Prevalence of Hypertension in Suspected Hypertensive Patients in Rajavithi Hospital using Ambulatory Blood Pressure Monitoring

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Background: *Hypertension (HTN) is one of the most important health problems in Thailand and worldwide. The accuracy of diagnosis of HTN is crucial to avoid adverse reactions from medications and reduce treatment costs. In 2011, The National Institute for Health and Clinical Excellence (NICE) recommended a diagnostic guidelines for hypertension using ambulatory blood pressure monitoring (ABPM) aiming to exclude patients with white coat hypertension (WCH). We investigated the prevalence of HTN in suspected hypertensive patients at Rajavithi Hospital according to the NICE guidelines and factors associated with WCH.*

Objective: *To determine the prevalence of HTN in suspected hypertensive patients at Rajavithi Hospital according to the NICE guidelines (using ABPM)and risk factors associated with WCH.*

Material and Method: *This cross-sectional study enrolled 31 subjects, age 18-80 years, with systolic blood pressure (SBP) $\geq$140 mmHg and/or diastolic blood pressure (DBP) $\geq$90 mmHg in the Outpatient Department at Rajavithi Hospital from March 2012 to December 2012. All participants had never had a diagnosis of HTN or been treated with anti hypertensive medications in the past four weeks. 24-hour ABPM was used to confirm the diagnosis of HTN based on daytime average blood pressure $\geq$135/85 mmHg. Subjects with an average daytime blood pressure below 135/85 mmHg were defined as having WCH.*

Results: *Among 31 subjects, 17 (54.8%) were confirmed to have HTN and 14 (45.2%) had WCH. Subjects with true HTN had a mean clinical blood pressure of 157.88$\pm$7.68/94.24$\pm$6.56 mmHg when measured at the initial presentation using a sphygmomanometer, whereas subjects with WCH had a mean clinic blood pressure of 148.18$\pm$7.06/89.39$\pm$4.10 mmHg. Mean SBP and DBP were significantly lower among WCH subjects (p = 0.001 and p = 0.018 respectively). Age, sex, smoking, alcohol consumption, BMI, lipid profile, uric acid and hemoglobin levels were not associated with the diagnosis of WCH.*

Conclusion: *The prevalence of hypertension in suspected hypertensive patients using ABPM was 54.8%. WCH should be suspected in patients with relatively lower clinic BP. We proposed that ABPM should be used to confirm the diagnosis of HTN according to the NICE guidelines as a standard practice among ambulatory patients suspected of having HTN.*

Keywords: *Hypertension (HTN), White coat hypertension (WCH), Ambulatory blood pressure monitoring (ABPM), Clinical blood pressure (BP)*

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Hypertension (HTN) is one of the most important risk factors of various cardiovascular diseases including myocardial infarction, heart failure, cerebrovascular accident, chronic kidney disease and hypertensive retinopathy[1]. HTN is highly prevalent with an estimated 972 million affected patients worldwide[2]. HTN was diagnosed in 30.0% of US adults over 18 years old[3]. Similarly, 22.0% of the Thai population over 15 years old has HTN[4]. The accuracy of a diagnosis of HTN is crucial to avoid adverse reactions from medications and reduce treatment costs. In 2011, The National Institute for Health and Clinical Excellence (NICE) recommended diagnostic guidelines for hypertension using ambulatory blood pressure monitoring (ABPM) aiming to exclude patients with white coat hypertension (WCH). The diagnosis of HTN was commonly made by clinical $\geq$ blood pressure (BP) measurement using a mercury sphygmomanometer or automated sphygmomanometer. HTN is defined by systolic blood pressure (SBP) 140 mmHg and/or diastolic blood pressure (DBP) $\geq$90 mmHg. To confirm the diagnosis, repeating the BP reading in two months

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has been recommended[5]. BP fluctuates according to various stimuli such as food, smoking, alcohol, pain, temperature, and stress. These factors can raise SBP as high as 20 mmHg. To avoid false diagnosis of HTN, patients are recommended to avoid smoking or consuming alcohol, as well as they are given an opportunity to rest before BP measurement[6].

