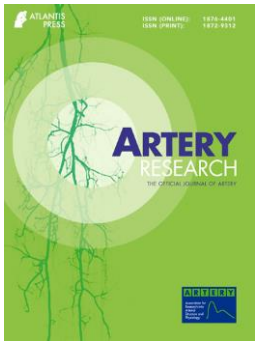

Artery Research

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

P2.39: ASSESSMENT OF FLOW MEDIATED DILATION. COMPARISON BETWEEN TWO METHODS

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To cite this article: S. Rastelli, F. Stea, E. Bozec, L. Zanoli, F. Faita, L. Ghiadoni, P. Castellino, P. Boutouyrie, S. Laurent (2012) P2.39: ASSESSMENT OF FLOW MEDIATED DILATION. COMPARISON BETWEEN TWO METHODS, Artery Research6:4, 174–175, DOI: https://doi.org/10.1016/j.artres.2012.09.119

To link to this article: https://doi.org/10.1016/j.artres.2012.09.119

Published online: 21 December 2019

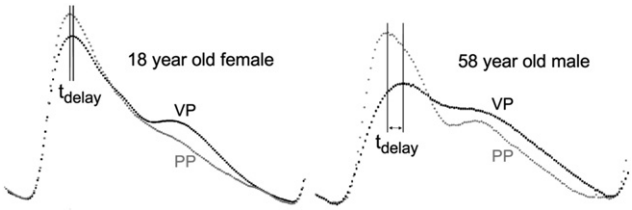

Figure 1

References:

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P2.37

VALIDATION OF AORTIC PULSE WAVE VELOCITY ESTIMATION FROM BRACHIAL ARTERY AND FINGER BLOOD PRESSURE WAVEFORMS IN HUMANS: ABILITY TO DETECT AGE- AND EXERCISE TRAINING- RELATED DIFFERENCES IN EFFECTIVE REFLECTING DISTANCE AND AORTIC PULSE WAVE VELOCITY

G. L. Pierce [1], D. P. Casey [2], J. G. Fiedorowicz [1], D. R. Seals [3], T. B. Curry [2], J. N. Barnes [2], D. R. Wilson [1], H. M. Stauss [1]

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It has been argued that aortic pulse wave velocity (APWV) cannot be determined from the reflected wave transit time (Δt) because the effective reflecting distance (EfRD, aortic valve to distal reflecting site) is not defined anatomically. We hypothesized that EfRD can be estimated from demographic/anthropometric data and used to indirectly determine APWV from peripheral blood pressure (BP) waveforms in humans. Invasive (n=25, brachial artery) and non-invasive (n=15, EndoPAT) BP waveforms were converted into aortic BP waveforms (transfer function) and Δt computed from decomposed forward and reflected waves. True EfRD was determined from measured carotid-femoral pulse wave velocity (CF-PWV) (SphygmoCor) and Δt. Stepwise regression analysis resulted in the equation: EfRD= 0.173*age+0.661*BMI+34.548 cm, used to indirectly estimate EfRD and APWV in the original 40 healthy adults, and in a separate cohort of young sedentary (YS, n=6; 22±2 years; VO_{2max} 39±2 ml/kg/min), older sedentary (OS, n=24; 62±1 years; VO_{2max} 27±1 ml/kg/min), and older endurance-trained (OT, n=14; 61±2 years; VO_{2max} 46±2 ml/kg/min) subjects. CF-PWV and indirectly determined APWV were highly correlated (n=40, Pearson's R=0.65, P<0.01; interclass correlation coefficient ICC=0.64, P<0.01). In YS, OS and OT, EfRD and APWV were 52.0±0.5, 61.8±0.4 and 60.6±0.5 cm (all P<0.05) and 6.4±0.3, 9.6±0.2, and 8.1±0.2 m/s (all P<0.05), respectively. In healthy adults, APWV can be reliably derived from invasive and non-invasive peripheral BP waveforms using age and BMI to determine EfRD. This method can detect the distal shift of the reflecting site with age and the increase in APWV with sedentary aging that is attenuated with endurance exercise.

