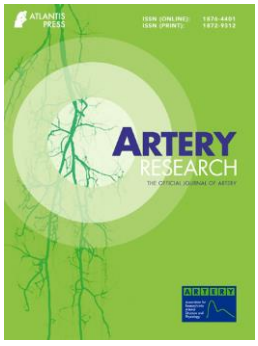

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P37: PULSE WAVE VELOCITY: DEPENDENCE ON CONTEMPORANEOUS AND HISTORICAL BLOOD PRESSURE COMPONENTS

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blood volume ejected by the ventricle into the aorta up to time of peak pressure and blood flow into the aorta (corresponding to the rate of ventricular ejection) up to this point. Increased flow and volume accounted for 20.1 mmHg (52%) of the 39.0 mmHg difference in PP between the upper and lower tertiles of the hypertensive subjects 1.

References

1. Vennin, S., Li, Y., Willemet, M., Fok, H., Gu, H., Charlton, P., Alastruey, J. and Chowienczyk, P. (2017). Identifying Hemodynamic Determinants of Pulse Pressure: A Combined Numerical and physiological Approach. Hypertension, 70(6), 1176—1182.

Poster Session I — Hypertension II

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DETERMINANTS OF PERIPHERAL WAVE REFLECTION IN A LARGE TREATED HYPERTENSIVE POPULATION

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Objective: To evaluate the determinants of the peripherial wave reflection measured by the second derivative of the fingertip photoplethysmogram (SDPTG) among known cardiovascular (CV) risk factors in a large treated hypertensive population.
Population and Methods: We studied prospectively 316 hypertensive patients under treatment (154 male, mean age 54 yrs) by SDPTG automatically recorded from the second digit of the right hand (Fukuda FCP-3166®). The SDPTG waveform consisted of a, b, c and d waves in systole and e wave in diastole. The heights of the a, b and d waves were measured from the baseline, and d/a and b/a ratio were calculated. Augmentation index (AUI) was defined as the ratio of the height of the late systolic peak to that of the early systolic peak; SDPTG aging index (AGI) was calculated as (b-c-d-e)/a. The CV risk factors analized were systolic (SBP) and diastolic (DBP) blood pressure, heart rate (HR), left ventricule mass index (LVMI), creatinine, glycemia, cholesterol, triglycerides and body mass index (BMI).
Results: In the multivariate analysis the most signicative associations were: AGI: age (+, $p<0{,}001$) and SBP (+, $p < 0{,}05$); b/a: age(+, $p < 0{,}001$), SBP(+, $p < 0{,}01$) and HR(-, $p < 0{,}01$); , d/a: BP (- , $p < 0{,}01$); AUI:SBP(+, $p < 0{,}001$), HR(-, $p < 0{,}001$) and BMI(- , $p < 0{,}01$). When compared according BP control (<140/90 mmHg), AUI, b/a and d/a ratio were significantly higher in the patients whose BP was not controlled.
Conclusion: In treated hypertensives, changes in vascular wave reflection and stiffness were influenced by age, HR, and blood pressure control, most importantly SBP.

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ARTERIAL STIFFNESS AND CHRONIC STRESS: ROLE OF GENDER — RIGIDITÀ ARTERIOSA E STRESS CRONICO: RUOLO DEL GENERE

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Aim: Evaluate whether exposure to chronic stress is associated with early vascular aging in hypertensive patients and possible gender differences in this relationship.
Methods: Patients where recruited in a Hypertension outpatient clinic during a visit for the evaluation of subclinical organ damage. Aortic stiffness was measured as carotid-femoral pulse wave velocity (PWV) by applanation tonometry; common carotid intima-media thickness (IMT) and distensibility were evaluated by automated analysis of carotid ultrasound clips. Chronic stress was assessed using three different standardized scales: Perceived Stress Score 4 (PSS4), Depression Anxiety Stress Scale (DASS) and Chronic Stress Burden (CSB).
Results: Data from 125 patients (age 56.7 $\pm$ 12.5years) were analyzed. No significant differences were found between men and women in terms of PWV [8.90 (1.9) vs 8.55 (1.8) m/s, $p = 0.14$], carotid distensibility (22.34 $\pm$ 8.79 vs 21.17$\pm$8.74 kPa^{-1}, $p = 0.545$) and IMT (0.74 $\pm$ 0.12 vs 0.70 $\pm$ 0.13 mm, $p = 0.132$). Women presented significantly higher scores of PSS4 (7(3) vs 5(3), $p = 0.007$) and CSB (1.42 $\pm$ 1.24 vs 0.59 $\pm$ 0.85, $p = 0.004$). In the linear multiple regression analysis, CBS was correlated with PWV in the general population (beta = 0.37, $p = 0.050$) being responsible for 4% of the variance of PWV, without significant gender differences. Among the components of CBS, difficulties in relationships with someone close to the participant were associated with increased PWV only in women ($p=0.01$). In a multiple regression model, this variable tended to be an independent predictor of PWV (beta = 0.37, $p = 0.057$), responsible for 7% of the PWV variance.
Conclusions: In hypertensive patients, chronic stress burden is associated with greater arterial stiffness; in particular, stress related to difficulties in relationships seems to be associated with greater vascular stiffness only in women.

