EVALUATION OF 12-LEAD ELECTROCARDIOGRAM (ECG) IN ATHLETES AND NON-ATHLETES IN ZARIA, NIGERIA

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Background: Sudden cardiac death (SCD) in well-trained athletes is most often superimposed on the presence of structural heart disease. However, some athletes die suddenly in the absence of overt heart disease. This study investigated resting electrocardiograms from 150 athletic subjects taken in the same laboratory and compared them with electrocardiograms recorded in 100 non-athletes with similar anthropometric parameters, with the aim of comparing the electrocardiographic patterns or distinctive abnormalities between different groups of athletes and non-athletes. **Methods:** All subjects underwent the same non-invasive cardiac investigations with electrocardiography. The athletes represent sport disciplines requiring predominatly isotonic (dynamic) or endurance exercise and isometric (static) exercise. **Results:** The common findings were significant sinus bradycardia (36%), first degree A-V block (4.7%), right and left axis deviation (2.7% and 8% respectively) according to voltage criteria which were all higher in athletes compared to non-athletes. On the other hand, right bundle branch block (2%), prolonged QT interval (1.3%) and Elevation of J point (9.3%) were only seen among the athletes. **Conclusion:** There was a correlation between gender and the development of ventricular hypertrophy ($p<0.05$). Pre-participation cardiovascular screening is an important step towards the prevention of SCD even among apparently healthy athletes.

Keywords: ECG, Athletes, Sudden Cardiac Death, bradycardia

INTRODUCTION

Exercise consists of voluntary activiation of skeletal muscle. Physical activity clearly benefit cardiovascular health.[1] Sudden death from cardiac causes often occurs during or just after physical exertion. In some cases, such deaths occur during organized youth sports, a circumstance in which the victims are regarded as the epitome of health and fitness and their death may become the subject of scrutiny by the news media. Sudden cardiac death (SCD) in seemingly healthy, active, and asymptomatic athletes has always been a tragic fact and is now occurring more frequently. Thus, the preventive detection of 'Subject at risk' becomes a priority.[2] Retrospective and cross-sectional data suggest vigorous exertion can trigger cardiac arrest or sudden death and that habitual exercise may diminish this risk. However, the role of physical activity in precipitating or preventing sudden death from cardiac causes has not been assessed prospectively in a large number of subjects.[3]

A number of studies have reported the ECG of athletes in Caucasians.[4] Nakamoto in 1969 reported the p-wave amplitude at rest to be greater in athletes than in non-athletes. It has also been shown that ECG of athletes contains large-amplitude QRS complexes in both limb and precordial leads which frequently satisfy voltage criteria for ventricular hypertrophy.[5] Reports of studies on well-trained Nigerian athletes are scanty.[6] Many authors have demonstrated that there are age, gender and racial differences in the ECG, and most of the studies dealt with small cases sample and failed to make quantitative measurements and criteria for the Negro ECG.[7] The aim of this study is to compare the electrocardiographic pattern or distinctive abnormalities between different group of athletes and non-athletes and also to improve methods of identification of athletes at high risk of sudden death.

MATERIAL AND METHODS

The study population involved 250 adult (18–53 years) Nigerians of both sexes. Subjects with history of hypertension, and associated pulponary disease (e.g., Asthma, Pneumonia), those with previous chest surgery, blood pressure greater than 140/90 mm Hg, low body temperature (hypothermia) were excluded from the study. Hospital in-patients, those on any medication on the time of the study, pregnant and puerperal females, alcohol, cigarette and tobacco users were all excluded from the study.[5–7]

The subjects were drawn from 150 athletes (128 males and 22 females) consisting of 100 dynamic athletes (sprinters, middle and long distance runners), 50 static athletes (hammer throwers, weight lifters) and 100-marched control group (68 males and 32 females). All subjects gave informed consent to participate in this study and approval was obtained from the ethical committee of Ahmadu Bello University Teaching hospital, Zaria.

The aim and the procedure of the test were explained to all the subjects. All qualified subjects had their ECG recording in the department of human physiology. The recording were carried out

in the standard way based on the American Heart Association specifications i.e. subject supine (lying uniformly flat), arms by the side, chest electrodes in their correct positions, limb electrodes on wrist and ankles, recorded at 25 mm/sec, calibrated at 10 mm/mV. The calibration was consistent and it was done for each tracing and three consecutive cardiac cycles were recorded for each lead and averaged.[11–13]

Results were expressed as Mean±SEM and statistical comparisons between measured variables were carried out using ANOVA and sequential differences among means were calculated at a level of $p<0.05$.

