Original Article

Electrocardiographic abnormalities in Cameroonian university athletes: a cross-sectional study

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Background: Pre-participation screening is not commonly done in Cameroonian amateur athletes. There are therefore very few studies describing the athlete's heart among Cameroonians. This study aims to describe electrocardiogram (ECG) abnormalities in a group of Cameroonian athletes participating in university games.

Methods: This was a cross-sectional study conducted at the Yaoundé University Teaching Hospital. All participants underwent a 12-lead ECG. The ECG analysis was done using the Seattle criteria.

Results: We recruited 145 athletes, of whom 37.2% were female. The average age is 23±3 years. The pathological abnormalities including left atrial hypertrophy, T wave inversion, left axial deviation and right ventricular hypertrophy. These were found in 5.6% of athletes, mostly in the males.

Conclusions: The abnormalities observed on the ECG in the University of Yaounde 1 athletes are similar to those described in the literature.

Keywords: Abnormalities; electrocardiography; athletes; Cameroonian

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Introduction

The practice of an intensive and prolonged physical activity is accompanied by several heart adaptations. These are mostly physiological and are known as the athlete's heart. These result in abnormalities on the electrocardiogram (ECG) and echocardiography. Cardiac adaptation to effort depends on several factors such as discipline, gender and geographic origin (1,2). The occurrence of sudden death in athletes during competitions has led to the almost systematic completion of screening for cardiac pathologies before any competition among high-level athletes in European countries. However, the border between the physiological and the pathological remains narrow (2,3). Thus, several learned societies have described the criteria for interpreting the ECG in athletes in order to classify abnormalities as either physiological, not requiring extensive explorations, or pathological (4-6). Ventricular remodeling and vagal hypertonia induced by physical activity are the main mechanisms responsible for the electrical changes that characterize the athlete's heart.

The most frequent are sinus bradycardia, sinus arrhythmia, and some disorders of the atrioventricular conduction (2). Early repolarization is also frequently

encountered in high-performance athletes of irrespective of the race. However, it is more common in athletes of African or Afro-Caribbean origin (1). Apart from these physiological abnormalities, the pathological abnormalities are observed in a proportion of up to 15% of athletes and even more, depending on the population studied and the interpretation criteria (7-9). In Cameroon, pre-participation screening for cardiac abnormalities in athletes is not routinely done. Data on the athlete's heart are scanty in our setting. The aim of this study was to describe the electrical anomalies in athletes representing the University of Yaoundé I, who participated in the inter-University games in Cameroon.

Methods

Study design and setting

We conducted a cross-sectional study in the ECG laboratory of the Yaounde University Teaching Hospital, a tertiary health institution with a catchment population of about 2 million inhabitants. The University of Yaounde 1 is the biggest and oldest higher education institution in the country with over 80,000 students. Yaounde is the political capital of Cameroon, located in the gulf of Guinea in Sub-Sahara Africa. There are over 10 state Universities in Cameroon distributed in the four ecological zones: Savanah in the North, Forest in the South, Littoral in the South-West, and Grassland in the North-West.

Study participants

These were consenting University athletes of both sexes, aged ≥18 years, who participated in the 2018 inter-University games. Participants involved in all sport disciplines were included. The participants were consecutively seen over a one week period.

Measurements and variables

For each participant, we collected data on age (years), height (W in kg), and weight (H in meters), which we used to compute the body mass index (BMI) as W/H^2. A 12-lead resting ECG was performed on all participants using a General Electric (GE) Kiss device and the corresponding software (GE Cardiosoft V6.5). A heart rate below 60 beats per minute was considered to be bradycardia. Early repolarization was defined as a J point elevation of ≥0.1 mV on at least two consecutive precordial leads, and left ventricular hypertrophy (LVH) was assessed via the Sokolow-Lyon index (RV_5 + SV_1). LVH was present if this index was ≥35 mm. The QT interval corrected for heart rate (QTc) was considered long when it was >470 ms for men and >480 ms for women, and the abnormalities were classified as normal or physiological and pathological according to the Seattle criteria.

