

ANALYSIS OF ARTERIAL PRESSURE VARIABILITY BY MEASURING PRESSURE ON BOTH ARMS AND AS A FUNCTION OF TIME IN PATIENTS WITH NEWLY DISCOVERED HYPERTENSION

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Summary: INTRODUCTION At the initial office visit, blood pressure should be measured in both arms, ideally with electronic devices that can measure them simultaneously. SBP difference between arms >10 mmHg must be confirmed by repeated measurements. If confirmed, the arm with the higher blood pressure should be used for all subsequent measurements, as its values more accurately reflect the level of blood pressure in the major arteries. Using blood pressure readings on the arm with higher pressure improves outcome prediction. A consistent difference in SBP between the arms >15 to 20 mmHg may be due to atherosclerosis and restriction of the large intrathoracic or supraclavicular arteries, necessitating investigation of arterial disease. The blood pressure values on the right and left brachialis arteries differ in most cases, and the higher one is taken as more accurate. Prognostic significance: for each 10 mmHg difference according to Agarwal (2008), the relative risk of total mortality increases by 24%. In order to accurately assess the degree of hypertension, the spontaneous variability of pressure as a function of time and the pressure difference between the arms must be taken into account. **WORK OBJECTIVES:** 1. Analysis of spontaneous blood pressure variability upon arrival and repeated after 5 to 30 minutes; 2. Blood pressure differences between the left (LR) and right arm (DR). **MATERIALS AND METHODS:** A prospective study was conducted from the database of the "Dr. Bastać" Internal Medicine Practice on 26 patients, average age 58±12 years, with newly discovered hypertension by measuring blood pressure with the indirect manometer method at the first examination immediately after arrival and after 15 minutes. The control group consists of 28 patients who do not have hypertension. The data were statistically processed with the Student's T test. **WORK RESULTS** The mean value (X_{sr}) of systolic and diastolic blood pressure (SKP/DKP) of the examined group on arrival is 166/92 mmHg on the right hand (DR), and 161/93 mmHg on the left hand (LR). and after rest at DR 153/90 mmHg and LR 149/87. There is a statistically highly significant difference especially between the CAP on the hands - it is always higher on the right hand by an average of 5 mmHg (p=0.002) and 4 mmHg after rest. Spontaneous variability was determined in 10 (40%) subjects where there was a statistically significant drop in tension after rest. After a 15-minute rest, the significance of pressure differences between arms is maintained, but the high variability of 40% post-rest pressure variability is lost. **CONCLUSION:** Pressure on arrival in newly diagnosed untreated patients is always higher on the right arm by an average of 5 mmHg (p=0.002), and after rest 4 mmHg, this difference is maintained. Spontaneous variability was determined in 10 (40%) subjects where there was a statistically significant drop in tension after rest. After 15 minutes of rest, the significance of the pressure differences between the arms is maintained, but the high pressure variability is lost. **Key words:** Blood pressure measurement/methods, hypertension/diagnosis, hypertension/pathophysiology, arterial blood pressure variability, blood pressure/difference between left and right brachial artery, hypertension/prognosis

INTRODUCTION:

According to the earlier guidelines and the latest European guidelines from 2023 as well as international guidelines [1-5], the definition of systemic arterial hypertension remains unchanged

(short: hypertension) and is defined on the basis of repeated measurements in the doctor's office: equal to and higher than 140 mmHg for systolic pressure and/or ≥90 mmHg for diastolic pressure. Arterial blood pressure (BP) is defined just as

before as optimal, normal, high normal or grade 1, 2, or 3 according to the pressure measured in the office (Recommendation class of evidence I, level of evidence C) [5].

However, it must be known that there is a continuous relationship between BP levels and cardiovascular, renal and fatal events starting with a pressure >115/75 mmHg [6], and that is why the definition is arbitrary and pragmatic due to the simplification of the diagnosis and the treatment.

