ORIGINAL ARTICLE

Prevalence and Determinants of Left Ventricular Hypertrophy in Hypertensive Patients at a Primary Care Clinic

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Abstract:

Left ventricular hypertrophy (LVH) has prognostic significance on cardiovascular mortality and morbidity. However, echocardiography screening for LVH is not routinely done for hypertensive patients in a primary care setting. Thus, this quantitative study aims to determine the prevalence and factors associated with LVH in hypertensive patients at a primary care setting. This was a cross-sectional study of 359 consecutive patients with uncomplicated essential hypertension attending a hospital-based clinic in Malaysia. All subjects underwent an echocardiography test. LVH occur when the left ventricular posterior wall thickness together with inter-ventricular septal thickness is ≥11 mm. It was found that 24% patients fulfilled the criteria for LVH. The mean age of the study population was 59.2±7.7 years; mean duration of hypertension was 9.7±7.5 years; and mean blood pressure was 136.5/81.5 (±13.7/7.7) mmHg. Using multiple logistic regression analysis, patients who were obese [odds ratio (OR) 8.34, 95% confidence interval (CI) 3.14, 22.22] and male gender (OR 1.96, 95% CI 1.08, 3.16) had significant positive association with LVH. LVH was found in approximately one fourth of the hypertensive patients at a hospital-based primary care setting. There was a significant positive association between LVH and obesity and being male. Guidelines for enhancing use of echocardiography in detecting LVH may be needed.

Introduction

Hypertension with its concomitant risks of cardiovascular and kidney diseases, is a serious public health problem worldwide.[1,2] It is also ranked third as a cause of disability-adjusted life years and contributes significantly to global mortality.[2-4] By 2025, globally a 60% increase in hypertensive adult patients is predicted from 972 million in 2000 to 1.56 billion in 2025.[3] In Malaysia, the prevalence of hypertension has increased dramatically from 33% to 43% over the last decade despite intensive health care campaigns and efforts.[5]

Left ventricular hypertrophy (LVH) is one of the earliest manifestations of organ damage among hypertensive patients, and is a strong independent predictor of cardiovascular mortality and morbidity.[6-11] The prevalence of LVH varies because different method, and cut-off points were used to diagnose LVH in previous studies.[12] Studies show that the incidence of LVH increases with age, obesity, being male and blood pressure (BP).[13-17] Angiotensin-receptor blockers (ARB) and angiotension-converting enzyme inhibitors (ACEI) are shown to reduce the incidence of LVH and stroke.[18-21] Early diagnosis of LVH

followed by risk stratification and aggressive treatment are essential to prevent cardioascular morbidity and mortality.

Primary care physicians are the front-liners who treat hypertension.[22] However, a study in Malaysia reported that cardiovascular risks are inadequately assessed among hypertensive patients [23] and little is known about the prevalence of LVH in the primary care setting. Echocardiography is not done routinely in primary care even though it is more accurate than electrocardiograph (ECG) or chest X-ray in determining LVH.[24-26] It will be useful to identify associate factors and to determine the difference between genders. It is hoped that the results will provide insights into developing a strategy for identifying LVH in patients with hypertension.

Methods

This is a cross-sectional study conducted from June to September 2009 at a university primary care centre in Kuala Lumpur, Malaysia. It was aimed at patients with hypertension, defined as when their case record fulfilled the following criteria:

- documented diagnosis of hypertension according to World Health Organisation (WHO) International Society of Hypertension (ISH) criteria, or
- based on current treatments consisting of lifestyle modification or antihypertensive agents

All eligible patients went through an echocardiogram examination. A standard two-dimensional M-mode transthoracic echocardiography was used to detect LVH in the study population. Echocardiography was performed by trained technicians in a tertiary centre who followed a standard protocol. LVH was diagnosed when the left ventricular posterior wall thickness together with inter-ventricular septal thickness is ≥11 mm.[27] The echocardiography results were interpreted by a cardiologist. Patients with echocardiograph evidence of myocardial infarction (MI), rhythm disorder (atrial fibrillation, bundle branch blocks, Wolf Parkinson-white syndrome or other conduction abnormalities) and structural heart disease [ventricular septal defect, aortic stenosis or mitral regurgitation] were excluded as they are confounders for LVH.

Patients' heights and weights were recorded using a digital weighing machine with stadiometer. BP was taken using a mercury sphygmomanometer. Body mass index (BMI) was calculated as weight in kilogrammes divided by the square of height in meters. Using the Asian Pacific obesity guideline, obesity is defined as having a BMI more than 27.5 kg/m^2.[28] Average of three BP readings was used to determine the measurement of BP. Target BP was defined as <140/90 mmHg among hypertensive patients and <130/80 mmHg among hypertensive patients with diabetes.[23,29]

The sample size of 323 was calculated by using Epi Info 6.0 following a pilot study. It was based on the estimated prevalence of LVH of 25%-30% with 80% power, 95% confidence interval (CI) and statistical significance level (α) at 5%.

