THE NEW ARMENIAN MEDICAL JOURNAL
Vol.11 (2017), No 1, p.76-82

CLINICAL DENTAL AND CLINICAL LABORATORY EXAMINATION OF PATIENTS WITH IMPAIRED FUNCTION OF SALIVA GLANDS AND ORAL MUCOSAL DISEASES

YESSAYAN L.K.

Department of Therapeutic and Family Stomatology, Yerevan State Medical University, Yerevan, Armenia

Received 11/05/2016; accepted for printing 20/01/2017

ABSTRACT

The oral cavity is a complex ecological system in which external factors interact with internal ones. As in the environment, all components of the oral cavity system are in dynamic balance. For this purpose acid-base balance plays an important role in the oral cavity. A significant role in the pathogenesis and progression of the diseases of mucous membrane is played by the state of acid-base balance in the oral cavity.

In the oral cavity, oral fluid is the main regulator of acid-base balance. At the same time, the state of this balance significantly affects the functions of the oral fluid.

Present study was aimed to describe and analyze the results of clinical dental and clinical laboratory examination of patients with impaired salivation and independent diseases of mucous membrane by the example of candidiasis and leukoplakia (monopathology).

Patients with chronic oral mucosal diseases, who had no concomitant general somatic pathology as a result of a comprehensive medical examination, were assigned to the study group of patients (132 patients). In the first subgroup of this group of patients, we combined patients with a violation of salivation, that is, with hyposalivation. In the subgroup "HS" we managed to attract 23 people. The second subgroup of this group united patients with fungal lesions of the oral mucosa (candidiasis). The subgroup "C" included 62 patients. The third subgroup included patients, who were diagnosed with leukoplakia of oral mucosa, mostly flat shaped. Practically all 47 patients of "L" subgroup were tobacco smokers.

Clinical dental and clinical laboratory examination of patients with impaired salivary gland function and diseases of mucous membrane showed that in this pathology there are noticeable changes in a number of indices of the oral fluid, which can directly or indirectly affect the condition of local homeostasis in the oral cavity and acid-base balance.

KEYWORDS: *oral mucosal diseases, hyposalivation, candidiasis, leukoplakia, oral fluid, saliva, acid-base balance.*

Introduction

The oral cavity is a complex ecological system in which external factors interact with internal ones (tooth tissues, parodontium, biofilm, local immune system, epithelium of oral mucosa, oral fluid, nerve endings) [*Martynova E et al., 2008; Volozhin A, Rumyantsev V, 2007*]. As in the environment, all components of the oral cavity system are in dynamic balance.

For this purpose acid-base balance plays an important role in the oral cavity. This balance is the most important element of local homeostasis [*Rumyantsev V, 1999; Malkin H, 2003*]. A significant role in the pathogenesis and progression of the diseases of mucous membrane is played by the state of acid-base balance in the oral cavity [*Sanli H et al., 2002; Marchini L et al., 2007; Agha-Hosseini F et al., 2009*]. pH of pure saliva depends on the rate of its secretion [*Anissimova I et al., 2005*]. The tendency of pH increase with increasing secretion rate of salivary is detected, and in hyposalivation, microbiocenosis is changed in the oral cavity [*Ryo K et al., 2006 a,b*].

ADDRESS FOR CORRESPONDENCE:
Lazar K. Yessayan
Department of Therapeutic and Family Stomatology
Yerevan State Medical University after M. Heratsi
2 Koryun street, Yerevan 0025, Armenia
Tel: (+374 60) 62-14-24
E-mail: lazyes@yandex.ru

In the oral cavity, oral fluid is the main regulator of acid-base balance. At the same time, the state of this balance significantly affects the functions of the oral fluid.

Many factors influence the salivation and saliva composition of humans, such as: state of the central and peripheral nervous systems, presence of systemic somatic diseases, circadian rhythm, nature of nutrition and age [*Humphrey S, Williamson R, 2001*].

