Effects of Tobacco Chewing on Cardiovascular Autonomic Function Tests

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Abstract

Cardiovascular autonomic function tests were conducted in twenty five male tobacco chewers and twenty five male non-tobacco chewers in the age group of 20-25 years. Resting heart rate showed a statistically significant increase (p value <0.05) in tobacco chewers. A significant increase (p value <0.01) in the incidence of resting tachycardia was also observed in tobacco chewers after Gutka chewing. Heart rate response to standing (Parasympathetic system test), (p value <0.01) and blood pressure response to sustained hand-grip (Sympathetic test), (p value <0.01) showed a statistically significant higher incidence of abnormality among tobacco chewers as compared to controls.

Keywords: Cardiovascular autonomic function tests; Tobacco chewing.

Introduction

Smokeless tobacco is re-emerging as a popular form of tobacco, particularly among male adolescents. Use of smokeless tobacco (chewing tobacco and snuff) indeed represents a health concern of growing magnitude for children and adolescents.[1] Nicotine is a major component of tobacco.[2] Use of smokeless tobacco results in levels of nicotine and cardiovascular effects throughout the day that are similar to those observed with daily cigarette smoking.[3] But smoking has been widely hypothesized to be associated with the dysfunction of the autonomic nervous system[4] and cardiac deaths in smokers are associated with cardiovascular autonomic dysfunction. Previous study[5] conducted in our laboratory showed that even smoking of short duration of one to five years is associated with significant increase in the cardiovascular autonomic dysfunction. However, effects of smokeless tobacco on cardio-vascular autonomic functions have not been studied so far. Therefore the present project was undertaken.

1. To study selective cardiovascular autonomic functions in tobacco chewers of duration one to five years.
2. To study the effects of chewing a packet of Gutka on the autonomic functions.

Materials and Methods

The present study was conducted on twenty five apparently healthy male tobacco chewers of age group 20 to 25 years, and equal number of healthy age and sex matched non tobacco chewer controls. Height, weight and surface area of tobacco chewers were matched with controls.

Duration of tobacco chewing was in the range of one to five years (mean duration three years) and the number of packets being chewed were in the range of two to ten packets per day. All subjects were non

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alcoholics and non smokers. No subject had any symptoms suggestive of autonomic dysfunction.

Tobacco chewing history was recorded in detail. On the day before the study Gutka chewers were instructed to abstain from Gutka chewing for at least 3 hours prior to the study of tests to avoid residual effects of their last Gutka chewing dose. Acute effects of Gutka on autonomic function tests were determined in Gutka chewers twenty minutes after chewing one packet of Gutka (4.6 gms). Study protocol was briefly explained to the subjects .Informed consent was obtained from them before taking part. This study was performed between 10.00 AM to 1.00 PM.

Five objective and reproducible Ewing tests were performed on all the subjects. Detailed instructions regarding the procedure employed for each test were given to the subjects. Autonomic function tests were performed by using the student physiograph (Bio-Devices).In our study, ECG coupler was used and heart rate was recorded on physiograph paper during various manoeuvres of cardio-vascular autonomic tests using limb II and paper speed 25 mm/sec. The different manoeuvres were demonstrated to the subjects, and they were trained to perform the tests. Actual recordings were made only after they were able to perform tests satisfactorily. The following cardiovascular autonomic function tests were performed. Results of tests were expressed as ratios and differences as suggested by Ewing and Clarke.[6]

1. Heart rate response to Valsalva manoeuvre (Valsalva ratio)
2. Heart–rate variation during deep breathing
3. Heart–rate response to standing (30:15 Ratio)
4. Blood pressure response to standing (Immediate)
5. Blood pressure response to sustained handgrip

(1), (2) and (3) tests reflect parasympathetic function and (4) and (5) tests reflect sympathetic function.

All these tests were conducted on twenty five male healthy controls (C), and tobacco chewers before Gutka chewing (T_1) and after 20 minutes of Gutka chewing (T_2). Resting heart rates and all the corresponding ratios and differences were calculated, the results were analysed by using student 't' test.

Results

There was no statically significant difference between the controls and tobacco chewers with respect to their age, height weight, body surface area.

