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A Study on the Reliability of ECG in Diagnosis of LVH as Compared to ECHO

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ABSTRACT
Left ventricular hypertrophy is no longer considered as an adaptive mechanism 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, congestive cardiac failure and stroke. Although newer diagnostic tools are available, the electrocardiogram (ECG) remains the most common mean for evaluating cardiac disease. Patient attending the Emergency department and those who was admitted in the Emergency medicine wards were the study subjects. The data was collected from the patients by the detailed clinical history, clinical examination of the patients and relevant investigation in a specially designed proforma. Chi-Square test was used to compare between ECHO and ECG of Romhilt and Estes criteria, it was not 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. From above table, Sensitivity is 45.16%, Specificity is 78.95%, PPV is 77.78%, NPV is 46.86%, Accuracy is 58% and Kappa measure of agreement is 0.21.

INTRODUCTION

Left ventricular hypertrophy (LVH) is an important and consistent complication of high blood pressure (BP)[1]. It is thought that this occurs as a result of increased after load imposed on the heart in high BP, which forces structural and functional adaptation. The later results in LVH involving an increase in muscle mass achieved by hypertrophy of the myocytes accompanied by high degree of polyploidy as well as hyperplasia of cardiac connective tissue cells[2]. In addition, functional adaptation involves increase in heart rate, minute volume and initially contractility[3]. With persistence of high BP and maintenance of LVH, functional adaptation decompensate and unless effective therapy is interjected, left ventricular failure ensues as the major cardiac haemodynamic consequence[4]. Left ventricular hypertrophy is no longer considered as an adaptive mechanism 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, congestive cardiac failure and stroke[5]. Although newer diagnostic tools are available, the electrocardiogram (ECG) remains the most common mean for evaluating cardiac disease[2]. Electrocardiographic evidence of left ventricular hypertrophy (LVH) is a major marker of cardiovascular morbidity and mortality[6]. In particular, several ECG criteria have been proposed for the detection of left ventricular hypertrophy (LVH) both in clinical practice and in epidemiological studies[2]. Though the specificities of these criteria are typically high (>90%), the sensitivities are lower and in the range of 20-60%. The advent of echocardiography has provided a noninvasive means of estimating left ventricular mass with close correlation to autopsy values (r>0.90). Emerging data suggest that echocardiographically defined LVH is also predictive of cardiovascular disease risk[6]. LVH is prognostic indicator of future events in hypertensive patients. Various modalities are available to detect it. ECG and Echocardigraphy are better tools. There are many ways of diagnosing LVH like by electrocardiography (ECG), roentgenography and echocardiography (ECHO)[7]. 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

Source of Data: Patient attending the Emergency department and those who was admitted in the Emergency medicine wards were the study subjects.

Sample Size: 100.

Study Method: Cross-Sectional Study.

Sample Technique: Simple Random Sampling.

Method of Collection of Data: The data was collected from the patients by the detailed clinical history, clinical examination of the patients and relevant investigation in a specially designed proforma.

Case History:

- Patients were assigned a case number and their name, age, sex, occupation socioeconomic status was noted.
- Total duration of hypertension, the medication used was recorded.
- History of smoking or tobacco in any other form, alcohol consumption was specifically noted in the personal history.
- Family history of hypertension, ischemic heart disease was specifically noted.

Investigation:

- Blood-Hb gm%, total counts (TC), differential counts (DC), Blood Urea, Serum Creatinine, random blood sugar (RBS).
- Chest X-ray.
- ECG.
- Echocardiography with color Doppler.

Inclusion Criteria: All cases of essential hypertension, irrespective of duration of hypertension, age more than 18 years and type of treatment received were included in the study.

Exclusion Criteria:

- Secondary hypertension.
- Ischemic heart disease.
- Ischemic cardiomyopathy.
- Congenital heart disease.
- Valvular heart disease.

RESULTS AND DISCUSSIONS

Out of 100 patients, 17 patients are mild left ventricular hypertrophy, 11 are moderate left ventricular hypertrophy and 10 are severe left ventricular hypertrophy in male 38 patients. Among 24 female patients, 12 mild left ventricular hypertrophy, 6 moderate left ventricular hypertrophy and 6 are severe left ventricular hypertrophy noted (Table 1).

Chi-Square test was used to compare between ECHO and clinical evaluation and it found highly significant. Clinical evaluation showed LVH in 24 patients. Sensitivity is 38.7%, Specificity is 100%, PPV is 100%, NPV is 50%, Accuracy is 62% and Kappa measure of agreement is 0.32 (Table 2).

