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HEART FAILURE;

CO-RELATION OF QRS DURATION WITH ATRIAL FIBRILLATION IN PATIENTS WITH REDUCED EJECTION FRACTION

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ABSTRACT… Introduction: Atrial fibrillation (AF) and wider QRS duration have long been identified to worsen heart failure and LV dysfunction and increase cardiovascular morbidity and mortality. Therefore, it is necessary to identify those patients of heart failure who are at greater risk for cardiovascular morbidity and mortality so that such subjects may be focused for preventive strategies. An association exists between QRS duration and AF with greater incidences of cardiovascular events in patients of heart failure with LV systolic dysfunction. **Study Design:** Cross sectional survey. **Setting:** Department of Cardiology, Punjab Institute of Cardiology Lahore. **Period:** 16-02-2015 to 15-08-2015. **Material and Methods:** The objective of study was to determine the Frequency of QRS Duration groups and Atrial Fibrillation in Patients with Left Ventricular Dysfunction. Sample size of 400 cases was calculated with 95% confidence level, 4% margin of error and taking expected percentage of atrial fibrillation in narrow QRS group i.e. 20.9% (least among all) in patients with left ventricular dysfunction. Sampling technique was non-probability, purposive sampling. **Result:** The study population consisted of male (72.3%) and female (27.7%). Mean LA diameter was 40.3±6.08 mm and mean LV ejection fraction 31.8±6.6 % in the study population. Ischemic heart disease was the most common cause of LV dysfunction (88.3%) followed by non-ischemic cardiomyopathy (8.75%) and non-Ischemic valvular heart disease (3.5%). The frequency of Narrow QRSd (<120 ms) was 62%, Intermediate QRSd (120-150 ms) was 26.5% and Wide QRSd (>150 ms) was 11.5%. The frequency of atrial fibrillation in study population was 15.75%. The frequency of atrial fibrillation was highest in Wide QRSd group (>150 ms) i.e. (60.9%), followed by Intermediate QRSd group (120-150 ms) i.e. (18.9%) and narrow QRSd group (<120 ms) i.e. (6.04%). Patient with atrial fibrillation were more likely to have poor ejection fraction (P<0.0023) and wider QRS duration (P<0.0001). Frequency of atrial fibrillation was highest in Valvular Cardiomyopathy (non-ischemic valvular heart disease) patients (42.8%) as compared to coronary artery disease group (15.3%) and non-ischemic cardimyopathy group (9.4%). **Conclusion:** In patients of heart failure with reduced ejection fraction (HFrEF), the frequency of atrial fibrillation increases as QRS duration widens. This group of patients must be focused for AF preventive strategies.

Key words: Atrial fibrillation (AF), Left ventricular (LV), QRS duration (QRSd).

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INTRODUCTION

The structural or functional cardiac disorders result in heart failure that impairs the ability of the heart to support a physiologic circulation.[1] The clinical features of heart failure are characterized by breathlessness, fatigue and fluid retention.[2-7] However sometimes the clinical features of heart failure are non-discriminating.[2–8] Systolic heart failure presents with impaired systolic performance (low ejection fraction) with or without dilatation of heart while in diastolic heart failure ejection fraction at rest is normal or near normal and the heart is small or normal in size or there is often left ventricular hypertrophy. The clinical features are similar in two types of heart failure and both can coexist. Framingham Heart Study indicates that left ventricular systolic or diastolic dysfunction of left ventricle increases the risk of heart failure. Moderate to severe diastolic dysfunction of left ventricle is an independent predictor of mortality in heart failure.[9,10,11] Electrocardiogram (ECG) and echocardiogram are reasonable screening tools in patients with heart failure.[12,13] An entirely normal ECG is uncommon in chronic HF.[14,15] The major

importance of the ECG is to assess cardiac rhythm and determine QRS width to ascertain whether the patient may benefit from resynchronization therapy. The systolic and diastolic function of left ventricle as well as etiology of heart failure may be accurately assessed on echocardiogram.[16-20] Several factors are associated with a poor prognosis in patients of heart failure, widening of QRS complex is one of them which is easily assessed on ECG. This study will help to identify the correlation of AF with wider QRS complex in patients of heart failure with systolic dysfunction (HFrEF) in our population.

MATERIAL AND METHODS

The objectives of the study were to determine frequency of different QRS duration groups in patients of LV systolic dysfunction and correlation of atrial fibrillation with different QRS duration groups. The QRS duration was assessed on ECG and patients will be assigned one of the following group:

- Narrow QRS group ----- QRSd < 120 milliseconds (ms).
- Intermediate QRS group ----- (120 ms $\geq$ QRSd $\leq$ 150 ms).
- Wide QRS group ----- (QRSd >150 ms).

