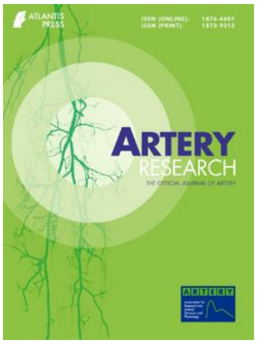

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P2.13: INVESTIGATION OF REGIONAL CAROTID MECHANICS USING ULTRASOUND SPECKLE TRACKING IMAGING (STI) AND THE INFLUENCE OF CAROTID AND AORTIC STIFFNESS, CARDIAC PARAMETERS ON CAROTID STRAIN

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P2.11
THE IMPACT OF ATRIAL FIBRILLATION AND PACEMAKERS ON ACCURACY OF CENTRAL BLOOD PRESSURE MEASURED BY A NOVEL CUFF-BASED TECHNIQUE

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Background: Non-invasive measurement of Central Blood Pressure (CBP) in the clinic setting is the advantage of the validated, tonometer-based SphygmoCor device. Recently, a novel brachial cuff-based SphygmoCor device (XCEL) has been tested and validated against the tonometer-based method of CBP measurement. We investigated the accuracy of the XCEL measurements in patients with Atrial Fibrillation (AF) and pacemakers.
Methods: Group demographics are listed in the Table. Tonometric and cuff-based assessment of CBP was made in triplicate in a randomized fashion after a period of seated acclimatization. The difference in central systolic (cSBP), diastolic (cDBP), pulse pressure (cPP) and augmentation index normalised to a heart rate of 75 beats/min (AIx75) were analysed. The agreement between parameters for each of these two non-invasive devices was evaluated using Student's paired t-tests and the Bland-Altman method.
Results: The difference between cSBP, cDBP, PP and AIx75 measured on the two devices in all groups is summarized in the Table. The mean and standard deviation of the difference of blood pressure values for each group were within the limits of international guidelines for blood pressure measurement (Table).
Conclusion: The cuff-based, SphygmoCor XCEL technique for non-invasive measurement of central blood pressure parameters has good agreement with the tonometer-based SphygmoCor device in patients with AF or pacemakers and could be used in routine evaluation of such patients in cardiac clinics.

	AF group	Pacemaker group	Without AF/ pacemaker
n	14	23	146
Men	8	13	123
Age (years)	76±11	79±10	65±16
Brachial SBP (mmHg)	121±15	129±17	129±16
Brachial DBP (mmHg)	68±11	69±7	71±10
Heart rate (bpm)	68±12	65±10	67±11
Mean difference between devices of:			
cSBP (mmHg)	-4.2±7.1*	-0.5±6.6	-0.6±6.3
cDBP (mmHg)	-3.8±5.9*	-2.3±3.1**	-1.5±3.8***
cPP (mmHg)	-0.7±8.9	1.5±5.6	1.0±5.7*
Aix75 (%)	-5.6±9.7	-3.1±7.6	-3.5±9.1***

* p<0.05, ** p<0.01, *** p<0.001

P2.12
NON-INVASIVE ESTIMATES OF CARDIAC OUTPUT: COMPARISON OF A NOVEL PULSE WAVEFORM ANALYSIS METHOD WITH INERT GAS RE-BREATHING

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Objectives Non-invasive, cuff-based systems are currently available for the assessment of central haemodynamic parameters. The aim of the current study was to compare measurements of cardiac output (CO) derived from pulse waveform analysis (Vicorder) with an inert gas re-breathing method (Innocor) in response to postural change, (study 1) and mild exercise. (study 2).
Methods Study 1 included 27 subjects, mean age 35±9 years. Haemodynamic indices were measured after 10 minutes each of supine rest, standing and further supine rest. Study 2 included 30 subjects, mean age 35±8 years. Haemodynamic indices were measured after resting on an upright cycle ergometer, and during the final minute of 5 minutes of steady-state cycling at 20rpm and 35rpm, corresponding to 12 and 20 watts respectively.
Results Overall, values of CO and SV were significantly correlated between devices (r=0.42, p=0.001, CO) and (r=0.27, p=0.001, SV). There was reasonable agreement between devices with a mean difference (±SD) in CO of 0.8±2.7 L/minute (supine) 0.7±2.5 L/minute (standing) and 0.7±1.3 (final supine). Similarly, in study 2, the mean differences were 0.4±3.6 L/minute (resting), 0.2±4.3 L/minute and 0.8±3.5 L/minute cycling at 20rpm and 35rpm respectively. The direction and magnitude of the changes in CO detected with each device were similar (Figures 1&2).
Conclusions: The Vicorder and Innocor devices produce similar estimates of CO at rest and detect similar changes in CO in response to physiological challenges. Moreover, the Vicorder is a simple-to-use, cost-effective device that may be considered for comprehensive haemodynamic monitoring.
Figure 1

