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Original Article

# The prevalence of abnormal ECG in trained sportsmen

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ARTICLE INFO

*Article history:*
Received 28 October 2014
Accepted 8 June 2015
Available online 31 August 2015

*Keywords:*
Electrocardiography
Endurance training
Strength training
Sports cardiology
Competitive sports training

ABSTRACT

*Background:* Competitive sports training causes structural and conductive system changes manifesting by various electrocardiographic alterations. We undertook this study to assess the prevalence of abnormal ECG in trained Indian athletes and correlate it with the nature of sports training, that is endurance or strength training.

*Methods:* We evaluated a standard resting, lying 12 lead Electrocardiogram (ECG) in 66 actively training Indian athletes. Standard diagnostic criteria were used to define various morphological ECG abnormalities.

*Results:* 33/66 (50%) of the athletes were undertaking endurance training while the other 33 (50%) were involved in a strength-training regimen. Overall 54/66 (81%) sportsmen had significant ECG changes. 68% of these changes were considered as normal training related features, while the remaining 32% were considered abnormal. There were seven common training related ECG changes–Sinus Bradycardia (21%), Sinus Arrhythmia (16%), 1st degree Atrioventricular Heart Block (6%), Type 1 2nd-degree Atrioventicular Heart Block (3%), Incomplete Right bundle branch block (RBBB) (24%), Early Repolarization (42%), Left Ventricular Hypertrophy (LVH) (14%); while three abnormal ECG changes–T-wave inversion (13%), RBBB(4%), Right ventricular hypertrophy (RVH) with strain (29%) were noted. Early repolarization (commonest change), sinus bradycardia, and incomplete RBBB were the commoner features noticed, with a significantly higher presence in the endurance trained athletes.

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http://dx.doi.org/10.1016/j.mjafi.2015.06.010

*Conclusion:* A high proportion of athletes undergoing competitive level sports training are likely to have abnormal ECG recordings. Majority of these are benign, and related to the physiological adaptation to the extreme levels of exertion. These changes are commoner during endurance training (running) than strength training (weightlifting).



## Introduction

Professional and competitive sports training can lead to reversible physiological changes in the heart. These changes can manifest by various electrocardiographic alterations mimicking changes seen in patients with structural heart disease. We undertook this study to assess the prevalence of abnormal Electrocardiogram (ECG) in trained athletes and correlate it with the nature of sports training.

## Material and methods

Between July 2012 and August 2012 all the athletes training for competitive sports in one of the premier training institutes of Indian Armed Forces were recruited for the study. Athletes had been screened by detailed history, clinical examination and investigation for any organic disease prior to joining the institute hence a mere willingness to participate in the study was used as the inclusion criteria. All the participants were divided into 2 groups depending on the type of the exercise training; Group 1 was constituted by athletes undergoing endurance training (long distance runners) while Group 2 was constituted by athletes undergoing strength training (weightlifters). The institutional ethics committee of the hospital approved the study protocol. Informed consent was obtained from all participants prior to the study.

A standard 12 lead ECG recorded using a digital electrocardiograph (Model Eli 250, Mortara Instrument Inc, Milwaukee, WI or Model MAC5000, GE Medical Systems, Freiburg, Germany) in the supine position after 3 min of rest during quiet respiration at paper speed of 25 mm/sec. Each ECG was interpreted for rate, rhythm, conduction abnormality, hypertrophy/enlargement, axis, and or ischemia/infarction. Particular attention was paid to heart rate (beats/minute), PR interval (milliseconds), QRS duration (milliseconds), QT interval corrected for the heart rate (milliseconds), P-wave morphologic abnormality (P-wave duration, amplitude, and terminal negative deflection in the right precordial leads), presence of Q-waves, R amplitude in precordial leads (V1 and V5) (mm), and T-wave inversion. Standard diagnostic criteria were used to define various ECG abnormalities.[1–3]

Data was recorded in a predesigned performa and managed on an excel spreadsheet. The ECG changes were divided into 2 groups. All the values were checked for any possible keyboard error. Distribution of continuous variables was assessed for approximate normal distribution. Continuous variables are presented as mean ± SD. Categorical variables are presented as frequencies and percentages. Categorical variables were compared using chi-square tests and continuous variables using independent two-sample t-test. All the analysis was done using SPSS software. In this study all the statistical tests were two-tailed and p-value of $<0.05$ was considered statistically significant.

## Results

A total of 66 athletes were enrolled in the study of which 33 athletes were in Group 1 (endurance training) and 33 were in Group 2 (strength training).

The baseline parameters are in Table 1A and the comparison of these baseline parameters between Group 1 and Group 2 are in Table 1B. There was a wide variation in the weight (range 35 Kg to 128 Kg; SD 13.99). The mean height ($p = 0.0$), was significantly higher, and the body mass index (BMI) lower in Group 1 (runners) than that of the Group 2 (weightlifters).

The baseline ECG parameters for all athletes and the comparison of these parameters between Group 1 and Group 2 are in Tables 2A and 2B respectively. Overall 54/66 (81%) athletes had noticeable alterations in the ECG. The overall heart rate varied widely from 32 beats/min to 98 beats/min (SD 13.91), and so did the PR interval (range 110–240 ms, SD 27.4). The QRS Axis (range $-19^\circ$ to $102^\circ$; SD 9.19), QRS duration (range 78–120 ms; SD 9.19) and the QTc interval (330 ms–446 ms; SD 21.9) were also noted in the individual athletes.

The PR-interval ($p = 0.0$), QRS duration ($p = 0.0$) and LVH ($p = 0.007$) was significantly higher I Group 1 (runners) than that of the Group 2 (weightlifters). None of the athletes had prolonged QTc. The mean heart rate of the runners was significantly lower ($p = 0.0$) than that of the weightlifters.

The normal and abnormal ECG changes noted in the athletes are tabulated in Table 3 (statistical analysis by difference of proportion using chi-square test). There were seven common training related ECG changes (Table 3). These were Sinus Bradycardia, Sinus Arrhythmia, 1st degree Atrioventricular Heart Block, Type 1, 2nd-degree Atrioventicular Heart Block, Incomplete RBBB, Early Repolarization and Left Ventricular Hypertrophy.

The 'Abnormal' ECG findings are either unrelated to the regular training or exaggerated by it. There were three such changes observed, i.e. T-wave inversion, RBBB, and RVH with strain.

The common training related changes (normal physiological variations) were seen in 33/66 (50%) athletes while 21/66 (32%) number of athletes had significant ECG changes