Blood pressure response to close or loose contact between physician and patient during attended office blood pressure measurement

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\textbf{ABSTRACT}

\textbf{Purpose}: Compared to unattended office blood pressure (uOBP), attended office blood pressure (aOBP) is higher. It is not known, however, to what extent distance between physician and patient influences blood pressure (BP) values.

\textbf{Materials and methods}: Participants were stable hypertensive patients, followed in the university hospital-based out-patient center. During a session, automated office BP was measured three times after a pre-set five-minute pause, using the Omron 907 device; both aOBP and uOBP were done, in a random order. Simultaneously, beat-to-beat BP measurement was performed using the Finapress device. During aOBP, some participants were in close contact with the physician while others were in loose contact where the doctor was sitting in the room about 2.5 m apart. One year later, the second session with the same protocol was organized, but the close and loose contact were interchanged. The data were analyzed using a paired t-test.

\textbf{Results}: Complete data were collected in 32 patients, baseline uOBP was 122.8 ± 14.8/69.5 ± 11.7 mmHg. Systolic and diastolic aOBP with close contact was higher by 4.6 ± 6.9 and 1.9 ± 3.4 mmHg (\(p < 0.0007\) and 0.0039, respectively), while aOBP with loose contact was not different from uOBP. Beat-to-beat BP increased during aOBP by 6.5 ± 8.5/3.3 ± 4.8 mmHg. The increase persisted during all the three aOBP measurements (\(p < 0.0001\) for all systolic and diastolic BP values); the results were similar for close and loose contact. The peak increase during uOBP was of similar magnitude as during aOBP but it lasted shorter: it reached the significance level of \(p < 0.0001\) only during the first uOBP measurement.

\textbf{Conclusions}: Compared to uOBP, aOBP values were higher with close, but not with loose contact between physician and patient. These differences were, however, not detected by beat-to-beat BP measurement.

\textbf{Introduction}

Automated office blood pressure (BP) measurement which enables to measure BP with patient left alone in the room has been developed during the last 15–20 years [1]. SPRINT has been the first and so far the only large randomized prospective trial where unattended office BP (uOBP) measurement was used [2]. Its results provoked much discussion, mainly about the interpretation of the data and their implementation to clinical practice. When the SPRINT data were matched with previous trials according to ambulatory BP monitoring, the office BP values in SPRINT were much lower [3]. Unattended and attended office blood pressure (aOBP) measurements were compared in numerous studies; while some showed a very large difference – up to 16/8 mmHg [4] – other ones found practically identical values [5].

Strictly taken, uOBP should be done in a separate room, free from noise and with no one passing through. It is difficult to find such space in many clinical centers, and in real-world clinical practice automated BP is often measured with staff member(s) present in the room, who are, however, often busy doing other things and are not concentrated to the

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BP measurement. In our study, we aimed to evaluate office BP measurements in two situations: (1) the physician is sitting close to the patient, similarly as during BP measurement with auscultatory method and (2) the physician is only present in the room, at a distance more than two meters from the patient. These measurements were compared to uOBP.

Methods

Study participants

Subjects were recruited from out-patient hypertensive center of the Faculty Hospital in Pilsen. The inclusion criteria were age between 40 and 80 years, medically treated hypertension with no change of treatment within the last six months, hemodynamic stability and absence of any severe illness including symptomatic heart failure. Of 40 patients examined at baseline (March 2019), five were not able to attend the second examination (March 2020), and we had to exclude other three patients because we were not able to measure BP by beat-to-beat method. Data on 32 patients who had complete data on both examinations were analyzed.

Study procedures

The study was approved by the Ethics Committee of the Charles University Medical Faculty and Teaching Hospital, and all participants signed informed consent. The sessions were performed in the morning, in a fasting state in a quiet room, with temperature of approximately 22–23 °C (see Figure 1 for schedule). ECG was registered, blood sample was taken, body weight and height were measured, and a standard questionnaire was administered to obtain information on medical history including drug treatment. The postgraduate student in casual clothing (VK) was responsible for the preparations; she gave a detailed information about the study procedures and instructed patient to sit quietly during BP measurements, not to talk, not to use mobile phone, to sit with back supported, not to cross legs and to have feet resting on the floor. BP was then measured simultaneously on both arms using Watch BP tonometer (Microlife AG Swiss Corporation, Widnau, Switzerland) to exclude a possible inter-arm difference. For office BP measurements, the Omron 907 device was used. Simultaneously, beat-to-beat BP was measured with a finger photoplethysmographic device (Finapress Medical Systems BV, Enschede, The Netherlands); it was shown to provide accurate estimate of means and variability of intra-arterial radial BP [6]. The Finapress device was sent to the producer for a regular check-up before the study. The Finapress arm cuff and finger cuffs were placed on the left arm and left mid or ring fingers; the device was then calibrated. The Omron arm cuff was placed on the right arm. Then, the student marked the start on the Finapress and left the room.

