Some Questions Concerning Non Invasive Diagnosis In Arterial Hypertension

M Adamek

Citation

M Adamek. *Some Questions Concerning Non Invasive Diagnosis In Arterial Hypertension*. The Internet Journal of Internal Medicine. 2004 Volume 5 Number 2.

Abstract

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.

The main goal of the study was to show that the groups are similar in important parameters, which may be of clinical importance and to find which of the non invasive examinations, with exception of classical blood pressure / BP / measurements, may still play the important role in setting the diagnosis of AH in early stage of the disease.

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.

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 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.

Fourtysix patients, otherwise healthy as to the cardiovascular system, with less or more elevated blood pressure at admission or at history and onehundredeight patients with 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 lifesytel, 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. 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, 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 1 are patients with chronic AH, group 2 are patients with new diagnosis of AH. 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.

Figure 1

Table 1: Comparison of data values in both groups of patients

Variable	t-tests; grouped: new and chronic AH = iif(v3= 3; 1;2) (Data) 1 – new diagnosis AH 2 – chronic AH										
	Averag 1	Averag 2	t	sv	p	Nu.val. 1	Nu.val. 2	S.dev. 1	S.dev. 2	F-ratio dispers.	p dispers.
LVS	32.38889	31	1.318203	140	0.189588	36	106	5.044248	5.594214	1.229944	0.491752
LVD	49.77778	49.00943	0.653095	140	0.514766	36	106	6.261497	6.043485	1.073449	0.761628
IVSD	10.83333	12.01887	-3.91515	140	0.000141	36	106	1.764733	1.499086	1.385815	0.209813
IVSS	14.52778	15.91509	-3.7273	140	0.00028	36	106	2.063092	1.882844	1.200628	0.474202
PWD	9.916667	11.25472	-4.20535	140	0.000048	36	106	1.962141	1.53102	1.642474	0.056708
PWS	13.86111	15.34906	-3.84166	140	0.000185	36	106	2.016401	2.004957	1.011443	0.93049
EFTCH	62.97222	66.41509	-1.82867	140	0.069587	36	106	10.54645	9.483689	1.236884	0.408914
eIVS	6.25	7.086538	-3.02105	138	0.003003	36	104	1.105182	1.527168	1.90944	0.031329
ePW	11.55556	11.38679	0.539585	140	0.590341	36	106	1.593638	1.630487	1.046781	0.905904
LA	34.11111	36.64151	-2.6394	140	0.009247	36	106	6.093452	4.533869	1.806292	0.022845
Ao	1.183333	1.238585	-1.28708	140	0.200191	36	106	0.167468	0.238077	2.021016	0.01945
E/A	1.444444	2.066038	-3.6119	140	0.000423	36	106	0.772544	0.928581	1.444751	0.215156
IVRT	0.103333	0.110394	-1.91291	138	0.057832	36	104	0.021044	0.018376	1.311402	0.297297
CMIT	0.062917	0.070604	-3.17456	140	0.001846	36	106	0.012949	0.012417	1.087386	0.725981
CPV	0.133389	0.135802	-0.69734	140	0.486745	36	106	0.017021	0.018233	1.147434	0.656803
TTP	0.200472	0.205123	-0.7162	140	0.475061	36	106	0.032982	0.034102	1.114838	0.73196
aveBPexeS	215.4815	215.5338	-0.01276	140	0.989839	36	106	20.51309	21.50461	1.099005	0.770434
aveBPexeD	122.3542	121.0715	0.436667	140	0.663026	36	106	15.17193	15.24509	1.009667	1
aveBPrecS	175.2431	177.5236	-0.52515	140	0.600284	36	106	22.21007	22.60950	1.036297	0.934552
aveBPrecD	109.5139	105.9953	1.125968	140	0.262106	36	106	15.67037	16.37223	1.091584	0.78891
Age ave.	51.08333	60.60952	-4.17078	139	0.000053	36	105	12.83605	11.46608	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 almost 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. 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.

Furher data and results are introduced on the following figures.

Figure 2

Figure 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.

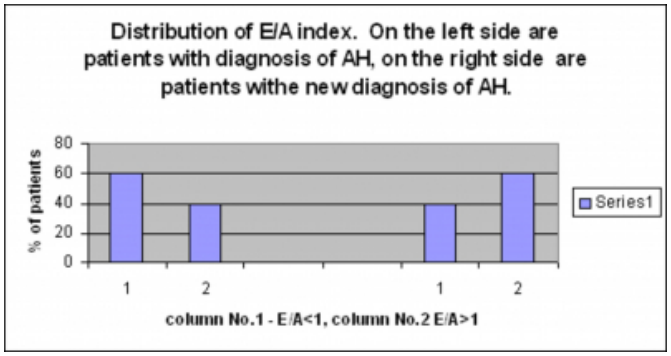


Figure 3

Figure 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. The difference is statistically not significant.

