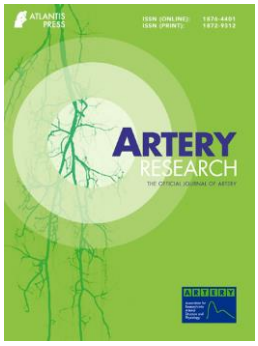

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P9.04: A NEW METHOD FOR CONTINUOUS MONITORING OF CENTRAL ARTERIAL STIFFNESS DURING STRESS

F. Faita, V. Gemignani, E. Bianchini, R.M. Bruno, T. Bombardini, L. Ghiadoni

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Methodological Aspects 3

P9.01
NON - INVASIVE EVALUATION OF ATHEROSCLEROTIC PLAQUE COMPOSITION: COMPARISON BETWEEN THE REFERENCE ANALYZER AND A NEW GRAY SCALE MEDIAN COLOR-MAPPING SOFTWARE

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Introduction: The non-invasive analysis of plaque echolucency (ECL) with Adobe Photoshop® has proven to reduce the subjectivity of ultrasonic evaluation of atherosclerosis. However, ECL provides information concerning only one of the aspects that contribute to vulnerability (plaque echodensity). Hemodyn 4m® is a grey scale median (GSM) plaque analyzer to asses distribution of areas with different tissue composition within atherosclerotic plaques, based in a color mapping process. AIM: To evaluate the correlation and concordance of a new GSM and color mapping plaque analyzer, Hemodyn 4m®, with the current reference method, Adobe Photoshop®.

Methods: Evaluation of fifty carotid atherosclerotic plaques (miointima thickness above 1.2 mm) obtained with a 10 MHZ linear array transducer (Vivid Five®, G. E. Corp.) from 50 consecutive patients. Correlation analysis was done with Spearman test; concordance, intraobserver and interobserver analysis with Bland and Altmann method.

Results: Hemodyn 4m® show excellent correlation (GSM, r^2: 0.84, $p < 0.001$) and concordance with Adobe Photoshop® (difference of Hemodyn 4m® compared to Adobe® Photoshop, - 1.9 units of the GSM average values, 2SD $\pm$17.8; $n = 50$), with low intraobserver (Difference Hemodyn 4 m®, 1 units of values of grey scale average median, SD $\pm$ 15.8; $n = 25$) and interobserver variability (Difference with Hemodyn 4 m®, 0.4 units of values of GSM average, SD $\pm$ 16.8; $n = 25$).

Conclusion: Adobe Photoshop® and Hemodyn 4m® are equivalent methods for GSM analysis of the ECL plaque evaluation. Hemodyn 4m® provides a more accurate visual characterization and location of the different tissue components of atherosclerotic plaques.

P9.02
EVALUATION OF PULSE WAVE VELOCITY AND AUGMENTATION INDEX IN SUPINE AND SITTING POSITION

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Background: Despite the introduction of arterial stiffness measurements in the recommendation of the European Societies for Hypertension and Cardiology, pulse wave velocity (PWV) and augmentation index (Aix) are still not used routinely in clinical practice. Possibly, current techniques, although non-invasive, validated, and easy to use, are still impractical and not favoured by patients. This includes the ability to perform such measurements in the sitting position as is done for blood pressure. New devices allow measurements in the sitting position. The aim of this study was to evaluate the role of posture on PWV and Aix, and to assess whether arterial stiffness measurements can be reliably measured in the supine position.

Methods: Arterial stiffness parameters were measured in 15 healthy volunteers and 15 patients with cardiovascular disease using three different devices: Arteriograph® (Arteriomed) and Vascular Explorer® (Enverdis) determining PWV and Aix from oscillometrically recorded pulse waves from the brachial artery; and SphygmoCor® (Atcor Medical). Three measurements were performed in supine position followed by three measurements in the sitting position.

Results: Arterial stiffness parameters did not differ between supine and sitting position. The table shows the results of the measurements (mean $\pm$ SD).

