

Correlation of Echocardiographic Left Ventricular Mass Index and Electrocardiographic Left Ventricular Hypertrophy Variables

T.N. Dubey¹, Uddhaves Paithankar², B.S. Yadav³

ABSTRACT

Introduction: Hypertensive left ventricular hypertrophy is one of the major prognostic indicators of cardiovascular morbidity and mortality. If timely detected it helps in guiding future therapeutic options to change the course of events to a significant measure. Electrocardiography and echocardiography are few of the various modalities available to detect it. In this study we have tried to review the relationship of Electrocardiographic and Echocardiography criteria of Left Ventricular Hypertrophy diagnosis.

Material and methods: 151 Hypertensive patients were studied. History and examination was conducted in detail to evaluate the duration and complication of systemic arterial hypertension. Patients were subjected to 12-lead ELECTROCARDIOGRAPHIC, chest X-ray and 2D/Colour Doppler Echocardiogram.

Results: Out of 151 patients 113 (74.8%) had Left Ventricular Hypertrophy by Echocardiography and 38 (25.2%) did not majority of which 79 patients (52.3%) were present in the age group of 50- 59years. Left Ventricular Hypertrophy was diagnosed by echocardiography in 40 females(95.2%) and absent in 2(4.8%), $P<0.01$ [More Left Ventricular Hypertrophy by echocardiography in females, statistically significant]. Maximum sensitivity was for Sokow-lyon index 43.4% $P<0.001$ and maximum specificity for Gubner-Ungerleider Voltage.

Conclusions: This study confirms the poor Electrocardiographic sensitivity, high specificity and correlation with echocardiographic Left Ventricular mass and suggests: (1) further refinement of Electrocardiographic criteria alone is unlikely to improve its relationship with Left Ventricular mass; and (2) combining the electrocardiogram with other non-Electrocardiographic variables or non-invasive measurements offers the best strategy for improving Electrocardiographic sensitivity and its prognostic value.

Keywords: electrocardiography, echocardiography, ECGvariables, LVMindex

INTRODUCTION

Hypertensive left ventricular hypertrophy is one of the major prognostic indicators of cardiovascular morbidity and mortality.¹ If timely detected it helps in guiding future therapeutic options to change the course of events to a significant measure.² LVH has many underlying causes one of which is hypertension. Hypertension is prevalent in 25% of the population. in spite of the magnitude of the problem, hypertension remains undetected in about 50% of the population. Of those in whom it is newly diagnosed, less than 50% are adequately treated. Hypertension is a slow and a silent killer. For most of the initial period it causes no hemodynamic problems or symptoms. The heart copes up with the excess after load by myocyte hypertrophy, wherein the individual muscle cells enlarges due to increase in the number of its

components, myofibrils mitochondria and other constituents. This compensatory change can cope up with the excessive work load only up to a limit after which it fails. There occurs morbid changes in the other systems of the body like vasculature of the heart, brain, kidney, eyes with imminent morbidity and ultimately death.³ The hypertrophied heart is particularly predisposed to morbid events. It is prone to angina, myocardial infarction, arrhythmias and sudden cardiac death. LVH is prognostic indicator of future events in hypertensive patients. Various modalities are available to detect it. ECG and Echocardiography are better tools. In this study we have tried to review the relationship of ECG and Echocardiography criteria of LVH diagnosis. The aim of this study is to evaluate the relationship between LVM/BSA [left ventricular mass index], measured by echocardiography (Echo), and 12-lead ECG variables in hypertensive patients stratified by age, gender and BMI. Also we have reviewed the sensitivity and specificities of the following ECG variables used in LVH diagnosis 1. Sokolow- Lyon index 2. RaVL 3. Cornell voltage⁴. Gubner-Ungerleider Voltage 5. Romhilt-Estes point score

MATERIAL AND METHODS

The study was done at the author's department of medicine for one year from January 2015 to December 2015. It was an observational cross-sectional study. The study group comprised of 151 hypertensive subjects fulfilling the inclusion criteria and giving informed consent. The institutional ethics committee approval was taken and patients were subjected to 12-lead Electrocardiographic, chest X-ray and 2D/Colour Doppler Echocardiogram.

History was taken in detail to evaluate the duration and complication of systemic arterial hypertension. A complete physical evaluation was recorded, care was taken to record height, weight, pulse rate and blood pressure which was measured manually with a mercury sphygmomanometer.⁴ Three readings of blood pressure with gap of 2 minutes were measured in sitting position and the mean was taken. Hypertension was defined according to JNC 7 criteria as systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90

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mmHg or patient on antihypertensive medication irrespective of blood pressure.⁵

Detailed ECG Analysis was done following criteria for detecting left ventricular hypertrophy were studied. 1) Sokolow-Lyon index:- ≥ 35 mm 2) RaVL :- ≥ 11 mm 3) Cornell voltage :- RaVL+SV3 > 28 mm in males and > 20 mm in females 4) Gubner-Ungerleider Voltage :- ≥ 25 mm 5) Romhilt-Estes point score:- 5 points or more indicates LVH. Detailed Echo analysis was done as per standard protocol to see for valvular structure and function, chamber dimensions, wall motions and dimensions chamber clots, pericardial abnormality. Following parameters were specially noted 1. IVSD 2. LVED 3. LVPWD

STATISTICAL ANALYSIS

It was done as desired and Mean and Standard deviation was calculated in cases and control to characterize the study population stratified by age, sex, BMI. SPSS for windows, version 10.0 was used for all statistical analysis. A p-value < 0.05 was considered significant.