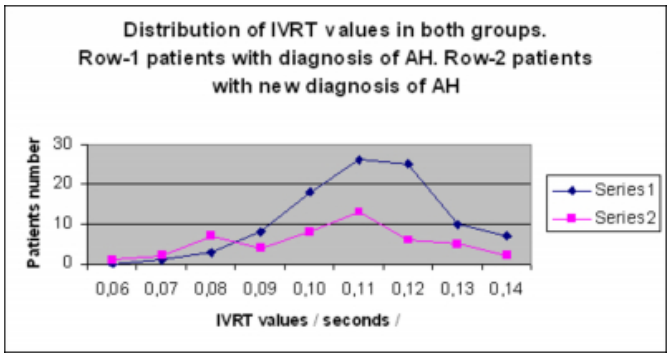


Figure 4

Figure 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.

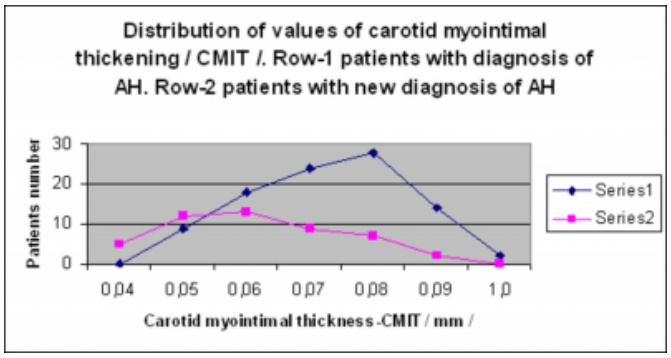
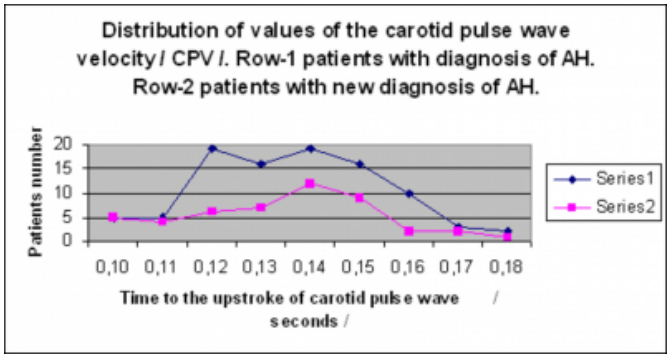


Figure 5

Figure 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 Â– 0,1350. There is no statistical difference between both groups.



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.

Figure 6

Figure 5: BP values during exercise and recovery period in patients with chronic AH

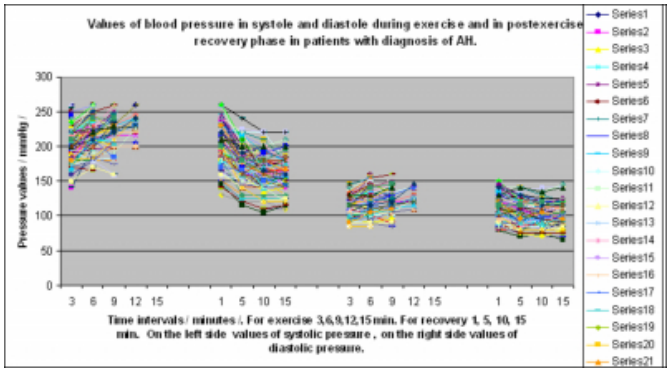


Figure 7

Figure 6: BP values during exercise and recovery period in patients with new AH

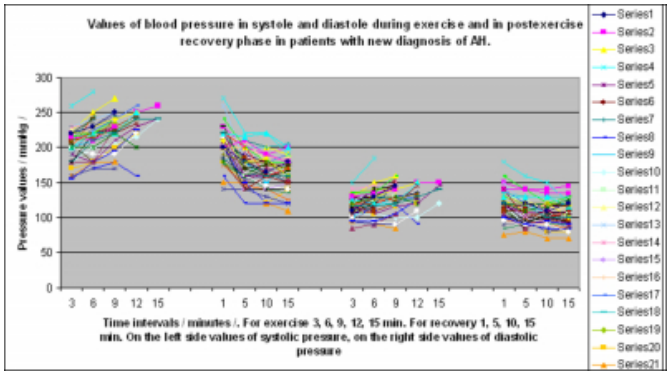


Figure 8

Table 2: Statistical comparison of BP values of single stages of exercise and recovery period. 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.

t-tests; groups: new and chronic AH : = if(v3=3; 1;2) (Data1)
Group 1: new AH
Group 2: chronic AH

