

EDITORIAL

Standing Up for Frailty: Blood Pressure Changes Do Matter

Maw Pin Tan , BMBS, MD

It has been 140 years since the sphygmomanometer was invented by Samuel Siegfried Karl Ritter von Basch, making it possible to measure blood pressure. Today, manual sphygmomanometers have now largely been replaced by automated oscillometric versions, for not just the clinic but also the home. In addition, ambulatory versions that are able to obtain automated measurements at regular intervals, usually 15 to 30 minutes during the day and 30 to 60 minutes at night, allow for more frequent recording, providing us with a 24-hour blood pressure profile that now often guides therapy choice.

See Article by Mol et al.

Although the focus has been to develop increasingly portable and user-friendly versions of the sphygmomanometer to allow for more frequent measurements either at home or in the clinic, these remain devices that are only able to capture snapshots of blood pressure without taking into account the fact that blood pressure does vary with each heartbeat. We are still largely treating hypertension on the basis of these snapshot measurements. Portable and accessible technology that is able to record accurate beat-to-beat blood pressure noninvasively remains largely elusive to most physicians, with only selected centers in possession of equipment capable of this technology.¹

The limited advances in clinical availability of equipment that produces more than just snapshot measurements have more or less led to the current confusion

on the implication of orthostatic hypotension (OH), let alone the actual diagnostic criteria for OH. All but a few published studies to date have used oscillometric measurement methods to obtain snapshot measurements in the supine position, followed by single measurements obtained within 3 minutes of the patient standing up.² Such methods of measurements will end up missing significant blood pressure decreases, which occur at times outside the point the single measurement is taken. With the advent of noninvasive beat-to-beat blood pressure measurement technology, which has yet to become widely available in clinical practice, the long-standing definition of a decrease in systolic blood pressure of 20 mm Hg or diastolic blood pressure of 10 mm Hg with standing is now being challenged, with a revised definition suggesting “sustained” reductions are needed before OH can be diagnosed (classic OH), because using beat-to-beat technology, transient decreases exceeding 20 mm Hg systolic and 10 mm Hg diastolic are present in a large number of individuals with no reported symptoms.³ In addition, the new consensus committee also added in the diagnostic criteria for initial OH, which requires a decrease of at least 40 mm Hg systolic and 20 mm Hg diastolic within 15 seconds of standing.

The clinical relevance of determining the presence of OH would be to identify a potential underlying cause for dizziness, falls, or syncope, which could be attributed to underlying autonomic neuropathy, hypovolemia, or medications. As clinics generally use oscillometric measurements, the presence of a documented decrease that fulfils current criteria for classical

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Correspondence to: Maw Pin Tan, BMBS, MD, Department of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia. E-mail: mptan@ummc.edu.my
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OH may not be relevant to the clinical presentation, with clinicians prompted to also rule out other attributable causes unless the magnitude of decrease is too large or the patient reports reproduction of symptoms. However, the risk of OH, falls, and syncope all increase with age, with nonspecific presentations often complicating the diagnostic process. Specifically, the older adult may have a lack of awareness of hypotensive symptoms, hence challenging the diagnostic relevance of symptom reproduction in this age group.⁴ Furthermore, the presence of hypotensive disorders and the magnitude of postural decrease have been linked to the volume of deep white matter hyperintensities on magnetic resonance imaging, suggesting a possible link between transient decreases in blood pressure and cognitive disorders.⁵

In this issue of the *Journal of the American Heart Association (JAHA)*, Mol et al⁶ have suggested a new approach to evaluating orthostatic blood pressure decrease as well as new clinical implications for changes in blood pressure with alterations in posture. Using non-invasive, beat-to-beat blood pressure measurements obtained during posture change, the authors identified not only the magnitude of blood pressure decrease with standing up from the supine position, but additionally calculated the rate of decrease, and separated these parameters into changes that occur in the first 15 seconds of standing and in the remaining 2 minutes 45 seconds of standing (15–180 seconds). Their study found that the rate of decrease in systolic blood pressure over all 3 minutes of standing was associated with the number of falls in the preceding year established through retrospective recall. Interestingly, the researchers also evaluated frailty using the Fried's phenotype as well as 4 frailty markers and found a significant association between frailty and the rate of systolic blood pressure decrease within 15 seconds of standing. The above study was conducted within a geriatric clinic.

