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### **P1.10: LOCAL AORTIC STIFFNESS ESTIMATED BY A BIOELECTRICAL IMPEDANCE TECHNIQUE**

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Oscillometric bSBP/bDBP was used for brachial waveform calibration. Radial and brachial waveforms were consecutively obtained with applanation tonometry. Brachial MAP (bMAP) was derived from brachial tonometry by area method. Radial waveforms were calibrated to bSBP/bDBP and to bMAP/bDBP; cPP values were obtained for each calibration method, PPa was calculated as bPP/cPP, and brachio-radial PPa was the difference between the two PPa values.

On average, bSBP/bMAP/bDBP was  $129/94/72 \pm 16/12/9$  mmHg. PPa was  $1.42 \pm 0.25$  when radial wave was calibrated to bSBP/bDBP, and  $1.20 \pm 0.13$  after calibration to bMAP/bDBP. Brachio-radial PPa was  $0.22 \pm 0.17$ , and on average represented  $52 \pm 18\%$  of central-to-peripheral PPa. In a multivariate regression model, age, male gender, heart rate and cPP were all independent predictors of brachio-radial PPa.

**Conclusions:** Results suggest that brachio-radial PPa may represent a significant proportion of central-to-peripheral amplification. These findings require confirmation with invasive measurements.

	B	$\beta$	Multiple R	p
Heart rate, bpm	0.01	0.43	0.21	<0.01
Age, years	-0.01	-0.62	0.28	<0.01
Central PP, mmHg	0.01	0.58	0.49	<0.01
Gender, M	0.09	0.18	0.52	0.02

Stepwise multiple linear regression  
Brachio-to-radial PP amplification as dependent variable  
BMI, height, hypertensive status: n.s.

#### P1.09

##### VALIDATION OF A NEW NON-INVASIVE TONOMETER FOR DETERMINING AORTIC PULSE WAVE VELOCITY IN RATS

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Carotid-femoral pulse wave velocity (PWV) is an established method for characterizing aortic stiffness. At present, to determine PWV in rats, the gold standard method is a surgical invasive measurement; inevitably this leads to the animal's death. The objective of this study is to validate a new device for determining non-invasive PWV measurements which allows longitudinal studies in rats.

The PulsePenLab (DiaTecne), the device validated in this study, was derived from the PulsePen model, a validated high-fidelity tonometer, currently used to assess PWV non-invasively in humans. Two PulsePen tonometers recorded simultaneously carotid and femoral blood pressure pulse wave. The probes were positioned and fixed on the arteries by means of mechanical arms. The acquisition sample rate was 1KHz. Carotid-femoral PWV was determined by two operators, and measurements were repeated after a week. Immediately after this second test, a surgical invasive measurement of PWV was performed. The real sternum-carotid and sternum-femoral distances were compared with the external distances previously acquired by the two operators.

Now we present the preliminary data concerning the early 8 rats (Zucker fa/fa and Fa/Fa) included in this study. PWV determined by the PulsePenLab was compared with the traditional invasive measurement: the difference between the values of two measurements was  $0.13 \pm 0.66$  m/s,  $R=0.71$ . All values of difference were  $<1.0$  m/s. Reproducibility of measurements was determined by inter-observer coefficient of repeatability (0.92 m/s) and coefficient of variation (9.79%).

These preliminary data suggest that PulsePenLab is an efficient device for determining a non-invasive measurement of PWV in rats.

#### P1.10

##### LOCAL AORTIC STIFFNESS ESTIMATED BY A BIOELECTRICAL IMPEDANCE TECHNIQUE

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To date, aortic stiffness is evaluated by the reference tonometric technique via the pulse wave velocity (PWV) measured in two points (i.e. regional aortic stiffness): the carotid and the femoral arteries. Based on a bioelectrical impedance signal processing recorded at the chest level, we have developed a new method for the determination of the aortic stiffness in one point (i.e. local aortic stiffness). The local aortic stiffness (AoStiff) was

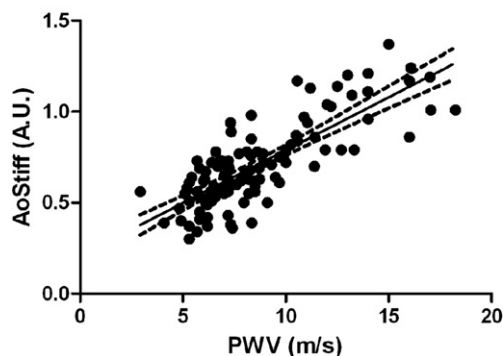
computed from two basic indices: The aortic flux resistance (AoRes) and the aortic distensibility (AoDist) indices.

The study was carried out on 129 consecutive patients at rest (89 men, mean age  $50 \pm 13$ ) recruited on the occasion of a vascular screening for atherosclerosis. Carotid-femoral PWV was determined by a trained operator and bioelectrical impedance signals were recorded at the chest for 2 min for AoStiff, AoRes and AoDist determination. Brachial arterial blood pressure was taken at the same time. Relationship between AoStiff index and PWV was evaluated by linear regression.

A Pearson's correlation coefficient of  $r=0.79$  was found between both variables (95% confidence interval 0.71-0.85;  $P<0.0001$ ;  $\text{AoStiff} = 0.06 \cdot \text{PWV} + 0.21$ ).

Our results show that the local and the regional methods can provide a reliable estimate of the aortic stiffness. The variability between both variables is likely explained by differences between the local and the regional elastic properties along the aortic tree.

$$\text{AoStiff} = 0.06 \cdot \text{PWV} + 0.21 ; r = 0.79$$



#### P1.11

##### A PHOTOPLETHYSMOGRAPHIC PULSE WAVE ANALYSIS FOR ARTERIAL STIFFNESS IN EXTREMITIES

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Peripheral arterial disease (PAD) is a problem over the world. It manifests in extremities as arterial stiffness. The diagnosis of the PADs it can be done by photoplethysmography (PPG). PPG is a non-invasive optical technique for detecting the arterial pulse waves and changes of waves. The PPG signal can contain clinically valuable information about status of conducting arteries and veins.

In this study, we present an examination of the pulse wave analysis by its time domain features for characterizing and quantifying arterial pulse wave components which were measured by a new PPG device. The issue of wave component separation by logarithmic normal function (LNF) both index finger and toe tip PPG in parallel measurements on healthy subjects are addressed. A comparative test procedure for pulse wave analysis based on a wave component separation was applied in addition to a second derivative method of the PPG signal (SNPPG), and a Lissajous-like plot. These tests were applied to arterial pulse wave time series for human ages between 5 and 81 years on 85 subjects. The results show good correlation of pulse wave changes as a function of age, thus support on the arterial pulse wave analysis based on blood pressure. The LNF model fitted to the PPG signals according to the correlations over 0.995 and residues represent the difference to be almost zero between the LNF and the PPG data points. The Lissajous plots demonstrate a high asymmetry dependent on age.

#### P1.12

##### COMPARISON OF CLINICAL USEFULNESS BETWEEN STIFFNESS PARAMETER BETA (SPB) AND PULSE WAVE VELOCITY (PWV)

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**Aims:** Brachial-ankle PWV (baPWV) is widely used to evaluate arteriosclerosis, however, it is easily influenced by occasional blood pressure (BP).