Comparison of Three Methods in Determining the Change in the Treatment of Hypertension in Family Medicine

Aile Hekimliğinde Hipertansiyon Tedavisinde Değişiklik Kararı Vermede Üç Yöntemin Karşılaştırılması

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ABSTRACT

Objective: This study aims to compare 24 hour-Ambulatory Blood Pressure Monitorization and Home Blood Pressure Monitorization (HBPM) and Office Blood Pressure Monitorization (OBPM) of hypertension patients whose BP was thought to be not under control despite appropriate medication and to decide the method that could be used in family medicine practice.
Method: Fifty patients whose BP values measured in office setting whose blood pressures were not under control despite antihypertensive treatment Each patient was assessed with at least 3 OBPMs, 7 day-monitorization of BP measurements at home (HBPM) and ambulatory blood pressure monitorization (ABPM) for 24 hours.
Results: A moderately positive correlation was detected between ABPM, OBPM and weekly HBPM.
Conclusion: The results of this study have shown that ABPM which is a gold standard is in good agreement with BPMH, but weakly compatible with OBPM Therefore, in hypertension patients with higher BP measurements detected in office, priorly ambulatory blood pressure measurements should be performed, if not possible, blood pressures should be monitored for at least 3-4 days at home.

Keywords: Hypertension, ambulatory blood pressure, office blood pressure, home blood pressure

ÖZ

Amaç: Bu çalışmanın amacı, tansiyon ilacı kullanmasına rağmen ofis ölçümlerine göre kan basınçları kontrol altında olmadığı düşünülen hipertansiyon hastalarında, 24 saatlik ambulatuar kan basıncı monitorizasyonu ile ofis ve evde tansiyon ölçümlerini karşılaştırmak ve aile hekimliğinde kullanılabilecek yönteme karar vermektir
Yöntem: Çalışmaya antihipertansif tedavi almakta olan ve ofis ölçümlerinde kan basınçları kontrol altında olmayan 50 hasta alındı. Tüm hastalara üç ofis kan basıncı ölçümü, yedi günlük evde kan basıncı takibi ve 24 saatlik ambulatuar kan basıncı monitorizasyonu ölçümü uygulandı.
Bulgular: Ambulatuar kan basıncı monitorizasyonu ile ofis kan basıncı ölçümü ve evde haftalık kan basıncı takipleri arasında genel olarak pozitif yönde ve orta kuvvette bir ilişki saptandı.
Sonuç: Bu çalışmanın sonuçları, altın standart olan ambulatuar kan basıncı ölçümü ile evde yapılan kan basıncı ölçümünün uyumlu olduğu, ofis ölçümlerinin ise zayıf uyumlu olduğunu gösterdi. Bu sebeple ofis kan basıncı ölçümleri yüksek tespit edilen hipertansiyon hastalarında, öncelikli olarak ambulatuar kan basıncı ile ölçüm yapılmalı, ambulatuar kan basıncı takibi yapılmıyor ise evde en az 3-4 günlük kan basıncı takibi yapılmalıdır.

Anahtar kelimeler: Hipertansiyon, ambulatuar kan basıncı, ofis kan basıncı, evde kan basıncı

INTRODUCTION

Hypertension (HT) is a very important disease with increasing frequency both in the world and in our country and threatens public health due to its complications. HT accounts for 13% of deaths worldwide, and it is estimated that around one billion people worldwide are affected by HT [1].

According to World Health Organization (WHO) data, the prevalence of HT is very high and it is the first cause of preventable deaths in the world [2]. The control rate of HT was found to be 28.7% in hypertensive individuals and 53.9% in patients under treatment [3].

In addition to the low awareness of the disease, inadequate and ineffective treatment of the disease plays a role in the inability to effectively control BP in patients .

The first step in the treatment of HT is the correct diagnosis. This is achieved by providing the necessary equipment and environmental conditions for detecting BP and making measurements using the right technique.

