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Correlation Between Electrocardiography and Echocardiography in Patients with Left Ventricular Hypertrophy

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Abstract

Background and Objectives: Left ventricular hypertrophy is a common condition thatprofoundly affects morbidity and mortality from cardiovascular diseases including myocardial infarction, congestive heart failure, 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, 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 hypertrophy using echocardiography as diagnostic standard and to assess Diastolic dysfunction in patients with ECHO proven LVH with normal systolic function. *Methods:* Patients from outpatient and inpatient department of tertiary care centre were included. Diagnostic standard of left ventricular hypertrophy was taken by Echocardiography. Patients with high index of clinical suspicion of left ventricular hypertrophy were subjected to electrocardiography and echocardiography, clinical suspicion was done by thorough physical examination and history. Statistical analysis was done by EPI Info Statistical Software version 3.5.2 and proportions; Chi-square test was used for test of significance. *Results:* The sensitivity was 46.5%, 36% and 37% for S – L Index, R.E. system and total QRS voltage criteria respectively. 44% of cases had diastolic dysfunction according to E/A Ratio and among them majority (26%) were in stage 1. *Conclusion:* This study shows that all the ECG criteria have low sensitivity than ECHO in diagnosing LVH. And hence these methods have a limited use as screening test. Interestingly ECG criteria were more sensitive in diagnosing Hypertensive LVH than LVH of other causes. Study also concludes that it is important to screen for diastolic dysfunction in patients with LVH.

Keywords: Correlation; Echocardiography; Electrocardiography; Left Ventricular Hypertrophy.

Introduction

Left ventricular hypertrophy is an important risk factor in patients with hypertension, leading to a fivefold to 10-fold increase in cardiovascular risk [1], which is similar to the increase seen in patients with a history of myocardial infarction [2]. The presence of left ventricular hypertrophy, in addition to hypertension, thus has important implications for assessing risk and managing patients, including decisions on interventions other than antihypertensive treatment, such as lipid lowering treatment and lifestyle modifications [3,4]. Accurate and early diagnosis of left ventricular hypertrophy is therefore an important component of treatment.

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 [5]. 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. 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 [6].

Left ventricular (LV) hypertrophy (LVH), whether determined by the ECG or echocardiogram [7,8], has been associated with various adverse cardiovascular outcomes, including mortality, myocardial infarction, and heart failure. Although there has been considerable speculation as to why LVH is such an important marker of risk [9,10], the basic mechanisms that predis-pose patients with LVH to develop atherosclerotic heart disease (ASHD) are not known.

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]. 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 [11].

Echocardiography is the test of choice to assess LVH. It is much more sensitive than electrocardiography and can also detect other abnormalities such as left ventricular dysfunction and valvular disease.

Considering the magnitude and prognostic implications associated with LVH, it becomes necessary to correlate between different ECG criteria of LVH using echocardiography as diagnostic standard.

Objectives

To assess the selected ECG criteria's of LVH using ECHO LVH as the diagnostic standard and to assess Diastolic dysfunction in patients with ECHO proven LVH.

Results

A total of 200 patients were included in the study for analysis. All the patients were diagnosed to have LVH according to the ECHO criteria.

Table 1: Showing Distribution of Study Group according to Age and Sex.

		SEX				Total
		Female (n=89)		Male (n=111)		
Age	< 40yrs	17	19.1%	20	18.0%	37 (18.5%)
	40 to 60 yrs	20	22.5%	29	26.1%	49 (24.5%)
	> 60 yrs	52	58.4%	62	55.9%	114 (57.0%)
	Mean ± SD	59.06 ± 15.339		58.98 ± 16.771		
Diagnosis	Aortic Regurgitation	6	6.7%	6	5.4%	12 (6.0%)
	Aortic Stenosis	10	11.2%	14	12.6%	24 (12.0%)
	Combined Lesion	6	6.7%	2	1.8%	8 (4.0%)
	Hypertension	63	70.8%	77	69.4%	140 (70.0%)
	Mitral Regurgitation	4	4.5%	12	10.8%	16 (8.0%)

In the study it was observed that majority 57% of them were in the age group greater than 60 yrs, 25% in the age group 40 to 60 yrs.55.5% of subjects were males and 44.5% were females and the mean age of Males and Females was 59 yrs. Majority i.e. 70% of patients were diagnosed to havehypertension, 12% had AS, 8% had MR, 6% had AR and 4% had CL. There was no significant difference between males and females. (Table 1).

