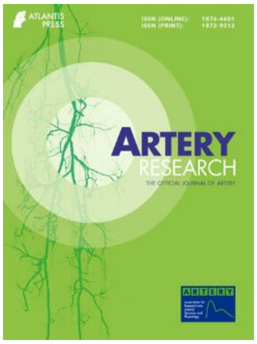


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# 12.01: MEASURING AORTIC DISTENSIBILITY WITH CMR USING CENTRAL PRESSURES ESTIMATED IN THE MAGNET: COMPARISON WITH CAROTID AND PERIPHERAL PRESSURES

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presented greater values 12.18±2.51 vs 9.84 ±1.75 in CT vs 9.71± 1.9 m/sec in TT genotype p=0.04, with ascending trend for the rest of the parameters p=NS), but only ascending trends (without statistical significance) were registered in men.
**Conclusion:** In the present study, the presence of the CC homozygote status was associated with the increase of arterial rigidity.

**P11.30**
**HERITABILITY OF CENTRAL BLOOD PRESSURE AND PULSE PRESSURE — A TWIN STUDY**

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**Objective:** Central blood pressure ($SBP_{ao}$), peripheral and aortic pulse pressure (PP, $PP_{ao}$) are powerful predictor of cardiovascular events. No comprehensive twin study has investigated their heritabilities.
**Methods**: 389 Italian, Hungarian and American twin pairs (230 monozygotic and 159 dizygotic) underwent oscillometric arterial stiffness investigation (TensioMed Arteriograph, TensioMed Ltd., Budapest) to measure brachial and aortic augmentation index ($Aix_{bra,}$, $Aix_{ao}$), pulse wave velocity on aorta ($PWV_{ao}$) and $SBP_{ao}$. MPlus Version6 statistical softwer was used.
**Results**: Age, sex and country-adjusted heritability of $SBP_{ao}$, PP and $PP_{ao}$ indicated 45.5% (95% confidence interval /CI/, 10.5 to 60.0%), 46.6% (95% CI, 29.8 to 58.0%), and 39.9% (95% CI, 1.4 to 53.9%). Unshared environmental effects accounted for the largest part of variance, respectively. Model fit was normal. Bivariate saturated model showed high and significant correlations between $SBP_{ao}$, $PP_{ao}$ and arterial stiffness measures (r=0.588, p<0.001 between $SBP_{ao}$ and $Aix_{bra}$; r=0.587, p<0.001 between $SBP_{ao}$ and $Aix_{ao}$; r=0.475, p<0.001 between $SBP_{ao}$ and $PWV_{ao}$; r=0.582, p<0.001 between $PP_{ao}$ and $Aix_{bra}$; r=0.581, p<0.001 between $PP_{ao}$ and $Aix_{ao}$; r=0.456, p<0.001 between $PP_{ao}$ and $PWV_{ao}$). Non-significant correlations were estimated for PP and Aix (r=-0.077, p=0.057 between PP and $Aix_{bra}$; r=-0.078, p=0.055 between PP and $Aix_{ao}$; r=0.083, p<0.05 between PP and $PWV_{ao}$).
**Conclusions**: $SBP_{ao}$, PP and $PP_{ao}$ are moderately heritable. High significant correlations were estimated between $SBP_{ao}$, $PP_{ao}$ and arterial stiffness, suggesting a genetic background.
(The research was supported by Medexpert Ltd, Twins Days Festival Committee, Balassa Institute Hungarian Scholarship Board Office, Ministry for Foreign Affairs of Republic of Italy.)