PWV m/s	Supine Position	Sitting Position	p-value
Arteriograph	7.6 ± 1.6	7.7 ± 1.8	0.29
Vascular Explorer	8.2 ± 0.9	8.5 ± 1.5	0.37
SphygmoCor	7.3 ± 1.5		
Aix %	**Supine Position**	**Sitting Position**	**p-value**
Arteriograph	18.4 ± 16.0	19.2 ± 16.4	0.35
Vascular Explorer	5.6 ± 13.1	8.1 ± 13.0	0.14
SphygmoCor	6.0 ± 9.4	6.2 ± 8.3	0.32

Conclusions: The close agreement between sitting and supine measurements suggests that both PWV and Aix can be reliably measured in the sitting position.

P9.03
REGIONAL AGE-RELATED CHANGES IN AORTIC PULSE WAVE VELOCITY AND SYSTOLIC DIAMETER MEASURED USING MAGNETIC RESONANCE IMAGING

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Aortic pulse wave velocity (PWV) is an independent predictor of cardiovascular risk. However, PWV is usually determined between the carotid and femoral sites, ignoring the proximal ascending aorta which may stiffen most with age. We tested this hypothesis by assessing regional PWV and aortic diameter along the entire aorta using MRI.

147 healthy subjects aged 18-85 years, free of cardiovascular disease and medication, were recruited from the ACCT Study. A PCMRI sequence (1.5 T scanner, GE) was then performed in all subjects at 5 aortic levels: ascending (L1), descending (L2), diaphragm (L3), 3 cm above the bifurcation (L5), and mid way between L3 and L5 (L4). Systolic diameter was measured at each level. PWV (PWV_{MRI}) was then determined in 4 aortic regions: the arch (R1), the thoracic-descending (R2), mid-descending (R3) and abdominal (R4).

Average PWV_{MRI} values increased from R1 to R4 (4.6 ± 1.5 m/s, 5.5 ± 2.0 m/s, 5.7 ± 2.3 m/s, 6.1 ± 2.9 m/s, respectively) and was not different between genders. The greatest age-related increase in PWV_{MRI} occurred in the abdominal aorta (R4) (0.9 m/s per decade, $P < 0.001$) followed by R2 (0.7 m/s,$P < 0.001$), R3 (0.6 m/s, $P < 0.001$) and R1 (0.4 m/s, $P < 0.001$). The average aortic diameters for L1 to L5 were 3.1 ± 0.4 cm, 2.3 ± 0.3 cm, 2.1 ± 0.3 cm, 1.9 ± 0.2 cm, and 1.7 ± 0.2 cm respectively. The aortic diameter at each level was correlated with age ($r = 0.41$, 0.50, 0.40, 0.43, and 0.25 for L1-L5 respectively, $P < 0.001$ for all values) with the greatest age-related increase occurring at L1 (0.093 mm/decade, $P < 0.001$).

Age-related increases in arterial stiffness are greatest in the abdominal aorta whereas the greatest increase in diameter occurred in the ascending aorta.

P9.04
A NEW METHOD FOR CONTINUOUS MONITORING OF CENTRAL ARTERIAL STIFFNESS DURING STRESS

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The continuous monitoring of arterial stiffness during pharmacological and dynamic stress is an intriguing and partially unexplored topic. In this work we present a new method for the continuous assessment of the aortic-to-carotid pulse transit time (PTT), which is inversely proportional to the pulse wave velocity (PWV), the gold-standard for arterial stiffness evaluation. The measurement is based on two cutaneous MEMS accelerometers: the first accelerometer is placed on the chest in mid-sternal precordial region and detects the heart vibrations; the second accelerometer is positioned on the neck and detects the carotid vibrations. The time corresponding to the closure of the aortic valve is found automatically on both the accelerometer signals and the PTT is computed as the difference between the two times. We tested our system by monitoring the pulse pressure transit time variation of 8 healthy volunteers during sublingual GTN administration (25 μg). The mean maximal percent variation of the PTT after GTN was $3.84 \pm 1.69\%$ (range 1.86-6.48%), that is in accordance with the literature where Wilkinson et al. (2002) showed a reduction of the PWV after GTN administration. In conclusion, we propose a new method which is able to the evaluate the variation of the true central PTT during pharmacological and dynamic stress. With this approach, only the proximal tract of the arterial bed (aorta-to-carotid) is considered: muscular arteries, whose contribution in the evaluation of arterial elasticity is usually poor, are excluded.