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Original Article

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Diagnosing Hypertension in Primary Care: A Comparison of Three Methods

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Abstract

Objective: The aim of this study was to compare the office and home blood pressure measurements with 24 hours ambulatory blood pressure measurements, and to decide which method could be used for the diagnosis of hypertension in primary care.
Materials and Methods: Patients who had blood pressure measurements of 140/90 mm Hg and over were included in this study. Subjects with an initial high blood pressure were evaluated by using three office measurements, seven days home blood pressure measurements, and 24 hours ambulatory blood pressure measurements. Bland–Altman plots and Passing–Bablok regression analysis were performed to find the compliance of the office, home, and ambulatory blood pressure measurements.
Results: Office measurements revealed 48.2% systolic and 62.0% diastolic hypertensive values, whereas home and ambulatory measurements showed 48.2% and 37.9% and 24.1% and 51.7% of systolic and diastolic hypertensive values, respectively. The intraclass correlation of ambulatory and home measurements (r=0.620) was higher compared to the ambulatory and office measurements (r=0.478).
Conclusion: The results of this study demonstrate that the home measurements were more compliant with the ambulatory blood pressure measurements than the mean value of three office measurements in the diagnosis of hypertension.
Keywords: Primary care, hypertension, diagnosis, ambulatory measurements

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INTRODUCTION

Hypertension (HT) is one of the most common chronic diseases. It is a public health problem and is treatable. HT is associated with cardiovascular diseases, stroke, renal diseases, early death, and loss of abilities (1). The relationship between blood pressure values and cardiovascular and renal morbidity has been evaluated in many observational studies (2). Therefore, correct diagnosis and effective treatment of HT are very important.

Studies have shown that cardiovascular morbidity and mortality are associated with systolic blood pressure (SBP) and diastolic blood pressure (DBP) (3). The aim of treatment in HT is to reduce the cardiovascular morbidity and mortality. World Health Organization reports that HT is the first among the preventable reasons of death (4). It has also been reported that a decrease in DBP and mean blood pressure reduces the development and mortality of stroke and ischemic heart disease (5).

Although there are many effective treatments for HT, awareness, treatment, and control rates are still low. Of the HT patients in the world, 50% are aware of their disease and 50% are under treatment. Only 50% of the patients taking medicine are under control (6). The diagnosis of HT is usually delayed because of its as-

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ymptomatic course. Of the 15 million HT patients in Turkey, more than half are not aware of their disease. Of the ones who are aware, 20.7% are under treatment and the blood pressure control rate has been reported to be 8% in all HT patients. This shows that HT treatment is not effective and sufficient. The most important factors leading to a low control rate are monotherapy and insufficient compliance in taking medicine for HT (7).

The aim of this study was to compare the office and home blood pressure measurements (OBPM and HBPM) with 24 hours ambulatory blood pressure measurements (ABPM), and to decide which method could be used for the diagnosis of hypertension in primary care.

MATERIALS AND METHODS

Patients and Methods

Study Population

Inclusion criteria

1. Patients with a prior measurement or OBPM of SBP≥140 and/or DBP≥90 and
2. Patients 18 years and older.

Exclusion criteria

1. Stage 3 HT,
2. Presence of end organ damage,
3. Use of medicine for HT, and
4. Pregnant patients.

This study was approved by the Ethics Committee of Erciyes University, Faculty of Medicine and informed consent was obtained from the participants. Data concerning the comparison of three hypertension diagnosis methods of the Scientific Research Council of Erciyes University Project (ERUBAP, Project No. TTU-2016-6645) have been used in this study.

Setting and Procedure

Patients who had submitted to the Erciyes University Medical Faculty, Family Medicine Outpatient Clinics for any complaint or suspicion of HT were enrolled in this study. The study period was four months between September and December 2016.

One patient with stage 3 HT, two patients who did not accept the ambulatory measurements, and one patient with insufficient ambulatory measurements were excluded from the study.

The demographic data, body mass index, smoking status, co-morbid diseases, and use of medicine were inquired. Kidney, liver, and thyroid function tests, cholesterol, fasting plasma glucose, complete blood count, and electrolytes (sodium and potassium) were studied.

