Hypertension in Aging Population
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Abstract
Hypertension is a major problem among the geriatric population and is usually associated with multiple comorbidities and organ system damage. Isolated systolic hypertension is commonly found in older (60–79 years of age) and elderly (≥80 years of age) people. It is now clear that isolated systolic hypertension and elevated pulse pressure also play an important role in the development of cerebrovascular disease, congestive heart failure, and coronary heart disease, which are the major causes of cardiovascular (CV) morbidity and mortality in the population aged older than 65 years. The elderly population represents several medical challenges, particularly in the management of hypertension. These individuals have more organ damage or clinical CV disease, and they may respond differently to treatment goals of normal aged populations. Each patient responds differently to treatment; thus, there is a need to individualize hypertension management in the elderly population.

Key words: Aging population, hypertension, systolic hypertension

Introduction
Hypertension is one of the most common morbidities in the older age groups significantly impacting their health conditions.[1] Older is defined as 65 years or more and the very old as 80 years or more.

Hypertension remains a growing problem in our aging population. The overall prevalence of hypertension in adults is around 30–45%,[1] with a global age-standardized prevalence of 24 and 20% in men and women, respectively, in 2015.[2]

This high prevalence of hypertension is consistent across the world, irrespective of income status, that is, in lower, middle, and higher income countries.[1] Hypertension becomes progressively more common with advancing age, with a prevalence of >60% in people aged >60 years.[2] It is estimated that the number of people with hypertension will increase by 15–20% by 2025, reaching close to 1.5 billion.

Hypertension is the main risk factor for most of the morbidities in older age including cardiovascular (CV) and cerebrovascular diseases and poor quality of life.[3] Numerous studies have demonstrated risk for stroke, left ventricular hypertrophy, congestive heart failure, coronary and peripheral artery diseases, vision impairment, end-stage renal disease, cognitive impairment, and dementia among hypertensives.[4] In addition, hypertension has adverse effects on most organ systems including cerebrovascular, CV, renal, ocular, and vascular.[5,6]

Although both systolic blood pressure (SBP) and diastolic blood pressure (DBP) are established risk factors, with advancing age, SBP becomes a better predictor than DBP, of CV disease and other comorbidities.[5,6] Hypertension in the elderly is a complicated disease and warrants control and adherence to prescribed medication to reduce the risks of CV, cerebrovascular, and renal disease.

Pathophysiology of Hypertension in the Elderly Population
Age-related BP elevations derive from changes in the arterial structure and function accompanying aging. The elasticity of the large vessels decreases due to the alteration of the various collagen components in the vessel wall.[6]

These changes cause increases in the pulse wave velocity, leading to late systolic BP augmentation and increasing myocardial oxygen demand. Reduction of forward flow also occurs, limiting organ perfusion. The arterial stiffness is...
manifested clinically by the widening of pulse pressure, which is seen commonly in the elderly patients.\textsuperscript{[10,11]} Data from the Framingham heart study suggest that after age 50, systolic BP continues to increase, whereas diastolic BP decreases, resulting in the widened pulse pressure.\textsuperscript{[12]}

Elderly patients are relatively more salt sensitive due to their reduced ability to excrete a sodium load. This is partly due to the decline in kidney function with age and secondarily due to the reduced generation of the natriuretic substances such as prostaglandin E2 and dopamine. Progressive renal dysfunction due to glomerulosclerosis and interstitial fibrosis with a reduction of glomerular filtration rate and other renal homeostatic mechanisms, leading to increased intracellular sodium, reduced Na-Ca exchange, and volume expansion may also contribute to the pathophysiology of hypertension in the elderly population.\textsuperscript{[13-15]}

Secondary causes of hypertension should also be considered in this age group, such as renal artery stenosis,\textsuperscript{[16]} sleep apnea, primary hyperaldosteronism, and thyroid disorders. Excess in lifestyle such as overeating or high alcohol consumption as well as medications such as nonsteroidal anti-inflammatory medications can also contribute to the elevation of BP in the elderly patients.

The prevalence of glucose intolerance and diabetes mellitus also increases with age, which further accelerates vascular injury and adversely affects kidney function. In addition, CV reflexes in older people become less responsive to maneuvers that activate the sinoaortic reflex and to upright tilt, and this change may contribute to the greater variability of ambulatory SBP associated with aging.\textsuperscript{[17,18]}

Despite advances in diagnosis and treatment over the past 30 years, the disability-adjusted life years attributable to hypertension have increased by 40% since 1990.\textsuperscript{[19]}

SBP appears to be a better predictor of events than DBP after the age of 50 years. Both office BP and out-of-office BP have an independent and continuous relationship with the incidence of several CV events such as hemorrhagic stroke, ischemic stroke, myocardial infarction, sudden death, heart failure, and peripheral artery disease, as well as end-stage renal disease.\textsuperscript{[20]}

Hypertension increases the risk of developing atrial fibrillation,\textsuperscript{[21]} and evidence is emerging that links early elevations of BP to increased risk of cognitive decline and dementia.\textsuperscript{[22]} In middle-aged and older people, increased pulse pressure has additional adverse prognostic significance.\textsuperscript{[23]}

Diagnosis and Treatment

Diagnosis of hypertension is established by demonstrating a SBP of $\geq 140$ mmHg and/or diastolic BP of $\geq 90$ mmHg on at least three different BP measurements taken on two or more than two separate office visits to account for natural variability.

