Does crossing legs affect the measurement of blood pressure?

Cruzar as pernas influi na medida da pressão arterial?

Nelson Rudi Koehler

Mestre em Clínica Médica/Cardiologia. Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, RS.

ABSTRACT

Aims: To compare oscillations in blood pressure with and without crossing legs.

Methods: Eight serial measurements of blood pressure with intervals of one minute were made in each of 80 consecutive patients, in the sitting position. In the first half of the patients (Group 1, 40 patients), the four last measurements were taken after the patient crossed the legs at knee level. In the second half of the sample (Group 2, 40 patients), all the eight readings were done without crossing legs.

Results: Systolic Blood Pressure in Group 1 oscillated from 132.4±20.9 mmHg pre-crossing to 137.3±24 mmHg post-crossing, and in Group 2, it changed from 132.1±16.2 mmHg in the first four measurements to 130.5±16,4 mmHg in the last four measurements. The variation in Group 1 was 4.9 and in Group 2 was -1.59 (range 6.5), and this difference was significant (p=0.001). Diastolic Blood Pressure in Group 1 varied from 80.9±4 mmHg pre-crossing to 82.3±14 mmHg post-crossing, and in Group 2, it varied from 79±11 mmHg to 80.1±11mmHg between the first four and last four measurements. The variation in Group 1 was 1.48 and in Group 2 was 0.79 (range 0.69), and this difference was not significant (p=0.59).

Conclusions: There was a statistically significant but very modest increase in Systolic Blood Pressure from pre-crossing to post-crossing legs. There was no significant change between Diastolic Blood Pressure pre and post-crossing legs. In clinical practice, variation in blood pressure measurement with and without crossing legs has probably no clinical relevance, because of its little magnitude, similar to variation that occur at random.

KEY WORDS: BLOOD PRESSURE; BLOOD PRESSURE DETERMINATION; LEG; POSTURE.

RESUMO

Objetivos: comparar as oscilações da pressão arterial, com e sem cruzar as pernas.

Métodos: oito medidas seriadas de pressão arterial, com intervalos de um minuto, foram feitas em cada um de 80 pacientes consecutivos. Na primeira metade dos pacientes (Grupo 1, 40 pacientes), as quatro últimas medições foram tomadas depois que o paciente cruzou as pernas na altura dos joelhos. Na segunda metade da amostra (Grupo 2, 40 pacientes), todas as oito leituras foram feitas sem cruzar as pernas.

Resultados: a Pressão Arterial Sistólica no Grupo 1 oscilou de 132,4±20,9 mmHg no pré-cruzamento das pernas para 137,3±24 mmHg após o cruzamento e, no Grupo 2, passou de 132,1±16,2 mmHg nas primeiras quatro medidas para 130,5±16,4 mmHg nas últimas quatro. A variação no Grupo 1 foi de 4,9 e no Grupo 2 foi de -1,59 (intervalo de 6,5), e esta diferença foi significativa (p=0,001). A Pressão Arterial Diastólica no Grupo 1 variou de 80,9±4 mmHg no pré-cruzamento para 82,3±14 mmHg após o cruzamento das pernas, e no Grupo 2, variou de 79±11 mmHg para 80,1±11 mmHg entre as quatro primeiras e as quatro últimas aferições. A variação no Grupo 1 foi de 1,48 e no Grupo 2 foi de 0,79 (intervalo de 0,69), diferença não significativa (p=0,59).

Conclusões: houve um aumento estatisticamente significativo, mas muito modesto, na Pressão Arterial Sistólica entre o pré-cruzamento e o pós-cruzamento das pernas. Na Pressão Arterial Diastólica pré e pós-cruzamento de pernas não houve diferença significativa. Na prática clínica, a variação na aferição de pressão arterial, com e sem cruzar as pernas, provavelmente não tem relevância clínica, devido à sua pequena magnitude, similar à variação que ocorre ao acaso.

DESCRITORES: PRESSÃO ARTERIAL; DETERMINAÇÃO DA PRESSÃO ARTERIAL; PERNAS; POSTURA.

Endereço para correspondência/Corresponding Author:
NELSON RUDI KOEHLER
Av. Ipiranga, 6690, conj. 207
CEP 90616-900, Porto Alegre, RS, Brazil
Telefone/Fax: (51) 3320-5106
E-mail: nelsonkoehler@yahoo.com.br

INTRODUCTION

Among the guidelines referred to the clinical measurement of blood pressure (BP) the precaution that the patient should be with theirs legs crossed is found in some papers.[1,2] Moreover, several works can be found referring that the act of crossing legs is associated to a statistically significant increase of BP.[2-6]

As already known, a spontaneous variation of BP occurs using the clinical method in serial measurements. The objective of this study was to measure BP oscillations with successive measurements in a group of patients before and after crossing legs and compare the results with a control group, without crossing legs.