Blood Pressure Measurements

Two consecutive OBPM were carried out at the outpatient polyclinic. A third measurement was done from the higher result arm after 5 minutes. The patients were trained on performing home measurements. Tel-O-Graph®, which measures blood pressure automatically from the arm, was used for home blood pressure monitoring. Home blood pressure monitoring was done for seven days, twice daily. Of the recorded 14 measurements, the first two were excluded from the analysis. The mean values were calculated. The patients were told not to smoke and drink tea or coffee at least for half an hour before the blood pressure measurement. The blood pressure measurements were carried out after at least five minutes of rest.

An ambulatory blood pressure monitoring device (Mobil-O-Graph® NG) was placed at the patients' arm by a family physician and instructions about measurements were given. ABPM was performed after HBPM. A special non-invasive kit was used to measure the patients' central blood pressure and analyze pulse wave (pulse wave velocity and reflection magnitude). Measurements were carried out once in every 15 minutes during the day and once in 30 minutes during the night. The ABPM measurements were transferred to every patient's own file in the HMS client server computer program. The mean blood pressure, daytime mean blood pressure, nighttime mean blood pressure, percentage exceeding the border value, and dipper and non-dipper values were calculated. The patients were accepted as hypertensive with the following conditions (8):

1. mean office blood pressure of SBP≥140 mmHg and/or DBP≥90 mmHg,
2. HBPM of SBP≥135 mmHg and/or DBP≥85 mmHg, and
3. ABPM of SBP≥130 mmHg and/or DBP≥80 mmHg.

Statistical Analysis

The analysis of the study data was performed through an R 3.2.0 (www.r-project.org) software. Bland–Altman plots and Passing–Bablok regression analysis were performed to find the compliance of the OBPM, HBPM, and ABPM. There was bias in the first stage comparison, where ambulatory systolic measurements were taken as reference measurements and office and home measurements were compared. The mean values were not around zero at the Bland–Altman graphics. Therefore, logarithmic transformation was performed and the Bland–Altman plots were re-drawn. The values were then close to zero and there was no bias. Further, the Passing–Bablok regression analysis was carried out. The value $p<0.05$ was accepted as statistically significant.

RESULTS

Patients' Characteristics

Twenty-nine patients were included in this study. Of those, 24 (82.8%) were women and 5 (17.2%) were men. The mean age was 50.65±12.38, where the minimum age was 18 and the max-

Table 1. Demographic data

Demographic Data		n	%
Gender	Men	5	17.2
	Women	24	82.8
Occupation	Housewife	18	62.1
	Lecturer	3	10.3
	Officer	4	13.8
	Employee	2	6.9
	Others	2	6.9
Smoking	Yes	4	13.8
	No	25	86.2
Co-morbid Diseases	Diabetes mellitus	3	10.3
	Asthma	2	6.9
	Thyroid disorder	3	10.3
	Hypercholesterolemia	1	3.4
	Malignity	2	6.9
	Rheumatic disease	3	10.3
Use of medicine (continuously)	Yes	12	42.4
	No	17	58.6

Table 2. Logarithmically transformed Bland–Altman graphic statistical values for the comparison of ambulatory, office, and home measurements

A-SBP	n	$\bar{d}$	SD	Lower	Upper
OffSBP	29	−0.110	0.105	−0.32	0.10
HomeSBP	29	−0.067	0.079	−0.22	0.09

imum age was 77. Only one patient was single. Sixteen patients had co-morbid diseases (55.2%). Thirteen patients (44.8%) had no chronic diseases. Twelve patients (42.4%) had body mass index values ≥30. The demographic data are provided in Table 1.

Blood Pressure Measurements

Fourteen patients (48.2%) had SBP mean values ≥140 mmHg, and eighteen (62%) had DBP mean values ≥90 mmHg. Twenty-one patients (72.4%) were accepted as hypertensive with their mean blood pressure measurements.

HBPM showed that 14 (48.2%) had SBP mean values of ≥135 mmHg and 11 (37.9%) had DBP mean values of ≥85 mmHg. Fifteen patients (51.7%) were accepted as hypertensive with their mean HBPM.

