ORIGINAL ARTICLE

EFFECT OF SMOKING ON SALIVARY FLOW RATE

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ABSTRACT

Background: The smoke of tobacco during smoking is spread to all parts of the oral cavity and therefore, the taste receptors, a primary receptor site for salivary secretion, are constantly exposed. Generally it is accepted that long term use of tobacco decreases the sensitivity of taste receptors which in turn leads to depressed salivary reflex. Presumably, this might lead to altered taste receptors response and hence to changes in salivary flow rate. The present study was designed to document these changes, if any.

Methodology: Subjects of the study were divided into smokers, and controls. Each group comprised of 20 healthy male adults. The saliva of each subject was collected under resting condition and following application of crude nicotine and citric acid solution to the tip of tongue.

Results: After stimulation with both nicotine and citric acid, all subjects of each group showed a high increase in salivary flow rate. Salivary flow rates of smokers were not much different from that of non-smokers.

Conclusion: Long-term smoking does not adversely affect the taste receptors response and hence salivary flow rate.

KEY WORDS: Saliva, Salivary flow rate, Smoking.

INTRODUCTION

Saliva, the fluid in the mouth, is a combined secretion of the three pairs of salivary glands: the parotid, the submandibular and the sublingual; together with numerous small glands.[1] It is the most easily accessible fluid in the human body and in future it is probable that it will provide an easy tool for non-invasive measurements of various body parameters.[2] Approximately 0.5 liters of saliva is secreted per day. The salivary flow rates are 0.3 ml per minute when unstimulated and rise to 1.5-2.0 ml per minute when stimulated but flow rate is negligible during night.[3] In normal individuals saliva is secreted in two stages; first, secretion occurs into the glandular acini which is approximately similar to extracellular fluid (ECF), then this primary secre-tion flows through the acinar ducts where re-conditioning occurs.[4] In addition, the differences in the function of excretion and the role of excretory duct cells are currently unknown in salivary glands.[5]

About all methods of tobacco use, predominantly smoking is linked to mouth and it is the smoke of tobacco which spreads to about all parts of the oral cavity and therefore, the taste receptors, a primary receptor site for salivary secretion, are constantly exposed to this smoke during the smoking process.

It has been discovered that smoking increases the activity of salivary glands and, indeed, this observation has been made by every one who begins smoking. It has also been observed that some tolerance develops to the salivatory effects of smoking because habitual smokers do not salivate as do novice smokers in response to smoking.[6] But in a study it was noted that there is no difference in the secretion rate of saliva between smokers and non-smokers, however it was also seen that regular but not immediate smoking did not cause any significant change in the salivary flow rate.[7,8] In an experiment it was discovered that application of nicotine and citric acid solutions at different locations to the tongue increases salivation but with different taste sensations.[9]

Generally it is accepted that long term use of tobacco decrease the sensitivity of taste receptors which in turn leads to depressed salivary reflex. Presumably, this might lead to altered taste receptors response and hence to changes in salivary flow rates. Therefore, the present study was designed to document these changes, if any.

MATERIAL AND METHODS

The subjects of the study were selected from the students of Basic Medical Sciences Institute (BMSI), Jinnah Post Graduate Medical Centre

(JPMC) and the general population of Karachi. The subjects were divided into two groups; smokers and non-smokers as controls. Each group comprised of 20 apparently healthy male adults. All the subjects were well matched with respective to age (25-30 years) and the duration of beginning smoking (5-7 years). Subjects in the habit of more than one type of tobacco use or bad orodontal hygiene or with too little salivary secretion were not included in the study. Before sampling, each subject was briefed about the procedure and instructed to wash his mouth and gargle with plain water. The saliva of each subject was collected for 10 minutes under resting condition and following application of crude nicotine solution (50 ml of 1% v/v) and citric acid solution (50 ml of 1% w/v) to the tip of his tongue. Crude nicotine was extracted from tobacco[10] and citric acid was obtained from the Physiology Department of BMSI, JPMC, Karachi. Flow rate (ml/min) of saliva was determined by allowing the saliva to flow into a graduated tube. The data was statistically analyzed by Student's t test.[11,12]

