The effect of crossing legs on blood pressure in hypertensive patients

Rukiye Pinar, Siddika Ataalkin and Roger Watson

Aims. The aim of this study was to examine whether there is any difference between BP readings with patients crossing a leg at the knee level and uncrossing during BP measurement.

Background. It is clear that numerous factors influence an individual’s blood pressure (BP) measurement. However, guidelines for accurately measuring BP inconsistently specify that the patient should keep feet flat on the floor.

Design. Repeated measures.

Method. Using a mercury-filled column sphygmomanometer, BP was measured at uncrossed leg position, crossed leg position and again at uncrossed leg position in 283 unmedicated or medicated patients. Three experienced nurses specially trained for the study performed BP measurements.

Results. The results indicated that BP increased significantly with the crossed leg position. Systolic and diastolic BP significantly increased approximately 10 and 8 mmHg, respectively.

Conclusion. Crossing the leg at knee results in a significant increase in BP.

Relevance to clinical practice. Leg position during measurement of BP should be standardised and mentioned in publications.

Key words: blood pressure measurement, cardiovascular, crossed leg, hypertension, nurses, nursing

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Introduction

Reduction in blood pressure (BP) to optimal levels and control of hypertension remain major public health priorities (Mancia et al. 2007). Hypertension is a common reason for outpatient visits and is a common, powerful and independent risk factor for cardiovascular disease and stroke and end-stage kidney disease (Segura et al. 2004, Altun et al. 2005, Mancia et al. 2007). Accurate measurement of BP is crucial, therefore, when hypertension is suspected, with its lifelong consequences for treatment.

BP monitoring is influenced by many stimuli including faulty equipment, improper cuff length or width, white-coat effect, anxiety, caffeine consumption and smoking shortly before BP monitoring, talking, noise, extreme temperatures, and arm and body positions (Hellman & Grimm 1984, Lovallo et al. 2004, Eser et al. 2007). Crossing legs at the sitting position is another possible effect on BP measurement.

Although BP can be measured when participants are lying or standing, it is stated that BP should be measured while patients are seated in a chair with back supported and arms bared and supported at the heart level. Some guidelines on BP measurement (JNC VII, American Heart Association-AHA) contain recommendations on the position of the feet advising to keep both feet on the floor (Chobanian et al. 2003, Pickering et al. 2005), whereas other important guidelines (British Hypertension Association-BHA; European Society of Hypertension-ESH), surprisingly, do not mention leg position (European Society of Hypertension 2003, Williams et al. 2004). However, guidelines for the measurement of BP are not consistent in recommending that patient’s legs should not be crossed during measurement, but in daily practice, we frequently see that patients spontaneously cross their legs at

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the knee, as it seems a comfortable position. The present study aimed to determine whether the leg crossed at the knee compared with feet flat on the floor affects BP measurement in a Turkish hypertensive sample.

Background

There have been only seven publications investigating the effect of crossing leg on BP. Six of them showed a BP rise when crossing the legs; however, a broad range of BP rise was present. Foster-Fitzpatrick et al. (1999) demonstrated a significant increase in BP taken with the leg crossed at the knee in 100 men with hypertension. In a study by Peters et al. (1999), crossing legs during BP measurement significantly increased systolic BP (SBP) and diastolic BP (DBP) in patients who had hypertension. In healthy volunteers, SBP and DBP increased at legs crossed position, but the effect was non-significant on DBP. In the same study, it was concluded that the cardiovascular risk class increased for many patients with hypertension but less for participants with normotension. Keele-Smith and Price-Daniel (2001) indicated that BP was significantly higher when legs were crossed vs. uncrossed among 110 participants in a senior population. In a previous study (Pinar et al. 2004), we showed that crossing legs on knee level increased BP readings in 238 untreated patients with hypertension. In another study, involving 111 patients (49 with hypertension), Adiyaman et al. (2007) found significant increases in BP readings at legs crossed position at knee level. Finally, a study conducted by Van Groningen et al. (2008), involving 102 participants (49 with hypertension, 24 of them treated for hypertension), was published while our study was in progress. In their study, BP was measured using a Finometer; they found increases in BP readings at legs crossed at knee level. In contrast to these studies, Avvampato (2001) showed no statistically significant difference in BP readings of participants with one leg crossed over the other vs. both feet flat on the floor.