False positive or false negative results may be obtained due to various errors in BP measurements. As a result of incorrect measurements, diagnosis and treatment are delayed in some hypertensive individuals, while some individuals undergo unnecessarily lifelong treatment even though they are not really ill. Finally, erroneous measurement causes serious increase in financial burden [4].

Today, although ambulatory blood pressure measurement (ABPM) is the gold standard for the detection of hypertension, hypertension is also diagnosed, and followed up with home blood pressure measurements (HBPMs) and office blood pressure measurements (OBPMs)

In our study we aimed to detect, whether there is a difference between ambulatory, home, and office blood pressure measurements in patients followed up with the diagnosis of HT, which is an important public health problem in our country and in the world, and determine the methods that should be preferred in the first step when deciding a change in the treatment.

BATERIALS and METHODS

This study was conducted in Erciyes University Department of Family Medicine policlinics between 01 February 2017 and 1 August 2017 with patients diagnosed with primary HT who were using one or more than five main classes (diuretic, calcium channel blocker, ACE inhibitor, angiotensin receptor blocker) of hypertension treatment within the last three months and had blood pressure values greater than systolic ≥140 mmHg, diastolic ≥90 mmHg in the office measurements despite antihypertensive treatment and agreed to participate were included in the study. Patients who were older than 18 years of age and who could wear a holter device were included in the study regardless of gender.

Arterial BP measurements of the patients in the office were carried out in an environment free of noise and temperature in accordance with the correct measurement rules. Patients were informed about avoiding exercise and not eating and drinking caffeinated drinks such as coffee, tea, cola, and smoking cigarettes half an hour before BP measurement and if needed they were waited 30 minutes for measurement.

During the measurement, the blood pressure was measured by paying attention that the patient's relaxed arm at the level of the heart was not squeezed, while he/she was sitting silently for at least 5 minutes on his back resting on the back of the chair without crossing legs. Tel-O-Graph®BT brand (manufacturer; IEMIndustrielle Entwicklung Medizintechnik

und Vertriebsgesellschaft mbH Cockerillstrabe 69, 52222, Stolberg, Germany, 2015) with high measurement quality (approved according to BHS (A/A classification) and ESH), easy to use for each patient for measurement and use in the clinic done with sphingomanometer. Simultaneous BP measurements were performed on both arms in the office measurements. Three consecutive measurements were taken from the arm with a high BP at 1-2 minute intervals. The average of the three measurements was calculated and recorded in the patient's file.

The measuring devices given to patients for home measurements were the same as those for office measurements. Patients were told how to measure BP. The patients were instructed to take measurements twice a day, 12 hours apart, in the morning and evening for 7 days.

Twenty-four-hour blood pressure monitoring was performed with Mobil-O-Graph NG (I.E.M. Stolberg Germany) using ambulatory blood pressure devices. An appropriate size cuff was used for each patient. The device was programmed to perform BP measurements at 15 minute intervals when patients are awake and 30 minutes when they are asleep. In order for the measurements to be meaningful, it was ensured that the device made at least 70% accurate measurements. Five patients were excluded from the study because more than 70% measurements were erroneous.

In the evaluation of the data; Data obtained from 50 participants were transferred to SPSS for Windows 22 (Statistical Package for Social Sciences) packet programe.

We used Bland-Altman graphics also known as the study of method comparison and passing-bablok regression analyses. Data distribution were checked with histogram, q-q graphics and Shapiro-Wilk test. In comparison of groups and for repetitive measurements we used 2-sample dependent t-test and vari-

ance analysis, respectively. Multiple comparisons are made with Bonferroni method. Comparison between methods of measurement was made with Passing-Bablok regression analyses and we created Bland-Altman graphics. In case of model constant obtained with Passing-Bablok regression analyses not containing "0" and of regression coefficient not containing "1"; respectively a sytematic and propartional error was determined. At the same time for assesing agreement between methods, we calculated Kappa coefficient with also intraclass and concordance correlation coefficients. Agreement between methods was accepted at a high level if coefficients are higher than %81, as medium if between %41 and %61, as weak agreement if between %21 and %40 and as very weak if lower than %20. Data were analyzed with R 3.2.0 (www.r-project.org). Values of $p < 0.05$ were considered significant

RESULTS

The study was conducted between February 2017-July 2017 with 50 patients over 18 years of age. Twenty-nine (58%) participants were female and 21 (42%) were male. The mean age of all patients was 57±10.54 years (minimum, 31 and maximum, 76 years).

