ELECTROCARDIOGRAPHIC DETECTION OF LEFT VENTRICULAR HYPERTROPHY BY THE NEW “SAI” CRITERIA

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ABSTRACT
Electrocardiogram (ECG) is widely used for detection of left ventricular hypertrophy (LVH). For the detection of LVH several different criteria have been used. These criteria have different sensitivity and selectivity, which widely varies from 22% to 54% sensitivity and 100% to 85% specificity respectively. Different LVH criteria has different results of LVH. The aim of the present study was to determine most accurate diagnostic relation of LVH with QRS-complex and T-wave of ECG by using new proposed “SAI” criteria. In sai criteria we relate QRS and T-wave abnormality with LVH. Fifty clinically diagnosed patients of LVH were included in this study. These were followed by echocardiography as a gold test. In conclusion; sai criteria for LVH may be the most accurate for the detection of LVH by 12-lead ECG. Limitations: subjects are from one racial and no other parameters were considered. Research work has been in progress for more generalized results.

Key words: left ventricular hypertrophy (LVH), Electrocardiogram (ECG), QRS -area (QRSA).

INTRODUCTION
Enlargement of left ventricle of the heart known as left ventricular hypertrophy (LVH). The LVH can be caused physiologically or pathologically[2,6,7,8] or due to aging and other problems shown
by Iain Morriso, Elaine clark and Peter W. Macfarlane[1,4,11,30]. LVH is an abnormal increase in the mass of the left ventricular myocardium caused by chronically increased workload on the heart might be due to hyper tension or genetically disorder or due to obesity[10,11,15,16,18]. The early detection and assessment of LVH has been an important objective of clinical electrocardiography (ECG) [11,12,15,16,18,19,28]. There were different criteria for ECG-LVH having wide range of sensitivity and specificity (cornell voltage:7.5%,95.1%, Sokolow-Lyon: 6%,95%, Gubner and Ungerleider: 6%,95%, where as sum of 12-lead 6%,91.7% and Levis 11.9%,93.3% respectively) by Iain Morrison and other. Michael A.Bauml and Donald A.Underwood found in their studies that all criteria for LVH were less sensitive than specific.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Median Sensitivity</th>
<th>Median Specificity</th>
</tr>
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<tbody>
<tr>
<td>Cornell voltage</td>
<td>15%</td>
<td>96%</td>
</tr>
<tr>
<td>Cornell product</td>
<td>19.5%</td>
<td>91%</td>
</tr>
<tr>
<td>Sokolow-Lyon voltage</td>
<td>21%</td>
<td>89%</td>
</tr>
<tr>
<td>Romhilt-Estes point score</td>
<td>17%</td>
<td>95%</td>
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The ranges of the published values were extremely broad [12,35,36,40]. For example the ranges were

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Range</th>
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<tbody>
<tr>
<td>Cornell voltage</td>
<td>2% to 41%</td>
</tr>
<tr>
<td>Cornell product</td>
<td>8% to 32%</td>
</tr>
<tr>
<td>Sokolow-Lyon voltage</td>
<td>4% to 51%</td>
</tr>
<tr>
<td>Romhilt-Estes point score</td>
<td>0% to 41%</td>
</tr>
</tbody>
</table>

All above criteria were used different combination of QRS and T amplitude/duration in different leads. The ranges were extremely wide might be due to small sample size or poor study quality, the wide range in values may be due to diverse study population as well as validation methods and different criteria were used. Electrocardiography is insensitive for diagnosing LVH because it relies on measuring the electrical activity of the heart by electrodes on the surface of the skin to predict LVH and other heart diseases. The measurements are affected by everything between heart and electrodes, just like fat, fluid and air etc. The diagnosis of LVH by ECG is strongly influenced by age, sex, and ethnicity recommended by AHA/ACC/HRS(American Heart Association , American College of Cardiology Foundation, Heart Rhythm Society)[10,18,19,20,22,29,31,36,39,40] .While ECG is not sensitive and cannot be rule out LVH, it is still have a role in its diagnosis and detection of cardiovascular abnormalities, and its management.

