

CHANGES IN INTIMA MEDIA THICKNESS, ANKLE BRACHIAL INDEX AND FLOW MEDIATED DILATION IN PRE HYPERTENSIVE INDIVIDUALS

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ABSTRACT

INTRODUCTION: Pre-hypertension (PH) is a state on the border of the physiological referent arterial pressure values and the pathological ones. The opinion concerned with its treatment is contradictory. Vascular alteration is an object of interest.

MATERIAL AND METHODS: Intima Media Thickness (IMT), Ankle Brachial Index (ABI) and Flow Mediated Dilation (FMD) indices were examined in 103 individuals with PH and 45 normotensives. Anthropometric and clinical chemical methods were applied too. The statistical processing was carried out by MS Excel 2000 and SPSS 11.0. **Results:** The pre-hypertensives' metabolic profile is unfavorable, they are overweight and have a bigger waist size, reflected in a higher cardiovascular risk. The percentage of FMD is reduced as an expression of the endothelial function. Structural vascular alterations are not registered – ITM and ABI values are of no significant difference in the two followed up groups.

CONCLUSION: The therapeutic approach in pre-hypertensives should be directed to the reestablishment of the endothelial function.

Keywords: pre-hypertension, IMT, ABI, FMD

INTRODUCTION

The term pre-hypertension (PH) has existed since 2003, when it was introduced by JNC-7 (Joint National Committee of USA) – manual for prevention, assessment and treatment of hypertension in USA (1). Individuals with arterial pressure (AP) values between 120-139 mmHg for the systolic and/or 80-89 mmHg for the diastolic are categorized as pre-

hypertensive. PH is on focus because of the fact that it is connected to about 1.8 times higher risk for cardiovascular incidents (2,3,4). Pre-hypertensive individuals are an object of examination concerning the presence of early functional and structural cardiovascular and metabolic changes. There are medically based evidences that the therapeutic treatment of PH with a definite group of drugs may delay the hypertension development (5). PH is not a disease, but a border between target AP values and pathologic ones. Sharing this state, the aim of the study is to find out early the changes in the vascular structure and function in individuals with pre-hypertensive AP values.

MATERIAL AND METHODS

Intima media thickness (IMT), Ankle Brachial Index (ABI) and Flow-Mediated Dilation (FMD)

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were followed up in 103 individuals with pre-hypertension and 45 normotensives (Table 1). The first two indices reflect structural arterial vascular alterations, while FMD is referred to endothelial changes.

cally by a computer program Q-Lab (figure 1). The results are expressed as a mean.

Ankle-brachial index (ABI) setting:

ABI measurement is carried out by a doppler

Table 1. Characteristics of the groups

Indices	Pre-hypertensives (103)	Normotensives (45)	P
Age	43.5	41.2	NS
Gender (m/f)	58/45	24/21	NS
Weight (kg)	104.88	75.57	<0.01
Waist circumference (sm)	106.12	82.43	<0.01
Total Cholesterol (mmol/l)	5.49	4.03	<0.05
Triglycerides (mmol/l)	2.08	1.13	<0.05
HDL-Cholesterol (mmol/l)	1.07	1.31	NS
LDL -Cholesterol (mmol/l)	3.46	2.25	<0.05
Plasma Glucose (mmol/l)	5.12	4.74	NS

IMT examination of the common carotid artery (CCA):

The extra cranial CCA part is studied by echocardiograph Phillips 11HE linear 7,5MHz triplex transducer. CCA, bulbar, internal (ICA) and external carotid artery (ECA) are scanned consecutively and slowly. Recently, the measurement is carried mainly on the distant CCA side in the anterior lateral position, 1-2 cm from the bifurcation. This is the way the present study was carried out too. This segment gives the opportunity for the distance to be optimal from the geometric point in order for the measurement to be more precise and best reproduced as the IMT method aims at determining the early atherosclerotic stages. The measurement is carried out in three zones of the left and the right CCA automati-

Huntleheigh Dopplex device and sphygmomanometer. The systolic arterial pressure (SP) of both hands is measured by a doppler blood flow measuring at the cubital fossa. Int the lower extremities SP is measured in the same way by a Doppler blood flow examination on tibialis posterior and dorsalis pedis. Higher SP values are taken into consideration, between the two brachial arteries respectively, as well as between the arteries of the low extremities. ABI is determined for each of the two low extremities as a function of the higher lower to the upper extremity ratio SP. The index represents the higher of the two measured on the tibialis posterior and the dorsalis pedis, the SP ratio of each leg, respectively and the higher of the two measured on the brachial arteries SP of each hand, respectively. ABI, taken into consideration, is the

