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THE INFLUENCE OF THE PATHOGENESIS OF MAXILLARY SINUSITIS ON THE DISTRIBUTION OF GLUCOCONJUGATES IN THE SCHNEIDER MEMBRANE

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Abstract

We assume that the nature of the pathological changes in the mucous membrane of the maxillary sinus should also depend on the nature of the stomatology procedures that were carried out before the development of maxillary sinusitis.

The literature suggests that changes in the composition of glycoconjugates correlate with the transformation of chronic maxillary sinusitis, with hyperplasia of the sinus mucosa and hypersecretion. Thus, changes in the microenvironment and in local inflammatory reactions in sinusitis can affect the carbon fragments of the cell surface.

The aim: to study the pathogenetic bases of differentiation of maxillary sinusitis, which develop on the background of dental manipulations.

Material and metods

Sampling of biomaterial, a portion of the mucous membrane of the maxillary sinus was performed with 129 (100.0 %) patients, which were distributed according to etio-pathogenetic groups of stomatological maxillary sinusitis. Into the group of odontogenic form of stomatogenic maxillary sinusitis (OMS) there were 14 (10.9 %) patients who had inflammation in the sinus developed from previously untreated teeth. Into the group of infectious-allergic form of iatrogenic maxillary sinusitis (IAFIMS) there were 22 (19.1 %) patients who had established a periapical infection of previously treated teeth in the sinus in the etiology of the disease; The group of the mixed form of iatrogenic maxillary sinusitis (MixFINS) included 24 (20.9 %) patients with a filling material or a fragment of the tooth root in the lumen of the sinus. 12 (10.4 %) patients (who iatrogenic maxillary sinusitis of stomatologic origin which of chronic used medication hormones, antibiotics, drugs) were included in the medical form group (MFIMS). In the group of traumatic form of iatrogenic maxillary sinusitis (TFIMS) there were 57 (49.6%) patients with sinusitis which developed against surgical manipulations in the area of the alveolar process or the body of the upper jaw.

Keywords: lectinhistochemistry of the Schneider membrane, iatrogenic maxillary sinusitis, carbohydrate metabolism.

Relevance

We determined the dependence of the distribution of glucoconjugates in the structures of the Schneider membrane from the pathogenesis of maxillary sinusitis, which indicates differences in the functional activity of different structures of the Schneider membrane depending on the pathogenesis of maxillary sinusitis. A high degree of bacterial damage to the Schneider membrane is determined in iatrogenic forms of maxillary sinusitis. The activity of metabolic processes in the deeper layers of the Schneider membrane is less with odontogenic maxillary sinusitis and with iatrogenic sinusitis after the treatment of complications of dental caries (IAFIMS). Low antibacterial activity is detected in iatrogenic sinusitis on the background of

oroanthral fistula (TFIMS) and against the background of the chronic use of hormonal preparations and drugs (MFIMS). Local immunostimulating activity is expressed in all groups.

Worldwide, the pathology of the paranasal sinuses occupies one of the top positions in the structure of inflammatory diseases [10]. From 5 to 15 % of the adult population is affected with various forms of sinusitis [6; 10]. In most cases, the causes of maxillary sinusitis are associated with oral pathology - up to 40.0 % of all inflammatory diseases of the maxillary sinus [8]. In 60.0% of cases, stomatogenic maxillary sinusitis has an iatrogenic nature [5]. In 40.0–53.0 % of cases of patients with inflammation of the maxillary sinus, the disease is diagnosed after previous dental interventions [4]. According to our clinical observations, the course of maxillary sinusitis depends not only on the phase, timing of inflammation, but also on the absence or presence of the fact of stomatogenic (therapeutic and diagnostic) interventions preceding the sinusitis and their duration. We assume that the nature of the pathological changes in the mucous membrane of the maxillary sinus should also depend on the nature of the stomatology procedures that were carried out before the development of maxillary sinusitis.

The literature suggests that changes in the composition of glycoconjugates correlate with the transformation of chronic maxillary sinusitis, with hyperplasia of the sinus mucosa and hypersecretion. Thus, changes in the microenvironment and in local inflammatory reactions in sinusitis can affect the carbon fragments of the cell surface [12].

The advantage of using the lectin binding method to analyze the distribution of glycoconjugates is that it specifically identifies carbohydrate residues in cells and tissues. Carbohydrate fragments of cell surfaces are involved in the interaction between cells and are considered important in cellular functions, including intercellular recognition and cell maturation [1].

