

Polo-Portes, C.E.; Del Castillo-Campos, M.J.; Ramos-Álvarez, J.J. y Lara-Hernández, M.T. (2017) Monitorización de la presión arterial en esfuerzo. ¿Brazo dominante, no dominante o ambos? / Monitoring of the arterial pressure in effort. Dominant, not dominant arm or both? Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 17 (65) pp. 63-72. [Http://cdeporte.rediris.es/revista/revista65/artension775.htm](http://cdeporte.rediris.es/revista/revista65/artension775.htm)
DOI: <http://dx.doi.org/10.15366/rimcafd2017.65.004>

ORIGINAL

MONITORING OF THE ARTERIAL PRESSURE IN EFFORT. DOMINANT, NOT DOMINANT ARM OR BOTH?

MONITORIZACIÓN DE LA PRESIÓN ARTERIAL EN ESFUERZO. ¿BRAZO DOMINANTE, NO DOMINANTE O AMBOS?

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This work was carried out thanks to research grants from the Sports Medicine Center of the Community of Madrid

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Código UNESCO / UNESCO Code: 2411.06. Fisiología del ejercicio / Exercise Physiology. 3299.15 Medicina del deporte/Sports Medicine:

Clasificación del Consejo de Europa / Council of Europe Classification:

6. Fisiología del ejercicio / Exercise Physiology 11.Medicina del Deporte / Sports Medicine

Recibido 13 de marzo de 2014 **Received** March 13, 2014

Aceptado 19 de noviembre de 2014 **Accepted** November 19, 2014

ABSTRACT

Objective: To evaluate different blood pressure readings between both arms.

Study design: cross-sectional study. **Case series.** **Level of evidence:** 3.

Methods: a population of 225 healthy athletes underwent stress tests in our center: 128 males and 97 females. **Age range:** 17 +/- 5.5 years.

Results: no significant differences in systolic or diastolic blood pressure readings were found between the right or left arm. We did, however, find cases where blood pressure is higher in one arm while resting and in the other arm during maximal exercise. Blood pressure readings were not associated with the dominant arm.

Conclusions: The possibility that the arm in which there is a predominant rest blood pressure does not coincide during maximum stress, makes it necessary, according to our judgment, to measure blood pressure in both upper limbs during stress tests.

KEY WORDS: blood pressure, stress test, dominant arm.

RESUMEN

Objetivo: evaluar la diferencia de los valores de Presión arterial (PA) entre ambos brazos, medida simultáneamente, durante una prueba de esfuerzo.

Diseño del estudio: estudio transversal. Series de casos. Nivel de evidencia: 3

Material y Métodos: La población se compone de 225 deportistas sanos que realizaron una prueba de esfuerzo en nuestro centro. 128 hombres y 97 mujeres. Edad: $17 \pm 5,5$ años.

Resultados: La PA tanto sistólica como diastólica no difiere significativamente entre ambos miembros superiores. No obstante, hemos encontrado casos de variabilidad individual donde la PA predomina en un brazo durante el reposo y en el otro brazo durante el máximo esfuerzo. Los valores de TA son independientes del brazo dominante.

Conclusiones: La posibilidad que el brazo donde predomina la PA de Reposo no coincida durante el máximo esfuerzo, hace necesario, en nuestra opinión, que se mida la PA en ambos miembros superiores durante la prueba de esfuerzo.

PALABRAS CLAVE: tensión arterial, prueba de esfuerzo, brazo dominante.

INTRODUCTION

The abnormally high Blood Pressure (BP) in the laboratory of effort is grounds for suspending a stress test or to diagnose hypertension (1). From the anatomical point of view, it is normal for some authors that higher levels of blood pressure in the right arm (2) are obtained, so typically in clinical practice one chooses to take it in the left arm (3); others prefer to perform the measurement in the "non-dominant" arm but the recommendations are to initially measure it in both arms and make successive measurements on the arm with highest numbers (4-5). Evidence has shown that differences greater than 10 mmHg are associated with vascular disease (6-8).

Proper BP measurement is so important that it has raised the wording of various clinical practice guidelines (9-10); however, the absence of a consensus to choose the arm that takes the BP during the stress test makes us believe that theoretically false positives or false negatives can arise because in the case of measuring interchangeably in either arm could be underestimating or overestimating the true value (11). On the other hand, it would have methodological importance, because in order to make comparisons in clinical measurements, the same methodology should be used in obtaining the data (12-13).

