

**“ECG & ECHOCARDIOGRAPHIC STUDY OF LEFT VENTRICULAR
HYPERTROPHY IN PATIENT WITH ESSENTIAL HYPERTENSION
IN A TERTIARY CARE HOSPITAL”**

Dr. Shalu Mishra, Dr. Abhilash. B, Dr. Lokesh. H C, Dr. Venugopal. K

Associate Professor, Department of Radiodiagnosis,
St. Peter's medical college and research institute,
The Tamil Nadu Dr. M G R Medical University.

Senior resident, Subbaiah Institute of Medical Sciences,

Associate Professor, Department of General medicine,
Hassan Institute Of Medical Sciences, Hassan

Associate Professor, Department of General medicine,
Hassan Institute Of Medical Sciences, Hassan

ABSTRACT:

BACKGROUND: Left ventricular hypertrophy is the adaptive mechanism to increased left ventricular stress is associated with many adverse events. This study was undertaken to study the left ventricular hypertrophy in patients of essential hypertension and to correlate between clinical, electrocardiography (ECG) and echocardiography in the identification of left ventricular hypertrophy.

MATERIALS AND METHOD: 100 patients attending the outpatient department and those who were admitted in our teaching institute from January 2022 to June 2023 were the study subjects. All cases of essential hypertension, irrespective of duration of hypertension and type of treatment received were included in the study. Patients with secondary hypertension, Ischemic heart disease/Myocardial infarction, Ischemic cardiomyopathy, congenital heart disease and valvular heart disease were excluded.

CONCLUSION: Out of different ECG criteria total QRS criteria showed a high sensitivity of 60%. ECG criteria have a high specificity but low sensitivity. Hence, limited use as a screening method. However in a poor resource country like ours where echocardiography facilities are not available in all rural parts, improved ECG criteria like total QRS voltage can be recommended as a routine investigation for LVH because of its cost effectiveness and easy availability with certain limitations.

KEY WORDS: *Left ventricular hypertrophy, sokolow-lyon, romhilt Estes, and echocardiography.*

INTRODUCTION:

Hypertension is one of the common public health problem and most of the patients remain asymptomatic. Left Ventricular Hypertrophy (LVH) is an adaptive state of the heart to increase the wall stress. It is common in hypertension. The prevalence of LVH increases with the age, severity of hypertension and the duration of hypertension. So presence of LVH indicates along run of uncontrolled hypertension.

LVH is a common condition that profoundly affects morbidity and mortality from cardiovascular diseases including myocardial infarction, congestive heart failure, and stroke. The prevalence of LVH is on the rise, more alarming in the developing nations. The Framingham heart study suggested that 1 in 10 persons will have left ventricular hypertrophy in age 65 to 69.^[1] LVH is no longer consider as an adaptive process that compensates the pressure imposed on the heart and has been identified as an independent and significant risk factor for sudden death, acute myocardial infarction and congestive heart failure.^[2] The study also stated that electrocardiogram diagnosed LVH was

associated with a 3-5 fold increase of cardiovascular events with the greater risk ratios for cardiac failure and stroke.

The studies clarify strong relation between left ventricular hypertrophy and adverse outcome and hence emphasize on the clinical importance for its detection. ^[3] The increase in left ventricular mass represents a final pathway towards the adverse effects on the cardiovascular system and higher vulnerability to complication. ^[4] The ECG in the assessment of cardiac dimensions has lost its prominence in favour of imaging techniques that provide a multidimensional display of the heart but secondary ST-T changes due to LVH which are uniquely determined from the ECG are known to increase the risk of cardiovascular morbidity and mortality. ^[5]

There are many ways of diagnosing LVH like by electrocardiography (ECG), roentgenography and echocardiography (ECHO). Though ECHO is superior to ECG, it is economically expensive and not widely available in rural parts of our country. So the purpose of this study is to explore the reliability of ECG in diagnosis of LVH as compared to ECHO.

