ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

"VALIDITY AND PREDICTIVE VALUE OF ELECTROCARDIOGRAM IN DIAGNOSING LEFT VENTRICULAR HYPERTROPHY AS COMPARED TO 2D ECHOCARDIOGRAPHY."

Jagadeesh Gaddeppanavar[1], Aravind Karinagannanavar[2], Vimala S Iyengar[3], Girish I[4], Kiran Meti[5]

1. Assistant professor, Dept of General Medicine, Gadag Institute of Medical sciences Gadag, Karnataka
2. Assistant professor, Dept of Community Medicine, Mysore Medical College and Research Centre, Mysore, Karnataka
3. Associate professor, Dept of General Medicine, Adichunchanagiri Institute Of Medical Sciences, B.G.Nagara, Nagamangala, Karnataka
4. Assistant professor, Dept of General Medicine, Basaveshwar Medical College, Chitradurga, Karnataka
5. Assistant professor, Dept of General Medicine, SDM Medical College, Dharwad, Karnataka

Manuscript Info

Manuscript History:

Received: 15 May 2015
Final Accepted: 26 June 2015
Published Online: July 2015

Key words:

Echocardiography; Electrocardiography; Left Ventricular Hypertrophy

Corresponding Author

Jagadeesh Gaddeppanavar

Abstract

Background: Left ventricular hypertrophy (LVH) is a common condition that profoundly affects morbidity and mortality from cardiovascular diseases. 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. Two-dimensional echocardiogram still demands considerably more time, cost, technical skill of the operator than routine 12 lead ECG. **Objectives:** 1) To diagnose the LVH by different ECG criteria's and 2D ECHO 2) To find the sensitivity, specificity, positive predictive value and negative predictive value of ECG in diagnosing LVH as Compared to echocardiography. **Methodology:** A cross sectional study was conducted on 100 patients at Adichunchangiri hospital during the year 2011-2013. Patients were divided into two groups, one is echo evidence of LVH and another one is with no evidence of LVH by echo**.** Different ECG criteria's were used to identify LVH. **Results:** The sensitivity and specificity for S – L Index was 38.88% and 64.28 %, For R.E. system it was 36.11% and 67.85% for 4 point score ,43.05% and 64.28 % for 5 point score and for Cornell voltage criteria it was 55.55% and 78.57%. **Conclusion:** All the ECG criteria's have a high specificity but a low sensitivity. ECG can be recommended as a routine investigation because of high specificity and secondary ST-T changes which are associated with high cardiac morbidity and mortality.

INTRODUCTION

Left ventricular hypertrophy (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 (Friedman A.J., et al 1982). 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 (Devereux RB

2000). 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 (Vakili B.A. et al 2001) The increase in left ventricular mass represents a final pathway towards the adverse effects on the cardiovascular system and higher vulnerability to complication (Devereux RB, Reicheck MD 1997).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 (Elena Martinova. et al., 2007).

It may be expected that association 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. Today, two-dimensional echocardiogram still demands considerably more time, cost, technical skill of the operator and complexity of processing than routine 12 lead ECG. 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 (Daniel Pewsneret. et al.,2007). Considering the magnitude of LVH the study is designed to correlate between three different ECG criteria of left hypertrophy using echocardiography as diagnostic standard.

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 validity of ECG in diagnosis of LVH as compared to ECHO.

OBJECTIVES

- To diagnose the left ventricular hypertrophy by different ECG criteria's and 2D ECHO
- To find the sensitivity, specificity, positive predictive value and negative predictive value of ECG in diagnosing left ventricular hypertrophy as Compared to echocardiography.

METHODOLOGY

Source Of Data:

The subjects are recruited from patients attending medical OPD, in-patients, including ICU and cases referred for pre-op evaluation at Adichunchangiri Hospital and Research Centre, B.G.Nagara, Mandya.

Study Design: Cross sectional study

Study Period: 18 months, from January 2012 to August 2013.

Sample Size: 100

Sampling Technique: Non probability purposive sampling

Method of Data Collection: Electrocardiogram –Standard 12-lead electrocardiogram was obtained in all patients.

The electrocardiographic variables recorded were

1) Voltage of R, S or Q waves in all the leads
2) ST-T changes
3) Axis
4) Duration of QRS complexes in limb leads
5) Intrinscoid deflexion in V5, V6.
6) 'P' terminale in VI

Electrocardiographic criteria's used in this study are:

I) Romhilt–Estes scoring system for left ventricular hypertrophy.

