Noninvasive Input Impedance of the Human Systemic Circulation

To the Editor:

The study of noninvasive aortic input impedance by Segers et al\textsuperscript{1} is a very important step in understanding age-related changes in humans and an advance on previous limited invasive studies conducted decades ago.\textsuperscript{2,3} One reason that these lapsed was the difficulty in accurately measuring aortic pulsatile flow, attributable to turbulence in the left ventricular outflow tract (LVOT) and proximal aorta. Subsequent emphasis was placed on pressure waveforms\textsuperscript{2,3} after introduction of high fidelity manometers\textsuperscript{2} and tonometers\textsuperscript{3} for noninvasive studies.

Segers et al present baseline data for a longitudinal study; long-term information is eagerly awaited. We offer the following explanations for major findings.

1. Fluctuations in modulus and phase of aortic impedance at all ages and both sexes are remarkably consistent and similar to previous invasive studies, and can only be explained on the basis of strong wave reflection.

2. The most obvious and consistent aging changes in this cohort were the simplest to measure (PWV and AIx) and are determined from pressure waveforms alone, using noninvasive tonometry.

3. Segers et al\textsuperscript{1} measured flow velocity and diameter in the LVOT, where the physical and geometric characteristics are much different from the elastic aorta beyond. Measures of compliance or characteristic impedance (Zc) in the LVOT are not necessarily applicable to the wider elastic aorta. Authors found no change (in females) and a fall (in males) of Zc with age, despite increases in aortic PWV with age in both sexes. Such discrepancy has previously been noted in the aorta and pulmonary artery\textsuperscript{3,4} and readily explained on the basis of aortic dilation with age (or pulmonary artery dilation with increasing pressure). In all situations there is a constant relationship between PWV and Zc when this is expressed in terms of linear flow velocity. Authors did not measure aortic diameter so could not calculate aortic Zc.

4. Authors discuss relative importance of changes in incident and reflected waves with aging. The incident wave is of necessity greater than the reflected wave. However, as age advances, the reflected wave contributes more to total amplitude of the wave, at least up to 60 years of age. There is no other way to explain the dramatic and consistent increase in AIx in this large cohort.

5. Data presented by Segers et al\textsuperscript{1} support the view that arterial stiffness, arterial diameter, and wave reflection increase with advancing age.\textsuperscript{5}

Disclosures

M.F.O. is a founding director of AtCor Medical, manufacturer of pulse wave analysis systems. W.N. is a consultant to AtCor Medical Pty Ltd. J.M. served as an expert witness for the plaintiff in Hendley et al vs the McIntosh Clinic, P.C. Superior Court of Thomas City, Ga.

Michael F. O’Rourke
St. Vincent’s Clinic/University of New South Wales
Sydney, Australia

Wilmer W. Nichols
Department of Cardiovascular Medicine
University of Florida
Gainesville, Fla

Joseph P. Murgo
Central Cardiovascular Institute of San Antonio
University of Texas Health Science Center
San Antonio, Tex


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Michael F. O’Rourke, Wilmer W. Nichols and Joseph P. Murgo

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