Atrial fibrillation was diagnosed on ECG with absence of P waves, presence of f (fibrillatory) waves between QRS complexes with irregularly irregular R-R intervals. LV dysfunction was diagnosed left ventricular ejection fraction less than 45% on Echocardiography.

Study design was Cross sectional survey. Sample size of 400 cases is calculated with 95% confidence level, 4% margin of error and taking expected percentage of atrial fibrillation in narrow QRS group i.e. 20.9% (least among all) in patients with left ventricular dysfunction. Sampling technique was non-probability, purposive sampling. Patients were selected based on following inclusion criteria:

1. Patients of age 18-80 years.
2. Both genders.
3. Patients of LV dysfunction (as per operational definition).

Following patients were excluded from study:

1. Patient on pacemaker therapy ----- (assessed on basis of History, ECG findings and previous record of patient if available).
2. Patient on cardiac resynchronization therapy (CRT) ----- (assessed on basis of History and previous record of patient if available).
3. Patient on implantable cardioverter-defibrillator (ICD) ----- (assessed on basis of History and previous record of patient if available).
4. Patient with electrolyte imbalance (Hyperkalemia, Hypocalcaemia) assessed on serum biochemistry.

400 cases of LV dysfunction will be enrolled for study from emergency, outpatient and inpatient departments of Punjab Institute of Cardiology Lahore from 16-02-2015 to 15-08-2015 and a fully informed consent will be taken. A 12-lead ECG will be recorded. QRS duration will be assessed according to operational definition and on this basis patients will be segregated into three groups:

1. Narrow QRS group ----- QRSd < 120 milliseconds (ms).
2. Intermediate QRS group ----- (120 ms $\geq$ QRSd $\leq$ 150 ms).
3. Wide QRS group ----- (QRSd >150 ms).

ECG will also be diagnose atrial fibrillation in patients with LV dysfunction of all QRS groups. All this information will be noted on proforma (attached) by researcher.

All the data was analyzed by SPSS version 11.0 for Windows. Quantitative variable age will be expressed as mean $\pm$ standard deviation. Qualitative variables i.e. sex, different QRS groups and atrial fibrillation will be expressed as frequencies and percentages. P values will be calculated using http://graphpad.com/quickcalcs.

RESULTS

400 patients with LV dysfunction (i.e. LVEF<45%) classified into 3 groups based on QRS complex duration. Mean age of sudy population is

56.94±11.54. Wide QRSd group patients are comparatively elder with mean age 59.13±9.52. Male constitute 72.25% & female constitute 27.75% of total population. Frequency of NICMP, ICMP & NIVHD in study population are 8.75%, 88% & 3.25% respectively i.e. IHD is the most common cause of LV dysfunction followed by NICMP and NIVHD. It is notable that Mean LA diameter progressively increases and LV dysfunction worsens (LVEF progressively decreases) as QRS widens. More than half of study population (206 cases i.e 51.5%) has moderate LV dysfunction. More than half of the study population in the wide QRS group (26 cases i.e. 56.52%) has severe LV dysfunction (LVEF<30%) (Table-I).

Frequency of AF in the study population is 15.75% and frequency of AF is higher in female group (18.02%) as compared to male group (14.87%). The frequency of AF is much higher in patients of NIVHD (61.54%) having LVEF<45% as compared to ICMP and NICMP group. Similarly, in QRS duration groups, the frequency of AF is much higher in wide QRS groups and severe LV dysfunction. (Table-II) The frequency of atrial fibrillation was highest in Wide QRSd group (60.87%), followed by Intermediate QRSd group (19.42%) and narrow QRSd group (5.98%). (Figure-1)

Characteristics	Narrow QRSd <120 ms n=251 (62.8%)	Intermediate QRSd 120-150 ms n=103 (25.8%)	Wide QRSd >150 ms n=46 (11.5%)	Total n=400
Age mean years	56.12±10.9	54.08±13.5	59.13±9.52	56.94±11.54
Gender Male Female	 183(73.91%) 68(27.09%)	 75(72.82%) 28(27.18%)	 31(67.39%) 15(32.61%)	 289(72.25%) 111(27.75%)
Non-Ischemic Cardiomyopathy (NICMP)	16(6.37%)	13(12.62%)	6(13.04%)	35(8.75%)
Ischemic Heart Disease (ICMP)	229(91.24%)	84(81.55%)	39(84.78%)	352(88%)
Non-Ischemic Valvular Heart Disease (NIVHD)	6(2.39%)	6(5.83%)	1(2.17%)	13(3.25%)
Echocardiographic Findings				
LA diameter mean mm	39.14±5.9	41.63±5.2	44.30±7.5	40.38±6.19
Mean LV ejection fraction (EF)	33.59±5.74	29.94±5.66	27.02±6.598	31.90±6.27
LV Dysfunction (LVD)				
Mild (EF= 40-45%)	76(30.28%)	14(13.59%)	4(8.7%)	94(23.5%)
Moderate (EF= 30-39%)	137(54.58%)	53(51.46%)	16(34.78%)	206(51.5%)
Severe (LVEF= <30%)	38(15.14%)	36(34.95%)	26(56.52%)	100(25%)