The study participants consisted of faculty members (n=2; 4%), housewives (n=28; 56%), civil servants (n=4; 8%) other professionals (n=16; 32%), married (n=46; 92%) and single (n=4; 8%).

Only 5 participants were cigarette smokers and the rest were nonsmokers. 16 participants had a comorbid disease other than EH and 32 paticipants had not any comorbid chronic disease.

BMI of one (%2) participant was 25,53 kg/m². Body mass indexes were between 25-30 kg/m² in 25 (50%), and between 30-40 kg/m² in 23 (46%) and BMI was 41 kg/m² in 1 (2%) iparticipant.

Mean SBP and DBP values were found respectively; in ABPM 129.92±14.87a mmHg and 80.40±11.01a mmHg, in HBPM 137.42±14.02b mmHg and 96.38±13.11b mmHg, in OBPM 158.21±17.81c mmHg and 83.28±9.40c mmHg. Mean SBP and DBP values between three methods were significantly different. Mean SBP values measured at day time were 131.82±14.86 mmHg in ABPM and 137.85±14.69 mmHg in HBPM; and the diffrence between two mean values were significant. Mean DBP values measured at day time were found 81.92±11.20 mmHg in ABPM and 83.59±9.91 mmHg in HBPM; and the diffrence between two mean values were insignificant. Mean SBP values measured at night were 122.10±16.45 mmHg in ABPM and 137.28±14.37 mmHg in HBPM; and the diffrence between two

mean values were significant. Mean DBP values measured at night were 74.46±11.02 mmHg in ABPM and 82.97±9.90 mmHg in HBPM; and the diffrence between two mean values were significant Table 1.

Table 1. Comparison of the mean of systolic and diastolic blood pressure measurements between ambulatory, home and office methods.

Variable	Ambulatory (n=50)	Home (n=50)	Office (n=50)	p
Total				
SBP	129.92±14.87[a]	137.42±14.02[b]	158.21±17.81[c]	<0.001
DBP	80.40±11.01[a]	96.38±13.11[b]	83.28±9.40[c]	<0.001
Day				
SBP	131.82±14.86	137.85±14.69	-	<0.001
DBP	81.92±11.20	83.59±9.91	-	0.115
Night				
SBP	122.10±16.45	137.28±14.37	-	<0.001
DBP	74.46±11.02	82.97±9.90	-	<0.001

