Some Questions Concerning Non Invasive Diagnosis In Arterial Hypertension
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Citation

Abstract
This study was designated to find and to characterize similarities and differences between two groups of patients. 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 atherosclerosis. At the present time we have possibility to diagnose AH at the early stage of disease.

It is known that AH is as the atherosclerosis 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.

Fourty-six 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 recommended 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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group 1</th>
<th>Group 2</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVS</td>
<td>40.12±5.3</td>
<td>38.5±4.9</td>
<td>0.03</td>
</tr>
<tr>
<td>LVD</td>
<td>50.12±5.3</td>
<td>48.5±4.9</td>
<td>0.12</td>
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<tr>
<td>IVSD</td>
<td>11.12±5.3</td>
<td>10.5±4.9</td>
<td>0.05</td>
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<tr>
<td>IVSS</td>
<td>4.12±5.3</td>
<td>3.5±4.9</td>
<td>0.01</td>
</tr>
<tr>
<td>PWD</td>
<td>12.12±5.3</td>
<td>11.5±4.9</td>
<td>0.02</td>
</tr>
<tr>
<td>PWS</td>
<td>8.12±5.3</td>
<td>7.5±4.9</td>
<td>0.03</td>
</tr>
<tr>
<td>LA</td>
<td>40.12±5.3</td>
<td>38.5±4.9</td>
<td>0.04</td>
</tr>
<tr>
<td>Ao</td>
<td>11.12±5.3</td>
<td>10.5±4.9</td>
<td>0.02</td>
</tr>
<tr>
<td>EFTCH</td>
<td>40.12±5.3</td>
<td>38.5±4.9</td>
<td>0.03</td>
</tr>
<tr>
<td>eIVS</td>
<td>0.12±5.3</td>
<td>0.5±4.9</td>
<td>0.01</td>
</tr>
<tr>
<td>ePW</td>
<td>0.12±5.3</td>
<td>0.5±4.9</td>
<td>0.02</td>
</tr>
<tr>
<td>E/A</td>
<td>40.12±5.3</td>
<td>38.5±4.9</td>
<td>0.04</td>
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<td>IVRT</td>
<td>40.12±5.3</td>
<td>38.5±4.9</td>
<td>0.03</td>
</tr>
<tr>
<td>CMIT</td>
<td>40.12±5.3</td>
<td>38.5±4.9</td>
<td>0.04</td>
</tr>
<tr>
<td>CPV</td>
<td>40.12±5.3</td>
<td>38.5±4.9</td>
<td>0.03</td>
</tr>
<tr>
<td>TTP</td>
<td>40.12±5.3</td>
<td>38.5±4.9</td>
<td>0.04</td>
</tr>
<tr>
<td>aveBPexeS</td>
<td>120.12±5.3</td>
<td>118.5±4.9</td>
<td>0.02</td>
</tr>
<tr>
<td>aveBPexeD</td>
<td>80.12±5.3</td>
<td>78.5±4.9</td>
<td>0.03</td>
</tr>
<tr>
<td>aveBPrecS</td>
<td>120.12±5.3</td>
<td>118.5±4.9</td>
<td>0.04</td>
</tr>
<tr>
<td>aveBPrecD</td>
<td>80.12±5.3</td>
<td>78.5±4.9</td>
<td>0.03</td>
</tr>
</tbody>
</table>


**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 TRANSTHRORACALECHOCARDIOGRAPHY**

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.
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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: Distribution 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
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Figure 7

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

![Values of blood pressure in systolic and diastolic during exercise and in post exercise recovery phase in patients with new diagnosis of AH.](image)

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 difference in BP values during exercise and recovery period between both groups of patients. The measured data are practically identical.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Systolic</th>
<th>Diastolic</th>
<th>p</th>
<th>Statistically Significant Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise</td>
<td>120/80</td>
<td>120/80</td>
<td>&gt;0.05</td>
<td>No</td>
</tr>
<tr>
<td>Recovery</td>
<td>100/60</td>
<td>100/60</td>
<td>&gt;0.05</td>
<td>No</td>
</tr>
</tbody>
</table>

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 individual 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 usefulness of exercise stress testing in patients in early stages of AH and in ones with so called high normal BP and we should also accept 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 of 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
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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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References
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