Journal Of Medical Science And Clinical Research
IGM Publication   An Official Publication Of IGM Publication

Heart rate variability among Tobacco Chewers: A Case Control Study

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Abstract
Background: *Tobacco chewing leads to dysfunction of autonomic nervous system has rarely been studied.*
Objective: *Evaluation of heart rate variability (HRV) in tobacco chewers for assessing autonomic functions.*
Material and Methods: *30 male tobacco chewer subjects (age group 25-30 years) along with 30 aged and BMI matched male healthy controls were evaluated for Time domain parameters SDNN (ms); RMSSD (ms); pNN50 (%) and Frequency domain HRV parameters: LF (ms^2); HF (ms^2); LF n.u. (%); HF n.u. (%) and LF/HF ratio. Level of significance derived using unpaired students "t"-test.*
Results: *The mean HF n.u. (%) was found to be lower whereas mean LF (ms^2), LF n.u. (%) and LF/HF ratio were found higher in tobacco chewers as compared to control group. (p value<0.001)*
Conclusion: *Decreased Heart rate variability indicates deranged cardiovascular autonomic functions in tobacco chewer subjects.*
Keywords: *HRV, smokeless tobacco.*

Introduction

Tobacco is the most widely distributed and commonly used habit forming substance for years.[1]

Many social factors, psychological states, economic and political factors have contributed to the global spread of tobacco consumption.[1]

An increase in consumption of smokeless tobacco has been noticed among high school, college students, and adults and indeed represents a health concern of growing magnitude among these groups.[2]

The prevalence of smokeless tobacco use is estimated at 29.6% for men and 12.8% for women and 21.4% of all adults in India as per Global Adult Tobacco Survey, India (2016-17).[3]

Smokeless tobacco contain more than 2500 chemicals including nicotine, carcinogenic chemicals such as tobacco-specific N-nitrosamines, benzopyrene, nitrate, cadmium, lead, arsenic, nickel, and chromium, flavoring additives and alkalines.[2], [4], [5], [6]

Smokeless tobacco chewing is associated with many health risks like oro-pharyngeal, esophageal

and other cancers, cardiovascular diseases (MI,HTN, CVA etc), oral diseases (periodontitis, gingivitis) affecting all organ systems.[7],[8],[9] Nicotine enhances the release of various neurotransmitters including epinephrine, norepinephrine, dopamine, acetylcholine, serotonin, vasopressin, glutamate, NO.[10]

Cardiovascular disease (CVD) is the leading cause of death worldwide, responsible for over 17 million annual deaths globally and tobacco has been estimated to directly cause 10% of all CVD worldwide and smokeless tobacco products contribute potential risk for cardiovascular mortality and morbidity. [11]

Analysis of heart rate variability (HRV) nowadays has become one of the most popular non-invasive tools for the detection of early autonomic nervous system dysfunction. Low variability in HR implies poor or inhibited ability to maintain internal homeostasis. Generally sympathetic influence increases HR (tachycardia response) and lowers variability of the heart rate, while parasympathetic input slows the HR (bradycardia response) and increases the variability. Low HRV is a known predictor of mortality in many clinical populations and it is associated with several cardiovascular risk factors. [12] The present study is an attempt to an early understanding of the autonomic nervous system dysfunctions in tobacco chewer subjects using HRV to prevent cardiovascular morbidity and mortality in these subjects.

Material and Methods

The present study was conducted in the Department of Physiology, S.M.S. Medical College and Attached Hospitals, Jaipur, Rajasthan from 1st March 2017 to 10th January 2018 on 30 tobacco chewers between the age group of 25-30 years, taken from the various departments of S.M.S. Medical College and Attached hospitals, Jaipur along with 30 healthy age and sex matched non tobacco chewers, non smoker from the same departments of S.M.S. Medical college and attached Hospitals, Jaipur. It was a community based case-control type of observational study.

Prior permission was obtained from the institutional ethical committee and research review board.

Inclusion criteria for case group subjects: male tobacco chewers aged 25-30 years, chewing 5 gram or more tobacco/day. Exclusion criteria: any acute or chronic diseases like diabetes, liver diseases, cardiac diseases, smoking, alcoholism.