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PULSE WAVE VELOCITY (PWV) RESPONSES TO 3 MONTHS OF YOGA POSES AND RESPIRATORY CONTROL (UJJAYI PRANAYAMA) IN HYPERTENSIVE POST MENOPAUSE WOMEN: RANDOMIZED CLINICAL TRIAL

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Background: Non-pharmacological management of hypertension includes regular exercises. Yoga has been pointed as effective on treatment of hypertension. Its many aspects like yoga poses (asanas), respiratory control (pranayamas), meditation and others have not yet been assessed separately to understant its effects on cardiovascular issues. Thus, this study aims to partially clear the effects of yoga poses including exclusive muscle contraction known as bandhas (pelvic floor, core and throat), a specific respiratory technique ujjayi pranayama, whose translation is victory breath and active control group composed of stretching exercises on PWV.
Methods: Randomized trial assessing carotid femoral pulse wave velocity (cfPWV) by Complior®. Hypertensive post menopause women (HPMW) non-obese and non-smokers randomized in 4 groups (1- yoga poses + ujjayi; 2- yoga poses, 3- stretching exercises + ujjayi, 4- stretching exercises) attending 60 minutes assisted video classes twice a week (24 sessions). Data are presented as mean(M) $\pm$ standard error (SE). Generalized estimation equation (GEE) was used to data analysis, $p \leq 0{,}05$.
Results: 24 women recruited, randomized, 15 concluded study (1- n=3; 2- n=6; 3- n=4; 4- n=2). Group 1 showed cfPWV at 10, 0 $\pm$ 0, 23 m/s; 2- 8,9 $\pm$ 0,29 m/s; 3- 7.7 $\pm$ 0,53 m/s; 4- 8.8 $\pm$ 0,24 m/s at baseline. Post intervention presented 1- -1,8 $\pm$ 0,31 m/s $p = 0{,}00$; 2- -0,43 $\pm$ 0,25 m/s $p = 0{,}08$; 3- -1,4 $\pm$ 0,27 m/s $p = 0{,}00$; 4- 1,4 $\pm$ 0,99 m/s $p = 0{,}16$.
Conclusion: The present study has demonstrated an effect of respiratory control ujjayi pranayama on cfPWV after 3 months in HPMW.

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PULSE WAVE VELOCITY: DEPENDENCE ON CONTEMPORANEOUS AND HISTORICAL BLOOD PRESSURE COMPONENTS

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Background: Arterial stiffness as measured by PWV along the aorta is an important determinant of cardiovascular risk. PWV is known to be dependent on contemporaneous blood pressure (BP) but its dependence on long-term BP has not been established.
Methods: Subjects from Twins UK who had tonometric measures of carotid-femoral PWV with previous longitudinal measures of blood pressure (n = 2094) and, in a sub-sample, PWV (n=956) were studied. Brachial artery pulse pressure (PP) and mean arterial pressure (MAP) were averaged over the period of longitudinal follow-up to obtain measures of historical PP and MAP (PPH and MAPH). The relationship of PWV to contemporaneous PP and MAP (PPC and MAPC) was compared with that to PPH and MAPH.
Results: The average duration of blood pressure measurement was 14.0 $\pm$ 4.3 years.PWV correlated strongly with PPC ($r = 0.542$, $p < 0.001$), PP_H ($r = 0.474$,$p < 0.001$), MAP_C ($r = 0.462$, $p < 0.001$) and MAP_H ($r = 0.360$, $p < 0.001$). In multiple regression analysis incorporating

historical and contemporaneous values of PP and MAP as well as age and heart rate, PWV was significantly associated with PP_C, MAP_C and PP_H but not with MAP_H. In the sub-study in which historical values of PWV were available, PWV increased by 0.75 ± 1.42 m/s, over an average of 5.5 ± 1.7years. The change in PWV was associated with MAP_C and with PP_H ($\beta = 0.144$, $p < 0.001$).
Conclusions: These results are consistent with strong dependence of PWV on contemporaneous BP but also historical values of pulse pressure which may drive arterial stiffening.

