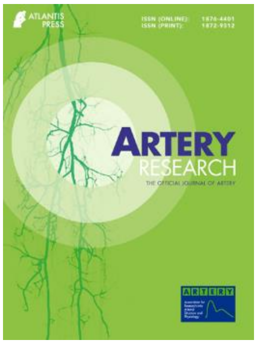

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S.S. Hickson, M. Butlin, M. Graves, I.B. Wilkinson, C.M. McEniery

5.4
THE REPEATABILITY AND VALIDITY OF PULSE WAVE VELOCITY MEASURED USING PHASE CONTRAST MAGNETIC RESONANCE IMAGING

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Background: Aortic pulse wave velocity (PWV) is an independent predictor of cardiovascular risk. Phase contrast magnetic resonance imaging (PCMRI) is a recent technique that allows PWV to be measured along the entire aorta ($aPWV_{MRI}$), as well as in regions of interest. The aim of this study was to test the repeatability of PWV assessed by MRI, and to validate this against carotid-femoral PWV using the Vicorder device ($PWV_{Vicorder}$) measured simultaneously to $aPWV_{MRI}$.
Methods: 147 subjects aged 18-85 years were recruited from the ACCT and ENIGMA Studies. All subjects were free of cardiovascular disease and medication. A PCMRI sequence (1.5T scanner, GE) was performed at two sites (1cm above the aortic valve, and 3cm above the aortic bifurcation) to determine $aPWV_{MRI}$. Brachial supine blood pressure and $PWV_{Vicorder}$ were measured in the scanner simultaneous to image acquisition. Repeatability of PWV_{MRI} was assessed across 2 visits, in a subset of 10 subjects.
Results: PWV_{MRI} showed good repeatability (mean difference = -0.4±2.1m/s). There was a strong correlation between $aPWV_{MRI}$ and $PWV_{Vicorder}$ (R=0.64, P<0.001), although, overall, $aPWV_{MRI}$ was significantly lower than $PWV_{Vicorder}$ (5.7±1.8 vs. 7.1±1.4m/s, P<0.001).
Conclusions: Measurements of PWV using PCMRI are reproducible and correlate with simultaneously measured carotid-femoral PWV.

5.5
DOES BEHAVIOUR OF THE REFLECTED WAVE IN HUMANS SUPPORT THE PREVAILING EXPLANATION OF THE ARTERIAL PRESSURE WAVEFORM?

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Background: It is widely believed that changes in the magnitude and timing of reflected waves reaching the heart result in deleterious cardiovascular effects. Inherent in this is the assumption that waves propagate well in the backward direction. There is limited information regarding retrograde travel of the reflected wave from an imposed occlusion. We investigated this.
Methods: In this study, 20 subjects (age 31-83 years), underwent invasive measurement of pressure & Doppler velocity with sensor-tipped intra-arterial wires placed in the aorta, iliac artery and femoral artery. An external cuff was inflated to occlude one femoral artery, creating a site of total reflection and the effect of this assessed. Separated wave intensity analysis was used to identify and quantify incident and reflected waves. Wave reflection index (WRI) expresses the backward compression wave as a percentage of the incident forward compression wave.
Results: The additional reflection (evident by statistically significant increase in WRI and earlier arrival of the reflected wave) generated in the femoral artery by femoral occlusion was not visible in the proximal aorta. Furthermore, the reflected wave in the proximal aorta occurred in systole in all subjects, much earlier than is widely proposed.
Conclusion: A reflection arising from an occlusion is wholly attenuated by the time it reaches the proximal aorta. This lack of retrograde travel could account for the limited reflection in the proximal aorta and prompts review of our understanding of the mechanisms underlying blood pressure augmentation.

5.6
QUANTIFICATION OF BOTH SYSTOLIC AND DIASTOLIC LOCAL ARTERIAL STIFFNESS IMPROVES IDENTIFICATION OF ARTERIAL STIFFENING WITH NORMAL AGING

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Background: We hypothesized that the discrepancy between local and global stiffness is explained by 1) differences in systolic and diastolic stiffness and 2) the co-existence of elastic and muscular arteries in the carotid-femoral trajectory.
Methods: For 1515 subjects (age 35-55, Asklepios cohort) we derived carotid-femoral pulse wave velocity (aoPWV) at diastolic blood pressure and determined carotid and femoral diastolic and systolic distensibility, using the dicrotic notch as cut-off, converted to local PWV using the Bramwell-Hill equation. We evaluated linear regressions of the local measures with brachial systolic blood pressure (SBP), aoPWV and age.
Results (Table): AoPWV increased with SBP at an intermediate rate compared to carotid and femoral diastolic stiffness. Femoral artery PWV increased stronger with aoPWV than carotid PWV (p=0.0006). Interestingly, diastolic and systolic carotid PWV were differentially related to aoPWV, while femoral diastolic and systolic PWV were not. On average, carotid PWV increased faster with age than femoral PWV (p=0.028). Femoral diastolic and systolic PWV did not show a differential increase with age. In contrast, carotid systolic PWV increased twice as fast with age than diastolic PWV.
Conclusion: In middle-aged healthy individuals, global stiffness as expressed by aoPWV is stronger determined by muscular than elastic artery stiffness. Changes in arterial stiffness with age are most strongly reflected in elastic arteries in the systolic pressure range.

PWV		mean ± SD	increase with SBP	increase with aoPWV	increase with age
carotid	dia	5.8 ± 1.0	3.0	0.15	6.7
	sys	10.0 ± 1.9 #	6.0 #	0.25 §	11.8 #
femoral	dia	8.2 ± 2.3	6.4	0.43	4.3
	sys	10.6 ± 3.0 #	8.2 §	0.55 ¥	5.2 ¥
aortic	dia	7.3 ± 1.4	4.7	-	7.7
		m/s	$cm \cdot s^{-1} \cdot yr^{-1}$	-	$cm \cdot s^{-1} \cdot mmHg^{-1}$

Systolic vs. diastolic: # p<0.0001, § p<0.009, ¥ non-significant.