SBP: Systolic Blood Plessure, DBP: Diastolic Blood Plessure. Data were expressed as mean ± standard deviation. The different letters on the same line represent the mean difference between the methods.
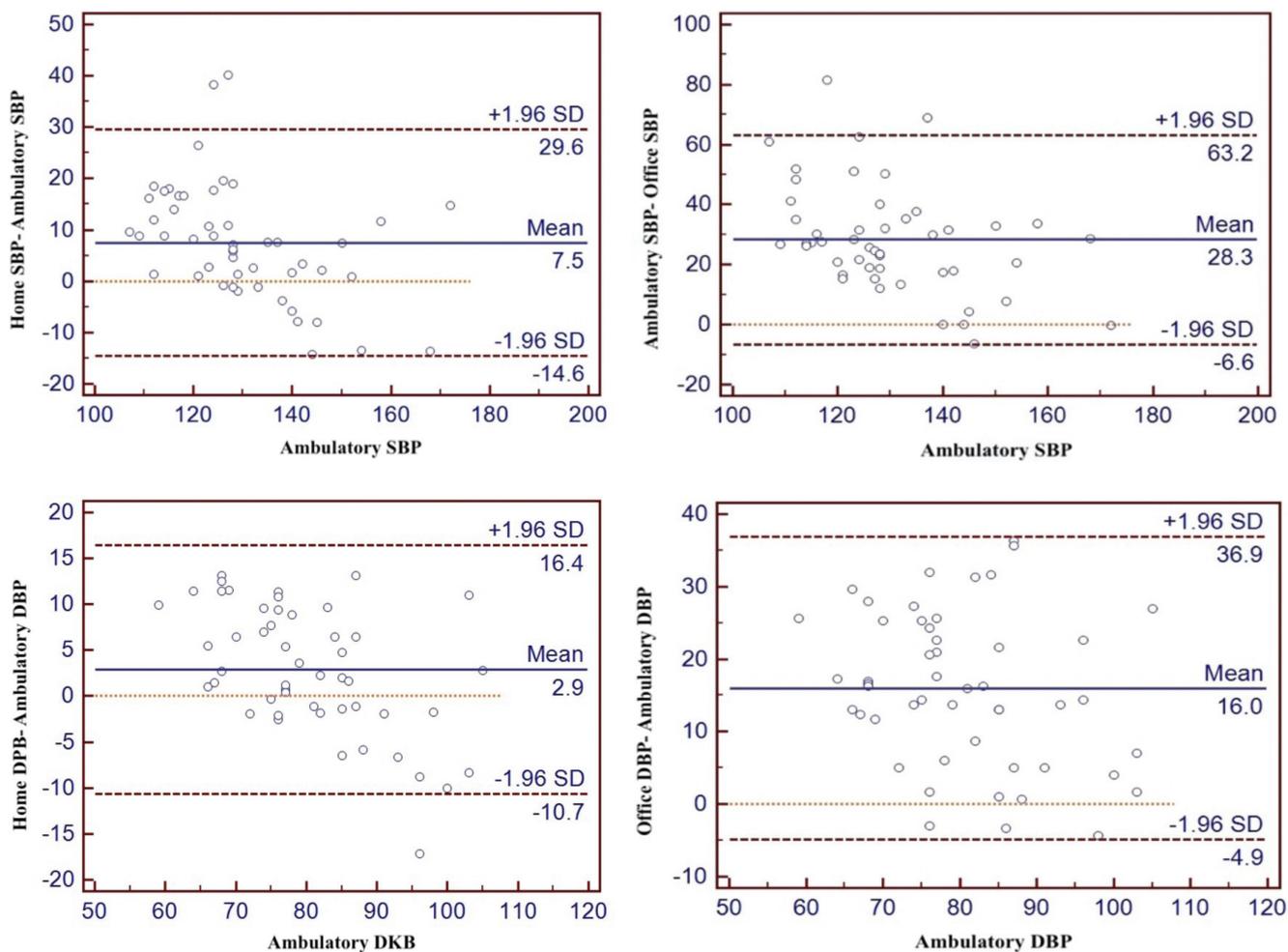

Figure 1. Bland-Altman graphics, comparison and assessement of agreement between ABPM, BPMH and BPMO methods in regard of SBP and DBP.

Table 2. Comparison of systolic and diastolic blood pressure measurements with ambulatory method at home and office measurement methods and compliance analysis.

