The Co-relations between Electrocardiographic QRS Duration with Several Clinical Findings among Healthy People

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Authors' contributions

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ABSTRACT

Background: The QRS duration signifies the time for ventricular depolarization. Normally, the QRS duration is 0.06 to 0.10 seconds. The measurement of left ventricular dimensions and the changes of left ventricular dimensions are important to assess cardiac as well as the cardiovascular conditions of patients. Co-relations between electrocardiographic QRS duration with other clinical findings among healthy people may help in assessing the cardio-vascular condition of cardiac patients.

Aim of the Study: The aim of this study was to assess the co-relation between electrocardiographic QRS duration with other clinical findings among healthy people.

Methods: This was an observational cross-sectional study which was conducted in the Department of Cardiology, University Cardiac Centre, Bangabandhu Sheikh Mujib Medical

University, Dhaka over a period of 2 years from July 2008 to June 2010. In total 92 apparently healthy people without heart failure (HF) or myocardial infarction (MI) were included as the study population. Among them, 22 were in Referent (QRS duration <100 ms), 40 in Incomplete BBB (QRS duration 100 - 119), and 30 in Complete BBB (≥ 120 ms) groups. Proper written consent was taken from all the participants and this study was approved by the ethical committee of the mentioned university. All data were processed, analyzed, and disseminated by MS Office and SPSS version 11.5.

Results: In analyzing the clinical findings of all the participants we observed, the mean systolic and diastolic blood pressure were almost identically distributed among the three groups (125.8 ± 27.7 mmHg vs. 130.1 ± 12.3 mmHg vs. 129.8 ± 14.5. p = 0.652 and 77.9 ± 6.4 mmHg vs. 79.1 ± 6.7 mmHg vs. 76.3 ± 6.7 mmHg, p= 0.225 respectively). The frequency of diabetic patients and antihypertensive drug users was found highest in complete BBB group than those in referent and incomplete BBB group, although the difference was not statistically significant (p=0.262 and p =0.104 respectively).

Conclusion: As a clinical status, systolic blood pressure, diastolic blood pressure and diabetes may be some potential concern in people with complete and incomplete BBB. Besides these, the present study revealed that longer electrocardiographic QRS duration was correlated with an increase in LV mass, LV diastolic dimensions, septal wall thickness, posterior wall thickness, and left atrial size. With complete BBB compared with a normal QRS duration, the association was most striking in individuals. Meanwhile, the presence of prolonged QRS in a patient's ECG can serve as a bedside clue to the presence of decreased fractional shortening and left ventricular ejection fraction.

1. INTRODUCTION

The measurement of left ventricular dimensions and the changes of left ventricular function are important to assess cardiac as well as the cardiovascular conditions of patients. The QRS duration signifies the time for ventricular depolarization. Normally, the QRS duration is 0.06 to 0.10 seconds. Co-relations between electrocardiographic QRS duration with other clinical findings among healthy people may help in assessing the cardio-vascular condition of cardiac patients. With the advent of ECG, a revolutionary change in the diagnosis and management of heart diseases was made with a consequent decrease in mortality and morbidity. The broad application of ECG as a screening tool and its easy access has made it one of the most common diagnostic tests performed in routine clinical practice [1]. The 12-lead electrocardiogram (ECG) is the most readily available non-invasive test for the detection of cardiac disease [2]. Recent advances have extended the importance of ECG in determining the extent and severity of myocardial ischemia, localizing sites of origin and pathways of tachyarrythmias, assessing therapeutic options for patients with heart failure, and identifying and evaluating patients with the genetic disease who are prone to arrhythmias [3]. In ECG the P wave

