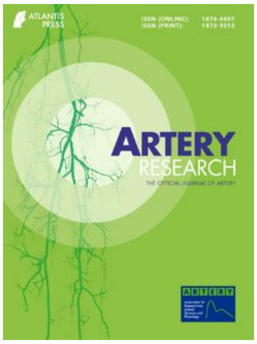

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P6.20: VASCULAR ACCESSES FOR HAEMODIALYSIS IN THE ARM CAUSE GREATER REDUCTION IN THE CAROTID-BRACHIAL STIFFNESS THAN THOSE IN THE FOREARM: STUDY OF GENDER DIFFERENCES

D. Bia, E.I. Cabrera-Fischer, Y. Zócalo, C. Galli, S. Graf, R. Valtuille, H. Pérez, M. Saldías, I. Álvarez, R.L. Armentano

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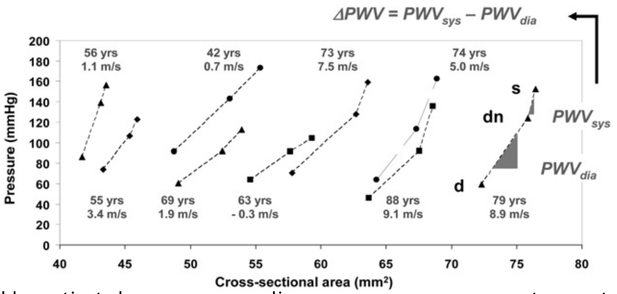
Methods and Results: In 29 patients (21m/8f), carotid artery blood pressure and CSA waveforms were obtained by catheter and ultrasound. Diastolic, systolic and dicrotic notch amplitudes were determined for each individual (Figure). In 15 older patients (77±5yrs) compared to 14 younger (59±7yrs) carotid ΔPWV and CSA were increased (+2.6m/s and +7mm^2, resp., $p<0.03$), despite similar blood pressures. Moreover, in multiple regression analyses, age was a determinant of both ΔPWV and CSA, independent of sex, height and pulse pressure ($p<0.01$).



Older patients have a more non-linear preessure-area curve, at a greater cross-sectional area. Tags shows age and ΔPWV of the subjects. S denotes systolic; d, diastolic; dn, dicrotic notch. (Only a sample of 29 is shown for clarity.) PWV values are calculating using Bramwel-Hill: PWV=sqrt(1/rho* distensibility).

Conclusions: Our study demonstrates detectable age-related differences in carotid stiffness non-linearity and cross-sectional area, suggesting these may act as markers of vascular ageing.

P6.18

COMPARISON OF ARTERIAL STIFFNESS ASSESSED BY ARTERIOGRAPH WITH ARTERIAL STIFFNESS ASSESSED BY APPLANATION TONOMETRY AND ECHOTRACKING: A CLINICAL STUDY

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Introduction: Large artery stiffness is recognized as a strong, independent marker of cardiovascular risk, mainly through aortic pulse wave velocity (PWV). Arteriograph is a new non-invasive oscillometric method, which estimates aortic PWV through brachial pressure wave analysis. In a previous study, Trachet et al. *(Annals of Biomedical Engineering* 2010) have shown, using a numerical model of arterial tree, that Arteriograph measured a brachial stiffness instead of aortic stiffness.

Aim: To compare PWV with Arteriograph (Ar PWV) to carotid-femoral PWV (CF PWV), carotid-radial PWV (CR PWV) and carotid-humeral PWV (CH PWV). And to compare Ar PWV to carotid stiffness (CS) and humeral stiffness (HS).

Methods: CF, CH, and CR PWV were assessed by applanation tonometry (SphygmoCor®). Ar PWV was assessed by Arteriograph and CS, HS were assessed by echotracking system (Mylab®). Pearson's correlation coefficient, r, between the methods was calculated.

Results: 43 subjects were included: 20 healthy subjects and 23 patients with essential hypertension. The correlation between CF PWV and Ar PWV is good and significant in healthy subjects and all subjects ($r=0.77$ and $r=0.76$ respectively $p<0.001$), and weak but not significant in hypertensive subjects. The same with CS in all subjects only ($r=0.72$, $p<0.001$) There are no significant correlation between Ar PWV and CH PWV, CR PWV, HS.