Sample size and data analyses

A convenient sample of all eligible participants was considered for this study. The statistical analysis was performed with the IBM SPSS Statistics V20 software. We have presented data as counts and percentages and according to sex for discrete variables, and as means ± standard deviation (SD) for continuous variables.

Ethical statement

This study was approved by the Institutional review board of the Faculty of Medicine and Biomedical Sciences (FMBS) of the University of Yaounde 1. Authorization was obtained from the hospital authorities. All participants gave their informed concern for this study. We carried out this study in accordance with the declarations of Helsinki. We report this work following the Strengthening the Reporting of Observational Study in Epidemiology (STROBE) checklist.

Results

Our population consisted of 145 athletes from 11 different sports disciplines (*Table 1*). The sex ratio was 1.7/1, the average age of the participants was 23±3 years, and the average BMI was of 24.26±4.00 (*Table 2*). *Table 3* presents the different abnormalities featuring on ECG. The physiological abnormalities were: early repolarization (56.6%), sinus bradycardia (33.1%), left ventricular electrical hypertrophy (20.0%), sinus arrhythmia (18.6%), first degree atrioventricular block (7.6%), incomplete right limb block (0.7%), and athlete with ST-segment dome appearance associated with T-wave inversion from V1 to V4. Among the pathological abnormalities found were left atrial hypertrophy (2.1%), T-wave inversion (1.4%), left axial deviation (1.4%), and right ventricular hypertrophy (0.7%). These non-exercise-related abnormalities accounted for 5.6% of the abnormalities observed on the ECG at rest. Other anomalies were present but not included in

Table 1 Distribution of athletes according to their disciplines

Discipline	Men, N (%)	Women, N (%)	Total, N (%)
Fans club	15 (16.5)	12 (22.2)	27 (18.6)
Basketball	12 (13.2)	9 (16.7)	21 (14.5)
Judo	13 (14.3)	5 (9.3)	18 (12.4)
Athletism	9 (9.9)	5 (9.3)	14 (9.7)
Football	14 (15.4)	0 (0.0)	14 (9.7)
Handball	13 (14.3)	0 (0.0)	13 (9.0)
Volleyball	0 (0.0)	12 (22.2)	12 (8.3)
Handisport	6 (6.6)	4 (7.4)	10 (6.9)
Lawn tennis	3 (3.3)	3 (5.6)	6 (4.1)
Table tennis	3 (3.3)	2 (3.7)	5 (3.4)
Wrestling	3 (3.3)	2 (3.7)	5 (3.4)
Total	91 (100)	54 (100)	145 (100)

Table 2 Basic features of the study population

Variables	Men, mean ± SD	Women, mean ± SD	Total, mean ± SD
Age (years)	23±3	22±3	23±3
Weight (kg)	77±16	66±12	73±15
Height (m)	1.78±0.11	1.67±0.09	1.74±0.12
BMI (kg/m^2)	24.26±4.00	23.72±4.13	24.06±4.04
HR (bpm)	63±12	72±13	67±13

SD, standard deviation; BMI, body mass index; HR, heart rate; bpm, beats per minute.

the Seattle criteria. These were nonspecific repolarization disorders (6.9%), sporadic premature ventricular contraction (1.4%), premature atrial contraction (0.7%), and right atrial hypertrophy (0.7%). Using the criteria of the European Society of Cardiology, we found 7.7% pathological abnormalities in the ECG.