P38
DIFFERENCES IN FORM FACTOR CALCULATED FROM OSCILLOMETRIC OR WAVEFORM MEAN ARTERIAL PRESSURE

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Background: Oscillometric mean arterial pressure (MAP) agrees closely with invasive MAP, [1] but most devices do not report MAP and it is usually estimated by a form factor (FF). However, blood pressure (BP) measurement errors will affect FF, its correlations with exposures, and introduce errors into MAP estimated from the BP waveform.
Methods: Brachial BP was measured using a Pulsecor device in 1,112 participants in the Southall and Brent Revisited study (68.8 ± 6.1 y; 78.2% male; 47.4% White-European; 38.3% South-Asian; 14.3% African-Caribbean). Form factors (FFosc and FFwave) were calculated as (MAP-diastolic BP)/(systolic BP-diastolic BP) by oscillometry (MAPosc) or from the BP waveform (MAPwave).
Results: FFosc and FFwave differed (0.28 (SD = 0.02) vs. 0.36 (SD = 0.04); $p < 0.001$) and were negligibly correlated ($r = 0.07$). Neither FF_{osc} nor FF_{wave} were associated with ethnicity, prevalent cardiovascular disease or current smoking status, and neither showed significant correlations with age, total- or HDL-cholesterol, or physical activity. Both FF_{osc} and FF_{wave} were lower in men (difference (Δ) = -0.005(95% CI = -0.007, -0.002) vs -0.015(95% CI = -0.020, 0.009) respectively) and were negatively correlated with height ($r = -0.14$ both), but only FF_{wave} correlated with body mass index ($r = 0.02$ vs $r = 0.10$) and heart rate ($r = -0.06$ vs $r = 0.20$). ΔMAP_{osc}-MAP_{wave} correlated with age ($r = 0.10$), height ($r = 0.15$) and heart rate (0.17) and was greater in women (0.9(95% CI = 0.5, 1.3) mmHg).
Conclusions: FF_{wave} agrees poorly with FF_{osc} probably due to measurement errors. This creates spurious associations between exposures and FF and causes systematic errors in estimated MAP_{wave}. These errors have the potential to confound associations in epidemiological studies.

References
1. Ramsey M. Med Biol Eng Comput 1979;17:11-8.

P39
ACUTE RESPONSES OF PULSE WAVE REFLECTION AFTER AEROBIC EXERCISE WITH DIFFERENT VOLUMES

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Background: Although Aerobic Exercise (AE) has been recognized for lowering Blood Pressure (BP), little is known about the alterations in aortic BP after exercise (1,2). PURPOSE: To investigate the acute pulse wave reflection responses induced by AE with different volumes in normotensive and hypertensive men.
Methods: We included 12 normotensives [aged: 38.3 ± 10.1 years, body mass index (BMI): 25.9 ± 3.6 kg/m^2, maximal oxygen uptake (VO2max): 31.4 ± 6.9 mL·kg^{-1}·min^{-1}, systolic/diastolic BP (SBP/DBP): 121 ± 6/74 ± 4 mmHg] and 7 hypertensive men [aged: 39.1 ± 6.0 years, BMI: 29.4 ± 3.1 kg/m^2, VO2max: 26.1±1.8 mL·kg^{-1}·min^{-1}, SBP/DBP: 140 ± 8/88 ± 7 mmHg]. The participants were submitted to a maximal cardiopulmonary exercise test, a non-exercise control session (CTL), and two bouts of continuous cycling at 50% VO2 reserve (150 vs. 300 kcal) in a randomized, counter-balanced order. Aortic systolic pressure, aortic pulse pressure, augmentation pressure, and augmentation index (AIx) were determined 10 min before and 70 min after the CTL and the two exercise bouts in a supine position by applanation tonometry (SphygmoCor v7).
Results: Central pressures and AIx were different between normotensive and hypertensive men after the two AE bouts as shown in table 1.
Conclusion: Although both AE were able to reduce pulse wave reflection in hypertensive men, only the major volume has attenuated the increase in central aortic BP observed in the control session.

Table 1: Mean ± SD values for the pulse wave reflection indicators at baseline and post- CTL and AE bouts with 150 and 300 kcal.

