

The relation between body mass index and end organ damage in white coat hypertension

Beyaz önlük hipertansiyonunda uç organ hasarı ile vücut kitle indeksi arasındaki ilişki

Atakan DEMİR, Mevlut Tamer DINCER

ABSTRACT

Objective: White coat hypertension (WCH) is characterized by blood pressure, which is high in the outpatient clinic and normal either on ambulatory blood pressure (BP) monitoring or home BP monitoring. In this study, our objective was to investigate the effects of obesity on end organ damage and the correlation between body mass index (BMI) and end organ damage caused by WCH.

Patients and Methods: Individuals, who applied to our outpatient clinic due to other complaints or who were not diagnosed with or treated for hypertension, were enrolled in our study. Based on daytime values, systolic blood pressures below 135mmHg and diastolic blood pressures below 85mmHg were considered as WCH. The patients were examined for the findings of end organ damage. The left ventricular mass (LVM) was measured with echocardiography. Findings of hypertensive retinopathy were evaluated and albumin levels were measured.

Results: The mean left ventricular mass index (LVMI) and LVM values were $96.29 \pm 25.6 \text{ g/m}^2$ and $170.87 \pm 50.17 \text{ g}$ respectively. The rate of hypertensive retinopathy was 17%. We determined a significant correlation between BMI and LVMI independently from blood pressure levels.

Conclusion: There are conflicting conclusions about the risks related to WCH. However, several types of end organ damage can be observed independently from the blood pressure levels in this group of patients. Cardiac failure is more common and has an early onset in obese patients with WCH. In conclusion, end organ damage may emerge during the follow-up of WCH patients without a significant change in the blood pressure values.

Keywords: Hypertension, Body Mass Index, Blood Pressure.

ÖZ

Amaç: Beyaz önlük hipertansiyonu (BÖH) poliklinik ölçümlerinde kan basıncının yüksek bulunması ancak ambulatuvar kan basıncı veya ev ölçümleri sırasında kan basınçlarının normal seyretmesidir. Biz bu çalışmada, obezitenin uç organ hasarına etkisini ve vücut kitle indeksi (VKİ) ile BÖH'nin neden olduğu uç organ hasarı arasındaki ilişkiyi incelemeyi amaçladık.

Hastalar ve Yöntemler: Çalışmamıza polikliniğimize başka nedenlerle başvuran veya hastalık saptanmayan sağlıklı kişiler arasından hipertansiyon tanısı almamış ya da hipertansiyon nedeniyle tedavi edilmemiş olan bireyler dâhil edildi. Gündüz ölçüm değerleri kriter alınarak sistolik kan basıncı 135 mmHg, diastolik kan basıncı 85 mmHg'nin altındaki değerler BÖH olarak kabul edildi. Hastalar uç organ hasarı yönünden değerlendirildi. Ekokardiografi ile sol ventrikül kitlesi (SVK) ölçüldü. Retinopati araştırıldı. Mikroalbuminüri düzeyine bakıldı.

Bulgular: Ortalama sol ventrikül kitle indeksi (SVKİ) ve SVK değerleri sırasıyla $96,29 \pm 25,64 \text{ gr/m}^2$ ve $170,87 \pm 50,17 \text{ gr}$ bulundu. Hipertansif retinopati sıklığı %17 idi. Kan basıncı değerlerinden bağımsız olarak VKİ ile SVK ve SVKİ arasında korelasyon bulundu.

Sonuç: Beyaz önlük hipertansiyonunun masumiyeti konusunda çelişkili ifadeler vardır. Değişen kan basıncı değerlerinden bağımsız olarak farklı uç organ hasarları görülmektedir. Obez olan BÖH hastalarında kardiyak yetmezlik daha sık ve erken görülmektedir. Sonuç olarak BÖH'lü bir hasta izlenirken kan basınçlarında anlamlı değişiklik olmaksızın uç organ hasarı oluşabilmektedir.

