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PULSE PRESSURE, BAROREFLEX SENSITIVITY AND INTIMA MEDIA THICKNESS (IMT) IN PATIENTS WITH ESSENTIAL HYPERTENSION UNDER THERAPY

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A b s t r a c t

The study was aimed at analyzing pulse pressure (PP), intima-media thickness (IMT) and baroreflex gain in patients with essential hypertension, treated with ACE inhibitors or Ca antagonists. We examined 30 patients with essential hypertension, all men. Blood pressure was recorded beat by beat (Finapres Ohmeda, USA, 5 min). ITH (a.carotis com.) was examined by Doppler echography (SONOS 5500, Hewlett Packard, USA). Baroreflex sensitivity of the heart rate was determined using spectral analysis of pulse interval and systolic blood pressure. The baroreflex component of the blood pressure response was determined by means of the original method developed in our department. Our results showed that the treated hypertensives with a higher pulse pressure are older, have a lower gain of the baroreflex response of systolic blood pressure and have a larger ITH.

K e y w o r d s

Pulse pressure, Baroreflex sensitivity, Intima-media thickness, Essential hypertension

INTRODUCTION

The increased diastolic and systolic blood pressure is an important risk factor of stroke and coronary heart disease (*1*). In elderly patients we observe more frequently the isolated systolic hypertension because naturally the diastolic pressure decreases after the age of 50 years (*2*). It is evident that the increased pulse pressure (the difference between systolic and diastolic pressure, PP) is seen in patients with isolated systolic hypertension. The importance of increased pulse pressure as a risk factor for mortality and morbidity was reviewed (*3*). It is also well known that decreased baroreflex sensitivity is a risk factor for mortality in ischemic heart disease patients (*4*). Recently we observed a lower baroreflex sensitivity in patients with higher pulse pressure (*5*). The question arises if the decrease of baroreflex sensitivity can be caused by lower distensibility of carotid arteries. For this reason we ana-

lysed the relationship between pulse pressure and intima –media thickness (IMT) in patients with essential hypertension treated with ACE inhibitors or Ca-antagonists. The relationship between pulse pressure and baroreflex sensitivity in these patients was the second aim of the present study.

MATERIAL AND METHODS

We examined 30 patients (all men) with essential hypertension treated with ACE inhibitors or Ca-antagonists. The patients were divided in two subgroups using the pulse pressure (PP) according to mean arterial blood pressure (MAP) diagram. The division was done according to the regression line expressing the linear relationship between MAP and PP. The dots over and to the right of the line corresponded to the patients with higher PP (group HPP), the dots under and to the right of the line corresponded to the patients with low PP (group LPP). The mean blood pressure MAP was similar in both groups.

We measured IMT of both common carotid arteries by Doppler echocardiography (SONOS 5500, Hewlet Packard, USA).

Baroreflex sensitivity was determined using two methods. Baroreflex sensitivity of heart rate (BRS) in ms/mmHg was measured by spectral method. Systolic (SBP) and diastolic blood pressure (DBP) were noninvasively continuously recorded beat-to-beat (Finapres, Ohmeda USA) for 5 minutes during metronome-controlled breathing 0.33 Hz. Power spectra of cardiac interval variations (FCI*CI) and cross-spectra between SBP and cardiac intervals (FCI/SBP) were calculated, the modulus between FCI*CI and FCI/SBP at 0.1 Hz corresponds to BRS (BRS=FCI*CI/(FCI/SBP)). Only the calculations where coherence calculated from FCI, power spectra of systolic blood pressure (FSBP) and FCI/SBP at 0.1 Hz was higher than 0.5 were taken into account.

The blood pressure component of baroreflex was measured by the following method. Two inflatable cuffs were placed on both thighs of the supine patient. The pressure in the cuffs was abruptly increased on suprasystolic value and kept constant for 5 minutes to induce ischemia in both lower extremities. Then the cuff pressure was rapidly released. A decrease of peripheral resistance in lower extremities resulted in blood pressure immediate decrease by 10–30 mmHg; it lasted some time and than returned back to the original level under the influence of baroreflex. The method was described elsewhere (*6*). The speed of the SBP and DBP return to the original level was evaluated. The curve of SBP and DBP return is of sigmoid shape, maximum slope of the curve expressed in mmHg/s for both SBP (SBP mmHg/s) and DBP (DBP mmHg/s) corresponds to the magnitude of the blood pressure component of baroreflex.

The results are summarized as means ± SD. The statistical significance of differences between both groups was determined by Wilcoxon non-parametric test.

The Local Ethics Committee of Teaching Hospital approved the study and all patients signed informed consent.