Protective function of saliva is aimed at preserving the structure and function of the mucosa, periodontal tissues, contacting with environmental factors (air, food, microflora, etc.). Saliva bathes all areas of the oral mucosa and, having buffer properties, neutralizes alkaline and acid agents [*Mashru R et al., 2005; Stryuk R, 2008; Yamamoto K et al., 2008; Golecka-Bakowska M et al., 2010*].

Present study was aimed to describe and analyze the results of clinical dental and clinical laboratory examination of patients with impaired salivation and independent diseases of mucous membrane by the example of candidiasis and leukoplakia (monopathology).

Material and methods

Patients with chronic oral mucosal diseases, who had no concomitant general somatic pathology as a result of a comprehensive medical examination, were assigned to the study group of patients. This group included 132 patients (Table 1).

In the first subgroup of this group of patients, we combined patients with a violation of salivation, that is, with hyposalivation. In the subgroup "HS" we managed to attract 23 people. The cause of decreased salivation in them were radiation injuries of salivary glands in the anamnesis (8 patients), chronic parenchymal or interstitial parotitis (7 patients), vegetative-vascular dystonia (sympathicotonia – 8 patients). This subgroup included only those patients whose rate of non-stimulated salivation was less than 0.3 *ml/min*. Additional exclusion criteria were: rheumatoid arthritis, systemic lupus erythematosus, autoimmune diseases of the liver and biliary tracts, avitaminosis, hyposiderosis, diabetes mellitus.

The second subgroup of this group united patients with fungal lesions of the oral mucosa (candidiasis). The subgroup "C" included 62 people. Oral candidiasis, often accompanied by glossitis and cheilitis, developed as a result of uncontrolled prolonged use of antibiotics or corticosteroids in the recent medical history, as well as unsatisfactory oral hygiene on the background of low immunity (viral or bacterial infections in the recent medical history). In all cases, the diagnosis was confirmed by laboratory examinations. Additional exclusion criteria were lichen planus, leukoplakia of oral mucosa, specific infections.

The third subgroup included patients, who were diagnosed with leukoplakia of oral mucosa, mostly flat shaped. Practically all 47 patients of "L" subgroup were tobacco smokers. We considered chronic mucosal injury and abuse of hot food as the cause of leukoplakia only in 3 patients. Additional exclusion criteria were lichen planus, oral candidiasis, specific infections.

At this stage, comprehensive dental examination was conducted to all volunteers, and the following indicators were studied:

- prevalence and intensity of dental caries
- prevalence and intensity of periodontal diseases

Table 1

Characteristics of groups and subgroups of examined patients

Groups and subgroups	Nosological forms of diseases	ICD-10	Number of examined male patients aged 35-44 years (n=132)
Hyposalivation	Disturbance of salivary gland secretion	K11.7	23
Candidiasis of oral mucosa	Oral candidiasis	B37.0	62
Leukoplakia of oral mucosa	Leukoplakia of oral mucosa (flat shaped)	K13.2	47
Note: *ICD – International Classification of Diseases (2010)*			

- total plaque index, interdental and lingual indicators of the integrated hygiene index (IHI)
- index of dental calculus intensity
- the rate of stimulated and non-stimulated salivation:
- qualitative composition of microflora of dental and lingual plaque, gingival sulcus or periodontal pocket
- saccharose and carmabide pH-tests were performed in oral fluid, dental and lingual plaque

In the oral fluid was determined:

- viscosity before and after stimulation of salivation
- buffer capacity by acid and alkaline before and after stimulation
- total acidity
- content of saccharose
- clearance of saccharose
- level of lysozyme
- complement titer
- concentration of immunoglobulins A, G and sIgA
- pH
- qualitative composition of microflora

We did not observe any significant deviations from the typical clinical picture of this pathology. The nature of complaints, anamnestic data, objective clinical manifestations in the oral cavity corresponded (with individual variations) to known symptoms.

The results of assessing the state of oral hygiene, teeth and periodontal tissues in the examined group of patients are shown in table 2. Its analysis shows that the average amount of dental plaque detected by the integrated hygienic index on the visible surfaces of the teeth among the subgroups of patients was minimal in patients with fungal lesions of mucous membrane (subgroup "C"). In patients with leukoplakia (subgroup "L"), it was on the average 44.0% higher, and maximum in patients with impaired salivary gland function (subgroup "HS") – 74.0% higher. The difference between all subgroups by the general index (G-IHI) was statistically significant ($p<0.0001$).

