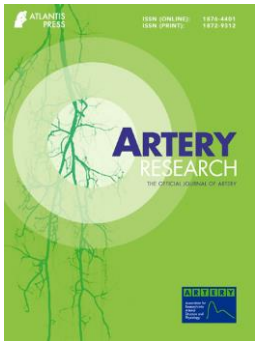


Artery Research

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

5.3: DISTANCE MEASUREMENT FOR PULSE WAVE VELOCITY CALCULATION – COMPARISON WITH INVASIVE FINDINGS

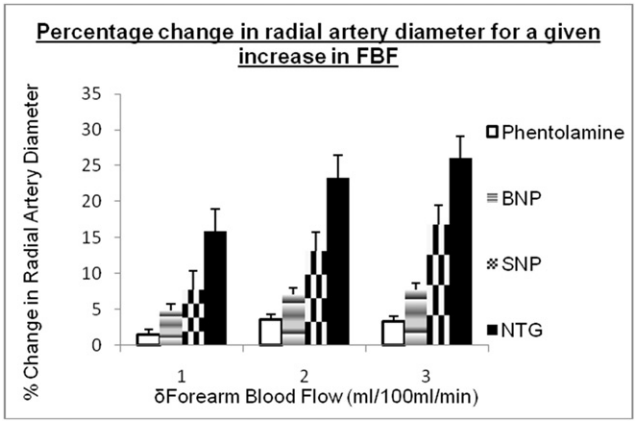
T. Weber, A. Haiden, S. Wassertheurer, C.C. Mayer, B. Hametner, J. Kropf, B. Eber

To cite this article: T. Weber, A. Haiden, S. Wassertheurer, C.C. Mayer, B. Hametner, J. Kropf, B. Eber (2011) 5.3: DISTANCE MEASUREMENT FOR PULSE WAVE VELOCITY CALCULATION – COMPARISON WITH INVASIVE FINDINGS, Artery Research 5:4, 142–143, DOI: https://doi.org/10.1016/j.artres.2011.10.221

To link to this article: https://doi.org/10.1016/j.artres.2011.10.221

Published online: 14 December 2019

efficacy of dilation of the radial artery was NTG>NP >BNP>PHT. Radial artery dilation by NTG and NP but not BNP was greater than that by PHT ($P<0.05$) and radial dilation by NTG greater than that by BNP ($P<0.05$). These results demonstrate that drugs acting on the guanylyl cyclase — cGMP pathway have differential actions on muscular conduit arteries.



3.6
THE "MARATHON PARADOX": DECREASED INTIMA-MEDIA THICKNESS AND IMPROVED FLOW-MEDIATED DILATATION, BUT INCREASED AORTIC STIFFNESS

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Background: Arterial stiffness, wave reflections, endothelial dysfunction and carotid intima-media thickness (cIMT) are predictors of cardiovascular events. Marathon running is an extremely vigorous aerobic exercise.
Methods: We enrolled 3 groups of regularly-trained marathon runners and 3 groups of matched recreationally-active controls. Aortic stiffness was evaluated with carotid-femoral pulse wave velocity (PWV), wave reflections with augmentation index (AIx), endothelial function with flow-mediated dilation (FMD) and nitroglycerine-mediated dilatation (NMD) of the brachial artery and early atherosclerosis with cIMT. PWV was studied in 49 runners (trained for 11.6±9.1 years) and 46 controls. IMT was measured in 36 runners (trained for 13.1±9.5 years) and 19 controls. FMD and NMD were assessed in 21 runners (trained for 14.5±8.5 years) and 17 controls.
Results: Marathon runners had significantly higher systolic, diastolic, pulse (aortic and brachial) and mean pressures ($P<0.05$ for all) and higher PWV compared to controls (6.89±1.0m/s vs. 6.33±1.03m/s, $P<0.01$). Athletes exhibited lower cIMT (0.58±0.10mm vs 0.63±0.80mm, $P<0.05$) and higher FMD (8.59±4.1% vs 6.25±1.6%, $P<0.05$). AIx, AIx@75 and NMD did not differ.
Conclusion: While marathon runners have higher FMD and decreased IMT compared to controls, indicating better endothelial function and lower subclinical atherosclerosis, they also have increased PWV. Increased aortic stiffness may be the result of elastic component damage due to excessive exercise burden; however, it may also represent an adaptive process that leads to a higher, but favorable -for this type of running- travel for waves, and possibly relates to why marathon runners reach their peak later in life compared to other athletes.