is generated by activation of the atria, the PR segments represent the duration of atrioventricular conduction. The QRS complex is produced by activation of both ventricles, and the ST-T wave reflects ventricular recovery [3]. Between the physiology and anatomy of the specialized ventricular conducting system and the ventricular myocardium, normal ventricular activations is a complex event that is dependent on interactions. The net result is the multiphasic QRS complex. Followed by a tall upright one (The R wave) and a deeply negative one (an S wave). the overall QRS complex may be described as QRS if it consists of an initial small negative wave (the q wave), [3] the upper normal value for QRS duration is traditionally given as shorter than 120 milliseconds measured in the lead with the widest QRS duration. Women, on average, have a somewhat smaller QRS duration than men (by about 5 to 8 milliseconds) [3]. A prolonged electrocardiographic QRS duration (≥120 ms) may be a marker of inter or intraventricular mechanical dyssynchrony and has been associated with adverse prognosis in systolic heart failure [4]. A wide QRS may be helpful in identifying the presence of interventricular dyssynchrony but it may not be related to intraventricular dyssynchrony [5]. Experimental investigations suggest that asynchronous LV contraction (indicated by

prolonged electrocardiographic QRS duration) may promote LV remodeling, manifested by increases in wall thickness of late-activated LV segments [4]. Prolongation of QRS duration may be the result of LV dilatation, with a concomitant increase in conduction time of the cardiac impulse [4]. It is possible that prolongation of the QRS complex is a marker of dyssynchronous LV contraction. Such non-coordinated mechanical contraction of the ventricle results in a redistribution of mechanical load & differential hypertrophy of the late activated LV segments [6]. Patients with a prolonged QRS duration (> 0.10s) had lower left ventricular ejection fraction (LVEF) compared to patients with a normal QRS duration. In patients with QRS duration >0.10s, there is a high likelihood that the resting LVEF will be abnormal [7]. Without a prior history of congestive heart failure (CHF) or myocardial infarction (MI), prolongation of electrocardiographic QRS interval is found to be associated with increased echocardiographic left-ventricular (LV) mass cross-sectionally in individuals. This observation raises the possibility that prolongation of the QRS duration may be a marker of adverse ventricular remodeling [4]. As part of the Framingham Heart Study, Schneider et al. [8] determined who were followed for up to 18 years, CV risk in 70 patients with RBBB. According to that study, CV mortality was three times greater in patients with RBBB than in an age-matched of population at large. Most likely to have associated CV abnormalities such as HF were ECGs with QRS duration greater than 130 ms. 55 patients who developed LBBB and the QRS duration did not correlate with the prevalence of associated CV abnormalities [9]. A higher mortality rate from CV disease was seen in men with LBBB versus RBBB these same investigator studies found. This rate was higher than in women with either conduction abnormality [10]. Kreger et al. [11] found the age-adjusted incidence of MI, angina pectoris, and coronary death to be unrelated to baseline QRS prolongation.

1.1 Objectives

1.1.1 General objective

To assess the co-relations between electrocardiographic QRS duration with other clinical findings among healthy people.

1.1.2 Specific objective

- To collect information regarding the demo-graphic status of the participants.

- To collect information regarding the electrocardiographic variables among participants.

2. METHODOLOGY AND MATERIALS

This was a cross-sectional study which was conducted in the Department of Cardiology, University Cardiac Centre, Bangabandhu Sheikh Mujib Medical University, Dhaka over a period of 2 years from July 2008 to June 2010. In total 92 apparently healthy people without heart failure (HF) or myocardial infarction (MI) were included as the study population. Among them, 22 were in Referent (QRS duration < 100 ms), 40 in Incomplete BBB (QRS duration 100 - 119), and 30 in Complete BBB (≥ 120 ms) groups. According to the inclusion criteria of this study healthy people, age between 25 and 80 years who are free from heart failure (HF) and myocardial infarction (MI) with proper documents of computerized electrocardiogram (ECG) and 2D & M-mode echocardiographic variables available were included. On the other hand, according to the exclusion criteria of this study patients with prevalent heart failure, myocardial infarction (MI), digoxin or quinidine use, and history of permanent pacemaker (PPM) implantation were excluded. The demographic variables included in the study were age, sex, BMI, and smoking habit. The clinical variables were systolic BP, diastolic BP, diabetes mellitus (DM), and use of antihypertensive medications. Data were collected by interview, observation, and clinical examination. Complete medical history, clinical examination, and assessment of cardiovascular risk factors like hypertension and diabetes mellitus, clinical examination, and relevant investigations reports like ECG and echocardiography of all patients were recorded in a pre-designed data collection sheet. All the participants underwent electrocardiographic (ECG) and 2D and M-mode echocardiographic examination. Hypertension was considered if the patient was on oral antihypertensive medication and/or systolic blood pressure >140 mmHg and diastolic blood pressure > 90 mmHg. Left ventricular fractional shortening and LVEF were considered as indicators of LV systolic function. Diabetes mellitus (DM) was considered if the patient was on oral antidiabetic medications or had fasting blood glucose >7 mmol/L or two hours after postprandial plasma glucose >11.1 mmol/L or > 200 mg/dl. Cigarette (any amount within first three years), significant smoking history were defined as >10 Pack years of cigarette use. Overweight and obesity were

