SPATIAL ORGANIZATION OF THE EXCRETORY DUCTS AND SECTIONS OF MICROCIRCULATORY BLOOD FLOW OF THE LABIAL SALIVARY GLANDS IN OLDER ADULTS

STRUKTURA PRZESTRZENNA PRZEWODÓW WYDZIELNICZYCH ORAZ PRZEKROJE NACZYŃ MIKROKRĄŻENIA WARGOWYCH GRUCZOŁÓW ŚLINOWYCH U DOROSŁYCH W STARSZYM WIEKU

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ABSTRACT

Introduction: Salivary glands have a significant impact on the state of the homeostasis of the human body, oral cavity in particular, sensitively responding to pathological processes. The reactivity of the salivary glands in response to pathological processes that are organically linked to morphology and functions of the organ's structures, and particularly the excretory ducts of the glands and their microcirculatory blood flow, is one of the problems which have not been solved to date.

The aim of the paper was to elucidate the features of the stereomicroscopic structure of the excretory ducts and sectors of the microcirculatory blood flow in labial glands of older adults.

Materials and methods: The object of the study was the labial mucosa of the older adults, which was cut into 3x3 mm pieces and fixed in the buffered 4% glutaraldehyde solution with subsequent 2-hour fixation in osmium. Once the pieces were washed and dehydrated they were embedded into the Epon-812. The series of the semi-thin sections, made from the obtained epoxy blocks, were stained in phosphate buffered 0,1% toluidine blue solution. The serial semi-thin sections were subjected to histological and cytological studies and multilayered plastic reconstruction.

Results and conclusions: The series of histological epoxy semi-thin sections, as well as graphic and plastic reconstruction of the sectors of microcirculatory blood flow and excretory ducts of the human labial glands have demonstrated a range of morphological facts that can be used to clarify the intertissue stereological relationships. They also determined the syntopic proximity of the capacitive sectors of microcirculatory blood flow to the excretory ducts of the gland. Such pattern is especially notable in the collecting venules and intralobular ducts. It has been shown that the biggest venule is the collecting venous vessel. Anastomoses between the intralobular arterioles and collecting venules have been found in the microcirculatory blood flow of the labial glands.

KEY WORDS: human being, labial glands, excretory ducts, microcirculatory blood flow.

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INTRODUCTION

For many years, human and animal exocrine and endocrine glands, as well as their microcirculatory blood flow have been studied at the Department of Human Anatomy, Department of Histology, Cytology and Embryology, Department of Pathological Anatomy of Higher State Educational Establishment of Ukraine "Ukrainian Medical Stomatological Academy". The study of various glands, including minor salivary glands, is a traditional field of activity of the Poltava morphological school [1, 2, 3, 4].

Notwithstanding the certain success in the study of structure and function of the human minor salivary glands the current publications report about contradictory and ambiguous morphological data on the structure of their excretory ducts and microcirculatory blood flow [5, 6]. The issue on morphological substantiation of the secretion movement on the bifurcated system of the excretory ducts of the minor salivary glands has not been solved to date, and their stereological analysis and morphometry has not been carried out, too [7, 8].

THE AIM

The paper was aimed at establishing the pattern and specific features of spatial organization of the system of excretory ducts and its syntopy with the capacitive sectors of microcirculatory blood flow of the labial glands of older adults.

MATERIALS AND METHODS

Specimens (n=15) of the glandular area of the labial mucosa of older adult have been studied. The mucosa was cut onto 3x3 mm pieces and fixed in the buffered 4% glutaraldehyde solution with subsequent 2-hour fixation in osmium [9, 10, 11, 12]. Once the pieces were washed and dehydrated they were embedded into the Epon-812 [9, 10, 11, 12]. The series of the semi-thin sections, made from the obtained epoxy blocks, were stained in phosphate buffered 0,1% toluidine blue solution. This dye allows detecting epithelial components, elements of connective tissue, blood vessels.

The serial semi-thin sections were used for histological and cytological analyses and to obtain 3D models by the method of multilayered plastic reconstruction [13, 14].

