A STUDY OF CARDIOVASCULAR AUTONOMIC FUNCTIONS IN SMOKERS
GIRJASIVAM S P
Department of Physiology, MADRAS MEDICAL COLLEGE AND GOVERNMENT GENERAL HOSPITAL

Abstract:
BACKGROUND AND AIM - Cigarette smoking is a prime risk factor for cardiovascular morbidity and mortality. Chronic smoking results in autonomic dysfunction leading to increased cardiovascular risk in smokers. The current study was aimed to evaluate the cardiovascular autonomic function in smokers. MATERIALS METHODS - 60 male subjects in the age group of 25 to 40 years were included in this study out of which 30 were smokers and 30 were non-smokers. All the study and control subjects were informed about the study. Written and informed consents were obtained from them. The sixty study and control subjects were subjected to a battery of autonomic function tests along with resting heart rate variability which is measured using Niviqure ambulatory digital ECG recorder. The results were analysed with SPSS version 17.
RESULTS - Smokers group showed a significant (P < 0.05) increase in mean heart rate and LF nu, LFHF ratio as compared to age matched controls. There was a statistically significant (P < 0.001) reduced RR interval and HF nu (P < 0.05) found among smokers. Also there was significant difference (P < 0.05) observed between the mean values of autonomic function test for parasympathetic system EI ratio, Valsalva ratio, 30/15 ratio among the smokers and the controls. Highly significant difference (P < 0.001) was observed between the mean values of autonomic functions test for sympathetic system orthostatic standing test and isometric hand grip test among the smokers and the controls. CONCLUSION - Abnormalities of autonomic function were found in smokers which manifested as sympathetic over activity and parasympathetic withdrawal. Chronic sympathetic over activity may be associated with the adverse cardiac events in smokers. Early recognition and treatment of these may improve quality of life of smokers. The battery of autonomic function tests and resting heart rate variability identify the autonomic dysfunction at the earliest stage.
Keyword: Autonomic function tests, Heart Rate Variability, smoking

INTRODUCTION
Cigarette smoking is a major risk factor for cardiovascular morbidity and mortality and it is considered to be a leading preventable cause of death in the world. (1,2) 25% of middle aged cardiovascular mortality are attributable to smoking worldwide. (3) India holds 17% of the total smoker population. (4) The Health Ministry of India reported recently that nearly 2,200 people per day and 9 lacs every year die in India due to tobacco related diseases. Chronic smoking results in dysfunction of Autonomic Nervous System. (5) The autonomic alterations may contribute to increased cardiovascular risk which is present in smokers. Smoking is associated with marked and a prolonged increase in heart rate and blood pressure. (6) Smoking attenuates the baroreflex sensitivity in human beings which leads to pressor and tachycardial effects in smokers, as well as to the concomitant alteration in variability. (7) In particular, smoking acting at peripheral sympathetic sites and increases the circulating level of catecholamines, augments sympathetic outflow, and causes a long-term reduction in vagal drive. (8) This sympathetic predominance, seen even in young heavy smokers, is also associated with impaired baroreflex function and reduced Heart Rate Variability. (9) Heart rate variability is a non-invasive and very useful tool in detecting cardiovascular autonomic disturbances. Heart rate variability measures the inter beat interval of consecutive heart beats and the oscillation between consecutive and instantaneous heart beats. (10,11) Therefore, the present study is aimed to evaluate the autonomic activity in smokers using a battery of cardiac autonomic function tests, which assess the resting heart rate variability and variability of heart rate and blood pressure in response to stress.

MATERIALS AND METHODS
60 male subjects in the age group 25 to 40 years were included in this study out of which 30 were chronic smokers and 30 were non-smokers. The normal healthy subjects were selected by simple random sampling method from general population who had no history of smoking. Inclusion criteria for study subject selection: chronic smoker of at least 5 pack years. (Pack year = number of cigarette packs per day X number of years; one pack = 20 cigarettes). Exclusion criteria for subject selection: History of any major illness like hypertension, diabetes mellitus, pulmonary disease, cardiovascular disorder, any endocrine and metabolic disorder, psychiatric disorder, drug intake for any ailments in last one month. All the Participants included were informed about the study and a written and informed consent were obtained from them. They were subjected to complete general and systemic examination. The sixty study and control group were subjected to a battery of autonomic function tests along with resting heart rate variability as described by Ewing et al. (12)
Autonomic Function Tests
1. Resting heart rate variability: subject was asked to lie for 30 minutes. ECG was recorded continuously for 5 minutes. Power spectral analysis of the converted ECG signals was done using Fast Fourier Transformation.
2. The Expiration – Inspiration Ratio (E/I Ratio): The study subjects were asked to take deep inspiration for 5 seconds, followed by full expiration for 5 seconds. The ECG was recorded for 3 such cycles.
3. The 30:15 ratio: The subjects were asked to lie down comfortably over the couch and then they were asked to stand up. The heart rate was recorded after 1 minute and 3 minutes. The R-R interval at the 15th and 30th beats was calculated.
4. The Valsalva ratio: The subjects were asked to sit comfortably. Their heart rates were recorded at rest with the ECG. They were instructed to exhale forcefully through the tube of the Mercury sphygmomanometer and to maintain pressure in the manometer up to 40 mm Hg for 15 seconds. ECG recording was taken during the manoeuvre and continued for about 30 seconds after the performance. The manoeuvre was repeated three times with few minutes time interval of rest.
5. Orthostatic standing test: The subjects were asked to lie comfortably in the supine position for 15 minutes and their blood pressures were recorded. They were then asked to stand up and their blood pressures were recorded immediately and after 1 minute and 3 minutes.
6. The Isometric Handgrip test: The subjects were asked to press the hand grip dynamometer with maximum force for few seconds and the values were noted. They were asked to maintain 30% of maximum voluntary contraction as long as possible for a maximum duration of 5 minutes. The increase in diastolic blood pressure just before the release of handgrip was noted. The results of the above tests were evaluated statistically using Statistical Package for the Social Sciences (SPSS) software version 17.

