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### **P8.7: VASCULAR ENDOTHELIAL SENESENCE AND METABOLIC SYNDROME**

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## P8.2

## ARTERIAL WAVE REFLECTIONS: LOOKING BEYOND THE FIRST HARMONIC AND PRESSURE INFLECTION POINTS TO ASSESS LATE-SYSTOLIC VENTRICULAR LOADING

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**Background:** Late-systolic ventricular loading is associated with impaired relaxation and adverse remodeling. Standard indices of relative wave reflections such as augmentation index (AIx) and reflection magnitude (RM) from wave separation analysis blend different times within the cardiac cycle and are unspecific to their loading in late-systole. We introduce an index of late-systolic load ( $QfQ_{rep}$ ), derived from wave transmission theory that integrates increased and earlier reflections specifically during late-systole while inherently normalized to the associated flow wave.

**Methods:** Central pressure and flow were measured in 226 subjects using carotid tonometry and phase-contrast MRI, respectively. AIx and RM were determined using standard methods. Reflected wave transit time ( $RWTT_{TUBE}$ ) was determined using tube-load modeling.

**Results:** Decreased  $RWTT_{TUBE}$  (standardized  $\beta = -0.525$ ;  $P < 0.001$ ) and increased RM ( $\beta = 0.629$ ;  $P < 0.001$ ) were significantly associated with  $QfQ_{rep}$  ( $R^2 = 0.791$ ).

**Conclusion:**  $QfQ_{rep}$  is strongly predicted by wave reflection timing and two standard wave reflection indices. RM is defined by the amplitude of the composite backward wave normalized by that of the composite forward wave, both of which occur at different times. AIx, also blending two different times, combines an early-systolic inflection point with a generally late-systolic pressure peak. The advantage of  $QfQ_{rep}$  is that it focuses on the reduced-ejection period to integrate effects of increased and earlier effects of reflections in late-systole.  $QfQ_{rep}$  can be obtained readily from standard wave separation analysis.

## P8.3

## RELATIONSHIP BETWEEN PULSE WAVE VELOCITY AND BIOPSY PROVEN RENAL MICROVASCULAR LESIONS

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Aortic stiffness is associated to chronic kidney disease. Although it is well established that patients with chronic kidney disease have classical and non classical risk factors correlated to a high pulse wave velocity, there is no data on the deleterious effect of high pulse wave velocity on intra renal microvasculature.

The aim of this study was to explore the relationship between arterial stiffness, assessed by cfPWV and renal microvascular lesions assessed by renal biopsy. In 25 patients who went through a renal biopsy we analysed renal vascular lesions, and obtained cfPWV using a Complior device.

cfPWV and age were positively correlated to the severity of vascular lesions. These results support the hypothesis that an elevated pulsatility in target organ microcirculation such as kidneys leads to vessel damage and contributes to worsen glomerular filtration rate.

## P8.5

## MORNING CENTRAL BLOOD PRESSURE SURGE IS RELATED TO AGE

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**Objective:** Morning surge of peripheral blood pressure (BP) is considered to be an independent risk factor for cardiovascular diseases. However, morning central blood pressure surge (MCBPS) has not been analyzed so far. Therefore, the aim of study was to evaluate the variables independently associated with MCBPS.

**Methods:** Fifty patients with never treated hypertension (age  $40.4 \pm 11.5$  years, 35 men) and 50 normotensive subjects (age  $38.3 \pm 12.0$  years, 35 men) were included into the study. Applanation tonometry of the radial artery and "n-point forward moving average" method have been used to derive 24-h CSP (BPro, HealtStats). The sleep-through MS was calculated as the difference between the morning pressure (the average BP during the 2 hours after awakening) and the lowest nighttime BP (the average of the lowest pressure and the 2 readings immediately preceding and after the lowest value). To assess the independent variables related to MCBPS multiple regression was used.

**Results:** Mean MCBPS was  $17.3 \pm 7.8$  mmHg in whole group,  $18.6 \pm 7.3$  mmHg in hypertensives, and  $16.0 \pm 8.2$  mmHg in normotensives ( $p = NS$ ). Sex, smoking, BMI, 24-h heart rate, glucose level, and kidney function were not related to MCBPS. Independent variables correlated with MCBPS are presented in the table.

**Conclusion:** Morning central blood pressure surge may be related to age in normotensive, but not in hypertensive subjects.

beta coefficient standard error p

whole group

age -0.33 0.10 0.001

24-h mean central BP 0.24 0.09 0.013

Normotensives

Age -0.43 0.13 0.001

## P8.6

## PULSATILE COMPONENT OF CENTRAL BLOOD PRESSURE AND THE RISK OF STROKE IN CORONARY PATIENTS. RESULTS FROM THE AORTIC BLOOD PRESSURE AND SURVIVAL STUDY

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**Background:** There is ongoing debate concerning the best blood pressure (BP) parameter predicting cardiovascular risk. The aim of the analysis was to investigate the relationship between central BP and stroke in patients undergoing coronary angiography.