Statistical analysis

SPSS version 18 (SPSS IBM New York) was used to perform the statistical analysis. Continuous data were described as mean and SD or median and interquartile range (25-75th percentiles). Chi square test was used to analyse the categorical data. Multiple logistic regressions were used to elucidate the various risk factors influencing LVH. A level of significance was set at p-value <0.05.

Results

Of the 428 patients, 376 agreed to participate in the study (response rate of 89.8%). Out of the 376 respondents, 17 (4.5%) were excluded from analysis due to underlying structural heart diseases.

The mean age of the study population was 59.2±7.7 years and mean duration of hypertension was 9.7±7.5 years. Two-fifth of the respondents were men (42.1%) and the mean BMI was 26.8±4.7 kg/m^2. The study population consisted of Chinese (50.1%), Malays (27.6%), Indians (21.2%) and others (1.1%). Majority were married, and two-third had secondary education and above (Table 1).

Table 1: Sociodemography of study population by echocardiographic LVH status

Variables		LVH (n=86) N (%)	No LVH (n=273) N (%)	p value N (%)
Age	<65	65 (25.8)	185 (74.2)	0.210
	>65	21 (19.6)	86 (80.4)	
Gender	Males	45 (29.8)	106 (70.2)	0.027
	Females	41 (19.7)	167 (80.3)	
Education	<Primary	16 (32.0)	34 (68.0)	0.311
	Secondary	43 (20.9)	163 (79.1)	
	Tertiary	27 (26.2)	76 (73.8)	
Ethnicity	Malay	26 (26.3)	73 (73.7)	0.079
	Chinese	42 (23.3)	138 (76.7)	
	Indian	15 (19.7)	61 (80.3)	
Job status	Still working	29 (29.6)	69 (70.4)	0.083
	Not working	57 (21.8)	204 (78.2)	
Mean age, years		58.9 (7.5)	59.5 (7.5)	0.989
BP duration, years		9.5 (6.4)	9.7 (7.8)	0.807
SBP, mmHg		137.9 (15.4)	135.8 (13.3)	0.216
DBP, mmHg		81.1 (7.4)	83.0 (8.7)	0.040
BMI, kg/m^2		28.8 (4.7)	26.2 (4.6)	0.001

Table 2: Clinical profiles of study population by echocardiographic LVH status (continuous variables)

	Total sample (n=359) mean ±SD	LVH* (n=86) mean ±SD	No LVH (n=273) mean ±SD	p value
Mean age, years	59.2 (7.7)	58.9 (7.5)	59.5 (7.5)	0.989
Duration of hypertension (years)	9.7 (7.5)	9.5 (6.4)	9.7 (7.8)	0.807
SBP (mmHg)	136.5 (13.7)	137.9 (15.4)	135.8 (13.3)	0.216
DBP (mmHg)	81.5 (7.7)	81.1 (7.4)	83.0 (8.7)	0.040
BMI (kg/m^2)	26.8 (4.7)	28.8 (4.7)	26.2 (4.6)	0.001

Table 3: Clinical profile of study population by echocardiographic LVH status (categorical variables)

Variables		LVH (n=86), %	No LVH (n=273), %	p value
BP controlled#, %		35(23.5)	114(76.5)	0.862
BMI **classification, %	<23.5	5(6.3)	74(93.7)	0.001
	23.5-27.4	33(23.7)	106(76.3)	
	≥27.5	48(34.0)	93(66.0)	
Number of medication, %	≤1	38(21.2)	141(78.8)	0.060
	2	31(23.7)	100(76.3)	
	≥3	17(34.7)	32(65.3)	
Types of antihypertensive, %	CCB	40(23.5)	130(76.5)	0.858
	ACE inhibitors	38(27.7)	99(72.3)	0.187
	β-blocker	31(27.4)	82(72.6)	0.295
	Diuretics	31(30.1)	72(69.9)	0.084
	ARB	12(17.9)	55(82.1)	0.199
Smokers, %		19(36.5)	33(63.5)	0.051
Alcohol consumption %		29(29.6)	69(70.4)	0.125
Diabetes mellitus , %		42(28.6)	105(71.4)	0.088

*LVH: left ventricular hypertrophy; **BMI: body mass index; BP: blood pressure; SBP: systolic blood pressure; DBP: diastolic blood pressure; #BP controlled indicate BP reading <140/90 mmHg among hypertensive and <130/80 mmHg in hypertensive with underlying diabetic; CCB: calcium channel blocker; ACE Inhibitor: Angiotensin converting enzyme inhibitor; ARB: Angiotensin II receptor blocker

The percentage of patients achieving target BP was 41.5% and the prevalence of echocardiography-diagnosed LVH was 24%. The Malays had the highest incidence of LVH (26.3%), followed by Chinese (23.3%) and Indians (19.7%). The mean systolic blood pressure (SBP) and mean diastolic blood pressure (DBP) were 136.5±13.7 mmHg and 81.5±7.7 mmHg respectively (Table 2). Generally, men had higher DBP (p=0.002) and longer duration of hypertension (p=0.003); more men smoked (33.1% versus 1%, p<0.001) and consumed alcohol (46.5% versus 13.5%, p<0.001). Table 2 a & b compares the clinical parameters between patients with and without LVH.

