ORIGINAL RESEARCH PAPER

General Medicine

A STUDY OF ELECTROCARDIOGRAPHY AND 2D ECHOCARDIOGRAPHY IN PATIENTS WITH LEFT VENTRICULAR HYPERTROPHY

KEY WORDS:
Echocardiography; electrocardiography; left ventricular hypertrophy.

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ABSTRACT

BACKGROUND: Left ventricular hypertrophy is a common condition that commonly affects morbidity and mortality from cardiovascular diseases, including congestive heart failure, myocardial infarction, and stroke. 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. Two-dimensional echocardiogram still demands considerably more time, cost, the technical skill of the operator than routine 12 lead ECG. Considering the magnitude of LVH, the study is designed to correlate between three different ECG criteria of left ventricular hypertrophy using echo cardio graphy as a diagnostic standard.

OBJECTIVES: To identify the left ventricular hypertrophy and to compare relative sensitivity, specificity, accuracy, positive predictive value, the negative predictive value of echocardiography, and 12 lead ECG for detecting left ventricular hypertrophy.

METHODOLOGY: The study was conducted on 100 patients at SVRRGH Hospital, Tirupati, during the years 2018 and 2019. Patients were divided into two groups the study group and the control group. Patients in the study group had echo evidence of LVH, whereas the patients in the control group had no echo evidence of LVH. After taking a full detailed history, all the patients were subjected to physical examination, ECG, and echo.

RESULTS: The sensitivity and specificity for S – L Index were 37% and 77%, For the R.E. system, it was 49% and 77%, and for total QRS voltage criteria, it was 58% and 89%. The kappa measure of agreement was 0.12, 0.23, and 0.41 for the three criteria, respectively. It means ECG has a weak correlation with echocardiography.

CONCLUSION: This study shows that all the ECG criteria have low sensitivity but high specificity, so we cannot use ECG to rule out LVH, but ECG can be recommended as a routine investigation because of high specificity and secondary ST-T changes which are associated with elevated cardiac morbidity and mortality.

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[1]. The study also stated that electrocardiogram diagnosed LVH was associated with a 3-5 fold increase of cardiovascular events with the higher risk ratios for cardiac failure and stroke. LVH is no longer considered 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 increase in left ventricular mass represents a final pathway towards the adverse effects on the cardiovascular system and higher vulnerability to complication[3]. The studies clarify a strong relation between left ventricular hypertrophy and adverse outcome and hence emphasize the clinical importance for its detection[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].

Today, a two-dimensional echocardiogram still demands considerably more time, cost, the 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[6]. Considering the magnitude of LVH, the study is designed to correlate three different ECG criteria of left hypertrophy using echo cardiography as a diagnostic standard.

Study Design

This was a Hospital based Correlation study conducted in SVRRGH hospital, Tirupati, from August 2018 to October 2019. The study Group and control group comprised of patients who have echocardiographic evidence of LVH and patients who had no echo evidence of LVH respectively. Detailed History was taken, Physical examination was done and following investigations like ECG, 2D ECHO, Chest X-Ray, Random Blood Sugar, Serum Creatinine, Blood Urea, Complete Blood Picture, Lipid Profile and Urine Examination were done. The electrocardiographic variables to be recorded are a)The voltage of R, S or Q waves in all the leads, b)ST-T changes, c) Axis, d) Duration of QRS complexes in limb leads, e)Intrinsicoid deflection in V5, V6 and f)'P' terminale in VI.

Electro cardiographic criteria used in this study are:

I. Sokolov- Lyon Index: S in V1, +R in V5 or V6>35mm
ii. Romhilt - Estes point score system:
iii. Total QRS voltage criteria

Inclusion Criteria:

1. Patients with echocardiographic evidence of Valvular heart diseases.
2. Hypertension.
3. Patients with echocardiographic evidence of Coarctation Of Aorta.
4. Patients with echocardiographic evidence Ventricular Septal Defect.