Methods

Participants

The study was conducted at the outpatient hypertension clinic at a university hospital in Istanbul, between July 2005 and February 2006. Ethical approval was obtained from the local ethical committee according to the Helsinki Declaration. Eligible participants (1) had to be over 18 years of age and (2) should have diagnosed hypertension. We excluded patients who had a history of peripheral vascular disease, lower extremities surgery or amputation or any condition that would interfere with lower extremity positioning. We also excluded patients who were pregnant, who had arrhythmias, who had smoked or consumed caffeine 30–60 minutes before BP measurement. There were no restrictions with regard to medication. Two hundred and eighty-three participants met the eligibility criteria. Demographic data were obtained using a questionnaire. Prior to the study, informed written consent was obtained from all participants.

Table 1 shows the characteristics of the study population. The sample (n = 283) ranged in age from 30–85 years (mean = 58 ± 1 years, SD 11.8 years) with more women (n = 162, 57.2%) than men. Mean duration of diagnosed hypertension was 7.3 years (SD 6.6 years, mode = 3, median = 5). Most of the patients had coexisting disease (n = 162, 57.2%), among them, principally, diabetes (n = 78, 48.1%).

<table>
<thead>
<tr>
<th>Age, mean years (SD) (range)</th>
<th>58.1 (11.7) (30–85)</th>
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</thead>
<tbody>
<tr>
<td>Gender (% female)</td>
<td>57.2%</td>
</tr>
<tr>
<td>BMI, mean kg (SD) (range)</td>
<td>27.2 (4-4) (17.4–41-0)</td>
</tr>
<tr>
<td>Normal weight</td>
<td>86 (30-4)</td>
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<tr>
<td>Overweight</td>
<td>137 (48-4)</td>
</tr>
<tr>
<td>Obese</td>
<td>34 (12-0)</td>
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<tr>
<td>Morbid Obese</td>
<td>26 (9-2)</td>
</tr>
<tr>
<td>Diagnosed for hypertension, mean yrs (SD) (range)</td>
<td>7.3 (6-6) (1–34)</td>
</tr>
<tr>
<td>Comorbid disease (% present)</td>
<td>57.2%</td>
</tr>
<tr>
<td>Diabetes (% present)</td>
<td>48.1%</td>
</tr>
</tbody>
</table>

Measurement of blood pressure

A mercury-filled column sphygmomanometer was used to measure BP. We had excellent information about sources of variance and this device is commonly recommended by hypertension guidelines as the gold standard with an accuracy of ± 2 mmHg (Turkish Cardiology Association & Hypertension Working Group 2000, Pickering et al. 2005). The BP monitor is equipped with a normal adult size cuff (16 × 30 cm) and large adult size cuff (16 × 36 cm) (Pickering et al. 2005). The appropriate cuff size was determined from the mid-arm circumference of the participant.

The participants were encouraged to empty their bladder prior to taking BP readings. Potential confounding factors include talking (Hellman & Grimm 1984) and body arm position (Adiyaman et al. 2006, Eser et al. 2007); therefore, participants were asked to sit upright with their elbows on a table and feet flat on the ground with back supported. They were asked not to talk or move during the procedure.

A first reading (simultaneously with two sphygmomanometric devices at both arms) was taken, to assess left to right arm BP differences. If this difference was more than 10 mmHg, the patient was excluded.
Physical stress involving active physical activity (dynamic or static exercise) increases BP (Fagard et al. 1996, Clement et al. 2003), therefore, we conducted all measurements, with a resting time of five minutes at the beginning on the right arm. After the rest period, two measurements were performed in the uncrossed leg position. Subsequently, the legs were crossed at the knee (popliteal fossa of one leg over the suprapatellar bursa of the other). After three minutes in this position, BP was measured twice. Finally, the uncrossed position was taken and the last two measurements were taken after three minutes of rest.