MATERIALS AND METHODS:

In this study, 100 patients of essential hypertension patients who visited outpatient department of our hospital for follow-up and patients admitted in medicine wards were included in the study according to inclusion and exclusion criteria. All the patients were evaluated with detail clinical history and physical examination. All patients were subjected to ECG and echocardiography with colour Doppler. Clinical detection of LVH was done by the position of apical impulse. Those patients, whose apical impulse was below the 6th intercostal space and 1-2 cm lateral to the left mid clavicular line was considered to be

having LVH. ECG criteria used in this study are Soko-low Lyon, Romhilt-Estes and Total QRS voltage criteria. Comprehensive two-dimensional tomographic planes were employed with multiple parasternal views of the left ventricle in long and short axis after positioning of the cursor through the inter-ventricular septum and posterior wall at the level of chordae tendinae simultaneous M-mode and two-dimensional recordings were obtained from the parasternal transducer position in both long and short axis of the ventricle. M mode measurements were taken by the leading edge-to-leading edge technique as recommended by the American society of echocardiography. All measurements were averaged to the closest 1 mm from three good quality cardiac cycles. Left ventricular mass is obtained from the L.V short axis diameter and a simple geometric cube formula with following equation:

$$L.V.M=1.04[(LVID+PWT+IVST)^3-LVID^3] \times 0.8+0.6.$$

Here 1.04 is specific gravity of myocardium, 0.8 is correction factor. All the measurements are made at end diastole in diameter. ^[6] In females LV mass of 163-186 gm/m² was taken as mild LVH, 187-210 gm/m² was taken as moderate LVH, and >211 gm/m² was taken as severe LVH. In males LV mass of 225-258gm/m² was taken as mild LVH, 259-292gm/m² was taken as moderate LVH, and >293gm/m² was taken as severe LVH.

Data obtained from these patients were systematically recorded and analysed using statistical package for social services (SPSS) version 15.0, chi square was used to assess statistical significance. A 'P' value of <0.05 was considered as statistically significant. The statistical tests were performed after obtaining the results of electrocardiogram and echocardiography diagnostic validity tests (sensitivity and specificity), Kappa measurement of agreement.

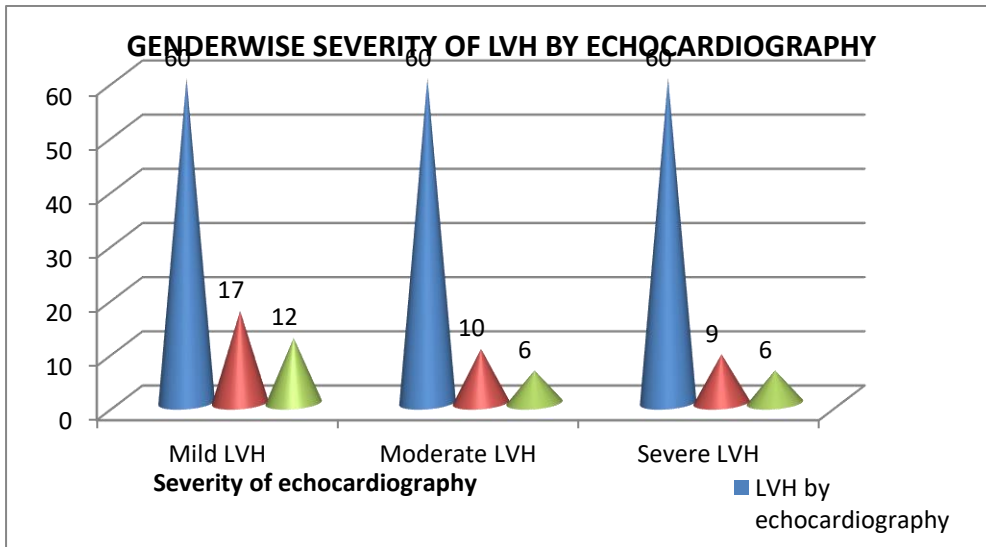
RESULTS:

Out of 100 patients, 59 (59%) were males and 41(41%) were females. Among 59 males, 36(61.01%) showed left ventricular hypertrophy and among 41 females 24(58.53%) showed left ventricular hypertrophy. Majority of cases were in age group 50-59 years (n = 48, 48%).The youngest patient was of 40 year and the oldest patient was 87 year old with mean age of 56.4 years.

