

Correlation between retinopathy, arterial stiffness, and blood pressure levels in naive hypertensive patients and normotensive individuals

E. Gavriilaki¹, A. Triantafyllou¹, M. Doumas¹, X. Zabulis², P. Anyfanti¹, K. Petidis¹, E. Gkaliagkousi¹, P. Karamaounas², N. Lazaridis¹, V. Goliás¹, T. Gkiourtzis¹, C. Zamboulis¹, S. Douma¹

¹2nd Propedeutic Department of Internal Medicine, Aristotle University of Thessaloniki, Greece

²Institute of Computer Science, Foundation for Research and Technology – Hellas

Objective

Both aortic stiffness (AS) and retinal vascular lesions are currently considered target organ damage in hypertension and independent cardiovascular risk factors^{1,2}. However, the relationship between those macro- and micro-vascular alterations remains a poorly investigated area.

In this study, we evaluated for the first time the relationship between aortic stiffness and retinal arteriolar narrowing (with quantitative methodology), in individuals with high or normal blood pressure and no other comorbidities.

Design and Method

Consecutive patients attending the Hypertension Unit of the 2nd Propedeutic Department of Internal Medicine, Aristotle University, Thessaloniki, Greece were included in the study.

Procedures in the study protocol were in accordance with institutional guidelines, and all subjects gave written informed consent.

Participants had never been treated with anti-hypertensive agents, did not currently receive other medication, and had no other known health problems.

In order to ensure the **recent appearance** (within 12 months) of hypertension in our study population, only patients with home blood pressure measurements within normal limits during the previous year before hypertension diagnosis were included.

The **normotensive group** was recruited from the Internal Medicine Outpatient Clinic from subjects admitted for regular check-up.

Ambulatory blood pressure measurement (Spacelabs 90207) was used to confirm blood pressure status.

AS was estimated by aortic pulse wave velocity (PWV), assessed by applanation tonometry (Sphygmocor).

Photographs of the retina were taken with a non-mydratic digital fundus camera (NIDEK AFC-230/210) and central retinal artery (CRAE) and vein (CRVE) equivalents and arterio-venus ratio (AVR) were calculated using a computer-based program³.

To define the metabolic and renal function profile of the participants, plasma glucose, serum lipids and creatinine were determined in blood samples taken after at least 12 hours fasting.

Results

The study population consisted of 162 participants, 123 untreated hypertensive patients, with recent appearance (<1 year) of hypertension and 39 normotensives. The age and male percent participation were 43.9±11.6 vs 43.5±11.5 and 72.7 vs 56.7, in each group respectively. Comparison of PWV and retinal measurements are depicted in figures 1-4. Univariate analysis of PWV with clinical, biochemical and blood pressure data showed a significant correlation with CRAE ($r=-0.316$, $p<0.001$, fig.5), AVR ($r=-0.295$, $p<0.001$, fig. 7), age ($r=0.518$, $p<0.001$), Body Mass Index (BMI) ($r=0.209$, $p=0.008$), total cholesterol ($r=0.389$, $p<0.001$), LDL-cholesterol ($r=0.366$, $p<0.001$), triglycerides ($r=0.215$, $p=0.009$), GFR ($r=-0.170$, $p=0.039$), glucose ($r=0.381$, $p<0.001$), office BP ($p<0.001$) and 24hour BP ($p<0.001$) measurements. However, in the multiple linear regression model (R Square=0.523) only age, AVR, glucose and office systolic BP remained statistically significant (table 1).

Conclusions

Our study shows that hypertensive retinal vascular alterations are independently related with arterial stiffness in a group of otherwise healthy hypertensive and normotensive individuals. The long-term significance of this correlation, as well as the prognostic significance of quantitative retinal alterations, remain to be evaluated in future studies.

References: 1)Sun C, Wang JJ, Mackey DA, Wong TY. Retinal vascular caliber: systemic, environmental, and genetic associations. *Surv Ophthalmol* 2009 Jan;54(1):74-95. 2)Vlachopoulos C, Aznaouridis K, Stefanadis C. Prediction of cardiovascular events and all-cause mortality with arterial stiffness: a systematic review and meta-analysis. *J Am Coll Cardiol* 2010 Mar 30;55(13) 3) G. Manikis, V.Sakkalis, X. Zabulis, P. Karamaounas, A.Triantafyllou, S. Douma, C.Zamboulis, K.Marias. An Image Analysis Framework for the Early Assessment of Hypertensive Retinopathy Signs. International Conference on e-Health and Bioengineering, Ialii, Romania, 24-26 November 2011. (Best conference paper award)

