

Study of Electrocardiographic and Echocardiographic Findings for the Diagnosis of Left Ventricular Hypertrophy in Hypertensive Patients

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Abstract

Background: LVH is a common feature of hypertension and an ominous harbinger of cardiovascular sequelae. Most patients with hypertension, the heart becomes secondarily involved in response to the progressively increasing LV afterload. Compared with values in the normotensive group, LV mass index, LV wall thickness, and prevalence of LVH were markedly increased not only in untreated hypertensive patients but also in treated hypertensive with inadequate BP control which are poor markers of cardiovascular events. So this study was to identify the left ventricular hypertrophy using Sokolow- Lyon and Romhilt estes and total QRS criteria in hypertensive patients, compare and correlate the efficacy of ECG to determine LVH in comparison to ECHO keeping ECHO as end point. **Subjects and Methods:** This was a cross-sectional observational study comparing ECG and ECHO in 100 patients diagnosed as hypertensive attending the outpatient in Department of Medicine or were admitted in the Medicine wards, Coronary Care units of Universal College of Medical College Teaching hospital, Bhairahawa for a period of 1 year from March 2014 to March 2015 were taken for study. **Results:** Our study shows Sokolow-Lyon criteria has sensitivity of 65% and specificity of 70% while Romhilt-Estes scoring system has a sensitivity of 70 % and a specificity of 73% and Total QRS criteria has sensitivity of 70% and specificity of 76%. Among the different criteria used, total QRS criteria showed better sensitivity and specificity compared to others in the present study **Conclusion:** ECHO facilities are not available in all rural regions, improved ECG criteria such as total QRS voltage can be recommended as a routine investigation for LVH because of its cost-effectiveness and easy availability despite certain limitations.

Keywords: Electrocardiography, Echocardiography, Left Ventricular Hypertrophy.

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Introduction

Left ventricular hypertrophy 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. 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. The ECG in the assessment of cardiac dimensions has lost its prominence in favor 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.

Today, two-dimensional echocardiogram still demands considerably more time, cost, technical skill of the operator and complexity of processing than routine 12 lead ECG. It may be expected that correlation with imaging techniques will improve the performance of the electrocardiogram in the assessment of cardiac anatomy by defining more accurately the limit of its capability.

More than 30 ECG indexes for the diagnosis of LVH have been described. Many of the proposed indexes have remained anecdotal, but others are commonly Used. Considering the magnitude of LVH the study is designed to correlate between three different ECG criteria of left hypertrophy using echocardiography as diagnostic standard. Hence this study is undertaken to compare the diagnostic efficiency of these methods in diagnosing left ventricular hypertrophy because the best means of decreasing the increased mortality and morbidity is to prevent the development of left ventricular hypertrophy which requires early and continuous antihypertensive therapy even before the hypertrophy becomes clinically manifest.

Aims and objectives

General

To compare and correlate the efficacy of ECG to determine LVH in comparison to ECHO.

Specific

1. To identify the left ventricular hypertrophy using Sokolow- Lyon and Romhilt estes and total QRS criteria in hypertensive patients.
2. Correlate the efficacy of ECG in detection of LVH keeping ECHO as end point.

Subjects and Methods

Type of study: This was a cross-sectional observational study comparing ECG and ECHO.

Place of study: Patients attending the outpatient Department of Medicine and those who were admitted in the Medicine wards, Coronary Care units of Universal College of Medical College Teaching hospital, Bhairahawa were taken as the study subjects.

Duration of study: Study was done for a period of 1 year from March 2014 to March 2015.

Sample Size: A total of 100 patients presenting with hypertension were taken into the study.

Sample technique: Simple Random Sampling.

Method of Collection of Data: The data collected from the patients by the detailed clinical history, clinical examination and by relevant investigations

Ethical clearance: The study was done after getting clearance from ethical committee and informed written consent was taken from every patient.

Study method: Cross – Sectional Study.

Inclusion Criteria

All cases of Systemic hypertension as defined by JNC-7 classification meeting various criteria of LVH in ECG, irrespective of duration of hypertension and the type of treatment received were included in the study.

Exclusion Criteria

- Ischemic heart disease/Myocardial infarction.
- Ischemic cardiomyopathy.
- Congenital heart disease.
- Significant valvular heart disease.

Data collection

The data were fed in the Microsoft Excel 2007 and analyzed by Statistical package for social service (SPSS)-IBM 20. Descriptive data were expressed in mean ± SD along with the frequency and percentage distribution tables. Means of continuous variables were compared by using the analysis of variance (ANOVA) and pearson’s chi square. The p-value of <0.05 was considered to be statistically significant. For demographic profile and other variables frequency and percentage distribution were calculated.

