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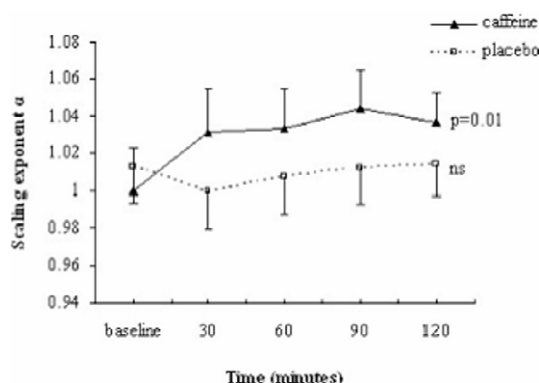
### **P.060: AGE-RELATED ARTERIAL STIFFNESS IN PATIENTS WITH WHITE COAT OR ESSENTIAL HYPERTENSION**

G. Vyssoulis\*, S.M. Kyvelou, P. Pietri, D. Adamopoulos, C. Vlachopoulos, A. Deligeorgis, E. Gymnopoulou, C. Stefanadis

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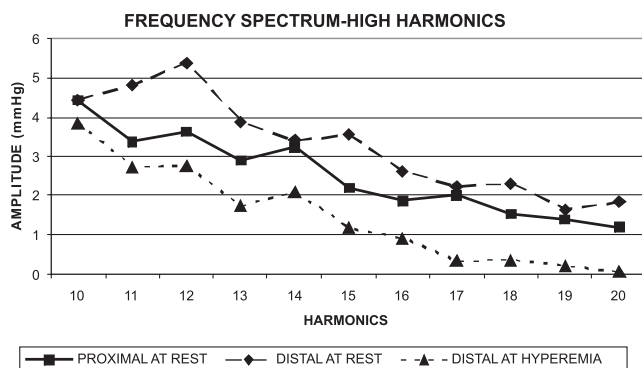
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**P.057**  
EFFECTS OF CORONARY MICROCIRCULATION ON INTRACORONARY PRESSURE WAVEFORMS AS ASSESSED BY FAST FOURIER TRANSFORM ANALYSIS

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Wave reflections from the periphery of the systematic circulation are known to be important determinants of the morphology of aortic pressure waveforms. Similar data regarding the effects of coronary microcirculation on intracoronary pressure waveforms are limited. We sought to investigate whether drug-induced changes of coronary microcirculation are reflected in the modification of intracoronary pressure waveforms. In eighteen patients with normal myocardial contractile function we studied pressure waveforms recorded by a high-fidelity pressure wire at the ostium and at a distal site of left anterior descending coronary artery, which had to be free of significant lesions in the epicardial and the microvascular segment, i.e. fractional flow reserve >0.75, corrected TIMI frame count <27 and coronary flow reserve by thermodilution >2.5. Pressure recording was performed both at rest and at hyperemia induced by intravenous infusion of adenosine. Analysis of pressure waveforms at the frequency domain was performed with Fast Fourier Transform. At baseline conditions, distal vs proximal pressure waveforms were characterized by higher pulsatility: higher fractional pulse pressure  $\Delta PP_f$  ( $p=0.009$ ), a higher presystolic wave probably due to atrial contraction ( $p<0.001$ ) and higher amplitude of the eleventh to the fifteenth harmonics ( $p=0.001$ ). Hyperemia increased  $\Delta PP_f$  ( $p=0.01$ ), compressed the notch and decreased the amplitude of higher than the tenth harmonics of distal waveforms ( $p<0.001$ ) (Figure).



The configuration of intracoronary pressure waveforms is significantly affected by the status of coronary microcirculation. Therefore, their analysis may facilitate assessment of microvascular disease.

