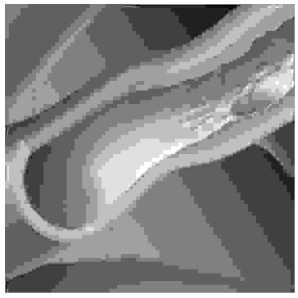
ORIGINAL **PROF-929**

ARTERIAL HYPERTENSION-NON INVASIVE DIAGNOSIS



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ABSTRACT... adsami@atlas.cz mil.ad@t-email.cz. **Aims & Objectives:** This study was designated to find and to characterize similarities andf differencies between two groups of patiens. One group were patients with established arterial hypertension / AH / and the second one were patients with new diagnosis of AH or who have so called high normal blood pressure / BP / or who had randomly found elevated blood pressure once time in their history but, therefore they had normal BP on check examinations, they were left without treatment. The main goal of the study was to show that the groups are similar in important parameters, which may be of clinical importance / decision about treatment / and to find which of the non invasive examinations, with exception of classical BP measurements, may still play the important role in setting the diagnosis of AH in early stage of the disease. And the second main goal of the study was to show that measurement of BP under basal conditions may sometimes be insufficient for decision making if the patient is hypertonic or not. **Methods:** Following methods and measurements were used to obtain necessary parameters – arterial blood pressure measurement, echocardiographic examination to obtain values as left ventricular diameter in systole and diastole, interventricular septum and posterior wall thickness in systole and diastole, ejection fraction - Teichholz, interventricular septum and posterior wall excursions, left atrial diameter, measurement of speed of aortic ejection, E/A index, isovolumic relaxation time, carotid myointimal thickening, carotid pulse velocity, time to peak of carotid upstroke and ambulatory blood pressure and electrocardiogram monitoring, measurement of blood pressure reaction on exercise stress testing and in recovery period post exercise and double product.

Key words: *Arterial hypertension - non invasive examination – early diagnosis*

INTRODUCTION

Essential arterial hypertension / AH / is the main risk factor in the development of aterosclerosis. At the present time we have possibility to diagnose AH at the early stage of disease.

It is known that AH is as the aterosclerosis the self perpetuating process. So, when we have qualified suspicion on this disease we should immediately start with antihypertensive therapy.

In this work is shown that between patients with new diagnosis of AH, or who have so called normal high blood pressure , or who had once time elevated BP in their history and than normal BP on check examinations under basal conditions and patients with defined diagnosis of AH exist great similarity in observed parameters, especially in blood pressure reaction on

exercise and in the development of blood pressure in recovery phase post exercise.

46 patients, otherwise healthy as to the cardiovascular system, with less or more elevated blood pressure at admission or at history or high normal blood pressure and 108 patients with established diagnosis of hypertensive arterial disease were studied. Under normal conditions the patients from the first group would be recommnended only to change and improve their lifestyle, as to the increase their physical activity, sufficient relaxation, stress reduction, body weight reduction, salt intake lowering etc. And they are summoned to checks of their BP after certain time periods for example after one year / 1, 2, 3 /. But we should be more active in this situation.

It was decided to put these patients through all of these above mentioned examinations inclusive exercise stress testing in order to find certain differencies or similarities on noninvasive examination between both groups.

METHODS

Following parameters were measured – arterial blood pressure, echocardiographic values as left ventricular diameter in systole and diastole, interventricular septum and posterior wall thickness in systole and diastole, ejection fraction - Teichholz, interventricular septum and posterior wall excursions, left atrial diameter, speed of aortic ejection, E/A index, isovolumic relaxation time, carotid myointimal thickening, carotid pulse velocity, time to peak of carotid upstroke and ambulatory blood pressure and electrocardiogram monitoring, blood pressure reaction in single stages of exercise stress testing and in single stages of recovery period post exercise and double product.

The results were analysed by means of Student´s t-test and the median and frequency rates were determined for different graphs.

RESULTS

Baseline characteristics of the patients of both groups are presented in Table 1. Group 2 are patients with chronic AH, group 1 are patients with new diagnosis of AH / this group includes – patients with high normal BP , patients with single or sporadic elevation of BP in their history – they were left without treatment, and patients with slight elevation of BP for the first time in their life at admission /. Light but statistically significant difference between the groups was found only in the following parameters – IVSD, IVSS, PWD, PWS, LA, E/A, CMIT, patient´s age.