Despite an attempt to avoid a false diagnosis, WCH is still common. This is defined by elevated BP when measured in the clinic but BP readings at home using ambulatory blood pressure monitoring (ABPM) were less than 135/85 mmHg[7]. The use of ABPM has been recommended to differentiate WCH from true HTN, found in 15-30% of the population[8].

The present study investigated the prevalence of HTN in suspected hypertensive patients at Rajavithi Hospital according to the NICE guideline and risk factors associated with WCH such as age, sex, alcohol or tobacco use, BMI, lipid profiles and hemoglobin levels to avoid a false diagnosis of HTN and reduce costs of unnecessary treatment and adverse reactions from anti-hypertensive medications.

Material and Method

Data source and subjects

This was a cross-sectional study approved by the Rajavithi Hospital Ethics Committee, and 31 adult subjects were enrolled age 18-80 years old, with SBP $\geq$140 mmHg and/or DBP $\geq$90 mmHg in the Outpatient Department at Rajavithi Hospital from March 2012 to December 2012. All participant had never had a diagnosis of HTN or been treated with antihypertensive medications in the past four weeks. The authors also excluded subjects who had been on medications that could falsely raise BP such as oral contraceptive pills, decongestants or steroids. Subjects with known cardiovascular disease, renal impairment (GFR <60 ml/min/1.73 m^2 using Cockcroft-Gault equations), diabetes mellitus, cardiac arrhythmia, or pregnancy were also excluded.

Blood pressure analysis

All subjects received an initial clinical BP measurement with a mercury sphygmomanometer using the auscultatory method by physicians. All subjects were asked to rest for at least five minutes before the measurement. They were also asked to avoid caffeine intake, exercise or smoking for at least 30 minutes. The length of BP cuffs was greater than 80.0% of subjects' arm circumference and BP was measured at the level of the heart. Brachial artery palpation was used to estimate SBP followed by the ausculatory method by raising the pressure to approximately 20 mmHg above the estimate SBP. Pressure was released at a rate of 2 mmHg per second until the first sound (Korotkoff sound phase 1) was appreciated which indicated SBP. DBP could be identified when the sound started to disappear (Korotkoff sound phase 5). BP measurement was repeated after two to five minutes and the average reading of both measurements was used. All subjects had clinical SBP $\geq$140 mmHg and/or DBP $\geq$90 mmHg with the BP difference between both arms less than 20/10 mmHg. They received 24-hour ABPM within two weeks after clinical measurement. ABMP measured BP twice per hour with a 30-minute interval, during the day. Daytime average BP was calculated using at least 14 BP readings. Subjects with clinical SBP $\geq$140 mmHg or DBP $\geq$90 mmHg were defined as having HTN when daytime average BP using ABPM at home were $\geq$135/85 mmHg. Subjects with daytime average BP below 135/85 mmHg were defined as having WCH.

Outcome of the study

The primary end point is to study the prevalence of HTN in suspected hypertensive patients at Rajavithi Hospital according to the NICE guidelines (using ABPN). The secondary endpoint includes factors associated with WCH such as age, sex, alcohol or tobacco use, BMI, lipid profiles and hemoglobin level.

Statistical analysis

Data were presented as mean $\pm$ standard deviation (SD) for continuous variables and number (%) for categorical variables. Differences in categorical variables were analyzed using Chi-square test or Fisher's exact test. Independent t-test was used to compare the mean between two groups. A p-value <0.05 was considered to be statistically significant. All analyses were performed with the statistical program SPSS, version 17.0.