ABPM showed that 7 (24.1%) had SBP mean values of ≥130 mmHg, and 15 (51.7%) had DBP mean values ≥80 mmHg. Sixteen patients (55.2%) were accepted as hypertensive with ABPM mean values. Seven (24.1%) patients had white coat hypertension, and two (6.9%) had masked hypertension.

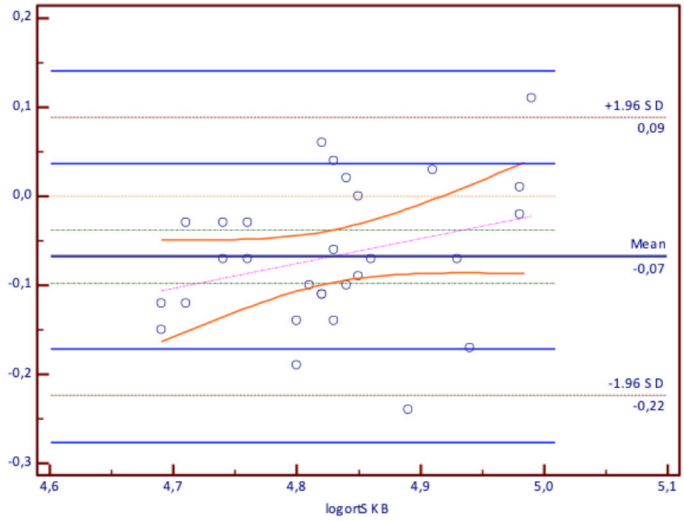

Figure 1. Logarithmically transformed Bland–Altman graphics for the comparison of ambulatory and home measurements.

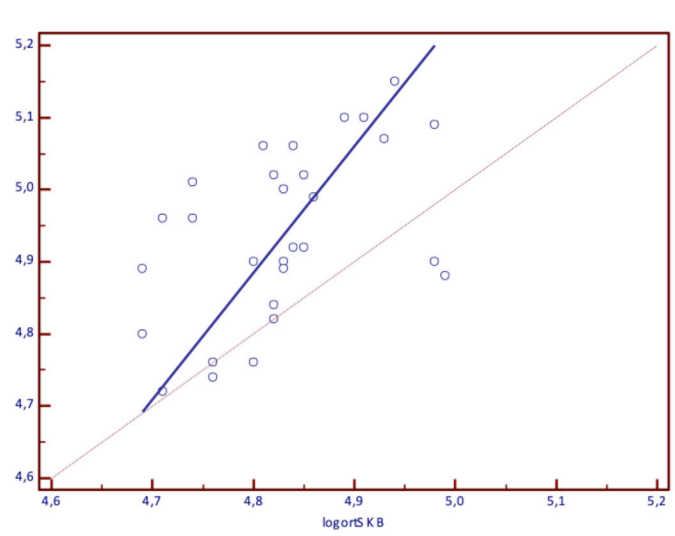

Figure 2. Comparison of ambulatory SBP and office SBP measurements using a Passing–Bablok regression graphic.

Bland–Altman graphics are drawn to see the compliance of the office, home, and ambulatory measurements. The mean value was not around zero. Therefore the graphics are re-drawn with a logarithmic transformation. Figure 1 shows the logarithmically transformed Bland–Altman graphic for the comparison of ambulatory and home measurements. Statistical values are given in Table 2. The Passing–Bablok regression analysis was carried out to show the comparison of ambulatory and office measurements (Figure 2) and ambulatory and home measurements (Figure 3).

Table 3. Passing–Bablok regression results showing the comparison of SBP measurements						
A-SBP	**a**	**95% Confidence Interval**		**b**	**95% Confidence Interval**	
OffSBP	−3.54	−8.35	0.11	1.75	1.00	2.75
HomeSBP	−0.93	−3.66	1.28	1.21	0.75	1.77
Passing–Bablok regression results showing the comparison of DBP measurements						
A-DBB	**a**	**95% Confidence Interval**		**b**	**95% Confidence Interval**	
OffDBP	−0.297	−3.175	1.692	1.093	0.642	1.750
HomeDBP	−1.07	−3.63	0.45	1.25	0.90	1.833