Alternatively, checking BP at home can be done with a clinic-calibrated arm cuff, though errors in measurement and reproducibility can confound the clinical picture. When BP is high at home but not in the office, the so-called “masked hypertensive,” the diagnosis of hypertension can be more challenging.

Masked and situational hypertension (previously known as “white coat hypertension”) must always be considered, and in addition to home and office BP measurements, 24-h ambulatory BP monitoring may be helpful in selected patients. Isolated office hypertension is more common at older ages and in females\textsuperscript{[24]} and is often mistaken for uncontrolled hypertension, which may lead to overtreatment.\textsuperscript{[25]}

Ambulatory BP monitoring provides important information on the pattern of nocturnal BP (nocturnal hypertension, nocturnal hypotension, dipping status, and autonomic dysfunction).\textsuperscript{[26]}

Several studies have shown that nocturnal hypertension and non-dipping of BP during sleep are important harbingers of poor CV prognosis and that nighttime pressures more accurately predict the occurrence of death and CV events than daytime pressures, independent of other confounders.\textsuperscript{[27,28]} The prevalence of non-dippers among hypertensive men and women increases progressively with age, reaching more than 40% in subjects aged 70 years or older.\textsuperscript{[29]}

Pseudohypertension is more common in older adults and should be considered early. Pseudohypertension is the result of age-related calcific arteriosclerosis that causes incompressible peripheral arteries. Essentially, the BP cuff is unable to measure the true intraluminal BP. A standing BP can be helpful in distinguishing pseudohypertension from true hypertension. For example, if a “resistant” patient is on several drugs and reporting symptoms of orthostasis, an elevated resting and standing BP would suggest pseudohypertension. Being aware of this entity in the elderly is important since unnecessary therapy escalation can lead to falls or functional impairment, causing significant disability in this population.

Risks

Elderly patients, in comparison to younger cohorts, have a higher baseline cardiac risk profile and benefit from even modest reductions in BP.\textsuperscript{[30]} In patients over the age of 60, isolated systolic hypertension is more common, and SBP is a better predictor of CV risk when compared to DBP.\textsuperscript{[31]} Data from The Second National Health and Nutrition Examination Survey-II and the SHEP trial revealed that in patients over the age of 65 years of age, there is a linear relationship between CV risk, particularly stroke, and increasing SBP (the absolute stroke risk in the placebo group of the SHEP trial was 8.2% over 5 years, compared to 5% in the treatment arm).\textsuperscript{[32]} Paradoxically, when DBP dropped $>65$ mmHg, there was an enhanced risk of mortality, possibly the result of decreased tissue perfusion and increased CV risk ("J-curve" phenomenon).\textsuperscript{[33]}

Subclinical organ damage is considered to be an important component in determining total CV risk. Simple, well-standardized, and inexpensive tests to detect subclinical organ damage such as electrocardiogram, echocardiogram, serum creatinine, urinalysis, and microalbuminuria are widely recommended for all hypertensive patients. Recently, the role of several emerging risk factors such as the blood levels of high-
sensitivity C-reactive protein and homocysteine, and the urine albumin-to-creatinine ratio to predict risk have been evaluated, and none was shown to substantially improve on the ability of conventional risk factors to classify risk.\(^3\)

**Treatment**

Accurate measurement of BP is important before initiating treatment for hypertension.

Effective non-pharmacologic options for reducing BP include lifestyle modifications as weight loss, dietary changes such as the dietary approaches to stop hypertension diet, and an increase in physical activity.

A 6-month study of aerobic and resistance training in 51 hypertensives compared to 53 controls lowered DBP but not SBP in older adults. The absence of improvement in aortic stiffness in exercisers suggests that older persons may be resistant to exercise-induced reductions in SBP. Body compositional improvements due to exercise probably improve CV health in older men and women.\(^3\)

Non-pharmacologic options are typically associated with fewer side effects than pharmacologic therapies and have other positive effects; ideally, they are included as the first therapy or used concurrently with drug for most patients with hypertension therapy.

Before initiating medical therapy, consideration should be given to the following variables: (1) The frailty of the patient, (2) their ability to follow instructions, (3) the complexity of their current medication regimen, and (4) supporting care. The anticipated benefits versus potential harm of BP treatment in older patients will be influenced by the patient’s ability to tolerate treatment and their health and functional status.

Careful review, the patient’s medication list is necessary to stop or reduce nonsteroidal anti-inflammatory drugs and decongestants. Reviewing the patient’s electrolyte and renal function before initiation of therapy is prudent, particularly if considering use of RAAS blockers or suspecting aldosteronism.

