



## Artery Research

ISSN (Online): 1876-4401

ISSN (Print): 1872-9312

Journal Home Page: <https://www.atlantis-press.com/journals/artres>

---

### 15.1: ANALYSIS OF THREE STATISTICAL METHODS TO PREDICT THE PRESENCE OF CAROTID ATHEROMATOUS PLAQUES

Daniel Schang, Mathieu Feuilloy, Magid Hallab, Mathieu Collette, Georges Leftheriotis

**To cite this article:** Daniel Schang, Mathieu Feuilloy, Magid Hallab, Mathieu Collette, Georges Leftheriotis (2016) 15.1: ANALYSIS OF THREE STATISTICAL METHODS TO PREDICT THE PRESENCE OF CAROTID ATHEROMATOUS PLAQUES, Artery Research 16:C, 85–86, DOI: <https://doi.org/10.1016/j.artres.2016.10.132>

**To link to this article:** <https://doi.org/10.1016/j.artres.2016.10.132>

Published online: 7 December 2019

powerful predictors of outcomes in patients after myocardial infarction (MI) continue now. Increased pulse wave velocity (PWV), a non-invasive index of arterial stiffness, predicts cardiovascular event in different clinical conditions, but no study on the relationship between PWV and improvement of LV ejection function (EF) in patients with acute MI.

**Methods:** 97 patients with acute MI and primary percutaneous coronary intervention (PCI) (67% male, age  $61.5 \pm 9.8$  years ( $M \pm SD$ ), 57 (58.7%) with ST-elevation myocardial infarction (STEMI), smokers 29%, arterial hypertension 80%, blood pressure  $129 \pm 8 / 79 \pm 8$  mmHg, left ventricular ejection fraction (LVEF)  $50.6 \pm 3.4\%$ . Arterial stiffness was assessed using applanation tonometry. Global longitudinal peak strain (GLPS) by STE was calculated in a 16-segment LV model as the average segmental value on the basis of three apical imaging planes. Mann-Whitney and Spearman tests were considered significant if  $p < 0.05$ .

**Results:** Baseline GLPS  $>18\%$  was not detected in any patient. GLPS increased from  $14.3 \pm 2.3$  to  $15.6 \pm 2.4\%$ ,  $p < 0.04$  in 4 weeks after PCI. GLPS normalized ( $>18\%$ ) in 24 (25%) patients. Achieved GLPS differed significantly in patients without vs with normalization ( $14.5 \pm 1.8$  vs  $18.6 \pm 0.3\%$ ,  $p < 0.02$ ). Mean carotid-femoral pulse wave velocity (PWV) decreased from  $11.5 \pm 1.9$  to  $10.1 \pm 2.3\%$ ,  $p < 0.05$ . Patients without vs with GLPS normalization were older ( $63.2 \pm 9.1$  vs  $56.6 \pm 11.4$  years,  $p < 0.04$ ), more frequent male (71 vs 33%,  $\chi^2 = 7.8$ ;  $p < 0.01$ ), smokers (83 vs 50%,  $\chi^2 = 6.5$ ;  $p < 0.05$ ), STEMI (60 vs 67%,  $\chi^2 = 4.6$ ;  $p < 0.03$ ), had higher diastolic BP ( $84 \pm 7$  vs  $80 \pm 8$  mmHg,  $p < 0.02$ ), higher baseline PWV ( $12.9 \pm 6.9$  vs  $9.9 \pm 2.1$  m/s,  $p < 0.03$ ). EF increased non-significant between groups. A significant correlation was found between decreased  $\Delta$  speckle tracking and higher PWV ( $r = -0.21$ ,  $p < 0.05$ ).

**Conclusions:** Arterial stiffening may result in a less effective recovery of LV function after acute MI. Measuring PWV values after acute MI important information could be obtained about LV function recovery.

#### 14.10

##### INCREASED CENTRAL PRESSURE AUGMENTATION IS ASSOCIATED WITH REDUCED SLEEP DURATION IN INDIVIDUALS EXPOSED TO AIRCRAFT NOISE POLLUTION: THE SERA-CV STUDY

Rosa Maria Bruno, Ugo Faraguna, Enrica Bonanni, Marina Di Pilla, Marco Di Galante, Tommaso Banfi, Angelo Gemignani, Gaetano Licitra, Francesco Fidecaro, Stefano Berrettini, Maria Angela Vigotti, Stefano Taddei, Lorenzo Ghiadoni  
University of Pisa, Italy

**Background:** Exposure to environmental noise might exert negative effects on cardiovascular function (1). Aim of the study is to explore whether sleep loss associated with exposure to aircraft noise has a detrimental effect on vascular function.

