

Electrocardiography of a Top Athlete in Bobo-Dioulasso, Burkina Faso

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Abstract

Elite sport results in electrocardiogram changes. Some are minor, others are likely to cause sudden death. The authors intended to describe the electrocardiogram features of top athletes at rest in Bobo-Dioulasso. This descriptive transversal study was carried out from August 2015 to February 2016 in the cardiology department of CHU Sanou Souro in Bobo-Dioulasso. The study sampled top athletes aged 17 to 35 with at least eight hours' training per week for more than six months regardless of the type of discipline. Two hundred top-level athletes from 4 sport disciplines were included. The median age of athletes was 24 years (IIQ: 21 - 27). The median duration in high level sport was 6 years (IIQ: 4 - 8) and the median length of weekly training sessions was 10 hours (IIQ: 10 - 10). Only 4% of the athletes had already conducted an Electrocardiogram (ECG). ECG abnormalities were reported in 90.5% of cases and sinus bradycardia was the most common abnormality reported in 72.5% of cases. Left ventricular and left atrial hypertrophy were reported in 44% and 34.5% of cases respectively. Early repolarization syndrome was registered in 47% of cases. Practicing top-level sport activity can result in electrical changes with athletes. These changes need to be identified by practitioners so that they can differentiate them from heart diseases.

Keywords

Heart, High Level Sport, Electrocardiogram Characteristics, Burkina Faso

1. Introduction

Although known as such for a long time [1], the heart of the athlete is a topical

subject in sports and general medicine, as illustrated by the recent recommendations from the European and American scholars. It has benefited from recent experiments and in particular, from non-invasive methods such as electrocardiogram (ECG) and Doppler Echocardiography [2].

The characteristics of the heart of the athlete must be known by practitioners. These characteristics can sometimes present differential diagnostic problems with high-risk cardiac conditions, including hypertrophic cardiomyopathy (HCM), which is considered as the factor that causes the most sudden cardiac death among athletes under 35 years of age [3]. The occurrence of sudden death during sport reveals a heart condition that is ignored or that has been ignored, that highlights the importance of the medical checkup for no contraindication (VNCI) to the practice of sport whether for leisure or competition.

Several studies have been carried out worldwide on the particularities of the heart of top level athlete [1] [2] [3]. But there are very few findings of particularities with black African athletes.

To the best of our knowledge, an article on electrocardiogram abnormalities of the heart of a top athlete is yet to be published in Burkina Faso. The lack of findings on this topic in Burkina Faso should then be addressed. It is against this background that we have decided to conduct this descriptive transversal study in the city of Bobo-Dioulasso in order to study electrocardiogram abnormalities in top athletes when at rest.

2. Patients and Methods

Type and period of the study

This descriptive transversal study was carried out from August 2015 to February 2016 in the cardiology department of CHU Sanou Souro in Bobo-Dioulasso. Bobo-Dioulasso has many national champions in the different sport disciplines with some African medalists.

Study population and selection criteria

The sampling included top athletes with at least eight hours' training per week for more than six months, regardless of the type of sport, aged 17 to 35 years and has provided a signed informed consent form. The selection criteria were to practice sport in a standard setting (clubs) and to agree to take part in the study. Excluded from the study were athletes with heart disease; those who had been on sick leave for more than 3 months due to illness or those with a disability.

Methods and techniques of data collection

Athletes were identified through club leaders and coaches. Information on the athlete's seniority in the club, presence, attendance at training sessions and sick leave were collected from the leaders and coaches. To participate in the study, these athletes were received at the CHUSS cardiology department in a special room for information and informed consent purposes.

After signing the consent agreement, each respondent was served with a complete clinical examination and interrogation, including a cardiovascular, and a

surface and resting electrocardiogram (12-lead) using a HELLIGE EK53 device.

