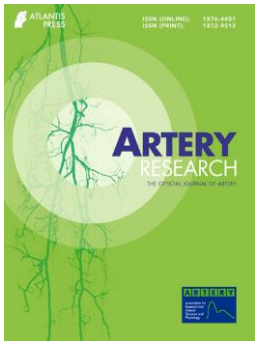

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P8.4: NON-INVASIVE ASSESSMENT OF LOCAL PULSE WAVE VELOCITY USING ELECTROMECHANICAL SENSORS: FEASIBILITY STUDY IN A HEALTHY POPULATION

H. Pereira, T. Pereira, J. Maldonado, T. Pereira, V. Almeida, J. Simões, J. Cardoso, C. Correia

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maladaptive remodeling, suggesting lower efficacy of conventional treatment on this vascular feature.

P8.3
AORTIC FLOW ALTERATIONS IN DILATED AND HYPERTROPHIC CARDIOMYOPATHY: NEW INSIGHT FROM QUANTITATIVE FLOW MRI

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Aims: Aortic structural and hemodynamic alterations have deleterious effects on the left ventricle (LV). Our aims were to: 1) design indices of ascending aorta (AA) flow from MRI data and 2) assess changes in such indices in dilated (DCM) and hypertrophic (HCM) cardiomyopathies.
Methods: We studied 17 DCM (53±11years) and 15 HCM patients (56±16years) matched for age with 34 controls (53±10years). MRI AA through-plane velocities were automatically segmented to estimate flow curves throughout the cardiac cycle. Then, indices reflecting flow curves changes during the late systolic deceleration time interval (DT) were derived: a) $T_{1/2}$: the time interval required for flow deceleration to reach half of its systolic peak, in percentage of DT, and b) $DR_{1/2}$: the decrease in flow during half of DT, in percentage of systolic peak.
Results: $T_{1/2}$ was 56.3±6.6% and $DR_{1/2}$ was 43.5±6.5% in controls. AA flow waveform during late-systole changes significantly in cardiomyopathies. Indeed, while it tends to be steeper in HCM as reflected by significant ($p<0.001$) decrease in $T_{1/2}$ (43.1±17.3%) and increase in $DR_{1/2}$ (54.9±16.1%), it tends to be flat in DCM as reflected by significant ($p<0.001$) increase in $T_{1/2}$ (68.2±6.7%) and decrease in $DR_{1/2}$ (31.6±7.8%). Furthermore, such differences remained significant while accounting for gender, BMI and heart-rate (MANOVA).
Conclusion: We found significant changes in AA flow patterns in the presence of cardiomyopathies, reflecting changes in both LV contractile capacity and aortic cushioning. Such aortic indices might be of major usefulness in pathologies associating aortic stiffening with LV hypertrophy such as hypertension.

P8.4
NON-INVASIVE ASSESSMENT OF LOCAL PULSE WAVE VELOCITY USING ELECTROMECHANICAL SENSORS: FEASIBILITY STUDY IN A HEALTHY POPULATION

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The assessment of local hemodynamics, namely in the carotid artery, has recently gained clinical relevance due to its significance in the development of coronary and cerebrovascular diseases. Local pulse wave velocity (PWV) constitutes one of the most important indices in carotid stiffness evaluation, but currently available devices require high technical expertise and specialized imaging technologies.
This paper proposes two novel electromechanical double headed probes for non-invasive measurement of local PWV. The PWV is assessed in a single location and implies the determination of the time delay between the signals acquired simultaneously by either two acoustic or two piezoelectric sensors, namely placed 11 mm and 15 mm apart, at the carotid site.
The acoustic probe (AP) and the piezoelectric probe (PZP) were tested in 20 healthy volunteers aged 22.12 ± 1.96 years. Carotid PWV along with other time-based hemodynamic parameters were estimated. The values were also compared with carotid-femoral PWV measurements using a Complior device.
The mean local PWVs obtained were lower than those achieved in other studies, exhibiting values of 3.05 ± 0.96 ms-1 for the AP and 3.01 ± 0.77 ms-1 for the PZP. These results demonstrated that AP and PZP PWVs were linearly correlated, presenting a significant and strong relationship ($R=0.76$, $p<0.01$). Contrarily, these values were non-statistically significant with Complior PWV, presenting negative and very weak relationships ($p>0.05$).
Although studies will be extended to a more significant number of patients to differentiate between ages and healthy/non-healthy groups, these probes appear to be promising alternatives to local PWV stand-alone devices.

