SECRETION OF CALCIUM IN THE SALIVA OF LONG-TERM TOBACCO USERS

Ghulam Jillani Khan, Rashid Mehmood, Salah-ud-Din, Fida Muhammad Marwat, Ihtesham-ul-Haq, Jamil-ur-Rehman

Department of Physiology, Khyber Medical College Peshawar

Background: Secretion of calcium in saliva depends upon salivary flow rates in non-tobacco users and greater is the rate, lower is the concentration and vice versa. In long-term tobacco users the taste receptors, a primary site for salivary secretion, are constantly exposed to tobacco for long time thus presumably affecting the salivary reflex. Therefore the main purpose of the study was to study the secretion of calcium in the saliva of theses individuals. **Methods:** Subjects of the study were divided into smokers, pan, (tobacco-betel-lime "quid") chewers, niswar (moist oral snuff) dippers and non-tobacco users as controls. Each group was 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 solutions to the tip of his tongue. **Results:** All groups of long-term tobacco users exhibited significantly higher concentrations of calcium before and after stimulation when compared with controls .However significant drop was observed in calcium levels of all groups including controls after stimulation but this drop was more pronounced after stimulation with citric acid than after stimulation with nicotine. **Conclusion:** We conclude that higher levels of calcium are present in the saliva of long-term tobacco users than non users which decreases as the flow of saliva increases.

Key Words: Saliva, calcium, tobacco users.

INTRODUCTION

In vertebrates, calcium is the major component of bones and teeth, and it is not surprising that disturbances in calcium metabolism have been implicated in most of the major chronic diseases, including osteoporosis, kidney disease, obesity, heart disease, and hypertension.[1] The traditional methods of tobacco use are smoking, snuffing, chewing and dipping. It was in18th century when it was discovered that smoking increases the activity of salivary glands. Indeed, this observation has been made by every one who begins smoking but some tolerance develops to the salivary effects of smoking because habitual smokers do not salivate as do novice smokers in response to smoking.[2] Pan (tobacco betel lime "quid") chewers secreted more saliva as compared to non-chewers on chemical but not on mechanical stimulation leading to concomitant decrease in enzyme and electrolyte contents.[3] However it has also been proved that sensation of taste and salivary flow rates in chronic tobacco users are not much different from that in non tobacco users,[4] and there is no difference in the secretion rate of saliva between smokers and non-smokers.[5] It was also observed that regular, but not immediate, smoking did not cause any significant change in the salivary flow rate.[6] With the increase in salivary flow rate, the sodium concentration increases and that of potassium decreases, and this observation in chronic tobacco users is not much different from that in non tobacco user. After smoking, there is temporary increase in the salivary content of calcium, potassium and phosphate.[2] In long-term tobacco users, the taste receptors, a primary site for stimulation of salivary secretion, are constantly exposed to tobacco for long time thus presumably affecting the salivary reflex. Therefore the main purpose of the study was to study the secretion of calcium in the saliva of these individuals.

MATERIAL AND METHODS

The subjects 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 smokers, pan (tobacco-betel-lime quid) chewers, niswar (moist oral snuff) dippers and non-tobacco users as controls. Each group was 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 tobacco use (5-7 years). Subjects in the habit of more than one type of tobacco use or bad oro-dental 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 µl of 1% v/v) and citric acid solution (50 µl of 1% w/v) to the tip of his tongue. Crude nicotine was extracted from tobacco[7] and citric acid was

obtained from the Physiology Department of BMSI, JPMC, Karachi. The concentration of calcium was determined by a kit obtained from Bio-Merieux, ref. 6 104 1. The data was statistically analyzed by Student's T test.

RESULTS

The concentration of calcium under resting condition (before stimulation)was 1.07±0.07 mml/l in controls, 1.30±0.09 mml/l in smokers, 1.30±0.07 mml/l in pan chewers and 1.39±0.09 mml/l in niswar dippers. The difference was statistically significant ($P < 0.05$) in smokers and pan chewers, and highly significant ($P < 0.005$) in niswar dippers when compared with controls.

Following stimulation with nicotine, the level dropped to 0.86±0.05 mml/l (19.63 % drop) in controls, 1.14±0.08 mmol/l (12.31 % drop) in smokers, 1.16±0.05 mmol/l (10.77 % drop) in pan chewers and 1.26±0.08 mmol/l (9.35 % drop) in niswar dippers. This drop was significant ($P < 0.05$) in controls but not in all tobacco user groups . However, the difference between the corresponding mean values of controls and all tobacco user groups was highly significant ($P < 0.005$). After stimulation with citric acid, calcium levels in saliva dropped further to 0.80±0.04 mmol/l (25.23 % drop) in controls, to 1.03±0.07 mmol/l (20.77 % drop) in smokers, to 1.04+/-0.04 mmol/l (20.00 % drop) in pan chewers and to 1.11±0.09 mmol/l (20.14 % drop) in niswar dippers. The decrease was significant ($P < 0.05$) in smokers and niswar dippers but highly significant ($P < 0.005$) in controls and pan chewers. However, the difference between the corresponding mean values of controls and all tobacco user groups was highly significant ($P<0.005$).