Normally, the epithelium of the maxillary sinus consists of ciliary epithelium in the surface layer and cubic epithelial cells in the basal layer, mixed with goblet cells. The experience of binding lectin to normal epithelium showed that Con A reacts with all epithelial layers with strongly marked cilia staining. In the presence of WGA, cilia are strongly stained. In the goblet cells and mucous glandular cells of the submucosal layer, WGA accumulation of medium intensity is detected. Other lectins, SBA and PSA, do not accumulate in the mucous membrane of the healthy sinus, with the exception of weak positive spots in the granules of the supranuclear goblet cell area [3].

The aim: to study the pathogenetic bases of differentiation of maxillary sinusitis, which develop on the background of dental manipulations.

Material and metods

Sampling of biomaterial, a portion of the mucous membrane of the maxillary sinus was performed with 129 (100.0 %) patients, which were distributed according to etio-pathogenetic groups of stomatological maxillary sinusitis. Into the group of odontogenic form of stomatogenic maxillary sinusitis (OMS) there were 14 (10.9 %) patients who had inflammation in the sinus developed from previously untreated teeth. Into the group of infectious-allergic form of iatrogenic maxillary sinusitis (IAFIMS) there were 22 (19.1 %) patients who had established a periapical infection of previously treated teeth in the sinus in the etiology of the disease; The group of the mixed form of iatrogenic maxillary sinusitis (MixFINS) included 24 (20.9 %) patients with a filling material or a fragment of the tooth root in the lumen of the sinus. 12 (10.4 %) patients (who iatrogenic maxillary sinusitis of stomatologic origin which of chronic used medication hormones, antibiotics, drugs) were included in the medical form group (MFIMS). In the group of traumatic form of iatrogenic maxillary sinusitis (TFIMS) there were 57 (49.6 %) patients with sinusitis which developed against surgical manipulations in the area of the alveolar process or the body of the upper jaw.

The biopsies were fixed in a 10% neutral formalin solution for 48 hours. Dehydration was carried out in an ascending battery of alcohols, starting with 50.0 % ethyl alcohol, as an intermediate medium, a solution of chloroform was used. Then a mixture of paraffin, wax and rubber was poured at a rate of 20: 1: 1. From paraffin blocks on a rotary microtome, 100-150 serial histological sections with a thickness of 5 μm were made. For observational microscopy, histological sections were stained with hematoxylin and eosin. The preparations were processed using the standard sets of "Lectinotest" (Lviv) in the dilution of lectin 1:50 according to the recommended procedure.

Visualization of binding places of lectin was carried out in the system of diaminobenzidine - hydrogen peroxide. Control of the specificity of the reaction was carried out by eliminating diaminobenzidine from the treatment regimen. Specificity of lectins to terminal non-reducing monosaccharide residues of glycoconjugates is given according to the literature data: lectin of “golden rain” shrub (LABA), specific for αL-fucose (αL-Fuc); lectin of wheat germ (WGA), specific for N-acetylneuraminic acid (NAcDGlc → NAcNeu); lectin of pea (PSA) - to αD-

glucose and αD-mannose (C6H12O6); lectin of peanut (PNA) specific for βD-galactose (βDGal→R); lectin of black elderberry (SNA) – to sialyl (α2-6) galactose (Neu5Acα2-6Gal). Statistical analysis of data on the distribution of glycoconjugates in the structures of the Schneider membrane, the intensity of the color of the sections by different lectins, which were initially evaluated by semi-quantitative methods: +++ is a strong reaction (color of color), «++» - moderate color (color), «+ "- weak reaction (color), 0 - lack of reaction, were replaced by ball scores 3, 2, 1, 0, respectively. Using the order scale for the intensity of coloring allowed to statistically estimate the differences in the concentrations of glycoproteins in certain structures in the control and e induced groups. For paired comparison of the material of the studied groups with the control (odontogenic form) group, a non-parametric criterion for ranks U, teste Mann-Whitney (pu) criterion was used; For a multiple comparison of three or more groups at the same time an analog of a one-parameter dispersion analysis for ranks was used - Crackel-Wallis criterion (pk-u).

The photo-documenting was carried out using a computerized analysis system consisting of an Axiolab binocular microscope, an Axiocam digital video camera with an 8 megapixel matrix, a video adapter connected to a microscope, a personal computer equipped with a video capture card connected to a digital camera via an interface and a video cable and the software "AxioVision 4.8" , allowing you to view the image of the histological preparation on the screen in real time, select the necessary area for the photographs to obtain a digital image of the histological preparation, to save it on the hard disk of the personal computer.

The study was conducted ethically in accordance with the 1964 Helsinki Declaration and in agreement with all patients.