Out of 40 smokers, 33 patients had LVH in echocardiography and out of 60 non-smokers 27 had LVH in echocardiography. And this was statistically significant ($p < 0.0001$).Family history of hypertension was present in 47 (47%) patients. Among 47 patients, 23(48.93%) showed LVH in echocardiography.53 (53%) patients had no family history of hypertension. Among 53 patients, 37(69.81%) showed LVH in echocardiography. This comparison was statistically significant. ($p < 0.0001$)

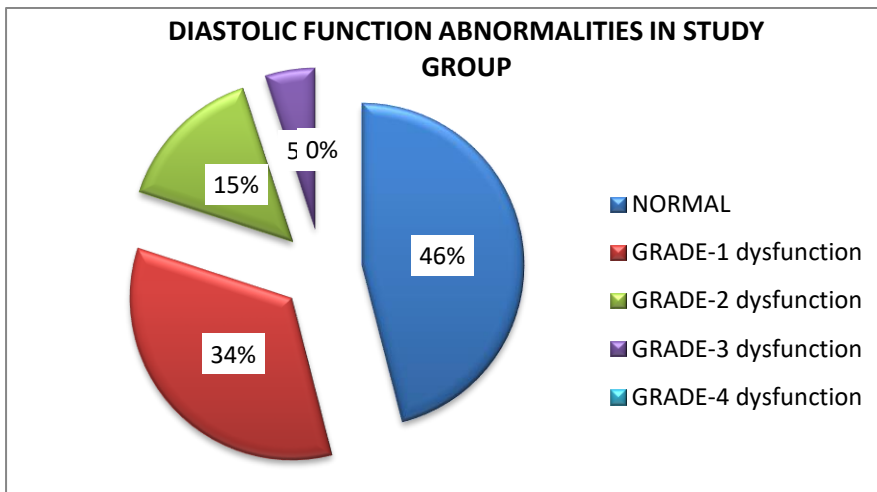
In this study, 8 out of 10 who had hypertension from last 16 to 20 years have LVH and 6 out of 6 patients who had hypertension more than 21 years has LVH. This study shows as duration of hypertension increases, chances of LVH increases. This was statistically highly significant ($p < 0.0001$).

Out of 100 patients, clinical evidence of left ventricular hypertrophy was noted in 18(18%) of the sample. Among 18, 12(66.66%) were males and 6(44.44%) were females. Sokolow-lyon criteria identified left ventricular hypertrophy in 24 patients. Among them, 18(75%) were males and 6(25%) were females. Romhilt-Estes criteria identified left ventricular hypertrophy in 28 patients. Among them, 16(57.14%) were males and 12(42.85%) were females. Total QRS voltage criteria identified left ventricular hypertrophy in 36 patients. Among them, 20(55.55%) were males and 16(44.44%) were females. Echocardiography identified left ventricular hypertrophy in 60 patients. Among them, 36(60%) were males and 24(40%) were females. Out of 60 patients, 29 had mild LVH, 16 had moderate LVH and 15 patients had severe LVH.



Out of 24 patients of blood pressure <140mmhg 6(25%) patient had left ventricular hypertrophy. 18(58.08%) patients out of 31 patients had LVH in the BP group of 140-159mmhg. 28(77.78%) patients out of 36 had LVH in the BP group of 159-180mmhg. 8(88.89%) out of 9 had LVH in the BP > 180mmhg. Out of 24 patients of blood pressure <90mmhg 4(16.6%) patient had left ventricular hypertrophy. 17(53.12%) patients out of 32 patients had LVH in the BP group of 140-159mmhg. 30(85.71%) patients out of 35 had LVH in the BP group of 100-109mmhg. 8(88.89%) out of 9 had LVH in the BP > 110mmhg. 60 patients presented with various complaints, among them 40 patients had LVH. Out of 40 follow-up patients, 20 had LVH.