Table-I Comparison of Data Values in Both Groups of Patients

Variable	t-tests; grouped: new and chronic AH: = if (V3 - 3; 1;2) (Data) 1- New diagnosis AH 2- Chronic AH										
	Aver 1	Aver 2	t	sv	p	Nu. Val. 1	Nu. Val. 2	S. Dev.1	S. Dev.2	F-ratio disp	P dis
LVS	32.38889	31	1.318203	140	0.189588	36	106	5.0442487	5.5942147	1.229944	0.491752
LVD	49.77778	49.00943	0.653096	140	0.514766	36	106	602614974	6.0434857	1.073449	0.761628
IVSD	10.83333	12.01887	-3.91519	140	0.000141	36	106	1.7647339	1.4990863	1.385815	0.209813
IVSS	14.52778	15.91509	-3.7273	140	0.00028	36	106	2.0630921	1.8828445	1.200628	0.474202
PWD	9.916667	11.25472	-4.20539	140	0.000046	36	106	1.9621417	1.531021	1.642474	0.056706
PWS	13.86111	15.34906	-3.84168	140	0.000185	36	106	2.016401	2.0049579	1.011447	0.93049
EFTCH	62.97222	66.41509	-1.82861	140	0.069587	36	106	10546458	9.4836882	1.236684	0.408914
eLVS	6.25	7.086538	-302105	138	0.003003	36	104	1.1051826	1.5271687	1.90944	0.031326

ePW	11.55556	11.38679	0.539585	140	0.590341	36	106	1.5936381	1.6304878	1.046781	0.905904
LA	34.11111	36.64151	-2.6394	140	0.009247	36	106	6.0934521	4.5338697	1.806295	0.022845
Ao	1.183333	1.238585	-1.28708	140	0.200191	36	106	0.1674685	0.2380774	2.021016	0.01945
E/A	1.444444	2.066038	-3.6119	140`	0.000423	36	106	0.7725448	0.9285818	1.444751	0.215156
IVRT	0.103333	0.110394	1.91291	138	0.057832	36	104	0.0210442	0.0183765	1.311402	0.297297
CMIT	0.062917	0.070604	-3.17456	140	0.001846	36	106	0.0129491	0.0124179	1.087386	0.725981
CPV	0.133389	0.135802	-0.69734	140	0.486745	36	106	0.0170215	0.0182331	1.147434	0.656803
TTP	0.200472	0.205123	-0.7162	140	0.475061	36	106	0.0322982	0.0341023	1.114838	0.73196
aveBPexeS	215.4815	215.5338	-0.01276	140	0.989839	36	106	20.513092	21.504613	1.099008	0.770434
aveBRexeD	122.3542	121.0715	0.436667	140	0.663026	36	106	15.17193	15.24509	1.009667	1
aveBPrecS	175.2431	177.5236	-0.52519	140	0.600284	36	106	22.210075	22.609509	1.036292	0.934552
aveBPrecD	109.5139	105.9953	1.125968	140	0.262106	36	106	15.670371	16.372232	1.091584	0.78891
Age ave.	51.08333	60.60952	-4.17078	139	0.000053	36	105	12.836054	11.466083	1.253236	0.38209

/ Legend : *LVS and LVD – left ventricular diameter in systole and diastole, IVSD, IVSS, PWD and PWS – thickness interventricular septum and posterior wall of left ventricle in systole and diastole, EFTCH – ejection fraction Teichholz, eIVS and ePW – excursions of IVS and PW, LA – left atrium diameter, Ao – speed of aortic ejection, E/A index – filling of left ventricle, IVRT – isovolumic relaxation time, CMIT – carotid myointimal thickening, CPV – carotid pulse velocity - time to upstroke of carotid pulse wave, TTP – time to peak of carotid pulse wave, aveBPexeS, aveBPexeD – average of BP in systole and diastole at the end of exercise, aveBPrecS, ave BP recD – average BP in systole and diastole during recovery period, Age ave – average age. T – test characteristic, sv – degree of freedom, p – dispersion, Nu.val. – number of valid, S.dev. – standard deviation, F-ratio disper.- ratio of dispersion /*

Ambulatory blood pressure monitoring:
29 patients, i.e. 30,5% of one´s from the group with diagnosed AH had maximal levels of BP during monitoring period lower than 140/90mmHg.

21 patients, i.e. 40,6% of one´s from the group with new diagnosis of AH had maximal levels of BP during period of monitoring lower than 140/90mmHg / blood pressure under 140/90mmHg on Holter BP monitoring is mostly left unremarkable /.

Ambulatory electrocardiogram monitoring in both groups was, with exception of unfrequent supraventricular and ventricular extrasystoles, unnoticeable.

