

# **Comparative characteristics of the content of serum IgG in the oral fluid in patients using traditional and electronic cigarettes**

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Abstract. Introduction: Saliva is the first line of defense against harmful factors entering the oral cavity. The most important role in the creation of local immunity of the oral cavity is played by antibodies participating in the neutralization and removal of pathogenic microorganisms from the body. The function of antibodies in the body is performed by immunoglobulins, represented by five classes: G, M, A, D and E. Studies aimed at studying the role of IgG have proven that they are able to mediate active humoral protection in various parts of the mucous membrane, the absence of changes in the IgG content in the oral fluid indicates the stability of the nonspecific protection of the oral cavity. The factors that can weaken the local immunity of the oral cavity include smoking conventional and electronic cigarettes. Objective of the study: to evaluate the effect of traditional and electronic cigarettes on the serum IgG content in unstimulated saliva. Materials and methods: 73 people of both sexes, aged 19 to 63, took part in the study, the participants were divided into 3 groups: 1st group: 28 people who smoke regular cigarettes, 2nd group: 27 people who smoke electronic cigarettes, 3rd: 18 people who do not smoke anything. The concentration of immunoglobulin G was determined in mixed saliva by enzyme immunoassay. Results of the study: among the participants of the 1st group, the total value of the serum IgG content in the oral fluid was  $3.327321 \cdot 10^{-2}$  g/l, the 2nd group:  $2.46963 \cdot 10^{-2}$  g/l, the 3rd group:  $3.260556 \cdot 10^{-2}$  g/l. Conclusions: the results of the study reflect varying degrees of deviation from the norm in the IgG content in a

large number of examined participants of the first and second groups, which indicates the instability of the nonspecific protection of the oral cavity. The lowest IgG values are observed in the group of e-cigarette smokers, which once again casts doubt on their safety in comparison with traditional cigarettes.

Keywords: local oral immunity, smoking, traditional cigarettes, electronic cigarettes, serum immunoglobulin G.

Saliva is the first biological fluid that comes into contact with everything that enters the oral cavity, so it is an important line of defense against emerging harmful factors. Saliva moisturizes and cleanses the tissues of the oral cavity, maintains the species composition of the microflora of the oral cavity, forms a protective barrier of mucin, antibodies, enzymes, etc. The surfaces of the mucous membranes, in particular, the oral cavity, are the main point of contact with numerous infectious agents. The first line of defense is provided by an indiscriminate mechanical action - the barrier of epithelial cells.

A more specialized action is carried out and regulated by dendritic antigen-presenting cells and other cells of the immune system of the mucous membrane, located in the local lymphoid compartments that make up the lymphoid tissue associated with the mucous membrane, as well as in the lamina propria of the mucous membrane. Cellular immunity plays an obvious role in the induction and coordination of an adaptive immune response on the surface of the mucous membranes [1], but in our work we would like to separately highlight the importance of the humoral immune response. The most important role in it is played by antibodies involved in neutralizing and removing pathogenic microorganisms from the body, as well as various substances identified by the immune system as foreign antigens. The function of antibodies in the body is performed by immunoglobulins synthesized by plasma lymphoid cells. In humans, immunoglobulins are represented by 5 classes (G, M, A, D and E). If we consider the oral cavity, then the greatest importance is always given to the role of secretory IgA, which is present in the highest concentrations on the mucous membrane in comparison with other immunoglobulins, which, despite this, play an important role in the formation of oral immunity.

In humans, IgG makes up 75% of the total amount of antibodies, and all other classes of immunoglobulins make up about 25% in total [2]. IgG, as a rule, are the main factor of the humoral link of the immune defense, which counteracts the development of the infectious process in the

body. Serum IgG enters saliva from blood plasma through the small salivary glands and the gingival sulcus. It is believed that saliva IgG mainly comes from the bloodstream, while a smaller part (less than 20%) is produced by local plasma cells in cases of lesions of the gums or salivary glands [3].

Little attention is paid to the value of the presence of IgG in the external secretion in the literature [4], but recent studies have demonstrated that they are able to mediate active humoral protection in various parts of the mucous membrane, in particular, the studies of L.E. Westerman and co-authors confirmed that serum IgG provides immunity mucous membranes against rotavirus infection [5]. Parenteral administration of passive neutralizing IgG has been shown to prevent lung infection by *Streptococcus pneumoniae* [6]. Normally, the value of IgG in unstimulated saliva is  $4.00 \pm 0.3 \cdot 10^{-2}$  g/l [7]. The absence of changes in the content of IgG in the oral fluid indicates the stability of the nonspecific protection of the oral cavity.