The mean value of the interdental index (I-IHI) was minimal in patients of subgroup "L", and maximum in patients of the subgroup "HS" ($p<0.0001$).

The minimum amount of lingual plaque (L-IHI index) was detected in patients of subgroup "L".

Table 2

Clinical indicators of the state of dentures, parodontium and oral hygiene in patients of 2 groups with oral mucosal diseases

Indices		Designations and units of measurement	Values of indicators in subgroups (M±m, n)		
			"HS" (n=23)	"C" (n=62)	"L" (n=47)
Integrated hygienic index	General index	G-IHI points	2.61±0.042	1.50±0.004	2.16±0.004
	Interdental index	I-IHI points	2.77±0.047	1.59±0.004	1.43±0.004
	Lingual index	L-IHI points	2.14±0.044	2.78±0.007	0.94±0.003
Caries Filling Extraction Index		Caries Filling Extraction Index (points)	17.3±0.52	9.2±0.17	11.6±0.27
Papillary-marginal-alveolar index		Papillary-marginal-alveolar index (%)	62.1±0.94	27.2±0.84	34.5±0.82
Index of dental calculus intensity		Index of dental calculus intensity (points)	0.34±0.017	1.24±0.066	2.42±0.085
Number of individuals with signs of periodontal lesions	Angiostaxis	%	87.0	41.9	76.6
	Dental calculus	%	21.7	46.8	90.7
	Periodontal pockets 3-5 *mm*	%	47.8	21.0	39.5
	Periodontal pockets >6 *mm*	%	30.4	4.8	9.5

The magnitude of the indicator in the examined subgroup "HS" was 2.3 times higher and 3.0 times higher in patients of subgroup "C". Definitely, the differences between the mean values of the lingual index in the subgroups were statistically significant ($p<0.0001$).

Attention is drawn to the high values of all indicators of the state of oral hygiene in patients with impaired salivary gland function (on average more than 2 points), as well as the high value of the lingual index in patients with fungal lesions of the oral cavity.

Since almost all the average values of the estimated indicators in the subgroups turned out to be more than 1 point, we can state that they have an unsatisfactory hygienic condition of the oral cavity. This is especially typical for patients of the subgroup "HS".

The prevalence of dental caries in the examined patients was 100%. The intensity of caries (according to the Caries Filling Extraction Index) in the "HS" subgroup, exceeding 17 points, was very high. The lowest average index was in the subgroup "C" (9.2±0.17). For 2.4 points more it was found in patients of subgroup "L" and for 8.1 points more in patients with impaired salivary gland function (subgroup "HS", $p<0.0001$). Chronic catarrhal generalized gingivitis was diagnosed in 2 examined patients of the "HS" subgroup (8.8%). Periodontitis of varying severity was diagnosed in 78.2%. Here the prevalence of periodontitis was 8.9 times higher than that of gingivitis. At the same time, 30.4% of those examined had a severe degree of periodontitis.

In the subgroup "C", 10 generalized patients (16.1%) also had chronic generalized gingivitis. In two patients, this was hypertrophic form, while in the others – catarrhal form. Periodontitis of various severity was detected in 16 persons (25.8%), which also indicates the prevalence of this pathology in the subgroup 1.6 times in the structure of periodontal inflammatory diseases. Severe degree of periodontitis was detected in 4.8% of patients.

Among patients with leukoplakia, gingivitis (of different prevalence and forms) was diagnosed in 13 patients (27.6%), and 23 patients (49.0%) had periodontitis of various severity, thereat severe degree was found in 9.5% patients.

According to the PMA (Papillary-marginal-alveolar) index, gingvitis was mostly pronounced in patients of subgroup "HS", and for the lowest – in patients with fungal lesions of the mucous membrane. The difference was in 2.3 times ($p<0.0001$).

According to the average values of the index of tartar deposit intensity, it was the highest in patients with leukoplakia and exceeded that of in patients with candidiasis by 2.0 times ($p<0.0001$). And the difference with the subgroup "HS" was 7.1 times ($p<0.0001$).