Data from transthoracalechocardiography:
53 patients , i.e. 40% from the group with diagnosed AH had left ventricular hypertrophy / IVS and PW thickness above 12mm /. 7 patients, i.e. 15,5% from the group with new diagnosed AH had left ventricular hypertrophy. 24 patients, i.e. 25% from the group with diagnosed AH had enlarged left atrium / more than 40mm /. 7 patients, i.e. 14,6% from the group with new diagnosed AH had enlarged left atrium.

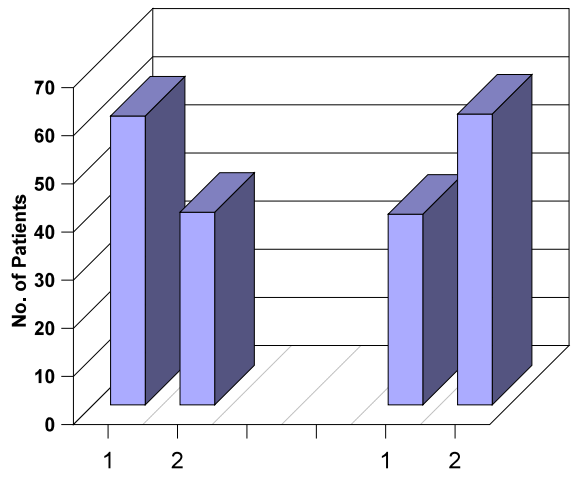


Fig.1 Distribution of the E/A index in both groups. 60% of patients from the group with diagnosed AH and 40% of patients with new diagnosis of AH had abnormal E/A filling index. There is shift to more abnormal

Ejection fraction was in normal limits in both groups. E/A index - filling of left ventricle was less than one in 60% of patients in the group with diagnosed AH and in 39,6% in the group with new diagnosed AH.

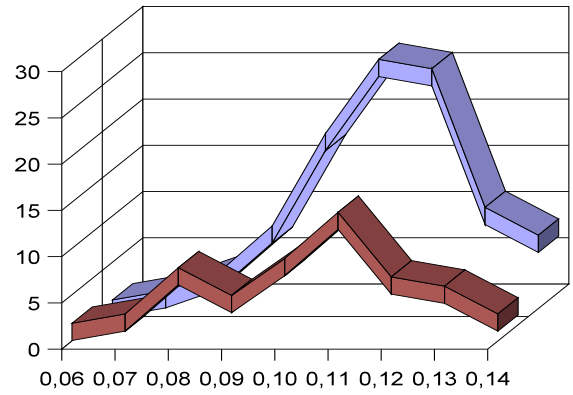


Fig.2 Distribution of the values of IVRT / isovolumic relaxation time /. There is evident shift to higher values in the group with diagnosed AH. Median for the group with defined AH is 0,1100 and for the group with new AH 0,1025, but the difference is statistically not significant.

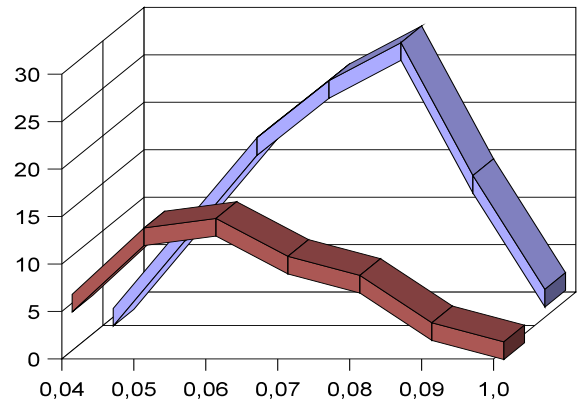


Fig.3 Distributin of the values of CMIT / carotid myointimal thickening /. There is evident shift of the values of the group with defined AH to the right to higher values. Median for the group with defined AH is 0,7000 and for the other group 0,6000. The difference between both rows is statistically significant. Patients with established AH had more thickened carotid myointima.

Further data and results are introduced on the following figures.

Exercise stress testing:
All patients of both groups have undergone exercise stress testing on bicycle ergometer. 121 probands, i.e. 83,4% patients had hypertensive reaction on exercise / blood pressure higher than 220/120mmHg /. 84,2% of patients in the group with defined AH and 85,4% of patients in the group with new diagnosed AH had hypertensive reaction on exercise.

The course of exercise pressure reaction and the development of pressure reaction in the postexercise recovery phase is shown on the Fig. 5 and Fig.6.

