TYPES AND FREQUENCY OF CARDIAC ARRHYTHMIAS IN PATIENTS WITH HEART FAILURE

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ABSTRACT

Objective: To determine the types and frequency of cardiac arrhythmias in patients with heart failure based on 48 hours ambulatory ECG recordings.

Study Design: Cross sectional descriptive study.

Place and Duration of Study: Armed Forces Institute of Cardiology/National Institute of Heart Diseases, from April 2013 to August 2013.

Patients and Methods: Fifty three heart failure patients with ejection fraction of ≤ 40 % were holter monitored for 48 hours. Patients who had acute myocardial infarction during the last six weeks were excluded. Digital ECG data were manually edited and type and frequency of arrhythmias were analysed using statistical software.

Results: The mean age of patients was 57.68 ± 16.41 years and male to female ratio was 3.4:1. The mean ejection fraction was 22.5 ± 6.3 and 59% patients had NYHA class III. Cardiac arrhythmias were present in 46 (87%) patients. In patients with chronic heart failure commonest arrhythmias were of ventricular origin followed by conduction blocks. Hypertension, diabetes mellitus and ischemic heart disease were the main underlying etiological factors in 71% patients.

Conclusion: There is a high frequency of cardiac arrhythmias among heart failure patients with ventricular arrhythmias being the most frequent. Arrhythmogenesis in heart failure is dependent upon degree of ventricular dysfunction, presenting NYHA functional class and etiology of heart failure.

Keywords: Arrhythmias, ambulatory ECG recording, holter monitoring

INTRODUCTION

Heart failure is a major health problem with increasing incidence and prevalence worldwide. Incidence of heart failure is continuously increasing among aging population and is associated with high mortality and morbidity rates. There are an estimated 23 million people globally with the diagnosis of heart failure. The main causes of death in heart failure are either electrical instability or pump failure. Electrical instability leads to ventricular arrhythmias terminating into sudden cardiac death. Almost 30 to 60% of all cardiac deaths in patients with heart failure are categorized as sudden deaths, with or without preceding symptoms.

Structural and electrical remodelling of myocardial tissue, alteration in the cellular ionic currents or gap junctions, myocardial stretch and dilation of cardiac chambers are the most common factors favouring arrhythmogenesis in heart failure. Decreased coronary perfusion, changes in geometry of the heart and electrical instability due to abnormal handling of calcium and potassium ions along with augmented activity of the sympathetic nervous system are key factors responsible for causing potentially fatal arrhythmias in heart failure. There is substantial evidence that arrhythmias developing in heart failure can significantly affect the prognosis and management of the patients.

Holter ECG recording helps to detect and quantify the nature, frequency and duration of different types of arrhythmias developing in these patients. It serves as a valuable tool in identification of factors that can contribute to sudden death. Studies have shown significant association between deranged holter parameters...
and decreased left ventricular ejection fraction with increasing incidence of arrhythmogenesis. Patients at high risk of sudden arrhythmic deaths can be screened out and put under medical surveillance. Present study was planned to carry out 48 hours holter monitoring in patients with heart failure having ejection fraction of $\leq 40\%$. The aim of the study was to determine the type and frequency of cardiac arrhythmias frequent in our population. Results of the study will help in identifying patients who are at high risk of sudden cardiac death due to arrhythmias and will aid in the establishment of risk profile in heart failure patients.

**PATIENTS AND METHODS**

It was a cross sectional descriptive study conducted at Armed Forces Institute of Cardiology/National Institute of Heart Diseases (AFIC/NIHD), Rawalpindi, from April 2013 to August 2013. After taking formal approval from Medical Ethics Committee and Institutional Review Board of AFIC/NIHD, an informed written consent was acquired from all the patients.

Patients from either sex, having age more than 19 years with left ventricular ejection fraction $\leq 40\%$ were included. Patients who had acute myocardial infarction during the last six weeks were excluded from the study.

Total 53 patients were included in the study through convenience sampling. After history and clinical examination, 12 lead ECG was recorded. Patients fulfilling the inclusion criteria underwent ambulatory ECG recording for 48 hours using holter monitors. Three different types of holter recorders, Life Card CF, DMS 300-4A and DMS 300-7A, were used in this study. After 48 hours of recording, the digital ECG data were transferred from holter recorders to the computer having compatible software. Out of three channels, the one which displayed best ECG recording and with least artifacts was selected. The data were edited with extreme care using visual checks and manual correction of all QRS complexes. All the erroneous beats were identified and edited from the data. After editing, the holter ECG data were analyzed for site of origin and various types and frequency of cardiac arrhythmias using ‘pathfinder 700’ and ‘premier 12’ compatible with Life Card CF and DMS 300-4A/DMS 300-7A respectively.

