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A RANDOMIZED STUDY OF CARDIAC RHYTHM PATTERNS IN YOUNG ADULTS EXPOSED TO ACADEMIC STRESS

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ABSTRACT

Electrocardiogram (ECG) is one of the frequently used screening tools to rule out possible cardiac anomalies in an otherwise healthy young adult proposed to be inducted into a job, training or an academic course requiring reasonably good semblance of body systems dependant on efficient cardiovascular functioning. Several factors are known to change action potential in cardiomyocytes reflecting the same in an ECG. Some of these factors like gender specificity, academic or physical stress are generally overlooked while interpreting ECG especially at the time of recruitment. Commonest changes observed are those pertaining to rate or rhythm parameters which may either be benign or may reveal a potentially dangerous cardiac anomaly which has remained silent so far. The aim of the present study was to assess changes in ECG parameters of young medical students as they undergo various phases of their academic year. Our study reveals that most changes are confined to rate and rhythm patterns and are consistent with expected physiological gender variations and magnitude of the stress level. None of the observed changes required intervention or further investigation as they were all within the homoeostatic limits having transient or insignificant impact on cardiac functioning.

Keywords: ECG, Arrhythmias, Young adults

INTRODUCTION

Cardiac screening is considered to be one of the important prerequisites for all young individuals aspiring to be recruited into sports and the professional courses. In case of athletes it was seen that systematic pre participation screening, with 12-lead electrocardiogram (ECG) history and physical examination, is effective in identifying athletes with potentially lethal cardiovascular disease and actually saves lives. (*Corrado D et al ,2006,1998*) However, concerns have been raised about the cost-effectiveness of screening because of the high level of false-positive results from the ECG (*Maron BJ et al,2007*). Variations in the cardiac rhythm generation by the SA nodal tissue are brought about by various physiological and pathological factors. In contrast to pathologic ECG patterns, normal variants can be described as constant ECG patterns that are neither linked to corresponding typical symptoms, nor to corresponding clinical and anamnestic findings, or those pertaining to drugs. As early as *1959,Goldman* demonstrated that misinterpretation of normal variants can lead to cardiac invalidism. Some of the subtle but definitely significant physiological factors like gender specificity, hormonal factors, environmental, work or academic stresses are often ignored while interpreting rhythm changes in apparently normal asymptomatic individuals. ECG screening forms an integral part of the induction or recruitment norms in various areas like professional courses, skilled jobs, pre participation events for sports, employment in armed forces etc or for simple procedures like prerequisites for health insurance. Often young adults between the age of 18-25 years are screened for above said purpose. A significant

majority of these young aspirants run the risk of being misinterpreted as per their cardiac status as reflected in their ECG, the most obvious variation being that found in their rhythm. There are well studied gender variations in ECG parameters in normal men and women. In general, females tend to have a faster baseline heart rate than males. There is also a shorter sinus node refractory time - this means that it takes a shorter time for the SA node to recover and become ready to fire an impulse again.(*Taneja et al , 2001).* The available literature documents that on an average, the QT interval is shorter in men than in women (*Stramba-Badiale M et al 1995*), beginning after puberty with a linear increase through the major part of adulthood to at least age 55. This period corresponds to the time period when androgen levels are highest in men. Therefore, androgen and estrogen levels may explain the gender differences in QT interval (*Rautaharju PM et al,1992*). QT intervals remain longer in women except during the luteal phase when the QT interval shortens. (*Nakagawa M et al , 2006*).

The heart rate is determined by the balance between the sympathetic output and parasympathetic output, the normal range being 60-100 beats /min. Any factor which will stimulate the sympathetic output (stress, fever or any pathological factor) will lead to increase in the heart rate and any factor which is going to influence the parasympathetic will cause decrease in the resting heart rate. So there are many factors which go into the development of the ECG patterns which may be physiological and have whatsoever no concern for any health status of the subject. In our present study we have analyzed the ECG patterns for normal medical students under various phases of stress and for females in various phases of the menstrual cycle. The heart rhythm is likely to be accelerated in case of stress like impending exams due to activation of the neurohumoral system.(*Babisch.W etal 2003*) The present study has therefore focused on the existing rhythm patterns and the possibility of gender specificity, hormonal, environmental or academic stress factors influencing changes as observed in a rhythm strip of ECG. The present study was done to observe prevailing pattern of overt ECG abnormalities in a cross section of medical students belonging to both sexes, actively studying in various stages of MBBS course, an academic course which is generally perceived as a stressful event during the professional studies. Gender, hormonal factors and imminent academic stress was specifically taken into consideration while observing the rhythm patterns in young adults.