RESULTS

The resting (basal) salivary flow rates in both the groups showed nearly a steady level during 10 minutes of sampling in the range of 0.46±0.05 to 0.51±0.05 ml/min in smokers and 0.43±0.05 to 0.49±0.05 ml/min in non-smokers (controls). After application of crude nicotine solution (50 ml of 1% v/v) to the tips of their tongues, a gradual increase in the flow rate was seen which reached its peak level (0.71±0.05 ml/min) within 3.0 minutes and subsided to its resting level (0.46±0.05 ml/min) within the next 4.0 minutes in smokers. However, in controls the maximum level (0.72±0.04 ml/min) was reached in 3.0 minutes and declined to its basal level (0.0.41±0.04 ml/min) in the next 6.0 minutes.

Following stimulation with citric acid solution (50 ml of 1% w/v), an abrupt rise in the flow rate was observed which reached its peak level (0.85±0.06 ml/min) within the 1st minute and then gradually came down nearly to its resting level (0.46±0.05 ml/min) within the next 8.0 minutes. In controls similar observations were noted where the peak level (0.89±0.05 ml/min) reached within 1st minute and the basal level (0.0.43±0.05 ml/min) reached within the next 7.0 minutes.

Under resting conditions the mean salivary flow rate of controls (0.44±0.04ml/min) and smokers (0.49±0.05 ml/min) did not show any great variation from each other and no statistically significant difference was observed when the smokers were compared with controls. After stimulation with nicotine, the mean salivary flow rates were increased to 0.54±0.04 ml/min (22.73%) in control and to 0.55±0.05 ml/min (12.25%) in smokers. However, the increase was statistically significant (P<0.05) in controls only but when the increase was compared with each other, it was not significant.

Following stimulation with citric acid, the mean flow rates further increased to 0.59±0.05 ml/min (34.09%) in controls and 0.60±0.05 ml/min (22.45%) in smokers. The increase was not statistically significant in smokers but significant (P<0.05) in controls. However, the increase was not significant when compared with each other.

Table 1: Comparison of salivary flow rates of smokers and non-smokers as controls before and after stimulation with nicotine and citric acid solutions.

Smokers (res)	Smokers (nic)	Smokers (cit)
0.5	0.53	0.85
0.5	0.59	0.81
0.48	0.71	0.74
0.46	0.7	0.62
0.46	0.62	0.54
0.5	0.52	0.49
0.49	0.46	0.51
0.48	0.46	0.48
0.51	0.46	0.46
0.49	0.45	0.48
Controls (res)	**Controls (nic)**	**Controls (cit)**
0.45	0.6	0.89
0.44	0.67	0.8
0.44	0.72	0.74
0.44	0.64	0.66
0.43	0.59	0.58
0.46	0.51	0.47
0.43	0.44	0.45
0.49	0.44	0.43
0.47	0.41	0.43
0.45	0.42	0.43

Each figure represents ml/minute (res = resting condition, nic = after stimulation with nicotine solution, cit = after stimulation with citric acid solution).