Out of 100 patients, diastolic dysfunction was noted in 54 (54%) patients. 34 patients had grade-1 diastolic dysfunction, 15 patients had grade-2 diastolic dysfunction and grade-3 diastolic dysfunction was noted in 5 patients.



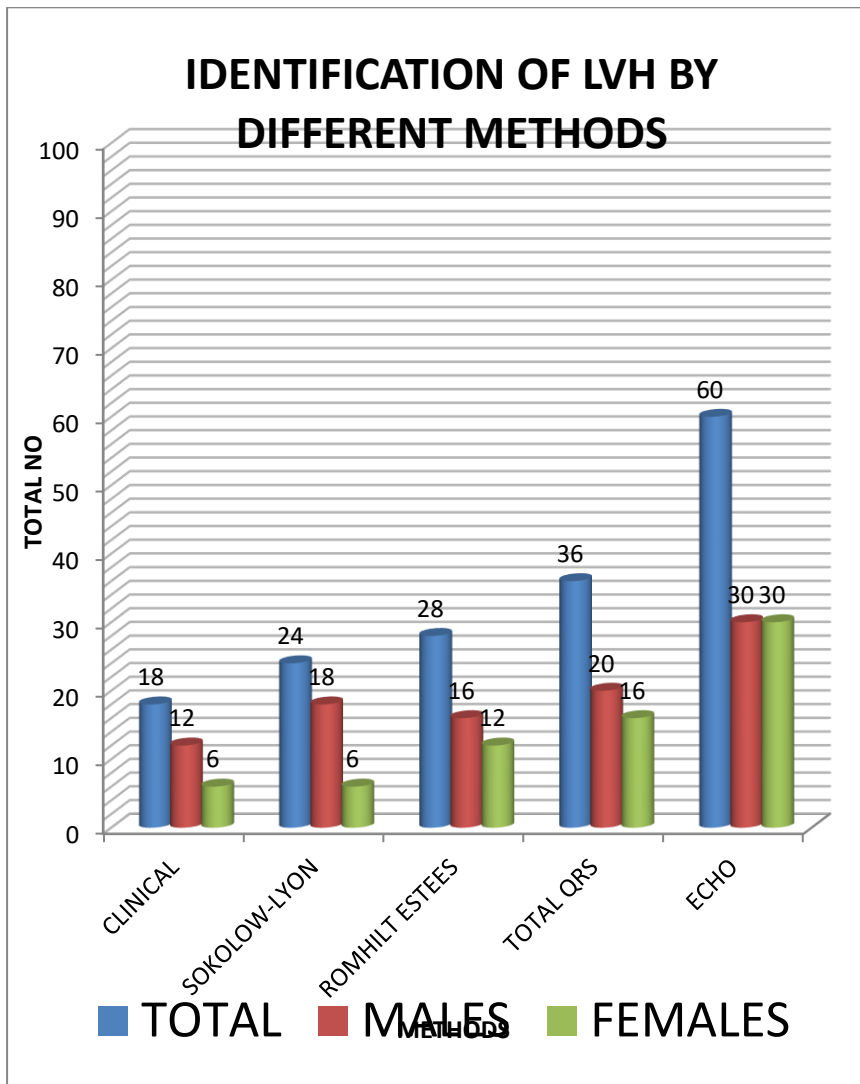
Clinical evaluation showed LVH in 18 patients. Sensitivity was 30%, Specificity was 100%, PPV was 100%, NPV was 48.78%, Accuracy was 58%, and Kappa measure of agreement is 0.25. Chi-Square test was used to compare between ECHO and clinical detection and it found highly significant.

