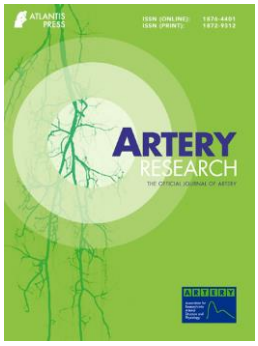

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P5.07: DIFFERENT EFFECTS OF AGEING AND BP ON SEVERAL AORTIC AND CAROTID SEGMENTS

F. Tosello, M. Bensalah, H. Ketthab, N. Kachenoura, P. Boutouyrie, S. Laurent, E. Mousseaux

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demonstrating that pre-load and after-load contributed approximately equally to the reduction of LV wall stress.
Conclusions: NTG reduces myocardial stress and increases myocardial contraction efficiency as a result of similar contributions from reductions in pre- and after-load.

P5.03 Withdrawn by author

P5.04
ARTERIAL STIFFNESS AND WAVE REFLECTIONS DECREASE DURING PREGNANCY

J. Bossuyt [1], I. Fabry [1], S. Vermeersch [1,2], J. Kips [1,2], K. Roelens [3], L. Van Bortel [1]
[1]*Heymans Institute of Pharmacology, Ghent, Belgium*
[2]*Institute Biomedical Technology, Ghent, Belgium*
[3]*Department of Obstetrics and Gynaecology, Ghent, Belgium*

Objective: Studies on changes in arterial stiffness and wave reflections during pregnancy are limited to cross-sectional studies. Our aim was to investigate maternal hemodynamic and cardiovascular adaptations at each trimester of pregnancy in a prospective longitudinal case-control study.
Methods: Cardiovascular measurements were performed at 12, 20 and 35 weeks of gestation, and included peripheral (Omron M6) and central (Sphygmocor) blood pressures, wave reflection and arterial stiffness measures (Sphygmocor and Esaote AU5 Wall track system).
Results: 109 healthy women with a normal pregnancy (mean age 29.3y, range 21-42) and 26 healthy non-pregnant control subjects (mean age 28.4y, range 21-40) were included. Except for peripheral and central systolic blood pressure, all cardiovascular parameters showed significant ($p<0.05$) changes during pregnancy. Heart rate increased linearly during pregnancy. In contrast, diastolic blood pressure (DBP), mean arterial pressure (MAP), augmentation index (AIx@75) and aortic stiffness (PWV) showed a typical V-shaped pattern, characterized by a significant drop from 12 to 20 weeks of gestation (DBP: -2.6 mm Hg; MAP: -1.6 mm Hg; AIx@75: -10.0 %; PWV: -0.6 m/s), followed by a rise (DBP: +4.2 mm Hg; MAP +4.0 mm Hg) or smaller drop (AIx@75: - 7.8 % ; PWV: -0.4 m/s) at 35 compared to 12 weeks of gestation.
Conclusions: The present longitudinal case-control study confirms the results of previous cross-sectional studies on peripheral and central hemodynamics. In addition, it shows a drop in wave reflection and arterial stiffness which may be due to vasodilation in the second and third trimester of pregnancy.

P5.05
EXERCISE- INDUCED ALBUMINURIA IS A MANIFESTATION OF EXERCISE AORATIC RESERVOIR FUNCTION IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

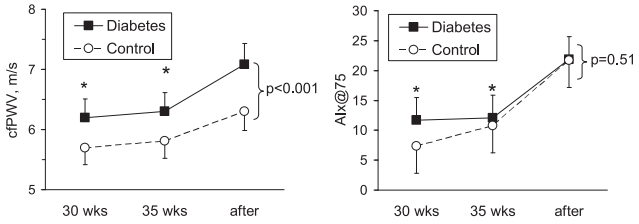
R. E. D. Climie [1], V. Srikanth [2], L. J. Keith [1], J. E. Davies [3], J. E. Sharman [1]
[1]*Menzies Research Institute Tasmania, Hobart, Australia*
[2]*Stroke and Ageing Research Group, Monash Medical Centre, Monash University, Melbourne, Australia*
[3]*International Centre for Circulatory Health, Imperial College, London, United Kingdom*