**P.058**  
LEFT VENTRICULAR FUNCTION IN RELATION TO ARTERIAL STIFFNESS IN HYPERTENSION. THE PROGNOSTIC IMPORTANCE OF PULSE PRESSURE IN LV REMODELLING - PRELIMINARY REPORT

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**Background.** Increased arterial stiffness has been reported to affect LV diastolic function in hypertension. Pulse pressure (PP) is independently

related to cardiovascular and all-cause mortality. Strain and strain rate deformation parameters can detect subtle changes of the left ventricular (LV) function.

**Aim.** To investigate the role of arterial stiffness in Systolic LV function and the effect of Pulse pressure in hypertension.

**Methods.** We studied 55 consecutive hypertensive patients and 25 controls, matched for age ( $49.7 \pm 5.7$  vs.  $45.5 \pm 4.1$  yrs), with normal EF ( $66 \pm 2.5$  vs.  $64 \pm 3.3\%$ , NS). All subjects had 2D and colour doppler myocardial imaging of basal and mid LV segments (12) in the longitudinal axis. Mean longitudinal strain (S) and strain rate (SR) were averaged from each of the 12 segments assessed. Pulse wave velocity (PWV) carotid-femoral was used for estimation of arterial compliance in 20 of the hypertensive patients.

**Results.** The hypertensive group had higher pulse pressure ( $59.5 \pm 16.6$  vs.  $41.4 \pm 7.2$  mmHg,  $P<0.001$ ), and lower mean longitudinal S and SR ( $S$ :  $18.1 \pm 2.2$  vs.  $20.5 \pm 2.0\%$   $P<0.05$  and  $SR$ :  $1.34 \pm 0.16$  vs.  $1.54 \pm 0.13/s$   $P<0.05$ ) compared to control. The patients with hypertrophy or diastolic dysfunction (DD) had higher PP than those without hypertrophy ( $65 \pm 15$  vs.  $46 \pm 11$  mmHg,  $P<0.001$ ) or DD ( $63 \pm 16$  vs.  $44 \pm 12$  mmHg,  $P<0.001$ ). Pulse pressure was correlated with LVMI ( $r=0.51$ ,  $P<0.001$ ), WT ( $r=0.61$ ,  $P<0.001$ ), RWT ( $r=0.52$ ,  $P<0.001$ ), mean SR ( $f=-0.58$ ,  $P<0.001$ ), mean S ( $f=-0.51$ ,  $P<0.001$ ), DT ( $r=0.36$ ,  $P<0.05$ ), A ( $r=0.45$ ,  $P<0.05$ ) and E/A ( $f=-0.54$ ,  $P<0.01$ ). PWV was correlated with mean S and SR ( $f=-0.58$ ,  $P<0.05$  and  $f=-0.49$ ,  $P<0.05$ ) and PP ( $r=0.47$ ,  $P<0.05$ ).

**Conclusion.** Pulse pressure is related with functional (S, SR) and structural (WT, LVMI, RWT) components of the left ventricle and with the arterial stiffness. Arterial stiffness seems to affect not only the diastolic, but also the longitudinal systolic function of the left ventricle.

**P.059**  
SEGMENTAL LEFT VENTRICULAR FUNCTION ESTIMATED BY STRAIN ECHOCARDIOGRAPHY IN RELATION TO ARTERIAL STIFFNESS IN HYPERTENSIVES. MRI FINDINGS IN RESPECT TO MYOCARDIAL FIBROSIS - PRELIMINARY REPORT

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**Background:** Left Ventricular (LV) diastolic function has been reported to be related with the presence of increased arterial stiffness in hypertension. Myocardial fibrosis is one of the main causes of diastolic dysfunction (DD).

**Aim:** To investigate the role of arterial stiffness in segmental LV systolic function and the presence of fibrosis with Delayed Enhancement (DE) MRI in hypertension.

