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RESEARCH ARTICLE

ELECTROCARDIOGRAPHIC ANALYSIS OF EARLY REPOLARIZATION AS ABENIGN VARIANT INATHLETES

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ABSTRACT

Aim: To analyse the prevalence and pattern of early repolarization in athletes and non-athletes.
Study design: Retrospective study
Sample size:
- Total sample of60
- Athletes30
- Non-athletes30

Inclusion criteria for Study group: 30 subjects who are involved in sports should haveundergone atleast2-3hoursofpracticeperdayfor5daysinaweekforminimum of 2years
Inclusion criteria for Control group: The control consists of 30 healthy volunteers matched forage and BMI. All of them had a relatively sedentary lifestyle.
Exclusion criteria (Study and Control group):
- H/Ohypertension,
- H/Ocoronaryartery disease
- H/Opulmonary disease
- H/O smoking, alcohol
- H/O drug (like antihistamine that causes prolongation of QT interval)
- Past history of cardiac surgery and family history of cardiovascular disease.

Materials and methodology: For both athletes and non-athletes ECG was taken in lying position, ECG paper having 1mm and 5mm squares is used. The tracing is usually made at a standard recording speed of 25mm/sec. The physical examination including height, weight, blood pressure and pulse rate were examined for all the participants and the ST segment morphology and amplitude of deviation from the isoelectric line was analysed.
Results: Athletes showed more prevalence of ST segment elevation with concave upwards type of morphology in leads V_3-V_6 than non-athletes.
Conclusion: Early repolarization which is a benign variant is more prevalent in athletes.

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INTRODUCTION

Athletes (greek-PRIZE FIGHTER) are considered as the special group of individual with a unique life style and often capable of extraordinary physical achievement. The extent of cardiac adaptation in athletes depends upon age, body surface area, sex and type of exercise. Some of the hemodynamic changes include increase in stroke volume, cardiac output, and reduction in heart rate and peripheral resistance. Frequently dynamic exercise produces volume overload and static exercise produces pressure overload resulting in eccentric and concentric hypertrophy of the ventricle respectively.

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After the invention of electrocardiogram by Augustus Waller these changes in the athlete's heart can be easily recorded and analyzed. Among the ECG changes prevalence of bradycardia and early repolarization pattern is found to be more common in athletes than non- athletes. The ER pattern is defined by ST-segment elevation, mostly accompanied by slurring or notching on the terminal QRS, called a J- wave Begano Benito *et al*. (2010). Early repolarization showing ST segment elevation ≤ 2mm and that occurs in lateral leads are benign. As recently as 19 years ago, an analysis of over 2,000 patients followed for 12 years, of whom 670 had ER, confirmed a benign outcome and a reduced arrhythmia burden. Prevalence of ER ranges from 1%-5% in normal healthy adults and is thought to be more common in young persons, males and athletes Arthur L Klatsky *et al*. (2003).

The aim of this study is to compare the prevalence and pattern of early repolarization between athletes and non-athletes by recording ECG in athletes to examine the morphology and pattern of ST segment in all the chest leads ie fromV1-V6.

MATERIALS AND METHODS

The study population involved sixty persons of age 17-35years, males with the mean BMI 22kg/m2 (avge18-25) of this 30 were sports person and 30 were healthy individual with sedentary life style.

Exclusion Criteria (study and control)

This includes history of hypertension, coronary artery disease, pulmonary disease, smoking, alcohol, drug (like antihistamine that causes prolongation of QT interval), past history of cardiac surgery and family history of cardiovascular disease.

Inclusion criteria for study groups

The 30 subjects who are involved in sports should have undergone at least 2-3 hours of practice per day for 5 days in a week for minimum of 2 years.

Inclusion criteria for control groups

The control consists of 30 healthy volunteers matched for age and BMI. All of them had a relatively sedentary life style. The procedure of the test was explained to both the subjects and controls. Consent was obtained from the study population. This study has obtained institutional ethical clearance.

Physical examination

It includes the measurement of height weight, BMI, blood pressure, resting heart rate and precordial examination.

Pre-test instruction

Electrocardiographic recording was performed 12 hours after rest. The recordings are taken 2 hours after a meal. All mobile phones switched off. Recording should be done in a quiet room under controlled temperature. The recording was carried out in the standard way based on the AMERICAN HEART ASSOCIATION specification-subject supine (lying uniformly flat) arms by the side.

Prepare skin and electrode sites by cleaning with alcohol swabs/soap& water if necessary The electrode are firmly fixed to the skin after applying ECGgel over the skin Apply the 10 leads from the machine to the electrodes Limb leads: ECG Electrodes are placed over bony points in order to produce a noise free signal

The lead (RA) is connected to the right arm near wrist
The lead (LA) is connected to the left arm near wrist
The lead (LL) is connected to the left leg near ankle
The lead (RL) is connected to the right leg near ankle
Chest leads:

V1 - Right side of the sternum near 4th intercostal space.
V2 –Left side of the sternum near 4th intercostal space.
V3 – Halfway between V2 and V4
V4 – Midclavicular line at left 5th intercostal space.
V5 – Anterior axillary line at left 5th intercostal space
V6 –Mid axillary line at left 5th intercostal space
Ensure leads are not pulling on electrodes & are not lying overreach other.