Variables	Conditions	Normotensive		Hypertensive	
		Baseline	Recovery	Baseline	Recovery
Aortic Systolic Pressure (mmHg)	CTL	99.83 ± 4.46	104.75 ± 7.81†	113.71 ± 14.52	124.86 ± 18.90†
	150 kcal	98.17 ± 6.21	99.08 ± 7.99	114.71 ±11.14	124.43 ± 18.11*
	300 kcal	100.25 ± 5.34	100.00 ± 6.98	114.43 ±15.14	119.57 ± 13.37
Aortic Pulse Pressure (mmHg)	CTL	29.67 ± 3.72	28.67 ± 4.25	30.57 ± 7.48	35.29 ± 9.30
	150 kcal	28.00 ± 5.54	27.83 ± 3.56	31.29 ± 3.90	33.71 ± 5.99
	300 kcal	30.08 ± 3.31	27.75 ± 4.04	31.14 ± 7.75	32.29 ± 4.64
Aortic Augmentation Pressure (mmHg)	CTL	4.83 ± 4.42	3.75 ± 3.51	3.43 ± 5.22	7.86 ± 5.52†
	150 kcal	3.67 ± 5.08	1.58 ± 3.60	4.57 ± 3.10	6.86 ± 5.52
	300 kcal	3.08 ± 4.33	1.83 ± 3.83	4.00 ± 6.13	5.43 ± 3.59
Augmentation Index (%)	CTL	13.33 ± 10.22	11.83 ± 12.34	10.43 ± 12.52	20.43 ± 10.81†
	150 kcal	10.75 ±16.76	5.50 ± 12.91	14.29 ± 8.46	5.50 ± 12.91
	300 kcal	9.50 ± 13.54	5.75 ± 12.48	10.14 ± 13.69	5.75 ± 12.48

*: Significant difference compared baseline and recovery in the same condition, using paired t-test ($P < 0.05$)
†: Significant difference compared baseline and recovery in the same condition, using paired t-test ($P < 0.01$)

References
1. Cornelissen VA, Smart NA.J Am Heart Assoc. Exercise training for blood pressure: a systematic review and meta-analysis. 2013;2(1):e004473.
2. Whelton SP, Chin A, Xin X, He J. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. Ann Intern Med. 2002;136(7):493-503.

P41
INCREASED STIFFNESS IN THE DIGITAL ARTERIES OF ESSENTIAL HYPERTENSIVE WOMEN: THE FUCHSIA STUDY

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Rationale and Aim: Essential hypertension is characterized by extensive alterations of arterial geometry and mechanical properties: increased stiffness, dilation and wall of large arteries, increased thickness in muscular arteries, small artery remodeling. This study is aimed at exploring function and structure of the digital arteries of the hand, muscular arteries with an internal diameter of 500-1000 mm, easily accessible by ultrahigh frequency ultrasound.
Methods: 24 hypertensive women (HT) and 37 healthy controls (C) were recruited. 5'-videoclips of left palmar digital arteries were obtained by VevoMD (FUJIFILM, VisualSonics, Toronto, Canada), by means of a 70 MHz probe (axial-lateral resolution 30-65 μm). An automatic system (Cvsuite, Quipu srl; Pisa, Italy) was used to measure intima-media thickness (IMT) and diameter. Distensibility and stiffness were then calculated using left brachial pulse pressure (PP - oscillometric)
Results: HT and C had similar age (57 ± 11 vs 53 ± 11 years, $p = 0.22$), BMI (24.9 ± 4.6 vs 24.5 ± 4.2 vs kg/m^2, $p = 0.80$) and mean blood pressure (BP, 95 ± 12 vs 91 ± 12 mmHg, $p = 0.24$); HT showed slighlty higher PP (54 ± 14 vs 47 ± 10, $p = 0.07$). Palmar digital lumen tended to be higher in HT (804 ± 201 vs 696 ± 191 μm, $p = 0.10$), while IMT was similar (120 ± 23 vs 125 ± 36 μm, $p = 0.81$). Distensibility was reduced (21.4 ± 18.2 vs 29.0 ± 18.8 kPa $^{-1}$, $p < 0.05$), while stiffness was increased (7.95 ± 2.22 vs 6.72 ± 2.11 m/s, $p < 0.005$).
Conclusions: This is the first report of the presence of altered mechanical properties (i.e. increased stiffness) in muscular arteries with lumen <1000 mm of essential hypertensive women. These findings suggest that increased hemodynamic load characterizing hypertension lead to a different vascular phenotype in each arterial segment.

P43
MASKED HYPERTENSION AND RETINAL VESSEL STRUCTURE AND FUNCTION IN YOUNG HEALTHY ADULTS: THE AFRICAN-PREDICT STUDY

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