**P11.31**
**CLINICAL AND VASCULAR PARAMETERS CORRELATED WITH AUGMENTATION PRESSURE IN A BRAZILIAN HYPERTENSIVE POPULATION**

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**Background:** Augmentation pressure (AP) has been considered an absolute index that represents vascular stiffness.
**Objective:** To evaluate clinical and vascular parameters in a Brazilian population presenting hypertension and increased augmentation pressure.
**Methods:** A cross-sectional study was carried out to evaluate hypertensive patients, both genders, aged 30-75 years. Cardiovascular risk was estimated using SCORE by gender, age, systolic blood pressure, total cholesterol and smoking status. Carotid-femoral pulse wave velocity (cfPWV) was measured by Complior SP, aortic pressures and AP were obtained using SphygmoCor device, and intima-media thickness (IMT) was measured by carotid ultrasonography.
**Results:** Subjects (n=129) were divided into two groups according to AP median (16mmHg). Individuals with increased AP were older (59 vs 51 years, $p<0.001$) and presented higher SCORE (4,0 vs 2,5%, $p<0.05$), pulse pressure (66 vs 48mmHg, $p<0.001$), time of hypertension (16 vs 8 years, $p<0.001$), total cholesterol (216 vs 193mg/dl, $p<0.01$), cfPWV (10.9 vs 9.8m/s, $p<0.01$), carotid intima-media thickness (0.87 vs 0.67mm, $p<0.05$), and lower estimated glomerular filtration rate (74 vs 84ml/min, $p<0.01$). All these variables were correlated with AP, but in a multiple linear regression, time of hypertension was the only parameter associated with AP.
**Conclusion:** Many clinical variables may contribute to an increased AP in hypertensive patients, and time of diagnosis seems to be important suggesting that intensive and early antihypertensive treatment could smooth the progress of patient's vascular status.

## P12 — Techniques and Mechanisms 2

**P12.01**
**MEASURING AORTIC DISTENSIBILITY WITH CMR USING CENTRAL PRESSURES ESTIMATED IN THE MAGNET: COMPARISON WITH CAROTID AND PERIPHERAL PRESSURES**

A. Redheuil [1,3], M. Bensalah [2,3], N. Kachenoura [3], E. Bozec [1,4], A. Decesare [3], P. Boutouyrie [1,4], E. Mousseaux [1,3]
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**Objective**: Evaluate the feasibility of local aortic distensibility measurement using central pressure estimation in the magnet, simultaneous to aortic imaging with cardiovascular magnetic resonance (CMR).
**Methods:** We studied 49 asymptomatic subjects (26 men, age 44±18 years). Ascending aortic strain was determined by CMR using automated segmentation of SSFP cine acquisitions. Central pressures were estimated as: 1) carotid pressures using tonometry measured immediately after CMR; 2) estimated from brachial cuff pressure using Vicorder™ acquired simultaneously with aortic cine imaging in the magnet. Central pressures were used to calculate aortic distensibility defined as aortic strain over central pulse pressure (AAD-carotid using carotid pressure and AAD-vicorder using Vicorder) and the carotid augmentation index (AIx). Carotid-femoral pulse wave velocity (cfPWV) was measured using tonometry.
**Results**: Average±SD systolic brachial, carotid and Vicorder pressures were respectively: 114±13, 105±13, 106±14mmHg. We found a strong linear relationship between AAD-carotid and AAD-vicorder (β=0.89, R2=0.91, p<0.001). The mean distensibility difference between the two methods was: -1.1±12 mmHg and variability 0.9%. Distensibilities measured using brachial pressures were higher than using either central pressures (Table).
The correlations with age, AIx and cfPWV obtained using AAD-vicorder (respectively: r=-0.82, r=-0.62; r=0.61; p<0.001) were significantly higher than using AAD-carotid (r=-0.79, r=-0.50, r=-0.58; p<0.001).
**Conclusions**: Aortic distensibility may be measured by CMR using central pressures measured in the magnet, simultaneously with cine acquisitions. Resulting distensibilities are closely related to those using carotid pressures measured by tonometry outside the magnet and achieve higher correlation with age and markers of global aortic stiffness such as AIx and cfPWV.

