PULSE WAVE VELOCITY - ITS IMPLICATIONS IN STRATIFYING CARDIOVASCULAR DISEASE PREVENTION MEASURES IN PATIENTS WITH CORONARY ANGIOPLASTY

Simina Urseanu, Cristian Andrei Sarau, Daniel Duda-Seiman, Vlad Alexandru Ionescu, Silvia Mancas

REZUMAT

Obiective: Determinarea velocității undei pulsatile (PWV) reprezintă cea mai simplă și non invazivă metodă de determinare a rigidității arteriale. Ne propunem analiza comportamentului PWV la coronarienii revascularizați intervențional cu profil aterogen poststentare și implicațiile sale în modularea programelor de profilaxie secundară. **Material și metode:** Am analizat un lot de 63 coronarieni revascularizați prin metoda intervențională incluși într-un program de recuperare cardiovasculară. Am cuantificat: vârsta, sexul, indicele de masă corporală, circumferința taliei, tensiunea arterială sistolică. Am determinat: glicemia a jeun, parametrii profilului lipidic. Criteriile ATP III au fost utilizate pentru definirea sindromului metabolic. În funcție de prezența sau absența sindromului metabolic, am regrupat lotul inițial astfel: subgrup A, coronarieni ce întruneau criteriile sindromului metabolic și subgrup B, coronarieni fără sindrom metabolic. Pentru determinarea velocitații undei pulsatile carotidă – radială am utilizat aparatul Complior SP. **Rezultate:** Pentru întregul lot PWV a înregistrat o valoare medie crescută, corelația acesteia cu parametrii profilului lipidic fiind una nesemnificativă. În subgrupul pacienților cu sindrom metabolic am găsit o corelație negativă și semnificativă între HDL și PWV de repaus. În subgrupul celor fără sindrom metabolic determinismul PWV este condiționat de intervenția LDL și a non-HDL. **Concluzii:** Coronarienii dislipidemici prezintă poststentare accentuarea scăderii complianței vasculare. Sindromul metabolic alterează comportamentul vascular prin creșterea rigidității arteriale, prezența sa justificând intensificarea măsurilor de creștere a HDL-colesterolului. În absența sindromului metabolic, programul de profilaxie secundară va fi centrat pe atingerea țintelor lipidice: LDL și non HDL colesterol. Postprocedural, determinarea PWV carotidă – radială ar putea defini criteriile de individualizare ale unui program comprehensiv de recuperare cardiovasculară.

Cuvinte cheie: rigidizare arterială, velocitatea undei pulsatile, dislipidemie aterogenă, sindrom metabolic

ABSTRACT

Objectives: Assessing pulse wave velocity (PWV) represents the most simple and non-invasive method to determine arterial stiffness. Our goal is to analyze PWV in coronary revascularized patients with proatherogenic lipid profile and its implications in stratifying secondary cardiovascular disease prevention programs. **Material and methods:** We analyzed 63 coronary interventional revascularized patients included in a cardiovascular rehabilitation program. We quantified age, sex, body mass index, waist circumference, systolic arterial blood pressure. We determined: fasting glycemia, lipid profile parameters. ATP III criteria were used to define metabolic syndrome. Depending on the presence or the absence of metabolic syndrome we regrouped the initial lot: subgroup A, patients that had metabolic syndrome and subgroup B, patients without metabolic syndrome. For the measurement of carotid- radial PWV we used the Complior SP device. **Results:** For the entire group PWV had an increased mean value with a non significant correlation between PWV and lipid profile parameters. In the metabolic syndrome subgroup a negative and significant correlation between HDL and base line PWV was found. In the non metabolic syndrome group PWV was influenced by LDL and non HDL. **Conclusions:** Coronary dyslipidemic patients have after revascularization an increased deterioration of their vascular compliance. Metabolic syndrome aggravates vascular behavior through an augmentation of arterial stiffness. The presence of metabolic syndrome justifies the improvement of augmentative measures for HDL. In the absence of metabolic syndrome, secondary prevention programs will be focused on reaching lipid targets: LDL and non HDL. After revascularization, measuring carotid-radial PWV might define individualization criteria for a cardiovascular rehabilitation program.

