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### **P5.14: HIGH INTENSITY AEROBIC EXERCISE IN PATIENTS WITH ANKYLOSING SPONDYLITIS REDUCES ARTERIAL STIFFNESS: RESULTS FROM A RANDOMIZED CONTROLLED TRIAL**

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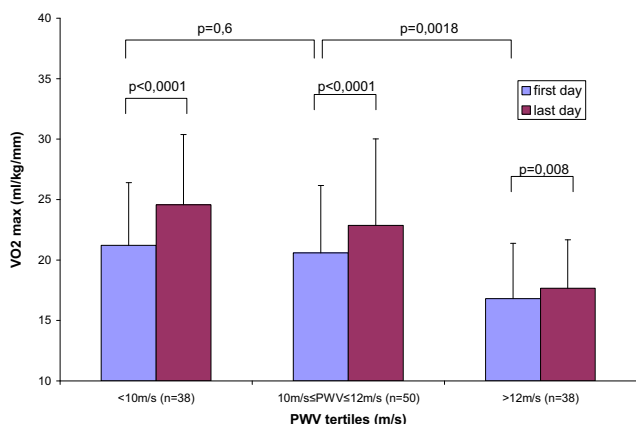
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Carotid femoral PWV, blood pressure (MAP) and heart rate (HR) were measured in a quiet room in the morning of their first and last day prior to any exercise. VO<sub>2</sub>max was also measured at entry and at the end of the rehabilitation program.

PWV was correlated with age ( $R^2=0.23$ ), MAP ( $R^2=0.10$ ) and VO<sub>2</sub>max ( $R^2=0.14$ ) on the first day of the program. There was a small significant reduction in MAP ( $92\pm 12$  to  $88\pm 10$  mmHg,  $p<0.001$ ), in PWV ( $12.1\pm 3.4$  to  $11.4\pm 3.1$  m/s,  $p=0.002$ ), an increase in VO<sub>2</sub>max ( $19.7\pm 5.5$  to  $21.8\pm 6.5$  ml/kg/mm,  $p<0.001$ ) but no change in resting HR ( $70\pm 13$  to  $67\pm 11$  bpm  $p=0.02$ ). When the cohort was separated into PWV tertiles at entry, patients with the lowest PWV exhibit the highest improvements in VO<sub>2</sub>max (see figure).

In our cohort, physical fitness improvement depends on entry arterial stiffness with highest results for patients with low PWV and poorest results for patients with high PWV.



#### P5.12

##### BRACHIAL-TO-RADIAL SYSTOLIC BLOOD PRESSURE AMPLIFICATION IS SIGNIFICANTLY BLUNTED IN PATIENTS WITH TYPE 2 DIABETES; UPPER LIMB HAEMODYNAMIC'S HAVE AN INFLUENTIAL ROLE

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**Objectives:** We recently found significant age-related increases in brachial-to-radial systolic blood pressure amplification (Bra-Rad-SBP<sub>amp</sub>), and this has implications for correct central SBP estimation. Patients with type 2 diabetes mellitus (T2DM) have vascular irregularities that may alter Bra-Rad-SBP<sub>amp</sub> and this study sought to determine the magnitude and mechanisms of Bra-Rad-SBP<sub>amp</sub> in these patients.

**Methods:** Twenty T2DM (64±8 years; 50% male) and 20 controls (60±8 years; 50% male) underwent simultaneous cuff auscultation and two-dimensional ultrasound imaging of the brachial and radial arteries. The 1<sup>st</sup> Korotkoff sound (denoting SBP) at each arterial site was identified from the first inflection point of Doppler flow during BP cuff deflation. Bra-Rad-SBP<sub>amp</sub> was calculated by radial minus brachial SBP. Local and systemic haemodynamics were recorded by tonometry and ultrasound.

**Results:** Radial SBP was higher than brachial SBP for both T2DM ( $136\pm 16$  vs  $127\pm 17$ ;  $p<0.001$ ) and controls ( $135\pm 12$  vs  $121\pm 11$ ;  $p<0.001$ ), and Bra-Rad-SBP<sub>amp</sub> was significantly lower in T2DM ( $9\pm 8$  mmHg vs  $14\pm 7$  mmHg,  $p=0.042$ ). Central SBP was significantly higher in both controls and T2DM when radial pressure waveforms were calibrated using radial, compared with brachial SBP ( $p<0.001$  both). The product of brachial artery flow velocity and diameter was significantly increased in T2DM ( $213\pm 108$  versus  $315\pm 144$  cm/s/mm,  $p=0.023$ ), and this was inversely correlated with Bra-Rad-SBP<sub>amp</sub> ( $r=-0.643$ ,  $p=0.003$ ) even after adjustment for age and sex ( $\beta=-0.031$ , adjusted  $R^2=0.366$ ,  $p=0.002$ ).