Oral Session 5
Free Oral Communications
In association with 'Pulse of Asia'

5.1
COMMON CAROTID ARTERY PROPERTIES ARE RELATED TO SYMPATHETIC OUTFLOW AND CARDIOVASCULAR VARIABILITY

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Objective: The relationship between sympathetic activity and common carotid artery (CCA) properties is unknown. We therefore tested the hypothesis that mechanical properties of arterial wall are independently linked to muscle sympathetic nerve activity (MSNA) and cardiovascular variability.
Design and Methods: We measured MSNA (microneurography), heart rate (ecg), arterial pressure (Finapres) and CCA properties (ART.LAB system) in 20 subjects with high normal blood pressure and newly detected stage 1 hypertension (18 males, age 36±2 years, BMI 27±1 kg/m^2, mean±SEM). SBP and RR-interval variabilities were defined as the standard deviation of the means.
Results: MSNA averaged 27±3 bursts/min., mean CCA intima-media thickness (IMT) was 0.57±0.03 mm, carotid distension was 499±27 μm, systolic (S) Carotid Wall Stress (CWS) was 119±6 kPa, pulsatile (P) CWS was 46±3 kPa. CCA IMT was related to MSNA ($r=0.54$; $P<0.01$), and SCWS ($r=-0.84$; $P<0.0001$), but not to variability of SBP ($r=-0.27$; P=NS) or RR-interval ($r=-0.26$; P=NS). MSNA was associated with reduction in carotid distension waveform ($r=-0.54$; $P<0.01$), SCWS ($r=-045$; $P<0.05$) and PCWS ($r=-0.57$; $P<0.01$). CWS was not linked to variability of SBP or RR-interval. Changes in CCA diameter were positively related to RR-variability ($r=0.49$; $P<0.05$), but not to variability of SBP ($r=0.3$; P=NS). The correlations between MSNA and CCA properties remained significant after adjustment for age, body mass index and blood pressure.
Conclusions: (1) Distension of the common carotid artery is related to muscle sympathetic nerve activity and cardiovascular variability. (2) Intima-media thickening and carotid wall stress are linked to sympathetic activation, but not to altered cardiovascular variability.

5.2
ARTERIAL STIFFNESS IS A MAJOR INDEPENDENT DETERMINANT OF VISIT-TO-VISIT VARIABILITY IN SBP: A 9.1 YEAR FOLLOW-UP IN TREATED HYPERTENSIVES

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Objective and background: Aortic stiffening, which favours the wave propagation generated by changes in cardiac output, and exaggerates the early return of wave reflection generated by changes in vasomotor tone, can increase the variability in SBP.
Methods: Aortic stiffness was determined through carotid-femoral pulse wave velocity (PWV) in 95 patients (age 62.9±10.8 years) who attended the outpatient hypertension clinic at Pompidou hospital during a total follow-up of 9.1±3.6 yrs. PWV was determined after 5.5±2.7 yrs. Visit-to-visit variability in office SBP was expressed as standard deviation (SD) of measurements and SD/mean, and calculated during the entire follow-up (FU). 8.5±4.8 visits occurred before PWV measurements, and 6.4±5.4 visits after.
Results: SD of SBP was 13.5±4.3 mmHg during FU. PWV was 11.4±2.7 m/s. In univariate analysis, SD-SBP during FU was significantly related to PWV (P=0.0007), age (P=0.021), SBP (P=0.033), MBP (P=0.0016) and diabetes (P=0.045). In multivariate robust regression analysis, PWV was a major determinant of SD-SBP (P=0.018) during FU, explaining 11.2% of SD-SBP variance (and 51% of explained variance), independently of age, gender, SBP, HR, BMI, diabetes, and dyslipidemia, which were not significantly associated with SD-SBP. Similar findings were observed when SD/mean of SBP was used instead of SD-SBP.
Conclusion: Aortic stiffness was a strong independent determinant of visit-to-visit variability in SBP, whereas no classical CV risk factor was associated with SD-SBP in multivariate models. These results suggest that antihypertensive treatment should aim at normalizing aortic stiffness to better reduce visit-to-visit SBP variability.