At the interview, the data collected included: Socio-demographic characteristics (age, sex, profession, level of education), data on sport activity (discipline, seniority, hourly volume of training per week, number of participation in national and international competitions). Cardiovascular risk factors: Personal or family high blood pressure (hypertension), overweight, obesity, active or passive smoking, diabetes, dyslipidemia; tea/coffee, alcohol, narcotics and/or anabolic drugs consumption; cardiovascular heredity (hypertension, coronary artery disease/accident or heart disease and history of sudden family death before age 50). Functional signs related to the effort (syncope or lipothymia, chest discomfort or pain, palpitations or irregular heartbeat, breathlessness and/or unusual fatigue).

Data collected during the clinical examination included: Anthropometric and clinical constants (weight, height, BMI, body surface area, heartbeat, blood pressure pulse after 15 minutes of rest); physical signs (heartbeat, heart rhythm, femoral pulse, varicose veins; dental caries).

With ECG, the following variables were registered: Heartbeat during rest, heart rhythm, duration and amplitude of the P wave, duration of the PR, duration of the QRS complex, QRS axis, Sokolov-Lyon index, QT and repolarization corrected.

Results of the electrocardiograms performed were approved by two cardiologists.

Sampling size

The sampling took into account the different groups or sports disciplines practiced in Bobo. Out of the 1811 licensed junior and senior athletes from 101 sports clubs in 18 sport disciplines, 394 met the criteria of a top athlete. These disciplines included: Football (92.5%); Athletics (2.5%); Cycling (2.5%); Judo (2.5%).

We used OPENEPI [4] to calculate the minimum sampling size. The expected prevalence of the heart of the athlete for the sampling was set at 50%; the desired accuracy at 5% and $z_{1 - \alpha/2} = 1.96$. Based on a field survey, the sampling was estimated at 394 athletes according to statistics from the Regional Directorate of Sports/Hauts Basins, leagues and sports districts. This resulted in a minimum calculated sampling size of 195 athletes.

Data analysis

All information reported on an individual sheet were registered and analyzed using Epi Data version 3.1 and Stata version 12.0 software. The analysis consisted of producing descriptive statistics (median or proportion) of the sampling.

Ethical considerations

Participation in our survey was based on an informed consensual agreement. Refusal to participate in the survey had no consequence. Confidentiality was upheld and data processing was anonymous. Participation in the survey was free for the people involved.

3. Results

A total of 200 top athletes took part in our study.

The median age was 24 years (IIQ: 21-27). Most of the sampling population were men (98.5%) and 18% were pupils or students (**Table 1**).

Data on sport activities

The distribution by sport discipline included 185 (92.5%) for football, 5 (2.5%) for judo, 5 (2.5%) for athletics, and 5 (2.5%) for cycling. The median seniority for high level sports performance was 6 years (IIQ: 4 - 8). The median duration for weekly training sessions was 10 hours (IIQ: 10 - 10). The median number of participants in national competitions was 13 (IIQ: 4 - 18).

Clinical characteristics

Results showed that 4.7% of athletes had already experienced discomfort, while 2% complained of chest pain. 40.5% had a family history of hypertension and 1.5 had abnormal blood pressure figures. No history of sudden family death was reported in our case study. Only 8 (4%) of athletes had already conducted an ECG in their career as top athletes. Consumption of tobacco, alcohol, tea/coffee and drugs were reported in 3.5%, 28%, 99% and 28.5% of athletes respectively. Bradycardia was shown in 72% of athletes (**Table 2**).

Electrocardiogram abnormalities

ECG performed during the exercise showed abnormalities in 90.5% of cases. The average heartbeat was 54.52 ± 8.36 (37 and 83). Sinus bradycardia was the most frequent abnormality reported in 72.5% of cases. Eleven cases (5.5%) of respiratory sinus arrhythmia and one case (0.05%) of ventricular extrasystole were reported.

