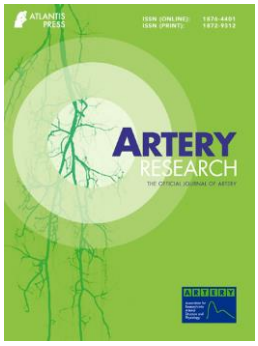

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P8.07: CUTANEOUS LASER-DOPPLER FLUX RESPONSE TO PHYSIOLOGICAL STIMULI

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Results: All four cSBP estimates were highly correlated (R>0.97).
Conclusion: When using both devices as advocated by their manufacturers, the mean difference in cSBP is 18.6 (4.5) mmHg. Carotid SBP is in the middle between the Omron and SphygmoCor estimates, indicating that the 'true' central cSBP should be sought between the Omron and SphygmoCor estimates.

P8.03
ASSESSMENT OF CAROTID ELASTICITY IN EXERCISE: A REPRODUCIBILITY STUDY

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Arterial stiffness may vary with physiological stimulus and therefore, its quantification in dynamic conditions could enhance the characterization of vascular elastic properties. The aim of this study was to evaluate the feasibility of the assessment of carotid artery's elasticity during exercise in terms of reproducibility.
Eighteen healthy volunteers (9 men, 34±3 years) underwent a maximal exercise testing on a graded semi-supine cycle ergometer. Ultrasound B-mode image sequences (DICOM format, high frame-rate) of right common carotid arteries were acquired at different steps (60%, 70%, 80% and 85% of maximal heart rate), and analysed by an automatic system (Carotid Studio, IFC-CNR) for the measurement of arterial diastolic diameter (D) and distension (ΔD). In addition, central pulse pressure (PPa) was estimated by tonometry (radial-aortic transfer function, Sphygmocor, AtcorMedical). Cross-sectional compliance (CC) and distensibility (DC) coefficients were then obtained for each step of the examination. Subjects were analysed in two different sessions 7 days apart, in order to evaluate intersession reproducibility of the measurements; variability was expressed as coefficient of variation (CV) for each step of the examination. At rest CVs were 3%±3% for D, 8%±6% for ΔD, 8%±6% for PPa, 9%±8% for CC and 10%±6% for DC.
During exercise maximal variability was found at peak: 7%±5% for D, 12%±8% for ΔD, 11%±7% for PPa, 19%±6% for CC and 24%±15% DC.
The reproducibility of carotid parameters, which is excellent at rest, remains more than satisfactory during exercise. Hence, the proposed approach might be used for investigating the dynamic behaviour of arterial elasticity.

P8.04
CAROTID INTIMA-MEDIA THICKNESS: COMPARISONS BETWEEN SEMI-AUTOMATIC EDGE DETECTION METHOD VERSUS A NEW AUTOMATIC ECHO TRACKING SYSTEM

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Rationale: The intima-media thickness (IMT) of the common carotid artery is a widely used clinical marker of cardiovascular diseases. To date, IMT is measured from longitudinal B-mode ultrasound images using manual or imaging analysis methods. Real-time automatic tracking of the lumen-intima and media-adventitia echoes using multi-echotracking technology could overcome some limits of manual and imaging analysis methods.
Material and methods: Common carotid intima-media thickness measured with a new multi-echotracking system (QIMT — Esaote - Italy) was compared to a semi-automatic edge detection imaging analysis method (IMT@televasc, www.televasc.fr, France) from B-mode ultrasound images.
Results: 93 scans were analyzed with both techniques on the same scans and from both carotids in 57 patients (age 55 +/- 17, 34 males). Mean QIMT was higher than IMT@televasc (690+/-173 vs 662+/-135, p<0.0001). Coefficient of variability for QIMT was 5% and 16 % for the IMT@televasc without significant inter-observer differences. Correlation coefficient were r= 0.657 (p<0.001, QIMT = IMT@televasc . 0.84 (+/-0.09) + 134+/-66 μm). Bland Altman plot did not showed systematic bias.
Discussion: QMIT gives more reproducible values of IMT than IMT@televasc with a significant correlation between the 2 methods. There was a systematic difference in absolute value between both techniques, values provided being higher with QIMT than with IMT@televasc. Conversion tables are needed for comparisons between echotracking technology and edge detection imaging analysis method for the routine use and follow up of the patients.

