LEFT VENTRICULAR MASS INDEX AND PREHYPERTENSION AMONG YOUNG MALES

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ABSTRACT

BACKGROUND

Those who have prehypertension are at increased risk of developing hypertension and CVDs, compared to normotensives. Prehypertension has been reported to be associated with LV structural and geometric abnormality. It has also been found that increased LV mass itself may be a predictor of future hypertension. Hence, as PHT and LV mass portend a risk of future hypertension, their simultaneous existence may have an additive role, nevertheless this needs to be determined. Despite this, presently no pharmacotherapy is recommended for pre-hypertensions. This study was aimed to assess effect of prehypertension on LV mass index in young males and to evaluate the clinical associates of abnormal LV mass index.

MATERIALS AND METHODS

This study was carried among young adult males admitted at a tertiary care teaching hospital. All study subjects underwent physical examination including anthropometric measurements and echocardiographic examination for determination of LV mass.

RESULTS

We found that 29 (14.5%) had abnormally high LVMI. Among prehypertensives 23% and among normotensives 6% had abnormally high LVMI. Older age and prehypertension were found to have higher odds of abnormal LVMI after multiple variable logistic regression.

CONCLUSION

It has been proposed that pre-hypertension and high LVMI are associated with significant risk of future adverse events including the emergence of hypertension. Our study further confirms this and supports the notion of screening for prehypertension and high LVMI. Still, no pharmacotherapy is recommended for prehypertension which requires future studies to shed light upon this grey area.

KEYWORDS

Prehypertension, LV Mass Index, Echocardiography, Blood Pressure, Obesity Indices.

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BACKGROUND

In 2003, pre hypertension (PHT) was first introduced by the Seventh Joint National Committee (JNC 7) replacing former categories of "high-normal" and "above-optimal" blood pressure (BP); and it was defined as systolic BP of 120-139 mmHg or diastolic BP of 80–90 mmHg based on 2 or more properly measured seated BP readings on each of 2 or more office visits.[1] It has been reported that worldwide 25-50% of adult population has PHT.[2] Importance of PHT can be understood from the fact that those who have PHT are at increased risk of developing hypertension and other cardiovascular diseases (CVDs) compared to normotensives.[3] The 10-year absolute CVD risk for middle-aged pre hypertensive adults without diabetes mellitus or CVD is ~10%, and ~40% for middle-aged and older individuals with either or both comorbidities.[2]

The literature has suggested association between PHT and left ventricular (LV) geometry and mass. PHT has been associated with left ventricular (LV) structural abnormality.[4] Although some studies did not find any statistically significant difference in the LV structure parameters between normotensive and pre-hypertensive individuals[5] others have found a linear correlation between PHT and increased left ventricular mass (LVM). It has also been reported that when compared to normotensive, PHT is associated with target organ damage in both pre-hypertensive young individuals[6,7] and elderly.[3] PHT is associated with increased risk of mortality compared to normotensives. It has been proposed that as the BP rises above >115/75 mmHg, mortality from both stroke and ischemic heart disease increases. Those with 20 mmHg systolic blood pressure (BP) or 10 mmHg diastolic BP above 115/75 mmHg (a level well within the range of PHT), have a twofold increase in cardiovascular deaths.[8] It has also been found that increased LV mass itself may be a predictor of

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future hypertension.[9] Hence, as PHT and LV mass portend a risk of future hypertension, their simultaneous existence may have an additive role, nevertheless this needs to be determined.

Despite this knowledge, presently no pharmacological treatment of this BP category is recommended. Intensive lifestyle intervention can decrease the relative risk of incident hypertension ~20%.[2] Thus it becomes important to determine LV structural changes among those who are pre hypertensive, so that lifestyle modifications can prevent emergence of hypertensive and increased mortality.

This study was aimed to assess effect of prehypertension on LV mass index in young male aged 20-40 years and to evaluate the association of various clinical parameters with LV mass index among study subjects.

MATERIALS AND METHODS

The study was conducted at AVBRH, JNMC, Sawangi, Wardha which is rural based tertiary care teaching hospital located in central India. The study was initiated after obtaining approval from the Institutional Ethics Committee. This cross-sectional study was carried out between 1st August 2011 to July 2013, among 200 male subjects admitted in various wards of General Medicine department of AVBRH, Sawangi (Meghe) Wardha. We enrolled 100 male individuals with prehypertension and age-matched 100 normotensive male individuals.