P8.5
EVALUATION OF VALVULOARTERIAL IMPEDANCE IN AORTIC VALVE STENOSIS BY USING CARDIAC MAGNETIC RESONANCE AND CAROTID ARTERY TONOMETRY

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In aortic valve stenosis (AVS), valvuloarterial impedance (Zva), as left ventricle (LV) afterload estimation, has been proposed in echocardiography (TTE) to predict adverse outcome better than conventional parameters such as aortic valve area (AVA). However its calculation method differs from standard temporal arterial characteristic impedance (Zc) assessment. The aim of our study was to apply the Zc concept of measurements to estimate Zva by using phase contrast magnetic resonance (PC-MR) and carotid tonometry.
Methods: 40 patients (76±13 years, 21 males) underwent MR with carotid tonometry and TTE.
-Zva-TTE was assessed with brachial systolic arterial pressure, TTE transvalvular mean gradient and stroke volume index to body surface area.
-Zva-MR was assessed with pressure waveform from carotid tonometry, transvalvular pressure gradient and Flow waveform on LV outflow track from PC-MR.
These methods were evaluated by comparing their links with diastolic dysfunction estimated by TTE E/Ea ratio.
Results: Zva values were higher in symptomatic patients using both TTE and MR. In univariate analysis, only Zva-MR was correlated with E/Ea ($r=0,5$, $p=0,001$).
In multivariate analysis of determinants of E/Ea, a significant model including age, Mean blood pressure, LV ejection fraction, LV mass and AVA was obtained ($R2=0,41$; $p<0,01$).When Zva-MR was included, the overall significance of the model was higher ($R2=0,56$;$p<0,01$). Only Zva-MR and LV Mass remained independently correlated to E/Ea.
Conclusions: By using MR in association with carotid tonometry, the calculation of Zva is feasible and can improve LV afterload assessment in AVS. This new way to estimate Zva may be clinically useful in patients evaluation.

P8.6
COMPARISON OF TRANSIT TIME ESTIMATION METHODS FOR THE DETERMINATION OF PULSE WAVE VELOCITY

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Pulse wave velocity (PWV) has been shown to be a reliable marker for arterial stiffness. Its accuracy depends heavily on the estimation of the transit time (TT) between proximally and distally measured pulse waveforms. Several methods of determining the TT exist, but no consensus for the standardization of one of them has been reached yet. In this work, various state-of-the-art TT estimation methods and the resulting PWV values are examined.
In total, 118 pair-wise measurements using applanation tonometry on the carotid and femoral arteries from 59 patients over a wide age range (21-88 years), recorded by the SphygmoCor system, were examined. For the TT estimation, two traditional methods based on intersecting tangents (IT) and the maximum systolic upstroke (MSU) were used. Furthermore, the two recently proposed methods "diastole-patching" (DP), which compares the region in the foot of the proximal waveform, and the cross correlation of the complete waveform (CC) were compared.
The resulting PWVs differed significantly ($p<0.05$, Bonferroni corrected paired T-test) between the various methods, with exception of MSU vs. DP. The means ± standard deviations were 8.2±1.8m/s using IT, 7.6±1.9m/s for the MSU, 7.8±2.2m/s using DP, and 9.9±6.7m/s by calculation of the CC. Comparisons of single measurements lead to differences of even more than 6m/s.
Although the 2013 ESH/ESC Guidelines for the management of arterial hypertension suggest a threshold of 10m/s as an estimate of alterations of aortic function, no evaluation method is mentioned. Our results suggest that an agreement on the optimal TT estimation may be useful.