Key Words: arterial stiffness, pulse wave velocity, atherogenic dyslipidemia, metabolic syndrome

Department of Cardiovascular Rehabilitation, Institute of Cardiovascular Diseases, Victor Babes University of Medicine and Pharmacy, Timisoara

Correspondence to:
Simina Urseanu, 4 Evlia Celebi Str., 300226 Timisoara, Romania, Tel. +40-722-956370.
Email: urseanusimina@yahoo.com

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INTRODUCTION

During the recent years a great interest has been shown to the part that arterial stiffness plays in developing atherothrombotic cardiovascular disease. Assessing pulse wave velocity (PWV) is accepted as the most simple and non-invasive method to determine arterial stiffness. Pulse wave velocity is recognized as the "gold standard" measurement for arterial stiffness.[1]

Using the high correlation between non-invasive measurement of arterial stiffness through PWV and assessment of endothelial dysfunction through flow mediated vasodilatation (FMV) we can use the Complior method in order to evaluate the vascular prognosis of revascularized coronary patients. The method consists in recording pulse wave at a proximal artery, such as the common carotid, as well as at a more distal one, such as the radial artery. Pulse wave is determined through transducers directly applied to the skin. The time delay in which the pulse wave travels between the two points is recorded by simultaneous measurement. The distance traveled by the pulse wave is measured and PWV is then calculated as distance (m)/time delay (s).[2,3]

Our goal is to analyze PWV in coronary revascularized patients having a proatherogenic lipid profile after revascularization and its possible implications in stratifying secondary cardiovascular disease prevention programs.

MATERIAL AND METHOD

We have analyzed a group of 63 coronary non-smoker patients that had normal fasting glycemia. Patients were revascularized through interventional method, included in a cardiovascular rehabilitation program and evaluated at approximately 3 months after revascularization. Variables quantified were: age, sex, body mass index (BMI), waist circumference, systolic arterial blood pressure (SBP). We determined: fasting glycemia, parameters of lipid profile - total cholesterol (CT), serum triglycerides (TG), HDL -cholesterol (HDL). In order to calculate LDL cholesterol (LDL) we used the Friedewald formula (LDL=CT-HDL-TG/5), for values of serum triglycerides under 400mg/dl. ATP III criteria were used to define metabolic syndrome as well as the value of non-HDL cholesterol (non-HDL=CT-HDL).[4]

For the measurement of carotid-radial PWV we used the Complior device which allows pulse wave recording and automatic calculation of PWV with 2 transducers, the first one placed at the base of the neck for the common carotid artery and the other over the radial artery, as previously described. We considered pathological the values superior to 10 m/s.[5]

Statistics

Percentages were calculated. Variables were expressed as mean value ± standard deviation. We used the non pair T Student test, univariate linear regression, Pearson correlation coefficient, ß coefficient.

RESULTS

From the entire group 57% of the 63 patients were men, 73% were hypertensive and 51% had values of CT>157 mg/dl. (Table1)

Table 1. Baseline characteristics of the analyzed group.

Demographical data		**n (%)**	**Mean ± SD**
Gender	Men	36 (57.14)	
	Women	27 (42.85)	
	Total	63	
Age (years)			57.33 ± 12.08
BMI (kg/m^2)			27.66 ± 3.56
Risk factors			
SBP (mm Hg)			126.19 ± 21.91
Fasting glycemia (mg/dl)			102.52 ± 46.89
CT (mg/dl)			189.28 ± 55.20
TG (mg/dl)			182.28 ± 47.08
HDL (mg/dl)			33 ± 6.89
LDL (mg/dl)			116.46 ± 48.21
Non HDL (mg/dl)			156.28 ± 56.43

PWV for the entire group had a mean value of 11.37 ± 2.24, with extreme values going from 7.8m/s to 16.2 m/s. Though there were no significant differences between women and men for the PWV value, we observed that women had significantly higher values of serum triglycerides and arterial blood pressure than men. (Table 2)

Table 2. PWV, SBP and lipid profile parameters in the men vs. the women group.

Variable	**Men (n=27)**	**Women (n=36)**	**p**
PWV (m/s)	11.65 ± 2.32	11.01 ± 2.12	NS
SBP (mmHg)	121.11 ± 19.46	132.96 ± 23.5	0.03
TG (mg/dl)	130.61 ± 38.20	197.85 ± 53.6	0.02
CT (mg/dl)	180.20 ± 50.67	201.33 ± 59.5	NS
LDL (mg/dl)	109.87 ± 49.77	125.25 ± 45.46	NS
HDL (mg/dl)	31.88 ± 6.62	34.48 ± 7.08	NS
Non-HDL (mg/dl)	148.36 ± 52.11	166.85 ± 61.12	NS

Depending on the presence or absence of metabolic syndrome we regrouped the initial lot (n=63) as follows:

- Subgroup A (n=38): coronary patients that had metabolic syndrome features;
- Subgroup B (n=25): coronary patients without metabolic syndrome.