Inclusion Criteria

Young male adults between the age group of 20-40 years who were found to be prehypertensive or normotensive.

Exclusion Criteria

A diagnosed case of hypertension, diabetes mellitus, cardiovascular disease, congenital heart disease, valvular heart disease, cardiac arrhythmia, renal disease and those unwilling to participate in the study.

Relevant history was taken and physical examination including anthropometric measurements (height, weight, waist circumference, waist-hip ratio, body mass index and body surface area) and blood pressure measurements were done using standard methods. Those with SBP of 120-139 mmHg and/or DBP of 80-89 mmHg were classified as prehypertensives and those with BP <120/80 were considered as normotensive. Waist circumference (WC) cut off for defining obesity for Asians was used, hence WC of ≥90 cm for males defined obesity. Waist-hip ratio (W/H) cut off used for males was 0.9. The height was measured in centimeter (cm) and weight was measured in kilogram (Kg).[10-12] Body surface area was calculated using Dubois formula[13] as follows -

$$\text{BSA } (m^2) = 0.20247 \times \text{Height (m)}^{0.725} \times \text{Weight (kg)}^{0.425}$$

Then all the study subjects were examined with echocardiography to measure various parameters of LV mass i.e. LV mass index (LVMI), LV internal diameter in diastole (LVIDD), LV posterior wall thickness in diastole (LV PWTD), interventricular septum thickness in diastole (IVSTD). LVM(gm) was measured using Devereux and Reichek cube formula[14] which is as follows:

$$\text{LVM} = 0.8\text{x}1.04\ [(\text{LV IVSTD} + \text{LVIDD} + \text{LV PWTD})^3 - \text{LVIDD}^3] + 0.6$$

As recommended by the American society of echocardiography, LVM was indexed for BSA to get LVM index (LVMI= LVM/BSA) and the normal range for LVMI was taken as 49-115 gm/m^2.[15]

Statistical Analysis

We used Microsoft Excel for data entry and STATA version 13 statistical software for analysis. Continuous variables were summarized by the mean ± standard deviation (SD). The mean ± SD of different variables were compared using t-test. To determine differences between categorical variables, the $\chi 2$ statistic was used. Relations between clinical and echocardiographic variables were assessed with consideration of appropriate covariates. Independence of differences from effects of covariates was assessed by logistic regression analysis for categorical variables. Association was assessed in terms of odds ratio (OR) and P value. Two-tailed values of $P<0.05$ indicated statistical significance.

RESULTS

We enrolled a total of 100 young male individuals with PHT and age-matched 100 young male with normal blood pressure. It was found that among all the study subjects 29(14.5%) had abnormally high LVMI (>115 gm/m^2). Among prehypertensive 23 individuals (23%) and among normotensive 6 individuals (6%) had abnormally high LVMI. This difference was statistically significant as odds of having high LVMI was 4.7 (95% Confidence interval, 1.81-12.07) among individuals with PHT compared to normotensive with two-tailed $P<0.001$. Mean age of the individuals with PHT was 27.08 ± 5.26 years and that of the normotensive group was 27.96 ± 6.03 years. The summary of mean ± SD for systolic BP, diastolic BP and anthropometric measurements for both groups is presented in table 1. It was found that the mean of systolic BP, diastolic BP, BMI, waist circumference and waist-hip ratio was significantly ($P<0.05$) higher among individuals with PHT while although BSA mean was higher among individuals with PHT but it was not statistically significant. Mean ± SD of echocardiographic parameters of LVM and LVMI are depicted in table 2. It was found that the mean of LVIDD, IVSTD, LV PWTD, LVM and LVMI were significantly higher ($P<0.05$) among individuals with PHT compared with normotensive. Table 3 shows the association of variables with prehypertension and depicts that individuals with PHT had significantly younger, had higher BMI, abnormal waist circumference, abnormal waist-hip ratio. Table 4 depicts the univariate and multivariate regression analysis to determine the association of age, BMI WC, W/H and prehypertension with high LVMI. On univariate

analysis, it was found that older age i.e. 31-40 years, higher BMI (i.e.>23 kg/m^2), higher WC (>90 cm), higher W/H (>0.9) and prehypertensive range of blood pressure were significantly associated with higher odds of abnormally high LVMI. To account for possible confounding effects of these multiple variable logistic regression analysis was done which revealed that only older age and prehypertension were significantly associated with higher odds of abnormally high LVMI.