RESULTS

Patients who fulfilled the criteria were stratified according to the age, gender and BMI. In our study out of 151 patients, 42 were females (27.8%) and 109 were males (72.2%), with male:female ratio of 2.59:1. In this LVH was diagnosed by echocardiography in 40 females (95.2%) and absent in 2 (4.8%), $P < 0.01$ [More LVH by echocardiography in females, statistically significant, fig-1]

Out of 151 patients 113 (74.8%) had LVH by Echocardiography and 38 (25.2%) did not majority of which 79 patients (52.3%) were present in the age group of 50- 59 years.

In our study 65 patients (43.0%) had BMI of > 25 . In this 53 patients (81.5%) had LVH diagnosed by echocardiography 86 patients (57.0%) had BMI of < 25 . In this 60 patients (69.8%) had LVH diagnosed by echocardiography (fig. 2)

The sensitivity and specificities of the respective ECG variables used in LVH diagnosis were as follows

Sokolow- Lyon index:	Sensitivity=43.4 %
	Specificity=94.7 %
RaVL:	Sensitivity=13.3 %
	Specificity=94.7 %
Cornell voltage:	Sensitivity=15.9 %
	Specificity=94.7 %
Gubner-Ungerleider Voltage:	Sensitivity=8.0 %
	Specificity=100.0 %
Romhilt-Estes point score:	Sensitivity=15.0 %
	Specificity=92.1 %

DISCUSSION

Hypertension is a slow and a silent killer. For most of the initial period it causes no hemodynamic problems or symptoms. The heart copes up with the excess after load by myocyte hypertrophy, wherein the individual muscle cells enlarges due to increase in the number of its components, myofibrils mitochondria and other constituents. This compensatory change can cope up with the excessive work load only up to a limit after which it fails. there occurs morbid changes in the other systems of the body like vasculature of the heart, brain, kidney, eyes with imminent morbidity and ultimately death.

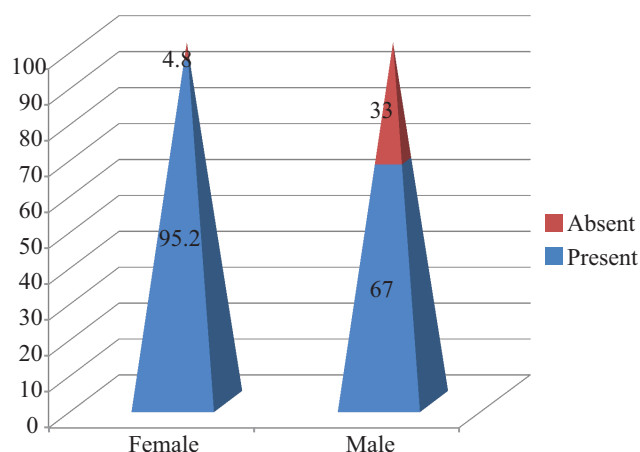


Figure-1: Correlation of gender and LVH in echocardiography

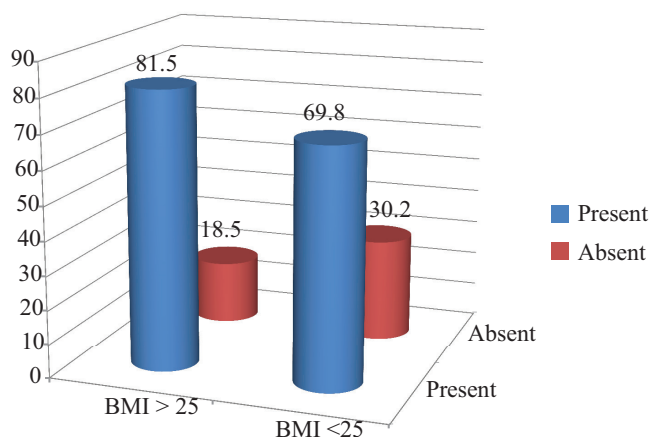


Figure-2: Correction of BMI and LVH in Echocardiography

the hypertrophied heart is particularly predisposed to morbid events. It is prone to angina, myocardial infarction, arrhythmias and sudden cardiac death. LVH is prognostic indicator of future events in hypertensive patients. various modalities are available to detect it. ECG and Echocardiography are better tools. This study has been undertaken to see whether left ventricular hypertrophy, as detected by echocardiography, has correlation with ecg variables or not.

151 hypertensive individuals fulfilling the inclusion criteria were studied, the cases were selected from Medicine, Cardiology OPD and wards of Hamidia Hospital, Bhopal.