Objectives

The aim of the present study was to observe the influence of gender specificity, hormonal factors and academic stress on cardiac rhythm patterns as assessed by ECG in normal apparently healthy medical students and to co-relate occurrence of dysrhythmias with symptoms if any in these subjects.

MATERIALS AND METHODS

The study was conducted at the Department of Physiology, Christian Medical College, Ludhiana, Punjab which has a cross section of undergraduate student population belonging to 18-25 years of age. The study included 100 apparently healthy volunteers (50 males and 50 females, age matched). None of the subjects had history of known cardiac illness, diabetes, hypertension, thyroid abnormality or were on current or recent medication. Subjects were advised to refrain from stimulants like coffee, tea, cola beverages at least 4 hours prior to recording of ECG each time. The research proposal was duly approved by Ethics and Research Committee of the institution. An informed consent was obtained from each subject prior to induction in the study. Limb Leads (I, II, III , aVR, aVL, aVF) and a rhythm strip(long Lead II or any other lead showing good morphology of wave forms) was recorded in each subject using BPL Cardiart 408 EKG machine. Electrodes were placed in the conventional lead positions using hypoallergic electroconductive jelly after preparing and cleaning the area of placement of electrodes.

The following ECG parameters were assessed

Atrial rate, ventricular rate, rhythm (sinus rhythm, tachycardia /bradycardia arrhythmia, sinus arrhythmia), location of pacemaker, PR interval, QRS duration, QT interval (QTc), premature atrial or ventricular contractions and conduction defects. The findings of the above parameters were compiled for males and females separately. A note

was made of the time of menstrual cycle phase at the time of recording ECG (in female subjects) and any known impending or prevailing academic stress like examinations/tests (for both sexes) at the time of recording of ECG.. The compiled results were analysed on the basis of percentage of observed changes in cardiac rhythm patterns in ECG recordings of the participating volunteers. Any deviation from the normal values for parameters under consideration were noted..

OBSERVATION AND RESULTS

The participants had an age range of 18-21 years with a mean age of 19.2 years, belonging to all professional classes of their MBBS course. Majority of the students (63%) belonged to the first professional class which is considered to be one of the most stressful years in the medical college. These 63 students (28 males and 35 females) had a sectional examination the following day and admitted to being under academic stress. Menstrual history of the 50 female participants revealed that 20 (40%) were in their follicular phase, 18 (36%) in the ovulatory phase and 12 (24%) were in their luteal phase. Electrocardiographic parameters were recorded in each subject and analysed as follows:

Heart rate (atrial and ventricular rate) :-On comparing the heart rate it was found to be more in females as compared to males (20% females rate > 90 beats /min as compared to 4% in males for the atrial contractions and 22% females had rate >90 beats /min for ventricular contraction as compared to 8% males) these results are in concurrence with the studies conducted by *Taneja et al* that the baseline heart rate is more in females as compared to males due to earlier firing of the SA node. The heart rate increase is also due to stress which causes increase in the sympathetic activity (stress of class test in 35 female first year MBBS students) *(Babisch et al,2003).*

Table I
Atrial rate in males and females

Atrial rate(beats / min)	Males (n==50)	Females (n=50)
60-69	56%	46%
70-79	24%	10%
80-89	6%	22%
> 90	4%	20%

Table II
Comparison of Ventricular rate in male and female students

Ventricular rate (beats/min)	Male (n=50)	Female (n=50)
60-69 beats /min	44%	38%
70-79 beats/min	34%	20%
80-89 beats /min	14%	20%
90-99 beats/min	2%	10%
more than 99 beats/min	6%	12%

Magnitude of P wave :- The magnitude of P wave(which is the strength of atrial depolarization) obtained was less than normal (0.5 mv) for both the groups (males and females). The cause can be change in the ionic concentration of the body fluid and also in cases of left ventricular hypertrophy, but these conditions are associated with other changes in the ECG as well, there are no other changes which are seen, so this can be an aberrant recording.

