

Research Article

Excessive pulse pressure response to standing in community population with orthostatic systolic hypertension

Jingsong Xu, MD^{a,1}, Yueying Zhou, MD^{b,1}, Kaiwu Cao, MD^a, Juxiang Li, MD, PhD^a,
Xuehua Tao, MD^c, Zhihong Zhang, MD^{a,d,1}, Xin Liu, MD^d,
Jiaqi Liu, MD^b, and Hai Su, MD, PhD^{a,*}

^aResearch Institute of Cardiovascular Diseases and Department of Cardiology, Second Affiliated Hospital of Nanchang University, Nanchang, Jiangxi, People's Republic of China;

^bDepartment of Medicine, Guizhou Hospital of Fushan city, Fushan, Guangdong, People's Republic of China;

^cDepartment of Medicine, Sixth Hospital of Nanchang city, Nanchang, Jiangxi, People's Republic of China; and

^dStatistic Teaching Group, Fuzhou Medical College of Nanchang University, Fuzhou, Jiangxi, China

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Abstract

The postural change of pulse pressure (PP) in the persons with orthostatic hypertension (OHT) is unclear. This study included 2849 (65.0 ± 9.3 years) community participants. Blood pressures (BPs) in supine and standing positions were measured. The differences between upright and supine BP and PP were recorded as Δ BP and Δ PP. The criteria for OHT was Δ BP ≥ 10 mm Hg, for orthostatic hypotension (OH) was ≤ -10 mm Hg and for orthostatic normotension (ONT) was -9 to 9 mm Hg. Fasting blood lipids and glucose were measured. The supine SBP of the sOHT group were similar to that of sONT group (140.9 ± 20.2 mm Hg vs 138.2 ± 19.7 mm Hg), but significantly lower than that of sOH group (151.9 ± 19.2 mm Hg; $P < .05$). Their PPs were 65.3 ± 15.9, 62.8 ± 14.7, and 71.1 ± 15.1 mm Hg, respectively, and with the similar group difference like SBP. When the position changed from supine to standing, the sOHT group showed PP rise, while sOH and sONT groups showed PP reduction (3.8 ± 7.1 mm Hg vs -17.0 ± 8.5 mm Hg and -5.8 ± 6.6 mm Hg; both $P < .05$). Thus, the standing PP in the sOHT group was significantly higher than in the sONT (69.1 ± 18.0 mm Hg vs 57.0 ± 15.8 mm Hg; $P < .05$) and in the sOH (54.2 ± 15.2 mm Hg; $P < .05$) groups. The postural PP profile varies with the postural responses of SBP. The sOHT group has obviously increased PP and significantly higher standing PP compared with the sONT group. *J Am Soc Hypertens* 2014;8(3):166–170. © 2014 American Society of Hypertension. All rights reserved.

Keywords: Orthostatic; hypertension; hypotension; blood pressure; heart rate.

Introduction

Hypertension is an important risk factor for cardio-cerebrovascular diseases. In addition to systolic and diastolic blood pressure (SBP and DBP), the contribution of increased pulse pressure (PP) to cardio-cerebrovascular risk is currently receiving growing attention.^{1,2} Several large prospective trials

as well as the re-analysis of previously collected data have convincingly demonstrated that the higher the PP level, the greater the incidence of mortality of cardio-cerebrovascular diseases in both normotensive and hypertensive subjects.³ Meanwhile, increased PP has also been implicated in the development of coronary heart disease^{4,5} and peripheral atherosclerosis.^{6–8}

Generally, there are three types of postural BP change: orthostatic normotension (ONT), orthostatic hypotension (OH), and orthostatic hypertension (OHT).^{9–12} Recent studies have shown that not only OH, but OHT is associated with higher cardio-cerebrovascular diseases.¹³

It is clear that the association of postural SBP with cardio-cerebrovascular diseases is different from that of postural DBP.¹⁴ But the contribution of postural pulse pressure (PP) to cardio-cerebrovascular diseases is unclear now as little

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*Corresponding author: Hai Su, MD, PhD, 330006, No 1 Mingde Road, Nanchang, Jiangxi, China.

E-mail: suyihappy@sohu.com

¹ Contributed equally.

Table 1

The prevalence and general information of sOH, sONT, and sOHT groups

	Case (%)	Male (%)	Smoking	FH of DM	FH of CHD	Age (y)	BMI (kg/m ²)
Total	1868 (100.0)	554 (29.7)	238 (12.7)	165 (8.8)	36 (1.9)	63.6 ± 9.4	23.0 ± 3.2
sOH	255 (13.7)	81 (31.8)	42 (16.5)	25 (9.8)	7 (2.7)	66.6 ± 7.9* [†]	22.8 ± 3.4
sONT	1249 (66.9)	364 (29.1)	157 (12.6)	105 (8.4)	24 (1.9)	62.8 ± 9.5 [†]	23.0 ± 3.2
sOHT	364 (19.5)	109 (29.9)	39 (10.7)	35 (9.6)	5 (1.4)	64.3 ± 9.7	23.2 ± 3.0
F, χ^2	–	0.715	4.568	0.857	1.454	18.080	1.337
P	–	0.699	.102	.651	.483	<.001	.263

BMI, body mass index; CHD, coronary heart disease; DM, diabetes; FH, family history; sOH, supine orthostatic hypotension; sOHT, supine orthostatic hypertension; sONT, supine orthostatic normotension.