The three nurses who performed BP measurements were unaware of the purpose of the research and were experienced and specially trained for the study. One nurse conducted the first two BP readings at the uncrossed leg, the second conducted two readings at the crossed leg and the third conducted two readings over the uncrossed leg again. The three nurses took two readings each and a total of six readings were taken from each participant. After all measurements were taken, the nurses recorded BP readings as mean (for two measurements) on separate sheets.

Statistical analysis

Data were coded to the information form and transferred to computer by independent staff. Data analysis was run on SPSS, version 15.0 (SPSS Inc., Chicago, IL, USA) by a statistician. A one-way repeated measures ANOVA was conducted to compare the scores on the BP with statistics test at DBP were approximately 10 and 8 mmHg, respectively. This study clearly shows that crossing the legs at knee level significantly increased BP in patients with hypertension.

<table>
<thead>
<tr>
<th>Table 2 Effect of crossed leg on blood pressure</th>
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</thead>
<tbody>
<tr>
<td>Blood pressure, mmHg, mean (SD)</td>
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<tr>
<td>Systolic BP</td>
</tr>
<tr>
<td>Uncrossed leg position</td>
</tr>
<tr>
<td>Crossed leg position</td>
</tr>
<tr>
<td>Uncrossed leg position</td>
</tr>
</tbody>
</table>

The differences found are relevant both from an epidemiological and from a clinical point of view, as can be seen from the large amount of misclassifications in the study population.

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## Results

The BP results as means and standard deviations are presented in Table 2. There was a significant effect of leg position on SBP, Wilks’s Lambda = 0.46, F (2, 28) = 165.03, p < 0.001, multivariate $\eta^2$ = 0.54. There was also a significant effect of leg position on DBP, Wilks’s Lambda = 0.26, F (2, 28) = 402.75, p < 0.001, multivariate $\eta^2$=0.74. Both SBP and DBP increased at leg crossed position. From leg uncrossed position to leg crossed position, mean increases in SBP and DBP were approximately 10 and 8 mmHg, respectively.

## Discussion

This study clearly shows that crossing the legs at knee level significantly increased BP in patients with hypertension.
Relevance to clinical practice

The BP differences in the current study could have important consequences in daily practice, as it can result in an incorrect diagnosis of hypertension, especially in those subjects with BP values within the range known as high normotensive (130–139 and 85–89 mmHg respectively for the systolic and diastolic BP). The importance of these findings for clinical practice can be better appreciated if one considers that initiation and modification of antihypertensive therapy are based on BP levels in categories of 5–10 mmHg. It has been suggested that underestimation of BP by 5 mmHg could result in almost two-thirds of individuals with hypertension being denied treatment. On the other hand, overestimation may involve unnecessary drug treatment and the labelling of a person for life as hypertensive, with its attendant socio-economic and health implications (Campbell & McKay 1999). Furthermore, changes in BP as low as 10 mmHg can consistently modify the risk of cerebral and cardiovascular complications of hypertension (Mancia et al. 2007).

Although guidelines for BP measurement are not consistent in recommending that a patient’s legs should not be crossed during measurement, instructing patients to keep feet flat on the floor during BP measurement is an important nursing intervention that can contribute to accurate measurements, interpretation and treatment of high BP.

The nurses were unaware of the purpose of this research, but the statistician was blinded to which set of data (uncrossed leg or crossed leg) was being analysed. The study was not randomised in terms of BP assessments in the uncrossed leg and crossed leg and the nurses who performed the BP measurements were not blinded. These may be considered to be limitations that would be worth addressing in a future study.

Acknowledgements

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Contributions

Study design: RP; data collection and analysis: RP and SA and manuscript preparation: RP, SA and RW.

Conflict of interests

The authors declare that they have no conflict of interests.

References