METHODS

Patients of two cardiological clinics (author's private clinic and an outpatient clinic of National Health System of Brazil) were examined by the author. In each of 80 consecutive patients, eight measurements of BP were successively accomplished with an interval of one minute. The BP was measured using an Omron HEM 705 CP device (Omron Healthcare Inc, Vernon Hills, USA), which is totally automatic and uses the oscillometric method. The patients were sitting comfortably, with their arms at the heart level and the left superior limb properly positioned on the table and used to record the BP. The environment was quiet, and none did smoke or use caffeine within the thirty minutes preceding the measurements. There were no restrictions to the use of medications.

After the four initial measurements, the patients of Group 1 were asked to cross the legs at the knee level and the last four readings of BP were accomplished at that position. The leg that was crossed was chosen by the patient. In Group 2 (control group), the eight successive measurements were accomplished without crossing of legs. Patients were recruited consecutively, with the first 40 being assigned to Group 1, and the last 40 to Group 2.

The mean age of Group 1 was 56±15 years, 10 were non-white, 39 were female, and 11 were hypertensive in treatment. Group 2 had a mean age of 59±15 years, being 47 white, 21 men, and 31 hypertensive in treatment. Exclusion criteria were presence of cardiac arrhythmia, tremor or spasticity of limbs, hemodynamic instability, incapacity or unwillingness to cooperate, arm circumference exceeding limits of standardized cuffs, pain and/or visible anxiety. All the ethical standards for human experimentation were followed, and the patients signed an informed consent.

The means of systolic BP (SBP) and diastolic BP (DBP) before and after crossing legs in Group 1 as well as along the first four and last four measurements in Group 2 (control) were compared. The statistical method used was the ANOVA for repeated measurements.

RESULTS

SBP in Group 1 oscillated from 132.4±20.9 mmHg pre-crossing to 137.3±24 mmHg post-crossing, and in Group 2, it changed from 132.1±16.2 mmHg in the first four measurements to 130.5±16.4 mmHg in the last four measurements. The variation in Group 1 was 4.9 and in Group 2 was -1.59 (range 6.5), and this difference was significant (p=0.001). DBP in Group 1 varied from 80.9±4 mmHg pre-crossing to 82.3±14 mmHg post-crossing, and in Group 2, it varied from 79±11 mmHg to 80.1±11mmHg between the first four and last four measurements. The variation in Group 1 was 1.48 and in Group 2 was 0.79 (range 0.69), and this difference was not significant (p=0.59). Therefore, a modest increase of SBP post-crossing occurred in Group 1 and it was statistically significant when compared with the variation in Group 2. In the case of DBP, the comparison of values before and after the crossing of legs did not evidence significant changes, although a slight decreasing has been noted (Figure 1 and Table 1).

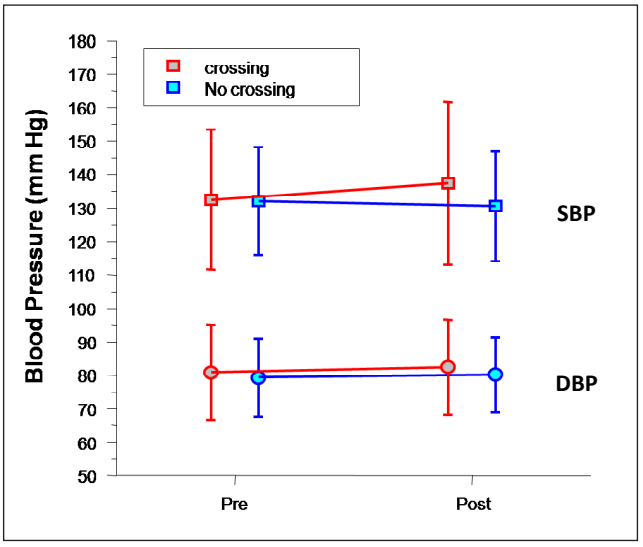

Figure 1. Variation of systolic (SBP) and diastolic (DBP) blood pressure in eight successive recordings in 80 patients. a) Group 1 (40 patients, red) – without crossing legs during the first four measurements (Pre) and with crossing legs at the knee level during the last four measurements (Post); b) Group 2 (40 patients, blue) – without crossing legs during the eight measurements (Pre and Post).

