach are key to reducing complications and improving the quality of life of affected older adults.

Keywords: Baroreflex; Arterial Stiffness; Cerebral Hypoperfusion; Falls; Vascular Aging; Dysautonomia

1. Introduction

Orthostatic hypotension (OH) is a common condition in the geriatric population, characterized by a significant decrease in blood pressure upon standing, with typical symptoms such as dizziness, blurred vision, postural instability, and even syncope. Its clinical importance lies in its association with an increased risk of falls, fractures, functional decline, and cardiovascular events. Nevertheless, despite its prevalence and potentially serious implications, orthostatic hypotension remains an underestimated and underrecognized entity in daily clinical practice. This undervaluation is

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related to a combination of factors, including diagnostic challenges, coexistence with other cardiovascular diseases, and the limited attention it has received in clinical research (1; 2).

From an operational perspective, orthostatic hypotension is defined as a decrease of at least 20 mmHg in systolic blood pressure or 10 mmHg in diastolic blood pressure, measured within three minutes of standing. The prevalence in the geriatric population is considerable; various studies report that it affects approximately 29% of older adults, and this figure may rise to 35.2% in outpatient settings when continuous monitoring methods are used (1). However, the true burden of the disease may be underestimated, particularly in low-income countries where access to appropriate diagnostic tools is limited and studies on this condition are scarce, leaving a substantial gap in the global epidemiology of orthostatic hypotension (2).

One of the main clinical challenges is the accurate diagnosis of this entity. Identifying orthostatic hypotension requires dynamic and continuous blood pressure monitoring during postural transition, which is not always feasible in conventional clinical settings. Frequently, measurements are performed intermittently, which may fail to capture the transient drop in blood pressure, thus favoring underdiagnosis. This is compounded by symptom variability, which may be nonspecific or even absent, particularly in older adults with cognitive impairment or reduced bodily awareness (1).

The situation is further complicated when orthostatic hypotension coexists with other cardiovascular conditions, such as orthostatic hypertension, which presents with a paradoxical rise in blood pressure upon standing (3; 4). In older adults with multiple comorbidities, it is common to encounter a mixture of resting hypertension and orthostatic hypotension, creating major challenges for both clinical and pharmacological management (5).

Another factor contributing to the limited attention to this entity is the lack of awareness among healthcare professionals. Historically, clinical training has focused primarily on the management of arterial hypertension, relegating complications arising from overtreatment—such as orthostatic hypotension—to the background. Fear of symptomatic hypotension may even lead to unnecessary reduction in antihypertensive therapy intensity, without considering the adverse effects of low blood pressure in older adults (5). This lack of training is also reflected in the research field, where the available scientific evidence on orthostatic hypotension is comparatively limited. Unlike other cardiovascular disorders, OH does not have universally standardized clinical guidelines, which further hinders its systematic diagnosis and treatment (4).

The aim of this review is to analyze the relationship between orthostatic hypotension and the occurrence of cardiovascular events in older adults, in order to highlight its underestimated clinical impact in geriatric practice, identify the main diagnostic challenges, and underscore the need for more comprehensive evaluation and management strategies to reduce complications and improve quality of life in this vulnerable population.

2. Methodology

For the development of this research on the relationship between orthostatic hypotension and cardiovascular events in the geriatric population, a comprehensive literature review was conducted with the aim of analyzing the prevalence, underlying pathophysiological mechanisms, diagnostic challenges, and clinical impact of this condition in older adults. In addition, the prognostic implications and potential clinical strategies to improve its identification and management in geriatric practice were addressed.

The review was based on the consultation of well-recognized scientific databases such as PubMed, Scopus, and Web of Science, selected for their relevance in internal medicine, geriatrics, and cardiology. Rigorous inclusion and exclusion criteria were applied to ensure the quality and timeliness of the information. Studies published between 2020 and 2025 in English or Spanish were included, provided they addressed the definition, prevalence, pathophysiology, diagnosis, and cardiovascular consequences of orthostatic hypotension in older adults. Research with incomplete data, duplicate publications, or lacking peer review was excluded. Keywords used for the search included: baroreflex, arterial stiffness, cerebral hypoperfusion, falls, vascular aging, dysautonomia.