**Conclusions:** Patients with T2DM have higher radial SBP than brachial SBP, but compared with controls, overall Bra-Rad-SBP<sub>amp</sub> is significantly blunted. Local haemodynamics influence the magnitude of Bra-Rad-SBP<sub>amp</sub> and overall these findings have implications regarding correct estimation of central BP.

#### P5.13

##### CHANGES IN VENTRICULO-ARTERIAL COUPLING IN PATIENTS WITH HYPERTENSION AND TYPE-2-DIABETES AFTER A PERIOD OF INTENSIFIED ANTIHYPERTENSIVE TREATMENT

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**Objective:** To examine changes in ventriculo-arterial coupling (VAC) and left ventricular systolic function (LVF<sub>SYS</sub>) after a period of intensified antihypertensive treatment in patients with hypertension and type-2-diabetes.

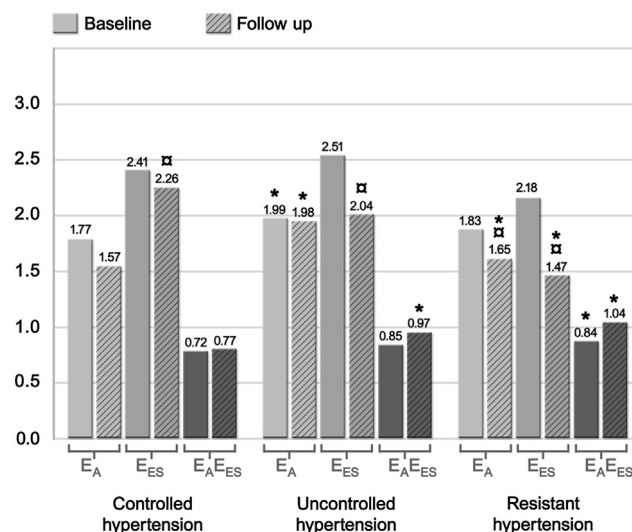
**Methods:** Patients were categorized as controlled- (CH), uncontrolled- (UH) or resistant (RH) hypertensives based on ambulatory blood pressures (BPs) and number of antihypertensive agents. Central BPs were estimated using radial applanation tonometry and a generalized transfer function. LVF<sub>SYS</sub> was evaluated using ejection fraction (EF) and S' (echocardiography). VAC was estimated as the ratio of effective arterial elastance (E<sub>A</sub>) to end-systolic elastance (E<sub>ES</sub>).

**Results:** 100 Patients were included (CH N=34, UH N=32, RH N=34). Median [interquartile ranges] follow up time was 6 [5;8] months.

At follow up patients with UH and RH had a significantly higher E<sub>A</sub> and E<sub>A</sub>/E<sub>ES</sub> compared to patients with CH. Despite a significant reduction in central BPs of 6/4 and 8/3 mmHg there was a non-significant increase in E<sub>A</sub>/E<sub>ES</sub> in patients with UH and RH respectively. E<sub>ES</sub> was significantly reduced in all hypertension groups (figure 1).

On average EF and S' was below 55% and 8 cm/s in all hypertension groups. In patients with RH EF and S' were further reduced from 48 [39;53] % to 42 [34;47] % ( $P=0.01$ ) and 7 [6;8] to 7 [5;7] cm/s ( $P=0.01$ ).

**Conclusion:** VAC and LVF<sub>SYS</sub> did not improve despite a reduction in central BPs. Instead E<sub>ES</sub> deteriorated in all hypertension groups. We speculate whether this is due to a reduction in myocardial perfusion or a gradual progression of diabetic cardiomyopathy.



#### P5.14

##### HIGH INTENSITY AEROBIC EXERCISE IN PATIENTS WITH ANKYLOSING SPONDYLITIS REDUCES ARTERIAL STIFFNESS: RESULTS FROM A RANDOMIZED CONTROLLED TRIAL

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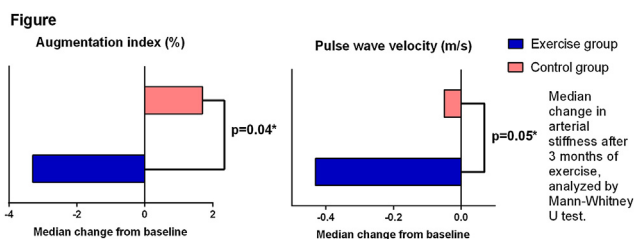
**Objective:** Patients with ankylosing spondylitis (AS) are at increased risk of CVD. The etiological mechanism or how to reduce risk is not known. Exercise can reduce CV risk in the general population. The objective was to test whether high intensity aerobic exercise reduces central arterial stiffness.