Anahtar kelimeler: Hipertansiyon, Vücut Kitle İndeksi, Kan basıncı

Atakan Demir (✉)
Medical Oncology Department, Maslak Acibadem Hospital, Maslak,
Istanbul, Turkey
e-mail: atakandemir85@gmail.com

Mevlut Tamer Dincer
Sub-department of Nephrology, Department of Internal Medicine,
Cerrahpasa School of Medicine, Istanbul University, Fatih, Istanbul,
Turkey

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Introduction

Hypertension is an important health problem affecting primarily the adult population. Some authors suggest that it will have a greater impact on public health in the future [1]. In hypertensive patients, diagnosis of the end organ damage is critical in respect of the treatment choice. During the decisions on the treatment, end organ damage and concomitant diseases should be considered along with

the blood pressure levels. White coat hypertension (WCH) is characterized by a blood pressure, which is high in the outpatient clinic and normal either on ambulatory blood pressure monitoring (ABPM) or home blood pressure monitoring. Systolic blood pressure (SBP) higher than 140mmHg and diastolic blood pressure (DBP) higher than 90mmHg during the measurements in the outpatient clinic and SBP lower than 135mmHg and DBP lower than 85mmHg during ABPM is defined as WCH [2].

The prospective studies demonstrated end organ damage in WCH patients although its rate was lower than the patients with continuous hypertension [3-5]. The rate of renal involvement is also lower in WCH patients compared to the hypertensive patients but higher compared to the normotensive patients in the control group. The rates of cardiovascular events such as left ventricular hypertrophy (LVH), left ventricular diastolic dysfunction, and early-onset of the microalbuminuria are also relatively higher in WCH patients [4-6].

Like in the hypertension treatment, the goal of the treatment in WCH is the prevention of end organ damage. Therefore, the factors contributing to this process should be well defined. It is known that obesity contributes to various risk factors including cardiovascular disorders and increases the prevalence of most of the cardiovascular risk factors and induces the development of arterial hypertension [7]. Our objective in this study was to determine the effects of obesity on end organ damage and the correlation between body mass index (BMI) and end organ damage caused by WCH.

Materials and Methods

Patients

A total of 100 adult patients, who had applied to our outpatient clinic due to other complaints or healthy patients, who were not diagnosed with hypertension or treated for hypertension and had a SBP>140mmHg and DBP>90mmHg were included in the study. All included patients were older than 18 years and had no diabetes mellitus or glucose intolerance. The demographic characteristics of the patients were recorded. The height and weight of the patients were measured and the body mass index (BMI) was calculated. The study was approved by the Clinical Research Ethics Committee of Cerrahpaşa School of Medicine, Istanbul University (01.03.2011;8736).

Blood pressure measurement

The blood pressure was measured with the standardized and internationally accepted mercury manometer in the sitting position after a 20-minute resting time. The measurements were carried out in three different days. The 24-hour ABPM of the participating patients was performed with A and D Engineering TM-2421 device. During the ABPM, the daytime blood pressure levels were measured between 06:00-00:00 in every 15 minutes and the nighttime levels were measured between 00:00-06:00 in every 30 minutes and the measured values were recorded. Patients, who were diagnosed with hypertension during the outpatient examination but had a mean daytimes levels of SBP and DBP lower than 135mmHg and 85mmHg respectively were diagnosed with WCH. Patients, who had SBP and DBP levels higher than 135mmHg and 85mmHg in the daytime measurements, were diagnosed with hypertension [8].