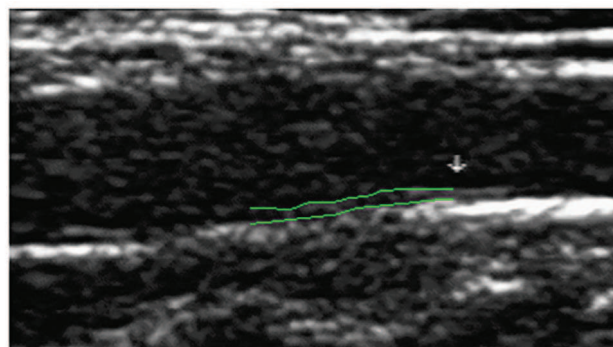
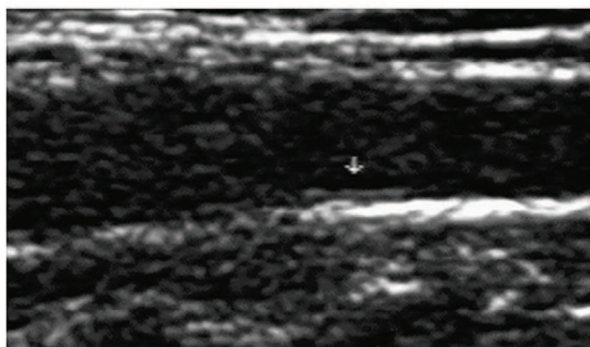


Fig. 1. & Fig. 2. Automatic measurement of the carotid artery IMT

lower from the two left and right measured. Six measurements – on the left and the right hand and two on each leg, were made on each patient.

Flow Mediated Dilation (FMD) examination:

The percentage of brachial artery dilation after a 5-minute ante brachial compression with 50 mm Hg above the systolic was carried out by an echocardiograph Phillips 11HE linear 7.5MHz triplex transducer. The examination was performed in two phases (Figure 2) – initial phase and a phase of suppression. The brachial artery diameter is measured initially and then every 30 seconds for 5 minutes the blood flow velocity and the vessel's diameter were measured. The highest values were taken into consideration. The percentage of vasodilation is calculated as ratio of the biggest diameter to the initial brachial artery diameter ratio.

The received data were *statistically processed* by MS Excel 2000 and SPSS 11.0, based on the operative system MS Windows. Within all the statistical analysis level of significance $P < 0.05$ was taken into consideration.

RESULTS

IMT and ABI indices.

IMT is considered an accessible method for peripheral vascular assessment and atherosclerotic process and treatment monitoring. An internal carotid artery ITM of above 1.2 mm is a certain sign of atherosclerotically changed vessel, i.e. progressive vascular impairment. PH, preceding hypertension, is a state without the expected structural vascular alterations. IMT values in PH individuals do not differ significantly from these in the normotensives (Table 2). ABI is changed when there are advanced vascular alterations. This is the situation when ABI goes down due the fact that SP in the low extremities is lower than the one in the upper extremities. ABI values below 0.9 are definitely pathologic, expressing considerable atherosclerotic changes of the low extremities. In our study, ABI values do not differ in pre-hypertensives as in normotensives (Table 2).

Flow Mediated Dilation (FMD) determination:

FMD registers functional vascular changes in contrast to IMT and ABI which give information about the structural one of the big arterial vessels. The FMD of the brachial artery is of the highest clin-

Table 2. Changes in IMT and ABI in pre-hypertensive and normotensive individuals

	N	Mean	Std. Deviation	P
IMT(mm)				
Pre hypertensives	103	0.5453	0.13825	NS
Normotensives	45	0.5586	0.12375	
ABI				
Pre hypertensives	103	1.1469	0.13016	NS
Normotensives	45	1.2214	0.12362	

ical value. An impaired FMD expresses endothelial dysfunction. Recently it has been announced that PH is connected to an impaired FMD (6). The statement that the endothelial dysfunction gives a start of the atherosclerotic process, preceding the morphological vascular alterations, is classic. FMD is the most sensitive method for providing information about the endothelial dysfunction, starting with the vascular impairment (7). The comparative assessment of FMD (Table 3) in pre-hypertensive and normotensive individuals indicates that the percentage of dilation is significantly lower in the PH group.