5.3
DISTANCE MEASUREMENT FOR PULSE WAVE VELOCITY CALCULATION — COMPARISON WITH INVASIVE FINDINGS

T. Weber [1], A. Haiden [1], S. Wassertheurer [2], C. C. Mayer [2], B. Hametner [2], J. Kropf [2], B. Eber [1]
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Background: A more simple yet accurate method for assessing travel distance (TD) for calculation of carotid-femoral pulse wave velocity (cfPWV) is desirable to improve acceptance of the method in clinical routine.
Methods: We compared the following methods for assessment of TD, as performed during non-invasive measurement of cfPWV with the SphygmoCor

system, with the invasive gold standard (aortic PWV), as measured during cardiac catheterization on alternate days, in up to 659 patients: M1 (invasive aortic PWV), M2 ("conventional" subtraction: suprasternal notch-femoral site minus suprasternal notch-carotid), M3 (estimation from body height: TD = body height/4 + 7.28), M4 (direct measurement carotid-femoral site * 0.8), M5 (subtracted method as M2 but using straight caliper instead of a tape).

Results: Transit times, as assessed invasively and with the SphygmoCor system, were in good agreement (62.8 and 63.4 msec, respectively). TD and corresponding cfPWV, as measured with M2 and M3, met the invasive values — Table. M4 overestimated invasive TD by 3.5 cm, resulting in an overestimation of PWV by 0.3 m/sec. M5 underestimated TD by 4.5 cm, resulting in an underestimation of PWV by 0.9 m/sec. Correlations with invasive method and respective coefficients of determination were not improved, when M4 or M5 was used.

Conclusion: Non-invasive estimation of TD for cfPWV (often labelled as aortic PWV) remains problematic. A simplified method, based on body height, may be of value.

	M1	M2	M3	M4	M5
Patient number	659	659	659		
TD cm	50.6	50.8	50.4		
PWV m/sec	8.6	8.4	8.4		
R^2 vs PWV invasive		0.378	0.373		
Patient number	401	401	401	401	
TD cm	50.4	51.1	50.5	53.9	
PWV m/sec	8.5	8.4	8.3	8.8	
R^2 vs PWV invasive		0.42	0.41	0.39	
Patient number	108	108	108		108
TD cm	50.5	50.1	49.8		46.0
PWV m/sec	8.9	8.7	8.7		8.0
R^2 vs PWV invasive		0.33	0.35		0.32

5.4
LIFETIME ADHERENCE TO A MEDITERRANEAN DIET (MD) PATTERN IS ASSOCIATED WITH LOWER CAROTID STIFFNESS IN YOUNG ADULTS: THE AMSTERDAM GROWTH AND HEALTH LONGITUDINAL STUDY

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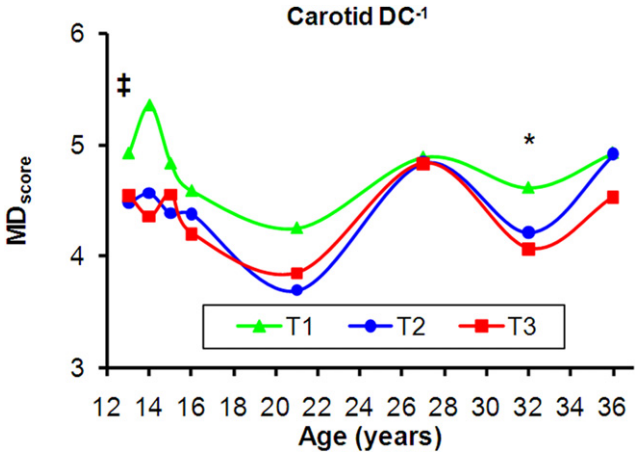
Purpose: To investigate whether lifetime adherence to an MD pattern (i.e., from adolescence to adulthood) is associated with arterial stiffness in adults.