Results

The prevalence of HTN according to the NICE guidelines among 31 suspected hypertensive subjects at Rajavithi Hospital from March 2012 to December 2012 was 54.8% (17 subjects). WCH was observed among 45.2% (14 subjects) (Fig. 1). Mean age of all subjects was 42.29$\pm$14.30 years old. The majority of subjects was male (74.2%), nonsmokers and did not consume alcohol. Baseline characteristics of subjects

are shown in Table 1. Age, sex, smoking, alcohol consumption, BMI, lipid profile, uric acid, and hemoglobin levels were similar in both groups. Subjects with true HTN had a mean clinical SBP of 157.88±7.68 and mean clinical DBP of 94.24±6.56 mmHg when measured atthe clinic using a sphygmomanometer, whereas subjects with WCH had a mean clinical SBP of 148.18±7.06 and mean clinical DBP of 89.39±4.10 mmHg (Table 2). Mean clinics SBP and DBP were significantly lower among WCH subjects, $p<0.001$ and $p = 0.018$, respectively, (Table 2). A similar trend was found between the two groups when BP was measured using ABPM (Table 3), whereas others clinical characteristics including age, sex, smoking, alcohol consumption, BMI, lipid profile, uric acid and hemoglobin levels were not significantly associated with the diagnosis of WCH.

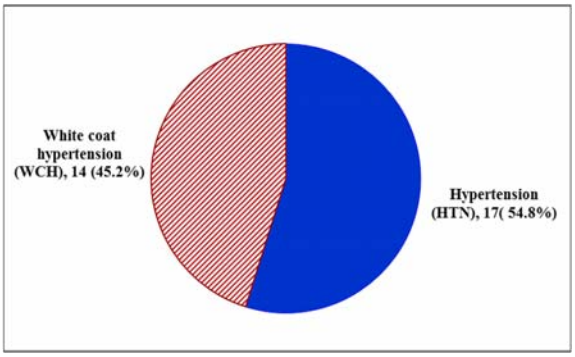

Fig. 1 The prevalence of hypertension according to the National Institute for Health and Clinical Excellence (NICE) recommended guidelines.

Discussion

Several studies have shown superior efficacies of ABPM in predicting outcome of HTN[9-11], as well as, reliability and reproducibility of BP measurement[12-14]. Moreover, ABPM is found to be the most cost-effective method since it can prevent the cost of treatment among patients who were falsely diagnosed with HTN[7].

In 2011, NICE recommended repeat BP measurement using ABPM among patients with clinical SBP ≥140 mmHg and/or DBP ≥90 mmHg. The diagnosis of HTN is made only when daytime average BP using ABPM is ≥135/85 mmHg[7]. Previous studies have found the prevalence of HTN according to NICE guidelines of around 68.0-88.0%[15-21].

The present study found the prevalence of true HTN based on NICE guidelines of 54.8%, which is slightly lower than previous studies. This might be

Table 1. Baseline characteristic of subjects

Characteristics	Total (n = 31)	HTN (n = 17)	WCH (n = 14)	*p*-value
Age (year)	42.29±14.30	42.76±13.44	41.71±15.78	0.843
Sex				
Male	23 (74.2)	11 (64.7)	12 (85.7)	0.240
Female	8 (25.8)	6 (35.3)	2 (14.3)	
Smoking	3 (9.7)	3 (17.6)	0 (0.0)	0.232
Alcohol consumption	6 (19.4)	2 (11.8)	4 (28.6)	0.370
BMI (kg/m^2)	26.03±5.58	26.49±5.82	25.48±5.44	0.625
Underweight (<18.5)	1 (3.2)	0 (0.0)	1 (7.1)	0.452
Normal weight (18.5-22.9)	10 (32.3)	6 (35.3)	4 (28.6)	1.000
Overweight (23.0-27.4)	8 (25.8)	4 (23.5)	4 (28.6)	1.000
Obesity (≥27.5)	12 (38.7)	7 (41.2)	5 (35.7)	0.445
Lipid profile				
HDL (mg/dL)	55.87±15.66	54.53±16.45	57.50±15.10	0.608
TG (mg/dL)	134.65±68.37	132.88±75.77	136.77±60.92	0.877
TC (mg/dL)	226.16±41.43	231.24±51.82	220.00±24.09	0.434
LDL (mg/dL)	157.74±40.03	164.71±48.73	149.29±25.19	0.293
Uric acid (mg/dL)	5.55±1.58	5.81±1.68	5.24±1.46	0.347
Hb (g/dl)	13.20±1.55	13.16±1.88	13.26±1.13	0.858