The initial search identified 28 relevant sources, including original articles, systematic reviews, cohort studies, and clinical guidelines issued by specialized societies in geriatrics and cardiovascular diseases. From these sources, a detailed analysis was conducted to extract information on the underlying mechanisms of orthostatic hypotension, its coexistence with other comorbidities, and its association with events such as acute myocardial infarction, stroke, and cardiovascular mortality.

The analysis was carried out using a qualitative and comparative approach. The findings were organized into thematic categories that made it possible to identify relevant clinical patterns, frequent diagnostic barriers, gaps in the literature, and emerging proposals for improving clinical management. This approach provides a critical and structured overview of the current state of knowledge on this underestimated relationship, highlighting the need for greater clinical attention and specific research in the geriatric field.

2.1. Pathophysiology of orthostatic hypotension

The pathophysiology of orthostatic hypotension in the geriatric population centers on the inability of reflex cardiovascular mechanisms to adequately respond to changes in body position, particularly upon standing. This dysfunction results in an abrupt drop in systolic or diastolic blood pressure, leading to clinical symptoms such as dizziness, blurred vision, and even syncopal episodes, which are especially dangerous in older adults due to the risk of falls and their consequences. At the hemodynamic level, orthostatic hypotension is associated with increased blood pressure variability and greater arterial stiffness, suggesting a systemic cardiovascular dysfunction that goes beyond a simple postural disorder (6; 7).

Under normal physiological conditions, the human body employs rapid and efficient compensatory mechanisms to maintain adequate cerebral perfusion during postural changes. The most important of these mechanisms is the baroreflex, a feedback system based on the detection of pressure changes in the great vessels, which triggers sympathetic responses to increase heart rate and peripheral vasoconstriction. These responses transiently restore blood pressure when a person moves from lying down to standing up. In healthy young individuals, this system acts quickly and effectively, preventing postural changes from translating into clinical hypotension (8).

However, in older adults, several aging-related factors impair the functionality of the baroreflex. Progressive neurodegeneration, atherosclerosis of the vessels housing the baroreceptors, and dysfunction of the autonomic nervous system reduce both the sensitivity and efficacy of this reflex. As a consequence, sympathetic responsiveness is diminished, favoring the onset of orthostatic hypotension during everyday postural changes. This deterioration of autonomic control has also been linked to a higher prevalence of resting hypertension and to complications such as falls, syncope, and osteoporotic fractures in the geriatric population (8).

Additionally, other physiological factors contribute to the development and worsening of orthostatic hypotension in older individuals. Among these, arterial stiffness plays a fundamental role. This phenomenon, characteristic of vascular aging, involves the loss of elasticity in central arteries, reducing the cardiovascular system's ability to buffer abrupt pressure changes. Arterial stiffness is inversely related to baroreflex sensitivity, further limiting adequate blood pressure regulation in response to postural stimuli (9). Likewise, a reduction in intravascular volumen whether due to dehydration, diuretic use, or loss of appetite commonly seen in geriatrics can further lower systemic blood pressure upon standing, exacerbating episodes of hypotension (6).

Finally, baroreflex dysfunction, clinically manifested by increased blood pressure variability, represents a central component in the pathophysiology of orthostatic hypotension in old age. This erratic blood pressure pattern suggests a loss of cardiovascular homeostatic control, which not only promotes orthostatic symptoms but has also been associated with an increased risk of major cardiovascular events, such as acute myocardial infarction and stroke, in recent studies (7).

2.2. Clinical diagnosis and assessment tools

The diagnosis of orthostatic hypotension is based on well-established criteria outlined by major international guidelines, which allow for accurate identification of this condition in the clinical setting. According to the most widely accepted definitions, orthostatic hypotension is diagnosed when there is a decrease of at least 20 mmHg in systolic blood pressure or at least 10 mmHg in diastolic blood pressure within three minutes of standing or undergoing a tilt test. This definition has been adopted by numerous scientific societies and constitutes the starting point for a systematic diagnostic evaluation (10; 11).