Table-I. Baseline Characteristics of the Study Population

CHARACTERISTICS	Frequency of Atrial Fibrillation
Study population (n=400)	63 (15.75%)
Gender Male (n = 289) Female (n = 111)	 43 (11.75% of total population) i.e; (14.88% of male population) 20 (5% of total population) i.e; (18.02% of female population)
Non-ischemic cardiomyopathy group i.e. NICMP (n=35)	4 (11.43%)
Ischemic heart disease group i.e. ICMP (n=352)	51 (14.49%)
Non-ischemic valvular heart disease group i.e. NIVHD (n=13)	8 (61.54%)
Narrow QRSd <120 ms group (n=251)	15 (5.98%)
Intermediate QRSd =120-150 ms group (n=103)	20 (19.42%)
Wide QRSd >150 ms group (n=46)	28 (60.87%)
Mild LV Dysfunction Group [EF = 40-45%] (n=94)	12 (12.77%)
Moderate LV Dysfunction Group [EF = 31-39%] (n=206)	30 (14.56%)
Severe LV Dysfunction Group [EF = less than 30%] (n=100)	21 (21%)

Table-II. Frequency of Atrial Fibrillation in the Study Population

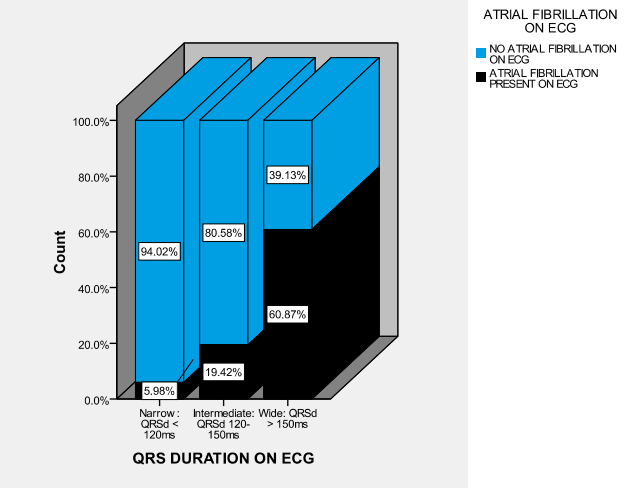

Figure-1. Relationship between atrial fibrillation and QRS duration

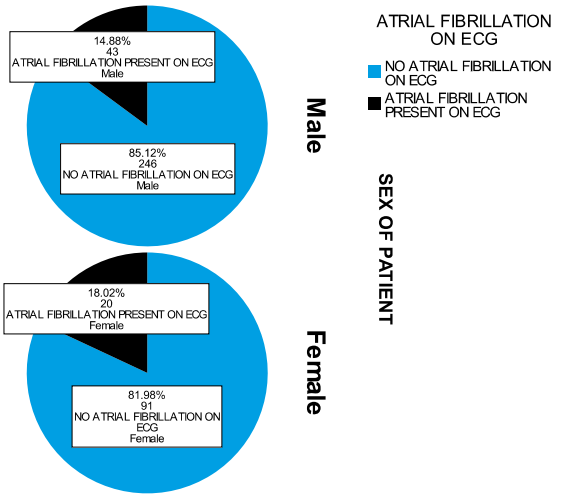

Figure-2. Gender distribution according to presence of atrial fibrillation

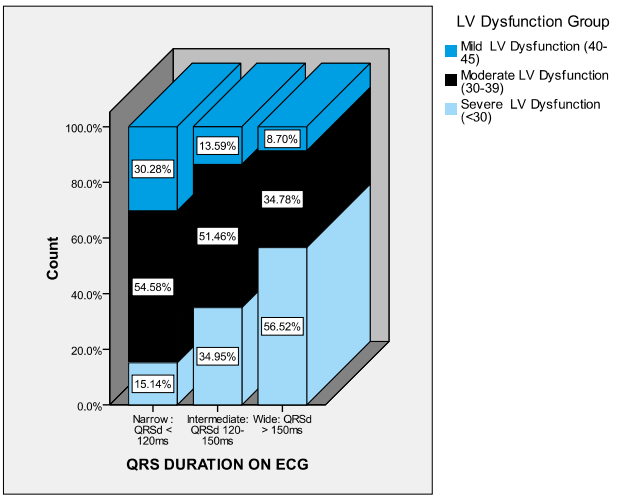

Figure-3. Impact of QRS duration on left ventricular ejection fraction

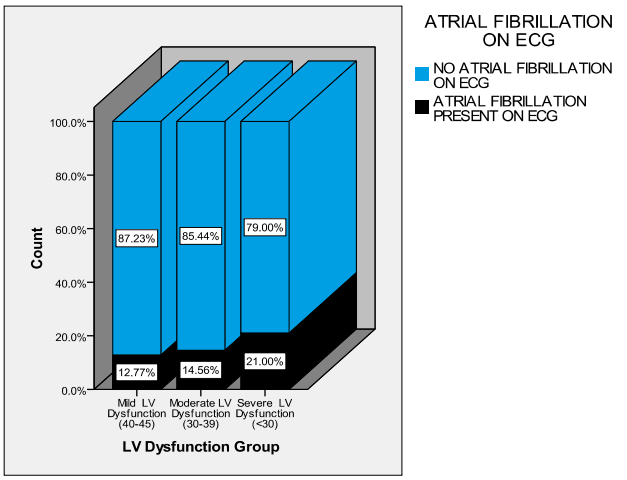

Figure-4. Relationship between ejection fraction and atrial fibrillation

DISCUSSION

Framingham Heart Study in the United States and the Hillingdon and Bromley Heart Failure Studies in England reliably estimates the incidences of heart failure which is approximately 2% of the adult population, with more incidences in men and elderly.[21-23]

Several factors are associated with a poor prognosis in patients of heart failure with systolic dysfunction. These are age, male gender, severity of symptoms, coronary artery disease, hypotension, deranged renal function, hyponatremia, and elevated plasma BNP levels.[24-27] Atrial fibrillation (AF) and wider QRS duration have long been identified to worsen heart failure and LV systolic dysfunction. Therefore, it is necessary to identify high risk patients of heart failure based on ECG findings like AF and increased duration of QRS complexes.

QRS complex duration is associated with systolic dysfunction of left ventricle. According to various reports, the prevalence of QRS complex duration >120 ms in patients with heart failure is 14%–47% and about 19% to 29% of patients have a QRS complex duration >150ms.[28-32] Similarly widening of QRS complex is associated with lower ejection