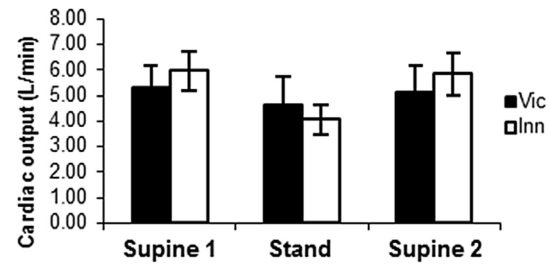
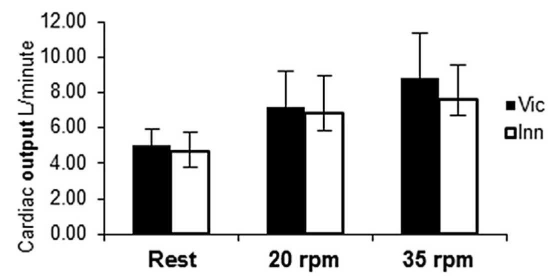


Figure 2



P2.13
INVESTIGATION OF REGIONAL CAROTID MECHANICS USING ULTRASOUND SPECKLE TRACKING IMAGING (STI) AND THE INFLUENCE OF CAROTID AND AORTIC STIFFNESS, CARDIAC PARAMETERS ON CAROTID STRAIN

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Objective: To investigate carotid strain and displacement and to assess their relations with arterial stiffness and cardiac systolic and diastolic parameters.
Methods: Study population consisted of 40 healthy subjects (aged 17-38, median-22). All subjects underwent comprehensive transthoracic echocardiography and ultrasound carotid exams. Peak carotid longitudinal, circumferential strains and longitudinal and radial displacement were measured using two-dimensional Speckle Tracking Imaging. Aortic (at the level of aortic root) and carotid stiffness was calculated using wall-tracking software.
Results: Values for carotid strains and displacements are shown in table 1. Test-retest reliability was higher for longitudinal strain and displacement as compared to radial displacement. Univariant analysis revealed direct associations between longitudinal carotid displacement and carotid (r=0.78) and aortic (r=0.66) distensibility coefficient (p<0.01). Direct correlations were also observed between carotid longitudinal strain and left ventricular (LV) fractional shortening (r=0.33), E/A (r=0.30), relative LV posterior wall thickness (r=0.28), ventricular septum thickness (r=-0.25) (p<0.05). These relations were tested by multivariate linear regression after adjusting for potential confounders (age, blood pressure, male gender, weight). The model demonstrated that both systolic and diastolic heart parameters are independent determinants of longitudinal carotid strain (Table 2).
Conclusions: Carotid strain and displacement are important reproducible parameters of regional carotid mechanics. They are directly related with both aortic and carotid stiffness. Both systolic and diastolic parameters of

left ventricular influence the carotid strain. Change in longitudinal carotid strain might serve as an early marker of cardiovascular disease.

Table 1 Peak Longitudinal (L) and Circumferential (C) Strain (S) and Strain Rate (SR), Longitudinal (L D) and Radial (R D) Displacement of carotid arteries

L S, %	L SR	L D, mm	C S, %	C SR	RD, mm
10.8±4.1	1.5±0.6	0.45±0.1	7.8±1.7	0.8±0.17	0.27±0.6

Data is expressed as mean ± SD; L S — peak Longitudinal Strain, L SR — peak Longitudinal Strain Rate, L D — peak Longitudinal Displacement, C S — peak Circumferential Strain C SR — peak Circumferential Strain Rate, R D — peak Radial Displacement

Table 2 Independent relations of longitudinal carotid strain with arterial stiffness and cardiac parameters

	β	*p*
Carotid Stiffness β	**-0.49**	**0.03**
Aortic Stiffness, β	**-0.42**	**0.04**
LV fractional shortening	**0.38**	**0.048**
relative LV posterior wall thickness	0.19	0.16
ventricular septum thickness	0.17	0.24
E/A	**0.40**	**0.045**

P2.14

COMPARISON OF AGE-RELATED CENTRAL AORTIC BLOOD PRESSURE PARAMETERS USING TWO SPHYGMOCOR TECHNIQUES

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Background. Central aortic blood pressure (CBP) parameters are increasingly proved to be stronger predictors of cardiovascular outcomes than peripheral blood pressure parameters. Aortic stiffness, which increases with age, alters these parameters. The aim of this study was to compare the CBP parameters measured by two SphygmoCor techniques: tonometric (Classic) and cuff-based (XCEL) with respect to age.
Methods: 186 individuals (mean age 68±45 years, range 21-93 years, 97 males) from general cardiac clinic patients were recruited. Tonometric and cuff-based assessment of central systolic blood pressure (cSBP), central diastolic blood pressure (cDBP), central pulse pressure (cPP) and augmentation index normalised to a heart rate of 75 beats/min (AIx75) was made in a randomized fashion after a period of seated acclimatization. Statistical analysis was performed by means of Analysis of Covariance (ANCOVA) with respect to device and age, with an interaction term between device and age to detect age dependent differences between devices.
Results. All parameters changed significantly with age (p<0.001). There was no significant difference between all parameters estimated by the two techniques (Table). The interaction term of device and age was not significant for any parameter, indicating that the devices did not differ with respect to age.
Conclusion. The new cuff-based SphygmoCor technique used for evaluation of CBP parameters in a clinical environment is a convenient and accurate proxy for the previous tonometric technique regardless of patient age.