Acknowledgements: Mr Martin D, Esaote company and V de Germain, Televasc

P8.05
INFLUENCE OF CENTRAL AND PERIPHERAL ARTERIAL STIFFNESS ON THE TIMING AND AMPLITUDE OF REFLECTED PRESSURE WAVE

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Background: Central stiffness is associated with increased pressure wave reflection. It is lower than peripheral in most subjects, but the reversal of central to peripheral stiffness gradient may occur at higher age and it may influence the mechanisms of wave reflection.
Objective: To evaluate the relationships of central and peripheral arterial stiffness to the parameters of wave reflection.
Methods: 528 untreated subjects, aged 25 to 74 years, selcted from general population, were examined. Pulse wave velocity on aorta (aoPWV) and on lower extremity (periphPWV) were measured by Sphygmocor. Wave reflections were assessed using carotid pulse waveform analysis.
Results: 46 subjects with the reversal of stiffness gradient (aoPWV > periphPWV). They had longer effective reflection distance (ERD; p<0.001 in both sexes); their carotid augmentation pressure (CAP) was higher in males (p<0.01), but not in females. We further studied the simultaneous influence of central and peripheral stiffness on parameters of wave reflection in the whole population in multiple linear regression. AoPWV predicted highly significantly (p<0.001) the parameters of wave reflection in both sexes, while periphPWV was only weakly positively associated with CAP in females (p<0.01) and ERD in males (p<0.05).
Conclusions: Reversal of stiffness gradient was uncommon in our sample. It was associated with prolongation of ERD, but the augmentation pressure was not decreased. These results do not confirm the previously published hypothesis that the reversal results in lower reflected wave and is therefore beneficial in older patients. The contribution of muscular-type artery stiffness to the timing and amplitude of reflected wave was small.

P8.06
DISCREPANCIES IN ESTIMATES OF LV ELASTANCE OBTAINED BY NON-INVASIVE METHODS

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LV elastance (Elv) denotes the slope of a line connecting a series of end-systolic pressure-volume relations during a load intervention. Non-invasive estimation is often done as LVESP/LVESV (simplified method, SM; smElv) which assumes that (A) intra-LV systolic blood pressure (smSBP) = 0.9 x brachial BP and (B) the Elv line intersects the volume axis (V_0) at zero. A more robust method exists which does not make assumption B (gold standard (GS) Elv: gsElv) but requires complex computation. We evaluated SM against GS in 22 consecutive patients (7 with heart failure, 32%; mean LVEF 43 ± 19%) attending our laboratory for echocardiography. Central pressure waveforms were obtained (radial artery tonometry; SphygmoCor, AtCor Medical, Sydney, Australia) and GS intra-LV SBP (gsSBP) was computed (aortic SBP + trans-aortic gradient; continuous-wave Doppler). gsElv was calculated as described previously.[1] smSBP and smElv were calculated as above. We found that intra-LV SBP was underestimated by SM (smSBP 117 ± 17 vs. gsSBP 126 ± 20 mmHg; p=0.002). The mean between-method difference was -8.4 ± 6.7 mmHg, range +6.5 to -17 mmHg). Nonetheless, SM overestimated Elv (smElv 3.4 ± 0.5 vs. gsElv 1.9 ± 0.8 mmHg/mL; p<0.001. The mean between-method difference (1.5 ± 0.7 mmHg/mL; range 0.6 to 2.7 mmHg/mL) was larger the more V_0 differed from zero (0.06 ± 0.03 mmHg/mL per 10 mL change in V_0; r=0.71, p<0.01). In conclusion, Elv obtained by SM differs markedly vs. GS, as a result of assumptions A and B.
Reference
1. Chen et al. JACC 2001;38:2028-34.