Determination of end organ damage

The patients were examined for the end organ damage in the outpatient clinics of the cardiology and ophthalmology departments. The hypertensive changes in the retina, which were determined during the fundoscopic examination, were evaluated according to Keith, Wagener, and Barker classification [9]. The echocardiographic examination was based on the recommendations of the American Society of Echocardiography [10]. The examination was performed with M-mode two-dimension Doppler echocardiography. Hawlett Packard 2500 ultrasound device with a 2.5MHz transducer was used. The left ventricular mass (LVM) was calculated with Devereux formulation. The sections of the left ventricle were done at the junction of the mitral valve [11]. The 24-hour urine analysis was also performed. The microalbuminuria and creatinine clearance was examined in the 24-hour urine. An albumin excretion between 30-300mg/day was accepted as microalbuminuria.

Statistical Analysis

The data were expressed with mean±standard deviation. The correlation between the parameters related to BMI and end organ damage was examined with Pearson's correlation analysis. P<0.05 was considered as statistically significant. Calculations were done with SPSS v22.0 (SPSS Inc. USA) software package.

Results

Fifty female and 50 male WCH patients were included in our study (n=100). The mean age of the patient group was 48.22 years and the mean ages of female and male patients were 49±17 and 48.6±10.8 years respectively. The difference between the mean ages was not significant.

During the examination in the outpatient clinic, the mean SBP and DBP of the participating patients were 153±5mmHg and 99±25mmHg respectively. Regarding the ABPM, the mean daytime SBP and DBP levels were 121±6mmHg and 74.6±5mmHg; the mean nighttime SBP and DBP levels were 108.8±9.8mmHg and 65.8±7.7mmHg respectively (Table I). There was no significant correlation between the blood pressure and end organ damage.

Table I. Results of blood pressure measurements performed in the outpatient clinic and ambulatory conditions (n=100)

	Systolic blood pressure	Diastolic blood pressure
Outpatient clinic (mmHg)	>153±15	>99±25
Ambulatory (daytime) (mmHg)	121±6.4	74.6±5.5
Ambulatory (nighttime) (mmHg)	108.8±8	65.8±7.7

The mean values of BMI, LVMI and LVM were 28.80±4.33 kg/m², 96.29±25.64 g/m² and 170.87±50.17g respectively. The mean protein excretion was 28.88±44.14g/dL (Table II).

Table II. Demographic findings and parameters of the end organ damage (n=100)

	Mean±SD*
Age (year)	48.70 ± 12.44
Weight (kg)	74.66 ± 11.99
Height (m)	1.61 ± 0.07
BMI (kg/m ²)	28.80 ± 4.33
MAU (g/dL)	28.88 ± 44.14
LVM (g)	170.87 ± 50.16
LVMI (g/m ²)	96.28 ± 25.63

* Standard deviation

BMI: body mass index, MAU: Microalbuminuria, LVM: Left ventricular mass, LVMI: Left ventricular mass index

The rate of the hypertensive retinopathy (HTR) was 17% (grade I: 12%, grade II: 4%, grade III: 1%) (Table III).

Table III. The rate of the hypertensive retinopathy grades (n=100)

Grades of hypertensive retinopathy	n (%)
Grade 1	12 (12%)
Grade 2	4 (4%)
Grade 3	1 (1%)

There was a significant correlation between BMI and LVM and LVMI (P<0.05, r=0.27 and P<0.001, r=0.39 respectively). However, we did not detect any significant correlation between BMI and microalbuminuria and hypertensive retinopathy (HTR) (P> 0.05, r=0.01 and P>0.05, r=0.16 respectively) (Table IV).

Table IV. Correlation rates of the end organ damage with body mass index (BMI) (n=100)

	r	P
BMI-LVM	0.27	< 0.05
BMI-LVMI	0.39	< 0.001
BMI-MAU	0.01	> 0.05
BMI-HTR	0.16	> 0.05

BMI: Body mass index, LVM: Left ventricular mass, LVMI: Left ventricular mass index, MAU: Microalbuminuria, HTR: Hypertensive retinopathy

Discussion

Regarding the literature, there are conflicting results about the end organ damage in WCH patients. Therefore, it was suggested that the presence of various concomitant factor(s) should be responsible for these discrepancies. Nevertheless, the studies were mostly focused on the confirmation or the refusal of the presence of end organ damage development and the correlation analysis between the possible factors remained rather in the background. In this study, we investigated the role of obesity to end organ damage. The correlation of BMI and end organ damages such as retinopathy, left ventricular hypertrophy, and microalbuminuria was evaluated.

