

“Impedance Matching” Between The Aorta And Large Muscular Arteries? Misinterpretation of Pulse Wave Velocity Gradients

Timothy S. Phan^a, John K-J. Li^a, Izzah Vasim^b, Zoubair Ahmed^b, Maheshwara R. Koppula^c, Julio A. Chirinos^c

^a Rutgers University, Piscataway, NJ, USA

^b Philadelphia VA Medical Center, Philadelphia, PA, USA

^c University of Pennsylvania, Philadelphia, PA, USA

Background: Given the increase in carotid-femoral Pulse Wave Velocity (cfPWV) with aging, without an increase in carotid-radial PWV (CR-PWV), some investigators have suggested an age-related “impedance matching” between the aorta and large muscular arteries, leading to a reduction of reflections arriving at the proximal aorta and a distal shift in reflection sites. However, characteristic impedance is much more sensitive to diameter than wall stiffness and PWV “matching” should not be equated to “impedance matching”. If PWV “matching” indeed produces a distal shift of reflection sites, it should be related to a greater reflected wave transit time (RWTT) for any given PWV.

Methods: Central pressure and flow waveforms were measured noninvasively using carotid tonometry and phase-contrast MRI, respectively, along with cfPWV and CR-PWV (n=175; mean age 62 years). Reflected wave transit time was calculated using (1) wave separation analysis (RWTT_{WSA}); (2) partially distributed modeling of the arterial system (RWTT_{TUBE}). The “matching” of large artery and muscular artery PWV was calculated as the difference (“gradient”) between CR-PWV and cfPWV.

Results: The PWV gradient was not related to RWTT computed with either WSA or partially distributed model of the arterial system (table). Similarly, this gradient was not related to the reflection coefficient measured at the proximal aorta. Distributed modeling demonstrated that RWTT occurs earlier with aging, in tandem with increases in PWV, therefore not supporting a “distal shift” in reflection sites, but rather supporting the logical presence of earlier wave reflections.

Conclusion: As dictated by well-established theoretical principles, impedance matching that determines reflection sites is defined by gradients of impedances, and not of PWVs. The controversial proposition of “impedance matching” and distal shift of reflection sites with aging is therefore not supported by either theoretical or experimental observations. Equating “PWV matching” to “impedance matching” can result in important misinterpretations of reflection phenomena.

	Predictors of RWTT_{WSA}	Predictors of RWTT_{TUBE}
Age	-0.110 (P=ns)	-0.280 (P=0.008)
Sex	0.018 (P=ns)	0.000 (P=ns)
cfPWV	0.232 (P=ns)	-0.169 (P=ns)
ΔPWV	0.282 (P=ns)	0.146 (P=ns)
Height	0.157 (P=ns)	0.210 (P=0.046)

Table. All values are standardized coefficients. Significance level is set at 0.05.