RESULTS

The results are seen in the *Table 1* and *Table 2*. Our results show that the treated hypertensives with a higher pulse pressure are older, have a lower gain of the baroreflex and have a larger IMT.

DISCUSSION

In a recent study we observed that PP magnitude is not an important factor with regard to peripheral resistance of cerebral arteries (*7*). However, in the present

Table 1

Age, systolic (SBP) and diastolic blood pressure (DBP), pulse pressure (PP) and mean arterial pressure (MAP) in hypertensives with low (PPL) and high pulse pressure (PPH). The results are given in the table (mean±SD).

	Age Years	SBP	DBP mmHg	PP mmHg	MAP	mmHg	mmHg
PPL	57±9		135±21	75±11		62±14	118±16
PPH	65±9 *		146±18	66±11		81±15	* 119±13

p<0.05: * set PPL versus PPH.; Wilcoxon

Table 2

Intima –media thickness (IMT), baroreflex sensitivity (BRS), pulse component of baroreflex for SBP, DBP in hypertensives with low (PPL) and high pulse pressure (PPH). The results are given in the table (mean±SD).

	ITH mm	BRS ms/mmHg	pulse component of baroreflex SBPmmHg/s	DBPmmHg/s
PPL	0.71±0.12	3.73±3.06	1.05±0.78	0.71±0.53
PPH	0.94±0.24*	2.14±2.27	0.71±0.50*	0.59±0.45

p<0.05: * set PPL versus PPH.; Wilcoxon, the results are given in the table (mean±SD),

study, where the division of pulse pressure was done according to the regression line expressing the linear relationship between MAP and PP, we found an increased IMT in increased PP. The answer of the question, what is the cause and what is the consequence of it, is not a simple one. The increased IMT corresponds to the higher stiffness of carotid arteries. The increased stiffness of aorta is the reason for increased pulse pressure and increased blood pressure is a stimulus increasing the stiffness of the arteries. It can be assumed that the increased stiffness is the cause of the decreased baroreflex sensitivity. Baroreceptors are stretch receptors in the carotid sinus. A lower distensibility of a.carotis because of a higher stiffness can be the cause of a decreased baroreflex sensitivity. The decrease of baroreflex sensitivity in patients with hypertension was seen in several studies (*8, 9*). Also the decline of baroreflex sensitivity with age was observed (*10*). This fact is in accord with our finding of a higher age in our HPP group.

The increased IMT has been shown to be an independent predictor of adverse cardiovascular events (*11*). The results of study of the relationship between IMT and BRS are controversial. It was shown that BRS correlates with ITM in the carotic sinus area and not in the common carotid region (*12, 13*).

We didn't observe a significantly lower baroreflex sensitivity of all parameters, only in SBPmm/Hg. This can be explained by the large variability of baroreflex sensitivity, like the variability of blood pressure which is also not constant at repeated measurements. From our results we can see that also BRS and DBPmm/Hg are lower in the HPP group, only the statistical significance was not reached.

Our results are not without clinical significance. Low baroreflex sensitivity only insufficiently suppresses the increase of sympathetic activity, the important factor participating in sudden cardiac death. It is possible that low baroreflex can contribute to the increased risk for mortality in patients with the high pulse pressure.

A c k n o w l e d g e m e n t

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PULZOVÝ TLAK, BAROREFLEXNÍ SENSITIVITA A TLOUŠŤKA INTIMY U LÉČENÝCH PACIENTŮ S ESENCIÁLNÍ HYPERTENZÍ

S o u h r n

Cílem práce bylo analyzovat pulzový tlak (PP), tloušťku intimy (intima-media thickness, IMT) a zisk baroreflexu u pacientů s esenciální hypertenzí, léčených s ACE inhibitory nebo Ca antagonisty. Vyšetřili jsme 30 pacientů s esenciální hypertenzí – muže. Krevní tlak jsme zaznamenávali tep po tepu (Finapres Ohmeda, USA, 5 min). ITH (a.carotis com.) jsem vyšetřovali Dopplerovou echografií (SONOS 5500, Hewlett Packard, USA). Baroreflexní sensitivita srdeční frekvence byla určena spektrální analýzou pulzových intervalů a systolického krevního tlaku. Baroreflexní komponenta krevního tlaku byla určena použitím originální metody vyvinuté v naší laboratoři. Naše výsledky ukázaly, že léčení hypertonici s vyšším pulzovým tlakem jsou starší, mají nižší zisk baroreflexní odpovědi – komponenty systolického krevního tlaku – a mají větší ITH.

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