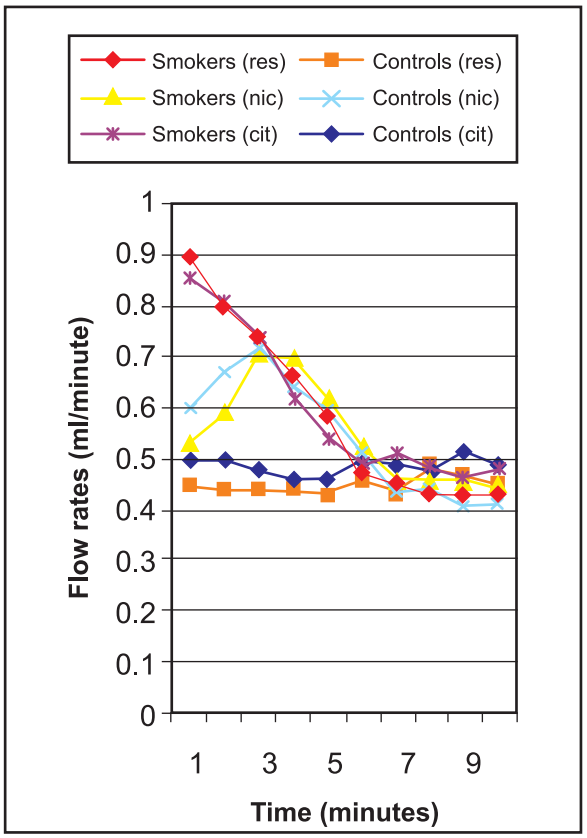

Fig 1: Comparison of salivary flow rates of smokers and non-smokers as controls before and after stimulation with nicotine and citric acid solutions; (res = resting condition, nic = after stimulation with nicotine solution, cit = after stimulation with citric acid solution).

DISCUSSION

The salivary secretion is a complex process and its flow and composition vary greatly under different conditions.[12] In a study it was thought that saliva collected routinely in the laboratory as "resting" saliva is in fact stimulated or activated secretion and gross variation in the rate of its secretion are due to fluctuation in intensity and frequency of internal stimulation. It is said that the secretion of saliva from the salivary glands is generally elicited only in response to stimulation of the autonomic innervations to the glands or in response to drugs that mimic the actions of autonomic innervations.[13-15] was also found that different chemicals stimulate the salivary secretion differently.[16] It has been observed that the pattern of taste sensations and salivary secretion in man following application of compounds, like nicotine and citric acid, to the tongue, which activate lingual sensory neurons, differ not only between the agents used but also between different sites of application[7]. It is suggested that oral mucosal wetness and minor salivary gland secretion could be influenced by various factors differently according to mucosal sites.[17] Moreover, temperature of stimulating substances also affects salivary secretion because the stimuli in the form of ice were the most effective and liquids at 37^0C were least effective in stimulating salivary flow.[18]

It was noted that buffering response in smokers in response to drinking acidic carbonated beverages is 20% lower than in non-smokers. On this basis an inactivation of the taste receptors by nicotine was suggested as an explanation for this depression of the salivary reflex.[19] Although we have not studied the buffering response of saliva in our study, yet we were unable to find any significant difference in the salivary response to stimulating substances between smokers and non-smokers. It seems, therefore, somewhat unreasonable to suggest an inactivation of the taste receptors merely on the basis of lowered buffering response of saliva in smokers[11]. Moreover it was also found that the pH of stimulated whole saliva, in both sexes, was lower in smokers than non-smokers[4]. In our opinion, this lowered buffering response to acidic carbonated beverages might be due to this acidic pH in these individuals. Similarly no statistically significant different was observed for either over all taste sensitivity or for the specific taste primaries between smokers and non-smokers.[20]

We found that lingual apex application of nicotine and citric acid was associated with a rise in salivary secretion rate but the salivation response to citric acid was abrupt and more pronounced as compared to nicotine proving that citric acid is more potent and quicker in its action.

The effect of nicotine on the taste nerve apparatus appears to be initial stimulation followed by depression.[5] In the present and in our earlier study[11] the initial increase in the flow of saliva following stimulation by both nicotine and citric acid and then gradual decline towards its basal level also gives similar impression but before establishing such an opinion it must be borne in mind that increased flow of saliva also gradually washes away the stimulating substances. It has recently been revealed that taste function presents significant resistance to smoking.[21]

CONCLUSION

In view of the present experimental work it is concluded that smoking does not adversely affect salivary reflex and salivary secretion.

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