All subjects were tested between 10 am to 1.00 pm under similar laboratory conditions and were allowed to adapt themselves to experimental and environmental condition for 30 minutes to make them comfortable, as anxiety and stress can affect autonomic functions. The subjects were asked to avoid caffeine, carbonated drink, tobacco 12 hours prior to and after having light breakfast 2 hours' prior recording of HRV. The room ambient temperature was maintained at 24-25°C.

The recording of Heart Rate Variability was done by Polygraph (RMS Polyrite D, version 1.0) based on the principle of EKG.

For short term analysis of HRV, ECG was recorded in the supine posture for 5 minutes after 15 minutes of supine rest in a quiet environment.

Following parameters of HRV were included in Time & Frequency Domain:

- SDNN (ms)
- RMSSD (ms)
- pNN50 (%)
- LF (Power in low frequency range) in ms²
- HF (Power in high frequency range) in ms²
- LF n.u. (normalized unit) in%
- HF n.u. (normalised unit) in %
- LF/HF ratio

Statistical analysis was performed using Microsoft Excel 2007 and unpaired students "t"-test was used to derive the level of significance.

Results

The mean of time domain parameter SDNN (ms) for tobacco chewer subjects were 42.89±13.51, while 43.23±11.37 for control subjects. (p value >0.05) (Table 2)

The mean of time domain parameter RMSSD (ms) for tobacco chewer subjects were 32.49±16.01 and 34.06±14.30 for control subjects.
(p value >0.05) (Table 2)

The mean of time domain parameter pNN50 (%) were 12.73±14.69 and 13.97±18.47 for tobacco chewer and control subjects respectively.

In frequency domain parameter mean of HF (ms^2) for tobacco chewers were 182.1±147.78 and for control subjects 199.21±152.11. (p-value >0.05) (Table 3)

The mean of frequency domain parameter HF n.u. for tobacco chewers were 33.21±10.25 and for control subjects 57.44±8.44. (p-value <0.001) (Table 3)

The mean of frequency domain parameter LF (ms^2) for tobacco chewers were 399.47±342.59 and for control subjects 156.12±132.08. (p-value <0.05) (Table 3)

The mean of frequency domain parameter LF n.u. for tobacco chewers were 66.76±10.61 and for control subjects 42.45±8.47. (p-value <0.001) (Table 3)

The mean of LF/HF ratio for tobacco chewers and control subjects were 2.39±1.39 and 0.76±0.21 respectively. (p-value <0.001) (Table 3)