There are many factors that weaken the local immunity of the oral cavity, including smoking conventional cigarettes and their modern counterparts - electronic cigarettes. Smoking is a serious problem for the health care system around the world [8], it affects both innate and adaptive immunity, by exacerbating pathogenic immune responses or weakening protective immunity. Chemical compounds contained in tobacco smoke, dissolving in saliva, change its biochemical composition, reduce the activity of saliva enzymes [9, 10]. In addition, tobacco smoke is physically harmful as it increases the temperature of the mouth and causes tissue burns. Clinical examination revealed among tobacco users: hyperpigmentation, black hairy tongue, superficial glossitis, periodontitis, leukoedema, nicotinic stomatitis, leukoplakia, or neoplasm [11].

In the past 10 years, electronic cigarettes have become increasingly popular, especially among young people, including those who have not yet smoked traditional cigarettes [12]. For most people, electronic cigarettes are perceived as a less harmful alternative to traditional ones, however, recently there has been more and more controversy on this issue. They were initially perceived as a less harmful alternative to tobacco smoking; however, this is becoming more and more controversial [13]. The aerosol generated by the use of electronic cigarettes leads to the appearance of side effects in the oral cavity: death of the oral epithelium [14] and periodontal fibroblasts occurs, and an increase in the release of anti-inflammatory cytokines occurs [15]. However, the full effect of conventional and electronic cigarettes and on the state of local immunity of the oral cavity is not fully understood.

Objective: to evaluate the effect of traditional and electronic cigarettes on the serum IgG content in unstimulated saliva.

## Materials and methods

The study involved 73 people of both sexes aged 19 to 63 years, without pronounced concomitant somatic pathology and without severe inflammatory periodontal diseases. All participants were divided into 3 groups: 1st group: 28 people who smoke regular cigarettes, including 17 men and 11 women. 2nd group: 27 people who smoke electronic cigarettes, including 15 men and 12 women, 3rd group: 18 people who smoke nothing, including 9 men and 9 women. The concentration of immunoglobulin G was determined in mixed saliva, which was taken from subjects in the morning on an empty stomach before brushing their teeth without stimulating the salivary glands, by spitting into a sterile plastic tube in an amount of 5 ml. The test tube with oral fluid was tightly closed with a sterile cotton swab, signed with a serial number and stored vertically frozen. The quantitative determination of serum immunoglobulin G was carried out by the method of enzyme immunoassay at the Institute of Traumatology FSBEI HE "PRMU" of the Ministry of Health of Russia. For the evaluation and comparative characteristics of the results, the method of analysis of variance, the Biostat program, and the Microsoft Excel software product using the Student's test were used.

## Research results

Among the participants of the 1st group, the total value of the serum IgG content in the oral fluid was  $3.327321 \cdot 10^{-2} \text{g/l}$ , and among men it was  $3.384941 \cdot 10^{-2} \text{g/l}$ , and among women  $3.238273 \cdot 10^{-2} \text{g/l}$ .

Among the participants of the 2nd group, the total value of the serum IgG content in the oral fluid was  $2.46963 \cdot 10^{-2} \text{g/l}$ , and among men it was  $2.616733 \cdot 10^{-2} \text{g/l}$ , and among women  $2.28575 \cdot 10^{-2} \text{g/l}$ .

Among the participants of the 3rd group, the total value of the serum IgG content in the oral fluid was  $3.260556 \cdot 10^{-2} \text{g/l}$ , and among men it was  $3.065556 \cdot 10^{-2} \text{g/l}$ , and among women  $3.455556 \cdot 10^{-2} \text{g/l}$ .

## Conclusions

The results of the study show that the most optimal serum IgG content is determined in the group of non-smoking women, and the lowest in the group of women who smoke electronic cigarettes. It should be noted that in the group of subjects who smoke regular cigarettes, the indicator is also close to the normal limits, however, if we consider not the overall value of the indicators, but individual ones, then among the participants in the third group, the serum IgG content is within the normal range in 9 out of 18 surveyed (50 % of the total), in other 9 this indicator is close to the values of the