The implications of a quicker rate of decrease in blood pressure immediately after standing in frail older people and the mechanisms underlying this relationship are unclear. A previous study has suggested an association between initial OH and frailty among older patients recruited from a falls and blackout clinic.⁷ A subsequent study conducted in a community-dwelling older population in a different continent, however, found the converse, with the presence of initial OH being associated with better cognitive scores and physical performance.⁸ The difference in observation obtained between the studies of Mol et al⁶ and Romero-Ortuno et al⁷ and the study of Saedon et al⁹ is in the study population. The former 2 studies evaluated older individuals attending outpatients specifically designed to accommodate older people, whereas the latter study involved primarily community-dwelling older adults. In addition, there may also be regional variations in this

relationship, suggesting that the clinical manifestations of initial OH may differ between Europe and Asia.

Deductively, a quicker decrease in blood pressure with standing may reflect defective baroreceptor control, with reduced or delayed heart rate and vasomotor responses.⁹ However, a slower decrease in blood pressure with standing may also be indicative of stiffer arteries, with a higher risk of concomitant cardiovascular disease.¹⁰ Individuals who present to the geriatric clinic who are frail are also likely to be sarcopenic, with a reduction in muscle pump to facilitate venous return.¹¹

Cerebral blood flow is said to be kept constant with changes in blood pressure within an autoregulatory range, a mechanism termed cerebral autoregulation. Therefore, unless the speed of blood pressure response or the magnitude of blood pressure reduction exceeds the cerebral regulatory capacity or range, no consequence to changes in blood pressure should be expected should cerebral autoregulation remain intact. It is, therefore, plausible that in older people presenting with falls in the geriatrics or falls and blackouts clinic, cerebral autoregulation is more likely to be impaired.¹² Hence, both rate and magnitude of blood pressure decrease would be related to increased risk of falls. Cerebral autoregulatory capacity is said to be controlled by hormonal, autonomic, and myogenic mechanisms. Although these mechanisms are poorly understood, cerebral autoregulation may become impaired in older individuals with frailty, which is associated with impaired hormonal, autonomic, and myogenic responses.¹³ The consequences of impaired cerebral autoregulation, including intermittent reduction in cerebral perfusion and falls, then in turn contribute to progressive frailty.

Conversely, in the general, community-dwelling older population, which consists mainly of more robust individuals, the magnitude and speed of fluctuations in blood pressure may be preferentially influenced by arterial wall elasticity, which, in turn, is a measure of atherosclerotic disease and cardiovascular risk. The relative contribution of impaired cerebral autoregulation in the general older population toward falls and frailty may, therefore, be lower than arterial stiffness. Initial OH and classic OH in the general population with primarily intact cerebral autoregulation, therefore, indicate a reduced cardiovascular risk, hence better cognitive and physical function.

Much has yet to be discovered on the patterns of blood pressure fluctuations that occur spontaneously and blood pressure responses to various challenges, including but not exclusive to posture change. Unfortunately, few investigators world wide currently possess either expertise or resources to explore this field. In addition to falls and frailty, blood pressure control mechanisms and fluctuations are also likely to be relevant to cognition, cardiovascular disease risk, and other end-organ conditions.¹⁰ Furthermore, with increasing

use of vasoactive agents in the treatment of chronic disease, our blood pressure control mechanisms are being increasingly challenged. In fact, published research exposing potential risk of overzealous treatment, such as syncope and dementia, with aggressive blood pressure lowering in older patients is now emerging.¹⁴

To enable progress in this field of research, improvements in technology to measure blood pressure noninvasively and new analytical approaches informed by those with both clinical and scientific knowledge in this area are urgently required. A better grasp of the interplay between blood pressure fluctuations, cerebral autoregulation and falls, frailty, and cognitive outcomes may well be an important piece of the jigsaw puzzle of age-related decline.

ARTICLE INFORMATION

Affiliations

From the Department of Medicine, University of Malaya, Kuala Lumpur; Department of Medical Science, Faculty of Healthcare and Medical Sciences, Sunway University, Bandar Sunway, Malaysia.

Disclosures

None.

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