All patients were subjected to the same battery of investigations. Patients with hypertrophic cardiomyopathy, myocardial infarction, valvular heart disease in whom pronounced variation in left ventricular wall thickness may occur were excluded from the study. In our study group, male female ratio was 2.56:1. Majority of patients were in age group 50-59 years. Left ventricular mass index was calculated in gm/m^2 .

In 1995 Richard S. Crow and colleagues studied the Relation between electrocardiography and echocardiography for left ventricular mass in mild systemic hypertension (results from Treatment of Mild Hypertension Study).⁶ They found that the correlations between ECG and echocardiographic LV mass index were modest (< 0.40). ECG-LV hypertrophy sensitivity at 95% specificity was $< 34\%$. Highest sensitivity of 17% was shown by Casale/Devereux ECG criteria at 95% specificity for all race-sex groups. LV mass indexed to body mass index and systolic blood pressure showed better

correlation with ECG criteria.

Dr. Lian Xie and colleagues worked on correlation between echocardiographic left ventricular mass index and electrocardiographic variables used in left ventricular hypertrophy criteria in Chinese hypertensive patients.⁷ They concluded that Cornell product and Cornell voltage are the most convenient predictors for LVM/BSA with stratification only by gender. They were also the best parameters for predicting LVH in obese and overweight Chinese hypertensives, whereas estimation of LVM/BSA, LVM/H(2.7) by ECG is inaccurate in Chinese hypertensives without LVH. The cut-off point of BMI=24 kg/m² is suitable for stratification of bodyweight in further studies regarding Chinese hypertensives.

In 2012 J.K.Park and colleagues studied the comparison of Cornell and Sokolow-Lyon electrocardiographic criteria for left ventricular hypertrophy in Korean patients.⁸

The study showed better correlation of Cornell-based criteria with LVH than that of the Sokolow-Lyon criteria, however, revised cut-off values were suggested to improve accuracy.

In 2015 Ljuba Bacharova and colleagues studied determinants of discrepancies in detection and comparison of the Prognostic significance of left ventricular hypertrophy by electrocardiogram and cardiac magnetic resonance imaging.⁹ In their study despite the low sensitivity of the ECG in detecting LVH, ECG was shown to be a strong predictor of cardiovascular risk.

The higher accuracy and reproducibility of LVM measured by cardiac magnetic resonance rather than M-mode echocardiography might explain the weak relationship of their study. In our study maximum sensitivity was for Sokow-Lyon index 43.4% $P<0.001$ and maximum specificity for Gubner-Ungerleider Voltage. Also, more Left Ventricular Hypertrophy by echocardiography was found in females, $P<0.01$ [statistically significant].

CONCLUSIONS

This study confirms the poor electrocardiographic sensitivity, high specificity and correlation with echocardiographic left ventricular mass and suggests: (1) further refinement of electrocardiographic criteria alone in white men is unlikely to improve its relationship with Left Ventricular mass; and (2) combining the electrocardiogram with other non-Electrocardiographic variables or non-invasive measurements offers the best strategy for improving Electrocardiographic sensitivity and its prognostic value.

REFERENCES

1. Verdecchia P. Changes in cardiovascular risk by reduction of left ventricular mass in hypertension: a meta-analysis. *American Journal of Hypertension*. 2003;16:895-899.
2. Klingbeil A, Schneider M, Martus P, Messerli F, Schmieder R. A meta-analysis of the effects of treatment on left ventricular mass in essential hypertension. *The American Journal of Medicine*. 2003;115:41-46.
3. Chobanian A. Vascular effects of systemic hypertension. *The American Journal of Cardiology*. 1992;69:3-7.
4. Schott A. An early account of blood pressure measurement by Joseph Struthius (1510-1568). *Medical History*. 1977;21:305-309.

5. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, Jones DW, Materson BJ, Oparil S, Wright JT Jr, Roccella EJ; The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA*. 2003;9:290:197.
6. Crow R, Prineas R, Rautaharju P, Hannan P, Liebson P. Relation between electrocardiography and echocardiography for left ventricular mass in mild systemic hypertension (results from treatment of mild hypertension study). *The American Journal of Cardiology*. 1995;75:1233-1238.
7. Xie L and Wang Z. Correlation between echocardiographic left ventricular mass index and electrocardiographic variables used in left ventricular hypertrophy criteria in Chinese hypertensive patients. *Journal of Hypertension*. 2010;28:1.
8. Park J, Shin J, Kim S, Lim Y, Kim K, Kim S et al. A Comparison of Cornell and Sokolow-Lyon Electrocardiographic Criteria for Left Ventricular Hypertrophy in Korean Patients. *Korean Circulation Journal*. 2012;42:606.
9. Bacharova L, Chen H, Estes E, Mateasik A, Bluemke D, Lima J et al. Determinants of Discrepancies in Detection and Comparison of the Prognostic Significance of Left Ventricular Hypertrophy by Electrocardiogram and Cardiac Magnetic Resonance Imaging. *The American Journal of Cardiology*. 2015;115:515-522.

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