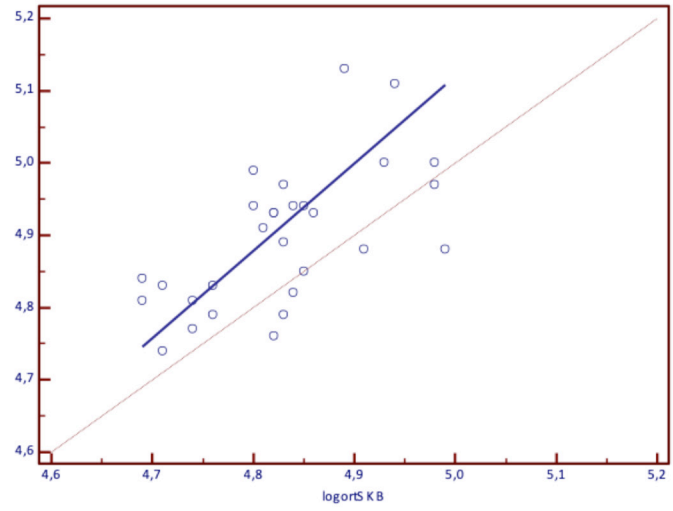

Figure 3. Comparison of ambulatory SBP and home SBP measurements using a Passing–Bablok regression graphic.

When the compliance of the ambulatory, office, and home SBP values were compared, the intraclass correlation of ambulatory and home measurements was higher (r=0.620) (good compliance) than that of the ambulatory and office measurements (r=0.478) (moderate compliance). For DBP, the intraclass correlation was higher for ambulatory and home measurements as well (r=0.655 vs. r=0.632), but they both had a good compliance degree. These results show that both the SBP and DBP compliances are better for the ambulatory and home measurements than the compliance between ambulatory and office measurements.

The Passing–Bablok regression analysis results showed that both office and home systolic measurements were compliant with the ambulatory measurements. Home and office SBP measurements are both alternatives to ambulatory SBP measurements. There was bias for the DBP measurements as well, and logarithmically transformed Bland–Altman graphics were drawn and the Passisng–Bablok regression analysis was performed. Office and home diastolic measurements were both compliant with the ambulatory measurements. Home and office DBP measurements are both alternatives to ambulatory DBP measurements.

DISCUSSION

Statement of Principal Findings

The compliances of the ambulatory, office, and home SBP values are compared; the intraclass correlation of ambulatory and office measurements had a moderate compliance and that of the ambulatory and home measurements had a good compliance. For DBP, the intraclass correlation was lower for ambulatory and office measurements as well, but they both had a good compliance degree. Home and office BP measurements are both alternatives to ambulatory BP measurements. The results of this study demonstrate that the home measurements were more compliant with the ABPM than the mean value of three office measurements in the diagnosis of hypertension.

Comparison with Existing Literature

The masked hypertension prevalence has been reported to be 13% (10%-17%) (8). In our study, there were 2 (6.8%) patients with masked hypertension. The white coat hypertension prevalence average has been stated to be 13% and a rate of 32% (25%-46%) has been reported in hypertensive patients (8). Seven patients (24.1%) had white coat hypertension in our study. Our results are compliant for white coat hypertension, but the masked hypertension is lower compared to other studies.

Bonafini S. and Fava C. have stated that HBPM is useful for defining masked and white coat hypertension. They also reported the necessity of further studies with HBPM (9). In a meta-analysis, the ABPM and HBPM were more correlated with end organ damage than the OBPM. HBPM was as good as ABPM and was more compliant with the ABPM than the office measurements (10). In another meta-analysis, HBPM has been reported as more effective in determining the white coat and masked hypertension (11). HBPM has also been reported as effective for the initial diagnosis and following the treatment success, but it has been concluded that further studies on cost-effectiveness are necessary (12).

In a study performed in Japan, the use of HBPM was compared with OBPM and ABPM. It has been stated that HBPM is superior to office and ambulatory measurements because it could be repeated. HBPM has been found more successful in defining

the prognosis of cardiovascular disease than the office measurements. It has also been stated that compliance to the use of medicine was better with HBPM (13).