That is why it is also important that, apart from the degree of hypertension based on the BP value, in reaching the decision on bigger lowering of the pressure, one should follow the classification according to the stages of hypertension: Grade 1 uncomplicated hypertension; Grade 2 presence of HMOD or CKD Grade 3 or diabetes; Grade III presence of CVD or CKD G4 and G5 [5].

Hypertension is the most common cardiovascular disorder and the standardized global prevalence for people aged 30-79 years is 34% for men and 32% for women. That is why it is additionally important that, in addition to the degree of hypertension based on the KP value, in the decision on a greater lowering of the pressure, a classification according to the stages of hypertension is taken: stage 1 uncomplicated hypertension; stage 2 presence of HMOD or CKD grade 3 or diabetes; Grade III presence of CVD or CKD G4 and G5 [5].

Hypertension is the most common cardiovascular disorder and the standardized global prevalence for people aged 30-79 years is 34% for men and 32% for women. [7].

Finding cases or opportunistic screening for hypertension is recommended for all adults (Class I C) [5]. Regular blood pressure measurement is recommended for people over 40 years of age or earlier in patients with high cardiovascular risk (Class I C) once a year, in order to detect hypertension [5].

Reliable determination of blood pressure by devices with a cuff on the upper arm and the indirect method with an aneroid manometer is the cornerstone the diagnosis and management of hypertension. [8].

At the initial office visit, BP should be measured in both arms, ideally with electronic devices that can measure them simultaneously. An interarm SBP difference >10mmHg must be confirmed with repeated measurements. If confirmed, the arm with the higher BP should be used for all

subsequent measurements because its values more accurately reflect the BP level in the major arteries. Moreover, using BP taken on the arm with a higher reading seems to improve the outcome prediction [90]. A consistent interarm SBP difference >15 to 20mmHg may be due to atherosclerosis and restriction of large intrathoracic or upper arm arteries, requiring investigation for arterial disease [8,9]. Blood pressure values on the right and left brachialis arteries differ in the majority of cases, and the higher one is taken as more accurate. Prognostic significance: for each 10 mmHg difference according to Agarwal (2008), the relative risk of total mortality increases by 24%. In order to accurately assess the degree of hypertension, the spontaneous variability of pressure as a function of time and the pressure difference between the arms must be taken into account [10].

AIM OF THE PAPER:

1. Analysis of spontaneous blood pressure variability on arrival and repeated after 5 to 30 minutes and
2. Blood pressure differences between left (LA) and right arm (RA).

METHODS:

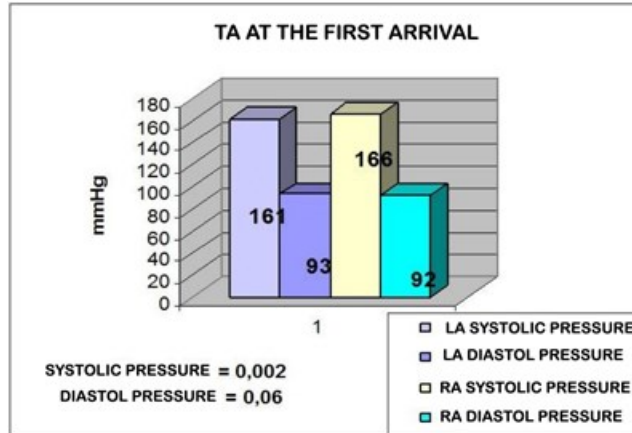
A prospective study was conducted from the database of the Office of Internal Medicine "Dr. Bastać" on 26 patients, whose average age was 58±12 years, with newly discovered hypertension, by measuring blood pressure with the indirect manometer method at the first examination and control examination 15 days later. The control group consisted of 28 patients who didn't have hypertension. The data were statistically processed with Student's T test.