For the entire group (n=63) the correlation between PWV and the lipid profile parameters (CT, TG, LDL, HDL, non-HDL) was non-significant ($p<0.05$).

In the metabolic syndrome subgroup (n =38) a negative and significant correlation between HDL and base line PWV was found ($r = -0.33$, $p= 0.04$). (Table 3, Fig. 1)

Table 3. Correlation of PWV and lipid factors in patients with/without metabolic syndrome.

Variable	Subgroup with metabolic syndrome		Subgroup without metabolic syndrome	
	β Coefficient	p	β Coefficient	p
CT	0.10	NS	0.30	NS
TG	0.04	NS	- 0.11	NS
LDL	0.06	NS	0.39	0.05
HDL	- 0.33	0.04	0.27	NS
Non-HDL	0.14	NS	- 2.67	0.04

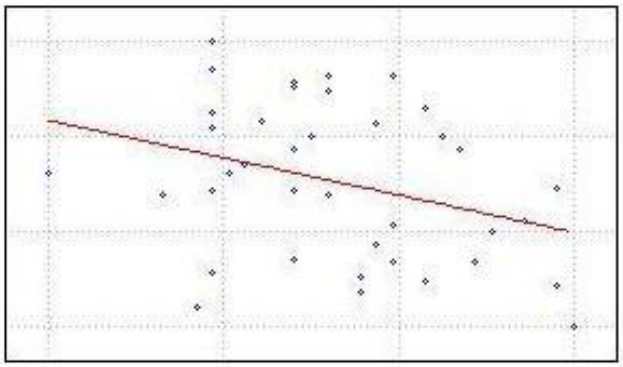

Figure 1. Correlation between PWV and HDL in the metabolic syndrome subgroup (n = 38).

In the non metabolic syndrome group (n= 25) PWV was influenced by LDL ($r = 0.39$, $p = 0.05$) and non-HDL ($r = -2.67$, $p = 0.04$). (Table 3)

DISCUSSIONS

In the recent years the traditional cardiovascular rehabilitation model was reconsidered. The new concept is based on a multifactorial and multidisciplinary approach of global cardiovascular risk after PCI, in order to influence the "active status" of vascular endothelium.

As distention and arterial compliance are already damaged in coronary revascularized patients, measuring carotid – radial PWV might be a proper indicator of arterial stiffness. PWV was used in a number of epidemiological studies that demonstrated its predictive value for cardiovascular events.[6-12] Blacher et al, consider aortic pulse wave velocity as a strong predictor of cardiovascular risk.[13]

Safar et al., analyzed risk factors (hypertension, dyslipidemia, hypertriglyceridemia and hypoglycemia) intervention on vascular behavior.[14] They have demonstrated that PWV was significantly higher in patients with at least 3 risk factors comparing with those with 0 - 2 risk factors. Moreover, they suggest that higher PWV in coronary patients with metabolic syndrome represents a vascular aging process and that it is more influenced by the presence of risk factors than mean arterial blood pressure.

In our study, coronary revascularized patients have a high baseline PWV value, that suggests an altered arterial compliance.

High values of PWV as a marker of endothelial dysfunction are significantly related with LDL and non-HDL in coronary patients without metabolic syndrome. This suggests that after revascularization the first (LDL) and the second lipid target (non-HDL) must be reached at a short notice.

The negative and significant correlation of PWV and HDL in coronary patients with metabolic syndrome suggests that a low level of HDL in revascularized patients aggravates endothelial dysfunction.

Others suggest that beyond major determinants of PWV (age, sex, blood pressure) after PCI local, systemic and pharmacological factors influence the vascular prognosis of these patients.[15,16]

Furthermore, Weber et al. sustain the use of PWV as a marker of identification for coronary patients predisposed towards new cardiovascular events after PCI.[17]

Nowadays it is not certain to whom the vascular prognosis after PCI is due, but it is certain that cardiovascular risk factors alter the functions of vascular endothelium and that the responsible homodynamic - metabolic - inflammatory mechanism must remain the target for secondary cardiovascular prevention programs.

CONCLUSIONS

1. After revascularization coronary dyslipidemic patients have an increased deterioration of their altered vascular compliance.

2. Metabolic syndrome aggravates vascular behavior through an augmentation of arterial stiffness.

3. The presence of metabolic syndrome justifies the improvement of augmentative measures for HDL cholesterol.

4. In the absence of metabolic syndrome,

secondary prevention programs will be focused on reaching lipid targets: LDL and non-HDL cholesterol.

5. After revascularization, measuring carotid-radial PWV might define individualization criteria for a comprehensive cardiovascular rehabilitation program.

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