It is worth noting that although orthostatic hypotension is the primary focus, some societies, such as the American Autonomic Society and the Japanese Society of Hypertension, have proposed specific criteria for another related entity: orthostatic hypertension. Unlike the blood pressure drop observed in orthostatic hypotension, this condition is characterized by an increase in systolic blood pressure upon standing, reflecting a distinct autonomic response which, although less studied, also requires clinical attention (12).

Proper measurement of orthostatic blood pressure is crucial for reliable diagnosis. It is recommended that readings be obtained after the patient has remained in the supine position for at least five minutes, followed by new measurements at one and three minutes after standing. This standardized protocol allows for consistent detection of posture-related hemodynamic changes. Furthermore, it has been determined that the change from supine to standing is more sensitive than the change from sitting to standing, particularly in patients with neurodegenerative diseases such as Parkinson's, where autonomic dysfunction is common (10; 13).

For a more comprehensive diagnostic assessment, complementary studies may be used to establish the underlying etiology and rule out other causes of similar symptoms. The tilt table test is a key diagnostic tool in this regard, as it enables evaluation of cardiovascular responses under controlled postural changes. Through this test, variations in heart rate and blood pressure can be observed, facilitating the identification of autonomic dysfunction and specific forms of syncope (14).

Continuous blood pressure monitoring using ambulatory devices has also proven useful, particularly for detecting episodes of orthostatic hypotension that do not appear during isolated clinical assessments. This technique improves diagnostic sensitivity, especially in patients with intermittent symptoms or underlying conditions such as poorly controlled arterial hypertension (13).

Finally, although there are currently no universally accepted specific biomarkers for orthostatic hypotension, complementary tests such as electrocardiography (ECG) and the evaluation of general cardiovascular parameters may contribute to an integral patient assessment. These tests allow the identification of rhythm disturbances, signs of structural heart disease, or other cardiovascular risk factors that may influence the clinical presentation of orthostatic hypotension (11).

2.3. Orthostatic hypotension as a marker of cardiovascular risk

OH, has been associated with a considerable increase in cardiovascular risk in older adults, particularly when the condition appears at an early age. Several studies have demonstrated that OH significantly increases the risk of major cardiovascular events, such as acute myocardial infarction and stroke. A recent analysis revealed that the presence of OH early in life was linked to an increased risk of myocardial infarction (HR=3.15) and stroke (HR=1.72), underscoring its clinical relevance beyond the immediate geriatric setting (15). In patients with stable coronary artery disease, OH has also been associated with a higher risk of cardiovascular death, although it did not show a significant association with all-cause mortality (16).

From a neurological perspective, OH may contribute to chronic reductions in cerebral blood flow, which has direct implications for cognitive function and the risk of neurological decline. Cerebral hypoperfusion induced by OH has been identified as a key mechanism in the genesis of unexplained falls in older adults. A marked decrease in cerebral oxygenation upon standing, in the presence of OH, was strongly correlated with a higher incidence of falls (OR 2.23) (17). Moreover, symptoms such as dizziness related to OH have been consistently associated with an increased risk of cognitive dysfunction, dementia, and cerebrovascular events, reinforcing the role of this condition as a predictor of adverse neurological outcomes (18).

OH, also represents a significant risk factor for falls and frailty in older adults. The reduction in cerebral blood flow upon adopting the upright position plays a crucial role in postural instability and the occurrence of falls, which are an important determinant of geriatric morbidity. Recent studies have demonstrated that the degree of decrease in cerebral oxygenation is a reliable predictor of future falls, making OH a condition of particular interest in the prevention of functional decline. Furthermore, the presence of OH has been documented to be associated with greater physical and functional frailty, exacerbating the risk of recurrent falls and related injuries (17).