In the event that in routine clinical practice arm preference would be determined by the comfort of the examiner; such is the case if the examination table, treadmill or bicycle test stress test, do not allow access by one of both sides, making the BP is done simply in the corresponding arm from the accessible side, and in addition is not included in the Medical History the arm in which the BP is taken. Therefore, in this paper, we have proposed to know the magnitude of the difference between the values of BP in both arms simultaneously measured at rest, during exercise and recovery from a stress test and its relationship with the dominant arm, age, sex and sport practiced; by conducting a cross-sectional study in the Sports Medicine Center of the Community of Madrid in the period of 2011-2013.

OBJECTIVES

To assess the existence and magnitude of the difference between the values of arterial tension between both arms simultaneously measured at rest, during exercise and recovery from stress test on healthy athletes.

To know the differences that may exist between the levels of blood pressure taken in the dominant arm with respect to the non-dominant arm.

MATERIAL & METHOD

The cross-sectional study was conducted at the Center for Sports Medicine of the Community of Madrid, with 225 healthy athletes who came to our hospital for a medical-sport check up in the period between May 2011 and November 2013. The study population consisted of 128 men (56.9%) and 97 women

(43.1%). The average age was of 17 years (SD \pm 5.5), between 11 and 37 years. The average years of practiced sport was of 7 (SD \pm 4), between 1 and 27 years. Sports practiced were hockey 67 (29%), track 29 (12.9%), swimming 25 (11.1%), table tennis 20 (8.9%), archery 14 (6.2%), basketball 11 (4.9%), fencing 9 (4%), badminton 7 (3.1%), other 43 (19.1%).

All subjects and their legal guardians were informed of the nature and characteristics of the study and previously signed informed consent according to the principles of the Declaration of Helsinki for research in humans (14).

All athletes underwent a complete medical history, a thorough physical examination and with appliances, spirometry and a baseline electrocardiogram. Subsequently a Maximum Forward treadmill exercise test was conducted with an incremental speed protocol (2 km / h / 2') a fixed slope (3%) to exhaustion and in compliance with the ergospirometric maximality criteria for a test effort (11).

The BP measurement was performed on both arms simultaneously in four moments when standing on the treadmill: at rest, the maximum stress and the first and third minutes of passive recovery, using two electronic sphygmomanometers Omron 705IT, designed for regular BP measurement (15-16).

The following exclusion criteria were considered: the absence of cardiovascular disease, which in the initial measurement of Hypertension does not exist greater than or equal to 10 mm Hg difference between both arms and do not meet maximality criteria for stress testing. All study participants met the criteria.

In the data collection absolute numbers and differences in blood pressure between arms are considered at all described times, dominance arm reported by the athlete, the sport practiced, years of practice, age and sex.

Data were processed with SPSS 17, we described frequencies and checked the normal distribution so we found the means \pm standard deviations (SD) and use parametric tests; Samples T Test. To compare nonparametric variables proved as the number of left-handed athletes used the Wilcoxon contrast tests and Mann-Whitney. In all cases the level of significance was of $p \leq 0.05$.

RESULTS

Table 1 shows the mean \pm SD of Systolic Arterial Pressure (SAP) and Diastolic (DAP), measured simultaneously in both right and left upper limbs, and the results of the Test of T found no statistically significant difference.

Table 1. Correlation of Related Samples. T Test					
AP	AP Right Arm		AP Left Arm		p
	Mean	SD	Mean	SD	
Rest TAS	123,2	12,2	121,3	12,6	0,945
Rest TAD	77,3	8,4	76,9	8,6	0,924
Max TAS	140	16,7	137,3	15,8	0,88
Max TAD	77,2	7,9	76,2	9,4	0,535
TAS 1 min Recovery	126,9	12,7	125,3	13,2	0,838
TAD 1 min Recovery	76,5	7,3	76,2	8,2	0,73
TAS 3 min Recovery	122,6	12,4	120,7	12,1	0,87
TAD 3 min Recovery	77,1	7,2	76,6	8,3	0,67

Both systolic and diastolic blood pressures found in the right arm are superior to those found in the left arm. These differences were not significant, regardless of sex, age, time, and practiced sport or sports.