**Methods:** The study group consisted of 954 patients (691 men and 263 women; mean age:  $57.3 \pm 10.0$  years) undergoing coronary angiography with left ventricular EF  $\geq 40\%$ . A vast majority of participants was prescribed BP-lowering drugs. Invasive ascending aortic BP during catheterization was taken at baseline. The duration of follow-up was  $53.4 \pm 18.8$  months. We defined pulsatility as the ratio of pulse pressure to mean BP. The Cox proportional hazard regression analysis was used to assess the relation between BP-derived indices and the risk of stroke.

**Results:** During the follow-up 19 (2.0%) patients suffered from stroke and 57 (6.0%) from stroke or CV death. The multivariate hazard ratios related to BP-derived indices according to the presence of HT are given in the table.

BP – related variables	Stroke	CV death or stroke
Systolic blood pressure per SD	1.32(0.85-2.04)	1.05(0.79-1.38)
Diastolic blood pressure per SD	0.88(0.57-1.36)	0.80(0.61-1.05)
Mean blood pressure per SD	1.08(0.71-1.64)	0.91(0.70-1.19)
Pulse pressure per SD	1.65(1.03-2.66)	1.25(0.93-1.67)
Pulsatility per SD	2.07(1.25-3.42)	1.50(1.11-2.03)

**Conclusion:** Pulsatile, but not steady component of central blood pressure predicts the risk of stroke in coronary patients.

## P8.7

## VASCULAR ENDOTHELIAL SENESENCE AND METABOLIC SYNDROME

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**Objectives:** Vascular aging and metabolic syndrome (MS) are both independent predictors of cardiovascular events. We examined whether MS accelerates the progression of vascular aging.

**Methods:** 142 subjects (mean age  $51.9 \pm 10.8$  years, 94 men) with no established cardiovascular disease were investigated in 2 examinations over a 2-year period (mean follow-up visit 1.84 years). MS was defined by the ATP III criteria. Subjects had at the beginning and end of the study

determinations of carotid-femoral pulse wave velocity (PWV), aortic augmentation index corrected for heart rate (Alx75), brachial flow-mediated dilatation (FMD) and carotid intima-media thickness (cIMT). Based on these measurements the annual absolute changes were calculated.

**Results:** At baseline patients with MS compared with patients without MS had lower values of FMD (6.0% vs. 7.0%,  $P=0.025$ ), but there were no statistically significant differences for PWV (7.04m/s vs. 7.26m/s,  $P=0.242$ ), Alx@75 (19.9% vs. 20.3%,  $P=0.846$ ) and cIMT (0.68mm vs. 0.68mm,  $P=0.957$ ). For the overall population, there were no statistically significant differences in the annual absolute changes of PWV, FMD, Alx75 and cIMT. However, when a subgroup of patients <60 years with more rapid progression of endothelial aging was investigated, MS was associated with almost 7 times higher annual change of FMD [-0.89% (95% CI: -1.50 to -0.28) in patients with MS vs. -0.13% (95% CI: -0.36 to 0.10) in patients without MS,  $P=0.032$ ]. This difference was not evident in the other vascular biomarkers. **Conclusions:** Presence of MS is associated with endothelial dysfunction as well as accelerated progression of endothelial dysfunction, especially in the younger subjects.

## P8.8

### CENTRAL ARTERIAL STIFFNESS IN COPD

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**Introduction:** Increased arterial stiffness is a marker of cardiovascular disease and suggested to be associated with impaired lung function in chronic obstructive pulmonary disease (COPD). However, whether patients with mild COPD have increased arterial stiffness and what factors are linked to it is still not explicitly studied. We hypothesised that patients with mild COPD would have increased arterial stiffness than controls independent of lung function.

**Methods:** As part of the ARCADE study, 70 patients with mild COPD and 150 controls free from lung disease were examined. Aortic pulse wave velocity (PWV), spirometry, body composition, blood pressure (BP), heart rate (HR) and C-reactive protein (CRP) were determined.

**Results:** Patients and controls were similar in age, body composition and gender. However, patients had greater aortic PWV 9.4 (1.96) m/s, systolic BP 147 (18) mmHg, HR 72 (12) bpm and CRP\* 3.1 (1.7) mg/l compared with controls PWV 8.4 (1.8) m/s, BP 140 (18) mmHg, HR 67 (10) bpm and CRP\* 1.7 (1.6) mg/l, all  $p<0.001$ . Aortic PWV was related to HR in patients ( $r=0.39$ ) and controls ( $r=0.26$ ), all  $p<0.001$ . A stepwise regression analysis adjusted for age and MAP showed heart rate was only predictor of increased aortic PWV (Adjusted  $R^2=33\%$ ,  $p<0.001$ ) where waist circumference and HR in the controls (Adjusted  $R^2=37\%$ ,  $p<0.001$ ).

**Conclusion:** Increased heart rate accelerates atherosclerosis process and vascular dysfunction and ultimately leads to increased incidence rate of coronary artery disease. Understanding the relationship between increased heart rate and greater aortic stiffness would allow for cardioprotective effect of lowering heart rate.