norm. Among the participants of the first group, the indicator is within the normal range only in 7 out of 28 surveyed (25% of the total number), for the rest of the participants in this group, the indicator value is in a wide range from  $1.468 \cdot 10^{-2} \text{g/l}$  to  $5.59 \cdot 10^{-2} \text{g/l}$ . Among the participants of the second group, the value of serum IgG is within the normal range in 1 of the subjects (5.9% of the total), in 12 people it is below  $3.4 \cdot 10^{-2} \text{g/l}$ , in 4 people it is above  $4.6 \cdot 10^{-2} \text{g/l}$ . Thus, we observe deviations from the norm in the IgG content in a large number of examined participants in the first and second groups, which indicates the instability of the nonspecific protection of the oral cavity. The lowest IgG values are observed in the group of e-cigarette smokers, which once again casts doubt on their safety in comparison with traditional cigarettes. In conclusion, it is worth noting the relative hygiene of the use of traditional cigarettes, since they are disposable, and, most often, one cigarette is consumed by one person. If we talk about the use of electronic cigarettes, then it should be borne in mind that the device supplying smoke is reusable, which contributes to the accumulation of microorganisms and various substances on its surface. In addition, sometimes in companies, people share one electronic device, which is not hygienic, since there is an imperceptible salivation, there is a high probability of contracting many infectious diseases, including the herpes virus and tuberculosis, all of which together contribute to a decrease in the local immunity of the oral cavity.

## References

1. Belyakov IM, Ahlers JD. What role does the route of immunization play in the generation of protective immunity against mucosal pathogens? *J Immunol* (2009) 183:6883–92. doi:10.4049/jimmunol.0901466
2. Spiegelberg H.L. // *Adv. Immunol.* 1974. V. 19. P. 259–294
3. Brandtzaeg P. Secretory immunity with special reference to the oral cavity. *J Oral Microbiol.* (2013) 5:20401. 10.3402/jom.v5i0.20401
4. Horton RE, Vidarsson G. Antibodies and their receptors: different potential roles in mucosal defense. *Front Immunol.* (2013) 4:200. 10.3389/fimmu.2013.00200
5. Westerman LE, McClure HM, Jiang B, Almond JW, Glass RI. Serum IgG mediates mucosal immunity against rotavirus infection. *Proc Natl Acad Sci U S A* (2005) 102:7268–73. doi:10.1073/pnas.0502437102
6. Saeland E, Vidarsson G, Leusen JH, Van Garderen E, Nahm MH, Vile-Weekhout H, et al. Central role of complement in passive protection by human IgG1 and IgG2 anti-pneumococcal antibodies in mice. *J Immunol* (2003) 170:6158–64.

7. E.I. Shabunina, L.G. Komarova, L.V. Korkotashvili "Handbook of laboratory diagnostics in pediatrics" edited by prof. Volkova A.I., N. Novgorod, 2004.
8. Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. *BMJ*. 2004;328:1519.
9. Weiner D., Levy Y., Khankin E.V., Reznick A.Z. Inhibition of salivary amylase activity by cigarette smoke aldehydes. *J. Physiol. Pharmacol.* 2008;59:727–737.
10. Salaspuro V., Salaspuro M. Synergistic effect of alcohol drinking and smoking on in vitro acetaldehyde concentration in saliva. *Int. J. Cancer*. 2004;111:480–483. doi: 10.1002/ijc.20293.
11. Michalak E, Halko-Gąsior A, Chomyszyn-Gajewska M. [The impact of tobacco on oral health - based on literature]. *Przegl Lek.* 2016;73(7):516-9. Polish. PMID: 29677424.
12. Maj A., Kusiak A., Wojtaszek-Slominska A., Kalinowska J., Zdrojewski T., Suligowska K. Electronic cigarettes use among 10–11-years old: Preliminary report. *Dent. Forum*. 2018;46:31–34. doi: 10.20883/df.2018.4.
13. Pisinger C., Dossing M. A systematic review of health effects of electronic cigarettes. *Prev. Med.* 2014;69:248–260. doi: 10.1016/j.ypmed.2014.10.009.
14. Semlali A., Chakir J., Goulet J.P., Chmielewski W., Rouabhia M. Whole cigarette smoke promotes human gingival epithelial cell apoptosis and inhibits cell repair processes. *J. Periodontal Res.* 2011;46:533–541. doi: 10.1111/j.1600-0765.2011.01370.x.
15. Sundar I.K., Javed F., Romanos G.E., Rahman I. E-cigarettes and flavorings induce inflammatory and pro-senescence responses in oral epithelial cells and periodontal fibroblasts. *Oncotarget*. 2016;7:77196–77204. doi: 10.18632/oncotarget.12857.