**Methods:** 22 individuals, heavily exposed (E) to aircraft noise ( $>50$  DbA) were recruited and matched with a group of non-exposed individuals (NE). Pulse wave velocity (PWV), central blood pressure (BP), augmented pressure (AP) and augmentation index (Aix) were performed. 7-day actigraphy was performed for the assessment of total sleep time (TST) and wake after sleep onset (WASO).

**Results:** E showed similar TST ( $7.2 \pm 1.8$  vs  $7.1 \pm 1.3$ h,  $p = 0.77$ ) and WASO ( $50 \pm 46$  vs  $47 \pm 30$  min,  $p = 0.49$ ) compared to NE. E showed higher Aix ( $26 \pm 12$  vs  $14 \pm 16$ ,  $p = 0.006$ ) and AP ( $11 \pm 7$  vs  $7 \pm 8$ ,  $p = 0.03$ ) than NE, in the presence of similar PWV, mean BP and heart rate (HR).

In E group, Aix was related with height ( $r = -0.56$ ,  $p = 0.009$ ), TST ( $r = -0.65$ ,  $p = 0.002$ ), while was not related with age, mean BP, PWV and HR. The association remained significant in a multiple regression model ( $\beta = -2.92$ ,  $p = 0.01$ ), with TST accounting for 12.9% of Aix variance ( $r^2$  full model 0.84). In NE Aix was related with age ( $r = -0.82$ ,  $p < 0.001$ ), HR ( $r = 0.76$ ,  $p < 0.001$ ), TST ( $r = -0.49$ ,  $p = 0.01$ ), mean BP ( $r = 0.61$ ,  $p = 0.01$ ), PWV ( $r = 0.57$ ,  $p = 0.004$ ). The only independent determinants of Aix in NE were age ( $\beta = 0.64$ ,  $p = 0.02$ ) and HR ( $\beta = -0.37$ ,  $p = 0.03$ ).

**Conclusions:** Central pressure augmentation is independently affected by sleep duration in individuals exposed to high levels of environmental aircraft noise.

#### References

1. Münzel T, Gori T, Babisch W, Basner M. Cardiovascular effects of environmental noise exposure. *Eur Heart J*. 2014 Apr;35(13):829-36.

#### 14.11

##### TOTAL ARTERIAL COMPLIANCE AS A RISK FACTOR FOR ORGAN DAMAGE IN HYPERTENSION

Dimitrios Terentes-Printzios, Charalambos Vlachopoulos, Nikolaos Ioakeimidis, Panagiota Pietri, Panagiotis Xaplanteris, Eleftherios Paschalidis, Nikitas Skliros, Dimitrios Tousoulis  
1st Department of Cardiology, Hippokraton Hospital, Athens Medical School, Athens, Greece

**Purpose/Background/Objectives:** Hypertension is associated with several markers of subclinical target organ damage (TOD). Total arterial compliance (TAC) is a prognostic factor for cardiovascular events. We hypothesized that there is a relationship between TAC and TOD in never-treated hypertensives.

**Methods:** We enrolled 990 consecutive essential hypertensives (mean age  $52.6 \pm 12.2$  years, 526 males). Markers of subclinical TOD [left ventricular mass index (LVMI), pulse wave velocity (PWV), ankle-brachial index (ABI) and estimated glomerular filtration rate (eGFR)] were evaluated in all patients. LVMI was assessed echocardiographically using the Devereux formula. Carotid-femoral PWV was estimated with the Complior. eGFR was calculated by the Cockcroft-Gault formula. ABI was calculated by dividing the highest ankle systolic blood pressure by the highest brachial systolic blood pressure. The ratio of stroke volume to pulse pressure was measured echocardiographically as a surrogate of TAC.

**Results:** In multivariable regression analysis, TAC exhibited significant association with LVMI ( $p = 0.004$ , adjusted  $R^2$  of model = 0.400), PWV ( $p < 0.001$ , adjusted  $R^2$  of model = 0.298) ABI ( $p = 0.002$ , adjusted  $R^2$  of model = 0.009) but not with eGFR. In further analysis, TAC was associated with the number of TOD markers ( $p < 0.001$ ) as suggested by the 2013 European Guidelines for Hypertension [left ventricular hypertrophy (LVMI  $> 115$  g/m<sup>2</sup> in men and  $> 95$  g/m<sup>2</sup> in women), increased PWV (PWV  $> 10$  m/s), decreased ABI (ABI  $< 0.9$ ) and decreased renal function (eGFR  $< 60$  ml/min)]. In logistic regression model increasing TAC was associated with a reduction in the likelihood of TOD, similarly to the multivariable regression model. ( $P < 0.05$  for all X eGFR).