Table 2: Showing the Frequency of Study Group Diagnosed by various indexes Sokolov – Lyon Index.

		Frequency	Percent
Sokolov – Lyon Index	< 35 Negative	107	53.5
	> 35 positive	93	46.5
Romhilt – Estes Criteria	< 5 Negative	128	64.0
	> 5 Positive	72	36.0
QRS Voltage Criteria	< 175 Negative	126	63.0
	> 175 Positive	74	37.0

Sokolov – Lyon Index had sensitivity of 46.5%, Romhilt – Estes Criteria had sensitivity of 36% and QRS Voltage Criteria had sensitivity of 37% in diagnosis of LVH compared to ECHO diagnosed LVH. Hence Sensitivity of Sokolov – Lyon Index was higher among the ECG criteria's in diagnosis of LVH. (Table 2).

Table 3: Showing Sokolov – Lyon Index for diseases in the Study group.

Disease	Sokolov – Lyon Index		Romhilt – Estes Criteria		Total QRS Voltage Criteria	
	< 35 Negative (n= 107)	> 35 positive (n=93)	< 5 Negative	> 5 Positive	< 5 Negative	> 5 Positive
Aortic Regurgitation	7 (6.5%)	5 (5.4%)	11 (8.6%)	1 (1.4%)	10 (7.9%)	2 (2.7%)
Aortic Stenosis	11 (10.3%)	13 (14.0%)	14 (10.9%)	10 (13.9%)	14 (11.1%)	10 (13.5%)
Combined Lesion	3 (2.8%)	5 (5.4%)	4 (3.1%)	4 (5.6%)	5 (4.0%)	3 (4.1%)
Hypertension	80 (74.8%)	60 (64.5%)	91 (71.1%)	49 (68.1%)	87 (69.0%)	53 (71.6%)
Mitral Regurgitation	6 (5.6%)	10 (10.8%)	8 (6.3%)	8 (11.1%)	10 (7.9%)	6 (8.1%)

In the study it was observed that maximum sensitivity by Sokolov – Lyon Index was for patients with Hypertension (64.5%), 14% for AS and 5.4% for AR and CL. Similarly maximum sensitivity by Romhilt – Estes Criteria was for patients with Hypertension (68.1%), 14% for AS and 1.4% for AR and maximum sensitivity by Total QRS Voltage Criteria was for patients with Hypertension (71.6%), 13.5% for AS and 2.7% for AR.Hence from the above table it can be concluded that ECG criteria's are sensitive in diagnosing Hypertensive LVH than Valvular diseases. (Table 3).

Table 4: Showing EA Ratio for Diastolic Dysfunction in LVH among the Study group for Diseases.

Disease	EA Ratio				Total
	0.75 to 1.5 Normal	< 0.75 Stage 1	Reversal with Valsalva Stage 2	> 1.5stage 3 & 4	
Aortic Stenosis	12 (12.9%)	7 (16.7%)	1 (20.0%)	4 (16.7%)	24 (14.6%)
HTN	81 (87.1%)	35 (83.3%)	4 (80.0%)	20 (83.3%)	140 (85.4%)
Total	93	42	5	24	164

In the study it was observed that 44% (73 out of 164) of cases had diastolic dysfunction according to E/A Ratio and among them majority (26%) were in stage 1, of them 85% had HTN and 14.6% had Aortic Stenosis. Hence ECHO can diagnose Diastolic dysfunction in earlier stages. (Table 4).

Discussion

A total of 200 patients were included in the study. All the patients were diagnosed LVH patients according to the ECHO criteria.

Demographic Profile of Patients

The present study observed that 55.5% of subjects were males and 44.5% were females and the mean age of Males and Females was 59 yrs. Majority 57% of them were in the age group greater than 60 yrs, 25% in the age group 40 to 60 yrs. (Table 5).