P8.07
CUTANEOUS LASER-DOPPLER FLUX RESPONSE TO PHYSIOLOGICAL STIMULI

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There is a predominance of sympathetic over parasympathetic activity in patients with developed essential hypertension. We were interested in

knowing whether reactivity of microvessels is different in young healthy adults with family history of hypertension and those without.
Experiments were performed on 38 healthy adults 19-24 years old. We measured ECG, arterial blood pressure and laser-Doppler (LD) flux in the skin of the fingertips first at rest in the supine position, then 3 minutes while having legs passively raised and finally 3 minutes with having them put down to supine position again. Subjects were divided in two groups: those that had hypertension in family history (N=17) and those that had not (N=21). There were no differences in systolic and diastolic blood pressure or in RR interval between the two groups. The study has ethical approval and the consent has been obtained from each subject.
The two groups of subjects showed significant difference in the LD flux while having legs lowered down again. Those without hypertension in family history exhibited greater LD flux than at rest (112.5±10%), while those with hypertension in family history exhibited smaller LD flux than at rest (83.6±8%) (t-test, $p<0.05$).
During physiological manoeuvre of lifting and lowering the legs in supine position young healthy adults show difference in the reactivity of skin vessels. It seems that sympathetic vasomotor action is pronounced or prolonged in subjects with hypertension in family history.

P8.08
A METHOD COMPARISON OF CENTRAL BLOOD PRESSURE MEASUREMENTS BY PULSECOR AND SPHYGMOCOR DEVICES

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Background: Estimated aortic (or central) systolic pressure (cSBP) differs from peripheral pressure and may be a better predictor of cardiovascular events. SphygmoCor® (AtCor, Sydney, Australia) uses applanation tonometery to derive cSBP by application of a generalised transfer function to radial pulse waveforms. PulseCor® (PulseCor, Auckland, New Zealand) is a new device that estimates cSBP from suprasystolic brachial cuff waveforms. We compared blood pressures measured by both devices.
Methods: 30 individuals (67.2±5yrs) underwent consecutive radial (SphygmoCor) and brachial (PulseCor) waveform measures. Method comparison was performed by Bland Altman analysis in Stata 11.0.
Results: Measurements made by the two devices were similar (Table 1). cSBP estimated by PulseCor tended to be higher than SphygmoCor, although the difference was within the American Association for the Advancement of Medical Instrumentation (AAMI) standards (< 5mmHg and SD_{diff} was <8mmHg). Bland Altman analysis showed no systematic bias between devices across the range of blood pressures measured.

Variable	PulseCor	SphygmoCor	Difference	LOA
Brachial SBP, mmHg	140.7 (13.1)	140.5 (13.0)	0.2 (1.4)	-2.4, 2.9
Brachial DBP, mmHg	84.7 (9.3)	84.7 (9.3)	0.0 (0.0)	0.0, 0.0
HR, bpm	65.4 (16.1)	64.6 (14.3)	0.8 (5.7)	-10.3, 11.9
Central SBP, mmHg	135.0 (12.8)	131.4 (13.0)	3.6 (4.3)	-4.9, 12.0
Central DBP, mmHg	85.8 (9.5)	85.4 (9.7)	0.3 (0.7)	-1.1, 1.7

DBP, diastolic blood pressure; HR, heart rate; SBP, systolic blood pressure; LOA, limits of agreement. Data are means (SD).
Conclusions: PulseCor and Sphygmocor give similar estimates of central blood pressures. The slightly higher cSBP measured by PulseCor could relate to the use of brachial rather than radial pressure to calibrate SphygmoCor.