Objectives: Patients with type 2 diabetes (T2DM) are susceptible to exercise-induced albuminuria even at submaximal exercise, but the mechanisms are unknown. Recent data indicates that T2DM patients have raised central blood pressure (BP) during submaximal exercise and this could contribute to renal dysfunction independent of upper arm BP. This study sought to determine the relationship between exercise central haemodynamics and exercise-induced albuminuria in T2DM.
Methods: Forty T2DM patients (62±9 years; 50% male) and 40 healthy controls (53±9 years; 50% male) were examined at rest and during a 20-minute bout of light cycle exercise (40W; 50RPM). Haemodynamics recorded included, aortic reservoir function (excess pressure integral [xsP] and aortic reservoir pressure), aortic stiffness, augmented pressure (AP), brachial and central BP. Albuminuria was assessed by albumin/creatinine ratio (ACR) at rest and within 20 minutes after exercise.
Results: There was no difference between groups in resting ACR ($p>0.05$). Exercise induced a significant ACR rise in T2DM patients but not controls (0.39±0.89 vs 1.05±1.38 mg/mol, $p=0.017$). All central haemodynamic variables indicative of systolic stress were significantly higher during exercise in T2DM participants (i.e. xsP, systolic BP and AP; $p<0.01$ all). For T2DM patients, exercise xsP was independently associated with increased ACR ($\beta=0.003$, $p=0.001$), independent of age, sex, body mass index, and 24-hour ambulatory SBP.
Conclusions: Aortic reservoir function, as determined by excess pressure during submaximal exercise, is independently associated with exercise-induced albuminuria in T2DM patients. These novel findings suggest that aortic reservoir function could be important for appropriate renal function in patients with T2DM.

P5.06
NATURAL TIME COURSE OF AORTIC STIFFNESS AND WAVE REFLECTIONS IN NORMAL PREGNANCY AND IN GESTATIONAL DIABETES: A LONGITUDINAL STUDY

F. Battista [1], G. Pucci [1], C. F. Sorrentino [2], E. Torlone [3], S. Gerli [2], G. Schillaci [1]
[1]*Università di Perugia, Medicina Interna, Terni, Italy*
[2]*Università di Perugia, Ginecologia, Perugia, Italy*
[3]*Azienda Ospedaliera di Perugia, MISEM, Perugia, Italy*

Pregnancy is associated with profound vascular adaptive changes. Cross-sectional studies show greater arterial stiffness in gestational diabetes than in normal pregnancy. However, the time course of maternal cardiovascular hemodynamics in normal and diabetic pregnancy can only be appreciated in longitudinal studies.
Thirty-six women with gestational diabetes (34±5 years, BP 111/69±13/8 mmHg) and 36 with normal pregnancy (33±3 years, BP 111/68±10/8 mmHg) were examined 3 times, at a gestational age of 30 and 35 weeks, and 12 weeks after delivery. On each occasion, tonometry-based carotid-femoral pulse wave velocity (cfPWV) and heart-rate corrected aortic augmentation index (AIx@75) were obtained (SphygmoCor).
Compared to women with normal pregnancies, women with gestational diabetes had a higher age- and mean arterial pressure-adjusted cfPWV ($p<0.001$, Figure), both during pregnancy (6.2±0.9 vs 5.7±0.8 m/s at week 30, 6.3±0.9 vs 5.8±0.9 at week 35) and after delivery ($p=7.1\pm1.0$ vs 6.3±1.1 m/s). AIx did not differ between the two groups ($p=0.51$). In both groups, cfPWV was significantly lower at 30 and 35 weeks than after delivery (Figure, both $p<0.001$). AIx@75 and central SBP were markedly lower during pregnancy than after delivery (both $p<0.001$), despite unchanged brachial SBP.
Conclusions: (1) compared with normal pregnancy, gestational diabetes is associated with a higher aortic stiffness, which remains elevated 3 months after delivery; (2) no significant differences in wave reflection are present in normal and diabetic pregnancies; and (3) aortic stiffness and augmentation are lower during the third trimester of gestation than after delivery, both in normal pregnancies and in gestational diabetes.



P5.07
DIFFERENT EFFECTS OF AGEING AND BP ON SEVERAL AORTIC AND CAROTID SEGMENTS

F. Tosello [1,2], M. Bensalah [3], H. Ketthab [1], N. Kachenoura [3], P. Boutouyrie [1], S. Laurent [1], E. Mousseaux [3]
[1]*Descartes University, Pharmacology Dpt, Paris, France*
[2]*Turin University, Medical Sciences Dpt, Turin, Italy*
[3]*Descartes University, Radioogy Dpt, Paris, France*

