P1.35: A NEW NON-INVASIVE ANALYSIS FOR THE DETERMINATION OF LOCAL PULSE WAVE VELOCITY AND WAVE INTENSITY: APPLICATION TO THE CAROTID ARTERY

A.W. Khir, N. Hadjiloizou, J. Feng, J.E. Davies, J. Mayet, D.P. Francis, A.D. Hughes

was assessed by the established foot to foot method (Complior Artech, Paris); PWVba and CAVI were obtained by a commercially available system (Vasera Fukuda, Tokyo), recording simultaneously brachial and tibial sphygmogram, ECG and phonocardiogram (PGC). CAVI is derived from the stiffness index Beta, according to Bramwell-Hill formula.

Results: PWba was significantly correlated with PWVcf (r = 0.785, p<0.001); in Bland Altman analysis, all points but two were included into ± 2SD of mean difference (mean difference= 0.804 ± 2.17 m/s). CAVI, PWVba, PWVcf were directly correlated with age (r = 0.778, 0.595, 0.687; p<0.001) and pulse pressure (r = 0.504, 0.300, 0.422; p<0.001).

Conclusions: PWVba, an integrated index of aortic and femoro-tibial stiffness, shows good agreement with PWVcf. CAVI index seems to provide the best associations with age and pulse pressure.

P1.33
COMPARISON BETWEEN ULTRASONIC MEASUREMENTS OF CAROTID WALL PROPERTIES AND NEW AUTOMATED METHOD BY ANALYSIS OF IMAGING

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Echotracking (ET) devices were developed to determine elastic properties of arterial wall material with high precision. The radiofrequency provides a higher precision than with B-mode image systems, limited by the spatial resolution of pixel. New approaches to analyse the B-mode imaging (IA) with offline semi-automated boundary tracking (AMSII) could enhance accuracy and limit variability of arterial measurements, but this method should be validated.

Objectives: To compare carotid parameters assessed with echotracking and applanation tonometry to IA process.

Methods: 10 healthy volunteers had successively common carotid artery measurements with ET and B-mode image analysis (standardized probe localization and orientation). Local carotid systolic and diastolic blood pressure (SBP, DBP), pulse pressure (PP) were measured with aplanation tonometry. Systolic and diastolic diameters (SD, DD), distension were assessed with both methods. Data were analyzed independently, blinded to the results of concurrent method. Coefficient of variation (CV) and Pearson's correlation coefficient between the methods were calculated. Wilcoxon's signed-rank test for matched pairs was used for significance.

Results: No significant differences were observed through results of the two assessment methods for local SBP, DBP, PP, Distension, DD and SD. All CV were inferior to 5%. Correlation coefficients between paired parameters were at least 0.90 for all the measurements.

Conclusion: Results from analysis of IA with AMS II seem to be in accordance with those from Artlab® echotracking (BM and FBM mode). Quality of image recording is an essential factor of concordance between the two methods and this implies further investigations in patients with cardiovascular diseases.

P1.34
VALIDATION OF THE WORKING PRINCIPLE OF THE ARTERIOGRAPH, A NEW DEVICE TO MEASURE PULSE WAVE VELOCITY

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The Arteriograph, a device basically consisting of a brachial cuff, has recently been launched as a new tool to measure pulse wave velocity (PWV). Brachial blood pressure is measured during supra-systolic pressure inflation of the cuff, yielding pressure waveforms with pronounced first and secondary peaks. The second peak is ascribed to a reflection from the aortic bifurcation, and PWV is calculated as the ratio of 2 times the jugulum-symphysis distance (∼ aortic root − bifurcation) and the time difference between the two peaks (DT_{s1-s2}). To test this working principle, we used a numerical model of the arterial tree to simulate pressure and flow in the normal configuration, and in a configuration with an occluded brachial artery (∼supra-systolic over-inflation). A pronounced second peak in the pressure signal was found at the location of the cuff for the occluded configuration. Wave intensity analysis showed that this peak was caused by a forward compression wave, confirming the Arteriograph hypothesis. Simulations with 6 different stiffness values showed a linear correlation between $1/DT_{s1-s2}$ and PWV (R^2=0.97). It was, however, hard to locate the reflection site which, in combination with the transit time, reproduced the correct PWV. The distance to the aortic bifurcation was 45 cm, whereas the effective length of the simulated arterial tree was 27 ± 3 cm. The distance needed to reproduce PWV from DT_{s1-s2} was 70 ± 6 cm. In conclusion, although the numerical model supports the basic working principle of the Arteriograph, measurement of actual PWV using the device might be more challenging.

P1.35
A NEW NON-INVASIVE ANALYSIS FOR THE DETERMINATION OF LOCAL PULSE WAVE VELOCITY AND WAVE INTENSITY: APPLICATION TO THE CAROTID ARTERY

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Background: Local Pulse Wave Velocity (LPWV) and Wave Intensity (WI) are used to assess arterial stiffness and the arrival time of reflected waves; indices of clinical importance. We present a new non-invasive analysis which directly uses flow velocity (U) and arterial diameter (D) measurements for the determination of LPWV and WI.

Methods: From the water hammer equation it can be shown that $LPWV = \frac{D}{2}\frac{dU_{\pm}}{dD_{\pm}}$ where dU and dD are the changes in U and D, and ± indicates the forward and backward directions. The separation of WI can also be determined using $WI_{\pm} = \pm\frac{1}{4(D/2c)}(dD \pm \frac{D}{2c}dU)^2$, where c is LPWV. We studied 28 patients (58±15 years, 21 male) with good systolic function (EF>55%) and no valve disease. We measured U and D in the left carotid artery using Doppler ultrasound and a wall tracking system (Aloka, SSD-5500). ECG was also recorded and data were sampled at 1kHz.

Results: LPWV in patients > 50 years (n=11) were higher by 20% (p < 0.05) than in patients < 50 years. Reflected waves in patients > 50 years arrived earlier by 35% (p < 0.05) than in patients <50 years. Neither the size of reflected waves nor the forward compression and expansion wave differed significantly between the two age groups.

Conclusions: Results of the new technique are in agreement with other approaches for determining LPWV and WI. The new technique offers the possibility of studying arterial sites that are not accessible by applanation tonometery, and does not assume a linear relationship between arterial diameter and arterial pressure.

P1.36
A PRELIMINARY STUDY FOR THE EVALUATION OF LARGE ARTERY STIFFNESS: A NON CONTACT APPROACH

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The evaluation of carotid-to-femoral pulse transit time (PTT) is required to estimate the carotid-femoral pulse wave velocity, a parameter considered as the gold standard for the quantification of large artery stiffness. In this study we propose a novel, non contact laser-based technique (laser class II ∼ laser pen), named optical Vibrocardiography (VCG), for evaluating PTT from synchronous recorded vibrations of the skin at the carotid and femoral artery site. It has been demonstrated that these skin vibrations are directly related to the radial displacement of the underlying arteries, and are hence related to the passage of the pressure pulse. In this feasibility study, measurements were performed on 14 young male healthy subjects (25.3 ± 0.8) using 2 commercially available vibrometers (Polytec Gmbh, Waldbronn ,