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COMMENTARY

Prevalence of prehypertension and left ventricular hypertrophy

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Hypertension (HT) is an important public health challenge worldwide because it is a major risk factor for cardiovascular disease (CVD) and is associated with increasing morbidity and mortality. The number of patients with elevated blood pressure (BP) has increased from 594 million in 1975 to 1.13 billion in 2015, and more than 40% of people >25 years old have HT.[1] HT is often called 'the silent killer' because it rarely causes symptoms in the early stages. Therefore, significant numbers of individuals with HT are unaware of their condition, and, according to a 2004 systematic review of the worldwide prevalence of HT, approximately half of patients with HT go undiagnosed.[2] The effective treatment and definition of HT are both continuously changing and are debated under the current medical and social circumstances in different countries. Moreover, ethnic differences in left ventricular mass (LVM) and geometry have been recognized. Therefore, data about the incidence of HT and left ventricular hypertrophy (LVH) need to be surveyed and updated.

LVH is characterized as a growth in LVM caused by increased cardiomyocyte size and is associated with systemic BP. The higher the pressure in the blood vessels, the harder the heart needs to work to pump an adequate stroke volume of blood, which leads to cardiac hypertrophy. LVM can increase with wall thickening (WT) and/or chamber dilatation. WT occurs more commonly in response to pressure overload, while chamber dilation occurs more commonly in response to volume overload. LVWT is more strongly related to systemic diastolic blood pressure (DBP) (concentric hypertrophy), which reflects pressure overload caused by increased systemic vascular resistance. On the other hand, LVM is more closely related to systolic blood pressure (SBP), which suggests influences of both pressure and volume overload (eccentric hypertrophy).[3] In addition, it is well known that long-term BPV is associated with cardiovascular events, but short-term BPV also suggests a weak positive correlation with LVM in a meta-analysis.[4]

Usually, systolic function at rest is normal or mildly increased; however, the degree of diastolic dysfunction can vary in patients with mild to moderate HT and LVH. Thereafter, LVH may evolve to overt systolic and/or diastolic dysfunction with the corresponding clinical presentation of HF with preserved or reduced EF.[3] LVH is a critical manifestation of hypertensive organ damage associated with an increased cardiovascular (CV) risk including renal dysfunction. The combination of LVH and renal dysfunction is associated with increased CV events.[5] However, ~20–60% of patients with uncomplicated HT showed increased LVM by echocardiography (UCG).[3] Because LVH can be limited and may eventually become maladaptive and evolve toward progressive LV dysfunction and heart failure (HF), LVH is strongly associated with an increased risk for a number of adverse clinical outcomes, including HF, incident coronary artery disease, stroke, arrhythmia and mortality.[6] A number of studies have reported that ethnic differences do exist in LVH. Kizer *et al.*[7] reported the strong association between black ethnicity and increased LVM and relative wall thickness in hypertensive adults compared with white individuals. Moreover, the influence of HT is remarkable in Asians compared with Caucasians.[8] Thus, we need to be aware of the ethnic disparities in LVH to understand and mitigate the increased CV mortality.

Prehypertension, defined as systemic BP between 120/80 and 139/89 mm Hg, is a 'danger zone' for the later development of HT and is also associated with an increased incidence of CVDs and CV mortality. Prehypertension is also associated with increased CV risk and end organ damage compared with that in normotensive people. An association has been reported between prehypertension and inflammatory markers linked to the atherosclerotic process, independent of other coexisting risk factors.[9] The prehypertensive patients showed higher levels of C-reactive protein, tumor necrosis factor-alpha, amyloid A, homocysteine and white blood cell counts after correcting for multiple factors. Therefore, people with prehypertension may already have a proinflammatory status, which reflects the promotion of atherogenesis. Although these patients may not complain of symptoms in the prehypertensive stage, cardiac geometrical and functional changes can be detected by UCG. Indeed, hypertensive patients had a higher prevalence of geometrical and functional changes in the left heart, although data regarding the association between prehypertension and geometrical and functional changes of the left heart are rare. However, SBP and DBP were significantly correlated with age and body mass index in patients with prehypertension,[10] and Jung *et al.*[11] reported the incidences of LVH and the odds ratios for each stage of patients with HT. Therefore, that large-scale study investigated geometrical and functional changes of the left heart with prehypertension and HT in Korean people to provide recent and important information. The authors reported that LV diastolic

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dysfunction, which is indicated by E/e, and deceleration time were recognized in the prehypertension group in addition to LV remodeling and hypertrophy. Impaired LV diastolic dysfunction occurred earlier than systolic dysfunction and was followed by a decrease in early diastolic ventricular filling and a greater atrial contribution to ventricular filling in the late-systolic period.[12] Additionally, the significantly progressive enlargement of the left atria dimension (LAD), as evidence of diastolic dysfunction, was also recognized in the prehypertension through HT groups. Recently, it was reported that BPV is related to LAD in newly diagnosed hypertensive patients.[13] Therefore, LAD is also one of the important pieces of data that cannot be overlooked.