**Methods:** We studied 20 consecutive hypertensive patients with mean age  $51.6 \pm 6.1$  years and normal EF  $66.3 \pm 4.1\%$ , with no history of coronary artery disease. All subjects had MRI with (DE) and 2D and colour doppler myocardial imaging of basal and mid LV segments (12) in the longitudinal axis. Mean longitudinal strain (S) and strain rate (SR) were averaged from each of the 12 segments assessed. Pulse wave velocity (PWV) carotid-femoral was measured.

Diastolic dysfunction was diagnosed based on published criteria regarding DT, IVRT, E/A and TDIEa.

**Results:** The mean duration of hypertension was  $10.4 \pm 5.7$  yrs. Diastolic dysfunction was evident in 16 out of the 20 patients. PWV was increased in patients with diastolic dysfunction ( $12.6 \pm 2.3$  vs.  $10.6 \pm 1.4$  m/s) compared to those without DD. Septal basal and mid segment had the lowest systolic strain (basal:  $15 \pm 2.7\%$ , mid:  $19.5 \pm 3.1\%$ ) and strain rate value (basal:  $1.1 \pm 0.2/s$ , mid:  $1.4 \pm 0.3/s$ ) in comparison to the other segments. PWV was correlated with septal mid SR ( $r=-0.60$ ,  $P<0.05$ ) and septal basal and mid S ( $r=-0.67$ ,  $P<0.05$  and  $r=-0.69$ ,  $P<0.05$ ). PWV was also correlated with mean S and SR ( $r=-0.58$ ,  $P<0.05$  and  $r=-0.49$ ,  $P<0.05$ ) and PP ( $r=0.47$ ,  $P<0.05$ ). MRI with DE detected 2 patients (10%) having replacement fibrosis, but did not detect interstitial or perivascular fibrosis.

**Conclusion:** Septal wall is the region mainly affected by the presence of hypertension in comparison to other segments. Arterial stiffness is related to global and regional longitudinal systolic function. MRI can exclude replacement but not subtle interstitial or perivascular fibrosis in hypertensive patients.

**P.060**  
AGE-RELATED ARTERIAL STIFFNESS IN PATIENTS WITH WHITE COAT OR ESSENTIAL HYPERTENSION

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**Background:** It is well documented that arterial stiffness is age-related. The purpose of the present study was to evaluate to what extent age affects

arterial stiffness in patients with essential or white coat hypertension (WCH) and the effect of previous antihypertensive medication.

**Methods:** We studied 850 patients, untreated or after a 15 days wash-out period, in our outpatient clinic. All patients underwent 24h ambulatory blood pressure monitoring (ABPM) and full biochemical assay. Large-artery stiffness and arterial wave reflections were evaluated by measuring carotid-femoral pulse wave velocity (PWVc-f) and augmentation index (Alx) respectively.

**Results:** Patients were classified in four groups, according to the ABPM results. 294 never treated patients with essential hypertension (group 1), 322 patients with essential hypertension after the wash-out period (group 2), 112 never-treated patients with WCH (group 3) and 322 patients with WCH after the wash-out period (group 4). Univariate analysis showed a significant correlation of age with PWVc-f in groups 1, 2 and 3 ( $r=0.43$ ,  $0.46$  and  $0.38$  respectively,  $p<0.001$ ) but not in group 4 ( $r=0.17$ ,  $p=NS$ ). Furthermore, age was positively correlated with Alx in all groups ( $r=0.53$ ,  $0.38$ ,  $0.47$  and  $0.67$  respectively,  $p<0.0001$ ). Finally, significant correlation of age with systolic blood pressure was found in groups 1 and 4 ( $r=0.20$  and  $0.30$  respectively,  $p<0.001$ ) and with diastolic blood pressure in group 2 ( $r=0.37$ ,  $p<0.0001$ ).

**Conclusion:** Age affects arterial stiffness differentiating in PWV or Alx. In patients with essential hypertension as well as in patients with WCH, the age effect is of similar magnitude whereas the effect of previous medication use is minimal.