RESULTS

The results of this study are summarized in Tables 1–3.

Table-1: Age distribution and sex ratio of subjects

Age group (years)	Percentage (n= 250)	Sex	Percentage (%)
18–29	80.0	MALE	77.6
30–41	17.2	FEMALES	22.4
42–53	2.8		

Table-2: Demographic characteristics of the athletes and Non-athletes.

Parameters	Athletes	Non-Athletes	*p*-Value
Age (yrs)	26.2±0.5	25.4±0.6	>0.05
Height (m)	1.75±0.01	1.70±0.01	>0.05
Weight (kg)	68.3±0.8	62.8±0.9	<0.05*
BM I (Kg/m^2)	22.3±0.2	21.9±0.3	>0.05
S B P (mmHg)	112..5±0.9	1119±1.1	>0.05
D B P (mmHg)	78.3±0.6	76.9±0.8	>0.05
MBP (mmHg)	89.6±0.6	88.5±0.8	>0.05
HR (bpm)	63.1±1.0	74.2±1.3	<0.05*
BT (^oC)	36.3±0.04	36.5±0.06	>0.05

*Significant

Table-3: Percentage of abnormal ECG changes in athletes and non- athletes

Abnormality	Percentage in Athletes (n= 150)	Percentage in Non- athletes (n= 100)
Sinus bradycardia	36.0	7.0
1st Degree A-V Block	4.7	3.0
RBBB	2.0	-
LVH	47.3	29.0
RVH	24.0	8.0
LAE	8.7	1.0
RAE	-	1.0
Prolonged QT interval	1.3	-
LAD	8.0	4.0
RAD	2.7	2.0
Tall T wave	17.3	9.0
Elevated ST	62.0	45.0
Elevated J point	9.3	-
Abnormal T axis	2.0	2.0

DISCUSSION

This study presents information obtained from the ECG of Nigerian athletes and non-athletes. About 80% of the subjects were below the age of 30 years at the time of the study. All subjects were in good physical health and had no history of any major illness. The findings of this study shows that the mean weight in athletes (see Table-4) is significantly higher ($p<0.05$) than in non-athletes.

This could be as a result of the increase in muscle mass due to vigorous training the athletes are engaged in particularly those doing isometric type of training like weight lifting, judo etc. The mean resting heart rate (HR) in athletes is significantly lower $p<0.05$ (see Table-4) than in non-athletes. Similar findings had been documented in previous studies in athletes.[6,8] Studies indicate that the SA node and AV node are suppressed by an increase in vagal tone in athletes thereby giving rise to sinus bradycardia and heart block.[9] Although the bradycardia is recognized as an adaptive response in athletes, it is sometimes associated with acute cardiovascular events, e.g., syncope in some athletes particularly when it is associated with atrioventricular block pattern.[10]

About 4.7% of the athletes had first degree AV block (P-R interval greater than 0.20 seconds). Increased vagal activity could cause prolongation of the PR interval in the athletes. About 1.3% of the athletes had prolonged QT interval (based on the upper limit for heart rate; QTc $\geq$0.47 sec. for males and $\geq$0.48 sec. in females). This is an infrequent ECG finding in the athletic population. The abnormality may have important clinical implications since it usually indicates a state of increased vulnerability to malignant ventricular arrhythmias, syncope and sudden death.[11-13] In one of the athlete (dynamic) who has prolonged QT interval he also has LVH and RVH while the other athlete (static) has only RVH.

This study also revealed that 47.3% of the athletes and 29% of the non-athletes met the ECG criteria for LVH (Sokolow and Lyon; SV_1+RV_5 or RV_6 >35 mm). Similarly, 24% of the athletes and 8% of the non-athletes had RVH (RV_1+SV_5 >10.5 mm). In conclusion, the number of athletes exhibiting LVH or RVH is higher than in non-athletes. The ECG criteria for diagnosing right or left ventricular hypertrophy are very insensitive, i.e., sensitivity is 50%, which means that 50% of the patients with ventricular hypertrophy cannot be recognized by ECG criteria. However, the criteria are very specific, i.e., specificity >90%, that means that if the criteria are met, it is very likely that ventricular hypertrophy is present.

Pre-participation cardiovascular screening is an important step towards the prevention of sudden cardiac death even among apparently healthy athletes.

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