Jung *et al.* evaluated 52 111 Korean adults receiving an echocardiogram and reported that the odds ratios of LVH were 2.10 (95% CI: 1.63–2.70) in the prehypertension group (120–139/80–89 mm Hg), 3.02 (95% CI: 2.33–3.91) in the controlled HT group, 5.03 (95% CI: 3.56–6.99) in the newly recognized HT group and 10.94 (95% CI: 7.99–14.87) in the uncontrolled HT group and 2.26 (95% CI: 1.73–2.94) in the non-diabetic prehypertension group, 3.20 (95% CI: 2.41–4.23) in the controlled HT group, 5.33 (95% CI: 3.70–7.54) in the newly recognized HT group and 13.08 (95% CI: 9.37–18.11) in the uncontrolled HT group after full adjustments. This was a large-scale epidemiological study, including echocardiographic data and precise BP data despite a single measurement of BP.[11] For BP, early detection and intervention with proper management are essential for the prevention of LVH. The authors discuss recent literature on the prevalence of LVH, as assessed by echocardiography, to offer updated information on the magnitude of subclinical alterations in LV structure in contemporary HT in Korea.

Despite the improved management of HT in the last two decades with advances in medical technology, it is clear that LVH remains a highly frequent biomarker of cardiac damage in the hypertensive population. These findings call for a more aggressive treatment of HT and for the early detection of prehypertension to prevent CV risk factors leading to LVH.

CONFLICT OF INTEREST

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1 NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in blood pressure from 1975 to 2015: a pooled analysis of 1479 population-based measurement studies with 19.1 million participants. *Lancet* 2017; **389**: 37–55.
2 Kearney PM, Whelton M, Reynolds K, Whelton PK, He J. Worldwide prevalence of hypertension: a systematic review J. *J Hypertens* 2004; **22**: 11–19.
3 Lazzeroni D, Rimoldi O, Camici PG. From left ventricular hypertrophy to dysfunction and failure. *Circ J* 2016; **80**: 555–564.
4 Madden JM, O'Flynn AM, Fitzgerald AP, Kearney PM. Correlation between short-term blood pressure variability and left-ventricular mass index: a meta-analysis. *Hypertens Res* 2016; **39**: 171–177.
5 Maruyama K, Nakagawa N, Saito E, Matsuki M, Takehara N, Akasaka K, Sato N, Hasebe N. Malnutrition, renal dysfunction and left ventricular hypertrophy synergistically increase the long-term incidence of cardiovascular events. *Hypertens Res* 2016; **39**: 633–639.
6 Levy D, Garrison RJ, Savage DD, Kannel WB, Castelli WP. Prognostic implications of echocardiographically determined left ventricular mass in the Framingham Heart Study. *N Engl J Med* 1990; **322**: 1561–1566.
7 Kizer JR, Arnett DK, Bella JN, Paranicas M, Rao DC, Province MA, Oberman A, Kitzman DW, Hopkins PN, Liu JE, Devereux RB. Differences in left ventricular structure between black and white hypertensive adults: the Hypertension Genetic Epidemiology Network Study. *Hypertension* 2004; **43**: 1182–1188.
8 Arima H, Murakami Y, Lam TH, Kim HC, Ueshima H, Woo J, Suh I, Fang X, Woodward M. Asia Pacific Cohort Studies Collaboration Effects of prehypertension and hypertension subtype on cardiovascular disease in the Asia-Pacific Region. *Hypertension* 2012; **59**: 1118–1123.
9 Chrysohoou C, Pitsavos C, Panagiotakos DB, Skoumas J, Stefanadis C. Association between prehypertension status and inflammatory markers related to atherosclerotic disease: the ATTICA Study. *Am J Hypertens* 2004; **17**: 568–573.
10 Tripolino C, Gnasso A, Carallo C, Scavelli FB, Irace C. Hemorheological profiles of subjects with prehypertension. *Hypertens Res* 2016; **39**: 519–523.
11 Jung JY, Park SK, Oh C-M, Kang JG, Choi J-M, Ryoo J-H, Lee J-H. The influence of prehypertension, controlled and uncontrolled hypertension on the left ventricular diastolic function and structure in Korean general population. *Hypertens Res* 2017; **40**: 606–612.
12 Wachtell K, Smith G, Gerdts E, Dahlöf B, Nieminen MS, Papademetriou V, Bella JN, Ibsen H, Rokkedal J, Devereux RB. Left ventriclar filling patterns in patients with systemic hypertension and left ventriclar hypertrophy (the LIFE Study). *Am J Cardiol* 2000; **85**: 466–472.
13 Cipollini F, Arcangeli E, Seghieri G. Left atrial dimension is related to blood pressure variability in newly diagnosed untreated hypertensive patients. *Hypertens Res* 2016; **39**: 583–587.