RESULTS

Study of the total histotopographic sections of the labial mucosa has revealed the greatest concentration of the glandular tissue in its middle third. The common excretory ducts of individual salivary glands, penetrating through the proper mucous layer of the mucosa, open on the surface of the covering epithelium by their orifices. The analysis of the serial semi-thin epoxy sections has established that the lobules of the labial salivary glands are the polymeric formation, where several layers of structural organization can be distinguished. One of them is the sub-lobular units, joined by the common lobular duct which is formed by the conjoining of 3-4 intralobular ducts. These ducts are rather continuous and have even width of tubes, connected with the acini through the intercalated ducts. Generally, each intercalated duct is capped by one acinus.

In the lobule of human labial salivary gland the following is distinguished: acini and intercalated units (excretory ducts), intralobular, lobular and interlobular ducts and the common excretory duct (Fig. 1 A). The architecture of the system of epithelial excretory ducts is featured by the significant difference in its diameters. It is markedly expressed when one duct drains into another (Fig.1 B). The contractions and the pyriform enlargements of the lumen as well as wall thinning are found exactly at this site. It is markedly expressed in the site when the intercalated duct drains into intralobular one. In this way the lumen (inner diameter) of the intercalated ducts is equal to 15,01 ± 1,05μm, and the lumen, formed by the conjoining of the intralobular ducts is 58,76 ± 0,81 μm. However, study of the interlobular and main excretory ducts showed no dramatic changes in their diameters. The largest outer diameter and lumen has been found in the common excretory duct (Fig. 2). The pyriform enlargement of its middle part and rough narrowing at its orifice has been revealed.

The wall of the common excretory duct is formed by two layers of epithelial cells. The outer layer is represented by the myoepithelium and the inner layer is represented by the proper ductal epithelial cells, which are the transitional forms in differentiation of cells of the basal layer of the covering epithelium into secretory glandular cells. The closer to the covering epithelium the thicker is the wall of the duct due to increasing number of epithelial cells and their layering. Keratinized epithelium was detected at the orifice from the side of the inner lumen.

Three arterioles are located in the depth of the labial mucosa, on the boundary of the proper plates and tela submucosa, where two of them occupy a marginal position and one is located between them. Arcuate arterioles with smaller diameter contribute to numerous relationships between them, but with a smaller diameter. Arterioles are involved in the formation of the subepithelial net of the exchange microvessels which deliver blood into the covering epithelium and connective tissue, as well as distribute blood among the epithelial complexes of the labial glands. Consequently, the covering epithelium and glands of the labial mucosa has common sources of blood supply and distribution of blood. Capacitive collecting venules are also located at this site, which collect blood from the whole mucous membrane.

The series of sequentially interconnected microvessels of the capillary type are located between each precapillary arteriole and the central collecting venule. The terminal segments of these microvessels belong to the postcapillary venules, which then drain into the collecting venule. These microvessels contribute to the formation of the canals of predominant blood flow in the labial glands. They greatly exceed the dimensions of the true capillaries. Postcapillary venules are located in those areas of the intersticium, which are directly adjacent to the intralobular ducts, and the precapillary arterioles are near the outer surface of the lobules. Capillaries, which penetrate into the depth of two adjacent lobules, bifurcate from the precapillary arterioles in the interlobular connective tissue of the labial glands' layers; while joining they form a three-dimensional (volumetric) net. The loops of the net cover the acini from all sides. The wall of the capillary has a typical structure. Each glandular lobule has a common net of blood capillaries with other lobules, where the capillaries are evenly located among the acini. Capillaries within the lobule are located in the space in different planes and occupy all the space between them.

DISCUSSION

Salivary glands are the glands which ducts open into the oral cavity and secrete protein and mucosal components of the saliva, and perform filtering of the liquid components of blood plasma from the capillaries to the composition of saliva and produce metabolic end products, hormone-like substances [2, 7]. The salivary glands sensitively respond to physiological and pathological processes in the body and have a significant impact on the state of homeostasis of the body and the organs of the oral cavity [1, 4]. These glands are very sensitive to changes in the internal and external medium of the body, and are the "target" of the immune destruction [15, 16].