Table 5: Showing the comparison of the demographic profile among various studies.

Study	No of patients	Mean age (years)	Male (%)	Female (%)
Present Study	200	59	55%	45%
Chapman, 2001[12]	386	48	49%	51%
Martinez 2003[13]	250	49	47%	53%
Salles 2005[14]	471	60	28%	72%
Prakash 2009[15]	100	55	60%	40%

The present study was in accordance with Chapman, Martinez, Salles, Prakash et al studies with respect to demographic Profile.

Diagnosis of Study Group

The present study showed that majority (70%) of patients was hypertensive, 12% had AS, 8% had MR, 6% had AR and 4% had CL. The findings were comparable with the studies done by Prakash et al, Waqas Hameed et al and Salles et al. (Table 6).

Table 6: Showing the comparison of the Diagnosis among various studies.

	HTN (%)	AS (%)	MR (%)	AR (%)
Present study	70%	12%	8%	6%
Salles et al [14]	72%	15%	10%	3%
Prakash et al [15]	80%	10%	6%	4%
Waqas Hameed et al [16]	85%	10%	3%	2%

The study compared three most important electrocardiographic criteria for diagnosis of left ventricular hypertrophy with echocardiography as diagnostic standard. (Table 7).

Table 7: Comparison of Sensitivity for Sokolov-Lyon Index between present and Previous Studies

Study	Sensitivity
Present study	46.5%
Prakash et al(2009)[15]	34%
Christian Jaggy et.al (2000)[17]	61%
G.R Lallijie et.al(2007) [18]	31%

Table 8: Comparison of Sensitivity for Romhilt and Estes Point Score System between present and Previous Studies

Study	Sensitivity %
Present study	36%
Prakash et al (2009)[15]	13%
Waqas Hameed et.al (2005)[16]	35%

Table 9: Comparison of Sensitivity for Total QRS Voltage Criteria between present and Previous Studies

Study	Sensitivity %
Present study	37%
Christian Jaggy et.al (2000)[17]	42%
Taroqwaseem et.al(2003)[19]	34%

Diastolic Dysfunction

In the study it was observed that 44% of cases had diastolic dysfunction according to E/A Ratio and among them majority (26%) was in stage 1. Hence ECHO can diagnose Diastolic dysfunction in earlier stages. Of them 50% of AS patients had Diastolic Dysfunction and 40% of patients of HTN patients had Diastolic dysfunction. The study was in accordance with the study by MensuraAsceric et al. [20] on 64 patients, 57 patients had left ventricular hypertro-phy. 65% of patients with left ventricular hypertrophy among 57 had diastolic dysfunction. Similarly the study was in accordance with the study by Gas-pare Parrinello et al. [21] among 55 HTN patients with LVH the prevalence of altered diastolic function was 42% (23/55). Similar observation was made by Adamu GU et al. [22], it was observed that 60 % of hypertensive LVH had diastolic dysfunction. (Table 8,9].

Conclusion

The study concludes thatsensitivity was 37% for total QRS voltage criteria, 46.5% for S.L criteria and 36% for Romhilt – Estes Criteria. Hence suggesting that all the ECG criteria have low sensitivity than ECHO in diagnosing LVH. And hence these methods have a limited use as screening test for LVH. 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. ECG criteria were more sensitive in diagnosing Hypertensive LVH than LVH of other causes. The study also observed that 44% of Concentric LVH patients had Diastolic dysfunction. And Majority was detected in stage 1. Hence it is important to screen for diastolic dysfunction in patients with LVH.

Limitations

In the study only three ECG criteria's were used for diagnosing LVH and Combination of ECG criteria's which is considered more sensitive in diagnosing LVH were not evaluated.

Recommendations

LVH is considered as an important and independent risk factor for cardiovascular morbidity. Because of the low sensitivity with ECG criteria's in diagnosing LVH, we recommend ECHO evaluation for all patients with conditions leading to LVH. The study also recommends screening of all LVH patients for diastolic dysfunction.

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