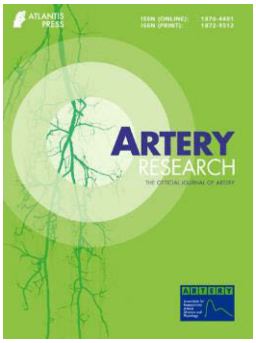

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P51: NON-CONTACT MEASUREMENT OF LOCAL CAROTID AND CAROTID-FEMORAL PULSE WAVE VELOCITY BY LASER DOPPLER VIBROMETRY: VALIDATION OF A NEW DEVICE AGAINST REFERENCE TECHNIQUES IN HYPERTENSIVE PATIENTS

Louise Marais, Soren Aasmul, Roel Baets, Mirko De Melis, Stephen E. Greenwald, Hakim Khettab, Yanlu Li, Frits Prinzen, Koen Reesink, Patrick Segers, Pierre Boutouyrie

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Table 1. MRI and US measurements of D, U and PWV. Data are means ± standard deviations (n=8).

	Min D (cm)	Max D (cm)	Min U (m/s)	Max U (m/s)	PWV (m/s)
MRI	2.5±0.4	3.0±0.3	0.1±0.0	0.9±0.2	3.5±0.8
US	2.4±0.2	2.8±0.2	0.3±0.1	1.1±0.2	3.6±1.0

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NON-CONTACT MEASUREMENT OF LOCAL CAROTID AND CAROTID-FEMORAL PULSE WAVE VELOCITY BY LASER DOPPLER VIBROMETRY: VALIDATION OF A NEW DEVICE AGAINST REFERENCE TECHNIQUES IN HYPERTENSIVE PATIENTS

Louise Marais [1], Soren Aasmul [2], Roel Baets [3], Mirko De Melis [2], Stephen E. Greenwald [4], Hakim Khettab [1], Yanlu Li [3], Frits Prinzen [5], Koen Reesink [5], Patrick Segers [6], Pierre Boutouyrie [1]
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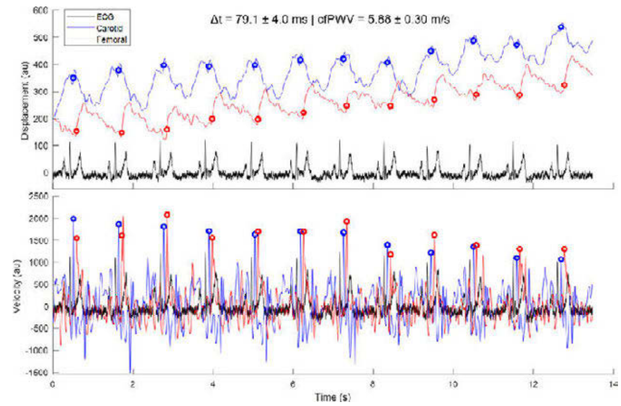
Objective: PWV measurement devices are technically demanding, expensive and prone to artefacts, thus limiting the measurement of arterial stiffness in primary care. The CARDIS consortium developed a non-contact device based on the detection of skin movements induced by arterial pulses through a laser Doppler vibrometer (CARDIS-LDV). Our objective is to validate CARDIS-LDV against reference techniques.
Methods: This study sponsored by INSERM will include 100 essential hypertensives, males and females, grade I—III, aged 18—80. The CARDIS-LDV comprises two rows of 6 laser beams spaced 5 mm (2.5 cm wide). These rows are either situated 2.5 cm apart for local PWV measurement or can be split in two for carotid to femoral measurement. To calculate PWV, the time delay between the two rows is assessed by analyzing the corresponding skin displacement signals. Aortic stiffness is measured by the Sphygmocor® technique and carotid stiffness by echotracking ArtLab®
Results: Measurements by CARDIS-LDV are easy and fast to perform. A simple palpation of pulse is enough to position the device and obtain good signals thanks to the 6-beam array. Figure 1 shows an example of a carotid-femoral recording on a healthy volunteer (age 28). PWV is 5.88 ± 0.30 m/s using the maximum of 1st derivative method, compared with 5.96 ± 0.40 m/s with tonometry. Data on larger sample size will be presented at the meeting.
Conclusion: CARDIS-LDV is a promising technique to assess arterial stiffness; we expect to demonstrate its good agreement with reference techniques and that it improves the screening of cardiovascular risk in large populations.



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ESTIMATING CENTRAL BLOOD PRESSURE FROM MRI DATA USING REDUCED-ORDER COMPUTATIONAL MODELS

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Purpose: Central Blood Pressure (CBP) is a better cardiovascular risk indicator than brachial pressure [1]. However, gold standard CBP measurements require an invasive catheter. We propose an approach to estimate CBP non-invasively from Magnetic Resonance Imaging (MRI) data coupled with a non-invasive brachial pressure measurement, using reduced-order (0-D/1-D) computational models. Our objectives were: identifying optimum model parameter estimation methods and comparing the performance of 0-D/1-D models for estimating CBP.
Methods: Populations of virtual (simulated) healthy subjects were generated based on [2]. Pressure and flow waveforms from these populations were used to develop and test Methods: for estimating model parameters. Two common clinical scenarios were considered: when a brachial pressure waveform is available; and when only systolic and diastolic blood pressures are available. Optimal parameter estimation Methods: were identified for each scenario and used with two 0-D Windkessel models and a 1-D aortic model. Results were compared with invasive CBP in a post-coarctation repair population (n = 10).
Results: Model parameters were best estimated by: fitting an exponential to the pressure waveform to estimate compliance and outflow pressure; using the least-squares method to estimate pulse wave velocity from flow data; assuming characteristic impedance was 5% of arterial resistance; and estimating end-systolic time from the second derivative of the pressure waveform. Average pulse and systolic CBP errors were <5 mmHg and <2 mmHg, respectively.
Conclusions: We have demonstrated the feasibility of estimating CBP from MRI and brachial pressure. Different reduced-order models provided similar performance, although the 1-D model reproduced pressure waveform morphology more accurately.

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