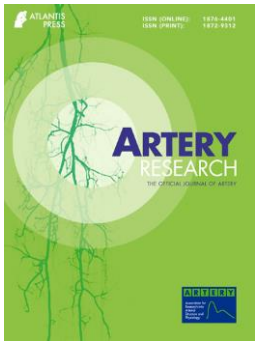


Artery Research

ISSN (Online): 1876-4401 **ISSN (Print): 1872-9312**
Journal Home Page: https://www.atlantis-press.com/journals/artres

P165: HIGHER BLOOD PRESSURE IN YOUTH IS ATTRIBUTABLE TO A COMBINATION OF HIGHER CARDIAC OUTPUT AND HIGHER TOTAL PERIPHERAL RESISTANCE

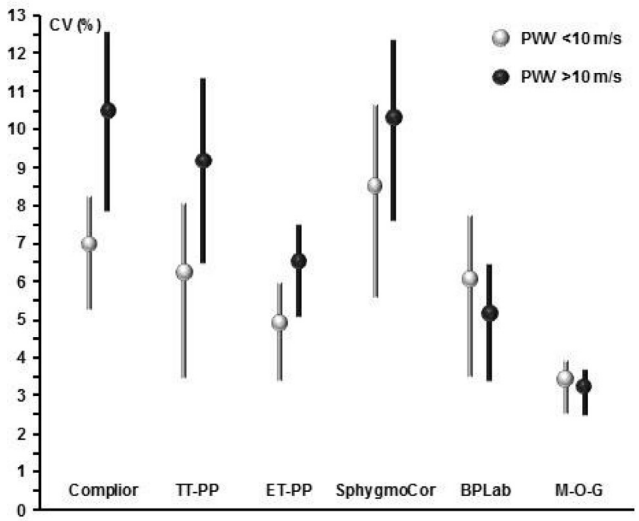
Alun Hughes, Chloe Park, Abigail Fraser, Laura Howe, Siana Jones, Debbie Lawlor, NIsh Chaturvedi, George Davey Smith

To cite this article: Alun Hughes, Chloe Park, Abigail Fraser, Laura Howe, Siana Jones, Debbie Lawlor, NIsh Chaturvedi, George Davey Smith (2017) P165: HIGHER BLOOD PRESSURE IN YOUTH IS ATTRIBUTABLE TO A COMBINATION OF HIGHER CARDIAC OUTPUT AND HIGHER TOTAL PERIPHERAL RESISTANCE, Artery Research 20:C, 82–83, DOI: https://doi.org/10.1016/j.artres.2017.10.114

To link to this article: https://doi.org/10.1016/j.artres.2017.10.114

Published online: 7 December 2019

Methods: In 102 patients planned to undertake a cardiac catheterization (65 ± 13 years, 70.6% males) duplicate non-invasive measures of PWV, 15-minutes apart, were obtained with 4 devices measuring two-points carotid-femoral PWV and the related pulse transit time (PTT): Complior (AlamMedical), PulsePenETT, PulsePenET (DiaTecne), SphygmoCor (AtCorMedical), and with 2 devices estimating PWV from the oscillometric cuff-derived brachial wave: BPLab (Petr Telegin), Mobil-O-Graph (IEM). PWV and carotid-femoral PTT measurements were compared using coefficients of variation (CV%) and their confidence intervals (CI).
Results: Devices evaluating carotid-femoral PWV showed a good repeatability (CV%[CI]: Complior: 8.8 [7.3—10.1]; PulsePen ETT: 8.0 [6.2—9.5]; PulsePen ET: 5.8 [4.9—6.6]; SphygmoCor: 9.5 [7.7—11.0]), whereas the repeatability of PWV estimated by cuff-based devices was for the BPLab = 5.5 [4.2—6.6] and for the Mobil-O- Graph = 3.4 [2.9—3.8]). A tendency toward a lower repeatability of carotid-femoral PWV was present for greater arterial stiffness, while repeatability of carotid-femoral PTT was not related to its mean values. Differences between repeated PWV measurements were not correlated with blood pressure ($R^2 = 0.005$) or heart rate variations ($R^2 = 0.013$).



Conclusions: Short-term repeatability of PWV measures was good, with some differences between different devices. A greater repeatability was observed in devices estimating PTT from a cuff-based measurement, compared to devices measuring carotid-femoral PTT, owing to the algorithm of calculation of PWV (Mobil-O-Graph) or to the procedure of correction which eliminates highly variable PWV values (BPLab).
Repeatability of PWV is not influenced by blood pressure or heart rate variations. For carotid-femoral PWV, the repeatability of measures is lower for higher PWV values.