Mucous part of the lip is covered with a multilayer squamous non-keratinized epithelium. Tela submucosa is well developed and rich in blood microvessels, among which the largest are the thin-walled collecting venules that form the wide reticulate net. In the submucous layer of the labial mucosa the arterial and venous vessels form the plexus. The plastic reconstruction shows that 2-3 postcapillary venules, which run from the acini at different sides to the site of draining into the collecting venule, form the enlargement (Fig. 3). Being conjoined, they form the major collecting venules, located in the center relative to the minor collecting venules. Postcapillary venules start forming the collecting venules in the immediate proximity to the place of the draining of the intercalated ducts into the intralobular ones. Within the individual module postcapillary venules drain into the centrally located collecting venule. The central collecting venules drain into the collector venules, which are located in the depth of the proper connecting tissue lamina of the labial mucosa and, while anastomosing, form the wide-reticulate

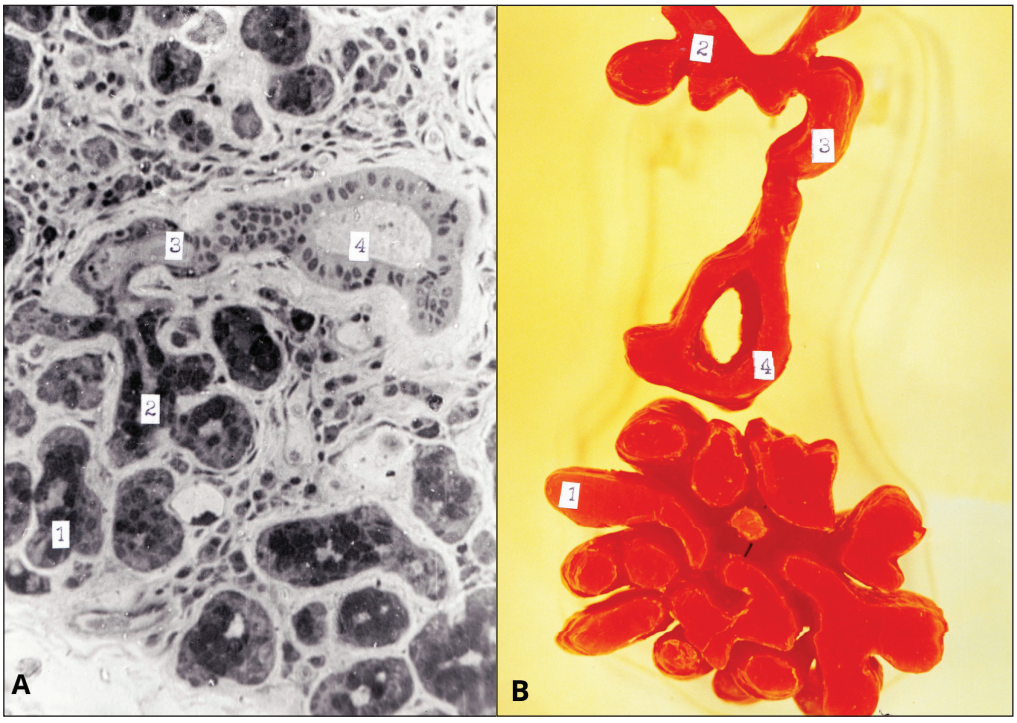

Figure 1.A – acini and excretory ducts of the labial gland of older adult.
Figure 1.B – plastic reconstruction on the series of semithin epoxy sections.
1:300 linear magnification. 1 – acini; 2 – intercalated duct; 3 – intralobular duct; 4 – lobular duct.