Variables	Prehypertensive Group Mean (SD)	Normotensive Group Mean (SD)	P value
Systolic BP (mmHg)	129.53 (4.46)	103.79 (9.46)	<0.0001
Diastolic BP (mmHg)	80.94 (5.99)	66.5 (7.34)	<0.0001
BMI (Kg/m2)	23.91 (2.50)	22.64 (2.14)	0.007
Waist circumference (cms)	93.67 (12.56)	79.81 (5.98)	<0.0001
Waist hip ratio	1.05 (0.24)	0.88 (0.02)	<0.0001
Body surface area	1.66 (0.09)	1.65 (0.07)	0.37

Table 1. Comparison of Mean of Blood Pressure and Anthropometric Measures in Prehypertensive and Normotensive Individuals

Variables	Prehypertensive Group Mean (SD)	Normotensive Group Mean (SD)	P Value
LVIDD (cm)	4.78 (0.36)	4.91 (0.43)	0.01
LV PWTD (cm)	0.78 (0.08)	0.72 (0.07)	<0.0001
IVSTD (cm)	0.80 (0.10)	0.74 (0.09)	<0.0001
LV mass (gm)	131.91 (28.54)	113.83 (20.88)	<0.0001
LVMI (gm/ m2)	79.82 (18.85)	68.98 (12.64)	<0.0001

Table 2. Comparison of Mean of Echocardiographic Measures of LV Structure and Mass in Prehypertensive and Normotensive Individuals

Variable	Prehypertension	Normotensive	Total	OR (95% C.I.)	P value
Age					
20-30 years	34 (34%)	40 (40%)	74 (37%)	0.77 (0.4-1.4)	0.4
31-40 years	66 (66%)	60 (60%)	126 (63%)		
BMI					
Group 1*	27 (24%)	12 (12%)	39 (19.5%)	2.31 (1.1-4.9)	0.02
Group 2**	73 (76%)	88 (88%)	161 (80.5%)		
WC					
Abnormal	21 (21%)	10 (10%)	31 (15.5%)	2.4 (1.1-5.3)	0.03
normal	79 (79%	90 (90%)	169 (84.5%)		
W/H					
Abnormal	19 (19%)	09 (9%)	28 (14%)	2.3 (1.01-5.5)	0.44
normal	81 (81%)	91 (91%)	172 (86%)		

Table 3. Correlation of Variables with Prehypertension

*Group 1 = those with BMI>23, ** Group 2 = those with BMI<23.

Variable	Univariable Analysis OR 95% C.I. P Value			Multivariable Logistic Regression Analysis OR 95% C.I. P Value		
Age	9.01	3.46-23.47	<0.0001	7.32	2.31-23.22	0.001
BMI	9.59	4.04-22.71	<0.0001	3.79	0.53-27.03	0.18
WC	3.56	1.46-8.65	0.005	0.28	0.05-1.46	0.13
W/H	7.87	3.21-19.25	<0.0001	2.45	0.44-13.51	0.3
PHT	4.67	1.81-12.07	<0.0001	4.44	1.46-13.48	<0.001

Table 4. Association of Variables with High LVMI

DISCUSSION

We had aimed to assess the effect of prehypertension on LV mass index in young male aged 20-40 years and to evaluate the association of various clinical parameters with LV mass index among study subjects. We found that 14.5% of all the study subjects had abnormally high LVMI. Among these 79% were pre-hypertensive while only 21% had normal blood pressure. We also found that the mean of BMI, WC, W/H,

LVMI were significantly higher among prehypertensive than normotensive males. On univariate analysis older age, higher BMI, wider waist, higher W/H and prehypertension were significantly associated with higher LVMI but on multiple variable logistic regression analysis, we found that only older age and prehypertension had significantly higher odds of abnormally high LVMI.