Table: Average ascending aortic distensibilities according to central pressure measurement technique and age group

| Distensibilities, $kPa^{-1}.10^{-3}$ | **Age < 50 years** n=26 | **Age≥50 years** n=23 |
|---|---|---|
| **AD peripheral (Brachial)** | 65±29 | 24±13 |
| **AAD central Carotid** | 80±34 | 31±17 |
| **AAD central Vicorder** | 83±37 | 30±18 |

### P12.02
### VARIATIONS OF WAVE REFLECTION INDEXES INDUCED BY ACUTE BLOOD PRESSURE CHANGES AT DIFFERENT ARM HEIGHTS

G. Pucci [1], B. Gavish [2], F. Battista [1], L. Settimi [1], E. Mannarino [1], G. Schillaci [1]
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Acute blood pressure (BP) changes might influence augmentation index (AIx), an integrated dimensionless measure of reflected wave timing and amplitude. In 30 healthy subjects (49±16 years, 43% men), supine brachial BP and radial-artery waveform (applanation tonometry, SphygmoCor) were obtained with the right arm supported in 3 different positions: at the heart level (0°), raised by 30° (+30°), and lowered by 30° (-30°). BP and tonometric measures were also obtained on the contralateral arm, which was held at the heart level during the examination.
Brachial systolic/diastolic BP was 121/67±18/8 mmHg. Radial AIx was 84±19%, and estimated central AIx 27±14%. As expected, changes in arm position modified substantially mean BP (96±12 mmHg at -30°, 85±11 mmHg at 0°, 74±11 mmHg at +30°, all p<0.001).
Radial and central AIx were both reduced at -30° (71±22% and 17±17%), and increased at +30° (97±21% and 30±14%, all p<0.001) vs corresponding values at 0°. Heart rate and contralateral BP and AIx did not change. Changes in radial and aortic AIx were strongly related each other (r=0.76, p<0.001). Percent variation in radial AIx (highest minus lowest, divided by AIx at heart level) had a strong inverse relationship with age (r=-0.43, p<0.001) and systolic BP (r=-0.37, p<0.001).
In conclusion, acute gravitational upper-limb BP changes generate opposite changes in radial AIx. Acute changes in radial Aix decrease with age and BP levels, and might represent a novel index of vascular aging. Artifactual changes in aortic AIx may arise in the presence of radial-aortic distending pressure gradient.

### P12.03
### VALIDATION OF A BRACHIAL CUFF-BASED METHOD FOR ASSESSING CENTRAL BLOOD PRESSURE AT REST AND DURING LIGHT EXERCISE

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**Background:** Central blood pressure (BP) may be more predictive of cardiovascular events than brachial BP. A cuff-based ambulatory central BP monitor is now available; the aim of this study was to compare values of central BP between this device and the SphygmoCor device.
**Methods:** Two studies were conducted. Study 1: We compared seated central systolic BP (cSBP) and pulse pressure (cPP) between the Mobil-o-graph and SphygmoCor devices. Study 2: We compared cSBP and cPP between the Mobil-o-graph and SphygmoCor devices at rest and during light bicycle exercise, corresponding to approximately 12 and 25 watts.
**Results:** Study 1 contained 51 healthy subjects (mean age 51±20yrs, 31 females) and study 2 contained 20 subjects (mean age 43±11yrs, 9 females). Study 1:The mean difference between devices was 1±5mmHg, P=0.18 (cSBP) and 0±4mmHg, P=0.54 (cPP). There was a strong correlation between devices for cSBP (r=0.94, P<0.0001) and cPP (r=0.92,P<0.0001). Study 2:The mean difference in cSBP between devices was 1±3mmHg at rest and 1±6mmHg at the highest workload. The mean difference in cPP between devices was 0±3mmHg at rest and 0±6mmHg at the highest workload. The devices were strongly correlated at rest (r=1.00, P<0.0001, cSBP) and (r=0.87, P<0.0001, CPP) and at the highest workload for (r=0.94, P<0.0001, cSBP) and (r=0.85, P<0.0001, cPP).
**Conclusion:** Non-invasive measurement of central BP by the mobilograph device is in good agreement and highly correlated with the widely used SphygmoCor device, both at rest, and in response to light exercise simulating everyday activities during which ambulatory BP measurements might be made.