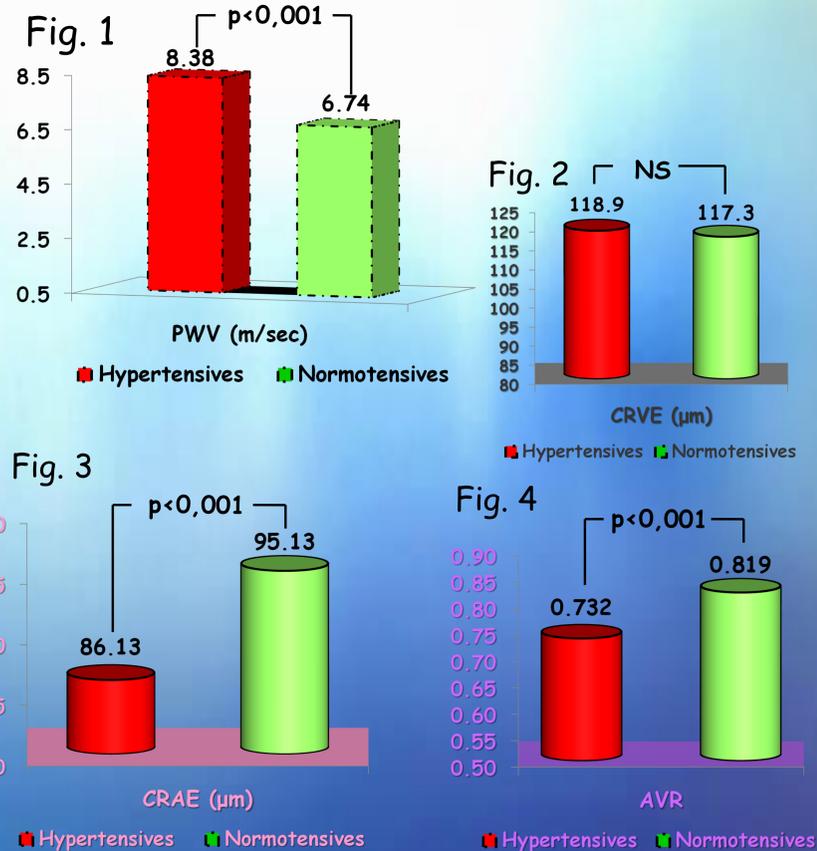


Figure 1-4. Comparison of aortic stiffness (PWV) and retinal vessel equivalents (CRAE, CRVE and AVR) between hypertensive and normotensive individuals.

Figure 5-7. Correlation coefficients of PWV with retinal vessels equivalents (CRAE, CRVE and AVR)

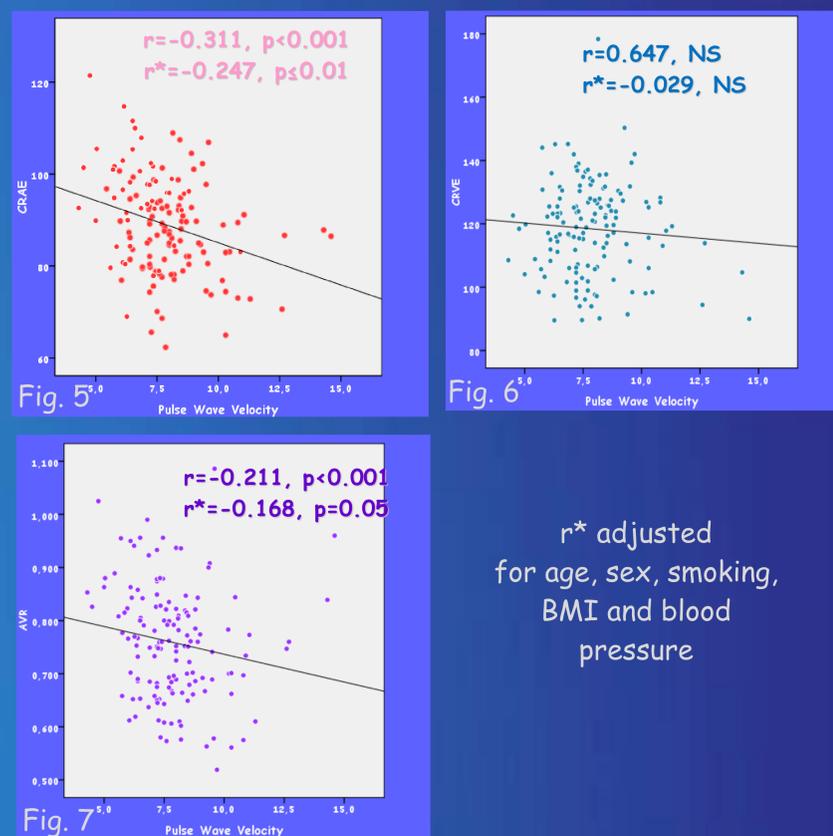


Table 1. Independent predictors of PWV, after multiple linear regression analysis Model: Dependent variable: logPWV, Adjusted R Sq.=0.494, R Sq.=0.523

	Unst. C (B)	St. C (Beta)	P value
Age, years	0.003	0.001	<0.001
AVR	-0.114	0.141	0.032
BMI, mg/Kg ²	0.001	0.054	0.490
Office SBP, mmHg	0.001	0.243	0.003
Day SBP, mmHg	0.001	0.243	0.076
Glucose, mg/dl	0.001	0.175	0.009
Total cholesterol, mg/dl	0.000	0.062	0.377
GFR, ml/min	0.000	-0.065	0.436