ECG analysis

From the ECG the ST segment morphology and amplitude of deviation from the isoelectric line was analysed in the precordial leads.ST segment is said to be elevated if the amplitude in the positive direction is greater than 1mm Van ganse *et al*. (1970)

RESULTS AND OBSERVATIONS

Comparison of ER between the athletes and the non-athletes was done by using student t test.

Thus from the above the results it is clear that

V1&V2-shows no change in ST segment in both the athlete and non- athlete.

In V3 P value is <0.001 and hence it is significant with athlete showing more ST segment elevation when compare to the controls

In V4 P value is <0.001 and thus there is a significant difference between the two groups with athletes, showing more ST segment elevation when compared to the controls.

Table 1. Comparison of the ST segment elevation between athlete and non- athlete in the precordial leads namely V1,V2,V3,V4,V5, and V6

		Study	Control	Study	Control	PValue
		Mean	Mean	Std. Deviation	Std. Deviation	
ST Segment elevation in millivolts	V1	0.00	0.00	0	0	
	V2	0.00	0.00	0.00	0	
	V3	0.95	0.00	0.855	0.018	<0.001
	V4	1.22	0.02	1.014	0.0461	<0.001
	V5	1.50	0.04	1.05	0.0765	<0.001
	V6	1.42	0.01	0.966	0.0403	<0.001

P<0.05 is significant

In V5 P value is <0.001, showing a significant difference between the two groups with athlete showing more ST segment elevation when compare to the controls

LeadV6 also shows P value<0.001, indicating a significant difference between the two groups with athlete showing more ST segment elevation when compare to the controls.
From the above data we infer that:

The ER is more prevalent in the athletes compared to the non-athletes.

The ST segment elevation shows concave upwards morphology in all the leads both in athletes and non-athletes.

The ST segment elevation occurs in mid-lateral precordial leads in both athletes and non-athletes

The prevalence of ER in the athletes is -86%

The prevalence of ER in the non-athletes is –13%

DISCUSSION

This study compares the pattern of Earlyrepolarisation between athletes and non athletes. Early repolarisation is defined as ST segment elevation ≥1mm with or without accompanying J wave which is the slurring of the terminal QRS complex Benito *et al*.

For ER to occur some region of the heart should repolarise earlier than the other .This produces a difference in the current flow between the two regions. Normally in ECG, the ST segment is found to be in the isoelectric line as there is no current flow during this period. But in ER because of difference in the repolarisation between two layers of the heart there is current flow causing elevation of the ST segment. This difference in current flow is due to vagus which causes increase in potassium efflux both in early and later part of repolarisation.

William J Brady in his study concluded that ER is 1-2% in young healthy males and 50-80% in athletes, similarly our study also shows prevalence of ER at 86% in athletes.In1970, Van ganse reported that ER was more common in young males of African descent in whom he found that ER was more common in lateral leads and less in inferior leads.

The density of Ito in right ventricular epicardium is more when compared to the left ventricular epicardium Thin Hlaing *et al*. (2007). So during more pronounced vagal action, the potassium efflux through Ito is less in the left ventricle, hence the difference in current flows between the two layers is also minimum when compare to the right ventricle. This minimum current flow between two layers in the left ventricle produces concave upwards type of ST segment elevation, whereas the large current flow across the layer of right ventricle produces convex type of ST segment elevation Tara *et al*. This also explains that the ER involving the right ventricle are arrhythmogenic; but that of left ventricular areas are benign Thin Hlaing *et al*. (2007).

Our study shows the ST segment elevation, in all mid to lateral precordial leads (that records the electrical changes of the majority of left ventricle) with concave upwards type of morphology confirming the benign nature of ER. In Burguda's syndrome which involves the right ventricle there is convex type of ST segment elevation in right precordial leads Sinhora *et al*. (2006). A study conducted by Chan *et al*. (1999) toanalyse the ECG manifestation in BERS, also showed the ST segment elevation with concave upward type of morphology in all mid-lateral precordial leads

Although Early repolarisation is benign it may mimic varying condition like Burguda's syndrome, myocardial infarction Shinde *et al*. (2007) hypothetrmia and many channelopathies like KCNJ8, 25 CACNAB2B CACNA1C.

Thus in this study ER show ST segment elevation with concave upwards type of morphology, in leads V3 – V6. Understanding this pattern of ER helps in differentiating the early repolarization from other disorder showing ST segment elevation.

Conclusion

The study concludes that, early repolarisation more commonly occurring in athletes is benign, affecting mid-lateral precordial leads with concave upwards type of ST segment elevation.

Abbrevations used in this study

BERS -Benign Early Repolarization Syndrome
BMI -Body Mass Index
ECG - Electrocardiogram
ER -Early Repolarisation

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