Table 3. Flow Mediated Dilation (FMD) in pre-hypertensive and normotensive individuals

FMD %	N	Mean	Std. Deviation	P
Pre-hypertensives	103	10.7497	9.54743	<0.05
Normotensives	45	16.0743	8.75174	

Anthropometric data and clinical chemical results of the lipid profile and plasma blood glucose.

Our previous study showed that the frequency of the Metabolic Syndrome (MS) is significantly higher in PH individuals (8). It is registered that the waist size is bigger and the individuals are overweight (Table 4). Total cholesterol, HDL-cholesterol and triglycerides (TRY) values are higher in the pre-hypertensives (Table 5).

DISCUSSION

When PH is discussed the question asked is if its values are connected with the normal state or with the pathological one. The answer is related to the decision of whether the treatment should be done by

Table 4. Anthropometric data in pre hypertensive and normotensive individuals

	N	Mean	Std. Deviation	P
Weight (kg)				
Pre hypertensives	103	104.88	15.243	
Normotensives	45	74.57	22.464	<0.01
Body area (m²)				
Pre hypertensives	103	2.0818	0.12203	<0.01
Normotensives	45	1.8586	0.29898	
Waist circumference (sm)				
Pre hypertensives	103	106.12	10.246	<0.01
Normotensives	45	82.43	15.799	

Table 5. Lipid profile and plasma glucose level in pre-hypertensive and normotensive individuals

	N	Mean	Std. Deviation	P
Total Cholesterol(mmol/l)				
Pre-hypertensives	103	5.4990	1.59668	<0.05
Normotensives	45	4.0300	1.47890	
LDL Cholesterol(mmol/l)				
Pre-hypertensives	103	3.4663	1.05520	<0.05
Normotensives	45	2.250	1.02300	
Triglycerides (mmol/l)				
Pre-hypertensives	103	2.0822	1.31150	<0.05
Normotensives	45	1.1300	1.15600	
HDLCholesterol(mmol/l)				
Pre-hypertensives	103	1.0775	0.18987	NS
Normotensives	45	1.3100	0.16400	
Plasma Glucose (mmol/l)				
Pre-hypertensives	103	5.1250	0.59221	NS
Normotensives	45	4.7400	0.56569	

administering drugs or not. The recent recommendations of the ESC guidelines from 2013 are that high normal arterial pressure should not be treated therapeutically – contrary to those given in 2007 (9,10,11,12). The argument is the lack of sufficient clinical trials proving the benefits. In this connection more detailed examinations of structural and functional alterations in PH are needed as the potential use of drug or non-drug treatment.

The metabolic profile of the examined PH individuals in our study is unfavorable - the body mass and the waist size are significantly bigger, TC, HDL-C and TG values are significantly higher. This confirms the idea that PH could be associated with considerable metabolic disorders (13). The cardiovascular risk is increased in PH individuals (14,15). It, com-

pared to normotensives' ones, is higher and is of significance when treatment is discussed (16).

Vascular alterations appear in the early stages of hypertension, pre-hypertension, respectively. FMD gets the earliest arterial vascular functional changes and expresses endothelial dysfunction. Recently, it has been established that FMD is impaired in PH (16,17). It correlates with the cardiovascular risk factors and diseases. The decreased percentage of FMD is connected to the vasodilators/vasoconstrictors ratio shifted to the right. In our study, FMD is significantly lower in pre-hypertensives. It is a good predictor for vascular impairment and may serve in determining the therapeutic approach. The application of Angiotensin converting enzyme (ACE) inhibitors' improves the endothelial dysfunction and FMD. This

would be a serious argument, for PH individuals to be treated with this. Thus, the endothelial dysfunction evaluation by FMD could serve for early preclinical diagnostics too (17,18). FMD could be used as a way to select early individual prevention screening as well as a way to determine the therapy (19).

In contrast to the FMD data, there are no differences in the IMT and the ABI indices in PH individuals compared to the normotensives ones. The last two indices are a sign of advanced atherosclerotic process. This proves that PH is a state of functional changes, yet in time it leads to structural cardiovascular alterations and the appearance of hypertension.

CONCLUSION

PH is a borderline state, being between the norm and the pathology.

Pre-hypertensive individuals have an unfavorable metabolic profile, thus increasing the cardiovascular risk.

As far as the vascular structure is concerned, the early alterations found would be put connected to the endothelial dysfunction, registered by the reduced FMD.

IMT and ABI values do not differ from those in the normotensives, there are no structural vascular alterations.

PH therapeutic management could be directed to the preservation of the endothelial function aiming its transition prevention to hypertension.

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