P2.38

COMPARISON BETWEEN TWO INDIRECT METHODS FOR PULSE WAVEFORM ANALYSIS

C. Ramos [1,2,3,4], L. Lonati [3], G. Bilo [1,3], A. Faini [3], E. Cardona [2,4], G. Parati [1,3]

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Introduction: The prognostic value of arterial stiffness has been shown in different groups of patients and also in apparently healthy populations. Several studies have already pointed out the prognostic importance of central Systolic Blood Pressure (cSBP)
Aim: To compare two devices that use indirect methods to asses central blood pressure: The SphygmoCor and OMROM HEM-9000AI.
Inclusion criteria
Age ≥18 years, Males and females, Arterial Hypertension
Methods: Eighty-four hypertensive subjects, mean age 58 ± 12 years were examined. Radial artery waveform recording at the left wrist was performed, patients with arrhythmias, severe hypertension, absence of radial pulse, diabetes were excluded.
Statistical software version 9.0 was used. Pearson's correlations and Bland–Altman plots were used to assess the agreement between methods.
Results: cSBP measured with both devices values showed a significant correlation,r= 0.76; r^2=0.58. cSBP values recorded with OMRON device were 16 mmHg higher (SD of difference = 13 mmHg) cSBP (Sphy) and pSBP2 (Omr) values showed a significant correlation (r= 0.74; r^2=0.55, P <0.001) (Figure 1) mean difference was of -0.8 , SD = 13 mmHg.
Conclusion: When compared both devices they offer discordant results, and this discrepancy tends to be larger at higher BP levels. In absence of invasive measurements of central aortic pressure, it is impossible to conclude which of the two systems provides cSBP values closer to true aortic cSBP. Our data suggest that pSBP2 reported by the Omron device more closely reflects the cSBP value assessed by the Sphygmocor device.

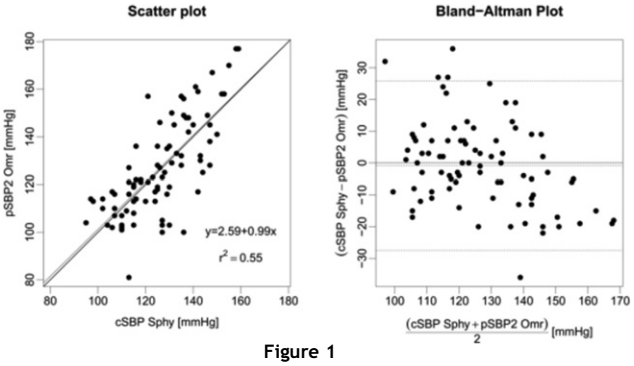

Figure 1

P2.39

ASSESSMENT OF FLOW MEDIATED DILATION. COMPARISON BETWEEN TWO METHODS
ART LAB VS. FMD STUDIO

S. Rastelli [1,2], F. Stea [2,3], E. Bozec [2], L. Zanoli [1,2], F. Faita [3], L. Ghiadoni [3], P. Castellino [1], P. Boutouyrie [2], S. Laurent [2]