Strengths and Limitations

There were few studies performed on ABPM in primary care. The strength of this study was the use of ABPM, which is a golden standard for the diagnosis of hypertension. The patients who enrolled in this study were initially diagnosed with hypertension in a primary care outpatient clinic. Therefore, the small number of patients was a limitation of this study.

Implications

Our study showed that both HBPM and OBPM were compliant with the ABPM in diagnosing HT. The HBPM compliance to ABPM was better when compared to OBPM. HBPM is better for diagnosing the masked and white coat hypertension.

CONCLUSION

The results of this study demonstrate that the home measurements were more compliant with the ambulatory measurements than the mean value of three office measurements in the diagnosis of hypertension. However, both OBPM and HBPM are compliant with the ABPM and can be used in the initial diagnosis of HT. HBPM is better than OBPM for diagnosing the white coat hypertension and masked hypertension. ABPM, which is the golden standard for hypertension diagnosis, may be used in primary care outpatient clinics for determining the prognosis of the cardiovascular disease.

Ethics Committee Approval: Ethics Committee approval was received for this study from the Ethics Committee of Erciyes University, Number: 2016/224, Date: 01.04.2016.

Informed Consent: Informed consent form received from the patients who participated in this study

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors have no conflict of interest to declare.

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REFERENCES

1. Weber MA, Schiffrin EL, White WB, Mann S, Lindholm LH, Kenerson JG, et al. Clinical practice guidelines for the management of hypertension in the community: a statement by the American Society of Hypertension and the International Society of Hypertension. J Clin Hypertens (Greenwich) 2014; 16: 14-26. [CrossRef]
2. Lewington S, Clarke R, Qizilbash N, Peto R, Collins R. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. Lancet 2002; 360: 1903-13. [CrossRef]
3. Poulter NR, Prabhakaran D, Caulfield M. Hypertension. Lancet 2015; 386: 801-12. [CrossRef]
4. Laffin LJ, Bakris GL. Hypertension and new treatment approaches targeting the sympathetic nervous system. Curr Opin Pharmacol 2015; 21: 20-4. [CrossRef]
5. Mohan S, Campbell NR. Salt and high blood pressure. Clin Sci (Lond) 2009; 117: 1-11. [CrossRef]
6. Erdine S. How well is hypertension controlled in Europe? J Hypertens 2000; 18: 1348-9. [CrossRef]
7. Altun B, Arıcı M, Nergizoğlu G, Derici Ü, Karatan O, Turgan Ç, et al. For the Turkish Society of Hypertension and Renal Diseases. Prevalence, awareness, treatment and control of hypertension in Turkey (the PatenT study) in 2003. J Hypertens 2005; 23: 1817-23. [CrossRef]
8. ESH/ESC Task Force for the Management of Arterial Hypertension. 2013 Practice guidelines for the management of arterial hypertension of the European Society of Hypertension (ESH) and the European Society of Cardiology (ESC): ESH/ESC Task Force for the Management of Arterial Hypertension. J Hypertens 2013; 31: 1925-38. [CrossRef]
9. Bonafini S, Fava C. Home blood pressure measurements: Advantages and disadvantages compared to office and ambulatory monitoring. Blood Pressure 2015; 24: 325-32. [CrossRef]
10. Bliziotis IA, Destounis A, Stergiou GS. Home vs. ambulatory and office blood pressure in predicting target organ damage in hypertension: a systematic re¬view and meta-analysis. J Hypertens 2012; 30: 1289-99. [CrossRef]
11. Sheppard J, Fletcher B, Gill P, Martin U, Roberts N, McManus RJ. Predictors of the Home-Clinic Blood Pressure Difference: A Systematic Review and Meta-Analysis. Am J Hypertens 2016; 29: 614-25. [CrossRef]
12. Stergiou GS, Bliziotis IA. Home blood pressure monitoring in the diag¬nosis and treatment of hypertension: a systematic review. Am J Hypertens 2011; 24: 123-34. [CrossRef]
13. Imai Y, Obara T, Asamaya K, Ohkubo T. The reason why home blood pressure measurements are preferred over clinic or ambulatory blood pressure in Japan. Hypertens Res 2013; 36: 661-72. [CrossRef]