* *P* < .05 compared with sONT group.

[†] *P* < .05 compared with sOHT group.

is known about the postural PP change. Therefore, the aim of this study was to investigate whether the profile of postural PP in systolic OHT is different from that in systolic ONT, as well as from that in systolic OH. This information will be useful for us to better understand the mechanism of higher cardio-cerebrovascular risk of OHT.

Methods

Participants

Between September and December of 2011, 3311 adult community residents were enrolled from two communities, one in Nanchang City of Jiangxi province, the other in Shunde City of Guandong province. The information on age, gender, smoking (more than one-half year), family history of hypertension, and histories of hypertension and diabetes were obtained by questionnaires and medical records. Waist and hip circumference, body mass index (BMI), fasting blood glucose, total cholesterol (TC), triglyceride (TG),

and high and low density lipoprotein cholesterol (HDL-C and LDL-C) were measured. The patients under antihypertensive therapy or with sitting BP of 140/90 mm Hg or more measured at investigation were diagnosed as hypertensive patients. The subjects with arrhythmias were excluded. Finally, 2849 subjects of ≥40 years (854 males and 1995 females, 40 to 108 years old, mean age 65.0 ± 9.3 years) with complete measurement data were included.

BP Measurements and Parameters

The proposal and the consent procedures of this study were approved by the Ethic Committees of the Second Affiliated Hospital of Nanchang University, the Sixth Hospital of Nanchang city and Guizhou Hospital of Fushan city. All participants provided verbal informed consent for BP measurement of four limbs as this measurement is a non-invasive clinical examination.

After 10 minutes of supine rest, supine BP of two arms were measured simultaneously using two electronic

Table 2

BP, PP, and HR among systolic OH, ONT, and OHT groups

	Total	sOH	sONT	sOHT	F	P
Supine SBP (mm Hg)	134.9 ± 18.8	147.0 ± 18.6* [†]	132.6 ± 17.8 [†]	134.4 ± 18.9	67.689	<.001
Standing SBP (mm Hg)	136.1 ± 19.4	131.1 ± 18.8 [†]	133.5 ± 17.8 [†]	148.7 ± 20.1	106.079	<.001
ΔSBP (mm Hg)	1.08 ± 11.19	−18.11 ± 9.11* [†]	0.79 ± 5.13 [†]	15.51 ± 5.25	2477.202	<.001
Supine DBP (mm Hg)	74.5 ± 10.0	79.7 ± 10.3* [†]	73.6 ± 9.7	73.8 ± 9.8	42.099	<.001
Standing DBP (mm Hg)	81.4 ± 10.3	80.3 ± 11.0 [†]	80.5 ± 9.8 [†]	84.9 ± 10.4	27.789	<.001
ΔDBP (mm Hg)	6.74 ± 6.43	−0.10 ± 7.00* [†]	6.80 ± 5.18 [†]	11.33 ± 5.65	317.629	<.001
Supine PP (mm Hg)	60.4 ± 13.6	67.3 ± 13.7* [†]	58.9 ± 13.0	60.6 ± 14.2	41.610	<.001
Standing PP (mm Hg)	54.8 ± 15.3	50.8 ± 14.6 [†]	53.0 ± 14.0 [†]	63.8 ± 16.6	87.157	<.001
ΔPP (mm Hg)	−5.61 ± 8.95	−16.53 ± 8.67* [†]	−5.95 ± 6.55 [†]	3.19 ± 7.09	602.254	<.001
Supine HR (bpm)	73.0 ± 10.9	72.3 ± 12.4	72.8 ± 10.8	73.8 ± 9.8	1.469	.231
Standing HR (bpm)	81.3 ± 12.0	83.0 ± 14.0	81.1 ± 11.7	81.0 ± 11.7	2.724	.066
ΔHR (bpm)	8.35 ± 6.52	10.66 ± 8.00* [†]	8.20 ± 6.00* [†]	7.24 ± 6.68	22.093	<.001

BP, blood pressure; bpm, beats per minute; DBP, diastolic blood pressure; HR, heart rate; OH, orthostatic hypotension; OHT, orthostatic hypertension; ONT, orthostatic normotension; PP, pulse pressure; SBP, systolic blood pressure; sOH, supine orthostatic hypotension; sOHT, supine orthostatic hypertension; sONT, supine orthostatic normotension.

* *P* < .05 compared with ONT.

[†] *P* < .05 compared with OHT.

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