Table 3 Interpretation of the ECG

Variable	Men, N (%)	Women, N (%)	Total, N (%)
Rhythm			
Normal sinus	76 (83.5)	42 (77.8)	118 (81.4)
Abnormal sinus	15 (16.5)	12 (22.2)	27 (18.6)
Heart axis			
Left axial deviation	2 (2.2)	0 (0.0)	2 (1.4)
Right axial deviation	1 (1.1)	0 (0.0)	1 (0.7)
Sinus bradycardia	41 (45.1)	7 (13.0)	48 (33.1)
Troubles of excitation			
Atrial extrasystole	0 (0.0)	1 (1.9)	1 (0.7)
Ventricular extrasystole	0 (0.0)	2 (3.7)	2 (1.4)
Troubles of conduction			
First degree AV block	6 (6.6)	5 (9.3)	11 (7.6)
Right bundle branch block	1 (1.1)	0 (0.0)	1 (0.7)
Left bundle branche block	0 (0.0)	2 (3.7)	2 (1.4)
Anterior hemi-fascicular block	2 (2.2)	0 (0.0)	2 (1.4)
Hypertrophies			
Left ventricular hypertrophy	29 (31.9)	0 (0.0)	29 (20.0)
Right ventricular hypertrophy	1 (1.1)	0 (0.0)	1 (0.7)
Left atrial enlargement	3 (3.3)	0 (0.0)	3 (2.1)
Right atrial enlargement	1 (1.1)	0 (0.0)	1 (0.7)
Troubles of repolarisation			
Early repolarisation	74 (81.3)	8 (14.8)	82 (56.6)
T wave inversion	1 (1.1)	1 (1.9)	2 (1.4)
Dome shape ST segment and of the T wave inversion V1-V4	1 (1.1)	0 (0.0)	1 (0.7)
Non-specific	5 (5.5)	5 (9.3)	10 (6.9)
Long/short QTc	0 (0.0)	0 (0.0)	0 (0.0)

ECG, electrocardiogram.

Discussion

The purpose of this study was to describe physiological and pathological abnormalities in the ECG of a group of university athletes. We used the Seattle criteria, which are not only the most used for pre-participation screening, but also show high sensitivity and specificity, especially in athletes of Afro-Caribbean origin, compared to the criteria of the European Society of Cardiology of 2010 (6,10). In 2014, Sheikh *et al.* proposed "refined criteria" for the interpretation of ECG in high-performance athletes after a study of 5,505 elite athletes. These criteria would be more specific for cardiac pathologies than the two previous ones while maintaining the same sensitivity (8). However, they have not been recommended at this time, hence our choice to use the Seattle criteria for interpreting

our athletes' ECGs. More than half of the athletes had early repolarization, which corresponds to the frequency described in the literature. This frequency is far superior to the 30% reported by Konopka *et al.* in Poland (11). This is explained by the Afro-Caribbean origin of the athletes in our study. Indeed, early repolarization would be more common in this population. Another aspect of the ECG peculiar to this ethnic origin is the domed appearance of the ST segment followed by a negative T wave in V1 to V4 found in an athlete (6). Similar to that reported by Konopka *et al.*, early repolarization was essentially found in male athletes. Sinus bradycardia was another physiological anomaly influenced by gender in almost half of male athletes, compared to only 13% of the opposite gender. Electrical signs of left ventricular remodeling such as left ventricular hypertrophy and pathological abnormalities were mainly found in male athletes which is consistent with observations in the literature on this topic (2,4). In this study, only 5.6% of athletes had pathological abnormalities on the ECG, which is far from the 18.4% found by Sheikh *et al.* in 2014 and the 11.6% found by Riding *et al.* in 2015. This difference is due to the fact that Sheikh *et al.* and Riding *et al.* conducted their studies in elite athletes training at least 6 hours per week (8,9). On the other hand, our sample consisted mainly of amateur athletes not participating in many competitions and therefore the training time would probably be less.

Limitations

We did not evaluate the weekly training time of the different groups of athletes, which would have shed more light on the association of training time and ECG changes. We used only Sokolow-Lyon index to assess for LVH. The conjoint use of other indices of LVH could improve on our detection rate. We carried-out this work in a group of athletes in only one University, thus our findings cannot be extrapolated to other Universities that are located in different ecological zones in the country.

Conclusions

The electrocardiographic abnormalities observed in the University of Yaounde 1 athletes are similar to those described in the literature. A small proportion had pathological abnormalities on the ECG. Cardiac morphological explorations are needed in this group to determine the exact proportion of athletes with heart disease.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/jxym.2019.06.02). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional review board of the Faculty of Medicine and Biomedical Sciences (FMBS) of the University of Yaounde 1 and written informed consent was obtained from all patients.

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