Results & Discussion

Relation between Sokolow- Lyon criteria and ECHO:

Table 1: LVH by ECG Sokolow-Lyon criteria

		ECHO		Total	p value
		+	-		
ECG	+	38 (a)	14 (b)	52 (a+b)	0.001
	-	22 (c)	26 (d)	48 (c+d)	
	Total	60 (a+c)	40 (b+d)	100 (a+b+c+d)	

Using Chi-Square Tests, this comparison between ECHO and ECG of Sokolow-Lyon index is significant. (p value 0.001)

ECG of Sokolow-Lyon index could diagnose LVH in total of 52 patients. Out of which 38 patients had LVH by 2D ECHO.

From above table,

Sensitivity is 63%, Specificity is 65%, PPV is 73%, NPV is 54%, Accuracy is 64% and

Kappa measure of agreement is 0.28.

Relation between Romhilt and Estes Point system and ECHO:

Table 2: LVH by ECG using Romhilt and Estes point system

		ECHO		Total	p value
		+	-		
ECG	+	48 (a)	10 (b)	58 (a+b)	<0.001
	-	19 (c)	23 (d)	42 (c+d)	
	Total	67 (a+c)	33 (b+d)	100 (a+b+c+d)	

Using Chi-Square Tests, this comparison between ECHO and ECG of Romhilt and Estes point system is significant. (p value <0.001)

ECG of Romhilt and Estes criteria could diagnose LVH in total of 58 patients. Out of which 48 patients had LVH by 2D ECHO.

From above table,

Sensitivity is 71%, Specificity is 69%, PPV is 82%, NPV is 54%, Accuracy is 71% and

Kappa measure of agreement is 0.19.

Relation between Total QRS voltage criteria and ECHO:

Table 3: LVH by ECG using Total QRS Voltage Criteria

		ECHO		Total	p value
		+	-		
ECG	+	42 (a)	10 (b)	52 (a+b)	<0.001
	-	16 (c)	32 (d)	48 (c+d)	
	Total	58 (a+c)	42 (b+d)	100 (a+b+c+d)	

Using Chi-Square Tests, this comparison between ECHO and ECG of Total QRS voltage criteria is significant. (p value <0.001)

ECG of Total QRS voltage criteria could diagnose LVH in total of 52 patients out of which 42 patients had LVH by 2D ECHO.

From above table,

Sensitivity is 72%, Specificity is 76%, PPV is 80%, NPV is 67%, Accuracy is 74% and Kappa measure of agreement is 0.24.

Table 4: Sensitivity, specificity, accuracy, positive predictive Value, negative predictive value and kappa measure of agreement of different electrocardiographic criteria for LVH

S L. no.	Criteria	Sensitivity	Specificity	Accuracy	PPV	NPV	Kappa measure of agreement
1.	S.L. Criteria	63	65	64	73	54	0.28
2.	R.E.P point	71	69	71	82	54	0.19
3.	Total QRS	72	76	74	80	67	0.24

Comparison of the efficacy of ECG in relation to ECHO in the detection of LVH so that its (ECG) validity for the diagnosis of LVH could be assessed is the main intention behind this study.

For this 100 hypertensive patients were chosen, and apart from routine investigations all patients underwent ECG recording and ECHO after they fulfilled the inclusion and exclusion criteria as per the study design.

Review of literature regarding the hypertension and LVH and various methods of ECG diagnosis of LVH was done. Present study is compared with various other established studies.

Conclusion

Our study shows Sokolow-Lyon criteria has sensitivity of 63% and specificity of 65% while

Romhilt-Estes scoring system has a sensitivity of 71 % and a specificity of 69% and Total QRS criteria has sensitivity of 72% and specificity of 76%. Among the different criteria used, total QRS criteria showed better sensitivity and specificity compared to others in the present study.

LVH is known to predict cardiovascular mortality in patients with hypertension. It has been found that with correct choice of antihypertensive LVH can be regressed. Hence it is important that all hypertensive patients should have routine CVS examination including ECG, ECHO.

One need to consider all the criteria for diagnosis of LVH and should be confirmed by standard test i.e. ECHO. Whenever possible quantification of LVH needs to be done since LVH is a reversible condition and LVH carries a increased risk of complication of CVS. Timely evaluation of LVH is recommended to prevent the possible complications.

