Relationship between the Protein Content in the Tissue of Salivary Glands, Oral Mucosa, and Saliva in Experimental Staphylococcal Sialoadenitis

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UDC 616.316−002:002−022.7:579.861.2]−092.9−07:616.316−008.939.6

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 115, № 5, pp. 475−476, May, 1993
Original article submitted December 24, 1992

Key Words: *sialoadenitis; protein; saliva; oral mucosa*

Acute sialoadenitis of various origin is characterized by a marked inhibition of both spontaneous and induced secretion in the salivary glands [5]. This inevitably leads to a change in the barrier properties of the oral mucosa (OM), the nature of which has not yet been identified. In this regard it was of interest to elucidate whether there is a relationship between the content and release of protein in the saliva, on the one hand, and its concentration in the tissue of the salivary glands and OM, on the other.

MATERIALS AND METHODS

The experiments were carried out on 66 outbred rats of both sexes weighing 154 g. The animals were divided into the following groups: 1) intact rats (spontaneous secretion); 2) rats with secretion induced by pilocarpine, 1 mg per kg body weight, injected subcutaneously 40 min earlier; 3) and 4) rats with spontaneous secretion in the early (2 hours) and late (24 hours) stages of acute experimental staphylococcal sialoadenitis induced by the injection of sterile staphylococcal toxin (Gamaleya Research Institute of Epidemiology and Microbiology, Lh-0.18, series 33) diluted 1:5 with saline; the toxin solution was injected in a volume of 0.1 ml under the capsule of the submaxillary salivary gland (SSG); 5) and 6) rats with induced salivation in the early and late stages of acute sialoadenitis, respectively.

In order to synchronize the secretory activity of the salivary glands, all the animals were deprived of food during the 24 hours preceding the start of the acute experiment. Water was given ad libitum.

Pieces of left submaxillary gland tissue and of OM were taken from anesthetized rats (nembutal, 40 mg per kg). In the animals with induced secretion this procedure was preceded by the collection of mixed saliva during 40 min using a special device. The collection of biological materials was performed in the morning, taking into account the circadian rhythms [2.6].

The material obtained was assayed for the content of protein [7].

All numerical data were statistically processed [3].

RESULTS

As can be seen in Table 1, in intact animals the ratio of protein content in SSG to OM during spontaneous secretion was 1:0.52. In the course of induced secretion the content of protein in SSG and OM decreased slightly (the ratio being 1:0.7). At the same time, the ratio of protein output to the protein concentration in the saliva was equal to 1:2.1. The staphylococcal sialoadenitis was accompanied by considerable changes in the ratio of the SSG to OM protein content, as well as of protein output to concentration in the saliva. For instance, 2 hours after the administration of staphylococcal toxin, in the absence of visible signs of

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0007-4888/93/0005-0513$12.50

TABLE 1. Protein Content (mg per g Wet Tissue) in Tissue of Submaxillary Salivary Glands and Oral Mucosa, and Protein Release (mg over 40 min) and Concentration (μg per ml) in the Saliva in Acute Staphylococcal Sialoadenitis ($M \pm m$)

Experimental group	Gland tissue	Mucosa	Saliva	
			Release	Concentration
Intact rats, spontaneous secretion	61.4±3.3 (11)	32.5±6.7 (11)	–	–
Intact rats, induced secretion	58.8±3.6 (11)	41.4±5.9 (11)	748.5±96.1 (9)	1571.2±62.9 (9)
Sialoadenitis (early stage), spontaneous secretion	46.7±7.7 (10)	52.9±5.5 (7) p^*	–	–
Sialoadenitis (early stage), induced secretion	40.7±1.1 (9) p^*_1, p^*_3	33.4±2.2 (7) (7)	335.5±79.4 (7) p^*_3	1525.1±119.3 (7) (7)
Sialoadenitis (late stage), spontaneous secretion	40.8±3.3 (8) p^*	72.4±4.3 (8) p^*	–	–
Sialoadenitis (late stage), induced secretion	59.1±5.4 (17) p^*_2, p^*_4	44.2±8.6 (7) p^*_2	309.2±72.2 (9) p^*_3	717.7±62.3 (9) p^*_3, p^*_4