Seven athletes (3.5%) presented left axis. No cases of right axis were reported. The median PR was 180ms (IIQ: 160 - 200). One case (0.05%) of short PR with associated delta wave subject of ventricular preexcitation has been reported. The 2nd degree Mobitz 1 type Luciani Wencheback of the ventricular atrial block (BAV) was present in three (1.5%) athletes.

Table 1. Sociodemographic characteristics of 200 top athletes, Bobo-Dioulasso, 2016.

Characteristics	N = 200
Age, median (IIQ)	24 (21 - 27)
• Age [20 - 29] (%)	80
Male (%)	98.5
Profession(%)	48.5
• Pupils and Students (%)	18
BMI, median (IIQ)	22.5 (21.2 - 23.7)
Overweight (%)	8.5
Education (%)	
None	4.5
Primary	16
Secondary	77
Graduate	2.5

Table 2. Clinical characteristics of 200 top athletes, Bobo-Dioulasso, 2016.

Characteristics	N = 200
History of training symptoms %	10.5
• Discomfort %	4.7
• Chest pains %	2
• Dyspnea %	3.8
Active smoking %	3.5
Sudden death history %	0
Family HBP history %	40.5
Family Diabetes history%	6.5
Occasional alcohol consumption%	7.3
Tee and/or coffee consumption %	99
Illicit drug consumption %	0
Drugs consumption %	28.5
• CaC1000 (ascorbic acid) %	27
• Gurosan (ascorbic acid + glucuronamide + caffeine) %	1.5
Energy drink %	3
• Red Bull	1.5
• XXL	1.5
Pulse rate, median (IIQ)	54.5 (IIQ: 50 - 60)
Bradycardia (FC < 60/minute) %	72
PAS, average	116.29 ± 8.28 [91.5 - 145]
PAD, average	71.86 ± 7.73 [56 - 93.5]
Grade 1% Hypertension	1.5

Red Bull (saccharose, glucose, ascorbic acid, taurine, caffeine, niacine, vitamins B5, B6, B12). XXL (saccharose, glucuronolactone, vitamin mix, choline, inositol, caffeine, taurine, gingeng...).

69 athletes (34.5%) showed left atrial hypertrophy, and 11 athletes (5.5%) showed right atrial hypertrophy. 88 cases (44%) of left ventricular hypertrophy (LVH) with a median Sokolov-Lyon index at 40 mm (IIQ: 37 - 44) and six cases (3%) of right ventricular hypertrophy were reported. Forty-six cases (23%) of incomplete right branch block and seven (3.5%) cases of left ante hemiblock were reported. No cases of complete or incomplete left branch block, and post hemiblock were reported. 94 cases (47%) showed early repolarization syndrome, most often in the anteroseptal and apical territory. The median QTc value was 387 ms (IIQ: 368 - 409). 4 cases (2%) of QTc extension were reported (**Table 3**).

4. Discussion

It is worth mentioning that one of the important challenges we faced during the exercise was the difficulty in attributing the abnormalities observed to the mere fact of sport in both the absence of a baseline ECG at the beginning of sport and of the control/comparison group. However, similarities of the data with other studies helped us to reasonably discuss the impact of sport even though the level

Table 3. Electrocardiogram abnormalities of 200 top athletes, Bobo-Dioulasso, 2016.

Electrocardiogram abnormalities	N (%)
Left atrial hypertrophy	69 (34.5)
Right atrial hypertrophie	11 (5.5)
Left axis	7 (3.5)
Tall T-Wave	11 (12.09)
Q-Wave abnormality	0
Right branch block	46 (23)
Left branch block	0
R/S > 1	0
Under ST, T < 0	14 (15.28)
QTc > 0.44	4 (2)
Ventricular extrasystoles	1 (0.5)
Supraventricular tachycardia, Flutter, Atrial fibrillation	0
Ventricular preexcitation	1 (0.5)
Atrioventricular block 1	35 (17.5)
Atrioventricular block 2	3 (1.5)
Atrioventricular block 3	0
Sinus bradycardia < 40 bpm	2 (1)

of responsibility cannot be specified.