Data had been analyzed using IBM SPSS.

**Table-1: Frequency of cardiac arrhythmias on basis of site of origin (n=46)**

<table>
<thead>
<tr>
<th>Arrhythmia</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventricular</td>
<td>42</td>
<td>91.3</td>
</tr>
<tr>
<td>Supra ventricular</td>
<td>9</td>
<td>19.5</td>
</tr>
<tr>
<td>Ventricular and supra ventricular</td>
<td>5</td>
<td>10.9</td>
</tr>
<tr>
<td>Conduction blocks</td>
<td>35</td>
<td>76.1</td>
</tr>
</tbody>
</table>

**Table-2: Frequency of patients based upon etiology of heart failure (n = 53)**

<table>
<thead>
<tr>
<th>Etiology of Heart Failure</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>11</td>
<td>20.8</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>9</td>
<td>17.0</td>
</tr>
<tr>
<td>Hypertension &amp; Ischemic heart disease</td>
<td>8</td>
<td>15.1</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>5</td>
<td>9.4</td>
</tr>
<tr>
<td>Diabetes and Ischemic heart disease</td>
<td>6</td>
<td>11.3</td>
</tr>
<tr>
<td>Valvular heart disease</td>
<td>3</td>
<td>5.7</td>
</tr>
<tr>
<td>Renal failure</td>
<td>2</td>
<td>3.8</td>
</tr>
<tr>
<td>Postpartum</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>COPD/asthma</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>No cause identified</td>
<td>7</td>
<td>13.2</td>
</tr>
</tbody>
</table>

version 21. Frequency and percentages were calculated for qualitative variables. Mean and standard deviation (SD) were calculated for quantitative variables. Chi-square test was applied to study association between ejection fraction and arrhythmias. A $p$-value of $< 0.05$ was considered significant.
RESULTS

The mean age of patients was 57.68 ± 16.41 years and male to female ratio was 3.4:1. The mean ejection fraction was 22.5 ± 6.3 and 59% patients had NYHA class III. Cardiac arrhythmias were present in 46 (87%) patients. In patients with chronic heart failure commonest arrhythmias were of ventricular origin followed by conduction blocks (Table-1).

Patients were grouped into various categories based upon history and laboratory investigations. Most of the patients were observed to have hypertension (20.8%), ischemic heart disease (17.0%) and diabetes mellitus (9.4%). A number of patients (15.1%) had both hypertension and ischemic heart disease, 11.3% had both diabetes mellitus and hypertension. Some patients (13.2%) had no history of any known illness prior to development of heart failure as shown in table-2.

Out of the 9 patients who had supraventricular arrhythmias, 56% had runs of supraventricular tachycardia as shown in table 3. Forty two patients who had ventricular arrhythmias, non sustained ventricular tachycardia was the most common type of ventricular arrhythmia seen in our patients followed by episodes of isolated premature ventricular contraction (PVCs) in 23.8 % patients as shown in table 4.

DISCUSSION

Sudden cardiac death is the major cause of death among heart failure patients. About one half of deaths in heart failure patients are sudden, mostly due to ventricular tachycardia degenerating to ventricular fibrillation14. Despite all the advancement in modern therapeutic measures the mortality and morbidity rate remains high in heart failure.

Detailed analysis of frequencies of cardiac arrhythmias on basis of site of origin revealed 20% patients in our study had supraventricular arrhythmias, 91% had ventricular arrhythmias and 76% had conduction blocks. Koyak et al, carried out a study on 419 patients with heart failure 23.8% of their patients with heart failure were found to have supraventricular arrhythmias 15. Recently in 2013 in Poland a study was carried out by Uznanska et al, on 84 patients with ischemic heart failure for analysis of cardiac arrhythmias using 48 hours ambulatory holter ECG recordings. Their results demonstrated 20.2% patients having supraventricular arrhythmias16. Results of these studies were in synchronization with our study. Likewise Viles-Gonzalez et al, studied frequency of supraventricular arrhythmias in 100 patients having heart failure due to cardiac sarcoidosis17. They found 32% patients had supraventricular arrhythmias. Slightly higher frequency found by Gonzalez et al, might be due to geographical variations or difference in etiology of heart failure. Detailed analysis of supraventricular arrhythmias revealed 56% of our patients showed runs of supraventricular tachycardia while 22% patients had isolated atrial ectopics and atrial fibrillation. Spinarova L, in Euro heart Survey studied 45,993 patients with heart failure18. This was a huge undertaking whereby data from 116 hospitals of 25 European countries were collected. Results for atrial fibrillation were

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**Table-3: Frequency of supraventricular arrhythmias (n = 9)**