**Conclusions:** Our findings support the relationship between TAC and TOD in hypertension.

#### 15.1

##### ANALYSIS OF THREE STATISTICAL METHODS TO PREDICT THE PRESENCE OF CAROTID ATHEROMATOUS PLAQUES

Daniel Schang<sup>1</sup>, Mathieu Feuilloy<sup>1</sup>, Magid Hallab<sup>4</sup>, Mathieu Collette<sup>2</sup>, Georges Leftheriotis<sup>3</sup>

<sup>1</sup>ESEO, Angers, France

<sup>2</sup>Groupe ESAIP, Saint Barthelemy d'Anjou, France

<sup>3</sup>UMR CNRS 6214-INSERM 771, CHU d'Angers, Laboratoire d'Exploration Fonctionnelles Vasculaires, Angers, France

<sup>4</sup>Departement de Medecine Geriatrique, CHU, Nantes, France

**Background:** At least 15-20% of all ischemic strokes are attributable to atherosclerosis [1]. We analyzed three statistical methods for 12 traditional risk factors (TRF) i.e. age, sex, arterial pressure, Intima Media Thickness (IMT), Pulse Wave Velocity (PWV) in order to predict the presence of carotid atherosclerotic plaques.

**Methods:** We studied 48 patients (27 men, mean age  $52 \pm 10.9$ ) after a vascular screening for atherosclerosis from a metabolic syndrome cohort in a retrospective way. Fourteen patients presented carotid atheromatous plaques confirmed by a trained operator using an ultrasound system. The sensitivity and specificity of the combination of the IMT and the PWV indices with other risk factors were considered using: multiple linear regressions (MLR), support vector machines (SVM) [2] and discriminant analysis (DA). The best combinations of variables were kept for each learning machine.

**Results:** The best sensibility and specificity were obtained using DA. This method reached a sensitivity of  $95 \pm 7\%$  and a specificity of  $73 \pm 36\%$  with an area under the ROC curve equal to  $0.84 \pm 0.35$ . The other methods showed a sensitivity of  $73 \pm 13\%$  for the MLR method and  $53 \pm 34\%$  for the SVM method with an area under the ROC curve of  $0.72 \pm 0.07$  and  $0.74 \pm 0.18$  respectively.

**Conclusion:** This preliminary study shows that carotid atherosclerotic plaques could be reliably predicted using discriminant analysis method.

Additional studies are needed to confirm the statistical differences observed using this method and to predict the severity of carotid atherosclerosis.

#### References

1. Paini A., Boutouyrie P., Calvet D., Zidi M., Agabiti-Rosei E., Laurent S., Multiaxial mechanical characteristics of carotid plaque: analysis by multi-array echotracking system, *Stroke*, 38(1), 117-123, 2007
2. Christopher M. Bishop, *Pattern Recognition And Machine Learning*, Springer, 2006

#### 15.2

##### ESTIMATES OF ARTERIAL STIFFNESS AND CENTRAL BLOOD PRESSURE IN PATIENTS WITH TYPE 2 DIABETES: A COMPARISON OF SPHYGMOCOR AND ARTERIOGRAPH

Christoffer Krogager<sup>1</sup>, Niklas B. Rossen<sup>1</sup>, Klavs W. Hansen<sup>2</sup>, Søren T. Knudsen<sup>1</sup>, Christian D. Peters<sup>1</sup>, Hans Erik Bøtker<sup>1</sup>, Per L. Poulsen<sup>1</sup>, Esben Laugesen<sup>1</sup>

<sup>1</sup>Aarhus University Hospital, Aarhus, Denmark

<sup>2</sup>Regional Hospital Silkeborg, Denmark

**Background:** The Arteriograph is a cuff-based oscillometric device for non-invasive assessment of central systolic blood pressure (cSBP), aortic augmentation index (Aix) and aortic pulse wave velocity (PWV). The reproducibility of Arteriograph measurements and the agreement with SphygmoCor measurements in diabetic patients has never been assessed.