In this study, we had enrolled 100 prehypertensive and 100 normotensive age-matched males who were 20 to 40 years of age. We found that prehypertensive were more likely to have abnormal LVMI than normotensive. We found that mean LVMI in males with PHT was 79.82 (SD, 18.85) and was significantly higher compared to 68.98(SD, 12.64) among normotensives (P<0.05). We found that prehypertensive had higher odds of having abnormally high LVMI compared to normotensive males (OR 4.67 (95% CI, 1.81-12.07), P<<0.0001)). After accounting for the confounding effect of other variables, PHT was still associated with higher odds of having abnormally high LVMI (OR 4.4 (95% CI, 1.46-13.48), P<0.001)). Drukteinis et al[6] had found that higher blood pressure was associated with increased LVMI. They found that mean LVMI among PHT individuals was significantly higher than normotensive (77.7±14.3 vs 71.9±12.9, P<0.001). Stabouli et al[16] also found similar results among children. They found that prehypertensive subjects had significantly higher LVMI than normotensives (34.1 ± 3.4 g/m2.7 vs. 29.5 ± 8.3 g/m2.7, P<0.01 and P <0.05, respectively). Similar results of increased LVMI among those with PHT compared with normotensive have been found in other studies also.[17,18] While most studies have reported this trend, Zhu et al[5] did not find any difference between LVMI among PHT and normotensive individuals. This difference in observation can be due to difference between the population characteristics among various studies.

We found that obesity indices like BMI, WC and W/H had significantly higher odds among prehypertensive compared to normotensives. Younger age group (20-30 years of age) had significantly lower odds of having prehypertension. Toprak et had also found that higher BMI was significantly associated with the prehypertension in both whites (OR 1.10, 95% C.I. 1.07-1.14) and black race (OR 1.05, 95% C.I. 1.01-1.09).[18] Gupta et al and other studies had found similar results that PHT was significantly associated with those with higher BMI and WC.[19,20]

We found that older age, higher BMI, WC, W/H and prehypertension had significantly higher odds of abnormally high LVMI(p<0.05) on univariate analysis. But on multiple variable logistic regression analysis, only older age and prehypertension were found to have significantly higher odds and BMI, WC and W/H were not found to be significant. LVM increases with age. Several studies have supported this finding even after accounting for confounding factors.[21,22] Mehta et al had reported an interesting finding that abnormally high BMI and normal WC were not associated with higher LVM but when both BMI and WC were abnormally high LVM was significantly high. Their study was among children aged 2-19 years.[23] The Fels longitudinal study found that BMI and WC were significantly associated with LVMI among males but not among females. They proposed that the significant curvilinear association of abdominal circumference and a linear association of BMI with LVMI was possibly because of positive covariate relationship of overall muscle mass with LVMI.[24] Similar results where higher BMI was associated with higher LVM have been reported.[25] The Strong heart study had reported that PHT was significantly associated with higher LVM.[6] The MESA study had reported higher LVM among those who had hypertension or PHT compared to normotensive. They also reported that increase in LVM occurred before the occurrence of hypertension among normotensive individuals.[9] A recent meta-analysis of echo studies has also suggested that prehypertension is associated with higher LVMI. It has been suggested that prehypertension may not a benign disease, hence necessitating preventive strategies.[19]

We have studied only male subjects in this study, hence the effect of gender differences on various parameters could not be determined. Secondly, we have studied a small number of individuals, which imposes some limitation when it comes to the generalizability of results. In addition, despite extensive efforts to standardize measurements as in other clinical and population-based studies, a subtle difference in performance and technique may also have influenced the results. These, we believe might be a limiting factor in this study. However, the significance of our findings is relevant to the increasing proportion of young adults who suffers from condition called prehypertension, for which no drug therapy exit today, but continues to have a significant future adverse event risk.

CONCLUSION

We found that prehypertension and older age are importantly associated with abnormally high left ventricular mass index among young males. It has been proposed for a long time now that prehypertension is associated with significant risk of future adverse events including the emergence of hypertension. Recent literature also suggests that increase in LVMI may precede hypertension onset. Hence, our study supports the notion of screening for prehypertension and high LVMI as it is reasonable if not recommended. Still, no pharmacotherapy is recommended for prehypertension which requires future studies to shed light upon this grey area.

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