Table-1: Salivary calcium levels (mmol/l±S.E) in long-term tobacco-users and non-users.

Groups	Before Stimulation	Following Stimulation with	
		Nicotine	Citric Acid
Controls	1.07±0.07	0.86±0.05 (19.63%)	0.80±0.04 (25.23%)
Smokers	1.30±0.09	1.14±0.08 (12.31%)	1.03±0.07 (20.77%)
Pan chewers	1.30±0.07	1.16±0.05 (10.77%)	1.04±0.04 (20.77%)
Niswar Dippers	1.39±0.09	1.26±0.08 (9.35%)	1.10±0.09 (20.14%)

DISCUSSION

Our results showed that the concentration of calcium in the saliva is mainly flow dependent both in tobacco users and non users and its concentration falls when the flow of saliva increases. In some earlier studies it was pointed out that concentration of both potassium and calcium are independent of salivary flow rate[11] but later on this observation was proved to be incorrect and indeed the calcium concentration falls when the salivary flow rate increases.[8]

It is generally accepted that saliva is secreted in two stages. First, the saliva is secreted into the acini of salivary glands and this fluid (primary secretion) is not much different from extra-cellular fluid (E.C.F.). Secondly, when the primary secretion flows through the acinar ducts, some ions are actively reabsorbed from and some are actively secreted into the acinar duct lumen. During maximal salivation, there is not much time for this process to occur and the levels of these ions are reversed.[9] We found significantly higher levels of calcium in the saliva of all tobacco users as compared to non users. In niswar dippers and pan chewers this may be due to the fact that pan and niswar contain lime ($Ca(OH)_2$) as one of its essential ingredients and there is a strong possibility that lime may get entangled in the gums and in between the teeth of these individuals which may flow with saliva during the process of sampling . However, the higher levels of calcium in the saliva of smokers cannot be explained on this basis.

The buffers in saliva maintain the oral pH at about 7.00 to prevent calcium loss from the teeth because at this pH, the saliva is saturated with calcium[10] but in smokers the oral pH is lower than non smokers.[6] Therefore, there is a great possibility for this acidic pH to extract calcium from the scales deposited on their teeth (or even from their teeth) of these individuals which might have been resulted in the elevated levels of salivary calcium. Another possibility may be that heavy smokers seem to have lower bone mineral density and higher salivary calcium than their non-smoking counterparts. So it was suggested that the high salivary calcium concentration of smokers is in connection with skeletal calcium disturbances.[11]

Therefore, on the basis of our experimental work, we conclude that higher levels of calcium are present in the saliva of long-term tobacco users than non-users and the calcium concentration decreases as the flow of saliva increases. Moreover, this latter observation in chronic tobacco users is not much different from that in non users.

REFERENCES

1. Tordoff MG. Calcium: Taste, Intake, and Appetite. Physiol Rev 2001;81:1567-97
2. Larson PS, Haag HB, Silvette H. Tobacco, Experimental and Clinical Studies. Baltimore, The Williams and Wilkins Company,1961.

3. Reddy MS, Naik SR, Bagga OP, Chuttani, HK. Effect of chronic tobacco-betel-lime "quid" chewing on human salivary secretions. Am J Clin Nutr 1980;33:77-80.
4. Khan GJ, Mehmood R, Salah-ud-Din, Ihtesham-ul-Haq. Effects of long-term use of tobacco on taste receptors and salivary secretion. J Ayub Med Coll 2003;15(1):37-9.
5. Heintz U. Secretion rate, buffer effect and number of lactobacilli and streptococcus mutans of whole saliva of cigarette smokers and non-smokers. Scand J Dent Res 1984;1:294-301.
6. Parvinen T. Stimulated Salivary flow rate, pH and lactobacillus and yeast concentrations in non-smokers and smokers. Scand J Dent Res 1984;92:315-8.
7. Pavia DL, Lampman GM, Kriz Jr GS. Introduction to Organic Laboratory Techniques. A Contemporary Approach. W B Saunders Company. Philadelphia. 1976:46-54.
8. Burgen ASV. The secretion of potassium in saliva. J Physiol 1956;132:20-39.
9. Jonhansson I, Ericson T, Steen L. Studies of the effect of diet on saliva secretion and development and the effect of fasting on the saliva composition of female subject. J Nutr 1984;114:2010-20.
10. Guyton AC, Hall JE. In:Textbook of Medical Physiology. Harcourt A Health Sciences Company. Philadelphia. WB Saunders and company. 2000: 738-53.
11. Ganong WF. Review of Medical Physiology. Appleton and Lange. Medical Publishing Division. California. 1987:406-7.
12. Sewon L, Laine M, Karjalainen S, Doroguinskaia A, Lehtonen-Veromaa M. Salivary calcium reflects skeletal bone density of heavy smokers. Arch Oral Biol 2004;49(5):355-8

Adress For Correspondence:
Dr. Ghulam Jillani Khan, Department of Physiology, Khyber Medical College, Peshawar, Pakistan