#### P.061

##### RELATIONSHIP BETWEEN FIBRINOGEN AND ARTERIAL STIFFNESS IN PATIENTS WITH ESSENTIAL HYPERTENSION

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**Introduction:** Increased levels of prothrombotic markers such as fibrinogen and plasminogen activator-inhibitor-1 (PAI-1) have been related to target organ damage and cardiovascular outcomes in hypertensive population. Arterial stiffness is an important determinant of cardiovascular performance and a predictor of the corresponding risk. The association of fibrinogen and PAI-1 with arterial stiffness in hypertensive patients has not been defined.

**Methods:** We studied 285 consecutive, non-diabetic patients with uncomplicated, never treated essential hypertension (mean age 50 years, 184 males). Carotid-femoral and carotid-radial pulse wave velocity (PWVc-f and PWVc-r) were measured as indices of elastic-type, large-artery (aortic) stiffness and muscular type, medium-sized arterial stiffness respectively. Serum PAI-1 and plasma fibrinogen were measured in all participants.

**Results:** Across the tertiles of fibrinogen, we found a significant increase in PWVc-f ( $7.36$  vs  $7.52$  vs  $8.17$  m/s at tertiles 1 to 3,  $p<0.001$ ) but not in PWVc-r as well ( $8.73$  vs  $8.70$  vs  $8.68$  m/s,  $p=NS$ ). Across the tertiles of logPAI-1 was also a gradual increase in PWVc-f ( $7.43$  vs  $7.73$  vs  $7.93$  m/s,  $p=0.02$ ) but no significant difference was observed in PWVc-r levels ( $8.57$  vs  $8.82$  vs  $8.74$  m/s,  $p=NS$ ). In multivariate analysis, the association of fibrinogen with PWVc-f remained significant ( $\beta=0.12$ ,  $p<0.05$ ) after adjustment for age, gender, systolic blood pressure, smoking, body mass index, HbA1c and serum cholesterol. However, the associations of PAI-1 with PWVc-f disappeared once the above confounding factors were taken into account.

**Conclusion:** The present study shows that in hypertensive subjects increased aortic stiffness is related to increased plasma levels of fibrinogen. This finding may have important implications for hypertensive patients.

#### P.062

##### WHITE BLOOD CELL COUNT PREDICTS WAVE REFLECTIONS IN PATIENTS WITH ESSENTIAL HYPERTENSION

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**Background:** Arterial stiffness and wave reflections are independent markers and predictors for cardiovascular events in patients with hypertension. White blood cell (WBC) count has been associated with high incidence of cardiovascular events. The aim of the present study was to assess the relationship between WBC count and augmentation index (Alx), a composite measure of arterial stiffness and wave reflections, in patients with essential hypertension.

**Methods:** We studied 235 consecutive patients with uncomplicated, never treated essential hypertension (mean age 51 years, 63% males). Alx was evaluated with a validated system (Sphygmocor) using applanation tonometry of the radial artery and pulse wave analysis. Alx was then adjusted for a steady heart rate of 75 beats/min ( $Alx_{75}$ ). WBC, high sensitivity

C-reactive protein (hsCRP) and serum amyloid A (SAA) were measured in all subjects.

**Results:** In univariate analysis,  $Alx_{75}$  was correlated with both log-hsCRP ( $r=0.13$ ,  $P=0.04$ ) and log-SAA ( $r=0.19$ ,  $P=0.002$ ). In stepwise regression analysis,  $Alx_{75}$  was independently associated with log-WBC ( $\beta=12.41$ ,  $P=0.02$ , 95%CI: 1.48-23.34) but not with log-hsCRP ( $P=NS$ ) and log-SAA ( $P=0.07$ ).

**Conclusions:** WBC count, but not hsCRP, predicts wave reflections in patients with essential hypertension. Considering that WBC count is an inexpensive, readily available laboratory assay, it might be used as a first line inflammatory marker for arterial function and cardiovascular risk assessment.

