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Electrocardiographic changes in young smokers: a cross-sectional study

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Abstract
This article assesses few electrocardiographic parameters in young adults (students) caused by smoking. The electrocardiogram of young smokers (with a history of at least six months of smoking) and young non-smokers were recorded using 12 leads, three channel ECG machine and the data thus obtained were analyzed statistically. It was found that there is extremely statistically significant difference in the timings of P-R interval and T-P interval when young smokers were compared with young non-smokers.

Keywords: Electrocardiograph, PR interval, TP interval, QRS complex.

Introduction

One of the sturdiest contributors to the menaces of cardiovascular diseases is cigarette smoking [1]. According to the World Health Organization (WHO) about 1.3 billion people globally are smokers, among them 4.9 million die yearly and almost 13,000 people die daily due to smoking [2]. Nicotine consumption is the solitary principal avoidable cause of death and disability.

Nicotine, found in cigarette is a powerful inhibitor of the cardiac A-Type potassium channels due to which there are changes in the electrophysiology of the heart which may even induce arrhythmias [3,4]. It is estimated that 20% of the overall deaths due to cardiovascular diseases is mainly attributable to smoking [5]. Cigarette smokers are likely to develop ischemic heart diseases at a younger age and additionally are most likely to die of sudden death as compared to nonsmokers [6]. Nicotine facilitates conduction block, re-entry and increases the vulnerability to ventricular fibrillation. Nicotine and other components of cigarette can produce profound changes in the heart, which can be assessed by an Electrocardiograph (ECG), being the cheapest and most reliable method for assessing cardiovascular abnormalities [7].

Hence, a comparative study of few important ECG parameters of young tobacco smokers with that of young non-smokers by taking a 12 lead ECG record was done to compare and see whether there is some significant changes brought about by smoking in young adults or not.

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Materials and Methods

Study Population

The present cross sectional study was conducted in Nobel Medical College with permission of local ethical committee. The subjects were male students between the age of 20-30 years. Study population includes 100 healthy male subjects divided into experimental group and control group (50 each). Experimental groups were chronic tobacco smokers with history of tobacco smoking for more than 6 months with no history of any major illness at present and in the past. Subjects below 20 years of age, smokers less than 6 months duration, smokers associated with systemic illness like diabetes mellitus, hypertension, bronchial asthma, quitters, ex-smokers and tobacco chewers, female population & subjects with other forms of smoking except cigarette were excluded from the study. Subjects were informed about the study and informed consent was taken from them.

Procedure

The electrocardiogram of all the subjects were recorded by using 12 leads, three channel ECG machine (ECG 3CH). The procedure was carried out in physiology lab in standard room temperature of 26 ± 2°C which was maintained by air conditioner. Subjects were instructed not to smoke for at least 4 hours before the procedure and to rest for 10 minutes by lying down on bed in supine position and then after the limb leads were placed. Three

Silver-chloride (Ag-Cl) electrodes were used to record ECG signal. Electrodes were affixed on right arm (RA), left arm (LA) and left leg (LL). Ground electrode was placed on right leg (RL) of the subject. The electrodes were connected to ECG machine using three leads. The following was the hardware setting of ECG: Gain: 10, Mode: Normal, Low pass filter: 35 Hz, High pass filter: 0.5 Hz. Recording was done for limb lead I, II and III. From lead II duration of PR interval, QRS complex, TP interval were taken.

Statistical Analysis

Obtained data was tabulated and statistical evaluation was done by mean, standard deviation (STDEV) and unpaired 't-test' using SPSS (Statistical Package for Social Sciences) 17 software. A *P*-value of less than 0.001 ($P < 0.001$) was considered to be extremely statistically significant.

Results

Smoking has diverse effects on the cardiovascular system. The quality, quantity, duration and frequency of smoking play a significant role in determining the harmful effects to the cardiovascular system. This study includes male subjects of age 20.98± 1.94 (mean± SD) in non-smokers group and smokers of age 21.02 ± 2.19 (mean± SD). This study concentrated on the P-R interval, T-P interval and QRS complex timing in seconds in ECG readings in smokers and non-smokers (Table 1). The mean P-R interval was 0.1606 seconds in non-smokers and 0.1036 seconds in smokers. The mean TP interval in seconds was 0.3676 in non-smokers and 0.2998 in smokers. The mean QRS in seconds was 0.0592 in non-smokers and 0.0554 in smokers (Figure 1).