Exclusion Criteria:

1. Myocardial Infarction.

2.Bundle Branch Block.

Statistical Methods

The statistical tests are diagnostic validity tests (specificity and sensitivity).Kappa measures of the agreement have been performed.

RESULTS

In this study, 100 patients were enrolled. Out of 100 patients, 61 were male, and 39 were female. The control group patients had no echocardiographic evidence of left ventricular hypertrophy, i.e., the average of sums of septal and posterior wall thickness was < 1.1 cm. The control group consisted of 35 patients, out of whom 20 were males and 15 females. As depicted in table 1,out of 65 patients in the study group, electrocardiographic criteria, in combination, could diagnose only 42 cases. The Sokolov-Lyon index could diagnose only 24 patients. Romhilt - Estes point score system was positive in 29 patients. Total QRS voltage criteria could diagnose 38 of these patients. Out of 35 patients in the control group, 8 had electro cardiographic evidence of left ventricular hypertrophy by using Sokolov-Lyon, 8 had electro cardiographic evidence of left ventricular hypertrophy by using Romhilt Estes criteria and only 4 with total QRS voltage criteria as shown in table 2.

Table 1 : Number Of Patients Detected To Have LVH With Various ECG Criteria

Total no. of patients with echo evidence of LVH	S.L Index	R.E.POINT SCORE		Total QRS
		4 points	5 points	
65	24	32	29	38

Table 2 : Number Of Patients Had False Positive LVH By ECG

Total no. of patients with echo evidence of LVH	S.L Index	R.E.POINT SCORE		Total QRS
		4 points	5 points	
35	08	08	07	04

Performance Of Each Electro Cardiographic Criterion For Diagnosis Of LVH:

1. Sokolov - Lyon Index:

		Echo		Total
		+	-	
ECG	+	24	08	32
	-	41	27	68
	Total	65	35	100

According to the above Table-

1) Sensitivity is 37 %
2) Specificity is 77%
3) Positive predictive value is 75%
4) Negative predictive value is 39%
5) Accuracy 51%
6) kappa measure of agreement is 0.12

2) Romhilt - Estes point score system: - i) By using 4 point score-

		Echo		Total
		+	-	
ECG	+	32	08	40
	-	33	27	60
	Total	65	35	100

According to the above Table-

1)Sensitivity is 49 %
2)Specificity is 77%
3)Positive predictive value is 80 %
4)Negative predictive value is 45%
5)Accuracy 59%
6)Kappa measure of agreement is 0.23

ii) By using 5 point score-

		Echo		Total
		+	-	
ECG	+	29	07	36
	-	36	28	64
	Total	65	35	100

According to the above Table-

1) Sensitivity is 45%
2) Specificity is 80%
3) Positive predictive value is 80 %
4) Negative predictive value is 44%
5) Accuracy 57%
6) kappa measure of agreement is 0.21

Total QRS Voltage Criteria:-

		Echo		Total
		+	-	
ECG	+	38	04	42
	-	27	31	58
	Total	65	35	100

According to the above Table-

1) Sensitivity is 58 %
2) Specificity is 89%
3) Positive predictive value is 90 %
4) Negative predictive value is 53%
5) Accuracy 69%
6) kappa measure of agreement is 0.41

Table : 3 SENSITIVITY, SPECIFICTY, ACCURACY, POSITIVE PREDICTIVE VALUE, NEGATIVE PREDICTIVE VALUE AND KAPPA MEASURE OF AGREEMENT OF DIFFERENT ELECTRO CARDIO GRAPHIC CRITERIA FOR LVH

Sl no	ECG Criteria	Sensitivity %	Specificity %	Accuracy %	PPV %	NPV %	Kappa measure of agreement
1	S.L Criteria	37	77	51	75	39	0.12
2	R.E point score-4 Point	49	77	59	80	45	0.23
	5 point	45	80	57	80	44	0.21
3	Total QRS	58	89	69	90	53	0.41

DISCUSSION

This study compared the three most important electro cardiographic criteria for the diagnosis of left ventricular hypertrophy with echo cardiography as a diagnostic standard.