Variable	Aver. 2	Aver. 1	t	sv	p	Num.val. 2	Num.val. 1	S.dev. 2	S.dev. 1	F-ratio disp.	p disp.
3minexeS	203.9906	199.1667	1.04922	140	0.295883	106	36	24.08339	23.06822	1.089951	0.793011
3minexeD	115.2358	115.5556	-0.11614	140	0.907706	106	36	14.31586	14.13091	1.026348	0.962106
6minexeS	218.2143	212.7778	1.26751	132	0.207205	98	36	21.74418	22.72332	1.092088	0.718494
6minexeD	122.5510	122.2222	0.09657	132	0.923211	98	36	17.29437	17.94613	1.076792	0.756957
9minexeS	223.2787	222.8788	0.07864	92	0.937489	61	33	24.42480	21.75971	1.259958	0.483038
9minexeD	123.5246	124.5455	-0.26524	92	0.791419	61	33	18.71595	15.97672	1.372298	0.333429
12minexeS	229.6429	227.8125	0.24138	28	0.811022	14	16	15.12312	24.56072	2.637543	0.086581
12minexeD	127.8571	125.6250	0.40892	28	0.685709	14	16	13.40412	16.11159	1.444776	0.511286
15minexeS	240.0000	240.0000	0.00000	4	1.000000	2	4	14.14214	8.16497	3.000000	0.363380
15minexeD	135.0000	128.7500	0.52058	4	0.630147	2	4	21.21320	10.30776	4.235294	0.263501
1minrecS	204.2453	202.2222	0.38662	140	0.699521	106	36	27.65254	25.47953	1.177843	0.591757
1minrecD	113.4906	118.7500	-1.47434	140	0.142634	106	36	18.38956	18.79875	1.044997	0.837179
5minrecS	175.8962	172.7778	0.66071	140	0.509886	106	36	24.38576	24.71103	1.026855	0.887123
5minrecD	104.6887	109.3056	-1.33783	140	0.183119	106	36	18.30918	16.56816	1.221206	0.507526
10minrecS	165.8019	165.1389	0.13901	140	0.889642	106	36	24.39884	25.67617	1.107445	0.676360
10minrecD	102.8302	107.2222	-1.41156	140	0.160297	106	36	15.85678	16.92186	1.138848	0.602903
15minrecS	164.1509	160.8333	0.72036	140	0.472502	106	36	23.77946	24.15722	1.032025	0.872761
15minrecD	102.9717	102.7778	0.06026	140	0.952034	106	36	16.84351	16.18838	1.082577	0.811686

Figure 9

Table 3: Results of the t-tests. There is statistically significant difference only in CMIT .

t-tests; grouped: New and chronic AH: = if(v3 = 3; 1;2) (Data1)
Group 1: 2
Group 2: 1

Variable	Aver. 2	Aver. 1	t	sv	p	No.valid 2	No.valid 1	S.dev. 2	S.dev. 1	F-ratio dispers.	p dispers.
IVRT	0.110394	0.103333	1.912905	138	0.057832	104	36	0.018377	0.021044	1.311402	0.297297
CMIT	0.070604	0.062917	3.174557	140	0.001846	106	36	0.012418	0.012949	1.087386	0.725981
CPV	0.135802	0.133389	0.697342	140	0.486745	106	36	0.018233	0.017021	1.147434	0.656803

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

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.

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 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 we should alos acccept the fact that to measure BP under so called basal conditions /when the patient is inactive at easy /is not sufficient to assess the disease and for decision making about antihypertensive therapy.

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

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.

CORRSPONDENCE TO

Milan ADAMEK M.D. Spa Podebrady a.s. 29033 Podebrady Czech Republic Tel. 00420604533781 Fax 00420325613882 adsami@atlas.cz mil.ad@t-email.cz

References

1. Exercise and the heart, Froelicher . Myers, 4th Edition, c.2000, W.B.Saunders Co., ISBN 0-7216-8450-5
2. Clinical cardiac rehabilitation, Pashkow, Dafoe, 2nd Edition,c.1999, Williams&Wilkins, ISBN 0-683-30224-8
3. Cardiac rehabilitation, adult fitness and exercise testing, Fardy, Yanowitz, 3rd Edition, c.1995, Williams&Wilkins, ISBN 0-683-03031-0
4. Heart disease, Braunwald, 6th Edition, c.2001, W.B.Saunders Co., ISBN 0-7216-566-8
5. Kardiologie, Štejfa, 1.vydání, c.1998, Grada, ISBN 90-7169-448-7
6. Ischemická choroba srdeční, Špinar,1.vydání, Grada, ISBN 80-247-0500-1
7. Textbook of internal medicín, Kelley, c.1997, Raven Publisher, ISBN 0-397-51283-X

Author Information

Milan Adamek, M.D.
Spa Podebrady a.s.