#### P.063

##### INSULIN LEVELS ARE ASSOCIATED WITH THE ANKLE-BRACHIAL INDEX IN HYPERTENSIVE PATIENTS WITH METABOLIC SYNDROME

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**Introduction:** Metabolic syndrome (MS) is a composition of several cardiovascular risk factors with hyperinsulinemia being the main underlying pathophysiological abnormality. Ankle-Brachial index (ABI) is a non invasive measure of peripheral artery disease and has been associated with cardiovascular risk. The purpose of this study was to evaluate the relationship between insulin levels and ABI in hypertensive patients with and without metabolic syndrome.

**Methods:** We studied 88 consecutive, non diabetic patients, mean aged 50 years, with newly diagnosed, uncomplicated essential hypertension. The patients were divided in two groups according to the presence of MS (38 patients with MS, 50 patients without MS), as defined by the criteria of the Adult Treatment Panel III. Fasting insulin levels and HbA<sub>1c</sub> were measured and HOMA index was calculated. ABI was assessed in all patients.

**Results:** The min ABI values were higher in hypertensives with MS ( $1.20$  vs  $1.15$ ,  $p=0.04$ ) as were insulin ( $12.4$  vs  $9.1$   $\mu$ U/ml,  $p=0.02$ ), HOMA index ( $57.5$  vs  $37.8$ ,  $p=0.007$ ) and HbA<sub>1c</sub> ( $5.80$  vs  $5.43\%$ ,  $p=0.0003$ ) values. In univariate analysis, insulin levels were associated with ABI in hypertensive patients with MS ( $r=0.59$ ,  $p<0.001$ ) but such an association was not found in hypertensives without MS ( $p=NS$ ). After adjustment for several confounders, insulin remained significantly associated with ABI in patients with metabolic syndrome ( $r=0.58$ ,  $p=0.001$ ).

**Conclusion:** Fasting insulin independently predicts ABI in patients with hypertension and metabolic syndrome. This finding provides further information for the pathophysiology of the relationship between metabolic syndrome and the risk for peripheral artery disease.

#### P.064

##### SERUM BILIRUBIN LEVELS ARE INVERSELY RELATED TO ARTERIAL STIFFNESS IN PATIENTS WITH ARTERIAL HYPERTENSION

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**Introduction:** Bilirubin has antioxidant effects and may protect against atherosclerosis. Arterial stiffness is an independent cardiovascular risk factor for patients with hypertension. The purpose of this study was to investigate the association between bilirubin levels and arterial stiffness in hypertensive subjects.

**Methods:** We studied 293 consecutive patients with uncomplicated, never treated essential hypertension. Bilirubin concentrations were measured in all subjects who were then divided according to tertiles of bilirubin levels (113 patients with bilirubin concentrations  $<0.7$  mg/dl, 82 patients with bilirubin concentrations between  $0.7$  and  $1.02$  mg/dl and 98 patients with bilirubin concentrations  $>1.02$  mg/dl). Arterial stiffness was evaluated by the measurement of carotid-femoral Pulse Wave Velocity (PWVc-f) and Augmentation Index (Alx).

**Results:** Using the ANOVA statistical analysis, Alx was significantly reduced with increasing bilirubin level tertiles ( $28.48\pm11.45$ ,  $27.26\pm12.11$  and  $23.98\pm13.60\%$  respectively,  $P=0.02$ ). There was also a gradual reduction of PWVc-f from the lower to the higher tertiles ( $8.02\pm1.66$ ,  $7.83\pm1.36$ , and  $7.55\pm1.17$  m/s respectively,  $P=0.06$ ). Having Alx as a dependent variable, after adjustment for potential confounders, no independent association between bilirubin levels and Alx was observed.

**Conclusion:** Hypertensive subjects with elevated bilirubin concentrations have decreased values of arterial stiffness. Although an independent association was not observed, because bilirubin might act favorably through other determinants of arterial stiffness, the present finding reinforces the notion of a protective effect of bilirubin.