Conclusion: Arteriograph is well correlated with CF PWV and CS in all subjects but not with brachial stiffness. Nevertheless, it is necessary to include more subjects in this study to see if the correlation is as well in healthy subjects and hypertensive patients.

P6.19

EFFECTS OF CARDIAC MOTION ON THE LEFT CORONARY ARTERY FLOW RATE

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The aim of this work was to investigate the effects of physiologically idealized cardiac-induced motion on flow rate in human left coronary arteries. The blood flow rate were numerically simulated in a elastic modelled left anterior descending coronary artery (LAD) having a uniform circular cross section of 3.6 mm diam. Blood was considered to be a non-Newtonian fluid and Arterial motion was specified based on monoplane physiologically idealized bending. Simulations were carried out with dynamic pressure difference conditions between inlet and outlet in both fixed and moving LAD models, to evaluate the relative importance of LAD motion, flow rate, and the interaction between motion and time-averaged flow rate. LAD motion was caused variations in time-averaged flow rate magnitude about 30% of the fixed models. There was significant variability in the magnitude of this motion-induced flow variation. However, the magnification of time-averaged flow rate is depending to specification of the cardiac motion. Furthermore, the effects of pressure pulsatility dominated LAD motion induced effects; specifically, there were local flow variation and secondary flow in the simulations conducted in moving LAD models. LAD motion has big effect on time-averaged flow rate and secondary flow. Therefore, the hemodynamic effects of LAD motion can not to be ignored as a first approximation in modelling studies.

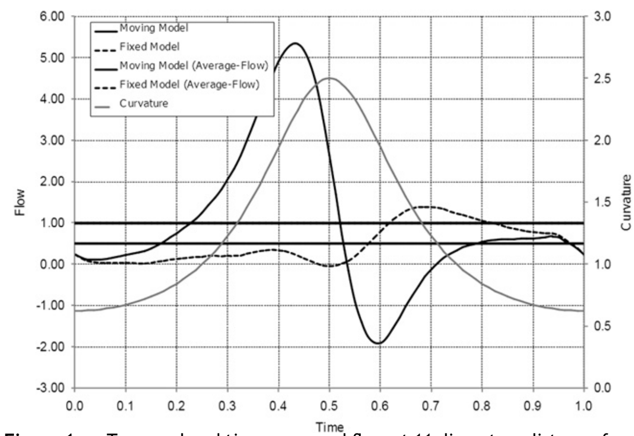

Figure 1 Temporal and time-averaged flow at 11 diameters distance from the LAD inlet for both moving and fixed models.

P6.20

VASCULAR ACCESSES FOR HAEMODIALYSIS IN THE ARM CAUSE GREATER REDUCTION IN THE CAROTID-BRACHIAL STIFFNESS THAN THOSE IN THE FOREARM: STUDY OF GENDER DIFFERENCES

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Purpose: to evaluate in chronically-haemodialysed patients (CHP) if, 1) the vascular access (VA) position (arm or forearm) is associated with differential changes in upper-limb arterial stiffness; 2) differences in arterial stiffness exist between genders associated with the VA; 3) the vascular substitute (VS) of choice, in biomechanical terms, depends on the previous VA location and CHP gender.

Methods: Clinical and biochemical parameters and left and right carotid-brachial pulse wave velocity (PWVcb) were measured in 38 CHP (males:18; Age:53±17 years; VA in arm:18). In *in vitro* studies, PWV was obtained from ePTFE prostheses and human arterial and venous homografts (brachial, femoral and carotid arteries and saphenous veins). The biomechanical mismatch (BM) between CHP native vessel (NV) and VS was calculated.