P130

TEST-RETEST RELIABILITY FOR PULSE WAVE VELOCITY AND CARDIO-ANKLE VASCULAR INDEX AMONG AFRO-CARIBBEAN YOUNG ADULTS

Janeil M. Williams [1], Trevor S. Ferguson [1], Nadia R. Bennett [1], Amanda Rousseau [1], Renee Walters [1], Novie O. Younger-Coleman [1], Marshall K. Tulloch-Reid [1], Seeromanie Harding [2], J. Kennedy Cruickshank [2], Rainford J. Wilks [1]
[1]*Caribbean Institute for Health Research, The University of the West Indies, Mona, Kingston, Jamaica*
[2]*Diabetes and Nutritional Sciences Division, School of Medicine, Kings College, London, UK*

Background: This study evaluated the test-retest reliability of carotid-femoral pulse wave velocity (PWV) and cardio-ankle vascular index (CAVI) among young adults in Jamaica.
Methods: We recruited participants from the Jamaica 1986 Birth Cohort Study. PWV was measured using the Arteriograph device™ (TensioMed, Budapest) and CAVI with the VaSera™ device (Fukuda Denshi, Tokyo). Both measurements were done twice on the same day with a 1-hour interval between measurements. Test-retest reliability was estimated using the intra-class correlation coefficient (ICC) and Bland-Altman plots. Kappa statistic was used to assess agreement between repeated tests in classifying participants as high PWV or CAVI, defined as being in the upper tertile of measurements.
Results: Analyses included 89 participants (43 males; 46 females; mean age 28.4 ± 0.50 years). Mean PWV for first and second readings were 6.56 cm/s and 6.64 cm/s, respectively (mean difference −0.08 [95%CI −0.18, 0.03, p = 0.142]). Mean values for first and second CAVI were 6.53 and 6.20, respectively, (mean difference 0.34 [95%CI 0.18, 0.50, $p < 0.001$]). ICC for PWV was 0.88 (95%CI 0.83, 0.92) and for CAVI 0.57 (95%CI 0.41, 0.69). Bland-Altman plots indicated that measurements taken from both devices were highly reproducible, with most points (85/89 for PWV; 86/89 for CAVI) falling within 2 SD of the mean difference. Kappa statistic was 0.76 for PWV and 0.56 for CAVI.
Conclusion: PWV (Arteriograph™) and CAVI (VaSera™) have good test-retest reliability among Jamaican youth adults; however repeated CAVI values were marginally lower than the first measurement and the ICC and kappa estimates were lower.

P131

DETERMINANTS OF A NEW, NON-INVASIVE INDEX OF VENTRICULAR-ARTERIAL COUPLING AND MYOCARDIAL PERFORMANCE IN A GENERAL POPULATION SAMPLE

Nicholas Cauwenberghs [1], Jan D'hooge [2], Lutgarde Thijs [1], Jan A. Staessen [1], Tatiana Kuznetsova [1]
[1]*KU Leuven — Research Unit of Hypertension and Cardiovascular Epidemiology, Belgium*
[2]*KU Leuven — Research Unit of Cardiovascular Imaging and Dynamics, Belgium*

Background: The interaction between the heart and arteries (i.e. ventricular-arterial coupling, VAC) is a key determinant of cardiovascular performance. As such, VAC indexes might reflect the interplay between arterial stiffness and left ventricular (LV) dysfunction. In a community-based sample, we assessed the determinants of a new, non-invasive VAC index reflecting myocardial performance.
Methods: In 364 subjects (45.1% women; mean age, 53.8 years; 46.7% hypertensive), we derived echocardiographic indexes of LV structure and function and tonometric measures of central haemodynamics and aortic stiffness. From two-dimensional LV strain curves and simultaneously recorded pressure waveforms, we constructed the pressure-strain loop and calculated ejection work density (EWD), a myocardial performance index, as the area of the pressure-strain loop during LV ejection.
Results: In multivariable-adjusted analysis, EWD increased linearly with age ($P < 0.0001$). While adjusting for age, anthropometric measures and heart rate, EWD was significantly higher in women and patients with hypertension as compared to men and normotensives, respectively ($P < 0.0001$ for all). After full adjustment, EWD increased with higher augmentation pressure, central pulse pressure and carotid- femoral pulse wave velocity in both men and women ($P \leq 0.031$). Furthermore, EWD correlated independently and directly with left atrial and LV end-diastolic volumes ($P \leq 0.015$) as well as peak early diastolic velocities of transmitral flow and mitral annulus movement ($P \leq 0.025$).
Conclusion: Higher age, female sex and hypertension were independent determinants of higher EWD. Being associated with indexes reflecting central haemodynamics, arterial stiffness and LV diastolic function, this myocardial performance index might reflect the interaction between LV performance and arterial properties.