RESULTS
The mean and standard deviation of the variable were determined for the two groups. Independent student t test was employed as the Test of significance at 95% confidence interval and P value < 0.05 was considered as significant.

<table>
<thead>
<tr>
<th>TABLE 1: Comparison of age &amp; BMI between Controls and Smokers</th>
<th>P VALUE</th>
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</thead>
<tbody>
<tr>
<td>AGE mean ± SD</td>
<td>33.89 ± 2.92</td>
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<tr>
<td>BMI mean ± SD</td>
<td>23.48 ± 2.19</td>
</tr>
</tbody>
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<tr>
<th>TABLE 2: Comparison of resting HRV parameters between Controls and Smokers</th>
<th>P VALUE</th>
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</thead>
<tbody>
<tr>
<td>Mean HR</td>
<td>79.79 ± 4.14</td>
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<tr>
<td>Mean RR</td>
<td>0.79 ± 0.04</td>
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<tr>
<td>LF nu</td>
<td>36.98 ± 9.05</td>
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<tr>
<td>HF nu</td>
<td>32.82 ± 6.9</td>
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<tr>
<td>LF/HF ratio</td>
<td>0.63 ± 0.24</td>
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<tr>
<th>TABLE 3: Comparison of Autonomic Function Tests between Controls and Smokers</th>
<th>P VALUE</th>
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<tbody>
<tr>
<td>E/I ratio</td>
<td>1.37 ± 0.14</td>
</tr>
<tr>
<td>Valsalva ratio</td>
<td>1.7 ± 0.22</td>
</tr>
<tr>
<td>30:15 ratio</td>
<td>1.29 ± 0.1</td>
</tr>
<tr>
<td>Hig test</td>
<td>11.73 ± 3</td>
</tr>
<tr>
<td>Orthostatic standing test</td>
<td>7.53 ± 4.5</td>
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The 30:15 ratio of the smoker was significantly lower in respiratory cycle and influenced by vagal tone. The E/I ratio in the ratio is based on respiratory sinus arrhythmia during each assessment of parasympathetic activity. The Expiration: inspiration the heart rate response to standing (30:15 ratio) are used for the Deep breathing test (E/I ratio), the Valsalva maneuver (VR) and JK et al (2010) also observed similar changes in LF/HF ratio.(14) suggesting an increased sympathetic activity in smokers. Behera

The baroreflex is impaired in smoking and a partial inability in smoking depends on an increased release of catecholamines. The activation of sympathetic system which is induced increased myocardial workload and stimulates catecholamine release.(8) The activation of sympathetic system which is induced by smoking depends on an increased release of catecholamines. The baroreflex is impaired in smoking and a partial inability in smoking and cardiovascular disease: An update. Journal of Cardiovascular Function: The role of Nicotine and Carbon monoxide has been found to be significantly lower in smokers (p = 0.03). Similarly, Behera JK et al (2010), Hirsch et al (1996) observed a similar findings with respect to mean HR, mean RR in smokers which may be due to decreased vagal tone. (14,15) LF nu values which is an indicator of sympathetic tone was significantly high in smokers. The HF nu values in normalized unit reflecting vagal tone was found to be significantly low in smokers (p = 0.03). Similarly, Behera JK et al (2010), Lucini et al (1996) and Karakaya et al (2007) also stated significantly high LF and reduced HF in smokers.(14,16,17) The LF/HF ratio , an indicator of sympathovagal balance was significantly high in smokers suggesting an increased sympathetic activity in smokers. Behera JK et al (2010) also observed similar changes in LF/HF ratio.(14) Deep breathing test (E/I ratio), the Valsalva maneuver (VR) and the heart rate response to standing (30:15 ratio) are used for the assessment of parasympathetic activity. The Expiration: inspiration ratio is based on respiratory sinus arrhythmia during each respiratory cycle and influenced by vagal tone. The E/I ratio in the smoker group was significantly lower than the control group (p = 0.04). The 30:15 ratio of the smoker was significantly lower in smokers than the control group (p=0.01). The Valsalva ratio is another reliable indicator of vagal tone . which is responsible for the recovery of heart rate after stress. The smoker group had a significantly lower value of VR compared to non smokers (P=0.03), thus indicating a condition of vagal withdrawal. Tayade et al (2014), Gould GA et al (1986), Mervi et al , Beatriz et al (2011) also observed similar results in the above tests (18,19,20,21) The rise in diastolic blood pressure just before the release of hand grip which is a function of sympathetic activity due to stimulation of baroreceptors and peripheral vasoconstrictor fibers was significantly high in smokers than controls. The blood pressure response to active standing is a function of sympathetic system. Highly significant difference was observed in systolic blood pressure in orthostatic standing test between smokers and controls. Thus, the sympathetic over activity in smokers is substantiated.

**REFERENCES**