



Left ventricular hypertrophy was not built in a day

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All roads lead to Rome, but Rome wasn't built in a day. Likewise, left ventricular hypertrophy (LVH) does not develop in a day, and the moderate-stable and moderate-increasing trajectories of the rate pressure product (RPP) lead to LVH.

In the disease trajectory of heart failure (HF), hypertension and obesity are categorized as stage A, and LVH is categorized as stage B [1]. LVH is associated with HF with preserved ejection fraction (HFpEF), and the prevention of progression from stage B to C is a major challenge [2]. Japan is the world's first superaged society, and annual trends in hospitalized patients show an increase in the number of older women with HFpEF [3, 4]. However, there is no effective treatment for HFpEF, a barrier that many previous therapeutic options have tried to address and failed to overcome. However, sodium-glucose cotransporter (SGLT)-2 inhibitors have led to a new era of HFpEF treatment and are key drugs in HF treatment [5, 6].

Recently, Asian trends in HF have become a topic of debate, with a focus on HFpEF in young adults, in which obesity and hypertension have been identified as common risks [7]. As Asian countries have transitioned from developing to developed countries (“epidemiological transition”), the causes of mortality and morbidity have shifted from infectious diseases and/or nutritional deficiencies to lifestyle-related diseases, such as cardiovascular disease, cancer, and diabetes mellitus [8]. Sakata et al. reported on HFpEF and the prevention of HF in Asia in their 2013 review [9]. Tromp et al. found that younger patients with HFpEF more often have higher rates of obesity and fewer comorbidities but have similar filling pressures and rates of

LVH as older patients with HF. Quality of life and mortality are better in younger patients with HFpEF, yet mortality is markedly worse in patients with HFpEF compared to age- and sex-matched control patients without HF [2].

Heart rate (HR) and blood pressure (BP) are incorporated into the RPP, which is an indirect index of myocardial oxygen consumption that predicts cardiac function, morbidity, and mortality in patients with cardiovascular disease [10]. Zheng et al. demonstrated that RPP trajectories in early life are associated with LVH in middle age, independent of anthropometric measurements and metabolic risk factors; thus, the identification of longitudinal RPP trajectories from childhood may provide additional information on risk prediction for an individual's cardiovascular health status in later life [11]. Furthermore, this study is valuable because the data were obtained before the development of hypertension and LVH and collected at regular intervals, with a long follow-up period of 30 years. It is also notable that the simplest and most noninvasive tests are performed by BP, HR, and electrocardiogram (ECG).

In addition to the Cornell voltage product used in this study, other criteria for LVH were included, such as Sokolow-Lyon criteria and the newly proposed ECG criteria; however, no perfect index exists [12, 13]. The sum of the R wave in limb lead I (RLI) and the S wave in V4 (SV4) (RLI + SV4) seems to be more useful in the general Japanese population than the previous LVH diagnostic criteria [13]. LVH should ultimately be confirmed by an increased left ventricular mass on echocardiography or MRI. One limitation of this study was the lack of proof of actual LVH based on these imaging modalities [11]. The LVH geometry includes concentric remodeling and hypertrophy and eccentric hypertrophy. In a U.S. study of white and black people of ~40 years of age, concentric remodeling was the most common, followed by concentric hypertrophy and eccentric hypertrophy [14]. In an Asian study, no age- and sex-matched control patients had any concentric hypertrophy compared to 25% of very young patients with

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Rate pressure product (RPP)	Systolic blood pressure (mmHg)								
	160	150	140	130	120	110	100	90	
Heart rate (bpm)	110	17,600	16,500	15,400	14,300	13,200	12,100	11,000	9,900
	105	16,800	15,750	14,700	13,650	12,600	11,550	10,500	9,450
	100	16,000	15,000	14,000	13,000	12,000	11,000	10,000	9,000
	95	15,200	14,250	13,300	12,350	11,400	10,450	9,500	8,550
	90	14,400	13,500	12,600	11,700	10,800	9,900	9,000	8,100
	85	13,600	12,750	11,900	11,050	10,200	9,350	8,500	7,650
	80	12,800	12,000	11,200	10,400	9,600	8,800	8,000	7,200
	75	12,000	11,250	10,500	9,750	9,000	8,250	7,500	6,750
	70	11,200	10,500	9,800	9,100	8,400	7,700	7,000	6,300
	65	10,400	9,750	9,100	8,450	7,800	7,150	6,500	5,850
60	9,600	9,000	8,400	7,800	7,200	6,600	6,000	5,400	

Moderate-Increasing	12,956 (11,808-14,294)
Moderate-Stable	10,019 (9,046-10,930)
Low-Stable	8,342 (7,480-9,275)

Fig. 1 The relationship between systolic blood pressure and heart rate is color-coded into three groups for the RPP values of patients aged 41–45 years. The RPP values are based on the quartiles in Supplemental Table 3 of the study by Zheng et al. [11]

HFpEF [2]. Another Asian study reported that Japanese/Korean patients (Northeast Asians) showed higher rates of eccentric hypertrophy, whereas Indian and Malay patients (South Asians) showed higher rates of concentric hypertrophy [7].

Figure 1 shows the relationship between systolic BP and HR for the RPP at the age of 41–45 years and has been color-coded into three groups. The RPP values were based on the quartile values in Supplementary Table 3 in the Zheng et al. study [11]. In the moderate-increasing group, approximately half of the patients developed hypertension in their early 40s. Hypertension is a risk factor for cardiovascular events; as per the ACC/AHA guidelines, lowering BP in patients with hypertension or stage 1 hypertension in their mid-40s (median age: 46 years) is suggested for the prevention of cardiovascular disease development, as reported in Japan [15]. An RPP value of 10,000 mmHg.bpm at the age of 25 years could be a possible benchmark in high-risk RPP trajectories [11]. Another factor to note is that the patients in the moderate-increasing group tend to be obese, and I hope that future studies will identify the predictors of LVH or an RPP increase.

Compliance with ethical standards

Conflict of interest The author declares no competing interests.

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