Results: PWVcb in upper-limbs with VA was lower than in the intact contralateral limbs, and differences were higher ($P<0.02$) when the VA was performed in the arm. Differences between PWVcb in upper limbs with VA (in the arm) with respect to intact upper-limbs were higher ($P<0.01$) in males than in females. Independently of the arterial region in which the VA was performed, the type of homograft that ensured the minimal BM was the brachial artery. The BM between VS and NV was highly dependent on gender and the location in the upper-limb in which the VA was performed.

Conclusions: In CHP, both gender and the arterial territory in which the VA is performed determined differences in arterial stiffness. BM between VS and NV determines different prostheses alternatives in the VA construction.

P6.21

THE STIMULATION OF THE VISUAL CORTEX RESULTED IN THE BLOOD FLOW INCREASE IN THE ENTIRE POSTERIOR CIRCULATION TERRITORY

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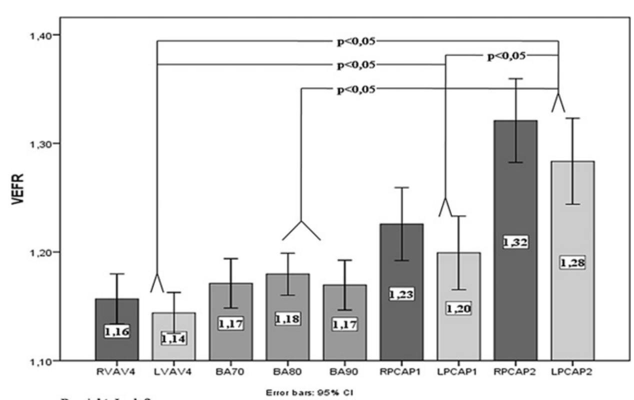
We hypothesized that visual stimulation results in blood flow increase in all main arteries of the posterior circulation territory (PCT). In an attempt to establish relation between visual stimulation and blood flow, we assessed visually evoked cerebral blood flow response (VEFR) in vertebral (VA), basilar (BA) and posterior cerebral arteries (PCA).

Methods: The study population consisted of 65 healthy volunteers (aged 21—57, median-35) subjected to elementary photostimulation (opening and closing of the eyes). We measured velocity and resistivity index (RI) using transcranial Doppler in VA (V4 segments), BA (in three different depths: 70mm, 80mm and 90mm), and PCA (P1 and P2 segments).

Results: Following photostimulation, we observed a significant increase in velocity and a decrease in RI in all arteries, in comparison with baseline values. The maximum VEFR was observed in PCA(P2) (Fig.1). The significant differences were detected between VEFR in VA and PCA (all segments), between VEFR in PCA(P2) and BA (all depths), PCA(P2) and PCA(P1). VEFR in BA was the same on different depths. VEFR was higher in right PCA and VA, although the difference was not statistically significant. Correlation analysis revealed significant relations between VEFR in left and right VA ($r=0.59$), PCA(P1) ($r=0.35$), PCA(P2) ($r= 0.41$) and between VEFR in BA in different depths ($r=0.64—0.75$). No significant correlations were observed for VEFR in different arteries.

Conclusions: VEFR is detected in all main arteries of the PCT. VEFR gradually increases as one goes from proximal segments to distal ones. The maximum VEFR is observed in PCA(P2).



P6.22

USE OF THE RIGHT VERSUS THE LEFT CAROTID ARTERY: IS THERE ANY DIFFERENCE WHEN MEASURING AORTIC PULSE WAVE VELOCITY?

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Background and aim: Aortic pulse wave velocity (aPWV) derived by use of applanation tonometry is a non-invasive method for assessment of arterial stiffness. Current methodology in aPWV assessment dictates ipsilateral measurements. However, the carotid arteries (CA) branch slightly differently from the aorta towards the right and left side of the neck. Theoretically, using right or left CA could influence aPWV results.

We aim to elucidate if use of the right or the left CA affects aPWV and to determine intra- and inter-observer reproducibility of aPWV in healthy subjects.

Methods: 50 healthy individuals without known cardio-vascular disease, aged 23-66 years, were examined twice by two different observers in a random order. The measurements were performed with the SphygmoCor© equipment using both the right and the left CA. In each subject, the same femoral artery was used in all measurements.

