

METHACRYLATE-INDUCED CHANGES IN METRIC PARAMETERS OF RAT PALATINE GLANDS

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Abstract

Application of removable acrylic dentures causes complaints of xerostomia, caused by the inadequate function of minor salivary glands.

The paper was aimed to determine the dynamics of methacrylate-induced changes in metric parameters of terminal parts and ducts of rat palatine glands.

The morphometric study has established that use of 1% methacrylic acid methyl ether solution to rats to reproduce experimental hypofunction of palatine salivary glands does not affect the parameter of lumen diameter of terminal parts, whereas other rates have shown a significant decrease in metric parameters (outer diameter, height of epithelial cells and diameter of duct lumens) before the 30 day of the experiment, as compared to the rates in intact group of animals. The detected phenomena are caused by the direct irritative effect of 1% methacrylic acid methyl ether solution on mucosa of glandular area of rat hard palate, as well as inadequate mucosal blood supply, leading to terminal parts trophism and duct system of rat palatine glands impairments.

Keywords: morphometry, palatine glands, methacrylate, terminal parts, ducts.

The current tendency to aging of population of the planet evokes the need in prosthodontics, but application of removable dentures leads to morphofunctional changes in oral mucosa [4, 13]. Publication data show [6] that use of acrylic dentures causes complaints of xerostomia, caused by the inadequate function of minor salivary glands. It has been proved that acrylic removable dentures have toxic, allergic and traumatic effect on prosthetic bed tissues in 40% of individuals, who use them [1]. Pressure on hard palate mucosa leads to chronic inflammation, its gradual thinning-down, resulted in atrophy [10]. Following the 3 – 5 years of denture use it is almost impossible to obtain the secret from the minor salivary glands on the area of prosthetic bed [8].

Problems related to mechanisms of plastics' pathologic effect on the organism and methods of their elimination are extensively described in the literature [1, 4, 6, 8, 10], but the problem of objective assessment of methacrylate-induced restructure of palatine glands has not been studied yet. Morphometric approach enables objecting of morphofunctional changes in structural components of the organ under the effect of various factors [2, 3, 12]. Our previous studies established that use of 1% methacrylic acid methyl ether solution leads to spasm of resistive chain on the 14 day of observation and dilatation on the 30 day. Persistent dilatation relative to metabolic and capacitive chain of microcirculating flow has been noted at all stages of the experiment [9].

The purpose of the research was to determine the dynamics of changes in metric parameters of terminal parts and ducts of rat palatine glands after administration of methacrylate.

Materials and Methods. 15 outbred white male rats were involved into experiment and assigned into control group (5 animals) and experimental group (10 animals). Xerostomia was simulated by preparation of rat oral mucosa with 1% methacrylic acid methyl ether solution during 30 days [8]. After animals' euthanasia on the 14 and 30 day, pieces of hard palate mucosa were embedded into Epon-812 [5]. Semi-thin sections were stained with polychromatic stain. Morphometric analysis and microshooting has been carried out on Biorex-3 BM-500T microscope with DCM 900 digital microphotohead with software programs, adapted to these studies.

Quantitative analysis of findings of morphometric study and statistical processing of morphometric data has been carried out according to conventional statistical methods, using Microsoft Excel software [7]. The following parameters have been measured: outer diameter (D_o), height of epithelial cells (H_e) and diameter of lumens of terminal parts and ducts (D_l). Animal housing and experiments on them have been carried out in compliance with the "General Ethic Rules for Conducting Experiments on Animals", adopted by the I National Congress on Bioethics (Kyiv, 2001) and the requirements of international principles of the "European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes"[11].

Results and Discussion. The morphometric analysis has established that the average outer diameter of terminal parts of palatine glands of rats from control group constituted $70,29 \pm 7,34$ mcm. On the 14 day of daily preparation of rat oral mucosa with 1% methacrylic acid methyl ether solution the parameter of outer diameter of terminal parts unreliably increased (Table 1), and to the 30 day significantly decreased by 20 %, as compared to values in intact group of animals (when $p < 0,05$). On the 14 day of the experiment the mean values of height of epithelial cells significantly increased by 25 % and reached $35,53 \pm 3,45$ mcm ($28,35 \pm 1,49$ mcm in the intact group ($p < 0,05$)). On the 30 day of the observation the values decreased by 26%, as compared to the previous values in the intact group, and by 41 %, as compared to previous observation

period. As far as the diameter of lumen of terminal parts is concerned, the mean values were tending to increase, but no significant changes have been found (Table 1).