Note: p indexes indicate reliable differences ($p<0.05$) when compared with the following groups: p – intact rats with spontaneous secretion; p_1 – rats with early-stage sialoadenitis, spontaneous secretion; p_2 – late-stage sialoadenitis, spontaneous secretion; p_3 – intact rats with induced secretion; p_4 – early stage sialoadenitis, induced secretion. Figures in parentheses show number of animals per group.

developing inflammation of the salivary glands, the protein content in SSG during spontaneous salivation was near the normal level, but the protein content in OM increased during this period (SSG to OM protein content ratio 1:1.13). At this stage of sialoadenitis induced secretion was accompanied by a drop of protein content in the SSG as compared to the control level. However, the SSG protein content in induced and spontaneous secretion did not differ reliably. The OM protein content, however, markedly decreased (ratio 1:0.82). At this stage the concentration of protein in the saliva was similar to the control level, while the protein output was considerably inhibited (ratio 1:4.5). More pronounced changes were observed in the later stages of sialoadenitis, when the signs of salivary gland inflammation appeared. During this period the drop in the protein content in the inflamed salivary gland was associated with its considerable rise in OM (ratio 1:1.77) However, in the course of induced secretion the level of protein rose to the control level in SSG and fell in OM (ratio 1:0.74). A simultaneous inhibition of the release and concentration of protein in the saliva took place (ratio 1:2.32).

It may be concluded that in the early (asymptomatic) stage of staphylococcal sialoadenitis, with no changes in the protein content in the salivary gland under conditions of spontaneous secretion, a considerable accumulation of protein occurred in OM. This may enhance its barrier functions [1,4]. However, under conditions of induced secretion, despite the lack of marked changes in the protein content in the glandular tissue, no accumulation of protein occurred in OM. During this period the protein concentration in the saliva remained on the control level, but its release decreased almost twofold. Activation of salivation and insufficient inflow of saliva-associated protein into the oral cavity, probably, counteract the accumulation of protein in the mucosa. In the later (clinical) stage of sialoadenitis the spontaneous secretion is associated with an even more pronounced accumulation of protein in OM, together with a reduction of its content in the salivary gland tissue. However, in the course of induced secretion an insufficient quantity of saliva with a low protein content was secreted into the oral cavity, as before. Just as in the early stage of acute sialoadenitis, the protein concentration in the mucosa was considerably decreased, despite a certain rise of the protein content in the salivary glands. Thus, in staphylococcal sialoadenitis the content of protein in the saliva, mucisa, and glandular tissue depends not only on the stage of the pathological process, but also on the functional activity of the salivary glands. Under such conditions the spontaneous secretion contributes to the accumulation of protein in OM, while the induced secretion reduces the protein content. This probably affects the barrier properties of OM.

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BIOCHEMISTRY AND BIOPHYSICS

Role of the Plasma Membrane Lipid Matrix in Information Transfer by Regulatory Peptides

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UDC 577.315:612:014

Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 115, № 5, pp. 477–478, May 1993
Original article submitted January 19, 1993

Key Words: *regulatory peptides; information transfer; plasma membranes; lipid matrix; peptide-membrane interactions*

Messages transmitted by biologically active substances, including regulatory peptides, to their target cells are materialized in altered rates and/or direction of intracellular biochemical processes. Such alterations are thought to result from stimulation or inhibition of secondary messenger systems (the adenylate cyclase, polyphosphoinositide, and other systems). The activity of these systems is regulated mainly by specific receptors found on the plasma membranes of effector cells. It is believed that the information contained in a regulatory peptide (RP) is transferred to the cell when the RP molecule binds to its specific receptor.

During the past decade, however, a large body of experimental evidence has been obtained demonstrating surface-active properties of RP and the ability of their molecules to modify lipid mono- and bilayers (as well as mono- and bilayers formed from isolated plasma membranes) by incorporating themselves between the lipids [1,3,5-8,12,14]. Such incorporation of an RP into the lipid matrix may precede its receptor binding and bring about alterations in the course of intracellular processes independently of the receptor. This indicates that the RP-lipid matrix interaction plays a role in information transfer to the cell's interior.

The purpose of the present study was to throw more light on the involvement of the plasma membrane's lipid phase in information transfer via RP.

MATERIALS AND METHODS

The amount of information contained in an RP molecule in solution was computed on the basis of the following considerations. The amount of information

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0007-4888/93/0005-0515$12.50