The prevalence of the signs of periodontal diseases in the subgroups was quite high. Thus, the symptom of gingival hemorrhage was noted in 87.0% of patients of the subgroup "HS", in 76.6% of patients of subgroup "L" and in 41.9% of patients of subgroup "C" ($p<0.001$). The lowest frequency of detection of solid dental deposits was in patients of the subgroup "HS" (21.7%), 2.2 times more in patients of the subgroup "C" and 4.2 times in the subgroup "L" ($p<0.001$). The last figure can be explained by the fact that almost all patients of this subgroup smoke. Parodontal pockets with a depth of up to 5 *mm* were detected in 21% of patients in subgroup "C", 39.5% of the examined in subgroup "L" and 47.8% of patients in the subgroup "HS'. Deeper pockets were revealed 2.3 times more often in patients of subgroup "HS" than in patients of subgroup "C" ($p<0.001$)

In the subgroups of examined patients, the comparison of the ratio of the number of patients with the symptom of gingival hemorrhage and those with periodontal pockets showed that in the "HS" subgroup patients this ratio is 1:1, 11; in patients of subgroup "C" – 1:1, 62; and in patients of subgroup "L' – 1:1; 56. The first figure suggests that if the salivary gland function is impaired, the inflammatory process in the periodontal tissues quickly passes into the destructive stage of periodontitis.

Thus, the conducted clinical dental examination showed that there is a high prevalence of dental caries and periodontal inflammatory diseases, accompanied by unsatisfactory hygienic state of the oral cavity, in patients with certain diseases of mucous membrane, as well as with impaired salivary gland function. Incomplete hygiene and self-cleaning of the oral cavity under such conditions can lead to the biocenosis change in mouth and are important local factors destabilizing the acid-base balance.

Indicator alues of oral fluid without stimulation in the examined patients of 2 groups are presented in table 3.

Analysis of the data presented in this table

TABLE 3

Values of a number of oral fluid indicators without stimulation in examined patietns of 2 groups with oral mucosal diseases

Indices	Designations and units of measurement	Values of indicators in subgroups (M±m, n)		
		"HS" (n=23)	"C" (n=62)	"L" (n=47)
Total acidity	TA ($mg \times eq/dm^3$)	0.037±0.0088	0.018±0.0035	0.022±0.0029
Content of saccharose	S (%)	1.56±0.031	0.97±0.022	0.79±0.014
Clearance of saccharose	C_S (*min*)	23.4±0.20	12.3±0.18	11.5±0.13
Level of lysozyme	L (*mkg/ml*)	0.06±0.009	0.11±0.03	0.11±0.02
Complement titer	CT	1:1.05±0.032	1:1.10±0.034	1:1.62±0.031
Concentration of immunoglobulin A	IgA (*mg/ml*)	0.05±0.007	0.09±0.005	0.10±0.004
Concentration of immunoglobulin G	IgG (*mg/ml*)	0.11±0.008	0.18±0.005	0.20±0.005
Concentration of secretory immunoglobulin A	s-IgA (*mg/ml*)	0.09±0.011	0.30±0.007	0.32±0.007

shows that the total acidity of the oral fluid was the lowest in the patients of subgroup "C". A bit higher (22.2% on average), it was in patients of subgroup "L", and even higher (by 105.6%) – in patients of subgroup "HS" ($p<0.0001$).

The concentration of saccharose in the oral fluid was the lowest in the subgroup "L", a bit higher – in the subgroup "C", in patients of subgroup "HS" it was the highest, almost 2 times higher than in other subgroups ($p<0.001$).

The rate of saccharose clearance was the lowest in patients with leukoplakia, and the highest in patients of subgroup "HS". The difference between these subgroups also was almost 2 times ($p<0.001$).

The patients of subgroup "HS" were also allocated the lowest in the oral liquid of lysozyme. In the examined subgroups "C" and "L", this indicator was on average 83.3% higher ($p<0.001$).

