Letters to the Editor

Terminology for Describing the Elastic Behavior of Arteries

To the Editor:

Gosling and Budge\(^1\) are to be commended on their call for simplification of the indices presently used to quantify arterial stiffness. This important subject is made almost incomprehensible to clinicians through the myriad of indices used by different authors.\(^2\) Conceptual difficulties are compounded by the seemingly conflicting results published for different diseases, physiological maneuvers, and drug therapies. Some of these are related to the nonlinearities and inhomogeneities illustrated by Gosling and Budge, but some result from lack of attention to fundamental instrumental measurements\(^2\) together with basic arithmetical errors.\(^3,4\)

Clinicians dealing with hypertension, aging, and cardiovascular complications need know how arterial stiffening affects the blood pressure they are measuring, the diseases they are treating or seeking to prevent, and their patients’ prognosis. They also seek to know how they can most logically utilize therapy to offset ill effects of stiffening in individual patients.

Safar et al\(^5\) have proposed that clinical questions can largely be satisfied by three indices: (1) aortic pulse wave velocity as a measure of aortic degeneration and stiffening (which is relatively independent of drug effect); (2) central arterial pressure augmentation (which is due to early wave reflection and a target for vasodilator drug therapy); and (3) central aortic systolic and pulse pressure (which are indices respectively of left ventricular load, and stress on coronary, carotid, cerebral, and other central arteries). All three indices are predictive of cardiovascular events, independent of conventional risk factors.\(^5\)

Such an approach accords with the core principles of the most recent consensus document on this issue\(^2\) and with European Society of Cardiology/European Society of Hypertension guidelines for assessment of target organ damage in hypertensive persons. It is practical for clinicians and avoids unnecessary complexities of physics and the detailed minutiae of arterial pathology.

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Response: Terminology for Describing the Elastic Behavior of Arteries

We are glad that Seward and O’Rourke agree that there has been a “myriad of indices” used by different authors to quantify arterial mechanical properties and that this is confusing to clinicians. They appear, however, to stop short of accepting our proposal that use of the terms strain, elastic modulus, or compressibility\(^1\) would put an end to the variable use of the terms arterial compliance and distensibility. Our primary objective was to address the current confused use of definitions and terminology in order to offer a starting point for further exploration.

Inevitably, this leads to a dialogue about the choice of parameters for clinical use derived from arterial examination via multiple available modalities. This choice requires a consideration of whether (1) these arterial parameters are equally accessible, reproducible, and explanatory in different applications (eg, description of the pathophysiology of cardiovascular changes with aging and disease, stratification of risk, and monitoring of treatment); (2) concerns about the noninvasive measurement of these parameters\(^2\) can be settled; (3) parameters of arterial stiffness would currently only be widely adopted if considered in conjunction with the longer-accepted measures of blood pressure; and (4) they offer advantage singly, or in combination, over echocardiographic or neurohormonal markers of cardiovascular status.

Seward and O’Rourke propose that 3 indices, mentioned within a thoughtful review by Safar et al,\(^5\) can largely satisfy clinicians’ needs in the management of cardiovascular diseases: aortic pulse wave velocity (PWV), central arterial pressure augmentation, and aortic systolic and pulse pressure. The latter two offer information that is potentially uniquely useful—especially if current noninvasive methods for their estimation are deemed to be sufficiently robust reflections of intra-arterial measurement. However, we believe, like others,\(^2,5\) that for practical and theoretical reasons the expression of arterial stiffness in terms of aortic PWV values alone may not be ideal.

If speculation is in order, we would offer one alternative by suggesting that the aortic oscillatory strain (AOS=elastic compressibility\(^1\)×half the pulse pressure), combining as it does pulse pressure and arterial stiffness, may be a most useful single parameter to monitor the management of aging adults with cardiovascular diseases.\(^6\)

We believe that the imperfect tools currently at our disposal, often in inexpert hands, suggest a pragmatic utility of the careful measurement of the 3 arterial parameters highlighted by Seward and O’Rourke. However, a quest for superior alternatives or combinations thereof should proceed in parallel with greater exploration of aging–disease–risk relationships. Meanwhile, we would plead for authors to include rigorous description of methods and instrument characteristics so that clinical and experimental colleagues may work together to progress this important evolution.

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