defined according to NIH 1998 Guidelines. All data were processed and analyzed and disseminated by using SPSS version 11.5 and MS Office as per need.

3. RESULTS

In this study, the ages were almost identically distributed among the three categories of patients based on QRS duration (53.2 ± 11.6, 52.1 ± 7.4 and 55.8 ± 9.4 years respectively, p = 0.242). Male patients comprised the main bulk in complete BBB (76.7%), while females were predominant in the referent group (59.1%) (p = 0.029). Nearly one-third (31.8%) of the referent group, 45% of the incomplete BBB group, and more than three-quarters (76.7%) of the complete BBB group were overweight and obese indicating that overweight & obesity status increases with the increase in QRS duration (p=0.003). No significant difference was,

however, observed among the groups in terms of smoking habits (p=0.911). The mean (±SD) QRS duration of Referent, Incomplete BBB, and Complete BBB group participants were found 88.3±7.1, 106.9 ± 4, and 162.4 ±15.8 ms respectively. On the other hand, the mean (±SD) QRS voltages were 1195.4±359.2, 1312.5± 390.4 and 1587.7±942.9 µv respectively. In analyzing the clinical findings of all the participants we observed, the mean systolic and diastolic blood pressure were almost identically distributed among the three groups (125.8±27.7 mmHg vs. 130.1±12.3 mmHg vs. 129.8±14.5. p= 0.652 and 77.9±6.4 mmHg vs. 79.1 ±6.7 mmHg vs. 76.3±6.7 mmHg, p=0.225 respectively). The frequency of diabetic patients and antihypertensive drug user was found highest incomplete BBB group than those in referent and incomplete BBB group, although the difference was not statistically significant (p= 0.262 and p=0.104 respectively).

Table 1. Comparison of demographic characteristics among groups (N=92)

| Characteristics	Referent (n=22)	Incomplete BBB (n=40)	Complete BBB (n=30)	p-Value
Age distribution in years (Mean ± SD)				
Age	53.2 ± 11.6	52.1 ± 7.4	55.8 ± 9.4	0.242[ns]
Gender distribution				
Male	9 (40.9)	22 (55.0)	23 (76.7)	0.029[s]
Female	13 (59.1)	18 (45.0)	7 (23.3)	
BMI (kg/m2) distribution				
<25 (normal)	15 (68.2)	22 (55.0)	7 (23.3)	0.003[s]
≥25 (Over-wt. & obese)	7 (31.8)	18 (45.0)	23 (76.7)	
Smoking habits among participants				
Yes	5 (22.7)	9 (22.5)	8 (26.7)	0.911[ns]
No	17 (77.3)	31 (77.5)	22 (73.3)	

Table 2. Electrocardiographic variables among participants (N=92)

Variables	Referent (n=22)	Incomplete BBB (n=40)	Complete BBB (n=30)	p-Value
QRS duration (ms)	88.3 ± 7.1	106.9 ± 4.5	162.4 ± 15.8	<0.05[s]
QRS voltage (µv)	1195.4 ± 359.2	1312.5 ± 390.4	1587.7 ± 942.9	<0.05[s]