1 .R or S wave in any limb ≥ 2 mv 3
Or S in V1 lead or V2
Or R in lad V5 or V6 ≥ 3 mv

2	left ventricular strain ST segment and T wave in opposite direction to QRS complex		
	Without digitalis	3	
	With digitalis		1
3	Left atrial enlargement	3	
	Terminal negativity of P wave in lead V1 is ≥0.10 mv in depth And ≥0.04s in duration		
4	Left axis deviation ≥ 30 degree		2
5	QRS duration ≥0.09s	1	
6	Intrinsicoid deflection in lead V5 or V6 ≥ 0.05s		1
	Maximum score	13	

Definite left ventricular hypertrophy -5 or more points
Left ventricular hypertrophy, probably – 4 points

II) Sokolow – Lyon criteria for left ventricular hypertrophy.
S wave in lead V1 plus R wave in lead in V5 or V6 ≥ 3.5 mv
Or
R wave in lead V5 or V6 ≥ 2.6 mv

III) Cornell voltage criteria for left ventricular hypertrophy.
Female - R wave in lead AVL plus S wave in V3 ≥ 2.00mv
Male - R wave in lead AVL plus S wave in V3 ≥ 2.8mv

Echocardiographic Studies:

Combined M-mode and two-dimensional echocardiography studies were performed. All patients were positioned in a 30 left decubitus position with slight elevation of the head. M –mode planes were employed with parasternal long axis views and after positioning of the cursor through the tip of the mitral valve the measurements of left ventricle are taken.

Measurement: The left ventricular posterior wall and septum were measured at the time of atrial depolarisation before the onset of a notch. The left ventricular internal dimension was measured at the level of chordae tendinae as the distance between the left side of interventricular septum and the posterior left ventricular endocardium. M mode measurements were taken by the leading edge to leading edge technique as recommended by the American society of echocardiography.

ECHO CRITERIAS (Lang RM et al., 2005) shown below for normal individual for both male and female .

IN MALES-- Septal wall thickness-- 0.6-1.00 CM

Posterior wall thickness—0.6-1.00 CM

IN FEMALE – Septalwall thickness-- 0.6-0.9 CM.

Posterior wall thickness----0.6-0.9 CM

ECHO CRITERIAS shown below for individual with left ventricular hypertrophy for both male and female.

IN MALES-- Posterior wall thickness-- ≥1.1 CM

Septal wall thickness-- ≥1.1 CM

IN FEMALE –Posterior wall thickness--- ≥ 1.0 CM

Septal wall thickness--- ≥1.0 CM.

Above readings were taken an evidence of left ventricular hypertrophy.

Statistical analysis: Data was entered in excel format and analysed using Epi-Info software. Descriptive statistics like frequencies and percentages were calculated. Validity and predictive value of ECG in Comparison to echocardiography in diagnosing left ventricular hypertrophy were calculated.

RESULTS

In this study 100 patients were enrolled. Out of 100 patients 58 were male and 42 were female. The patients were divided into two groups, ECHO positive group means those who have evidence of LVH by ECHO and negative group means those who have no evidence of LVH by ECHO.

In our study the majority had history of hypertension followed by IHD, Mitral regurgitation, Aortic stenosis, Aortic regurgitation and least was Mitral regurgitation and aortic regurgitation. (**Table I)**

This group patients had echocardiographic evidence of left ventricular hypertrophy i.e., both of septal and posterior wall thickness ≥1 cm in female and ≥1.1 cm in male. This study group comprised of 72 patients out of whom 41 were males and 31 female. (**Table II)**

The ECHO negative group patients had no echocardiographic evidence of left ventricular hypertrophy i.e., septal and posterior wall thickness was ≤ 1.1 cm in male and ≤1 cm in female. This group consisted of 28 patients out of whom 17 were males and 11 females. (**Table III)**

Out of 72 patients in the ECHO positive group, electrocardiographic criteria in combination could diagnose only 58 cases. The Sokolow-lyon index could diagnose only 28 patients. Romhilt - Estes point score system was positive in 31 patients. Cornell voltage criteria could diagnose 40 of these patients.

Out of 28 patients in the ECHO negative group, 10 had electrocardiographic evidence of left ventricular hypertrophy by using Sokolow-lyon, 10 had electrocardiographic evidence of left ventricular hypertrophy by using Romhilt Estes criteria with 5 point score ,9 had electrocardiographic evidence of left ventricular hypertrophy by Romhilt Estes criteria with 4 point score and only 6 with cornell voltage criteria.