A significant increase in resting heart rate, and heart rate response to standing was observed in tobacco chewers in comparison to controls before tobacco chewing.

A significant rise in resting heart rate, heart rate response to standing, and blood pressure response sustained hand grip was observed in tobacco chewers after 20 minutes of tobacco chewing in comparison with the controls.

There was a statically significant increase in resting heart rate, heart rate response to

Table 1: Physical Parameters

Parameters	Controls(n=25) (Mean± S.D)	Tobacco chewers(n=25) (Mean±S.D)
Age(Years)	21.4±1.68	21.88±1.59
Height(cms)	165.24±8.13	164.04±8.13
Weight (Kgs)	59.48±6.73	61.36±5.89
Body surface area(sq.mts)	1.65±0.13	1.66±0.1

Table 2: Comparision of autonomic function tests between controls and tobacco chewers before tobacco chewing

Variable	Group	Mean	SD	t-value	p-value	Significance
Resting heart rate(Beats/min)(n=25)	C	78.88	6.53	1.7705	0.0419 or <0.05	S
	T_1	77.08	9.89			
Valsalva Ratio(V.R.)(n=25)	C	1.40	0.15	0.1893	0.4254 or >0.05	NS
	T_1	1.41	0.26			
(Heart rate variation during deep breathing)E:1 ratio(n=25)	C	1.46	0.18	0.0064	0.4975 or >0.05	NS
	T_1	1.45	0.26			
30:15 ratio (Heart rate response to standing)(n=25)	C	1.08	0.08	3.6624	0.0064 or <0.01	S
	T_1	1.00	0.06			
Systolic fall in B.P(mm of Hg)(n=25)	C	6.44	1.63	0.6274	0.267 or >0.05	NS
	T_1	6.16	1.51			
Rise in diastolic B.P(mm of Hg)(n=25)	C	18.88	1.64	0.338	0.3685 or >0.05	NS
	T_1	18.72	2.57			

S - Significant, NS-Not significant,
C - Control, T_1- Tobacco chewers (Before Gutka chewing)

Table 3: Comparision of autonomic function tests between controls and tobacco chewers after tobacco chewing

Variable	Group	Mean	SD	t-value	p-value	Significance
Resting heart rate(Beats/min)(n=25)	C	78.88	6.53	6.6182	0.00 or <0.01	S
	T_2	91.04	12.06			
Valsalva ratio(V.R.)(n=25)	C	1.40	0.15	0.0845	0.4665 or >0.05	NS
	T_2	1.41	0.21			
(Heart rate variation during deep breathing)E:1 ratio(n=25)	C	1.46	0.18	1.4672	0.0745 or >0.05	NS
	T_2	1.37	0.20			
30:15 ratio (Heart rate response to standing)(n=25)	C	1.08	0.08	6.066	0.00002 or <0.01	S
	T_2	0.96	0.05			
Systolic fall in B.P(mm of Hg)(n=25)	C	6.44	1.63	0.0608	0.2729 or >0.05	NS
	T_2	6.72	1.62			
Rise in diastolic B.P(mm of Hg)(n=25)	C	18.88	1.64	8.9917	0.00 or <0.01	S
	T_2	25.12	3.05			

S - Significant, NS-Not significant,
C - Control, T_2-Tobacco chewers (After Gutka chewing)

Table 4: Comparision of autonomic function tests in tobacco chewers before tobacco chewing and after tobacco chewing

Variable	Group	Mean	SD	t-value	p-value	Significance
Resting heart rate(Beats/min)(n=25)	T_1	77.08	9.89	7.4709	0.00 or<0.01	S
	T_2	91.04	12.06			
Valsalva ratio(V.R.)(n=25)	T_1	1.41	0.27	0.176	0.4309 or >0.05	NS
	T_2	1.41	0.21			
(Heart rate variation during deep breathing)E:1 ratio(n=25)	T_1	1.45	0.03	1.5561	0.06664 or >0.05	NS
	T_2	1.37	0.20			
30:15 ratio (Heart rate response to standing)(n=25)	T_1	1.01	0.07	4.5107	0.0 or <0.01	S
	T_2	0.96	0.05			
Systolic fall in B.P(mm of Hg)(n=25)	T_1	6.16	1.51	2.2811	0.0159 or<0.05	S
	T_2	6.72	1.62			
Rise in diastolic B.P(mm of Hg)(n=25)	T_1	18.72	2.57	8.7949	0.0008 or<0.01	S
	T_2	25.12	3.05			

S - Significant, T_1- Tobacco chewers (Before Gutka chewing)
NS - Not significant, T_2-Tobacco chewers (After Gutka chewing)

standing, and blood pressure changes to sustained hand grip test in tobacco chewers after chewing tobacco, in comparison to the same parameters being recorded before tobacco chewing in them.