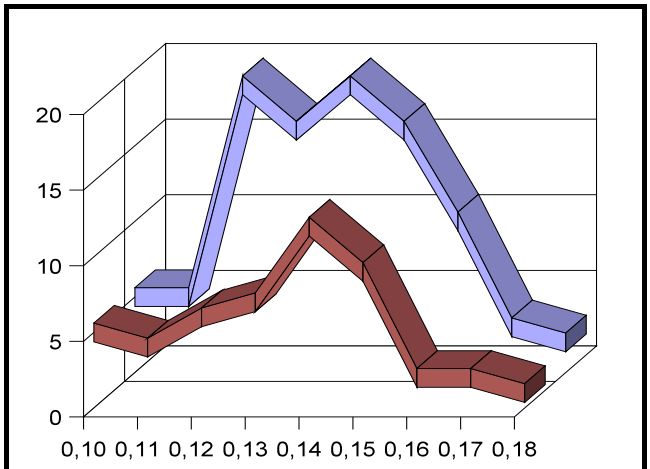
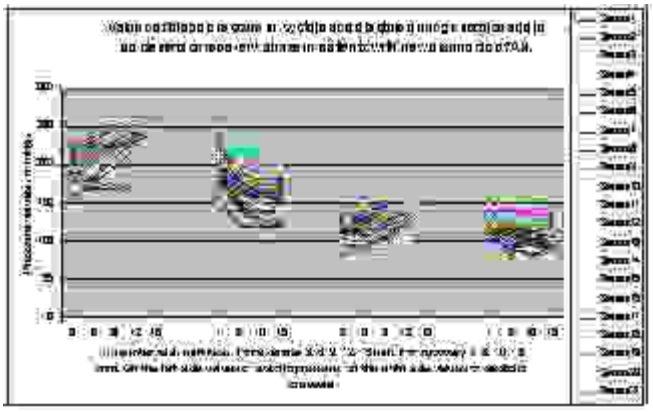


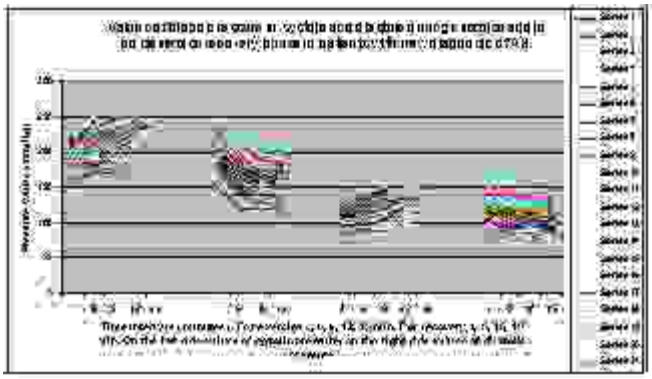
Fig.4 Distribution of the values of CPV / carotid pulse velocity /. The frequency of shorter times / higher velocities / is apparently higher in the group with defined AH. But medians of both groups are identical – 0,1350. There is no statistical difference between both groups.



DISCUSSION

The statistically significant difference / $p < 0.05$ / between both groups was obtained in the following parameters -

IVSD, IVSS, PWD, PWS, LA, E/A index, IVRT, CMIT, double product. The finding of these differencies is logical therefore in the course of development of AH there is increased incidence of myocardial hypertrophy, enlargement of left atrium, increased thickness of carotid myointima while double product and maximal heart frequency are decreasing. At present this is natural



development of AH in most of patients, despite our medical treatment.

There was no statistically significant difference between both groups of patients in the following parameters – CPV, TTP, average watts loading at the end of exercise and in the values of BP in the indivudual stages of exercise and recovery period / p>0.05 /.

The values of CPV and TTP are identical. It could be explained, that in the group with diagnosed AH, there is reduced compliance of arterial wall / higher value of CMIT / and in consequence higher speed of blood flow. In the group with new diagnosed AH it may be due to hyperkinetic circulation. These data are evidence that different groups of patients were examined.

The identical BP reaction and development of BP at exercise and in the recovery period in both groups of patients is rather striking. The averaged, distribution and trend curves are in both groups identical. / Fig.5, Fig.6 and Table 2 /. If we take hypertensive reaction on exercise and the abnormal course of BP in recovery period as a risk factor for development of AH / 4, 5 / then the above mentioned results confirm the usefullness of exercise stress testing in patients in early stages of AH and in ones with so called high normal BP and in ones with single BP elevations in their history. We should also acccept the fact that to measure BP under so called basal conditions / when the patient is inactive at easy / may be insufficient to decide if the patient is already hypertonic or not hypertonic. We can use exercise testing for assessmen of the disease and for decision making about antihypertensive therapy.