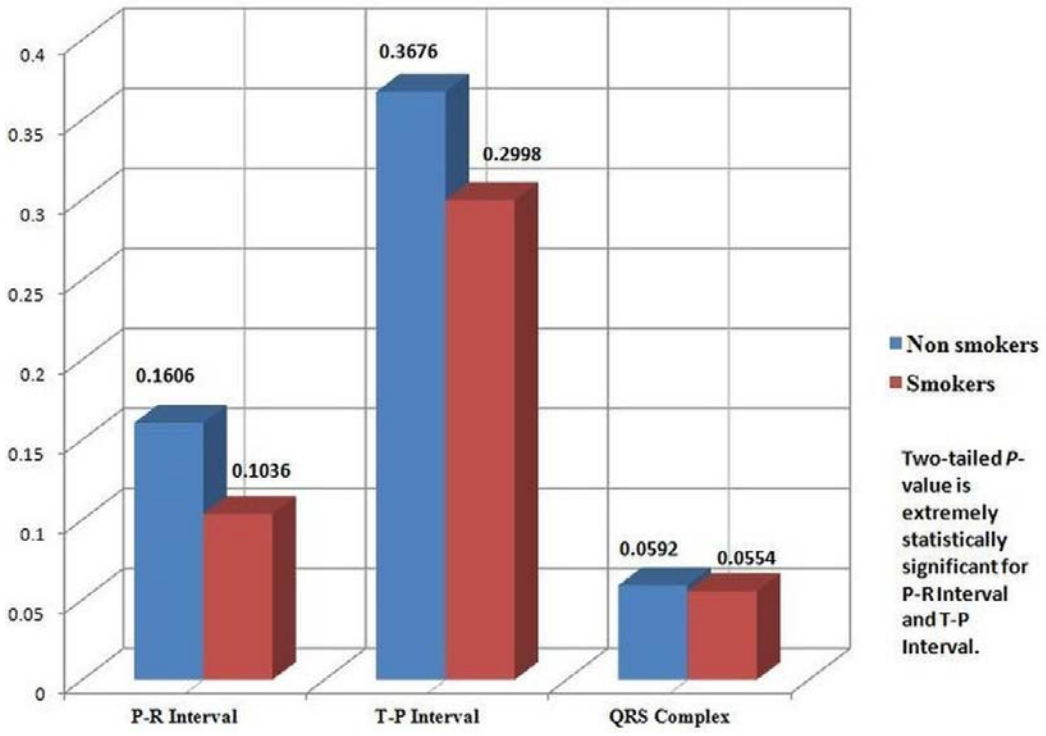
Unpaired t-test was applied to the collected data and it was found that the two-tailed *P* value was less than 0.0001 for P-R interval and for T-P interval but for QRS complex it was 0.3015. By conventional criteria, the difference in P-R interval and T-P interval for non-smokers and smokers can be considered to be extremely statistically significant. The duration of QRS complex was decreased in smokers as compared to non-smokers but statistically not significant, from our study.

Table 1. ECG Readings of Non-smokers and Smokers

ECG Readings	Non-smokers		Smokers		Standard Error of Difference	two-tailed *P*-value
	Mean (In seconds)	*STDEV	Mean (In seconds)	*STDEV		
P-R interval	0.1606	0.049709	0.1036	0.041392	0.009	< 0.0001#
T-P interval	0.3676	0.043685	0.2998	0.074051	0.012	< 0.0001#
QRS complex	0.0592	0.018934	0.0554	0.017636	0.004	0.3015

**STDDEV:- Standard Deviation; #P < 0.001 highly significant*

Figure 1. The means of P-R interval, T-P interval and QRS complex (in seconds) in smokers and non-smokers.



Discussion

The present study which focused on few ECG parameters of non-smokers and smokers showed highly statistically significant decrease in P-R and T-P intervals. The change in P-R and T-P intervals is in accordance with findings of Venkatesh G et al [8] who compared the ECG changes in smokers to normal human beings in 2010. There was significantly decrease in smokers QRS complex timing in above study but it was not found to be statistically significant in our study though there was decrease in QRS complex when analyzed by unpaired t test.

The highly significant decrease in P-R and T-P intervals in ECG reading in smokers in our study can be ascribed to the nicotine present in tobacco because in a study where nicotine was infused in fourteen healthy young men by Benowitz et al [9], it was found nicotine increased their heart rate. In ECG strip if heart rate increases, then the space between the end of a T wave of one cardiac cycle and the start of P wave of a new cardiac cycle will definitely decrease which causes shortening of P-R and T-P intervals. Therefore, nicotine in smoked tobacco pilots to increase the heart rate which in turn leads to decrease in P-R and T-P intervals.

Our study shows that smokers are more prone to cardiac rhythm disorders and we can say that the early finding of decreased P-R and T-P intervals may be a warning to quit smoking so as to prevent cardiac diseases. We would recommend cessation of smoking which is a significant step toward preventing cardiovascular disease, also recommended by Wannamethee et al [10]. Smoking, although identified to have several ECG effects, its temporal relationship to the ECG changes is not known which needs to be sorted out through further longitudinal studies.

Conclusion

This study has focused on very important cardiac functions: conduction through atria, ventricular contraction and the most important the time of ventricular filling. The electrocardiographic readings evaluated for parameters like, P-R interval, QRS complex and TP interval shows significant decrease in atrial conduction time and ventricular filling time in smokers. Very few studies are done regarding changes in TP interval. The T-P interval reduction seen in smokers, which may alter the heart rate as well, was not analyzed in present study. This study shows that smoking can cause significant changes to the electrical activities ongoing in the heart, even in young people. It is the responsibility of ours and physicians to discourage smoking in the community. Areas of further research may include detailed study of each and every electrocardiographic parameters and in different age groups.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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