Proximal Aortic Diameter and Aortic Pressure-Flow Relationship in Systolic Hypertension

To the Editor:

Mitchell et al.1 promote a controversial view that elevated pulse pressure in systolic hypertension of older subjects is attributable to decreased diameter and elevated characteristic impedance (stiffness) of the ascending aorta. They further propose that drugs such as omapatrilat can reduce aortic stiffness directly and thereby provide effective treatment of systolic hypertension.1,2 The prevailing view is that systolic hypertension is largely due to early return of wave reflection, is associated with degeneration and dilation of the proximal aorta, and is best treated by reduction in peripheral wave reflection by vasodilator drugs.3,4

The authors did not provide measured aortic diameter or aortic pressure/flow relationships, yet they referred to both in the title of their article. They used surrogates of aortic diameter and pressure. Although their protocol entailed ultrasonic measurements of flow velocity and diameter in the ascending aorta for calculation of volumetric flow (their Tables 2 to 5), the actual measured diameter was not stated. Instead, a convoluted process was applied whereby carotid (not aortic) pressure was related to aortic volumetric flow for calculation of “aortic” characteristic impedance; this was then compared with carotid/femoral pulse-wave velocity using the Waterhammer formula to obtain a value of “effective aortic diameter.” The Waterhammer formula is only valid in a reflectionless system and must have pressure and flow measured at the same site and pulse-wave velocity measured locally.1 Given the errors inherent in indirect measurements and the theoretic requirement to measure impedance and wave velocity at the same site, one wonders why such a complex indirect method was applied when aortic diameter had to be measured directly in the first place.

Mitchell et al stressed reduction of effective aortic diameter in hypertensive patients. Their patients (78 male, 50 female) and controls (19 male, 11 female) differed markedly in size. When aortic diameter was expressed in relation to body surface area as in the National Institute of Aging studies of Lakatta,5 values were similar (1.48, 1.41, 1.45, and 1.43 cm/m², respectively) and within the normal range. We favor the existing view, which is based on a host of direct measurements in large cohorts by different groups, and which conforms to mechanical principles and large epidemiological studies. We also favor scaling of body size by comparing pressure to pulsatile flow velocity so that characteristic impedance can be directly related to pulse-wave velocity as an index of arterial stiffness.3

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