The patients of "HS" subgroup were also distinguished by the lowest complement titer in the oral fluid. Its maximum value was determined in patients of subgroup "L". The difference was 2.2 times ($p<0.001$).

In addition, in the examined patients with impaired salivary gland function, the lowest concentrations of immunoglobulin A, G and secretory IgA were found among all subgroups. In patients of subgroup "L", the concentration of immunoglobulins was greatest. Differences in the listed indicators among all subgroups were found to be significant ($p<0.001$).

Thus, the study showed that patients of 2 groups with diseases of mucous membrane in the oral fluid have risk factors that can directly or indirectly contribute to the disturbance of acid-base balance in the oral cavity.

Table 4 shows the parameters characterizing the changes in the rate of salivation and some physicochemical properties of the oral liquid under the influence of stimulation with a test solution of saccharose. According to the data the rate of unstimulated salivation was greatest in patients of subgroup "C", somewhat less (by 13.4%) in patients of subgroup "L", and minimal in patients of subgroup "HS" ($p<0.0001$). In this last subgroup of the examined patients, the average salivary rate was 3.7-4.2 times less than in the other subgroups ($p<0.0001$).

Table 4

Changes in the physico-chemical properties of the oral fluid in response to stimulation by the test product in patients of 2 groups with oral mucosal diseases

Indices	Designations and units of measurement	Values of indicators in subgroups (M±m, n)		
		"HS" (n=23)	"C" (n=62)	"L" (n=47)
Rate of salivation before stimulation	$CC_н$ (*ml/min*)	0.22±0.048	0.93±0.018	0.82±0.022
Rate of salivation after stimulation	CC_c (*ml/min*)	0.54±0.097	5.03±0.045	4.87±0.057
Viscosity before stimulation	$W_н$ $n \times sec/m \times 10^3$	28±0.4	24±0.2	23±0.2
Viscosity after stimulation	W_c $n \times sec/m \times 10^3$	25±0.4	16±0.2	15±0.2
Buffer capacity by acid before stimulation	$B_{к-н}$ *mg-eq* HC1	8±0.7	26±0.2	29±0.2
Buffer capacity by acid after stimulation	$B_{к-с}$ *mg-eq* HC1	14±1.1	50±0.3	64±0.3
Buffer capacity by alkaline before stimulation	$B_{о-н}$ *mg-eq* NaOH	48±2.2	200±3.7	211±2.2
Buffer capacity by alkaline after stimulation	$B_{о-с}$ *mg-eq* NaOH	62±2.6	284±4.5	299±5.1

In this same subgroup of patients with impaired salivary gland function, the increase in the rate of salivation after stimulation was the smallest, on average 2.5 times. At the same time in the subgroup "C" this increase was 5.4 times, and in the subgroup "L" – 5.9 times.

The index of viscosity of oral fluid without stimulation was minimal in patients of subgroup "L", not much, but statistically significant ($p<0.0001$) more in patients of subgroup "C", and maximum – in patients of subgroup "HS". The decrease in the index as a result of stimulation of salivation was almost the same in patients of subgroups "C" and "L" and amounted to 20.8-21.7%. In the subgroup"HS" it was less – 10.7% ($p<0.0001$).

Buffer capacity of oral fluid by acid without stimulation was the lowest in the subgroup "HS". In the subgroup "C" – on average 3.3 times, and in the subgroup "L" – 3.6 times more. After stimulation with a test solution of saccharose, the increase in the buffer acid capacity index on average was 1.8 times in the subgroup "HS", 1.9 times in the subgroup "C" and 2.2 times in the subgroup "L". That is, the increase in the indicator as a result of stimulation was minimal in patients of subgroup "HS" and maximal in patients of subgroup "L".

Buffer capacity of oral fluid by alkaline without stimulation was the lowest in patients of subgroup "HS". In patients of subgroup "C" it was 4.2 times more, and in patients of subgroup "L" – more for 4.4 times ($p<0.0001$). The increase in the buffer capacity of the oral liquid by alkaline after stimulation with test solution of saccharose averaged 29.2% in patients of subgroup "HS", 42.0% in patients of subgroup "C" and 41.7% in patients of subgroup "L".