ECG of Sokolow-Lyon index could diagnose LVH in total of 28 patients. Out of which only 24 patients had LVH by 2D ECHO. Sensitivity was 40%, Specificity was 90%, PPV was 85.7%, NPV was 50%, Accuracy was 60% and Kappa measure of agreement was 0.27. Chi-Square test was used to compare between ECHO and ECG of Sokolow-Lyon index and it found highly significant.

ECG of Romhilt and Estes criteria could diagnose LVH in total of 36 patients. Out of which only 28 patients had LVH by 2D ECHO. Sensitivity was 41.17%, Specificity was 80%, PPV was 77.78%, NPV was 53.3%, Accuracy was 60% and Kappa measure of agreement was 0.24. Chi-Square test was used to compare between ECHO and ECG of Romhilt and Estes criteria, it was not significant.

ECG of Total QRS voltage criteria could diagnose LVH in total of 39 patients. Out of which 36 patients had LVH by 2D ECHO. Sensitivity was

60%, Specificity was 92.5%, PPV was 92.3%, NPV was 60.6%, Accuracy was 73% and Kappa measure of agreement was 0.49. Chi-Square test was used to compare between ECHO and ECG of Total QRS voltage criteria and it found highly significant.



DISCUSSION:

Our study compared the three most important ECG criteria's for the diagnosis of LVH in hypertensive patients with ECHO as the diagnostic tool. ASokolow-Lyon criterion is the oldest criteria devised by Sokolow M. and

Lyon in 1949. It is the oldest, simplest and quickest method for the detection of LVH by ECG. In our study it had Sensitivity of 40%, Specificity of 90%, PPV of 85.7%, NPV of 50%, Accuracy of 60% and Kappa measure of agreement of 0.27. Sensitivity and specificity of Sokolow-Lyon criterion has been studied in various studies.

A Romhilt and Estes point score system was proposed in 1968 and it involves complicated data acquisition for scoring. Total score is 13 and when 4 points (probable LVH) were used as criteria it increases the sensitivity and specificity, but when 5 points (definite LVH) were used as criteria, it decreases the sensitivity and specificity. In the present study 5 points were used, and showed following results. In our study it had Sensitivity of 41.17%, Specificity of 80%, PPV of 77.78%, NPV of 53.3%, Accuracy of 60% and Kappa measure of agreement of 0.24. Sensitivity and specificity of Romhilt and Estes point score has been studied in various studies.

A total QRS VOLTAGE criterion was devised by Roberts et al. A total QRS voltage greater than 175 mm was taken as diagnostic. In our study it had Sensitivity of 60%, Specificity of 92.5%, PPV of 92.3%, NPV of 60.6%, Accuracy of 73% and Kappa measure of agreement was 0.49. Sensitivity and specificity of Romhilt and Estes point score has been studied in various studies.

SUMMARY AND CONCLUSION:

We studied 100 hypertensive patients for the comparison of clinical and different criteria of ECG in the diagnosis of LVH with echocardiography as the diagnostic standard.

- ✚ In our study, Clinical detection of LVH shows a sensitivity of 30% and a specificity of 100%.
- ✚ Sokolow-Lyon criteria showed a sensitivity of 40% and a specificity of 90%
- ✚ Romhilt-Estes scoring system showed a sensitivity of 41.2% and a specificity of 80%.
- ✚ Total QRS criteria showed a sensitivity of 60% and a specificity of 90.5%.
- ✚ Among the different criteria used, total QRS criteria showed better sensitivity compared to others in the present study.
- ✚ ECG criteria have a high specificity but low sensitivity. Hence, limited use as a screening method.
- ✚ In the evaluation of hypertensive patients for LVH, echocardiography is the method of choice.
- ✚ However in a poor resource country like ours where echocardiography facility is not available in all rural parts, improved ECG criteria like total QRS voltage can be recommended as a routine investigation for LVH because of its cost effectiveness and easy availability with certain limitations.