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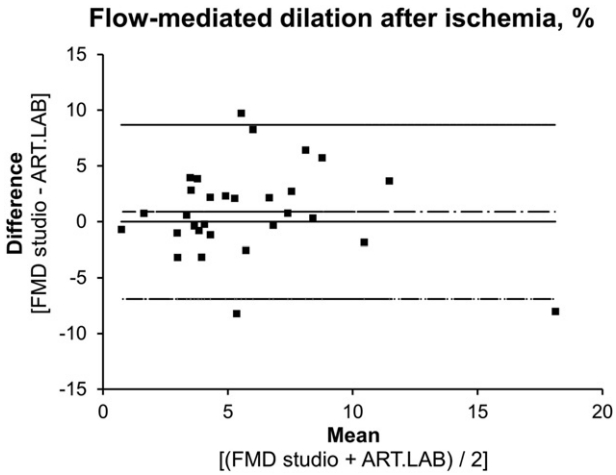
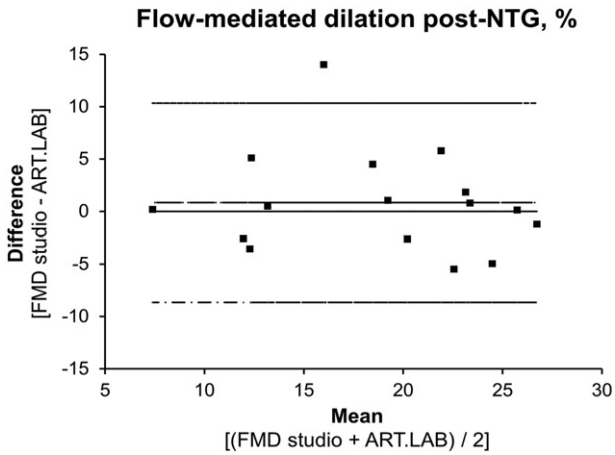
Introduction an Aim. The ultrasound assessment of flow-mediated dilation (FMD) of the brachial artery is a non-invasive and reproducible technique to evaluate the endothelial function. FMD is classically expressed as a percentage rise of the change in diameter from the baseline after ischemia or administration of sublingual nitroglycerin (NTG).
We compared FMD and internal diameter measurements obtained with an echotracking system (ART.LAB; Esaote BV, Maastricht, the Netherlands), to those obtained with a new, image-based, system for real time measurement of FMD (FMD Studio, Pisa, Italy).
Methods: FMD studio-ART.LAB mean difference of FMD after ischemia and internal brachial diameter at baseline, peak and post-ischemia were tested in 30 subject. Moreover, in a subgroup of 16 subjects, we measured FMD after NTG administration. All measurements were performed simultaneously by ART.LAB and FMD studio.
Results: Mean difference of internal diameter was 0.27±0.24 mm at baseline (7% of mean value), 0.33±0.25 mm at peak (8% of mean value), and 0.30±0.23 mm after ischemia (8% of mean value); mean difference of FMD after ischemia was 0.89±3.97%, corresponding to 15% of mean value. Mean difference of FMD post-NTG was 0.85±4.85%, (5% of mean value). All the values obtained by FMD studio were not significantly different (P=NS) to those obtained by ART.LAB.
Conclusions: We reported a good agreement of FMD and internal diameter measurements between an echotracking device, which represents the gold standard for arterial parameters measurements, and a new, image-based, system for real time measurement of FMD.





P2.40

TENSILE MEASUREMENTS ON VERY SMALL BLOOD VESSELS AND VASCULAR GRAFTS

M. S. Stoiber [1,4], C. G. Grasl [1,4], K. K. Kessler [3], B. M. Messner [3], D. B. Bernhard [3], V. G. Gschlad [1,2], H. S. Schima [1,2,4]
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Aims: Biomechanical evaluation of small blood vessels and vascular grafts is an important task. In this work a method is presented for testing mechanical behaviour of very small tubular structures with less than 1mm diameter.
Methods: For the tensile measurements a BOSE ElectroForce system (Bose Corp. MN, USA) with a controllable linear motor for static and dynamic measurements was used. To measure very small ring-shaped specimens the system was modified with a cantilever and a special designed probe fixation.
Firstly, tensile behaviour on thoracic mice aortae after 19 weeks high-fat-diet (group 1) and a control group (group 2) were analyzed. Secondly, on electrospun vascular grafts repeated loading-unloading measurements were performed to obtain the dynamic behaviour in the physiological range.
Results: The modified system allowed measurements on very small specimen (0.7mm inner diameter in case of the mice aortae) and the use of very sensitive load cells of 10N and up to 0.5N.
For the mice aortae significant higher maximum tear forces in group 1 with 0.41 +/- 0.12N, than in group 2 with 0.34 +/- 0.10N were measured. Diverse tear forces and braking strains at different zones of the aorta could be observed. For the vascular grafts hysteresis curves could be recorded with peak-to-valley forces of 0.03 to 0.08N, corresponding to 80 and 120mmHg.
Conclusion: The established method enables a reproducible and sensible measurement of static and dynamic mechanical properties in small ring-shaped specimen of arteries and vascular prostheses.