**Methods:** A proof of concept randomized controlled pilot study. AS patients were allocated to exercise group (EG) or control group (CG). The 3 months exercise intervention consisted of aerobic high intensity training 40 minutes 3 days a week and muscular strength training 20 minutes twice a week. The control group received care as usual. Augmentation Index (AIx) and pulse

wave velocity (PWV) were assessed at baseline and after intervention. Statistical analyses (SPSS 20) were performed using Mann-Whitney U test to compare median change (from baseline to 3 months) of the parameters between EG and CG. Analyses were performed pr protocol.

**Results:** 28 AS patients were recruited, 24 patients fulfilled the study, 10 in the EG and 14 in the CG. There were some differences in demographics (EG vs. CG): age, years [median (min-max)] 43 (30-67) vs. 50 (26-68), male gender: 20% vs. 71%. After the study period, arterial stiffness was reduced in the EG compared CG, both significant for Alx (%) median (min-max) -3.3 (-24.5-2.5) vs. 1.7 (-13.5-10.3),  $p=0.04$  and for PWV (m/s) median (min-max) -0.4 (-1.9-0.1) vs. -0.1 (-1.5-0.1),  $p=0.05$  (figure).

**Conclusion:** Intervention with high intensity aerobic exercise in AS patients reduced arterial stiffness after 3 months compared to controls.



#### P5.15

##### SEX DIFFERENCES IN CENTRAL ARTERIAL STIFFNESS AND PRESSURES BEFORE AND FOLLOWING MAXIMAL EXERCISE

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**Objective:** There are sex differences in resting central pulse wave velocity (cPWV) but it is unclear if there are sex differences in the response to exercise. We evaluated potential sex differences of two measures of arterial stiffness and central pressures before and following maximal exercise.

**Methods:** We compared aortic and carotid systolic blood pressure (SBP), carotid  $\beta$ -stiffness and cPWV at rest, 15 minutes and 30 minutes following peak aerobic exercise in 73 participants (age=24 yrs; male n=34, female n=39).

**Results:** Women had lower aortic SBP, carotid SBP and cPWV, but similar carotid  $\beta$ -stiffness as men. Aortic SBP did not change, but carotid SBP and carotid  $\beta$ -stiffness increased 15 min post exercise ( $p<0.05$ ) and returned to baseline at 30 min post exercise in both men and women. cPWV was unchanged with exercise in women, but decreased 30 min post exercise in men ( $p<0.05$ ). These sex differences were unchanged when the data were corrected for differences in resting BP.

**Conclusions:** Resting cPWV and the cPWV response to exercise differ between men and women, without any sex differences in carotid stiffness. This suggests that sex may affect arterial stiffness differently in different arterial segments. Furthermore, the central BP response to exercise differs between the aorta and carotid arteries, in both men and women, suggesting the BP response to exercise is dependent on the arterial segment where it is measured.

#### P5.16 Withdrawn by author

#### P5.17

##### NOCTURNAL CHANGES OF AUGMENTATION INDEX MAY BE RELATED TO DIPPING STATUS

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**Aim:** Important prognostic significance of day-night brachial blood pressure (BP) decline for cardiovascular morbidity and mortality has been established. It is little known about diurnal variations of arterial stiffness parameters – augmentation index (AI@75) and aortic pulse wave velocity (PWV) as the non-invasive techniques for their 24-h ABPM has been just recently developed and validated. The aim of the study was to evaluate diurnal variations of AI and PWV in hypertensive subjects.

**Methods:** ABPM was done in untreated hypertensive subjects using BPLab VASOTENS (“OOO Petr Telegin”, Nizhny Novgorod, Russia) brachial oscillometric device which allows to derive aortic AI and PWV. Analysis included

the successful ABPM results of 87 (47 male, age 61 years) subjects. Diurnal BP pattern was evaluated by diurnal index of systolic BP=(daytime SBP-nighttime SBP)/day-time SBP. Subjects were classified to dippers, non-dippers, night-peakers and over-dippers using usual cut-offs for brachial systolic BP.