Table: 1 Comparison of anthropometric and baseline clinical characteristics of tobacco chewer and control subjects:
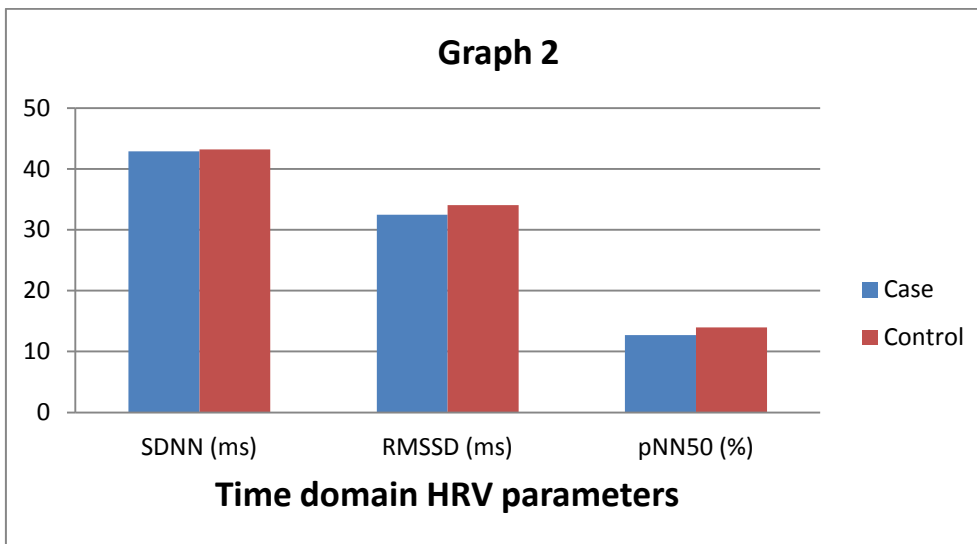
| Parameter	Groups (Mean±SD)		p-value	Significance
	Case(n=30)	Control(n=30)		
Age (years)	27.83±1.64	27.85±1.58	>0.05	NS
Weight (kg)	65.83±8.67	66.5±7.92	>0.05	NS
Height (cm)	171±8.83	174.03±6.56	>0.05	NS
BMI (kg/m^2)	21.78±2.09	21.46±1.87	>0.05	NS
HR (beats/min)	80.3±2.09	74.10±6.23	<0.05	Significant
SBP (mmHg)	123.2±9.30	119.68±7.84	>0.05	NS
DBP (mmHg)	77.67±7.70	72.46±8.63	<0.05	Significant
BMI: body mass index, HR: heart rate, SBP: systolic blood pressure, DBP: diastolic blood pressure, NS: not significant				
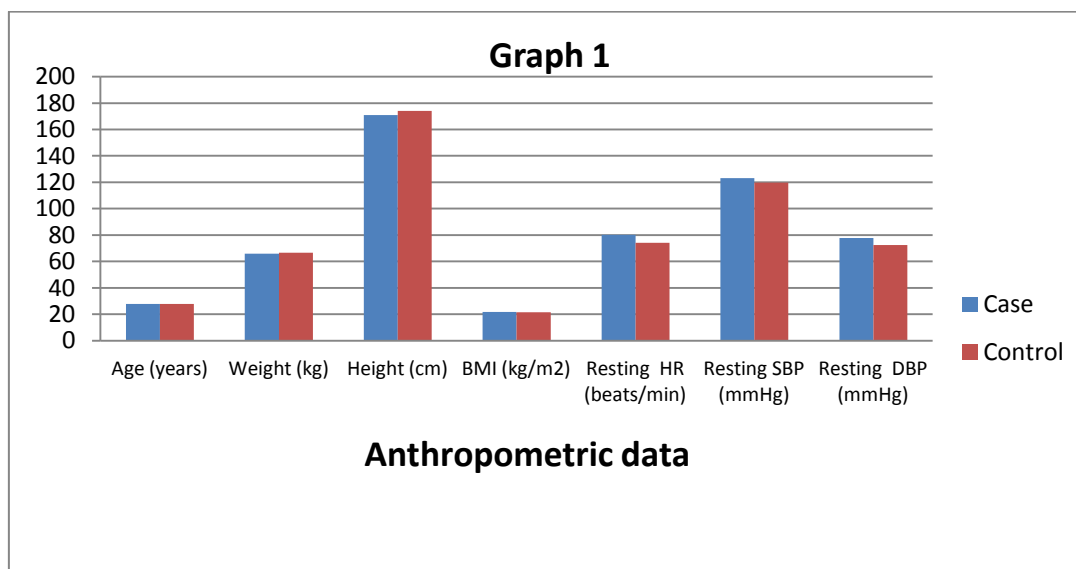
Table: 2 Comparison of Time domain HRV parameters in tobacco chewer and control subjects:

Parameter	Groups (Mean±SD)		p-value	Significance
	Case(n=30)	Control(n=30)		
SDNN (ms)	42.89±13.51	43.23±11.37	>0.05	NS
RMSSD (ms)	32.49±16.01	34.06±14.30	>0.05	NS
pNN 50 (%)	12.73±14.69	13.97±18.47	>0.05	NS

Graph 2 — Time domain HRV parameters

Table: 3 Comparison of frequency domain HRV parameters in tobacco chewer and non tobacco chewer subjects:

Parameter	Groups (Mean±SD)		p-value	Significance
	Case(n=30)	Control(n=30)		
HF (ms^2)	182.1±147.78	199.21±152.11	>0.05	NS
LF (ms^2)	399.47±342.59	156.12±132.08	<0.05	HS
HF n.u.	33.21±10.25	57.44±8.44	<0.001	HS
LF n.u.	66.76±10.61	42.45±8.47	<0.001	HS
LF/HF ratio	2.39±1.39	0.76±0.21	<0.001	HS