The sensitivity and specificity for S – L Index was 38.88% and 64.28 %, For R.E. system it was 36.11% and 67.85% for 4 point score ,43.05% and 64.28 % for 5 point score and for Cornell voltage criteria it was 55.55% and 78.57%. The positive predictive value and negative predictive value for S – L Index was 73.68% and 29.03% For R.E. system it was 74.28% and 29.23% for 4 point score and 75.60% and 30.50% for 5 point score and for Cornell voltage criteria it was 86.97% and 40.74%. (**Table IV)**

TABLES

Table I: Disease and gender wise distribution of study subjects

SL No	DISEASES	MALE	FEMALE	TOTAL
1	Hypertension	35	27	62
2	Ischaemic heart disease	8	3	11
3	Aortic stenosis	3	6	9
4	Aortic regurgitation	2	3	5
5	Mitral regurgitation	8	3	11
6	Mitral regurgitation and aortic regurgitation	2	0	2
	Total	**58**	**42**	**100**

Table II: Disease and gender wise distribution of patients in ECHO positive group

SL NO	DISEASES	MALE	FEMALE	TOTAL

1	Hypertension	26	21	47
2	Ischaemic heart disease	4	2	6
3	Aortic stenosis	2	4	6
4	Aortic regurgitation	1	2	3
5	Mitral regurgitation	6	2	8
6	Mitral regurgitation and aortic regurgitation	2	0	2
	Total	41	31	72

Table-III: Disease and gender wise distribution of patients in ECHO negative group

SL NO	DISEASES	MALE	FEMALE	TOTAL
1	Hypertension	9	6	15
2	Ischaemic heart disease	4	1	5
3	Aortic stenosis	1	2	3
4	Aortic regurgitation	1	1	2
5	Mitral regurgitation	2	1	3
6	Mitral regurgitation and aortic regurgitation	0	0	0
	TOTAL	17	11	28

Table IV: Validity, Accuracy and Predictive Value of Different Electrocardiographic Criteria For LVH.

Sl No	ECG Criteria's	Sensitivity	Specificity	Accuracy	PPV	NPV
1	S L Criteria	38.8	64.28	46	73.68	29.03
2	R E Point Score					
	4 Point	36.11	67.85	45	74.28	29.23
	5 Point	43.05	64.28	49	75.6	30.5
3	Cornell Voltage	55.55	78.57	62	86.97	40.74

Table V: Comparison of Sensitivity and Specificity For Sokolow-Lyon Index of previous studies And Present Study

SL NO	Study	Sensitivity	Specificity
1	Reichek&Devereux (Devereux R.B., Richek N, 1981)	21	95
2	Murphy et al (Murphy M.L 1985)	60	80
3	Devereux & Casale(Devereux R.B., et aI 1986)	22	93
4	Christian Jaggy et.al (Christian jaggy et al 2000)	61	68
5	G.R Lallijie et.al (G.R Lallijie et.al 2007)	31	86

6	Oluwadareogunladea , ObafemiAwalow , (Oluwadareogunladea , ObafemiAwalow 2013)	58.62	60.66
7	Present study	38.88	64.28

Table VI: Comparison of Sensitivity And Specificity For Romhilt And Estes Point score system of Previous Studies And Present Study

S l no	Study	Sensitivity	Specificity
1	Reichek and Devereux (Devereux R.B., Richek N, 1981)	50	95
2	Kansal S. (Kansal.S, Roitman, Sheffield 1983)	57	81
3	Murphy et al.10 (Murphy M.L 1985)	60	90
4	Devereux and Casale11 (Devereux R.B., et al 1986)	48	85
5	WaqasHameed et.al (WaqasHameed et al 2005)	35	90
6	Present study	36.11	67.85

Table VII: Comparison of Sensitivity And Specificity Cornell Voltage Criterion, of Previous Studies And Present Study

SL no	Study	Sensitivity	Specificity
1	Norman and Levy D. et al (Norman J.E. Jr., Levy D 1995)	32	-
2	Denarie N, Linhart A, et al (Denarie N., et al 1998)	50	-
3	PewsnerD ,et al (Pewsner D et al 2007)	15	96
4	Oluwadareogunladea, ObafemiAwalow , (Oluwadareogunladea , ObafemiAwalow 2013)	51.72	73.77
5	Present study	55.55	78.57

DISCUSSION

In this study three most important electrocardiographic criteria for diagnosis of left ventricular hypertrophy compared with echocardiography as diagnostic standard.