ECG at rest is the first examination of the athlete's paraclinical status. In our case study, only 4% of athletes had already carried out this routine examination in their careers. Meanwhile, it is proven that this simple examination helps to detect at least 60% of athlete's cardiovascular diseases [5] [6] [7].

This situation testifies to the absence of no contraindication of sport exercise even at the highest level here in Burkina Faso. This could be seen as a challenge for executives in charge of sport management at all levels in Burkina Faso. A regulatory framework ought to be put in place to address this loophole and prevent sport-related heart conditions.

The heart of a top athlete may be strictly normal electrically, which should not affect his level of training [8]. In our series, 55.5% of athletes had a strictly normal ECG or with minor abnormalities. In Italy, Pellicia *et al.* [9] reported a similar proportion to that of our case study (60%) when they carried out a study on 1005 athletes in 38 different sport disciplines with an average age similar to ours.

In our series, sinus bradycardia was the most frequent of the changes commonly associated with the heart of an athlete (72.5%). This proportion is quite equal to that of Kervio *et al.* [5] with Japanese footballers, which was 69.1% and close to those reported by Balady *et al.* [10] and Wilson *et al.* [7], which were 77% and 80% respectively. Bradycardia is the result of a physiological adaptation of the autonomic nervous system in relation to vagal hypertonia. It is common

in athletes and depends on the type of sport and the level of training/competition [6] [10] [11]. BAVs are commonly described in trained athletes. In our series, the 1st degree BAV was registered with 17.5% of cases, higher than the 9.7% presented in Ba [12] series. Our results are close to those reported by Wilson [7] and Crouse [13] which were 13% and 14.8% respectively. Three (1.5%) footballers showed BAV 2 type Mobitz 1. This result is similar to those registered by Lahady [14] and Ba [12] who reported two cases in each of their respective series. Slow atrioventricular conduction and atrioventricular blocks are related to an increase in parasympathetic tone associated or not with a decrease in sympathetic tone [15].

The prevalence of HVG in our series stood at 44%, higher than 25.80%, 26.8% and 36.3% reported by Siransy [16], Wilson [7] and Ondze [17] respectively, but lower than those of Ba [12] and Di Paolo [18] series which were 85.44% and 89%. These differences obviously resulted in the criteria used to define electrical HVG in athletes. The Sokolow-Lyon criteria, which are the most commonly used, do tend to increase the frequency of electrical HVGs in athletes, unlike other criteria often used by some practitioners.

The early repolarization syndrome stood at 47% among our athletes, similar to the 49.51% reported by Ba [12] among Senegalese footballers. Sharma [19] registered a frequency close to ours and it was about 43%. This early repolarization was more frequent with 12-lead V3, V4 and V5. Ba [12] made the same observation. It is usually noted that early repolarization is more common with athletes [18] [20] and linked to hypervagotonia. Although frequent, the early repolarization remains a minor disorder that should not be ignored as some practitioners have attributed a higher risk of ventricular fibrillation to it [21].

In order to reduce the risk of heart diseases in top athletes, there should be mandatory initial and annual clinical assessments which include ECG and detection of drug consumption. The capacities of local sport physicians should then be strengthened for this purpose.

5. Conclusion

Electrocardiogram abnormalities in top athletes are caused by sinus bradycardia, left ventricular hypertrophy and early repolarization syndrome in our case study. The electrocardiogram, a simple acquisition test, despite its high positive predictive value of cardiovascular conditions, is not yet common with top athletes in Burkina Faso. Efforts should be made to systematically introduce no contraindication checkup with an electrocardiogram test for top athletes. This will help detect sudden death risk heart diseases of athletes as recommended by the scholars.

Authors' Contribution

Each author of the article contributed, agreed and approved the final version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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