				p		
Parameter	Device	Slope	Intercept	Device	Age	Age*device
cSBP/age	Classic	0.28±0.07	97±5	0.49	<0.001	0.58
(mmHg/yr)	XCEL	0.23±0.06	101±4			
cDBP/age	Classic	-0.16±0.04	82±3	0.66	<0.001	0.99
(mmHg/yr)	XCEL	-0.16±0.04	84±3			
cPP/age	Classic	0.45±0.06	14±4	0.55	<0.001	0.42
(mmHg/yr)	XCEL	0.39±0.05	17±3			
AIx75/age	Classic	0.22±0.04	6±3	0.13	<0.001	0.38
(%/yr)	XCEL	0.16±0.06	14±4			

P2.15 Withdrawn by author

P2.16

PULSE WAVE VELOCITY ASSESSED BY NON-INVASIVE TONOMETRY, IN ANESTHETIZED GÖTTINGEN MINIPIGS

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Introduction: Assessment of pulse wave velocity (PWV) is recognized as a marker of arterial stiffness within human medicine. Non-invasive evaluation of arterial structural changes in relation to atherosclerosis in porcine models of cardiovascular disease, would be valuable in longitudinal assessment of pathophysiological changes, e.g. in relation to drug effect.
Objective: To evaluate the feasibility and reproducibility of PWV in anesthetized male Göttingen minipigs.
Method: Animals were anesthetized every second day (three days in total) using constant intravenous infusion of ketamine and midazolam. Mean arterial blood pressure (MAP) assessed by oscillometry and heart rate (HR) were registered. PWV was calculated as the distance between the carotid and femoral artery divided by the time delay of pressure pulses, assessed by aplanation tonometry and simultaneously recorded electrocardiography (ECG).
Results: MAP was 87.6 mmHg ± 11.9 (mean ± SD), 80.5 mmHg ± 12.7 and 84.3 mmHg ± 19.4 at the three examinations respectively, and HR was 77 beats per minute (BPM) ± 12, 71 BPM ± 8 and 74 BPM ± 9. PWV was 6.3 m/s ± 2.19, 5.7 m/s ± 0.6 and 5.9 m/s ± 1.4, respectively. There was no significant effect of examination day, MAP, or HR on PWV, evaluated by analysis of variance. Mean inter-examination coefficient of variation was 16%.
Conclusion: Assessment of PWV is feasible in anesthetized Göttingen minipigs, and therefore could have perspectives in a porcine model of atherosclerosis. Furthermore, reference values from this study corresponded to PWV values obtained from infants or young human individuals.

P2.17

ECHOGENICITY OF THE COMMON CAROTID ARTERY INTIMA-MEDIA COMPLEX IN STROKE

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Introduction: Grey scale median of the carotid artery intima-media complex (IM-GSM) is a recently introduced measurement thought to reflect the composition of the arterial wall. Carotid artery intima-media thickness (IMT) has been shown to be a predictor of a future stroke incidence, but the relationship between IM-GSM and stroke is unclear. This study therefore examined IM-GSM in individuals with stroke.
Methods: Fifty-seven healthy individuals (CONTROL: 64.1±7.8yrs, 26F) and 96 individuals with cerebrovascular disease (either stroke or transient ischemic attack) diagnosed within 3 months before the study visit (CRVD: 68.6±9.8yrs, 30F) were included in this study. Common carotid artery diameter and far-wall IMT images were obtained using a Doppler ultrasound machine. IMT and IM-GSM were analyzed using semi-automated edge-detection software.
Results: Carotid diameter and IMT were greater in CRVD than CONTROL (all $p<0.005$). IM-GSM was significantly higher in CONTROL than CRVD (119.5±27.3au vs 105.8±30.3au, $p<0.01$). IMT and IM-GSM were similar between the carotid arteries of the affected and unaffected sides in CRVD. In a pooled data set, there was a significant reduction in IMT ($r=-0.53$) and wall-to-lumen ratio (WLR; $r=-0.50$) with the increase in the quartiles of IM-GSM (both $p<0.001$).
Conclusion: These results demonstrate that IM-GSM was lower in CRVD than CONTROL, and the level of IM-GSM appeared to be systemic in CRVD. The inverse association observed between IMT, WLR and IM-GSM may suggest an alteration in carotid artery wall composition with the degree of arterial remodelling.

P2.18

TOWARDS COMPUTATIONAL DIAGNOSIS OF CORONARY ARTERY DISEASE

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