RESULTS

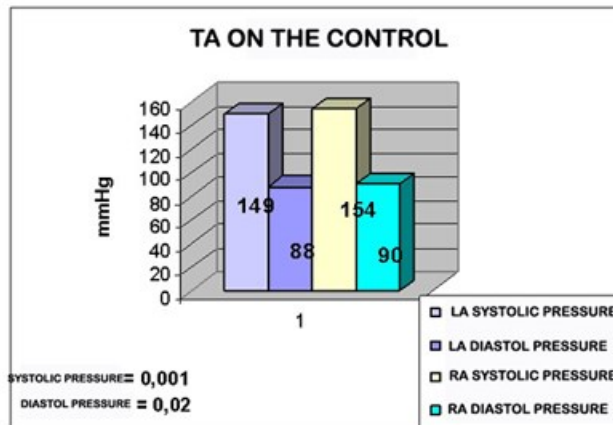
By comparing the mean values of systolic and diastolic pressures between the arms at the arrival of GRAPHIC 1, we note that there is a statistically highly significant difference between the SKP on the arms. The systolic pressure is higher on the right arm by an average of -5 mmHg ($p=0.002$), which is maintained even after a 15-minute rest and then remains 5 mmHg ($p=0.001$).

Diastolic pressure does not differ significantly between measurements on the left and right arm ($p=0.06$) at the first measurement, and after rest it is statistically significantly higher by 2 mmHg ($p=0.02$), which is not clinically significant.

GRAPH 1. COMPARISON OF SYSTOLE AND DIASTOLE PRESSURES ON THE LEFT AND RIGHT ARMS AT THE FIRST ARRIVAL



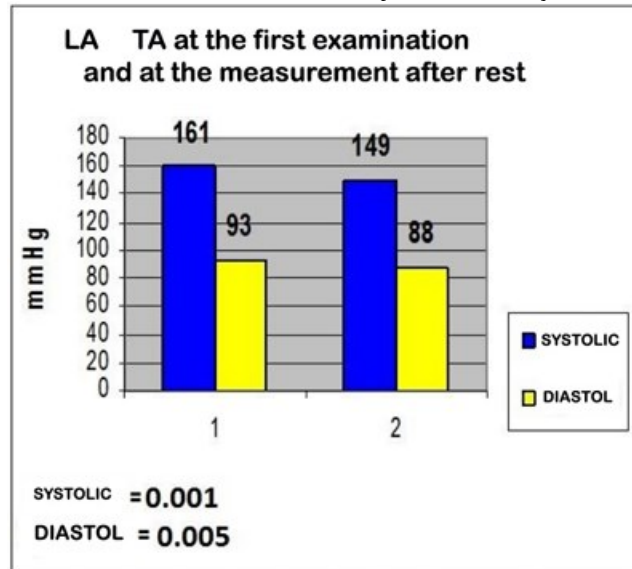
GRAPH 2. COMPARISON OF SYSTOLE AND DIASTOLE PRESSURES ON THE LEFT AND RIGHT ARMS after rest - statistically significant variability



The mean value (\bar{X}_{sr}) of systolic and diastolic blood pressure (SKP/DKP) of the studied group on arrival was 161/93 mmHg on the left arm (LR) and 149/88 after rest. (GRAPH 3) which is highly statistically significantly lower pressure after rest:

by 12 mmHg systolic ($P= 0.001$) and by 5 mm Hg diastolic ($P=0.005$).

GRAPH 3. AVERAGE PRESSURE VALUES ON THE LEFT HAND AT THE FIRST EXAMINATION - 1 and at the measurement after rest (CONTROL - 2)