During the BP measurements, the patient was sitting with both forearms on the table (Figure 2). Office BP was measured with oscillometric method three times after the pre-set five-minute pause with one-minute intervals. During each session, both aOBP and uOBP were measured. For aOBP, the physician in a white coat (JS, JF), other than the one who follows patient regularly, entered the examination room 3 to 4 min after the start of the rest. For uOBP, the patient stayed alone during a five-minute resting period and BP measurement. There were two types of aOBP – (1) with close contact: in order to have standardized distance from the patient, the physician placed the stethoscope to the cubital fossa as if he measured BP with auscultatory method and (2) with loose contact where the doctor was sitting in the room, about 2.5 m apart, and worked on the computer (Figure 2). In both aOBP types, the physician first came close to the patient, greeted him and introduced himself, but he did not talk to the participant anymore. The order of measurement (attended vs. unattended) was randomized. The session was planned for 90 min, because mainly the preparation and calibration of Finapress measurements lasted long. Its length was the reason why we planned the second session one year later in order to have

![Figure 1. Schedule of a study session. See text for details.](image-url)
complete data in all the subjects. During the second session, the type of contact and the order of measurement were reversed, i.e. altogether, each participant had one aOBP measurement with close contact, another one with loose contact and two uOBP measurements.

For each set of BP measurements, five 20-second recordings of beat-to-beat BP were used for analysis. They were defined as follows:

- **Start**: the recording started after the student had marked on the Finapress that the procedure was prepared and left the examination room.
- During 1st OBP measurement: five minutes after the start had been marked on the Finapress.
- During 2nd OBP measurement: 80 seconds after the end of 20-second recording of the first measurement.
- During 3rd OBP measurement: 80 seconds after the end of 20-second recording of the second measurement.
- **Recovery period**: 5 min after the 3rd Omron measurement.

**Statistical analysis**

SAS 9.4 software (SAS Inc., Cary, NC) was used for analysis. Paired Student’s t-test was used for comparison between different measurements.

**Results**

Basic characteristics of the sample is shown in Table 1. Most of the patients (84%) took at least two antihypertensive drugs, 67% were on hypolipidemic therapy and 41% had diabetes mellitus. Table 2 shows average office BP values measured using Omron device according to the presence or absence of the physician. The mean difference between aOBP and uOBP was 3.6 ± 7.2 mmHg (p = 0.0002) and 1.9 ± 3.4 mmHg (p = 0.0011) for systolic and diastolic BP, respectively, when all measurements were taken into account. However, when we analyzed separately aOBP with close and with loose contact, only aOBP with close contact was significantly higher in comparison with uOBP values: the differences were 4.6 ± 6.9 mmHg (p = 0.0007) and 1.9 ± 3.4 mmHg (p = 0.0039) for systolic and diastolic BP, respectively. The order of measurements played a role: the difference between aOBP and uOBP was significantly higher when aOBP was performed first. Systolic, but not diastolic aOBP was significantly higher in both years. Figure 3 shows the analysis of beat-to-beat BP with all the measurements included. BP increased during aOBP by up to 6.5 ± 8.5/3.3 ± 4.8 mmHg (corresponding to the 2nd aOBP measurement, p < 0.0001), as compared to baseline BP values (‘start’) measured before the physician entered the office. The increase persisted during all the three aOBP measurements (p < 0.0001 for all systolic and diastolic BP values). The peak increase during uOBP was of similar magnitude as during
from each other three $aOBP$ values were not significantly different obtained by beat-to-beat measurements (Figure 3): the BP measurements. They correspond to the BP curves $<p$lasted shorter: it reached the significance level of $p$0.0001 only during the first $uOBP$ measurement. Supplemental Table 1 shows the values of three office BP measurements. They correspond to the BP curves obtained by beat-to-beat measurements (Figure 3): the three $aOBP$ values were not significantly different from each other – this agrees with the plateau of increased BP values shown in Figure 3 – while during $uOBP$, the office BP slightly dropped and the third office BP measurement was significantly lower than the first one ($p$0.0032 and 0.045 for systolic and diastolic BP, respectively).

Supplemental Figures 1–3 show changes in beat-to-beat BP according to the type of contact, order of measurement and study visit. They have similar patterns as shown in Figure 3.

## Discussion

To our knowledge, this is the first study designed to investigate the impact of close or loose physician – patient contact during office BP measurement. We found that close contact, compared to $uOBP$, resulted in significant BP increase, while with loose contact, the BP values were only slightly higher and they did not reach statistically significant difference from $uOBP$ in our relatively small sample. The office BP changes during different BP measurements were rather small. This was due to several factors: our probands were stable well controlled hypertensive patients, familiar with the staff and premises, followed usually for a long time. The session with $uOBP$ and $aOBP$ measurement was long and this could have diminished the alarm reaction. During $aOBP$ of both types, there was no talking after the formal greeting and no noise, e.g. phone ringing; these conditions, difficult to keep in clinical practice, could also contribute to the small BP reaction.

