Comparison of QRS Duration in African Blacks and European Caucasians

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Abstract

This study aimed to compare the QRS duration in a large population of healthy individuals living in Nigeria with a Caucasian population living in Scotland. The Nigerian population consisted of 782 males and 479 females with an age range of 20-87 years. The Caucasian population consisted of 859 males and 637 females with an age range from 18-82 years. For the Nigerian population, the overall QRS duration for males was 87.9 ± 9.4ms and for females, it was 83.4 ± 7.6ms. For the Caucasian population, the overall QRS duration in males was 93.7 ± 9.8ms and in females was 86.1 ± 7.7ms. In both populations, the mean QRS duration was higher in males than in females. There was a significantly longer QRS duration in Caucasian males and females compared to their Nigerian counterparts. However, the upper limits of normal QRS duration differed little between the two races.

1. Introduction

QRS duration, which is the actual time interval for ventricular depolarization, has a very wide application in cardiology practice, not only in diagnosis and prognosis determination, but also in therapeutic decision making and evaluation [1-3]. Availability of computerized analysis of the electrocardiogram (ECG) in the western world for well over four decades has brought about better understanding of the variation and normal limits of the interval, which, at best, is still poorly defined [4,5]. Since most biological normal references in Blacks have always evolved through the extrapolation of studies done among the Caucasian population, even though evidences abound attesting to racial differences in the ECG, we thought it fit and proper to compare the QRS duration between these two populations.

2. Material and Methods

Two age and sex-matched distinct populations were compared with respect to QRS duration in this study. The first population consisted of a total of 1,496 adult Scottish students and local government employees in the West of Scotland. The local government employees had a variety of sedentary and non sedentary occupations. The ECGs in this group were recorded using a locally designed and built electrocardiograph [6]. The second population consisted of adult Nigerians from a background of mixed occupational groups. The ECGs in the Nigerian population were recorded using a Burdick Atria 6100 electrocardiograph, produced by Cardiac Science Corporation. Both populations were regarded as apparently healthy. In the Scottish group, every individual was examined by a physician and any individual with an abnormality likely to affect the cardiovascular system was excluded. In the Nigerian population, individuals were screened by a physician and only those who were normotensive and had no history of any problem likely to affect the cardiovascular system were included.

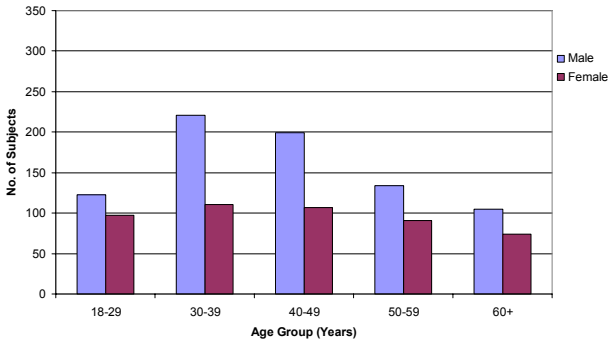

Figure 1. Age and sex distribution of Nigerian population.

The ECGs from the two populations were analysed using the same version of the University of Glasgow ECG analysis program [7]. Details of the methodology for each of the two studies have been published elsewhere [8,9].

3. Results

The Nigerian population consisted of 782 males and 479 females with an age range of 20-87 years (Figure 1). The Caucasian population consisted of 859 males and 637 females with an age range of 18-82 years (Figure 2).

For the Nigerian population, the overall QRS duration for males was 87.9 ± 9.4 ms and for females, it was 83.4 ± 7.6 ms ($p < 0.001$). The upper limit of normal was 112 ms and 100 ms in males and females respectively.

For the Caucasian population, the overall QRS duration in males was 93.7 ± 9.8 ms and in females, was 86.1 ± 7.7 ms ($p < 0.001$). The upper limit of normal was 114 ms and 102 ms for males and females respectively.

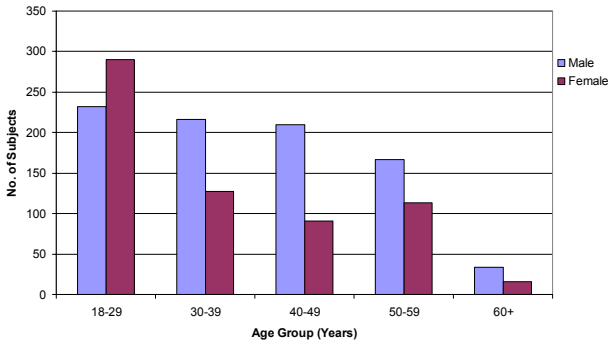

Figure 2. Age and sex distribution of Scottish population.

In both populations, the mean QRS duration was higher in males than in females in each age group. This is presented in Table 1.