Graph 3 — Frequency domain HRV parameters
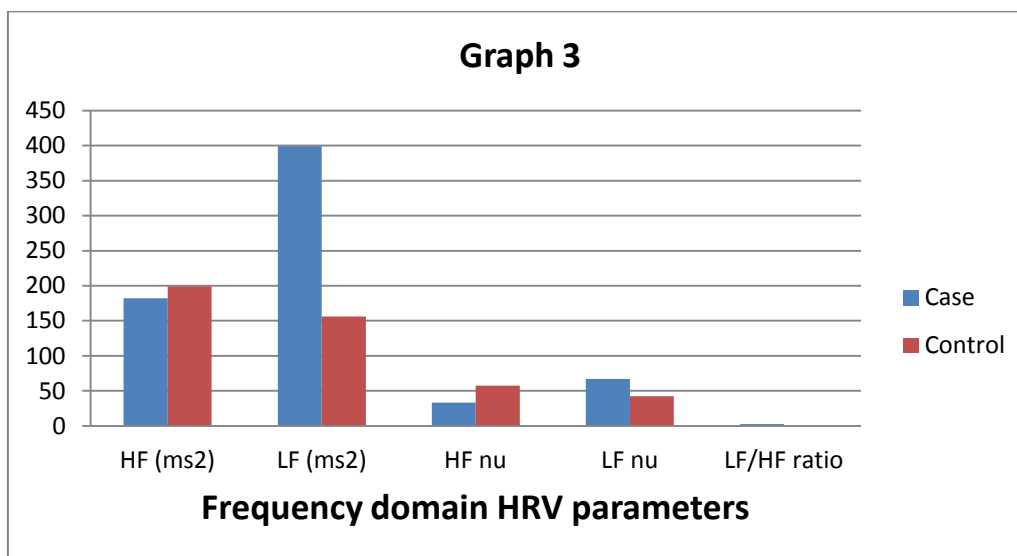
Discussion

In recent years, there has been increasing trend of tobacco chewing in youngsters [2].

Consumption of tobacco in any form has harmful effects on health, which leads to disease, disability and death.

Apart from serious ill effects on various systems of body, chewing tobacco is one of the important causes of cardiovascular morbidity and mortality. [11], [17]

Cardiovascular system is influenced by autonomic nervous system and use of smokeless tobacco leads to sympatho-vagal imbalance, which may leads to MI, HTN, stroke and arrhythmia etc in future. [18]

Despite extensive health burden of tobacco chewing, only a small number of studies have explored its effect on cardiovascular health.

HRV is a simple, economic, non invasive technique to evaluate sympatho-vagal balance and widely used method to assess autonomic functional status. [12]

Time domain parameters of HRV

Mean value of SDNN, RMSSD and pNN50 mean values were 42.89±13.51, 32.49±16.01 and 12.73±14.69 in tobacco chewers respectively and 43.23±11.37, 34.06±14.30 and 13.97±18.47 in control subjects respectively. Although the values are higher in controls as compared to tobacco chewers, the difference is statistically not significant. ($p > 0.05$)

Our observations supported by the studies of Mohesh MIG et al [14] and Pakkala A et al. [13] was found to be higher

Frequency domain parameters of HRV

Mean of LF absolute power was found to be 399.47±342.78 ms^2 in tobacco chewers as compared from 156.12±132.08 ms^2 in control subjects ($p<0.05$) and mean of LF n.u. was found to be 66.76±10.61 in tobacco chewers as compared from 42.45±8.47 in control subjects ($p<0.001$).

These findings emphasized sympathetic over activity in tobacco chewers. These results were comparable with Pakkala A et al[13], Doss DSD et al. [16]

Mean of HF n.u.(%) in tobacco chewers was significantly lower (33.21±10.25) as compared to control subjects (57.44±8.44), ($p<0.001$) and LF/HF ratio was found to be significantly higher in tobacco chewers (2.39±1.39) as compared to in control subjects (0.76±0.21), ($p<0.001$). Studies of Pakkala A et al [13] and Doss DSD et al [16] corroborate our findings.

The pathophysiological footing of the development of autonomic dysfunctions in tobacco chewers is not clearly known, however literature suggests that nicotine and additives present in tobacco release epinephrine from adrenal gland in response to using tobacco & increase in plasma epinephrine causes preganglionic sympathetic excitation. It can lead to dominance of sympathetic nervous system over the parasympathetic nervous activity in tobacco chewers. [10]

Our study results showed hyperactive sympathetic and hypoactive parasympathetic system in tobacco chewers as compared to non tobacco chewers.

Conclusion

Chewing tobacco in any form predisposes for autonomic dysfunctions, which may lead to cardiovascular morbidity and mortality. Therefore HRV testing can be used to screen the subjects consuming tobacco for timely diagnosis and treatment to limit further complications.

Limitation

Study was conducted on small sample size in short time duration. For better results large sample size spanned over a longer time duration may be taken.

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