Table-II

Variable	t-tests; grouped: new and chronic AH: = if (V3 - 3; 1;2) (Data) 1- New diagnosis AH 2- Chronic AH										
	Avere 1	Ave 2	t	sv	p	Num. Val. 2	Num. Val. 2	S. dev.2	S. dev.1	F-ratio disp	P disp
3 minexeS	204	199	1	140	0	106	36	24	23	1.1	
3 minexeD	115	116	0	140	1	106	36	14	14	1	
6 minexeS	218	213	1	132	0	98	36	22	23	1.1	
6 minexeD	123	122	0	132	1	98	36	17	18	1.1	
9 minexeS	223	223	0	92	1	61	33	24	22	1.3	
9 minexeD	124	125	0	92	1	61	33	19	16	1.4	
12 minexeS	230	228	0	28	1	14	16	15	25	2.6	
12minexeD	128	126	0	28	1	14	16	13	16	1.4	
15 minexeS	240	240	0	4	1	2	4	14	8	3	

15minexeD	135	129	1	4	1	2	4	21	10	4.2	
1 minrecS	204	202	0	140	1	106	106	28	25	1.2	
1 minretcD	113	119	-1	140	0	106	106	18	19	1	
5 minrecS	176	173	1	140	1	106	106	24	25	1	
5 minrecD	105	109	-1	140	0	106	106	18	17	1.2	
10 minrecS	166	165	0	140	1	106	106	24	26	1.1	
10 minrecD	103	107	-1	140	0	106	106	16	17	1.1	
15 minrecS	164	161	1	140	0	106	106	24	24	1	
15 minrecD	103	103	0	140	1	106	106	17	16	1.1	

As is shown there is no statistically significant diffrence in BP values during exercise and recovery period between both groups of patients. The measured data are practically identical.

Table III Results of the t-tests. There is statistically significant difference only in CMIT.

Variable	t-tests; grouped: new and chronic AH: = if (V3 - 3; 1;2) (Data) 1- New diagnosis AH 2- Chronic AH										
	Aver 1	Ave 2	t	sv	p	No.. Val. 2	No.. Val. 1	S dev.2	S dev.1	F-ratio disp	P disp
IVRT	0	0	2	138	0	104	36	0	0	1	0
CMIT	0	0	3	140	0	106	36	0	0	1	1
CPV	0	0	1	140	0	106	36	0	0	1	1

group No.1 – patients with chronic AH, group No.2 – patients with new diagnosed AH

The exercise stress testing is advisable still from another reason. Therefore 40,6% of patients from the group with new AH had unremarkable result during ambulatory BP monitoring / maximum BP was less than 140/90mmHg /, but if these patient have undergone exercise stress testing then 85,4% of them had hypertensive reaction.

CONCLUSION

1. measurement of blood pressure under so called basal conditon must not be sufficient for well timed decision making if the patient is or is not hypertonic
2. regime arrangements and life style changes must not be sufficient to treat the patient even in the situation of only light elevation of blood pressure
3. hypertensive blood pressure reaction on exercise is not dependent od duration of the disease at all
4. it may be advisable to engage exercise testing to the spectrum of examinations in AH, especially in earliest stages of the disease, in the situation of accidentaly measured higher blood pressure and during observation of the efficacy of the antihypertensive therapy.

It is clear from the study that blood pressure reaction on exercise and in the postexercise recovery period is the diagnostic factor of greatest value from the spectrum of used measurements . If we accept the fact that hypertensive reaction on exercise stress testing is definitive risk factor for development af arterial hypertension than we have also accept the fact that

blood pressure should not be measured only under so called basal conditions especially in patients with high normal blood pressure, who can have normal blood pressure when inactive at ease, who can have even normal blood pressure on ambulatory BP monitoring. Hypertensive reaction on exercise is one of the important diagnostic moments and signs in the earliest clinical stadium of arterial hypertension at present. And if we have hypertensive reaction on stress in this group of patients than we could immediately start with antihypertensive therapy and not to recommend only changes in life style and not to wait until the patient shifts himself to the group with elevated blood pressure under basal conditions. It seems, that measurement of BP only under basal conditions may be insufficient for exclusion of AH especially in early stage of the disease. We should be more active.

Stress dosing and exercise stress testing should be the part of our antihypertensive diagnostic armaments.

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