Table 3. Clinical variables among the three groups (N=92)

Characteristics	Referent (n=22)	Incomplete BBB (n=40)	Complete BBB (n=30)	p-Value
Systolic BP	125.8 ± 27.7	130.1 ± 12.3	129.8 ± 14.5	0.652[ns]
Diastolic BP	77.9 ± 6.4	79.1 ± 6.7	76.3 ± 6.7	0.225[ns]
Antihypertensive used	2 (9.1)	4 (10.0)	8 (26.7)	0.104[ns]
Diabetes	3 (13.6)	5 (12.5)	8 (26.7)	0.262[ns]

Sex Wise Patients Distribution
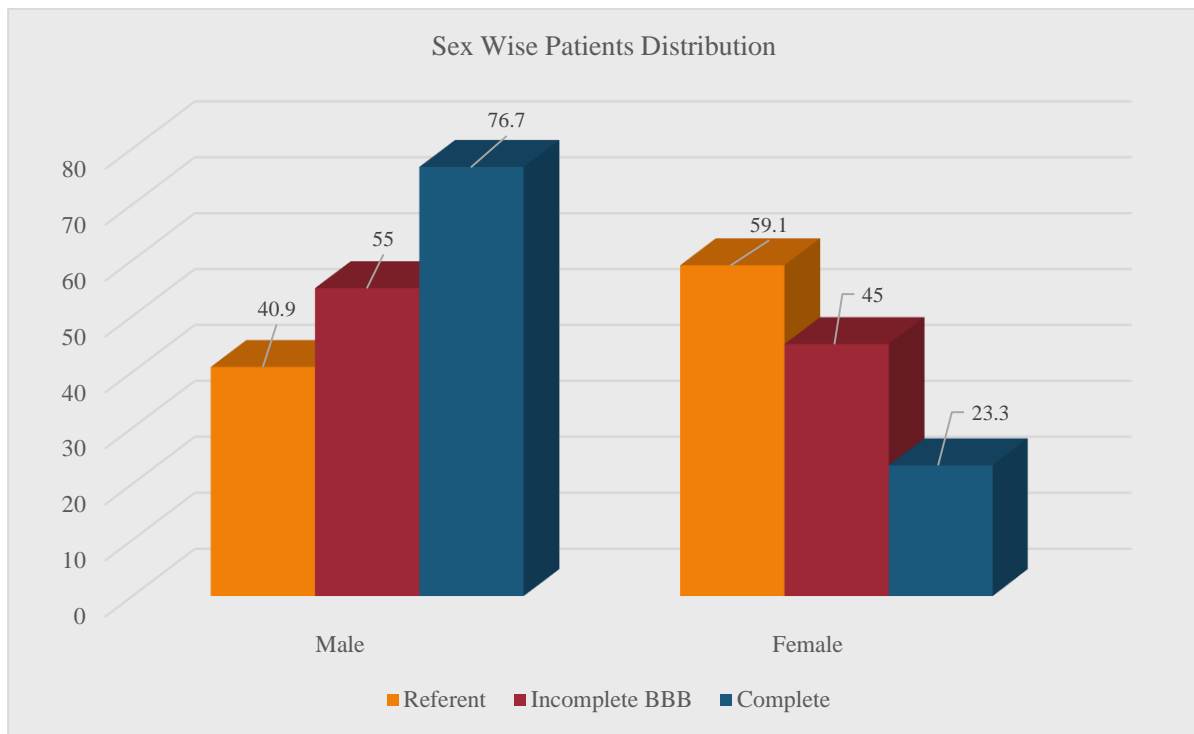
Fig. 1. Sex wise patients distribution