Value are represented as n (%), mean ± SD
HTN = hypertension; WCH = white coat hypertension

Table 2. Blood pressure readings of both groups when measured by sphygmomanometer

Blood pressure	Sphygmomanometer		*p*-value
	HTN	WCH	
SBP (mmHg) (mean ± SD)	157.88±7.68	148.18±7.06	<0.001*
DBP (mmHg) (mean ± SD)	94.24±6.56	89.39±4.10	0.018*
Mean (mmHg) (mean ± SD)	115.43±5.76	108.93±3.64	<0.001*

* = Significant at $p<0.050$
SBP = systolic blood pressure; DBP = diastolic blood pressure; HTN = hypertension; WCH = white coat hypertension

Table 3. Blood pressure readings of both groups when measured by ABPM

Blood pressure	ABPM		*p*-value
	HTN	WCH	
SBP (mmHg) (mean ± SD)	149.65±11.81	126.07±5.48	<0.001*
DBP (mmHg) (mean ± SD)	89.53±8.57	75.00±5.68	<0.001*
Mean (mmHg) (mean ± SD)	109.71±7.90	92.00±5.17	<0.001*

* = Significant at $p<0.050$
SBP = systolic blood pressure; DBP = diastolic blood pressure; HTN = hypertension; WCH = white coat hypertension

due to a small sample size and could be related to a cultural influence among Thai patients, in which they tend to feel nervous when attending the clinic, and thus have a higher prevalence of WCH. The authors found that subjects with true HTN had significantly higher mean clinicalSBP and DBP than subjects with WCH, whereas, other clinical characteristics including age, sex, smoking, alcohol consumption, BMI, lipid profile, uric acid and hemoglobin levels were not significantly associated with the diagnosis of WCH. This finding is different from previous studies from other countries. Among 967 Korean subjects, WCH was associated with being female, lower BMI and clinical SBP <150 mmHg[18]. A study from Morocco found that being female, lower SBP and DBP when measured in the clinic and ABPM were independent predictors of WCH among 2,462 subjects[22]. The limitation of our study is a smaller sample size when compared with previous relevant studies, which created a higher possibility of misrepresentation of a true population. This was a cross-sectional study in which causal relationships could not be obtained.

Conclusion

WCH should be suspected in patients with relatively lower clinical BP. We propose that ABPM should be used to confirm the diagnosis of HTN according to the NICE guidelines as a standard practice among ambulatory patients who are suspected to have HTN, especially subjects with relatively lower BP and a higher chance of WCH.

Potential conflicts of interest

None.

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ความชุกของผู้ป่วยความดันโลหิตสูงในโรงพยาบาลราชวิถีโดยใช้เครื่องวัดความดันโลหิตชนิดติดตามตัว

ปริวัตร เพ็งแก้ว, สุรัช สุวรรณการ

ภูมิหลัง: ความดันโลหิตสูงนับเป็นปัญหาทางสุขภาพที่มีความสำคัญทั้งในประเทศไทยและทั่วโลกการวินิจฉัยโรคที่ถูกต้องจะช่วยลดผลข้างเคียงจากการใช้ยาลดความดันโดยไม่จำเป็นและลดค่าใช้จ่ายจากการรักษาในปี พ.ศ. 2555 The National Institute of Health and Clinical Excellence (NICE) ได้เสนอแนวทางการปฏิบัติการวินิจฉัยความดันโลหิตสูงโดยใช้เครื่องวัดความดันโลหิตชนิดติดตามตัวเพื่อแยกกลุ่มผู้ป่วยที่มีภาวะ white coat hypertension (WCH) ออกจากภาวะความดันโลหิตสูง