<table>
<thead>
<tr>
<th>Arrhythmia</th>
<th>Frequency (n=9)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supraventricular tachycardia</td>
<td>5</td>
<td>56</td>
</tr>
<tr>
<td>Isolated ectopic beats</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>2</td>
<td>22</td>
</tr>
</tbody>
</table>

**Table-4: Frequency of ventricular arrhythmias (n = 42)**

<table>
<thead>
<tr>
<th>Arrhythmia</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non sustained ventricular tachycardia</td>
<td>24</td>
<td>57.1</td>
</tr>
<tr>
<td>Isolated PVCs</td>
<td>10</td>
<td>23.8</td>
</tr>
<tr>
<td>Couplets and triplets</td>
<td>6</td>
<td>14.3</td>
</tr>
<tr>
<td>Bigeminy and trigeminy</td>
<td>2</td>
<td>4.8</td>
</tr>
</tbody>
</table>
shown to be present in 25.3% patients. Likewise Viles-Gonzalez et al, found atrial fibrillation to be present in 18% of their patients. Results of our study were comparable to the ones mentioned above as we found atrial fibrillation to be present in 22.2% of our patients.

In our study, we found 91% patients having ventricular arrhythmias indicating high prevalence of ventricular arrhythmias in patients with chronic heart failure. Majority of patients (62%) were noted to have frequent premature ventricular contractions including bigeminy, trigeminy, couplets, and triplets along with isolated ectopic beats while 57.1% of our patients had runs of nonsustained ventricular tachycardia recorded on 48 hours ambulatory ECG holter recording. In a study carried out by Lasisi et al, for the analysis of ventricular arrhythmias, 60 patients with heart failure were holtered for 24 hours19. Majority (65%) of their patients were found to have multiform PVCs whereas 46.7% patients had nonsustained ventricular tachycardia. The results of our study were similar to those of Lasisi et al, as we also found PVCs to be present in 62% of our patients and nonsustained ventricular tachycardia in 57% patients. Teerlink et al, in PROMISE (Prospective Randomized Milrinone Survival Evaluation) trial studied ventricular arrhythmias in 1080 patients with chronic heart failure20, 24 hours holter data were analysed and the results showed 55% of their patients had PVCs. Uznanska et al, carried out a study for analysis of ventricular arrhythmias16. They holter monitored 84 patients with chronic heart failure for 48 hours. Their results showed that 40.5% of the patients had nonsustained ventricular tachycardia. In our study, we found 57.1% of our patients suffering from nonsustained ventricular tachycardia. The results of our study were similar to those conducted by Teerlink et al, and Uznanska et al.

The prognostic significance of arrhythmias varies with the etiology of heart failure. We, therefore, studied the association between etiology of heart failure and severity of arrhythmias. Results of our study demonstrated that the patients were widely distributed among various etiologies of heart failure. Most of the patients were observed to have hypertension (20.85%), ischemic heart disease (17.0%) and diabetes mellitus (9.4%). Incidence of heart failure rose when hypertension combined with ischemic heart disease (15.1%) or diabetes mellitus (11.3%). This suggests hypertension is the leading cause of heart failure in our population followed by ischemic heart disease and diabetes mellitus. Interestingly a comparable percent of patients (13.2%) did not give any history of past illness prior to development of heart failure.

In Framingham heart study, Haider et al, reported hypertension to be a major risk factor for the development of heart failure. They also concluded in the same study that hypertensive patients having coronary artery disease, diabetes mellitus, left ventricular hypertrophy, and valve disease had increased risk of developing heart failure21. Ischemic heart disease alone or with hypertension results in remodelling of myocardial tissue leading to left ventricular dysfunction and heart failure. Development of potentially lethal arrhythmias is very common in this setting22,23. In two different studies, it was concluded that the risk of heart failure increased further when diabetes mellitus was associated with hypertension and ischemic heart disease24,25.

These results conclude that hypertension, ischemic heart disease and diabetes mellitus are the leading causes of heart failure and fatal ventricular arrhythmias in these patients.

CONCLUSION

The study concludes that a large percentage of patients with heart failure had cardiac arrhythmias, and ventricular arrhythmias were the most frequent. Genesis of arrhythmias in heart failure was dependent upon degree of ventricular dysfunction, presenting NYHA functional class and etiology of heart failure. Hypertension was the leading etiology of heart failure followed by ischemic heart disease and diabetes mellitus. These co morbidities worsen the prognosis of heart failure by enhancing the
risk of developing fatal ventricular arrhythmias. Since, about 50% patients with heart failure undergo sudden cardiac death, therapeutic approaches should focus on detecting arrhythmias in order to predict the outcome and timely management.

REFERENCES