References

- Messerli F, Grodzicki T. Hypertension, left ventricular hypertrophy, ventricular arrhythmias and sudden death. *Eur Heart J*. 1992;13(Suppl D):66-9.
- Woythaler JN, Singer SL, Kwan OL, Meltzer RS, Reubner B, Bommer W,

- et al. Accuracy of echocardiography versus electrocardiography in detecting left ventricular hypertrophy: comparison with postmortem mass measurements. *Journal of the American College of Cardiology*. 1983;2(2):305-11.
- Romhilt DW, Bove KE, Norris RI, Conyers E, Conradi S, Rowlands DT, et al. A Critical Appraisal of the Electrocardiographic Criteria for the Diagnosis of Left Ventricular Hypertrophy. *Circulation*. 1969;40(2):185-96.
- Reichek N, Devereux RB. Left ventricular hypertrophy: relationship of anatomic, echocardiographic and electrocardiographic findings. *Circulation*. 1981;63(6):1391-8.
- Sharma SK, Ghimire A, Radhakrishnan J, Thapa L, Shrestha NR, Paudel N, et al. Prevalence of hypertension, obesity, diabetes, and metabolic syndrome in Nepal. *International journal of hypertension*. 2011;2011.
- Bhandari B, Bhattarai M, Bhandari M, Ghimire A, Pokharel PK, Morisky DE. Adherence to Antihypertensive Medications: Population Based Follow up in Eastern Nepal. *J Nepal Health Res Counc*. 2015;13(29):38-42.
- Mancia G, Carugo S, Grassi G, Lanzarotti A, Schiavina R, Cesana G, et al. Prevalence of Left Ventricular Hypertrophy in Hypertensive Patients Without and With Blood Pressure Control: Data From the PAMELA Population. *Hypertension*. 2002;39(3):744-9.
- Kannel WB. Left ventricular hypertrophy as a risk factor: the Framingham experience. *Journal of hypertension Supplement: official journal of the International Society of Hypertension*. 1991;9(2):S3-8; discussion S-9.
- Kronmal RA, Lima JA, Liu K, Olson J, Burke GL, et al. The relationship of left ventricular mass and geometry to incident cardiovascular events: the MESA (Multi-Ethnic Study of Atherosclerosis) study. *Journal of the American College of Cardiology*. 2008;52(25):2148-55.
- Vakili BA, Okin PM, Devereux RB. Prognostic implications of left ventricular hypertrophy. *American heart journal*. 2001;141(3):334-41.
- Dower GE, Horn HE, Ziegler WG. On electrocardiographic-autopsy correlations in left ventricular hypertrophy. A simple postmortem index of hypertrophy proposed. *American heart journal*. 1967;74(3):351-67.
- Romhilt DW, Bove KE, Norris RI, Conyers E, Conradi S, Rowlands DT, et al. A Critical Appraisal of the Electrocardiographic Criteria for the Diagnosis of Left Ventricular Hypertrophy. *Circulation*. 1969;40(2):185-96.
- Okin PM, Roman MJ, Lee ET, Galloway JM, Howard BV, Devereux RB. Combined Echocardiographic Left Ventricular Hypertrophy and Electrocardiographic ST Depression Improve Prediction of Mortality in American Indians The Strong Heart Study. *Hypertension*. 2004;43(4):769-74.
- Kansal S, Roitman D, Sheffield L. A quantitative relationship of electrocardiographic criteria of left ventricular hypertrophy with echocardiographic left ventricular mass: a multivariate approach. *Clinical cardiology*. 1983;6(9):456-63.
- Lang RM, Bierig M, Devereux RB, Flachskampf FA, Foster E, Pellikka PA, et al. Recommendations for chamber quantification: a report from the American Society of Echocardiography's Guidelines and Standards Committee and the Chamber Quantification Writing Group, developed in conjunction with the European Association of Echocardiography, a branch of the European Society of Cardiology. *Journal of the American Society of Echocardiography : official publication of the American Society of Echocardiography*. 2005;18(12):1440-63.
- Prakash O, Karki P, Sharma S. Left ventricular hypertrophy in hypertension: Correlation between electrocardiography and echocardiography. *Kathmandu University Medical Journal*. 2009;7(2):97-103.
- Fragola PV, De Nardo D, Calò L, Cannata D. Use of the signal-averaged QRS duration for diagnosing left ventricular hypertrophy in hypertensive patients. *International journal of cardiology*. 1994;44(3):261-70.
- Gubner R, Ungerleider HE. Electrocardiographic criteria of left ventricular hypertrophy: factors determining the evolution of the electrocardiographic patterns in hypertrophy and bundle branch block. *Archives of Internal Medicine*. 1943;72(2):196-209.
- Schulman SP, Weiss JL, Becker LC, Gottlieb SO, Woodruff KM, Weisfeldt ML, et al. The effects of antihypertensive therapy on left ventricular mass in elderly patients. *New England Journal of Medicine*. 1990;322(19):1350-6.

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