In the HYVET trial, treating to an SBP target of <150 mmHg (achieving a mean SBP of 144 mmHg) in the very old patients (>80 years) demonstrated significant reductions in mortality, fatal stroke, and heart failure, with the caveat that the “very old” patients in this study were active and independent.\(^3\)

However, more recent evidence supports a lower SBP target for older patients (older than 65 years). The SPRINT trial included a high proportion of patients over the age of 75 years (\(n = 2636\)) and demonstrated that more intensive BP-lowering treatment (mean achieved BP = 124/62 mmHg) significantly reduced the risk of major CV events, heart failure, and all-cause death by >30%, compared with standard treatment (mean achieved BP = 135/67 mmHg).\(^3\)

It has been noted that the BP measurement technique used in SPRINT generated lower values than those provided by the conventional office BP measurement.\(^3\) Consequently, the SBP of 124 mmHg achieved in the intensively treated older patients in the SPRINT trial most probably reflects a conventional office SBP range of 130–139 mmHg.

Although HYVET and most other RCTs in older patients have recruited relatively fit and independent patients, the SPRINT study also suggested that there are benefits of more intensive treatment being extended to older patients who were frailer meeting the inclusion criteria, with reduced gait speed.\(^3\)

Several trials have shown that in old and very old patients, antihypertensive treatment substantially reduces CV morbidity and CV and all-cause mortality. Treatment has been found to be generally well tolerated. However, older patients are more likely to have comorbidities such as renal impairment, atherosclerotic vascular disease, and postural hypotension, which may be worsened by BP-lowering drugs.

Furthermore, a recent study of a cohort of older patients from the general population (thus including those with frailty) has shown that better adherence to antihypertensive treatment was associated with a reduced risk of CV events and mortality, even when age was >85 years (mean 90 years).\(^3\)

Antihypertensive doses should start low, and BP should be lowered gradually. In very old patients, it may be appropriate to initiate treatment with monotherapy. In all older patients, when combination therapy is used, it is recommended that this is initiated at the lowest available doses. In all older patients, and especially very old or frail patients, the possible occurrence of postural BP should be closely monitored and symptoms of possible hypotensive. Renal function should be frequently assessed to detect possible increases in serum creatinine and reductions in eGFR as a result of BP-related reductions in renal perfusion.

The risk of orthostatic hypotension increases with aging, diabetes, and certain antihypertensive drugs.\(^2\) Angiotensin-converting enzyme inhibition (ACEI) is reasonable, especially if there is concurrent coronary artery disease, diabetes, proteinuria chronic kidney disease, or heart failure.

While the JNC 8 guidelines\(^3\) have no preference among ACEIs, calcium channel blockers, or diuretics as the initial medication, the ESH/ESC guideline recommends a calcium antagonist or diuretic in elderly patients with isolated systolic hypertension.

Robust randomized evidence, specifically the antihypertensive and lipid-lowering treatment to prevent heart attack trial data, would suggest that low-dose daily chlorthalidone is the most effective agent in this population.\(^3\) However, consideration of the patients free water intake and comorbid alcohol intake is important due to a real risk of hyponatremia with this medication. Hypokalemia is also relatively common with thiazide diuretics, and there are small, adverse effects on lipids, and glucose levels.

In a primarily elderly Scandinavian population, the Anglo-Scandinavian cardiac outcomes trial - BP-lowering arm study showed significant overall mortality benefit in subjects aged >60 years when using a combination regimen of calcium channel blocker and ACEI when compared to a beta-blocker and thiazide regimen.\(^4\)

In some of these old patients, it may not be possible to
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Babu

Table 1: Office blood pressure treatment target range in older and very old patients

<table>
<thead>
<tr>
<th>Age group</th>
<th>Office SBP treatment target ranges (mmHg)</th>
<th>Office DBP treatment target range (mmHg)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hypertension</td>
<td>+ Diabetes</td>
</tr>
<tr>
<td>65–79 years</td>
<td>Target to 130–15 if tolerated</td>
<td>Target to 130–139 if tolerated</td>
</tr>
<tr>
<td>&gt;80 years</td>
<td>Target to 130–139 if tolerated</td>
<td>Target to 130–139 if tolerated</td>
</tr>
<tr>
<td>Office DBP treatment target range</td>
<td>70–79</td>
<td>70–79</td>
</tr>
</tbody>
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CAD: Coronary artery disease; CKD: Chronic kidney disease (includes diabetic and non-diabetic CKD); DBP: Diastolic blood pressure; SBP: Systolic blood pressure; TIA: Transient ischemic attack. *Refers to patient with previous stroke and does not refer to blood pressure targets immediately after acute stroke.

**Conclusion**

Aging is an inevitable event and hypertension in the old is a complex issue to manage. However, studies have shown that it is safe to treat hypertension in this population with individualization of therapy and careful monitoring and that it is safe to treat hypertension in older patients who are frail and independent.

Table 1 shows the recommended targets of BP, but it needs to be appreciated that any amount of BP lowering is likely to reduce the risk of major CV events (especially stroke and heart failure) and mortality.

The recommendations by ESC/ESH in their 2018 guidelines are shown in Table 1.

**References**


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