## P8.9

### EFFECT OF CARDIAC RESYNCHRONISATION THERAPY ON THE ARTERIAL STIFFNESS

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Development of cardiac resynchronisation therapy (CRT) in recent years became a breakthrough in treatment of severe heart failure, as it improves exercise capacity, reduces a rate of hospitalisations due to heart failure exacerbation, and the mortality rate, as well as improves quality of patients' life. However, data on CRT effects on a number of heart failure comorbidities remains scarce. The aim of this study was evaluation of CRT effect on the arterial stiffness.

**Methods:** The study covered a group of 55 patients (45 men and 10 women; mean age  $67.04 \pm 9.13$  years) with chronic heart failure stable for at least last 3 months, in the NYHA functional class III or IV despite optimal pharmacotherapy, with a reduced left ventricular ejection fraction (LVEF)  $\leq 35\%$ , wide QRS complexes  $\geq 120$  ms. Before the resynchronisation system was implanted and after twelve months of observation arterial stiffness was evaluated with the carotid-femoral pulse wave velocity (PWV).

**Results:** Statistically significant changes weren't demonstrated for carotid-femoral pulse wave velocity value, only a tendency for its reduction ( $11.73 \pm 2.37$  m/s vs  $11.32 \pm 2.78$  m/s,  $p = 0.08$ ).

**Conclusions:** After the resynchronisation system implantation, no statistically significant change in arterial stiffness was observed, only a trend towards its reduction.

## P8.10

### EFFECTS OF BARIATRIC SURGERY ON ENDOTHELIAL FUNCTION IN EXTREMELY OBESE PATIENTS

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**Introduction:** Bariatric surgery in extremely obese patients has influence on metabolic variables and body weight however data about influence on flow-mediated dilatation (FMD) of brachial artery are inconsistent.

The aim of the study was to assess the effect of bariatric surgery on endothelial function measured by flow-mediated dilatation.

**Material and methods:** We examined 35 patients with extreme obesity who met the eligibility criteria and underwent bariatric surgery (sleeve gastrectomy or Roux-en-Y Bypass).

Brachial flow-mediated dilatation was performed using linear-array transducer (GE Vivid 3, GE Healthcare Medical Diagnostics, Little Chalfont, UK).

**Results:** Data from 35 patients (34% men; age:  $45 \pm 10$ ) were collected. BMI decreased from  $47.5 \pm 6$  kg/m<sup>2</sup> before surgery to  $35.5 \pm 5$  kg/m<sup>2</sup> six months after surgery. FMD after six months has significantly improved. Median flow mediated dilatation before intervention was 6.5% (IQR 2-10.7) and after operation 8.5% (IQR 6.2-16.8). Improvement in FMD was higher in patients who underwent by-pass surgery (median 142% (IQR: 85-453)) in comparison to sleeve gastrectomy intervention (median 118% (IQR 67-246) but no statistical significance was observed between two groups.

**Conclusions:** Bariatric surgery resulted in significant improvement in endothelial function and may have potential impact on reduction of cardiovascular risk.

## P8.11

### EFFECT OF CARDIAC RESYNCHRONISATION THERAPY ON THE AUTONOMIC NERVOUS SYSTEM FUNCTION

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Development of cardiac resynchronisation therapy (CRT) in recent years became a breakthrough in treatment of severe heart failure. The aim of this study was evaluation of CRT effect on the autonomous nervous system function.

**Methods:** The study covered a group of 55 patients (45 men, 10 women; mean age  $67.04 \pm 9.13$  years) with chronic heart failure stable for at least last 3 months, in the NYHA functional class III or IV despite optimal pharmacotherapy, with a reduced left ventricular ejection fraction  $\leq 35\%$ , wide QRS complexes  $\geq 120$  ms, and sinus rhythm present during the examination. Before the resynchronisation system was implanted and after three months of observation arterial baroreflex sensitivity (BRS) was evaluated with the sequence technique, and with the  $\alpha$  coefficient and the transfer function.

**Results:** Three months after implantation of the CRT device, a statistically significant increase in the arterial baroreflex sensitivity was observed for all methods used in the study, both when lying and breathing spontaneously (BRSseq:  $5.96 \pm 2.07$  ms/mmHg vs  $7.64 \pm 4.73$  ms/mmHg,  $p<0.001$ ;  $\alpha$ LF:  $6.00 \pm 4.44$  ms/mmHg vs  $7.68 \pm 5.09$  ms/mmHg,  $p=0.029$ ;  $\alpha$ HF:  $6.53 \pm 3.19$  ms/mmHg vs  $10.15 \pm 6.84$  ms/mmHg,  $p<0.001$ ; TFLF:  $3.18 \pm 3.05$  ms/mmHg vs  $4.18 \pm 3.17$  ms/mmHg,  $p=0.01$ ; TFHF:  $3.54 \pm 2.02$  ms/mmHg vs  $5.72 \pm 4.24$  ms/mmHg,  $p<0.001$ ), as well as when lying with breathing controlled. Furthermore, after three months from the CRT implantation, all monitored BRS indicators were significantly reduced in response to orthostatic stimulus. Such modulatory ability was not observed before implantation of the CRT device.

**Conclusions:** The study confirmed the beneficial effect of the CRT on the autonomous nervous system function.