Objective: Carotid-femoral PWV (cfPWV) is a regional marker of vascular ageing: our aim was to take advantage of Magnetic Resonance (MRI) and High resolution Echotracking (HRE) in order to non-invasively investigate the effect of age and blood pressure (BP) on different segments of large arteries.
Methods: Regional stiffness was measured as cfPWV using Sphygmocor and as aortic arch PWV using MRI (ArchPWV). Local stiffness was measured at the carotid artery site using HRE (carPWV), and at the ascending and

descending thoracic aorta sites using MRI (As and DsAoPWV). Local PWVs were calculated using Bramwell-Hill equation and all velocities were expressed in m/s. We included 72 normotensive non diabetic subjects (56.7% men), free from overt cardiovascular disease.
Results: In these 42±15 yrs-old subjects, having SBP/DBP 119±11/66±8 mmHg, PWV increased from proximal to distal segments: AsAoPWV=5.37±2.07 m/s; ArchPWV= 5.47±2.07 m/s; DsAoPWV=5.45±1.40 m/s; carPWV=5.79±1.5 m/s; and cfPWV=7.65±1.58 m/s. In univariate analysis, all PWVs strongly increased with age (r^2 ranging from 0.36 for ArchPWV to 0.54 for AsAoPWV; $p<0.0001$). The stiffness gradient between AsAoPWV and CarPWV reversed with ageing. ($r=0.42$, $p<0.001$). Mean blood pressure (MBP) was more strongly associated with CarPWV and cfPWV ($r=0.53/0.71$ respectively; $p<0.001$).
Conclusion: In this cohort of normotensive subjects we showed that age and BP had different effects on various segments of large proximal arteries. Age was a determinant of arterial stiffness in all carotid and aortic segments, with a more pronounced influence on AsAoPWV whereas MBP affected more aortic stiffness on the carotid-femoral pathway.

P5.08
ACUTE CHANGES IN CAROTID DIAMETER AND THICKNESS AFTER AND IRONMAN COMPETITION

R. M. Bruno [1,2], E. Bianchini [1], A. Vezzoli [3], S. Mrakic Sposta [3], A. I. Corciu [2], M. Comassi [2], R. Sicari [1], E. Picano [1], L. Pratali [1]
[1]*Institute of Clinical Physiology — CNR, Pisa, Italy*
[2]*University of Pisa, Pisa, Italy*
[3]*Institute of Bioimaging and Molecular Physiology - CNR, Milano, Italy*

Objective: The aim of this study was to evaluate the acute effects of participation in Ironman triathlon competition on carotid properties, in relation to hemodynamic load.
Methods: 28 male triathletes (41±8 years), participating at the Ironman competition (swimming 3.8 km, cycling 180 km, running 42,2 km; 13 athletes performed half-race), underwent carotid and cardiac ultrasound examinations at rest and within 20' from the arrival. Right carotid diameter (D), distension (ΔD) and Intima-Media-Thickness (IMT) were estimated by an automatic system applied to ultrasound B-mode image sequences, and carotid pulse pressure (PP) by tonometry.
Results: The mean duration of the competition was 12:48±1:14 h (6:14 ± 0:37 hrs for the half-race). At the end of the competition the athletes showed increased heart rate (60.2±13.1 to 82.8±15.6 bpm, $p<0.0001$), unchanged mean BP (93±14 to 91±10 mmHg, p=ns), carotid PP (from 42 to 42 mmHg, p=ns), and stroke volume (64±14 to 59±16 ml, p=ns) and total body water (48.0±4.0 to 46.5±3.9 kg, p=ns). Cardiac output was significantly increased (5.5±1.2 to 6.7±2.4 l/min, $p<0.05$), and total peripheral resistances were reduced (17.6±3.9 to 14.8±4.6, $p=0.01$). D was increased (7.19±0.65 to 7.61 ± 0.76mm, $p<0.05$), while IMT was significantly reduced at the end of the competition (537±70 to 495±70 μm, $p<0.05$). ΔD and CC were not modified (588±139 to 568±168 μm and 1.12±0.58 to 1.22±0.54 mm^2/KPa, p=ns).
Conclusions: In an Ironman competition, strenuous exercise induced a marked carotid dilation and a decrease in IMT.

P5.09
INCREASED SYSTEMIC VASCULAR RESISTANCE DURING MODERATE EXERCISE INDEPENDENTLY PREDICTS A HYPERTENSIVE RESPONSE TO EXERCISE

S. N. Nikolic [1], M. J. Adams [2], L. M. Edwards [3], J. E. Sharman [1]
[1]*Menzies Research Institute Tasmania, University of Tasmania, Hobart, Australia*
[2]*School of Human Life Sciences, University of Tasmania, Launceston, Australia*
[3]*Centre of Human & Aerospace Physiological Sciences, King's College London, London, United Kingdom*