วัตถุประสงค์: ศึกษาความชุกของความดันโลหิตสูงในผู้ป่วยที่ถูกสงสัยว่าเป็นความดันโลหิตสูงที่เข้ามารับการรักษาที่โรงพยาบาลราชวิถีวัดตามแนวทางปฏิบัติของ NICE และศึกษาปัจจัยที่เกี่ยวข้องกับภาวะ white coat hypertension

วัสดุและวิธีการ: ศึกษาความชุกของความดันโลหิตสูงแบบ cross sectional study โดยผู้เข้าร่วมการศึกษาเป็นผู้ที่มารับการรักษาที่อาคารผู้ป่วยนอกที่โรงพยาบาลราชวิถีอายุ 18-80 ปี จำนวน 31 ราย ซึ่งมี systolic blood pressure (SBP) ≥140 mmHg และหรือ diastolic blood pressure (DBP) ≥90 mmHg ในช่วงเวลาระหว่างเดือน มีนาคม พ.ศ. 2555 ถึง เดือนธันวาคม พ.ศ. 2555 ผู้เข้าร่วมการศึกษาไม่เคยได้รับการวินิจฉัยว่าเป็นโรคความดันโลหิตสูงหรือได้รับยาลดความดันโลหิตภายในเวลา 4 สัปดาห์ และจะถูกวัดความดันโดยเครื่องวัดความดันโลหิตชนิดติดตามตามตัวเพื่อยืนยันการวินิจฉัยความดันโลหิตสูงถ้าผลความดันเฉลี่ยมากกว่าหรือเท่ากับ 135/85 mmHg และผู้เข้าร่วมการศึกษาที่มีผลความดันเฉลี่ยน้อยกว่า 135/85 mmHg จะได้รับการวินิจฉัยว่ามีภาวะ WCH

ผลการศึกษา: ผู้เข้าร่วมการศึกษา 17 ราย จากทั้งหมด 31 ราย (54.8%) ได้รับการยืนยันภาวะความดันโลหิตสูงและอาสาสมัคร 14 ราย มีภาวะ WCH (45.2%) ผู้เข้าร่วมการศึกษาที่ได้รับการยืนยันภาวะโรคความดันโลหิตสูงมีผลความดันเฉลี่ย 157.88±7.68/94.24±6.56 mmHg เมื่อวัดโดยเครื่องวัดความดันปรอทในขณะที่กลุ่ม WCH มีผลความดันเฉลี่ย 148.18±7.06/89.39±4.10 mmHg Mean clinic SBP และ DBP ในกลุ่ม WCH ต่ำกว่ากลุ่มที่ได้รับการยืนยันภาวะความดันโลหิตสูงอย่างมีนัยสำคัญทางสถิติ ($p<0.001$ และ $p<0.018$) โดยอายุ, เพศ, การสูบบุหรี่, สุรา, ดัชนีมวลตัว (BMI), ไขมันในเลือด, กรดยูริกและระดับความเข้มข้นของเลือด (hemoglobin) ไม่มีผลต่อภาวะ WCH

สรุป: ความชุกของโรคความดันโลหิตสูงโดยเครื่องวัดความดันโลหิตชนิดติดตามตัวคือ 54.8% โดยผู้เข้าร่วมการศึกษาที่มีความดันโลหิตในเกณฑ์ค่อนข้างต่ำจากเครื่องวัดความดันโลหิตชนิดปรอทมีโอกาสที่จะมีภาวะ WCH สูงกว่า โครงการวิจัยนี้แนะนำการใช้เครื่องวัดความดันโลหิตชนิดติดตามตัวตามแนวทางปฏิบัติของ NICE เพื่อใช้วินิจฉัยความดันโลหิตสูงในกลุ่มผู้ป่วยนอก