Although OH has been widely recognized as a relevant clinical marker, it is also essential to consider other alterations in orthostatic blood pressure that may have even more significant clinical implications. For example, orthostatic hypertension, characterized by an increase in systolic blood pressure upon standing, has shown a stronger correlation with adverse cardiovascular outcomes compared with OH. This observation highlights the need for a broader and more nuanced evaluation of postural hemodynamic responses, as both conditions may coexist and represent complementary risks in the geriatric population (19).

2.4. Associated comorbidities and aggravating factors

One of the most relevant comorbidities is type 2 diabetes mellitus, in which a notable prevalence of OH has been observed. In these patients, autonomic dysfunction secondary to chronic hyperglycemia compromises the

cardiovascular reflexes responsible for maintaining blood pressure during postural changes. In fact, it has been reported that patients with type 2 diabetes who present OH have a 2.7-fold higher risk of falls and a 1.54-fold greater probability of in-hospital mortality compared with patients without this metabolic condition, underscoring the need for active surveillance and comprehensive management in this subgroup (20).

Likewise, OH frequently manifests in the context of neurodegenerative diseases, particularly Parkinson's disease. In this case, the prevalence of OH reaches 27.7% compared with 7.9% in healthy controls, reflecting a statistically significant association. This relationship has been quantified with a pooled odds ratio of 4.343, indicating a robust connection between the two entities (21). The pathophysiological explanation lies in the dysautonomia that accompanies neurodegenerative disorders, which compromises baroreceptor function and disrupts reflex regulation of blood pressure. This autonomic dysfunction, recognized as one of the main causes of OH, represents a constant clinical challenge due to its progressive course and poor response to conventional treatments (12; 22).

Among the factors that aggravate OH in older adults, the use of multiple medications stands out, especially those with hypotensive effects. Polypharmacy is a common condition in this population due to the coexistence of several chronic diseases requiring simultaneous pharmacological treatment. Drugs such as diuretics, antihypertensives, and tricyclic antidepressants can interfere with postural compensatory mechanisms, exacerbating the blood pressure drop upon standing (23).

In addition, conditions such as malnutrition and dehydration play an important role in the exacerbation of OH. Both reduce the available intravascular volume, limiting the cardiovascular system's ability to maintain adequate perfusion in the upright position. These states are often underdiagnosed in older adults, making nutritional support and adequate hydration essential pillars in the treatment of OH in this vulnerable population (12).

2.5. Therapeutic approach and management strategies

One of the fundamental measures is to ensure adequate hydration. Increasing water intake can significantly help maintain blood volume, thereby improving orthostatic tolerance and reducing the risk of falls and syncope. Dehydration, which is common in older adults due to impaired thirst perception or the use of diuretics, greatly worsens OH symptoms (12; 23).

In addition, certain active physical maneuvers, such as leg crossing, squatting, or tensing the muscles of the lower limbs, have been shown to transiently improve venous return. These actions raise blood pressure during orthostatic stress and are particularly useful as immediate measures when imminent symptoms occur (23). Similarly, the use of compression garments, such as abdominal binders or elastic stockings, helps counteract blood pooling in the lower extremities, contributing to blood pressure stabilization and symptom reduction (12; 24).

At the same time, a thorough review of pharmacological treatment is essential in polymedicated patients, since multiple drugs particularly antihypertensives, diuretics, vasodilators, and some antidepressants can induce or worsen OH. Adjusting or discontinuing these medications, when clinically feasible, represents a key strategy to reduce the symptomatic burden of the disease (25). Special attention must also be given to balancing hypertension control with the prevention of OH, as intensive antihypertensive treatment may exacerbate orthostatic drops. Therefore, an individualized approach is recommended, taking into account the patient's overall cardiovascular profile and prioritizing both safety and therapeutic efficacy (11; 26).

When non-pharmacological interventions and medication adjustments are not sufficient to control symptoms, pharmacological treatment should be considered. Among the available options, fludrocortisone has been widely used. This mineralocorticoid increases sodium reabsorption and, consequently, expands plasma volume, thereby contributing to improved hemodynamic stability. However, its use requires close monitoring due to the risk of fluid retention and secondary hypertension (23; 27). Another effective alternative is midodrine, an alpha-1 agonist that increases vascular tone and raises blood pressure. Its main limitation lies in the potential to induce supine hypertension, which necessitates careful monitoring in high-risk patients (24; 27).