REFERENCES:

- 1) Friedman AJ, Roeske WR, Sahn DH. "Accuracy of M-mode echocardiographic measurements of left ventricle". Am J Cardiol, 1982;99:716-720.

- 2) Devereux RB. "Does increased blood pressure cause left ventricular hypertrophy or vice versa?" *Ann Intern Med*, 2000; 112:57-8.
- 3) Vakili B A, Okin P M, Devereux R B, "Prognostic implications of left ventricular hypertrophy". *Am Heart Journal*, 2001;141:334- 41
- 4) Devereux R B, Reichek M D. " Echocardiographic determination of left ventricular mass in men; Anatomic validation of the method" *Circulation*, 1997; 55: 613-18
- 5) Elena Martinova. Automated Computer Analysis in Diagnosis of left ventricular hypertrophy by electrocardiography. *Journal of Electrocardiology*, 2007;40:541-42.
- 6) Heidi M., Connolly and JalK.O.H. "Echocardiography" *Braunwald's Heart disease. A text book of cardiovascular medicine*, 2008; 8th edition: 245-46
- 7) Devereux R.B., Richek N. "Left ventricular hypertrophy relationship of anatomic, echocardiographic and electrocardiographic findings". *Circulation*, 1981; 63: 1391-97.
- 8) Murphy M.L, Thonabadu. "Sensitivity of electrocardiographic A multivariate criteria for left ventricular hypertrophy according to type of disease". *Am. J. Cardiol.* 1985; 55: 545-50.
- 9) Devereux R.B, Casale PN, Klingfield P, Eisenberg RR, Miller D, Campo E et al.. "Performance of primary and derived M-mode echocardiographic measurements for detection of left ventricular hypertrophy in necropsied subjects and in patients with systemic hypertension, mitral regurgitation and dilated cardiomyopathy". *Am J Cardiol*, 1986; 57: 1388-91
- 10) Odom H., Lyn D., William C.R. "QRS voltage measurements in autopsied mass free of cardiopulmonary disease: A basis for evaluating total QRS voltage as an index of left ventricular hypertrophy". *Am J Cardiol*, 1986; 58: 801-04.
- 11) Norman J.E, Levy D. "Improved electrocardiographic detection of echocardiographic left ventricular hypertrophy: Results of a correlated data base approach". *J Am Coll. Cardiol*, 1995; 26(4): 1022-9
- 12) Nicolas Denarie, Ales Linhart, Jaime Levenson, Alain Simon. "utility of electrocardiogram for predicating increased left ventricular mass in asymptomatic men at risk for cardiovascular disease". *Am.j.Hypertension*, 1998;11:861-65

- 13) Christian jaggy, Francois Perret, Pascal Bovet, Guy Van Melle, NicZerkiebel, George et al. "performance of classic electrocardiographic criteria for left ventricular hypertrophy in an African population." Hypertension, 2000;36:54
- 14) Warram.J.H, Laffel.LMB, Valsania.P, Christlieb A.R, Krolewski.A.S. "Excess mortality associated with diuretic therapy in diabetes mellitus" Arch intern med, 1991; 151:1350-56.
- 15) Kansal.S, Roitman, Sheffield. "A quantitative relationship of electrocardiographic criteria for left ventricular hypertrophy with echocardiographic left ventricular mass approach". Clinical cardiology, 1983; 6(9): 456-463.
- 16) WaqasHameed, Muhammad ShamaunRazi, MuhammedAlamgir Khan, MuhammedMazharHussain, Sohail Aziz, ShahidHabib et al. "electrocardiographic diagnosis of left ventricular hypertrophy: comparison with echocardiography" Pak j physol.2005;1:1-2
- 17) Tariq Waseem, MuhammedAsifNadeem, Turab Ali, Abdul Hafeez Khan. "Left ventricular hypertrophy (LVH): Sensitivity of different electrocardiographic criteria to diagnose LVH in patients having left ventricular mass index on echocardiography" Ann king Edward med uni.2003;9(2):101-104