Group	Home - Ambulatory					Office-Ambulatory				
	Passing-Bablok Regression		Aggreement Statistics			Passing-Bablok Regression		Agreement Statistics		
	Constant	Regression Coefficient	İCC	CCC	κ	Constant	Regression coefficient	İCC	CCC	κ
SBP Total										
Coefficient	29.14	0.82	0.76	0.61	0.43	-1.06	1.22	0.28	0.16	0.01
%95 Cİ	(-2.14/56.72)	(0.61/1.07)	(0.42/0.89)	(0.43/0.74)	(0.17/0.70)	(-77.93/44.52)	(0.85/1.81)	(-0.19/0.61)	(0.05/0.27)	(-0.09/0.10)
İnterpretation	No Constant Error	No Proportional Error	Good Agreement	Moderate Agreement	Moderate Agreement	No Constant Error	No Proportional Error	Weak Agreement	Weak Agreement	Very Weak Agreement
DBP Total										
Coefficient	18.87	0.80	0.85	0.74	0.46	-3.88	1.25	0.49	0.32	0.21
%95 Cİ	(1.77/31.95)	(0.64/1.01)	(0.72/0.92)	(0.60/0.84)	(0.14/0.78)	(-43.12/22.33)	(0.92/1.77)	(-023/0.79)	(0.18/0.45)	(0.06/0.34)
İnterpretation	Constant Error is Present	No Proportional Error	Very Good Agreement	Good Agreement	Moderate Agreement	No Constant Error	No Proportional Error	Moderate Agreement	Weak Agrement	Weak Agreement

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, ICC: Intra-class correlation coefficient, CCC: concordance correlation coefficient, κ: Kappa coefficient, CI: Confidence interval. Confidence intervals were expressed as 95% confidence level (lower limit / upper limit). Comments Passing-Bablok regression analysis for the presence of systematic or proportional error, the compliance of the strength of compliance statistics (0-0.20: very weak, 0.21-0.40: weak, 0.41-0.60: moderate, 0.61-0.80: good, 0.81-1.00: very good).

Bland-Altman graphics and Passing-Bablok regression analyses we used in comparison and assessement of agreement between ABPM, HBPM and OBPM methods in regard of SBP and DBP (Figure 1). Agreement analyses are shown in Table 2.

There was an equilibrium between home systolic blood pressure (HSBP) and ambulatory systolic blood pressure (ASBP) in the form of HSBP = 29.14 + 0.82 X ASBP.

An equalization between home diastolic blood pressure (HDBP) measurement and ambulatory diastolic blood pressure (ADBP) measurement was obtained as HDBP = 18.87 + 0.80 X ADBP.

There was an equation between office systolic blood pressure (OSBP) and ambulatory systolic blood pressure (ASBP) as ASD = 1.06 + 1.22 X ASDB.

There was an equation between office diastolic blood pressure (ODBP) and ambulatory diastolic blood pressure (ADBD) as ODDB = -3,88 +1,25 X ADBD.

In 41 patients including 19 patients whose ABPM results were <120/80 mmHg and 22 patients having SBP between 120-138 mmHg and DBP between 80-89 mmHg; we recommended them to revisit the outpatient clinic after 3 months with advices on restriction of salt intake and on regulations of life style and dietary habits such as starting to a diet without changing medication.

In 5 of 9 patients having SBP between 140-175 mmHg and DBP between 90-99 mmHg in ABPM, doses of current medication increased with restriction of salt intake and regulations of life style wheras in 4 of the same 9 patients a second antihypertensive medication were added.

DISCUSSION

In terms of both economical anf practical advantage the most preferred diagnostic method for hypertension is OBPM .

Higher blood pressure values due to white coat effect may be found in OCD measurements and masked, episodic or nocturnal hypertension patients can be omitted. Ambulatory blood pressure measure-

ment is recommended as the most reliable method for diagnosing hypertension and monitoring treatment [6]. Monitoring BP at home throughout the day and night is not as useful as ABPM, but the diagnosis of masked hypertension and isolated office hypertension can be also accurately detected with BP measurements at home.

Correct and reliable measurement of increase in BP is crucially related to the method of measurement used.

First of all, we compared these three methods to assess their agreement for determining blood pressure most correctly. When papers comparing ABPM with HBPM and OBPM are reviewed, they were related only to studies which involve also EH patients without medication.

Analyses show that 1) Mean SBP values measured with HBPM and ABPM have a good agreement and mean DBP values measured with HBPM and ABPM have a very good agreement, 2) Mean SBP values measured with OBPM and ABPM have a weak agreement and mean DBP balues measured with OBPM and with ABPM have a weak agreement.