Results: with intra-class correlation coefficients (ICC) are shown in Table 1 and 2. Use of the right CA gave significantly higher aPWV values than the left CA (both observers and pooled data). When comparing the two observers, we found a significant difference (0.3±0.8 m/s, $p=0.02$) in right CA derived aPWV values. There was no inter-observer difference in left CA derived aPWV values.

Conclusion: Using right or left CA affects aPWV. We strongly suggest using the same CA and the same femoral artery in repeated measurements. Inter-observer differences are important to consider when using aPWV and could be minimized by training and if possible by using the same observer.

Table 1		Observer 1			Observer 2			Inter-observer
		Mean ±SD (m/s)	*p value (ICC)*	*Mean 1st, 2nd ±SD (m/s)*	*Mean ±SD (m/s)*	*p value (ICC)*	*Mean 1st, 2nd ±SD (m/s)*	*p value (ICC)*
Right carotid aPWV	1.	6.4 ±1.3	0.47 (0.86)	6.4 ±1.2	6.7 ±1.2	0.95 (0.87)	6.7 ±1.3	0.02 (0.79)
	2.	6.4 ±1.3			6.7 ±1.4			
Left carotid aPWV	1.	6.3 ±1.2	0.75 (0.76)	6.3 ±1.1	6.5 ±1.3	0.49 (0.84)	6.4 ±1.2	0.13 (0.77)
	2.	6.3 ±1.1			6.4 ±1.2			

Table 2	Right versus left carotid artery			
	Right carotid aPWV (m/s)	Left carotid aPWV (m/s)	Difference right-left (m/s)	*p value (ICC)*
Observer 1 *(mean 1st, 2nd ±SD)*	6.4 ±1.2	6.3 ±1.1	0.1 ±0.4	0.04 (0.93)
Observer 2 *(mean 1st, 2nd ±SD)*	6.7 ±1.3	6.4 ±1.2	0.2 ±0.6	0.007 (0.87)
Pooled data *(mean Obs1, Obs2 ±SD)*	6.5 ±1.2	6.4 ±1.1	0.2 ±0.4	0.002 (0.93)

P7 — Population Studies 2

P7.01

AORTIC PULSE WAVE VELOCITY, ESTIMATED WITH A SIMPLIFIED METHOD BASED ON RADIAL WAVEFORMS AND BODY HEIGHT, PREDICTS CARDIOVASCULAR EVENTS

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Background: The prognostic role of aortic pulse wave velocity (aPWV) is well known. Its non-invasive determination (carotid-femoral PWV) is inconvenient, and easier yet accurate methods could be of value to facilitate the adoption by clinicians.

Methods: We recently developed the ARCSolver method to estimate aortic flow from pressure waveforms. Characteristic impedance is derived from this, and finally aPWV, using Waterhammer equation. Travel distance is estimated from body height, using a previously developed formula. In this study, we tested the prognostic value of the estimated aPWV, in comparison with invasively measured aPWV, in 620 patients (mean age 63 years, 43% women, 19% diabetes, 41% coronary artery disease) undergoing coronary angiography.

Results: Both methods for assessing aPWV showed moderate agreement ($R^2 = 0.51$, $p<0.0001$). After a follow-up of 3 years, 90 patients suffered from cardiovascular events (death, myocardial infarction, stroke, coronary and peripheral revascularizations). In univariate analysis, an increase in aPWV of one standard deviation was associated with a 42.1 (CI 15.7 — 74.6) % (estimated aPWV) and 36.2 (CI 17.8 — 57.5) % (measured aPWV) increased risk for cardiovascular events. In stepwise logistic regression models, including age, gender, presence of smoking, hypertension and diabetes, extent of coronary artery disease, systolic function, systolic and diastolic blood pressure, heart rate, and aPWV, both estimated (HR 1.48 per SD, $p=0.001$) and measured (HR 1.32 per SD, $p=0.002$) aPWV showed a statistically significant association with cardiovascular events.

Conclusion: Our results indicate that a simplified method to estimate aPWV can predict cardiovascular events in high-risk patients.