Chi-Square test was used to compare between ECHO and ECG of Sokolow-Lyon index and it found highly significant. ECG of Sokolow-Lyon index could diagnose

Table 1: Distribution of the Study Group According to the Severity of Left Ventricular Hypertrophy by Echocardiography

Grade	Males (n=60)		Females (n=40)		
	Number	Percentage	Number	Percentage	Total
Mild	17	44.7%	12	50%	29
Moderate	11	28.9%	6	25%	17
Severe	10	26.31%	6	25%	16
Total	38	63.33%	24	60%	62

Table 2: Clinical Detection of LVH

Clinical Evaluation	Echocardiography		
	Positive	Negative	Total
Positive	24(a)	0(b)	24 (a+b)
Negative	38(C)	38(d)	76 (c+d)
Total	62 (a+c)	38 (b+d)	100

Table 3: LVH by ECG Sokolow-Lyon Index

	ECHO			Total
ECG		+	-	
	+	24(a)	4(b)	28(a+b)
	-	38(c)	34(d)	72(c+d)
	Total	62(a+c)	38(b+d)	100(a+b+c+d)

LVH in total of 28 patients. Out of which only 24 patients had LVH by 2D ECHO. From above table, Sensitivity is 38.7%, Specificity is 89.5%, PPV is 85.7%, NPV is 47.22%, Accuracy is 58% and Kappa measure of agreement is 0.24 (Table 3).

Table 4: LVH by using Romhilt and Estes Criteria

	Echo			Total
		+	-	
ECG	+	28(a)	8(b)	36(a+b)
	-	34(c)	30(d)	64(c+d)
	Total	62(a+c)	38(b+d)	100(a+b+c+d)

Chi-Square test was used to compare between ECHO and ECG of Romhilt and Estes criteria, it was not 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. From above table, Sensitivity is 45.16%, Specificity is 78.95%, PPV is 77.78%, NPV is 46.86%, Accuracy is 58% and Kappa measure of agreement is 0.21 (Table 4).

Table 5: LVH by ECG Using Total QRS Voltage Criteria

		Echo		Total
		+	-	
ECG	+	36 (a)	3 (b)	39 (a+b)
	-	26 (c)	35 (d)	61 (c+d)
	Total	62 (a+c)	38 (b+d)	100

Chi-Square test was used to compare between ECHO and ECG of Total QRS voltage criteria and it found highly 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. From above table, Sensitivity is 58.06%, Specificity is 92.10%, PPV is 92.3%, NPV is 57.37%, Accuracy is 71% and Kappa measure of agreement is 0.4 (Table 5).

Kappa Measure of Agreement: Kappa measure of agreement for Clinical detection of LVH was 0.25, for LVH by ECG Sokolow-Lyon index was 0.24, for LVH by ECG using Romhilt and Estes criteria was 0.21 and LVH by ECG using Total QRS voltage criteria was 0.4. Romhilt and others in 1969 reviewed 33 different voltage criteria for left ventricular hypertrophy in 360 autopsied hearts. Results clearly pointed lack of sensitivity of these voltage criteria. Reichek and Devereux[8] in 1981 found sensitivity of point system and sokolowlyon criteria were 50% and 21%. Both had specificity of 95%. In 1985, Devereux and Casale[9] found Romhilt and Estes had sensitivity of 48% and specificity of 85%. Sokolow-lyon had sensitivity of 22% and specificity of 93%. In 1986 Odom and Davies[10] gave a basis for evaluating total QRS voltage as an index of left ventricular hypertrophy. Daniel Levy[11] examined 4,684 subjects of Framingham heart study found sensitivity of ECG was overall 6.9% and specificity was 98.9%. William C. Roberts[12] in 1992 found that total QRS amplitude ha highest sensitivity of 71%. While Sokolow-lyon and Romhilt, 'Estes showed sensitivity of 17 percent. In 1995, Roman M.J. and[6] found that 12 lead voltages had sensitivity of 50%, Cornell voltage had 37% and sokolow-lyon had 45% and Romhilt and Estes had 30%. In 1998, Denarie N, Linhart A, Levenson[13] found that sensitivity of Romhilt Estes and Sokolow criteria were from 20-25% but Cornell criteria had 50%. In 2000 Christian Jaggy[14] did a study to know the performance of classic electrocardiographic criteria for left ventricle hypertrophy in African population and found that Sokolow-Lyon index had a sensitivity of 61% with a specificity of 68% whereas total QRS voltage criteria had a sensitivity of 42% and a specificity of 78%[14]. In year 2005 Waqashameed[15] found the sensitivity of R.E point score system 35% and specificity of 90%. 16 Our study compared the three most important ECG criteria's for the diagnosis of LVH in hypertensive patients with ECHO as the diagnostic tool.

Sokolow-Lyon Criteria: This 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. With kappa measure of agreement being 0.24, kappa shows a poor measure of agreement between ECG and ECHO. The previous studies showed the following results. The Sokolow-Lyon criteria as been studied in many studies to determine its sensitivity and specificity.

Table 6: Studies and Present Study

	Sensitivity	Specificity
Reichek and Devereux (1981)[2]	50%	95
Kansal S (1983)	57%	81
Murphy (1985)	60%	90
Devereux and Casale (1985)[9]	48%	85
William C Roberts (1995)	17%	---
Norman and Levy (1995)	34%	---
Denarie N, Linhart (1998)	20%	---
Waqas Hameed (2005)[15]	35%	90
Our study	45.16%	78.95%

CONCLUSION

In our study, Clinical detection of LVH shows a sensitivity of 38.7%, Sokolow-Lyon criteria showed a sensitivity of 38.7%, Romhilt-Estes scoring system showed a sensitivity of 45.16%, Total QRS criteria showed a sensitivity of 58.06%. Among the different criteria used, total QRS criteria showed better sensitivity compared to others (Table 6). 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.

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