Mean BP values measured with HBPM have been seen in a higher agreement with mean BP values measured with ABPM compared to mean BP values measured with OBPM. In previous studies BP values measured with HBPM have been found to be lower than BP values measured with OBPM [6,7]. In addition, the HBPM is both inexpensive and reliable in detecting daily BP changes, and according to results of our study, the HBPM was reported to be closer to the ABPM results than the OBPM [8,9]. No statistical difference was found between the methods.

However, the difference between methods is clinically negligible.

This difference is much less in the HBPM values and is closer to the ABPM results.

HBPM values better than OBPM values may give us an idea, in order to decide our course of treatment with higher values. However, the most accurate results can be obtained by ambulatory measurement in patients with high limit values of 135-85 mmHg. The 2013 ESH/ESC guideline also recommends the use of ABPM method for individuals with OBPM results at borderline [10]. The higher the number of measurements, the greater the accuracy of the average value.

In the study data found in the literature and blood pressure guidelines, it has been stated that the all three methods namely ABPM, HBPM and OBPM can be used in the diagnosis and monitorization of blood pressure, and the methods have several advantages over each other [11].

In our study 34 (%68) persons had higher values with OBPM. Since most of the studies in literature are population surveys or focus to stage 1 hypertensive individuals, there are no sufficient evidence in literature on the higher values detected with OBPMs of untreated patients. Since our patients had known primary hypertension, it was seen that occasional differences in nutritional habits (such as increased salt consumption), factors effective on personal activity such as excitement, sadness and stress are the reasons of increased incidence of patients with irregular uncontrolled hypertension.

Patients with hypertension were found to be more sensitive to lifestyle variabilities and fluctuations in blood pressure values which were seen within a short time. In our study, high blood pressure values may be found more frequently because the participants were not receiving adequate treatment and their blood pressures were not at the targeted levels.

Since our patients were primary HT patients, we had to arrange our treatment by making separate evaluations for each individual according to their personal characteristics.

If the mean BP measurements are above 125/76 mmHg and below 135/85 mmHg, the ABPM can be used for diagnosis. In addition to these, for the diagnosis of HT and the effectiveness of antihypertensive treatments, HBPM should be started at least 3, but mostly recommended 7 days before the doctor visits. The patient should not take any antihypertensive, and measurements should be within 1 hour after waking up in the morning and in the evening, and the first day measurements should be excluded from the assessment due to probable inaccuracy of BP measurements or anxiety of the patients.

CONCLUSIONS

A positive and moderately strong relationship was found between the ABPM and the HBPM and OBPM.

As a result of the statistical analysis of our study, both HBPM and OBPM can be used to define high blood pressure in primary care. However, differences between methods were clinically significant (8-30 units for systolic, 3-15 units for diastolic BP measurements). At high BP measurements, all three methods can be used reliably to diagnose hypertension. However, at borderline high BP values, if the mean blood pressure measurements are >125/76 <135/85 mmHg, ABPM should be used for diagnosis.

HBPM is more in agreement with ABPM. For this reason HBPM has priority in diagnosis and treatment follow-up in terms of blood pressure measurements compared to OBPM.

With patients unable to undergo HBPM (unable to measure BP properly, unable to cooperate, and unable to afford device), OBPM may be used to diagnose EH. Yet in these cases white coat hypertension should be taken into consideration.

Since with HBPM we are able to measure BP more frequently and especially obtain morning/evening measurements which are especially important for hypertension-related morbidity and mortality; it might be possible to replace ABPM with the combination of OBPM and HBPM. ABPM might be used selectively if required.

There is a significant difference between the ABPM and HBPM/OBPM methods. ABPM is a safe method that can be easily applied by all physicians in family medicine outpatient clinics. In family medicine outpatient clinics, decision-making for hypertension treatment should be done firstly acoording to ABPM results. Especially in patients with high risk of developing target organ damage, ABPM should be preferred first.

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