Table III
Comparison of the magnitude of P wave in male and female students

Magnitude of p wave in millivolts	Male (n=50)	Female (n=50)
0.1-0.19 mv	42%	48%
0.2-0.29 mv	46%	48%
0.3-0.39 mv	10%	2%
> 0.39 mv	2%	2%

Magnitude of R wave:- QRS complex represents the depolarization of the myocardial cells in the ventricles. R wave magnitude when compared was almost same for the male and female students with no significant change.

Table IV
Comparison of the magnitude of R wave in male and female students

Magnitude of r wave in milli volts	Male (n=50)	Female (n=50)
0.5- 0.9 mv	6%	4 %
1-1.4 mv	26%	28%
1.5- 1.9 mv	34%	38%
2-2.4 mv	16%	22%
> 2.5 mv	18%	8%

Duration of P-R interval:-. In our study there is increase in the P-R interval (normal 0.12 -0.20 millisec) for males as compared to females (12% males > 2 millisec whereas 10% females >have more than 2 millisec). The increased in the PR interval is a normal variant as stated *(Johnson et al 1960)* in a study on 67,000 healthy airmen where 0.52% found to have a prolonged PR and 80% of the PR prolongations ranged from 0.21 to 0.24. In a second study also *(Manning G 1962)* 59 of 19,000 (0.31%) airmen had a PR of 0.24 or more..There are physiological variations in the duration of P-R interval, it tends to increase with age In childhood: 0.10 - 0.20 msec, In adolescence: 0.12 - 0.16 msec , In adulthood: 0.14 - 0.21 msec.

Table V
Comparison of P-R interval in male and female students

PR interval (in millisec)	Male (n=50)	Female (n=50)
0.15-0.2 millisec	88%	90%
0.21-0.25 msec	8%	10%
0.26-0.30 msec	2%	0%
>0.30 msec	2%	0%

QT_c interval:- The corrected QT interval using Bazett's formula gives a better understanding of the heart rhythm conditions(normal value 0.4 – 0.4 msec). There is decrease in the duration of the QT interval in the luteal phase in females as stated in earlier studies. (*Nakagawa M et al , 2006*) in our study the interval was more than 0.4 millsec for 26 % females and 22% males. Out of 50 female subjects there were 20 in the follicular phase and 12 in the luteal phase.

Table VI
Comparison of QT c interval in male and female subjects

QT c interval	Male (n=50)	Female (n=50)
0.25- 0.3 msec	4%	6%
0.31-0.35 msec	28%	36%
0.36-0.40 msec	44%	32%
0.41-0.45 msec	18%	20%
0.46-0.50 msec	6%	6%

Premature Atrial/ Ventricular Contractions: No ectopic beats (PAC or PVC) were observed in any of the ECGs recorded in this study.

CONCLUSION

Our study concludes that in healthy young adults, the ECG changes which are seen as deviations from the normal, but well within homoestatic limits, are largely due to the gender difference or due to prevailing physiological stress.. Minor changes in the PR interval usually seen in the athletes bear no clinical relevance and this finding is consistent with those stated by Pellicia et all *(Pellicia et al, 2000)*.Our experience suggests that in a large and unselected population of young individuals undergoing cardiovascular screening, the prevalence of markedly abnormal ECG patterns which can be correlated with any structural cardiac disease is low, and this should not represent an obstacle for their further entrance into any career. The diagnosis of clinically significant cardiac disease should not be made on the ECG findings alone and should be supplemented with other specific tests. The present study also suggests that ECG screening tests for purely academic course admission is superfluous and therefore can be easily excluded from admission protocols and lists of pre-requisites,

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