**Methods:** We compared Arteriograph reproducibility and agreement with SphygmoCor with data from two study populations: Study 1 (n=17/mean age 64 years/diabetes duration 9 years) was conducted in a research laboratory and Study 2 (n=19/mean age 67 years/diabetes duration 9 years) in a catheter lab. SphygmoCor PWV data was only available in study 1.

**Results:** Reproducibility: Mean differences (Standard deviation of the difference (SDD)) between duplicate cSBP, Aix and PWV Arteriograph measurements were  $-0.6 \pm 6.6$  mmHg (cSBP),  $-1.1 \pm 3.3\%$  (Aix) and  $0.1 \pm 0.5$  m/s (PWV) in study 1 and  $-0.01 \pm 4.3$  mmHg (cSBP),  $1.5 \pm 3.2\%$  (Aix) and  $-0.2 \pm 0.6$  m/s (PWV) in study 2, all differences non-significant.

**Agreement:** Mean differences between SphygmoCor and Arteriograph were  $-14 \pm 10$  mmHg (cSBP),  $-8 \pm 7\%$  (Aix) and  $2.4 \pm 1.8$  m/s (PWV), ( $p < 0.001$  for all) in Study 1 and  $-5 \pm 10$  mmHg,  $p = 0.04$  (cSBP) and  $-10 \pm 8\%$ ,  $p < 0.001$  (Aix) in Study 2. In study 1, a significant correlation was observed between the mean and the (SphygmoCor – Arteriograph) difference for cSBP,  $r = -0.75$ ,  $p < 0.001$  and for Aix,  $r = -0.67$ ,  $p < 0.001$ .

**Conclusion:** In patients with type 2 diabetes, Arteriograph data were reproducible yet the device systematically overestimated cSBP, Aix and PWV compared with the SphygmoCor. Hence, the two devices cannot be used interchangeably in patients with type 2 diabetes.

#### 15.3

##### ARTERIAL STIFFNESS RECORDINGS WITH POPMÈTRE® IN A GENERAL PRIMARY CARE POPULATION: THE IPC COHORT

Hasan Obeid<sup>2</sup>, Frederique Thomas<sup>1</sup>, Pierre Boutouyrie<sup>2</sup>, Magid Hallab<sup>3</sup>, Philippe Coucke<sup>1</sup>, Nicolas Danchin<sup>1</sup>, Bruno Pannier<sup>1</sup>

<sup>1</sup>IPC Center, Paris, France

<sup>2</sup>Pharmacological Department, G.Pompidou Hospital, Paris, France

<sup>3</sup>Axelif SA, Nantes, France

**Objectives:** Aortic stiffness, best approached by pulse wave velocity (PWV), is a determinant of health. Among the devices measuring PWV, gold standard are pulse transit time recordings. pOpmètre® (P®) measures pulse at finger and toe levels using oximetry clips and adequate algorithm in less than 5 minutes. It showed good agreement against reference techniques, but P® feasibility and relevance were never tested in a large general population.

**Population and methods:** From September 2015, 527 Normotensives (43.8±13.6 years) had a standard health check-up at the IPC Center (Paris, France) including finger to toe pulse wave velocity recording with pOpmètre®, performed by nurses after 10 minutes supine rest permitting ECG and blood pressure measurements (three values averaged). Data were compared to aortic PWV reference values (Eur Heart J, 2010 31, 2338-2350).

**Results:** Pre-specified factors for measurement failure were variation coefficient within one record > 30%, and PWV extreme outliers: 13 were excluded. BP and PWV were respectively:  $121 \pm 10 / 73 \pm 7$  mmHg  $7.64 \pm 2.7$  m/sec. 231 had optimal BP, 202 normal and 81 high normal BP. PWV

increased with age classes from <30 to >70 years. The P® values fell exactly within the aortic reference ranges for age classes:  $6.2 \pm 1.2$ ,  $7.1 \pm 2.1$ ,  $7.4 \pm 2.2$ ,  $8.2 \pm 2.8$ ,  $10.2 \pm 3.6$ ,  $9.6 \pm 2.6$  m/sec.

**Conclusion:** The simple and quick measurement with pOpmètre® device can be performed by nurses during a tight time schedule. It provides values within aortic Reference value ranges in normal population. It is a promising substitute to reference techniques for assessing PWV during standard health check-up.