### P12.04
### HOW MUCH DOES PRESSURE WAVE REFLECTION CONTRIBUTE TO AUGMENTATION INDEX?

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**Background:** Aortic pulse pressure can be partitioned into the height of the first systolic shoulder (P1) and augmentation pressure AP. P1 is thought to be determined by an outgoing pressure wave generated by ventricular contraction and AP by a backward wave "reflected" from the distal circulation. Augmentation index (AIx = AP / cPP) is commonly used to quantify wave reflection. Nitroglycerin (NTG) has a powerful effect to reduce AIx which has been attributed to a reduction in wave reflection. The objectives of this study were to examine the contribution of forward and backward waves to AIx at rest and after administration of NTG.
**Methods:** A ComboWire 9500 catheter (VolcanoCorp, USA) with a Doppler probe and a pressure sensor at the tip was placed in the aortic root in 21 subjects (11 men, aged 45-81). Simultaneous measurements of aortic blood flow velocity and blood pressure were made at baseline and after the admission of sublingual NTG (400 μg). Using wave decomposition, AIx was expressed as the summation of forward and backward components, $F_{AIx}$ and $B_{AIx}$ respectively.
**Results:** AIx decreased by 17.3% (from 39.5±3.6 to 22.2±5.0%, P<0.001) after NTG. The decrease in AIx was attributable to a similar decrease in both forward and backward components (decreases in $F_{AIx}$ and $B_{AIx}$ by 8.7% and 8.6% respectively (P<0.05).
**Conclusions:** These results suggest the forward wave is a major determinant of AIx and that the role of reflection in mediating effects of NTG may be less than previously thought.

### P12.05
### AMBULATORY ARTERIAL STIFFNESS INDEX: ANOTHER AMBIGUOUS STIFFNESS INDEX?

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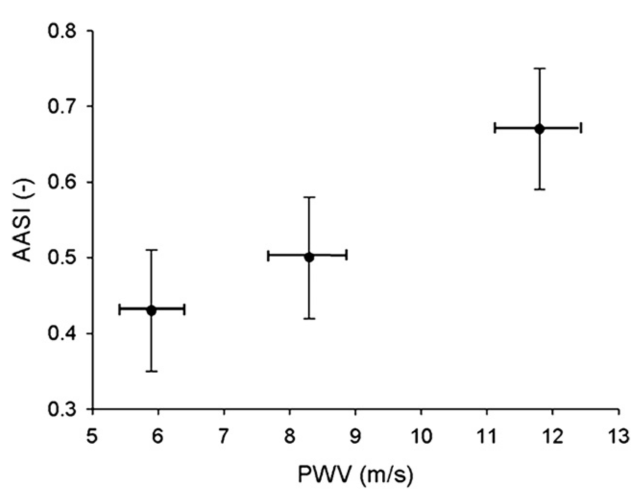
**Introduction:** The Ambulatory Arterial Stiffness Index (AASI), derived from ambulatory blood pressure (ABPM) recordings, has been proposed as a surrogate marker of arterial stiffness. However, there is controversy to which extent it reflects stiffness or is affected by other parameters. Using a computer model of the arterial circulation, the relative importance of the different determinants of the AASI was explored.
**Methods:** Arterial distensibility (inverse of stiffness), peripheral resistance, heart rate, maximal cardiac elastance and venous filling pressure were varied from 80 to 120% of their initial value in steps of 10% to generate 3125 BP-values, mimicking the daily fluctuations in one theoretical subject. From this dataset, we assessed the confidence with which AASI can be derived in this subject, as well as the influence of different individual parameters on AASI. To assess the ability of AASI to detect large changes in arterial stiffness, two additional subjects were simulated with a distensibility of 50% and 25% of the default distensibility, respectively.




Range of AASI- and PWV-values associated with each of the three theoretical subjects