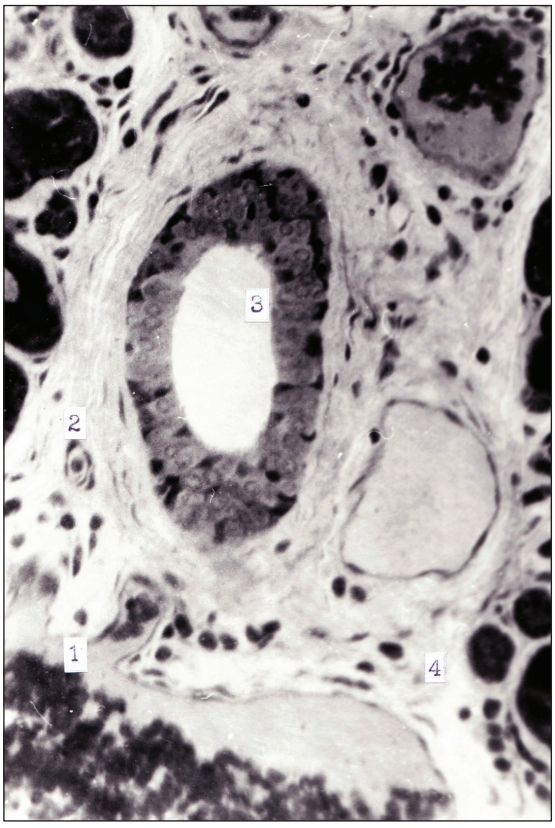

Figure 2. Microanatomical correlation between the common excretory duct and blood vessels of the labial gland of older adult. 1 – collector venule, 2 – postcapillary , 3 – the common excretory duct, 4 – connective tissue.

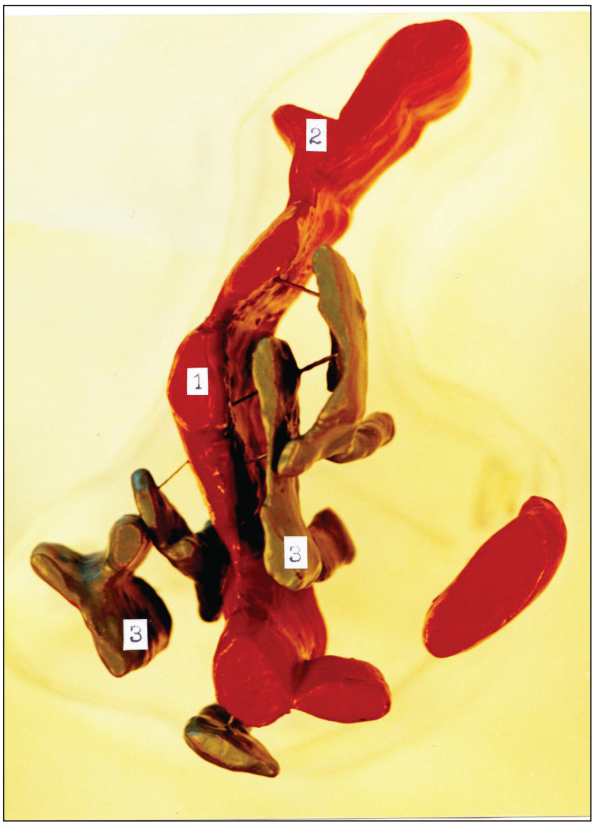

Figure 3. Plastic reconstruction of the ducts and blood vessels of the labial gland of older adult. 1:300 linear magnification.
1 – lobular duct; 2 – interlobular duct; 3 – collector venule.

microvascular venous network. Collector venules are the most capacitive thin-walled venous microvessels in the labial glands of the older adults. In older people their diameter is 42,03 ±1,13 μm. They are involved in the venous blood outflow from the capillary net, surrounding the common excretory duct that located at some distance from the collector venule. The right and left venules, accompanying the arteriole and supplying blood in to the microcirculatory flow of the labial mucosa, contribute to the blood outflow from the net of collector venules into the common venous flow.

CONCLUSIONS

Each individual human labial gland has complicated bifurcated system of the excretory ducts: intercalated, intralobular ducts (are localized in the volume, occupied by individual lobule), lobular, interlobular (are located in the preepithelial area of the mucous membrane), excreting mainly a mucous secretion.

Blood capacitive microvessels of the investigated glands (collecting and collector venules) ensure blood outflow from the lobules and spaciously occupy the place along the running of interlobular and common excretory ducts. Postcapillary venules and capillaries (exchange microvessels) are in the tight relationships with bifurcated intralobular ducts.

Rough narrowing of the outer diameter and the lumen at the intercalated duct has been found in the labial glands. The pyriform enlargements (so-called retention stations) are located within the interlobular and common excretory ducts.

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