The main advantage of ECG-LVH detection is to minimize the morbidity and mortality due to LVH. As LVH due to hypertension and other problem can be reversed by proper treatment of the Losartan Intervention For End point(LIFE) strongly recommended by P.M.Okin,S.Jern,R.B.Devereux et.al.[1,2,41].
However, differences in the diagnostic value among various criteria of ECG-LVH, it is cost effective tool for the detection of LVH and other cardiovascular diseases. Therefore the aim of the present study was to find new ECG criteria to detect LVH by new “sai” criteria (“sai”=named in memory of spiritual saint) to test the criteria we confirmed the results with 2-D echocardiograph results as gold standard for LVH. We also find out statistical regression of the sai-criteria by using SPSS.

Method

A standard 12-lead ECG was recorded in the supine position. All the participants (age range 45±1ed 5years) with age and gender matched to data collected. From these 25 were selected and remaining were filtered out due to different diseases. These patients clinically diagnosed based on ECG identification of hypertrophy. All patients were volunteers with no evidence of cardiac diseases based on a negative history and physical examination. The patients comprised Indian from independent of their profession. Conventional ECG parameters were analysed by 12-lead ECG software with respect to the RR, PR, P and QRST amplitude as well as duration. We analyzed 12-lead ECG with our “Sai criteria” for the detection of LVH and validated with 2-D Echocardiographic results.

The Sai criteria we consider the 12-lead ECG the negative T wave ≥1mm in depth in at least two leads except aVR, V1 and V2 with QRS-amplitude in lead aVF, QRS<0.55mV
(The “Sai” named after famous saint of Shirdi who miraculously cure diseases and spread brotherhood, humanity among the INDIANS.)

Digital Electrocardiography

Digital ECGs were analyzed with software and manually by two blind methods of experts who were unknown to patients and previous results by cardiologist, which provided detailed data on the duration and amplitudes of all important segments of in all 12-leads. Amplitudes recoded to the nearest tenth of milli volt and times recorded to the nearest of milliseconds. The leads aVr, V1 and V2 as well as V5 and V6 has been identified as superior marker of coronary artery disease.

Statistical analysis

Sensitivity was defined as true positives/(true positives+ false negatives)X100; specificity was defined as true negatives / (true negatives + false positives) X 100.[42] Data were analyzed by using sample T-test and ANNOVA by using SPSS, differences were considered to be statistically significant at a P value<0.05.

Promising candidate sets of ECG parameters for potential inclusion in Sai criteria were first identified using data analysis by following standard procedure of ECG reading and analysis[18]. Table:1.
ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1.792</td>
<td>13</td>
<td>.138</td>
<td>1.241</td>
<td>.364</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1.222</td>
<td>11</td>
<td>.111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3.013</td>
<td>24</td>
<td></td>
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</table>

The graphical relation between T wave amplitude and QRS amplitude is shown in graph1.

Graph 1 Relation between T wave amplitude and QRS-amplitude.

Results
Table 1 shows one-sample statistics in T wave amplitude and QRS amplitude individually, ANOVA and the graph1 shows the linear relation between the T wave amplitude and QRS-amplitude.
From the calculation of sensitivity and specificity we achieved the Sensitivity 88% and specificity 100% by using the new Sai criteria rather than conventional criteria for LVH. IN the purely retrospective analyses this Sai criteria yielded only a three false negative result(sensitivity 88%),and none of the false positive results(specificity of 100%) occurring within the selected group of persons.
Discussion

The results of the present study have demonstrated that Sai criteria for LVH have good Sensitivity 88% and specificity 100% for the selected group of subjects. The results were validated by using gold standard 2-D echocardiograph which shows good correlation with the Sai criteria. If collaborated with future studies and prospective, it might help in reducing the costs that are now unnecessary for further testing for LVH. After further validation, the implementation of Sai criteria might be also accomplishable with only smaller changes to many existing ECG software’s.

CONCLUSION

Sai criteria can be more sensitive than other conventional ECG criteria for LVH and also more specific. Further improvement will be possible if more generalized data will be available.

Limitations:
The most important limitation of this study was its limited data set and for the only one racial, here we did not consider other parameters such as gender, age, diseases which affects the heart rate and other parameters of heart, hypertension, body mass index, etc. Further studies are therefore also required to address these issues.

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