Generally, more than half of the study population were elderly (aged 60 years and above). Those who had echocardiographic evidence of LVH were found in the 50-60 age group. Elderly patients appeared to have better BP control compared with the younger group (43.4% versus 38.8%).

Table 4 shows the odds of having LVH by using multiple logistic regressions after adjusting for established LVH risk factors. Hypertensive patients who were obese [odds ratio (OR) 8.34, 95% confidence interval (CI) 3.14 to 22.22] and male gender (OR1.96, 95%CI 1.08 to 3.16) had significant positive association with LVH.

Discussion

The study revealed that one in four hypertensive patients have LVH despite 41.5% of them having achieved a target BP. This figure was comparable to the prevalence of 23-26% in New York and Rome primary care settings.[12,30]

Table 4: Predictors of LVH in multivariate analysis at UMMC

Variables		OR*	95.0% CI**	p value
Age		1.02	(0.98, 1.06)	0.302
Male gender		1.96	(1.08, 3.16)	0.010
BMI	Normal	1		
	Overweight	4.62	(1.72, 12.45)	0.002
	Obese	8.34	(3.14, 22.22)	0.001
BP duration		0.996	(0.96, 1.03)	0.810
Achieve BP control		0.71	(0.31, 1.62)	0.420
Diastolic BP		1.02	(0.99, 1.06)	0.209
Smoking		1.84	(0.88, 3.87)	0.106
Diabetes		1.39	(0.83, 2.32)	0.209

It was higher compared with Japan and United States primary care studies, which reported prevalence of 15%[31] and 19% respectively.[12] Our study was aimed at raising concerns about rising hypertension cases in Malaysia, especially when the incidence of hypertension is increasing throughout the Asia-Pacific region due to ageing and lifestyle changes.

There is an increasing body of evidence as well as controversies regarding the role of gender in developing LVH.[13-14,16,32] A study has shown that females have a positive association with LVH. However, other studies have shown that male gender was an independent predictor for LVH.[13-14] At the same time, another study has reported that there is no difference between gender and LVH.[32] Our study found that the male gender is a predictor for the development of LVH. This is probably because men in this study had more cardiovascular risk factors as they had higher DBP (p=0.002), suffered from hypertension for a longer time (p=0.003) and smoked (p<0.001) as well as consumed alcohol (p<0.001) more than women. This is consistent with the findings in a local study where the coronary heart disease risks classified by Framingham risk score was higher in men compared to women.[33] These risk factors make them prone to developing LVH compared to female patients. A study conducted in 2006 in Spain reported that men had a higher prevalence of LVH and were at higher risks for cardiovascular disease.[14] In this particular study, 15,798 hypertensive patients who were more than 55 years were enrolled, and the prevalence of ECG-diagnosed LVH was 20.3%. These two observations reaffirm that male patients often have higher cardiovascular risk factors and are more prone to getting ischaemic heart disease. [14,34]

Previous studies found that patients with obesity have a higher risk of developing LVH.[16, 17, 34-38] In this study obesity was one of the predictors for developing LVH among hypertensive patients. The odds of developing LVH were 4.62 times higher for an overweight patient compared with a patient who has normal weight. Furthermore, the odds of developing LVH doubled for an obese patient compared with an overweight patient. Study from India found similar trend in associating obesity with the risk of developing LVH.[39] This is probably related to obesity cardiomyopathy, which is characterised by the presence of LVH.[40] As such, weight reduction may play an important role in retarding the LVH progression as shown in other studies.[41, 42]
There is a negative relationship between age and LVH. It could be because LVH had regressed among the elderly group because this group

had a better BP control (43.4% versus 38.8%). The mean age of the study population was 59.2 years, which was relatively younger compared with the other studies which reported that age is associated with the development of LVH.[13]

In this study, Chinese made up 50.1% of the population, Malays 27.6%, Indians 21.2% and others 1.1%, which represent the ethnic distribution in the urban areas in Malaysia. However, there was no relationship observed in terms of prevalence of LVH among hypertensive patients. This could be attibuted to the small sample size.

Our study has several limitations. The study has several limitations. First, the result of the study may not be generalised or applicable to other settings since it was confined to one primary care centre in KL. Secondly, the factors associated with the development of LVH in this study may not be robust as the study was cross-sectional. However, with the limited resources in primary care setting in Malaysia, we believe that the result from this preliminary study is useful and relevant to the daily clinical practice. It is useful in developing a strategy to identify LVH in patients with hypertension. It is consistent with the European Society of Cardiology Guidelines which recommends echocardiography for hypertensive patients whose routine ECG does not show the presence of LVH.[7]

Conclusion

The study found that the prevalence of LVH was high among hypertensive population in a primary care setting. Effort should be made for early detection of LVH. Therefore, as front-liners, primary care doctors must develop a proper strategy to address this problem. Male and obese patients are at higher risk and must be considered for an echocardiograph assessment even though their ECG may not show the presence of LVH.

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