Background: A hypertensive response to exercise (HRE) at moderate intensity is an independent risk factor for cardiovascular events and mortality, but the underlying mechanisms are unknown. This study sought to determine the haemodynamic predictors of exercise blood pressure (BP) and an HRE.
Methods: Study sample comprised 75 consecutive patients (aged 57±10 years; 73% male) who were free from coronary artery disease and had completed a clinically indicated exercise stress test. Participants were stratified according to systolic BP (SBP) at moderate exercise intensity (Bruce protocol stage 2) with the highest tertile (SBP ≥169 mmHg) defined as an HRE. All participants underwent comprehensive haemodynamic assessment at rest and during moderate exercise; including, brachial and central BP, aortic stiffness, cardiac output (CO) and systemic vascular resistance (SVR; using bioimpedance).
Results: At rest, subjects with HRE had higher body mass index (BMI), triglycerides, aortic stiffness, brachial and central BP compared with normal exercise BP responders ($p<0.05$ for all), but no difference in resting SVR ($p>0.05$). During exercise, subjects with HRE had normal CO but significantly increased SVR ($p=0.033$) and, of all variables measured, this had the strongest correlation with exercise brachial and central SBP ($r=0.527$ and $r=0.626$ respectively; $p<0.001$). On multiple regression, exercise SVR ($\beta=0.357$, $p=0.002$) predicted exercise brachial SBP, independent of age, sex and BMI (Adjusted $R^2=0.399$, $p<0.001$).
Conclusions: Increased SVR during moderate exercise is independently related to exaggerated exercise SBP (HRE) in people undergoing clinically indicated stress testing. This suggests that abnormal peripheral vascular function may be a mechanism explaining exercise hypertension.

P5.10
MAJOR BRACHIAL-TO-RADIAL-SYSTOLIC-BLOOD-PRESSURE-AMPLIFICATION OCCURS IN HEALTHY PEOPLE AND IS SIGNIFICANTLY INCREASED WITH AGE

D. S. Picone [1], R. E. D. Climie [1], K. D. K. Ahuja [2], M. A. Keske [1], J. E. Sharman [1]
[1]*Menzies Research Institute Tasmania, University of Tasmania, Hobart, Australia*
[2]*School of Human Life Sciences, University of Tasmania, Launceston, Australia*

Objectives: The reference standard for non-invasive central blood pressure (BP) measurement is radial tonometry calibrated using brachial BP. Brachial-to-radial-systolic-BP-amplification (Bra-Rad-SBP_{Amp}) may introduce error into central BP measurement but the magnitude of Bra-Rad-SBP_{Amp} in healthy people is uncertain. This study aimed to determine the magnitude of Bra-Rad-SBP_{Amp} as well as effects of ageing.
Methods: Forty healthy younger (28±5 years; 50% male) and 20 older (60±8 years; 50% male) participants underwent brachial and radial artery ultrasound measurement to identify SBP (1st Korotkoff sound) from the 1st Doppler flow inflection point during BP cuff deflation. Regional and local haemodynamics were recorded by ultrasound and tonometry. Bra-Rad-SBP_{Amp} was calculated by radial minus brachial SBP.
Results: Radial SBP was significantly higher than brachial SBP in both younger (118±12mmHg versus 110±10mmHg; $p<0.001$) and older (135±12mmHg versus 121±11mmHg; $p<0.001$) participants. However, the magnitude of Bra-Rad-SBP_{Amp} was higher in older age (14±7mmHg versus 8±7mmHg; $p=0.004$), and this was independent of heart rate, mean arterial pressure and sex. A higher proportion of older participants had major (>15mmHg) Bra-Rad-SBP_{Amp} (45% versus 12.5%; $p=0.028$). Recalibration of radial waveforms using radial versus brachial SBP resulted in higher central SBP in both younger ($p<0.001$) and older ($p<0.001$) age groups ($p<0.001$ between groups). Brachial artery stiffness was related to Bra-Rad-SBP_{Amp} in females only.
Conclusions: Major Bra-Rad-SBP_{Amp} occurs in healthy people and is significantly increased with age. These findings have implications for correct central BP estimation using radial tonometry and brachial BP calibration, whereby greater underestimation of central SBP is likely with advancing age.

P5.11
PHYSICAL FITNESS IMPROVEMENT AFTER CARDIAC REHABILITATION PROGRAM DEPENDS ON PWV

D. Agnoletti [1], S. Millasseau [2], G. Amah [3], C. Guiti [3], S. Gagey [3], J. Peroz [3], M. Duval [3], K. Abdennbi [3]
[1]*Paris Descartes University, APHP Hotel Dieu, Diagnosis and Therapeutic Center, Paris, France*
[2]*Pulse Wave Consulting, Saint Leu La Foret, France*
[3]*Cardiac rehabilitation, Bellan Hospital, Paris, France*

Aortic pulse wave velocity (PWV) is a measure of vascular organ damage. After a cardiac event, patients can be proposed to follow an educational and exercise program to prevent future events and improve their cardiovascular risk. We hypothesized that the improvement of aerobic performance will depend on their initial arterial health measured with PWV.
126 patients (99men, 27 women) followed cardiac rehabilitation programs of Bellan Hospital in Paris. Programs duration lasted from 1 to 4 months.