There was a significantly longer QRS duration ($p < 0.001$) in white males and females compared to their Nigerian counterparts.

There was a significantly longer QRS duration in white males vs Nigerian males ($p < 0.001$) and white females vs Nigerian females ($p < 0.001$).

Table 1. Mean QRS duration (± SD) in the adult male and female for Nigerian and Caucasian populations.

Age group (years)	Nigerian		Caucasian	
	Male	Female	Male	Female
18-29	88.83±10.8	81.77±8.44	94.48±9.78	85.63±7.74
30-39	89.26±8.79	83.25±6.65	94.66±9.70	86.98±7.34
40-49	87.61±9.47	83.93±7.46	93.10±9.66	86.18±7.90
50-59	87.67±7.89	84.07±7.70	92.49±10.43	85.91±7.91
60+	84.84±9.73	84.41±7.82	93.18±8.33	87.25±6.53

4. Discussion

Until now, previous studies on QRS duration among apparently healthy Nigerians have always quoted a single range for all age groups and both sexes [10]. Araoye, in a study of 1,033 Nigerians about three decades ago, had posited that there was no age, sex or racial difference in the durations of ECG waves, intervals and segments, including the QRS duration. A single normal QRS duration of 0.06 to 0.11 seconds was reported for all Nigerians. The present work is the first from an indigenous African population that presents age and sex based limits of the normal QRS duration in Nigerians using automated methods. This finding may apply to the entire sub-Saharan Africa. The study has demonstrated that normal limits of the QRS duration vary according to gender and age. This variation further underscores the need to develop automated analysis of the ECG in the African continent since it is practically difficult, if not impossible, to commit these various normal values to memory for clinical application by the bedside of the patient.

The mean ± SD for overall QRS duration in Nigerians in both genders combined was found to be 86.21 ± 9.0 ms. The 96th percentile range was also found to be 70-110 ms. Indeed, over 90% of the population studied had a QRS duration between 70 and 100 ms, which is within the traditional normal range [11]. Only 2% of the population had overall QRS duration above 110 ms which was the upper limit advocated from an earlier work on the same population [10]. In a multinational study where 3% of the enrolees were Africans, Mason and his team reported a 96th percentile range of 69-109 ms for overall QRS duration [12]. The same study had reported higher QRS duration among males compared with females. This is similar to our observation among Nigerians and the observations of Macfarlane et al and Chen et al among British and Chinese populations respectively [4,5]. The comparative mean QRS duration in males among Nigerian and British populations is illustrated graphically in Figure 3. Higher QRS duration in males than females

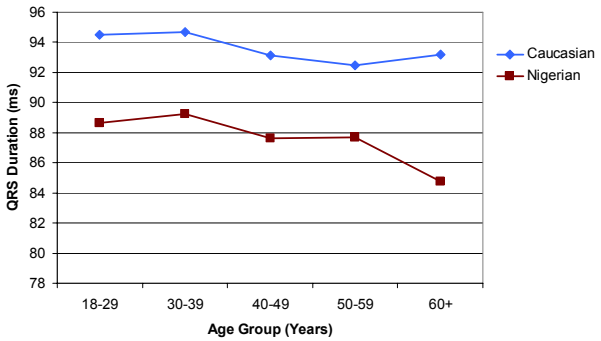

Figure 3. Mean QRS duration in males in Nigerian and British populations.

may be related to the fact that men have a heavier heart with higher left ventricular mass, thereby taking longer time for impulses to be conducted and cause ventricular depolarisation. A small but significant correlation between body weight and QRS duration ($r=0.18$, $p < 0.001$) was however observed.

Whereas, the QRS duration tends to increase marginally with aging in females, the change in males is less consistent. This is similar to the observation of Mansi

et al and Vitelli et al among African Americans [13,14]. Mason et al had reported stability across age groups in a predominantly American but mixed population [12].

Although Figure 3 shows quite clearly that there is a significant different in mean QRS duration between Caucasian and Nigerian males, it is surprising to find that the overall upper limit of normal in males for both groups differs by only 2 milliseconds. This can only be due to the skewed nature of the distribution of QRS measurements in each population. It does, however, relate to the whole question of how QRS duration can be applied clinically to maximum benefit.

The data would suggest that it is the difference between male and female normal limits that is more important than any difference between Caucasians and Blacks where the upper limits of normal in both is similar in males and in females. There is a clear 10 millisecond difference approximately between the male and female upper limits of normal in both races and in a way the question that has to be answered is why does the medical community not acknowledge this difference? Criteria for conduction defects in the ECG never make reference to sex based differences in QRS duration.

The answer is essentially that while a 10 millisecond difference can be demonstrated statistically, the human reader can not readily discriminate such a difference in QRS duration unless it is associated perhaps with a morphological QRS change in addition.