**Results:** In dippers (n=29) nocturnal decline was 12,8±2,5% for brachial and 16,3±3,6% for aortic SBP, night- and day-time values of PWV and AI@75 were similar: 10,8±1,1 and 10,2±1,3 m/s, and 25,9±15,0 and 27,3±14,5%, respectively. In non-dippers nocturnal decline was 5,9±2,6% for brachial and 4,3±2,9 for aortic SBP, day- and night-time PWV values were similar (10,8±0,9 and 10,3±0,9 m/s), AI@75 tended to be higher during night then daytime (32,7±16,8 vs 27,9±14,6%). In night-peakers (n=13) night-time nocturnal decline was -3,9±3,75% for brachial and -4,8±3,9% for aortic SBP, day- and night-time PWV values were similar (10,6±1,0 and 10,5±1,3 m/s) and AI@75 tended to be higher during night then daytime (27,6±16,0 vs 36,8±32,6%). In over-dippers (n=4) night-time nocturnal decline was 20,7±0,9 for brachial and 20,2±1,0 for aortic SBP, day- and night-time PWV values were similar (10,3±0,9 and 9,5±0,8 m/s) and AI@75 tended to be higher during day then night-time (20,2±13,1 vs 14,2±18,7%).

**Conclusion:** The results suggest that PWV is relatively constant during 24-h, but nocturnal changes of AI@75 may vary across different SBP diurnal patterns

#### P5.18

##### CENTRAL HEMODYNAMIC'S ARE ASSOCIATED WITH DIABETIC COMPLICATIONS IN TYPE 1 DIABETES

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**Objectives:** We investigate associations between central hemodynamics and complications in type 1 diabetes.

**Methods:** Cross-sectional study, 676 type 1 diabetes patients, mean±SD age 55±13, 375(56%) male. Central hemodynamics measured by pulse wave analyses (PWA) (SphygmoCor (Atcor Medical, Australia) as central aortic systolic pressure (CASP), central pulse pressure (CPP), central diastolic pressure (CADP) and subendocardial viability ratio (SEVR) (index of myocardial oxygen supply and demand). Standardized values of hemodynamic measures were used in adjusted analyses. Complications were presence of albuminuria ( $\geq 30$ mg/24-hour), cardiovascular disease (CVD), retinopathy or autonomic dysfunction (heart rate variability  $< 11$  beats/minute).

**Results:** PWAs were available in 636 patients. Mean±SD CASP: 118±17 mmHg, CADP: 75±10 mmHg, CPP: 43±14 mmHg and SEVR: 150±32.

CVD (n=120) and autonomic dysfunction (n=349) was associated with: CASP (per +1 standard deviation (SD)): odds ratios (OR)= 3.6(2.0-6.5) and 4.8(2.6-8.8); CPP (per +1SD): OR=2.0(1.5-2.7) and 2.2(1.6-3.1); CADP (per -1SD): OR=2.9(1.7-5.0) and 2.9(1.7-5.1); and SEVR (per -1SD): OR=1.7(1.1-2.6) and 2.4(1.6-3.5) (adjusted for gender, diabetes duration, mean arterial pressure, heart rate, height, urinary albumin excretion rate (UAER), eGFR, HbA<sub>1c</sub>, cholesterol, antihypertensive medication and smoking). None of the hemodynamic variables were associated with albuminuria (n=335) or retinopathy (n=469) ( $p\geq 0.14$ ). However, if analysing UAER as a continuous variable, all hemodynamic variables were independently associated with level of UAER ( $p\leq 0.001$ ).

**Conclusions:** In patients with type 1 diabetes, central hemodynamics are independently associated with CVD, autonomic dysfunction and level of UAER, but not with albuminuria grade or retinopathy. Future studies are needed to determine if targeting central hemodynamics improve outcome.

#### P5.19

##### STIFF ARTERIES, STIFF HEARTS?

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**Objectives:** To examine the relationship between arterial stiffness and diastolic function in healthy normotensive subjects.

**Methods:** For this study, 43 male (40±10 years) and 64 female (40±9 years) subjects were recruited. All were lifelong non-smokers, normolipidaemic, normoglycaemic and had normal 24-hour blood pressure responses (SBP/DBP  $< 140/90$ ). For each subject, metabolic profile and anthropometric measurements were recorded. Carotid-femoral pulse wave velocity (PWV) was measured to assess arterial stiffness. Early/late mitral valve filling velocity (MV E/A) and isovolumetric relaxation time (IVRT) was used to assess diastolic function.