As emerging therapeutic alternatives, droxidopa a norepinephrine precursor has been employed, particularly in cases of neurogenic OH, such as those observed in patients with Parkinson's disease. This agent has shown promising results in reducing orthostatic dizziness and improving functional status. Moreover, recent research is exploring the role of novel drugs, such as norepinephrine transporter inhibitors, which may provide additional benefits by modulating sympathetic tone and enhancing perfusion in the upright position (24; 27).

2.6. Prognostic implications and clinical follow-up

The prognostic implications of OH in the geriatric population are multiple and complex, as this condition is not only linked to acute symptoms such as dizziness or syncope, but also associated with long-term adverse clinical outcomes. One of the most relevant aspects is its relationship with an increased risk of falls and fractures, particularly when it coexists with cognitive impairment and mobility problems. This clinical trial has been described as a "Bermuda triangle" of risk factors, due to its capacity to significantly increase the vulnerability of older patients (28).

Chronic cerebral hypoperfusion accompanying OH has been identified as a fundamental mechanism underlying many unexplained falls in older adults. Recent studies have shown a strong correlation between the magnitude of cerebral oxygenation decline and the probability of future falls, underscoring the importance of actively assessing postural hemodynamic parameters in geriatric patients (17). Although OH has not been directly linked to an increased incidence of cardiovascular disease episodes, it is associated with hospitalizations related to hypotension, which negatively affects both quality of life and healthcare system costs (18).

Given this scenario, it is essential to establish specific recommendations for comprehensive geriatric follow-up. Routine blood pressure measurement during postural changes is a key tool for the early detection of OH and allows timely intervention to prevent complications. A well-structured therapeutic strategy combining non-pharmacological interventions with tailored medical treatment has proven effective in improving both clinical and functional outcomes in affected patients (23). Furthermore, addressing common comorbidities such as cognitive decline and motor weakness is crucial, as their correction helps reduce the risk of OH-related falls and fractures (28).

In this context, the implementation of a patient-centered multidisciplinary approach becomes decisive. The coordinated participation of geriatricians, cardiologists, physiotherapists, nurses, and nutritionists enables a comprehensive approach to OH, taking into account both the pathophysiological causes and the psychosocial factors influencing its management (12). This approach should include personalized interventions combining lifestyle modifications, educational strategies, and pharmacological adjustments tailored to the clinical profile and individual risks of each patient. Ultimately, multidisciplinary teams ensure continuous and holistic care, guaranteeing that all aspects of older adults' health are considered in the design of the therapeutic plan (12).

3. Conclusion

OH, represents a clinically relevant manifestation of cardiovascular and autonomic aging, whose pathophysiology is profoundly influenced by baroreflex dysfunction, arterial stiffness, and reduced intravascular volume. This hemodynamic alteration not only affects the quality of life of older adults but is also associated with an increased risk of cardiovascular and neurological events, such as acute myocardial infarction, stroke, cognitive decline, and falls.

Early and accurate detection of orthostatic hypotension, through standardized measurement protocols and complementary tests such as tilt table testing or ambulatory monitoring, is essential to establish a reliable diagnosis. This process should also take into account common comorbidities, such as type 2 diabetes mellitus and Parkinson's disease, which contribute to autonomic deterioration and worsen the prognosis of geriatric patients.

The clinical management of orthostatic hypotension should adopt a comprehensive approach that combines non-pharmacological strategies, adjustment of polypharmacy, and, when necessary, individualized pharmacological therapies. A multidisciplinary approach, involving the coordinated participation of geriatricians, cardiologists, physiotherapists, and nutritionists, enables intervention on modifiable risk factors, optimization of therapeutic response, and reduction of associated complications in the older adult population.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict-of-interest to be disclosed.

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