fraction of left ventricle.[33] Shenkman et al also documented this finding.[34] Previous reports have shown that AF incidences varies with severity of systolic dysfunction among the heart failure patients.[35] There is strong association between duration of QRS complex and AF. EL-Chami et al. documented this relation in his study named "QRS Duration Is Associated with Atrial Fibrillation in Patients with Left Ventricular Dysfunction".[36] Moreover, the patient pool of atrial fibrillation relatively increases as EF declines and QRS widens. Widening QRS duration and worsening ejection fraction may be the marker for generation of trigger foci in pulmonary veins, heterogenenity of electrical conduction around pulmonary veins, atrial structural and electrical remodeling with fibrosis, abnormal atrial electrograms and intra-atrial conduction prolongation that needs further insight studies. The results of this study are similar to previous studies. We documented that widening of QRS complex duration is strongly associated with worsening of left ventricular systolic dysfunction and more incidences of AF in patients of heart failure with reduced ejection fraction.

Results from this study suggest that a simple ECG of patient with heart failure can predict the risk of AF. The effect of widening QRS duration on worsening of LV dysfunction and AF generation appears to be more potent than the effect of worsening LV dysfunction alone on atrial fibrillation generation. This indicates that worsening LV dysfunction is strongly associated with atrial fibrillation only in context of widening QRS duration. Hence, it may be postulated that in patients with LV dysfunction, QRS duration on ECG is the alone strongest predictor for worsening LV dysfunction as well as atrial fibrillation occurrence.

Study Limitations

Confounding variables that could affect the incidence and prevalence of atrial fibrillation and its association with QRS duration have not been accounted in this cross sectional survey. Moreover, the sample size of the study population is small and repeat study with larger sample size is required before generalizing the results to the whole population of patients with LV dysfunction.

CONCLUSION

In patients of heart failure with systolic dysfunction (HFrEF), the frequency of atrial fibrillation increases as QRS duration widens. This group of patients must be focused for AF preventive strategies.

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PREVIOUS RELATED STUDY

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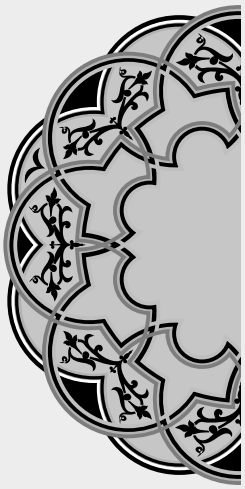

"Whoever is trying to bring you down,
Is already below you."

Unknown

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Dr. Naeem-ur-Rehman Mir	Main author writing	
2	Dr. Naeem Asghar	Data collection, Introduction, Proof reading	
3	Dr. Shaukat Javed	Discussion, Research	