1) Sokolov - Lyon index: Sokolov - Lyon criteria are the oldest, simplest, and quickest method for the diagnosis of left ventricular hypertrophy. In the present study, the criteria showed the Kappa measure of agreement is 0.12, suggesting that there is a poor measure of agreement between electrocardiogram and echocardiogram in diagnosing left ventricular hypertrophy. The previous studies showed the following results-

Table 4: Sensitivity And Specificity For Sokolov-lyon Index In Previous Studies And Present Study

Sl. No	Study	Sensitivity	Specificity
1	William C. Robertsv[6](1995)	17%	-
2	Cabezas et al [7] (1997)	22%	79%
3	Verdechia P et al [8](2000)	11.2%	91.1%
4	Prakash O et al. [9](2009)	34%	-
5	Kumar Narayan et al [10] (2014)	12%	-
6	Sjoberg et.al [11] (2015)	29%	-
7	M baye et al. [12] (2017)	17%	-
8	Present study	37%	77%

Romhilt and Estes point score system:

In the present study, the criteria showed the Kappa's measure of agreement is 0.23 suggesting a poor measure of agreement between echocardiogram and electrocardiogram in diagnosing left ventricular hypertrophy. The study shows a better sensitivity compared to the Sokolov-Lyon index. It showed the lowest sensitivity in patients with mitral regurgitation 28% and the highest sensitivity of 75% in Aortic regurgitation and 71% in patients with combined lesions (MR and AR, AS, and AR). The study showed 43% sensitivity when 5 points were used and 49% sensitivity when 4 points were used. Previous studies showed the following results.

Table 5: Sensitivity And Specificity For Romhilt And ESTES Point Score System In Previous Studies And Present Study

Sl. No	Study	Sensitivity %	Specificity %
1	Norman and Levy D. et al[13] (1995)	34	-
2	Verde chia P et al [14] (2000)	6	96.4
3	Prakash O et al. [9](2009)	13	-
4	Sjoberg et al. [11](2015)	21	-
5	Present study	49	77

Total QRS Voltage Criteria:

This is recently proposed by Robert and Day as criteria for the diagnosis of left ventricular hypertrophy. A total QRS voltage higher than 175mm was taken as a diagnostic. Compared to Sokolov - Lyon, and Romhilt - Estes criteria, the total QRS criteria showed better sensitivity, specificity, accuracy, and a fair Kappa measure of agreement. The Kappa measure of agreement is 0.41, which suggests that there is a fair measure of agreement between electrocardiogram and echo diagnosing left ventricular hypertrophy. The sensitivity and specificity of previous studies are as follows.

Table 6: Sensitivity And Specificity Total QRS Voltage Criteria In Previous Studies And Present Study

Sl . No.	Study	Sensitivity %	Specificity %
1	Verdechia P et al [8](2000)	15	91
2	Taroq waseem et.al[15] (2003)	34	-
3	Calderon A et al. [16] (2010)	33	-
4	Ogun lade et al [7](2013)	52	74
5	Sjoberg et al. [11](2015)	50	-
6	Mbaye et al. [12](2017)	13	-
7	Present study	58	89

Some of the reasons why the voltage criteria failed in diagnosing left ventricular hypertrophy may be due to –

1. Patients having thin chest wall
2. Left anterior fascicular block (the superiorly directed mean frontal plane axis results in abnormally high voltage in I and a VL).
3. Left-sided intraventricular conduction delay or left bundle branch block pattern (the abnormal depolarization sequence per se can produce abnormally high voltages).
4. Acute myocardial ischemia (changes in voltage may be secondary to local intraventricular conduction delay).

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