The strong sides of our work, however, lie in the careful adherence to the study protocol, homogeneity of the study group and random assignment to the type of contact and order of measurement.

In our study, we used the same device and protocol of BP measurement as in SPRINT; this trial is still in the center of debate about $uOBP$ and $aOBP$. While the 2017 US guidelines for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults changed the definition of hypertension mainly based on the SPRINT results [7], the ESC/ESH guidelines remained more reserved [8]. The reason is that prognostic data based on $uOBP$ are very preliminary [9] and there are no data comparing the prediction of cardiovascular morbidity/mortality by $uOBP$ and classic office BP measurements. After the SPRINT trial had been finished, questionnaires about how BP was measured were sent to the participating centers. The results were heterogeneous across centers [10] and it seems that health care personnel was often present, either during the five-minute pause before the first measurement or during the measurements. In accordance with our results, automated office BP can probably give lower values even in the presence of staff members when the contact is not close.

Beat-to-beat systolic BP increased similarly during $aOBP$ in our study, with no difference between the type of contact, and during $uOBP$ as well (by about 6 mmHg). The only difference against $uOBP$ was that the increase during $aOBP$ lasted longer. Using the

### Table 2. Differences between attended and unattended office blood pressure.

| Attended BP, mmHg | Unattended BP, mmHg | $\Delta$ | 95%CI of the difference | $p$ |
|-------------------|---------------------|---------|-------------------------|-----|
| Systolic BP       | 126.6 ± 15.9        | 123.0 ± 15.0 | 3.6 ± 7.2 | 1.8–5.4 | 0.0002 |
| Diastolic BP      | 70.7 ± 11.5         | 69.3 ± 11.4 | 1.4 ± 3.4 | 0.6–2.3 | 0.0011 |
| Contact           |                     |          |                        |       |
| Systolic BP       | Close               | 127.6 ± 16.6 | 123.0 ± 16.1 | 4.6 ± 6.9 | 2.1–7.1 | 0.0007 |
|                   | Loose               | 125.6 ± 15.2 | 123.0 ± 14.0 | 2.6 ± 7.4 | –0.1–5.2 | 0.059 |
| Diastolic BP      | Close               | 71.0 ± 12.4 | 69.1 ± 11.9 | 1.9 ± 3.4 | 0.6–3.1 | 0.0039 |
|                   | Loose               | 70.5 ± 10.7 | 69.5 ± 11.2 | 1.0 ± 3.3 | –0.2–2.2 | 0.10 |
| Order of measurements |                   |          |                        |       |
| Systolic BP       | First attended      | 128.5 ± 15.8 | 123.7 ± 15.0 | 4.8 ± 7.7 | 2.0–7.6 | 0.0014 |
|                   | First untreated     | 124.7 ± 15.9 | 122.3 ± 15.1 | 2.4 ± 6.5 | 0.1–4.7 | 0.044 |
| Diastolic BP      | First attended      | 71.8 ± 11.5 | 70.0 ± 12.1 | 1.8 ± 3.3 | 0.6–3.0 | 0.0039 |
|                   | First untreated     | 69.7 ± 11.6 | 68.7 ± 10.9 | 1.0 ± 3.4 | –0.2–2.2 | 0.095 |
| Year of examination |                   |          |                        |       |
| Systolic BP       | First year          | 128.2 ± 15.1 | 122.8 ± 14.8 | 5.4 ± 7.6 | 2.6–8.1 | 0.0004 |
|                   | Second year         | 125.1 ± 16.6 | 123.3 ± 15.4 | 2.3 ± 2.9 | 1.2–3.3 | 0.0001 |
| Diastolic BP      | First year          | 71.7 ± 11.6 | 69.5 ± 11.7 | 2.3 ± 2.9 | –0.5–4.1 | 0.11 |
|                   | Second year         | 69.8 ± 11.5 | 69.2 ± 11.3 | 0.6 ± 3.6 | –0.7–1.9 | 0.35 |

Means ± SD are given; they are based on average of three OBP measurements in each individual. $p$ Values for the difference between attended and unattended BP were calculated using paired $t$-test.
same method, a higher increase during aOBP – by 12 mmHg – was observed by Saladini et al. [11], but this study was done in untreated hypertensive subjects. Our results are different from the findings of a recently published study performed in 18 subjects, where the authors showed that beat-to-beat peak systolic BP was 14 mmHg lower during uOBP compared to aOBP [12]. The subjects were, however, newly diagnosed untreated subjects and their mean office BP was 153/102 mmHg while in our group, it was 123/70 mmHg. BP level is known to be a crucial factor determining the BP increase during stress.

In conclusion, despite a relatively small number of subjects and moderate BP changes, we proved that physician’s close proximity to the patient increased office BP; this was not the case when the physician was only present in the room and left the patient undisturbed. This aspect of office BP measurement merits further attention.

Disclosure statement
The authors report no conflict of interest.

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