Poster Session II — Pathophysiology P165

HIGHER BLOOD PRESSURE IN YOUTH IS ATTRIBUTABLE TO A COMBINATION OF HIGHER CARDIAC OUTPUT AND HIGHER TOTAL PERIPHERAL RESISTANCE

Alun Hughes [1], Chloe Park [1], Abigail Fraser [2], Laura Howe [2], Siana Jones [1], Debbie Lawlor [2], NIsh Chaturvedi [1], George Davey Smith [2]
[1]*University College London, UK*
[2]*University of Bristol, UK*

Background: It has been proposed that high blood pressure (BP) in young people is due to high cardiac output (CO) with normal total peripheral resistance (TPR) — a hyperkinetic/hyperdynamic circulation. We investigated this in a large, population- based cohort of adolescents.

Methods: The study was conducted on 2091 participants in the Avon Longitudinal Study of Parents and Children (ALSPAC), a prospective population-based birth cohort study, aged 17. BP measurement and echocardiography was performed and heart rate (HR), stroke volume (SV) and TPR calculated. Data are means (SD).
Results: Table 1 shows selected characteristics of the sample. Higher quintiles of systolic BP were associated with higher SV, higher HR and higher TPR. However, the proportional contribution made by SV, HR and TPR to mean arterial pressure differed little by systolic BP quintile (stroke volume (32–34%) heart rate (25–29%) and TPR (39–41%)).

Variable	Males (n = 939)	Females (n = 1152)	All (n = 2091)
y	(0.3)	(0.3)	(0.3)
kg/m^2	(3.7)	(4.2)	(4.0)
mmHg	11)/64(8)	9)/65(7)	11)/65(8)
bpm	0	0	0
L/min	1.0)	0.8)	0.9)
ml	3	1	3
mmHg ml/min	(5.9)	(6.0)	(6.0)

Conclusions: Higher blood pressure is attributable to a combination of higher cardiac output (i.e. SV×HR) and higher TPR in a population-based sample of adolescents. There is no evidence of a disproportionate contribution from CO at higher BP levels.

P166
HEAD-DOWN TILT BED-REST SIGNIFICANTLY INCREASES CENTRAL ARTERIAL STIFFNESS

Fouassier David [1], Hakim Khettab [1], Pierre Boutouyrie [2], Carole Leguy [3], Catalin Cristian [3]
[1]*Pharmacologie clinique, Hôpital Européen Georges Pompidou, APHP, Paris, France*
[2]*Pharmacologie clinique, INSERM U970, Hôpital Européen Georges Pompidou, APHP, Paris, France*
[3]*Cardio Vascular Research Technology (CVE), Helmholtz Institute, Aachen, Germany*

The vascular system is subject to continual variation in mechanical stresses, both physiological and pathological. Vascular remodeling via changes in vessel wall properties, including thickness and stiffness, is a major feature of aging and cardiovascular disease.
A more detailed understanding of the interplay between mechanical stress, aging, CVD and vascular remodeling will aid prevention of increased cardiovascular risk following long term microgravity.
This study aims at assessing vascular remodeling processes resulting from a 60-day head-down-tilt bed-rest period during the European Space Agency Study (Toulouse, France).
We hypothesize that arterial remodeling processes are modified by long term bed- rest and constitute a significant cardiovascular risk in the long term for astronauts. Applanation tonometry is used to assess carotid to femoral pulse wave velocity (PWV) and non-invasive ultrasound imaging are used to assess arterial remodelling processes at the carotid, femoral, brachial and popliteal arteries.Measurements are performed at baseline; at day 29 and 52 of bed-rest; and at day 6 and 30 of the recovery period.
The preliminary results including 10 first subjects, demonstrate a strong effect of bed- rest on arterial PWV.The average PWV at baseline equals $7{,}6 \pm 1.4$m/s and is increased to 9.0 ± 1.9m/s after 29 days, and, 9.3 ± 1.8m/s after 52 days bed-rest. This increase is significantly different between baseline, and, 29 and 52 days bed-rest ($p < 0.005$).
Increase in PWV suggests a rapid and significant stiffening of the central arteries, which on healthy subjects corresponds to an aging process wich occurs many years. Low gravity conditions as during bed-rest induce significant arterial stiffening that could be linked to long term CVD risks for either patients in bed-rest or astronauts.