Sokolow - Lyon index: Sokolow - Lyon criteria is the oldest, simplest and quickest method for the diagnosis of left ventricular hypertrophy which was described in 1949 by Sokolow M. and Lyon T.P. (**Table V)**

In the above studies, Christian Jaggy et.al shows maximum sensitivity 61 % and Reichek & Devereux shows maximum specificity 95 %. In present study shows 38.88 % sensitivity and 64.28 % specificity. (**Table V)**

Romhilt and Estes point score system: It was proposed in 1968. When 4 points were used as criteria it increased the specificity marginally. (**Table VI)**

In the above studies, Murphy et al. maximum sensitivity 60 % and Reichek & Devereux shows maximum specificity 95 %. In present study shows 36.11 % sensitivity and 67.85 % specificity. (**Table VI)**

Cornell voltage criteria: This is recently proposed by Robert and Day as criteria for diagnosis of left ventricular hypertrophy. A total voltage greater ≥2MV in female and ≥2.8MV diagnostic. In comparison withSokolow - Lyon and RomhiltEstes criteria Cornel voltage criteria showed better sensitivity, specificity, accuracy and a fair Kappa measure of agreement. (**Table VII)**

In the above studies, Oluwadareogunladea,ObafemiAwalow shows maximum sensitivity 51.72 % and Pewsner D, JuniP, et al shows maximum specificity 96 %. In present study shows 55.55 % sensitivity and 78.57 % specificity. (**Table VII)**

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

1) Patients having thick 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 intra-ventricular conduction delay.

CONCLUSION:

The study was carried out on 100 patients for finding the role played by electrocardiogram in the diagnosis of left ventricular hypertrophy.

- Criteria with highest sensitivity is Cornell voltage criteria i.e. 56 % in present study.
- Criteria with highest specificity is Cornell voltage i.e. 78.57% in present study.
- All the ECG criteria have a low sensitivity and high Specificity. Low sensitivity means these methods have a limited use as screening test.
- ECG can still be recommended as a routine investigation for LVH because of its cost effectiveness and easy availability but should not be used to rule out LVH.

ACKNOWLEDGEMENT

The authors thank the Professor and Head department of General Medicine Adichunchanagiri Institute Of Medical Sciences, B.G.Nagara for their kind support. The authors are also grateful to authors/editors/ publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed. The authors are also thank all the study subjects for their kind support.

REFERENCES

1) Christian jaggy et al., " performance of classic electrocardiographic criteria forleft ventricular hypertrophy in an African population." Hypertension, 2000;36:54

2) Daniel Pewsneret. et al.,"Accuracy of electrocardiography in diagnosis of left ventricular hypertrophy in arterial hypertension: systematic review" BMJ,2007;335:711-714

3) Denarie N., et al., "utility of electrocardiogram for predicating increased left ventricular mass in asymptomatic men at risk for cardiovascular disease". Am.j.Hypertension, 1998;11:861-865

4) Devereux R.B., Richek N., "Left ventricular hypertrophy relationship of anatomic, echocardiographic and electrocardiographic findings". Circulation,1981; 63: 1391-1397.

5) Devereux R.B., 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: 1388-1391.

6) Devereux RB, Reicheck MD. " Echocardiographic determination of left ventricular mass in men; Anatomic validation of the method" Circulation, 1997; 55: 613-8

7) Devereux RB. " Does increased blood pressure cause left ventricular hypertrophy or vice versa?" Ann Intern Med, 2000; 112:57-8.

8) Elena Martinova. et al., Automated Computer Analysis in Diagnosis of left ventricular hypertrophy by electrocardiography. Journal of Electrocardiology, 2007;40:S41– S42.

9) Friedman A.J., et al., "Accuracy of M-mode echocardiographic measurements of left ventricle". Am.J.Cardiol,1982;99:716-720.

10) G.R.Lallijie et.al "sensitivity and specificity of ECG in predicting the presence of LV mass", west Indian med.j,2007; vol;56:2

11) 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.

12) Lang RM, Bierig M, Devereux RB, 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. J Am SocEchocardiogr 18:1440, 2005

13) Murphy M.L., Thonabadu "Sensitivity of electrocardiographic A multivariate criteria for left ventricular hypertrophy according to type of disease". Am. J .Cardiol., 1985; 55: 545-550.

14) Norman J.E. Jr., Levy D. "Improved electrocardiographic detection of echocardiographic left ventricular hypertrophy : Results of a correlated data base approach". J Am ColI. Cardiol, 1995; 26(4): 1022-9

15) OluwadareOgunladea, ObafemiAwolowo, Assessment of voltage criteria for left ventricular hypertrophy in adult hypertensives in south-western Nigeria,journal of cardiovascular disease research ,Volume 4 ,issue1,march 2013 ,page 44-46.

16) Pewsner D, Jüni P, Egger M, Battaglia M, Sundström J, Bachmann LM. Accuracy of electrocardiography in diagnosis of left ventricular hypertrophy in arterial hypertension: systematic review. BMJ 2007; 335:711

17) Vakili B.A., Okin P.M., Devereux R.B., "Prognostic implications of left ventricular hypertrophy". Am Heart Journal, 2001;141:334- 341

18) WaqasHameed et al., "electrocardiographic diagnosis of left ventricular hypertrophy:comparison with echocardiography" Pak j physol.2005;1:1-2