Discussion

Tests reflecting parasympathetic system damage

1. Resting heart rate

Resting heart rate showed a statistically significant increase, even before chewing tobacco (p value <0.05). some studies have shown greater prevalence of resting tachycardia in tobacco chewers.[7] Resting heart rate also statistically significant increase after chewing a pocket of Gutka (p value <0.01) Nicotine, on its turn has been reported to bring about these changes through sympathetic stimulation[8,9], release of epinephrine and norepinephrine[9] and the consequent vasoconstriction.[8,9]

2. Incidence of resting tachycardia

After chewing a packet of Gutka there was a significant increase of resting tachycardia (Heart rate more than 100 beats/min).The major action of nicotine consists of a primary transient stimulation and a secondary more persistent depression of all sympathetic and parasympathetic ganglia.[10]

Therefore higher resting heart rate and higher incidence of resting tachycardia seen in Gutka chewers appears to be due to an increase in the catecholamine activity as well as decrease in the vagal tone.

3. Valsalva manoeuvre (Valsalva ratio)

Valsalva ratio did not show any significant abnormality in the experimental group as compared to the control group.

The absorption of nicotine from smokeless tobacco produces a similar level and temporal pattern of sympathetic nervous system activation as does cigarette smoking. Daily exposure of nicotine in smokeless tobacco use is in general similar to that of cigarette smokers.[3] Otfried N. Niedermaier *et al* (1993) observed that there is an augmented sympathetic activity during Valsalva manoeuvre after smoking a cigarette. Peak sympathetic nerve activity and systolic pressure overshoots during and after valsalva straining; also increased significantly in proportion to increase of plasma nicotine levels.[11]

Valsalva ratio depends upon both sympathetic and parasympathetic control on heart. Valsalva ratio does not appear to be very sensitive to tobacco chewing induced autonomic dysfunction.

4. Heart rate variation during deep breathing

Incidence of heart rate variation during deep breathing was not statistically significant among control group as well as in experimental group. Nadeau and James have shown that, although the direct perfusion of nicotine (10μg) to the sinoatrial node in the dog causes a cholinergically mediated brief slowing of the heart within the initial 10 seconds it also causes a non reaction of the heart to electrical stimulations of the cervical vagus for over 5 minutes.[12]

5. Heart rate response to standing: (30:15 ratio)

In the present study, 30;15 ratio showed a statistically significant higher incidence of abnormality among tobacco chewers as compared to controls.

Ewing and Campbell et al (1978)[13] showed that heart rate changes to immediate standing may also be detected with routine electrocardiography. As loss of a normal response is due to vagal damage,

this provides the basis for a simple test of autonomic function that has considerable advantages over those autonomic tests now in use. Measurements of the 30:15 ratio gives a simple numerical value that reflects the presence or absence of the relative bradycardia. Ewing *et al*[12] found abnormality of this test in all diabetics with autonomic neuropathy but none in control group.

Tests reflecting sympathetic system damage

Blood pressure response to standing shows statistically higher values in T_2 as compared to T_1 and in response to sustained hand-grip which showed statistically higher values in T_2 as compared to C and T_1.

Ewing and Clarke[6] (1986) have reported that the natural course of autonomic damage in diabetics is characterised by an early damage and a late damage. The present study shows both parasympathetic and sympathetic abnormalities with tobacco chewing of one to five years duration.

Conclusion

Chewing tobacco for a short duration of one to five years (mean duration three years) predisposes one for cardiovascular autonomic dysfunction. However, it is too premature to conclude the significance of this particular observation. Further studies may follow more light in this regard.

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