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

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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), 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
camer) measured simultaneously to aPWV.

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. Brachial supine blood pressure and PWV
r were measured in the scanner simultaneous to image acquisition. Repeatability of PWV was assessed across 2 visits, in a subset of 10 subjects.

Results: aPWV showed good repeatability (mean difference = -0.4 ± 2.1 m/s). There was a strong correlation between aPWV and PWV
r (R = 0.64, P < 0.001), although, overall, aPWV was significantly lower than PWV
r (5.7 ± 1.8 vs. 7.1 ± 1.4 m/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. However, 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 occlusion. Wire placed in the aorta, iliac artery and femoral artery. An external cuff was inflated to occlude one femoral artery, creating a site of total occlusion. Wave intensity analysis of the reflected wave from an imposed occlusion. We investigated this.

Conclusions: In middle-aged healthy individuals, global stiffness as expressed by aPWV 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.

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 aPWV 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.

<table>
<thead>
<tr>
<th>PWV</th>
<th>mean ± SD</th>
<th>Increase with SBP</th>
<th>Increase with aoPWV</th>
<th>Increase with age</th>
</tr>
</thead>
<tbody>
<tr>
<td>carotid dia</td>
<td>5.8 ± 1.0</td>
<td>3.0</td>
<td>0.15</td>
<td>6.7</td>
</tr>
<tr>
<td>sys</td>
<td>10.0 ± 1.9</td>
<td>6.0</td>
<td>0.25*</td>
<td>11.8*</td>
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<tr>
<td>femoral dia</td>
<td>8.2 ± 2.3</td>
<td>6.4</td>
<td>0.43</td>
<td>4.3</td>
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<tr>
<td>sys</td>
<td>10.6 ± 3.0</td>
<td>8.2</td>
<td>0.55*</td>
<td>5.2*</td>
</tr>
<tr>
<td>aortic dia</td>
<td>7.3 ± 1.4</td>
<td>4.7</td>
<td>-</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>m/s</td>
<td>cm·s⁻¹·yr⁻¹</td>
<td>-</td>
<td>cm·s⁻¹·mmHg⁻¹</td>
</tr>
</tbody>
</table>

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