Conflicting results were also reported about the development of left ventricular hypertrophy in WCH patients. Kristensen et al., reported that LVM was lower in WCH compared to hypertension but higher compared to normotension [12]. Verdecchia et al., demonstrated that LVMI was increased in WCH compared to the normotensive subjects and was in correlation with the changing blood pressure levels. However, they did not evaluate any correlation between BMI and LVMI [13]. Owens and colleagues showed that LVM and LVMI were increased in individuals with the same blood pressure and stated that this increase in WCH occurred independently from the blood pressure levels. They did not evaluate any correlation with BMI [14]. In our study, we determined a significant correlation between BMI and LVM and LVMI.

Microalbuminuria, which is an indicator of the renal involvement, is evaluated in the hypertensive

patients. Martinez and colleagues conducted studies on hypertensive patients and showed that hypertension causes microalbuminuria and had a correlation with BMI [15]. Di Mauro and Kristensen conducted studies on WCH patients but did not detect any significant microalbuminuria in the patients [16, 17]. Palatini et al., compared WCH patients with hypertensive patients and showed that the protein excretion was increased in WCH patients but it was more prominent along with end organ damage in hypertensive patients [18]. In our study, the protein excretion was within normal limits and had no significant correlation with BMI.

In WCH patients, similar to end organ damages there was also hypertensive changes in the retina. However, its rate and severity were less prominent than the hypertensive patients. In the study of van Leiden et al, the development of retinopathy was demonstrated in hypertensive patients. In this study, the investigators detected a significant correlation between retinopathy and BMI [19]. In the study conducted by Klein and Wong, it was reported that hypertension caused retinopathy but this causality was independent from BMI [20]. In the study of Pose-Reino and colleagues, the rates of retinopathy were 58.3% and 33% in hypertension and WCH groups, respectively [21]. The same rate was 29% in the study of Cerasola et al. [22]. In our study, the rates of grade I, II and III HTR were 12%, 4% and 1% respectively in patients diagnosed with WCH (Total rate of retinopathy=17%). We observed that there was no significant correlation between retinopathy and BMI. In contrary, Pose-Reino et al. reported a significant correlation between retinopathy and BMI [21]. The presence of this significant correlation may depend on relatively prolonged exposure to WCH due to the higher mean age of the subjects and increased weight gain with the age. This increased BMI may cause a misleading correlation between BMI and HTR.

Considering the end organ damage, the conflicting results in the previous studies might depend on that the duration of the exposure to WCH was not taken into consideration during the formation of the groups. If the exposure time is not adjusted, the comparison of the groups for the end organ damage is rather difficult. The different definitions of the WCH and different age groups may be also causing these conflicting results. Therefore, instead of investigating end organ damage in the patient groups with WCH, hypertension and normotension with the absolute numeric values, we preferred to evaluate obesity, which might be effective on the development of the end organ damage, and found out that it had a strong correlation with an increase in LVM.

The “white coat effect”, which was caused by increased sympathetic activity, leads to the development of WCH. This mechanism may also explain the increase in the LVM. On the other hand, obesity shows that there is an interaction between the sympathetic activity and the satiety in central nervous system. The neurohormonal mechanisms shaping this interaction are areas that need to be investigated in the future.

There are conflicting suggestions about the risks of WCH. In WCH, various end organ damages may be encountered independently from blood pressure levels. This finding points to the presence of other factors affecting the prognosis. BMI is one of these factors causing an increase in LVM. In obese patients with WCH, the rate of cardiac failure is relatively higher and it develops in an earlier stage.

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