P2.41

ACUTE RESPIRATORY CHANGES IN AUGMENTATION INDEX ARE RELATED TO AORTIC RESERVOIR FUNCTION

M. G. Schultz [1], J. E. Davies [2], A. D. Hughes [2], J. E. Sharman [1]
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[2]*International Centre for Circulatory Health, Imperial College, London, United Kingdom*

Background: Augmentation index (AIx) is an independent predictor of mortality. Current theory states augmented pressure (AP) is principally due to wave reflection. Subtle changes in AP occur with respiration, but the mechanisms are not fully understood. This study aimed to determine the possible contribution of wave reflection and aortic reservoir function to respiratory changes in AP.
Methods: Simultaneous invasive pressure and Doppler flow velocity were recorded in the ascending aorta via intra-arterial wire in 24 consecutive participants undergoing cardiac catheterisation or surgery. We performed wave intensity analysis to derive forward and reflected waves, and calculated reservoir pressure in five patients displaying marked respiratory AP changes (see figure). Data was compared between four respiratory cycles of expiration (high AP) with inspiration (low AP) in each individual.
Results: AP and AIx were raised during expiration compared to inspiration (5±6mmHg, 10±13% vs.-1±2mmHg, -6±9%, $P<0.001$ for both). Despite this, wave reflection was not significantly changed ($-7x10^6 \pm 9x10^6$ vs. $-6x10^6 \pm 5x10^6$ $W.m^{-2}s^{-2}$, $P=0.50$). However, reservoir pressure was significantly higher during expiration compared with inspiration (95±23 vs. 88±20 mmHg, $P<0.001$), as were forward compression waves ($41x10^6 \pm 27x10^6$ vs. $36x10^6 \pm 24x10^6$ $W.m^{-2}s^{-2}$, $P=0.04$). The change in AP between inspiration and expiration correlated with change in reservoir pressure ($r=0.81$, $P<0.001$), but not reflected wave intensity ($r=-0.19$, $P=0.41$) or heart rate ($r=-0.33$, $P=0.15$).
Conclusions: Acute changes in AP and AIx occur during normal respiration. These changes appear related to aortic reservoir function and cannot be explained by conventional wave reflection theory.

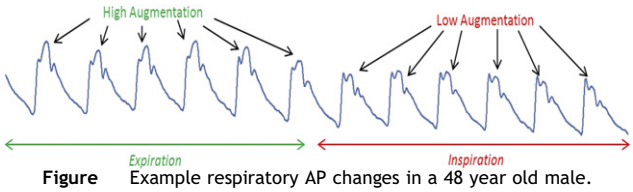

Figure Example respiratory AP changes in a 48 year old male.

P2.42

A NEW BLOOD PRESSURE-INDEPENDENT ARTERIAL STIFFNESS INDEX, CARDIO-ANKLE VASCULAR INDEX (CAVI)

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Sakura Hospital, Toho University, Sakura, Chiba, Japan

The Cardio-Ankle Vascular Index (CAVI) is a new indicator of the stiffness of arteries from the origin of the aorta to the ankle of the lower leg. The theory is based on the stiffness parameter β. CAVI is essentially independent of blood pressure at a measuring time. This is confirmed by the study using adrenergic β1 receptor-blocking agent, metoprolol in human. When metoprolol is administered to men, blood pressure decreased and pulse wave velocity is decreased. But, CAVI remains constant. This result was also confirmed by the study on the rabbits using same apparatus.
CAVI increased with aging and showed higher values in males than in females. CAVI showed high value in patients with cerebral infarction, coronary stenosis, and chronic kidney disease.
As for the risks of coronary artery disease, CAVI showed high value in hypertension, diabetes mellitus, dyslipidemia, smoking, and metabolic syndrome. Furthermore, improvement of those risk factors by drugs or lifestyle changes reduced CAVI in most cases. In other words, CAVI is a useful indicator for the management of coronary risk factors.