Consider the two ECGs of Figure 4. The QRS duration is similar but one is abnormal according to the normal limits established by this study.

It is surprising that so much stress is laid on differences of 10 milliseconds for example in thorough QT studies and yet a proportionately higher difference in QRS duration goes ignored.

Although QRS widening is generally considered a criterion for a conduction defect, it may also accompany left ventricular hypertrophy and hence criteria for this ECG abnormality should also take into account the difference in normal limits of QRS duration between males and females.

Criteria for ECG abnormality, and in particular conduction defects, are long established and inbuilt to the cardiologists thought process. Enhanced criteria, which might for example suggest that a left bundle branch block could be reported at 110 milliseconds in females, are unlikely to be met with general acclaim.

All of this discussion refers to the adult ECG. It is well known that the ECG of neonates, infants and children shows a QRS duration which steadily increases from birth through to adolescence. In this situation, age dependence when considering QRS duration is absolutely critical.

5. Conclusion

These are the first data from large indigenous populations in Africa and Western Europe that demonstrate a significant difference in mean QRS

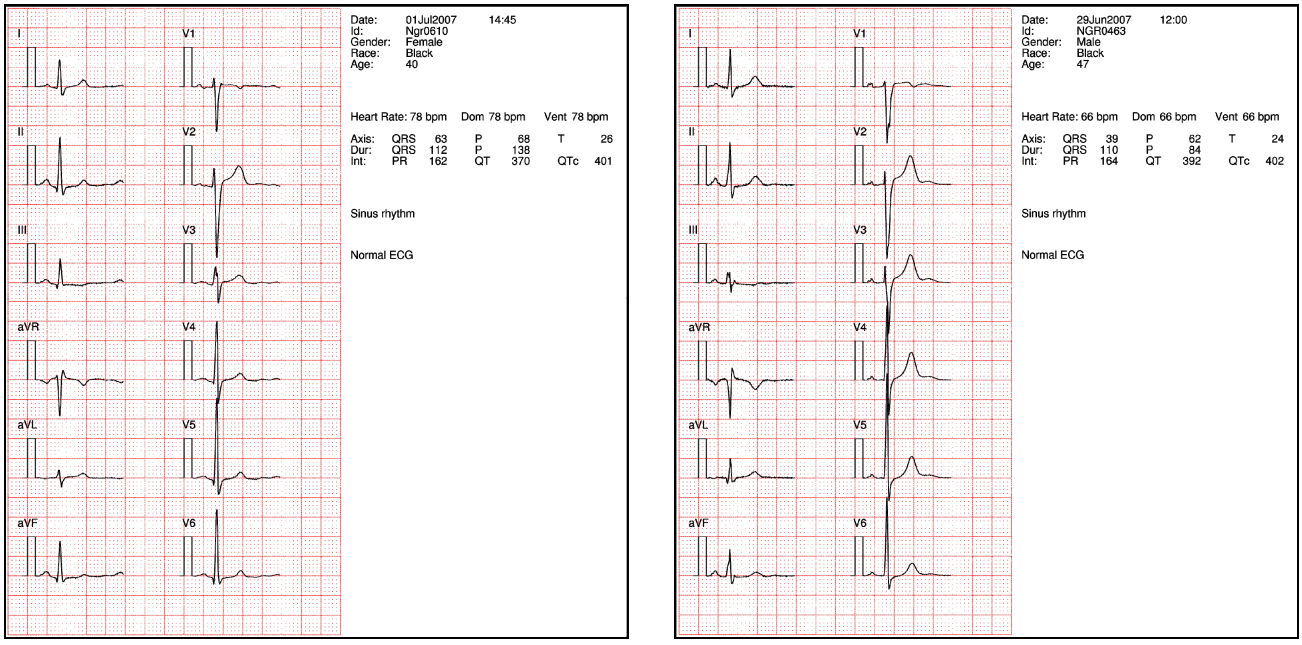

Figure 4. The above illustration shows two ECGs with similar QRS duration, but one is from a female (on the left) and the other is from a male (on the right). The former is abnormal according to the proposed definition of upper limit of normal in black females whereas the other from a black male is normal. At present, the existing diagnostic logic uses a threshold of 120 msecs for a conduction defect and so both ECGs are reported as being within normal limits.

duration between the two racial groups. On the other hand, because there is essentially no difference in the upper limit of normal QRS duration between Black and Caucasian populations, there would seem to be no requirement to utilize race in interpretation of QRS duration measurements. On the contrary, there is every justification for utilizing sex differences in QRS duration. Unfortunately, given that these have been known for many years at least in Caucasians, it seems unlikely that the cardiological community will make a move to optimize diagnostic criteria by acknowledging these differences.

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