P8.09
A COMPARISON OF CENTRAL BLOOD PRESSURES, AUGMENTATION INDEX AND PWV ESTIMATED BY «BPLAB VASOTENS» AND SPHYGMOCOR

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Aortic pulse wave velocity (PWV), wave reflection, measured as central augmentation index (AIx) and central (aortic) blood pressure (cSBP) are independent predictors for total and cardiovascular morbidity and mortality. The «BPLAB VASOTENS» is a new cuff-based, operator-independent device which obtains brachial BP waveforms derives (and saved in memory during 24-h) cSBP, AIx and PWV using brachial-to-aortic transfer function.
Aim: Compare «BPLAB VASOTENS» to standard techniques for measuring cSBP, AIx and PWV (SphygmoCor) in normotensive and hypertensive subjects.
Methods: 75 subjects (53 ± 12 years, 42% males) without cardiovascular diseases and with arterial hypertension were studied after 10 minutes of supine rest. Brachial pressure waveforms calibrated to brachial systolic and diastolic pressure were recorded using the «BPLAB VASOTENS» and radial pressure waveforms calibrated to brachial mean and diastolic pressure were recorded using the SphygmoCor. The corresponding cSBP, AIx, PWV measurements were compared between devices (cSBPbp vs cSBPshyg, Aixbp vs AIxshyg, PWVbp vs PWVshyg).
Results: There was good agreement between cSBPbp (123 ± 19mmHg) and cSBPshyg
(120± 18mmHg; $p<0.01$, $r=0.92$, $p<0.01$). Moderate results were observed for AIx − 27± 6 vs 27 ± 11 ($p=0.8$, $r=0.64$, $p<0.01$) and for PWV − 7.7± 0.6 m/s vs 7.9± 1.9 m/s, $p=0.5$, $r=0.45$, $p<0.01$).
Conclusions: the values of cSBP, but not Aix and PWV provided by the «BPLAB VASOTENS» and SphygmoCor devices show good agreement. Further comparative data are required in a larger sample size, and with invasive BP measurements.

P8.10
LOCAL CAROTID PULSE WAVE VELOCITY ASSESSMENT: A VIBRATIONAL APPROACH

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Arterial stiffness is a key parameter in evaluating vascular health. When locally evaluated at carotid site, it well correlates with the stage of degenerative atherosclerotic process and it could be considered an useful indicator of global cardiovascular risk.
At the present, the state-of-the-art methods for evaluation of local carotid stiffness are based on the analysis of vascular distensibility and local tonometry.
Aim of this work is to introduce a new system for local carotid pulse wave velocity (PWV) assessment based on the evaluation of the vibrations locally induced by the propagation of the arterial pulse pressure.
Eight young healthy subjects (28.4±2.1 years, 62.5% males, BMI 21.6±2.14 kg/m^2) have been recruited.
Two percutaneous accelerometers were placed on the neck of each subject few centimetres apart along a straight segment of the common carotid artery. The accelerometric signals were acquired and processed beat-to-beat in order to obtain the temporal value (i.e. pulse transit time, PTT) at which the maximal degree of similarity between them was obtained. In particular, ad-hoc fiducial points have been chosen, allowing an optimal signal alignment. The mean PWV, calculated from the distance (mean 3.81±0.58 cm) between the position of the two accelerometers and the PTT, was 3.16±1.09 m/s, a reasonable value for elastic artery of young people.
In conclusion, a new cheap, easy-to-use and non-invasive system for local carotid pulse wave velocity assessment based on the analysis of local vibrations is proposed. For its characteristics it might be considered as a valid alternative to available approaches.

Epidemiology
P9.01
DETERMINANTS OF ARTERIAL STIFFNESS: A 16-YEAR FOLLOW-UP FROM THE WHITEHALL II STUDY

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Background: Although several risk factors for cardiovascular disease (CVD) have been shown to be associated with arterial stiffness, the relative importance of these determinants is largely unknown. The aim of this study is to compare the relation between a wide range of baseline CVD risk factors and arterial stiffness 16 years later in a middle-aged population of civil servants.
Methods: We studied 3591 participants of the Whitehall II cohort. At baseline (1991-1993) blood pressure, BMI, waist and hip circumference, a lipid profile, fasting and 2-hour glucose were measured, and information on physical activity, alcohol intake, smoking habits, and employment grade was collected. At follow-up (2007-2009) arterial stiffness was assessed by carotid-femoral pulse wave velocity (PWV). Medication use, incident diabetes and coronary heart disease (CHD) events were assessed throughout