4. DISCUSSION

The aim of this study was to assess the co-relations between electrocardiographic QRS duration with several clinical findings among healthy people. The result of the current study demonstrated that age was almost identically distributed among the three categories of patients based on QRS duration (53.2±11.6 in referent, 52.1±7.4 in complete BBB, and 55.8±9.4 years in the complete BBB group respectively, p=0.242). The complete BBB was significantly common in male patients (76.7%), while females were predominant in the referent group (59.1%) (p=0.029). Overweight and obese subjects were significantly less in the referent group (31.8%) compared to those in incomplete BBB (45%) and complete BBB (76.7%) indicating that overweight and obesity status increases with the increase in QRS duration. Around one-quarter of the subjects was a smoker. Dhingra and associates (2005) [4] conducted an almost similar study where, the age distribution of subjects in referent, incomplete BBB and complete BBB group in man 54±14, 51±14, 61± 15 years respectively and in women 55±15, 58±15 and 68±12 years respectively. However, one year after the same investigators reported higher mean age in three groups (70±7, 70±7, and 72±7 years respectively) [12]. They observed

male predominance in incomplete (60%) and incomplete BBB (58%), while the referent group was preoccupied with females (70%). The BMI was almost similar among the subjects with referent, incomplete and complete BBBs. No significant difference was observed among the three groups in terms of smoking habits. Prolonged QRS duration was predominantly observed in male subjects (76.7%) which was also found in the study of Shenkaman et al. [7]. In the present study, mean systolic and diastolic blood pressure were almost identically distributed among the three groups. The prevalence of diabetic patients and use of antihypertensive drugs were found highest incomplete BBB group than those in the referent and incomplete BBB group, although the difference did not turn significant. In 2006 Dhingra associates [12] reported that systolic BP was highest incomplete BBB group than those in the referent and incomplete BBB group, though diastolic BP was almost similar among the three groups. The mean QRS duration and mean QRS voltage were significantly highest incomplete BBB group than those in the referent and incomplete BBB group. In this regard, Dhingra's study (2006)[8] was almost consistent with the present study (mean QRS duration was 87±7 ms in referent, 106±5 ms in incomplete BBB, and 140±14 ms in complete BBB group). Echocardiographic

variables pertaining to LV function revealed that left ventricular (LV) mass, left ventricular diastolic dimension, septal wall thickness, posterior wall thickness, and left atrial size were significantly higher in the complete BBB group compared to the referent and incomplete BBB group. However, fractional shortening and left ventricular ejection fraction were observed to be decreased significantly with the increase in QRS duration. These findings are consistent with the study done by Dhingra et al. [4] who reported a significant association of increased electrocardiographic QRS duration with decreased LV fractional shortening and LV ejection fraction. QRS duration was observed to be linearly correlated with LV mass, LV diastolic dimension, septal wall thickness, posterior wall thickness and left atrial size with correlation coefficients being r=0.577, r=0.480, r=0.583, r=0.521, and r=0.418 respectively. Brophy et al. [13] reported that IVCD was associated with worsened survival in patients with HF. Shenkman et al. [14] found a linear relationship between increased QRS duration and decreased ejection fraction. A prolonged QRS duration demonstrated increased mortality of 120 to 149 ms. QRS prolongation over time predicted mortality and that a greater than 20% increase in duration was associated with the worst prognosis Shamim et al. [15] found. Iuliano et al. [16] found that LBBB was associated with worse survival than RBBB or IVCD and that among a given ejection fraction class, QRS duration is still a stratified risk. Bruch et al. [17] prospectively enrolled 193 patients with HF and an ejection fraction less than 45%.

5. CONCLUSION AND RECOMMENDA-TIONS

As clinical status systolic blood pressure, diastolic blood pressure, and diabetes may be some potential concerns in people with complete and incomplete BBB. Besides these, the present study revealed that longer electrocardiographic QRS duration was correlated with an increase in LV mass, LV diastolic dimensions, septal wall thickness, posterior wall thickness, and left atrial size. The association was most striking in individuals with complete BBB compared with a normal QRS duration. Meanwhile, the presence of prolonged QRS in a patient's ECG can serve as a bedside clue to the presence of decreased fractional shortening and left ventricular ejection fraction. For getting more reliable information we would like to recommend conducting more studies in several places with large sample sizes.

CONSENT

As per international standard or university standard, participants' written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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