Conclusion

Thus, clinical dental and clinical laboratory examination of patients with impaired salivary gland function and diseases of the mucous membrane showed that in this pathology there are noticeable changes in a number of indices of the oral fluid, which can directly or indirectly affect the condition of local homeostasis in the oral cavity and acid-base balance.

REFERENCES

1. *Agha-Hosseini F, Mirzaii-Dizgah I, Mikaili S, Abdollahi M.* Increased salivary lipid peroxidation in human subjects with oral lichen planus. Int J Dent Hyg. 2009; 7(4): 246-250.
2. *Anissimova IV, Galiulina MV, Ganzina IV, Kurochkin KA, Leontiev VK, Chesnokov VA.* [Structural properties of mixed saliva in individuals with different levels of tooth resistance to tooth decay] [Published in Russian]. Stomatologiya. 2005; 84(4): 8-10.
3. *Golecka-Bakowska M, Mierzwinska-Nastalska E, Bychawska M.* Influence of hormone supplementation therapy on the incidence of denture stomatitis and on chemiluminescent activity of polymorphonuclear granulocytes in blood of menopausal-aged women. Eur J Med Res. 2010; 15(2): 46-49.
4. *Humphrey SP, Williamson RT*. A review of saliva: normal composition, flow, and function. J Prosthet Dent. 2001; 85(2): 162-169.
5. *International Statistical Classification of Diseases*. International Statistical Classification of Diseases and Related Health Problems: 10th Revision, Volume 2. Instruction manual, 2010 Edition. World Health Organization. 195p.
6. *Malkin HM.* Historical review: concept of acid-base balance in medicine .Ann Clin Lab Sci. 2003; 33(3): 337-344.
7. *Marchini L, Campos MS, Silva AM, Paulino LC, Nobrega FG.* Bacterial diversity in aphthous ulcers. Oral Microbiol Immunol. 2007; 22(4): 225-231.
8. *Martynova EA, Makeeva IM, Rozhnova EV*. [The oral cavity as a local ecological system] [Published in Russian]. Stomatologiya. 2008; 87(3): 68-75.
9. *Mashru RC, Sutariya VB, Sankalia MG, Sankalia JM*. Effect of pH on in vitro permeation of ondansetron hydrochloride across porcine buccal mucosa. Pharm Dev Technol. 2005; 10(2): 241-247.
10. *Rumyantsev VA*. [Regularities of acid-base processes in the oral cavity and interdental spaces] [Published in Russian]. Diss. abstr. dr. med. sci.Moscow. 1999. 44p.
11. *Ryo K, Yamada H, Nakagawa Y, Tai Y, Obara K., et al.* Possible involvement of oxidative stress in salivary gland of patients with Sjogren's syndrome. Pathobiology. 2006a; 73: 252-260.
12. *Ryu OH, Atkinson JC, Hoehn GT, Illei GG, Hart TC*. Identification of parotid salivary biomarkers in Sjogren's syndrome by surface-enhanced laser desorption/ionization time-of-flight mass spectrometry and two-dimensional difference gel electrophoresis. Rheumatology (Oxford). 2006b; 45(9): 1077-1086.
13. *Sanli H, Cetinkaya H, Tursen U, Kaya M, Kuzu I, Gurler A.* Upper gastrointestinal findings in oral lichen planus. Turk J Gastroenterol. 2002; 13(1): 31-34.
14. *Stryuk R.* [The interconnection of somatic pathology with diseases of the the oral cavity mucous membrane and the dentoalveolar system] [Published in Russian]. Cathedra. 2008; 7(2): 52-55.
15. *Volozhin AI, Rumyantsev VA*. Pathophysiology (Textbook for medical universities). In 3 volumes, ed. Prof. Volozhin A.I. and Poryadin G.V., 2nd ed, volume 2. Chapter "Pathophysiology of acid-base balance". Moscow: Akademiya. 2007. 256p, pp. 80-103.
16. *Yamamoto K, Nagashima H, Yamachika S, Hoshiba D, Yamaguchi K., et al*. The application of a night guard for sleep-related xerostomia. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008; 106(3): e11-14.