P167
PULSE PRESSURE AMPLIFICATION AND AUGMENTATION INDEX CHANGE IN OPPOSITE MANNER WITH ARTERIAL STIFFNESS INDEPENDENTLY OF SYSTEMIC RESISTANCE

Nicolaas Westerhof [1], Berend Westerhof [1,2]
[1]*Department of Pulmonary Diseases, VU University Medical Center, Amsterdam, The Netherlands*
[2]*Department of Medical Biology, Section Systems Physiology, Laboratory for Clinical Cardiovascular Physiology, Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands*

Background: Pulse Pressure Amplification (PPA) is the increase in Pulse Pressure (PP) from proximal to distal arteries. The Augmentation Index (AIx) is the secondary increase in aortic pressure in systole relative to PP. With aging and increased arterial stiffness the PPA *de*creases while the AIx *in*creases. Since both depend on the reflection of pressure waves, the finding that PPA and AIx change in opposite ways seems surprising.
Methods: Aortic PPA, AIx and Reflection Magnitude ($RM = P_{reflected}/P_{forward}$) were determined in a multibranched model and during control and Valsalva Maneuver in the human.
Results: During the Valsalva Maneuver reflections decrease: the lower mean arterial pressure results in lower stiffness and Pulse Wave Velocity (PWV) while Systemic Vascular Resistance (SVR) is increased. The model confirms that SVR plays a minimal role in terms of reflections. Reflections result from many reflections sites in the larger arteries. The lower PWV implies shorter wave length and thus artery length/wave length increases. This increase makes the differences in travel times from the many reflection sites to the heart more different resulting in lower total reflection: RM and AIx decrease. The lower PWV, thus the shorter wave length, also implies an increase in travel time over the aorta, and larger amplification. (It has been shown that local reflections change little with changes in stiffness.)
Conclusions: Reflections are mainly determined by travel times of reflected waves of the larger arteries. Mean pressure determines arterial stiffness and the stiffness change, via PWV, results in the opposite changes in RM and PPA.

References
Murgo JP, Westerhof N, Giolma JP, Altobelli SA. Manipulation of ascending aortic pressure and flow wave reflections with the Valsalva maneuver: relationship to input impedance. Circulation. 1981;63:122-32.
Murgo JP, Westerhof N. Arterial reflections and pressure wave forms in humans. In: Ventricular/Vascular Coupling. FCP Yin. London, Spinger Verlag 1987, pp 140-158.
Latham RD, Westerhof N, Sipkema P, Rubal BJ, Reuderink P, Murgo JP. Regional wave travel and reflections along the human aorta: a study with six simultaneous micromanometric pressures. Circulation 1985;72:1257-1269.

P168
ENDOTHELIAL REGULATION OF AWV IS IMPAIRED DURING INCREASE IN BLOOD FLOW IN ESSENTIAL HYPERTENSION

Frederic Roca [1,2,3,4], Jeremy Bellien [1,2,3,4], Michele Iacob [1,2], Robinson Joannides [1,2,5,4]
[1]*Rouen University Hospital, Department of Pharmacology, F 76000 Rouen, France*
[2]*Normandie Univ, UNIROUEN, Inserm U1096, F 76000, Rouen, France*
[3]*University of Rouen, Institute for Research and Innovation in Biomedicine, Rouen, France*
[4]*Clinical Investigation Center CIC-CRB 1404, Rouen University Hospital, Rouen, France*
[5]*University of Rouen, Institute for Research and Innovation in Biomedicine, Rouen, France*

Background: Arterial wall viscosity (AWV) depends on endothelium-derived factors in physiological conditions (1,2). Hypertension is characterized by an altered FMD during sustained flow increase due to endothelial dysfunction (3). Whether NO and EETs regulate change in AWV during increase in flow in hypertensive patients (HT) as compared with normotensive controls (NT) remains to be evaluated.
Methods: Radial artery diameter, wall thickness and arterial pressure were measured in 18 untreated essential HT and 14 frequency matched