Table 1. Difference (from Group 1 to Group 2) in the variation between the means of the first four and the last four measurements of blood pressure (of eight successive measurements) taken in 80 patients in the sitting position. Group 1: with crossing legs in the last four measurements; Group 2: without crossing legs during the eight measurements.

	Variation between the first four and the last four measurements in Group 1 (N=40) (mmHg)	Variation between the first four and the last four measurements in Group 2 (N=40) (mmHg)	Difference in the variation between the two groups (mmHg)	*p*
SBP	4.9	-1.59	6.5	0.001
DBP	1.48	0.79	0.69	0.59

SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure.

DISCUSSION

A slight increase of SBP was the only relevant finding of this study. Observing the results with attention, we note that the oscillations of both SBP and DBP along the eight measurements were very modest. Reviewing the literature on spontaneous variations that occur in SBP along successive measurements in resting human beings, it is found that they may reach similar values or even higher. In a previous work, the author[7] used the average of standard deviations of four blood pressures (series of four successive measurements) to compare the variation of BP in pairs of measurements with interval of interposed time versus pairs of measurements without interval of interposed time between the two measurements. The variations noted were of 5.4 to 3.10 mmHg in different groups, for SBP, and of 5.4 to 2.2 mmHg for DBP.[7]

In the related literature, we note that in Lipsitz et al.[8] the variation of SBP was 22 and 24 mmHg, by the clinic method, in healthy young adults, measured by standard deviation.[8] Hughson et al.,[9] using measurements beat to beat (Finapres), noted a variation of SBP of 6.5 mmHg (heart transplanted) and of 6.4 mmHg in controls, always measured by standard deviation.[9] By the same method, Triedman et al.,[10] in a sequence of 8 minutes of measurements, observed a variability of 3.2 mmHg, in randomized breath and randomized negative pressure, respectively.[10] Takalo et al.,[11] in intra-arterial measurements for 5 minutes, noted a variation of SBP of 10 mmHg (normotensive), 10 mmHg (borderline patients) and of 12 mmHg in slightly hypertensive patients, according to standard deviation.[11] Using Finapres method during 20 minutes of observation, in young adults and elderly people, Veerman et al.[12] found variations of 6, 18 and 18 mmHg for SBP at supine position, and 9, 14 and 17 mmHg at the erect position.[12]

Comparing the values obtained in the present study with those reported in the literature on similar evaluations of BP variation, we believe that the oscillations of SBP and of DBP observed after crossing legs at knee level are of similar magnitude as those occurring at randomized successive measurements of BP. A statistically significant difference occurred, in the case of SBP; however, it probably has no clinical relevance, because of its little magnitude, similar to variation that occurs at random. It was very important to compare not only BP recordings before versus after legs crossing, but also BP spontaneous variation without crossing legs.

Special comments are deserved on the excellent papers of Van Groningen et al.[13] and Peters et al.[14] In the first one, BP was recorded by beat-to-beat non invasive methods, and the increase in SBP was 6.6 mmHg, being 1.4 mmHg in the case of DBP. According to Peters et al.,[14] mean SBP increase was 2.5 (95% CI 1.3-3.8) in normotensive and 8.8 mmHg (95% CI 5.8-11.7) in hypertensive subjects. In both studies, as in the present one, DBP changes were not significant. Interestingly, in the same mentioned papers, there was no comparison between oscillation of BP that happens in sitting subject with and without maneuvers or movements of inferior limbs. Regarding this aspect, significant oscillations of BP (3.1 to 24 mmHg SBP and from 2.2 to 11.2 mmHg for DBP) were found in sequential BP measurements of relaxed sitting or lying subjects.[15-17]

Concerning the term "variability" of BP, we consider that some researchers prefer to use it exclusively for beat-to-beat method (Finapres) or intra-arterial records. Hence, they used "oscillation" or "variation" of BP in short-time serial recordings. Nonetheless, several authors in the field have used "BP variability" in another context, mainly in ambulatory BP measurements.[18-24]

Clinical BP behavior by clinical recordings in the resting human being deserves careful study, because the overwhelming BP recordings taken all around the world still use the good and old arm sphygmomanometer.

Its kind of clinical variability has important practical value; it is a real problem to manage, notwithstanding the accuracy and importance of beat-to-beat recordings obtained in research laboratories.

ACKNOWLEDGEMENTS

The author is deeply indebted to Prof Mario Wagner for statistical analysis, and to Librarian Rosaria M. P. Geremia for bibliographical assistance.