Table 2 expresses the mean differences in BP measurements between the two arms at each of the times that they were measured. The mean \pm SD of differences in SAP Rest in the upper limb was 1.91 ± 4.14 . The mean \pm SD of the difference in the TAD resting was 0.36 ± 3.32 on upper extremities. Furthermore, the mean \pm SD of the difference in upper limbs Maximum TAS was 2.70 ± 8.04 and the mean \pm SD of the difference in upper limbs Maximum TAD was 1.00 ± 8.87 .

Table 2. AP differences among both arms	Mean	SD
Rest TAS	1,91	4,14
Rest TAD	0,36	3,32
Maximum TAS	2,70	8,04
Maximum TAD	1,00	8,47
TAS 1 min Recovery	1,60	7,41
TAD 1 min Recovery	0,28	5,79
TAS 3 min Recovery	1,94	6,28

TAD 3 min Recovery	0,54	6,45
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Moreover, we found three isolated cases of individual variability, where the PA prevails in the arm at rest and on the other arm during maximum effort. The measures found respectively after the 1st and 3rd minute of rest tend to return to the initial resting values.

Athletes who reported being left handed were 19 (8.4%) being 13 men and 6 women, while 206 (91.6%) reported being right handed; 115 men and 91 women. In Table 3 we can see that no significant differences for the PA, Systolic and Diastolic, in both arms, both in Left and Right handed.

Table 3. Contrast with Wilcoxon & U of Mann-Whitney for left-handed vs. right-handed. Bilateral Significance.				
PA	TAS		TAD	
	Right Arm	Left Arm	Right Arm	Left Arm
Rest AP	p=0,587	p=0,262	p=0,887	p=0,821
Max. AP	p=0,563	p=0,506	p=0,982	p=0,838
1st Min Recovery.	p=0,725	p=0,195	p=0,818	p=0,865
3rd Min Recovery.	p=0,867	p=0,523	p=0,993	p=0,233

DISCUSIÓN

Studies in normotensive patients, which measured the AP in both arms at the same time using the same automated sphygmomanometers Omron HEM 725, were similar to ours, finding that the AP was higher in the right arm, without statistical significance (16). The fact of having used two oscillometric sphygmomanometers allowed us simultaneous measurements without the existence of inter observer error that had generated that two different people take the PA simultaneously with an aneroid sphygmomanometer or that the same person had to first measure the Blood Pressure in one arm and then the other.

Previous studies conducted with healthy individuals, found no significant difference between the two arms (7,16,17), with values (mean \pm SD) of 1.1 ± 7.1 TAS and TAD 0.21 ± 5.0 (16), these results are similar to the ones we conducted in young athletes, having found no previous work done to date in this population.

Other authors find that the difference between TAS of both arms can become 14% and 7% for TAD (18). In the latter study, they did not exclude patients whose AP difference between arms were equal to or greater than 10 mmHg. However, like other studies (19), we found absolute and clinically relevant differences individually. This finding, in a young athlete population leads us to recommend AP measurement simultaneously in both arms during exercise testing. There may be several factors that could explain these individual

differences: the measuring instrument (20), the age of the participants or the condition of healthy athletes. Further research would be needed by controlling several variables.

In our study, as we discussed previously, we excluded subjects who had more than 10 mmHg difference between the two arms in the TAS and TAD, since most of the authors established that in normal individuals the difference in blood pressure between the members above does not exceed 10 mmHg and to overcome it should be suspected vascular disease (6-8, 21-22).

The acceptance by following the recommendations of clinical practice guidelines for the diagnosis and management of Hypertension in consultations about taking AP in both arms would be better accepted if there is more evidence of this need (23-24). In this sense there is no consensus or opinions regarding stress tests in the field of sports medicine.

According to the data of our study, the dominance of the arm does not seem to influence blood pressure levels. Consistent with other studies any difference found is unlikely to be due to the dominance of the arm (25-26).

CONCLUSIONS

- 1- In our healthy athletes both systolic and diastolic blood pressure did not differ significantly between both upper limbs, with the right arm showed higher AP.
- 2- The dominance of the arm does not seem to influence blood pressure levels.
- 3- On an individual level, the absolute differences were significant in some cases, with the possibility that the arm where the rest AP prevails does not coincide with the maximum effort, making it necessary, in our view, that the AP is measured in upper limbs in the process of stress testing members.
- 4- We suggest uniformity in data collection, documenting the AP found in each arm, or reflect the measurement arm, both for making medical records and medical reports, and for research protocols in the field of Medicine of Physical Education and Sport.

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