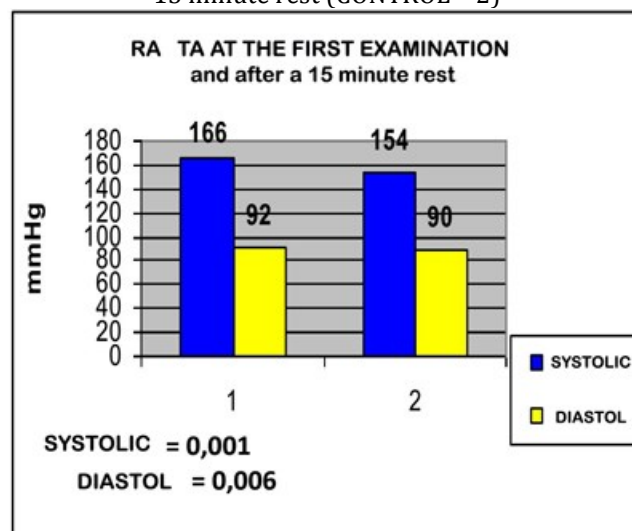


The mean pressure values on the right hand (GRAPHIC 4) are at the first measurement 166/92 mmHg (GRAPHIC 4). and after rest they drop to 154/90 mmHg, that is 12 mm systolic pressure and after rest is statistically significantly lower 12 mmHg ($p < 0.001$), while diastolic pressure is only 2 mmHg lower without statistical significance ($p = 0.06$).

It is similar in the normotensive control group for systolic pressure: the systolic pressure on the right

arm decreases after rest by 8 mmHg, and on the left arm by 6 mm Hg. In contrast to hypertensive patients, the diastolic blood pressure in the control group of healthy people at rest decreased significantly more in both arms compared to the examined group of hypertensive individuals, namely on the right arm by 5 mmHg ($p < 0.01$) and on the left by 4 mmHg ($P < 0,01$).

GRAPH 4. AVERAGE VALUES OF PRESSURE ON THE RIGHT ARM AT THE FIRST EXAMINATION - 1 and after a 15 minute rest (CONTROL - 2)



In the individual distribution, blood pressure dropped by >10% in 24%, and by >20% in 16% of patients - high spontaneous variability. At the follow-up examination, the significance of the differences in pressure between the arms was maintained. On the contrary, the mean value of blood pressure at RA was 154/90mmHg, at LA it was 149/88mmHg, and after rest there was no statistically significant drop in pressure.

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DISCUSSION

Our results show that the mean systolic blood pressure in the right arm was significantly higher - by 5 mm Hg at the first measurement and by 4 mm Hg after rest. According to data in the literature, the difference in systolic blood pressure values between the arms was associated with all-cause mortality and with increased cardiovascular mortality [10,11]. Systolic difference between arms is associated with increased all-cause mortality, cardiovascular mortality, and cardiovascular events. Blood pressure should be measured in both arms during the cardiovascular assessment. A systolic difference between arms of 10 mm Hg is suggested as the upper normal limit [11].

Clinically, blood pressure variability [12] is classified into 4 main types based on monitoring time: very short-term (beat-to-beat), short-term (within 24 hours), medium-term (within days), and long-term (over months and years) and simultaneous measurement on both arms, for which new blood pressure meters have already been created, is particularly important, [13].

LITERATURE

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Blood pressure variability is a strong risk factor for cardiovascular disease, chronic kidney disease, cognitive decline, and mental illness. The diagnostic and therapeutic value of measuring and controlling blood pressure variability may offer critical targets in addition to lowering mean blood pressure in the nonhypertensive population [12,14].

Therefore, it is very important to measure blood pressure in both arms in all patients, and doctors who are directly involved in patient care must always keep in mind that failure to measure blood pressure in both arms can lead to misdiagnosis, unnecessary testing, and inadequate therapy. A systolic difference between the arms of 10 mmHg is suggested as the upper normal limit [15,16]. In order to be fully responsible for the patients, it is best that we doctors, measure the patients' blood pressure on both arms ourselves, particularly during the first examination, using the proper functioning validated devices. If we do transfer that responsibility to our medical associates, we must be sure that both they and the equipment they use are reliable.

CONCLUSION

There is an extremely statistically significant difference particularly between the systolic pressure on the arms: it is always higher on the right arm by an average of -5 mmHg ($p=0.002$) and 4 mmHg after rest. This difference is further maintained. Spontaneous variability was determined in 10 (40%) subjects where there is a statistically significant drop in tension after rest. After the introduction of antihypertensive therapy 15 days later, the significance of differences in pressure between arms is maintained, but the variability of pressure after rest is lost.

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