REFERENCES

1. Chobanian AV, Bakris GL, Black HR, et al. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure: the JNC 7 report. Jama 2003;289:2560-72. Erratum em: Jama. 2003; 90:197.
2. Sociedade Brasileira de Hipertensão, Sociedade Brasileira de Cardiologia, Sociedade Brasileira de Nefrologia. Diretrizes brasileiras de hipertensão arterial, IV. Campos do Jordão, São Paulo; 2002 fev 1-3; Campos do Jordão, São Paulo, SP.
3. Foster-Fitzpatrick L, Ortiz A, Sibilano AOH, et al. The effects of crossed leg on blood pressure measurement: brief report. Nurs Res. 1999;48:105-8.
4. Peters GL, Binder SK, Campbell NRC. The effect of crossing legs on blood pressure: a randomized single-blind cross over study. Blood Press Monit. 1999;4:97-101.
5. Levin ME, Sicard GA, Baumann DS, et al. Does crossing the legs decrease arterial pressure in diabetic patients with peripheral vascular disease? Diabetes Care. 1993;16:1384-6.
6. Takishita S, Touma T, Kawazoe N, et al. Usefulness of leg-crossing for maintaining blood pressure in a sitting position in patients with orthostatic hypotension: case-reports. Angiology. 1991;42:421-5.
7. Koehler NR, Figueiredo CEP, Mendes-Ribeiro AC. Serial blood pressure measurements. Braz J Med Biol Res. 2002;35:555-9.
8. Lipsitz LA, Mietus J, Moody GB, et al. Spectral characteristics of heart rate variability before and during postural tilt: relations to aging and risk of syncope. Circulation. 1990;81:1803-10.
9. Hughson RL, Maillet A, Dureau G, et al. Spectral analysis of blood pressure variability in heart transplant patients. Hypertension. 1995;25:643-50.
10. Triedman JK, Saul JP. Blood pressure modulation by central venous pressure and respiration: buffering effects of the heart rate reflexes. Circulation. 1994;89:169-79.
11. Takalo R, Korhonen I, Turjanmaa V, et al. Short-term variability of blood pressure and heart rate in borderline and mildly hypertensive subjects. Hypertension. 1994;23: 18-24.
12. Veerman DP, Imholz BPM, Wieling W, et al. Effects of aging on blood pressure variability in resting conditions. Hypertension. 1994;24:120-30.
13. Van Groningen LFJ, Adyaman A, Elving L, et al. Which physiological mechanism is responsible for the increase in blood pressure during leg crossing? J Hypertens. 2008;26:433-7.
14. Peters GL, Binder SK, Campbell NRC. The effect of crossing legs on blood pressure: a randomized single-blind cross-over study. Blood Press Monit. 1999;4:97-101.
15. Macor F, Fagard R, Vanhaecke J, et al. Respiratory-related blood pressure variability in patients after heart transplantation. J Appl Physiol. 1994;76:1961-2.
16. Reeves RA, Shapiro AP, Thompson ME, et al. Loss of nocturnal decline in blood pressure after cardiac transplantation. Circulation. 1986;73:401-8.
17. Palatini P, Penzo M, Racioppa A, et al. Clinical relevance of nighttime blood pressure and of daytime blood pressure variability. Arch Intern Med. 1992;152:1855-60.
18. Parati G, Valentini M. Prognostic relevance of blood pressure variability . Hypertension. 2006;47:137-8.
19. Pickering TG. New ways of measuring blood pressure. Am J Hypertens. 2006;19:988-90.
20. Tatasciore A, Renda G, Zimarino M, et al. Awake systolic blood pressure variability correlates with target-organ damage in hypertensive patients. Hypertension. 2007;50: 325-32.
21. Plange N, Kaup M, Daneljan L, et al. 24 hour blood pressure monitoring in normal tension glaucoma: night-time blood pressure variability. J Human Hypertens. 2006;20: 137-42.
22. Ozawa M, Tamura K, Okano Y, et al. Identification of increased short-time blood pressure variability on ambulatory blood pressure monitoring as a coronary risk factor in diabetic hypertensives: clinical and experimental. Hypertension. 2009;31:3 259-70.
23. Mancia G, Grassi G. Mechanisms and clinical implications of blood pressure variability. J Cardiovasc Pharmacol. 2000;35(7 Suppl 4): s15-9.
24. Pierdomenico SD, Lapenna D, Bucci A, et al. Blood pressure variability and prognosis in uncomplicated mild hypertension. Am Heart J. 2005;149:934-8.