#### 15.4

##### MEASURING ARTERIAL STIFFNESS WITH POPMÈTRE® IN CARDIAC REHABILITATION PROGRAM

Hasan Obeid<sup>1</sup>, Bruno Pavy<sup>2</sup>, Magid Hallab<sup>3</sup>, Julie Darchis<sup>2</sup>, Erick Merle<sup>2</sup>

<sup>1</sup>Paris Descartes University, Paris, France

<sup>2</sup>Readaptation Cardiovasculaire, Centre Hospitalier Loire Vendée Ocean, Machecoul, France

<sup>3</sup>University Hospital of Nantes, Gerontology Department, Nantes, France

**Background and Objectives:** Pulse Wave Velocity (PWV) is a good surrogate of the arterial aging. This is an independent biomarker of cardiovascular events (ESH-ESC Guidelines 2013). PWV seems to be reduced with regular exercise. The effect of cardiac rehabilitation (CR) is less known on this biomarker. The aim of this study was to evaluate the impact of a CR program on arterial stiffness measured by pulse wave velocity (PWV).

**Patients and Methods:** Data from 100 consecutive patients recruited in a French CR centre were analyzed after exclusion for High variability  $cv > 30\%$  and aberrant values  $PWV > 30$  m/s. The finger-toe PWV was measured with a new validated device (pOpmètre®-Axelif SAS-France) at the beginning and the end of CR (mean duration =  $18.3 \pm 4$  days). They were measured at the same time and under the same recommended conditions.

**Results:** Patients (Mean age  $64 \pm 11$  years, 84% males), were coronary artery disease (51%), valvular (38%), heart failure (3%) and other (8%). The classical cardiovascular risk factors were the following: 1- current smoking (n=3), 2- Diabetes (n=26), 3- high blood pressure (n=58), 4- high blood cholesterol (n=48), There were also obesity (n=15) coronary heredity (n=19) sedentary lifestyle (n=20). They took part in 155 physical training sessions (mean duration 120 min/day) The maximal workload (MWL) increased from  $94.9 \pm 35$  to  $116 \pm 37$  Watts and the 6min walking test (6MWT) from  $430 \pm 113$  to  $505 \pm 106$  m ( $p < 0.0001$ ). PWV decreased from  $9.16 \pm 3.0$  to  $8.39 \pm 2.5$  m/s ( $p < 0.008$ ). We found a positive correlation with age ( $r = 0.38$   $p < 0.0003$ ) and inverse correlation with maximal workload ( $r = -0.34$   $p < 0.001$ ) and 6MWT ( $r = -0.22$   $p < 0.003$ ).

**Conclusion:** Maximal physical capacity and 6MWT correlated with PWV measured with pOpmètre®, and a current CR program seems to improve the arterial stiffness in a cardiac population.

#### References

1. Maureen Alivon et al. Archives of Cardiovascular Disease (2015). A novel device for measuring arterial stiffness using finger-toe pulse wave velocity: Validation study of the pOpmètre.

#### 15.5

##### ASSOCIATION OF A NEW SURROGATE OF TOTAL ARTERIAL COMPLIANCE WITH LEFT VENTRICULAR MASS: THE SAFAR STUDY

Theodore Papaioannou<sup>4</sup>, Athanase Proterogerou<sup>2</sup>, Antonis Argyris<sup>3</sup>, Evangelia Aissopou<sup>3</sup>, Eftymia Nasothymiou<sup>3</sup>, Christos Tountas<sup>3</sup>, Petros Sfikakis<sup>3</sup>, Nikolaos Stergiopoulos<sup>4</sup>, Dimitrios Tousoulis<sup>1</sup>

<sup>1</sup>Biomedical Engineering Unit, 1st Department of Cardiology,

"Hippokraton" Hospital, Medical School, National and Kapodistrian University of Athens, Athens, Greece

<sup>2</sup>Cardiovascular Prevention & Research Unit, Department of Pathophysiology, Medical School, National and Kapodistrian University of Athens, Greece

<sup>3</sup>Hypertension Center and Cardiovascular Research Laboratory, 1st Department of Propaedeutic Medicine, "Laiko" Hospital, Medical School, National and Kapodistrian University of Athens, Greece

<sup>4</sup>Laboratory of Hemodynamics and Cardiovascular Technology, Institute of Bioengineering, École Polytechnique Fédérale de Lausanne, Switzerland

We investigated the association of total arterial compliance ( $C_T$ ) with left ventricular mass (LVM) and hypertrophy (LVH). The study hypothesis was