Methods: Longitudinal data on dietary intake (2-8 repeated measures; ages 13-36) were retrieved for 373 subjects in whom carotid stiffness was assessed by means of ultrasonography at age 36. An MD_{score} [range: 0 to 9 (higher values indicate better adherence)] was calculated based on values < or > the sex-specific medians or pre-defined cut-off values of vegetables, legumes, fruits/nuts, whole grains, fish, meat/poultry, dairy products, alcohol and the ratio of mono-unsaturated to saturated lipids intake. Adherence to an MD pattern (yes/no) was defined based on values > or < median of the MD_{score}. We used generalized estimating equations to compare, throughout the 24-yr longitudinal period, the MD_{score} between subjects with increasing levels [i.e., tertiles (T)] of the *inversed* distensiblity (DC^{-1}) and compliance coefficients, and Young's elastic modulus.

Results: After adjustment for height, energy intake, physical activity, smoking and mean arterial pressure, and as compared to subjects with 'stiffer' arteries (i.e., in T3), those with 'less stiff' arteries (T1) had a higher lifetime mean MD_{score} [e.g., +0.44 (95%CI: 0.20-0.69), when considering the DC^{-1} levels - Figure]. Subjects with 'less stiff' arteries were also more likely to have had adhered to an MD pattern throughout the longitudinal period than those with 'stiffer' arteries [OR=1.68 (1.22-2.31)].

Discussion: Promoting adherence to the MD throughout the course of young life might offer an important means to prevent accelerated arterial stiffening later in life.



5.5
IMPACT OF URBAN VERSUS RURAL ENVIRONMENT ON CENTRAL BLOOD PRESSURE, AORTIC STIFFNESS AND WAVE REFLECTIONS: THE PURSE-HIS STUDY

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Urbanisation of developing countries has had a marked impact on population health. In particular, in India, the prevalence of coronary heart disease is markedly increased in urban versus rural settings. The aim of the current study was to assess the impact of geographic location on large artery stiffness and central blood pressure (BP) as part of the PURSE-HIS study.

Methods: In all, 7676 individuals (4276 females) from three distinct geographical regions of Tamil Nadu, India were studied. The mean age was 44±10 years (range 19-79 years). Following completion of a detailed medical history questionnaire, all participants underwent haemodynamic screening including brachial and central BP, augmentation index (AIx) and aortic pulse wave velocity (PWV, SphygmoCor). Subjects were then grouped according to geographical region (urban, semi-urban and rural) and decade of age.

Clinic brachial and central BP increased significantly with age in all three geographical regions ($P<0.001$). However, both brachial and central pressures were significantly lower in rural participants at all ages ($P<0.001$ for all). Aortic PWV also significantly increased with age in all geographical regions ($P<0.001$ for all). However, the age-associated increase in PWV was significantly attenuated in rural participants ($P<0.001$), even after adjusting for confounders (Figure 1). In contrast, AIx was significantly higher in younger rural individuals (<40 years,$P<0.001$), although this difference was not evident in older individuals.

These data indicate that urban lifestyle adversely impacts on blood pressure and large artery stiffness in an Indian population, which may contribute to the increased cardiovascular risk observed in these individuals.

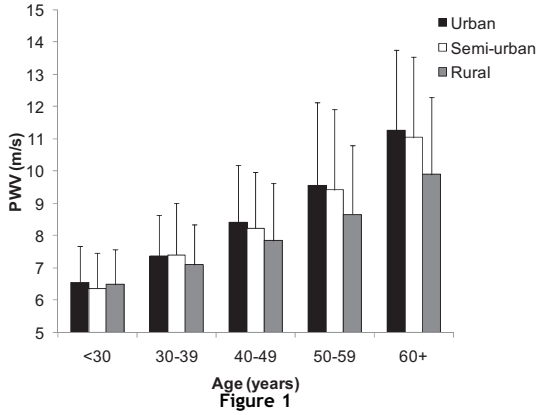

Figure 1