Table 1

Dynamics of methacrylate-induced changes of metric parameters of terminal parts of rat palatine glands (mcm)

	Terminal parts		
	D _o	H _e	D _l
Intact group (No 5)	70,29±7,34	28,35±1,49	13,18±1,33
14 day of the experiment (No 5)	72,46±2,91	35,53±3,45 *	14,80±1,38
30 day of the experiment (No 5)	56,23±6,01 *, **	21,18± 2,98 *, **	15,02±1,64

Notes: * - differences are reliable as compared to control group of rats ($p < 0,05$);

** - differences are reliable as compared to previous period of observation ($p < 0,05$).

Morphometric study of the duct system of palatine glands of rats from the intact group has defined three classes of ducts. Ducts with average outer diameter from 71,86 to 91, 38 mcm have been assigned to Class I; ducts with average outer diameter from 109,54 to 136, 26 mcm have been assigned to Class II, and from 139,21 to 167,79 mcm – to Class III.

On the 14 day of the experiment the effect of 1% methacrylic acid methyl ether solution on the metric parameters of Class I ducts manifested by reliable decrease of the average outer diameter by 21 %, as compared to parameters in the intact group of animals (when $p < 0,05$). To the 30 day of the observation further significant decrease of the parameter by 9% was found (when $p < 0,05$); the value was 25,5 % less than the values in the intact group of rats (Table 2). On the 14 day of the experiment the mean values of height of epithelial cells reliably increased by 26 % and reached 34,24±3,28 mcm (when $p < 0,05$). However, to the 30 day of the observation the parameter significantly decreased and was 19 % less than the value in the intact group of animals (Table 2). During the experiment the mean values of the diameter of lumen of Class I ducts progressively decreased by 32 % to the 14 day and by 40 % to the 30 day (when $p < 0,05$), as compared to the parameter in the intact rats (Table 2).

Table 2**Dynamics of methacrylate-induced changes of metric parameters of excretory ducts of rat palatine glands (mcm)**

	Parameters	Intact group (No5)	14 day of the experiment (No5)	30 day of the experiment (No5)
Class I ducts	D _o	81,62±9,76	64,55±5,89 *	60,84±5,13 *, **
	H _e	27,11±2,55	34,24±3,28 *	21,94±2,71 *, **
	D _l	28,89±2,78	19,66±1,45 *	17,36±1,49 *
Class II ducts	D _o	122,91±13,37	97,10±7,46 *	98,33±7,64 *
	H _e	42,08±2,98	37,90±2,35 *	33,14±1,91 *, **
	D _l	36,21±3,41	24,62±2,54 *	28,97±1,73 *, **
Class III ducts	D _o	153,5±14,29	122,80±11,68 *	128,42±10,01 *
	H _e	49,96±3,17	44,96±4,25 *	39,97±4,08 *, **
	D _l	64,53±5,86	41,95±4,30 *	51,62±4,73 *, **

Notes: * - differences are reliable as compared to control group of rats (p<0,05);

** - differences are reliable as compared to previous period of observation (p<0,05).

On the 14 day of the experiment metric parameters of Class II and III ducts progressively significantly decreased, particularly, outer diameter by 20-21 %, respectively, height of epithelial cells by 10-11 %, respectively, average diameter of duct lumen by 33-35 %, respectively (Table 2). To the 30 day of the experiment insignificant increase in mean values of ducts' outer diameter was detected. Height of epithelial cells of Class II ducts reliably lowered by 13 %, as compared to previous period of observation, and was 22 % lower than the parameter in the intact group of animals (Table 2). It has been established that the height of epithelial cells of Class III ducts was significantly lower by 12 %, as compared to the value on the 14 day of the experiment, and 20 % lower than the parameter in the intact group of animals. The mean values of diameter of lumen of Class II and III ducts reliably increased by 19-23 %, respectively, as compared to 14 days period, but were significantly lower than the values in intact group of rats (Table 2).

Conclusions

Administration of 1% methacrylic acid methyl ether solution to rats to reproduce experimental hypofunction of palatine salivary glands does not affect the parameter of lumen diameter of terminal parts, whereas other rates have shown a significant lowering of metric parameters (outer diameter, height of epithelial cells and diameter of duct lumens) before the 30 day of the experiment, as compared to the rates in intact group of animals. The detected phenomena are caused by the direct irritative effect of 1% methacrylic acid methyl ether solution on mucosa of glandular area of rat hard palate, as well as inadequate mucosal blood supply, leading to terminal parts trophism and duct system of rat palatine glands impairments.

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