Results of the study

We identified morphological signs that indicate chronic mucositis of Schneider membrane in all patients. β-D-galactose was higher in the ciliary cells of the Schneider membrane of patients with TFIMS (++), MixFIMS (++), MFIMS (++) and IAFIMS (+++) than in the control group (+). The accumulation of β-D-galactose in the goblet cells of patients in the MixFIMS and MFIMS groups was minimal (+). The saturation of β-D-galactose of goblet cells in all other groups that we studied, was average (++). The concentration of β-D-galactose (+) was the same in the basement membrane in TFIMS, MixFIMS and MFIMS. In OMS (control) and IAFIMS - was completely absent (0) (pk-u = 0,058). We observed a small

amount of β-D-galactose in the basal cells of the Schneider membrane of patients in the control group, TFIMS and MixFIMS (+). Basal cells in the IAFIMS group contained more (+ / ++) of this carbohydrate residue than the previous three groups (+), but less than in the MFIMS group (++ / +), pk-u = 0.9.

The concentration of sialic acid (Neu5Acα2-6Gal) in the ciliary cells of the control group (++) was higher than in the TFIMS group (pu = 0.66) and MFIMS (pu = 0.88) (+); L-fucose (+++) was higher compared with the groups IAFIMS (+) (pu = 0.5) and MFIMS (+) (pu = 0.88) (pk-u = 0.73). Sialic acid (Neu5Acα2-6Gal) was almost the same (pu = 0.56) in the ciliary cells of patients with MixFIMS (+ / ++) and IAFIMS (++). Sialic acid (Neu5Acα2-6Gal) was greater in the intracytoplasmic inclusions of the basal (+) and goblet (++ / +++) cells of patients of the MixFIMS and in the control group: (0) and (+), respectively. The distribution of carbohydrate residues of sialic acid (Neu5Acα2-6Gal) as part of intracytoplasmic inclusions of epithelial cells of the mucous membrane of the maxillary sinus in patients with MixFIMS was uneven. In most cases, the cytoplasm of basal and goblet cells was stained with a golden color (+), and the cytoplasm of ciliated cells was stained with golden brown (++) (pk-u = 0.49). The basement membrane did not contain SNA + compounds. The fibers of lamina propria of the mucosal were also predominantly SNA negative.

The remains of D-mannose in the studied groups were distributed with the same density (pk-u = 0,0114).

The saturation of the basal cells of the Schneider membrane in the control group (OMS) with carbohydrate residues of N-acetylneuraminic acid (NAcDGlc / Neu) was average (++); goblet and ciliary cells - less intense (+) (pk-u = 0.34). The basement membrane was painted light brown (+) unevenly: we identified areas of the basement membrane where there were no receptors for WGA - wheat lectin (0). Fibers of the mucosal lamina propria were predominantly WGA-negative, with the exception of fibro-modified regions.

The presence of α-L-fucose (Fucα1-2Gaβ1-4Glc) was intense (+++) in the ciliated cells of the maxillary sinus of patients of the TFIMS, MixFIMS and control group. The expression of α-L-fucose in the groups IAFIMS and MFIMS was weak (+). The basement membrane of patients with odontogenic sinusitis (control), TFIMS and IAFIMS was equally saturated with (+ / ++) α-L-fucose. It was more than in MixFIMS and MFIMS (+). In intracytoplasmic inclusions of basal cells of TFIMS and MFIMS and in the goblet cells of patients with MixFIMS, there was a high concentration of α-L-fucose (++) relative to the control (+).

Discussion

Enzymes, lecidins, defensins, histins and lectins carry out an important role in the protection of mucous membranes. The mucous membrane covering the respiratory system is a complex biochemical environment rich in glycoproteins, antimicrobial peptides, immunoglobulins and many other proteins, lipids and electrolytes. The outer layer of the mucous membrane is a layer of proteolytic cleaved mucins and is formed by transmembrane glycoproteins. Mucins are glycoproteins with a high molecular weight (more than 1 x 10^6), which are 50.0 - 80.0 % composed of carbohydrates. They (mucins) form a group of biologically important glycopolymers that are involved in modeling the immune response, inflammation, adhesion, prevention of intracellular invasion, etc. [9]. Bacteria settle in the outer layer [11]. According to the literature, five monosaccharide residues are found in mucus: L-fucose, N-acetyl-D-glucosamine (galactose), N-acetyl neuraminic (sialic) acid, acetylglucosamine, N-acetylgalactosamine [13].

A high content of β-D-galactose in ciliary cells of the Schneider membrane in patients with maxillary sinusitis with dental manipulations may be an indicator of the high activity of these cells and indirectly indicate a higher bacterial contamination than in the control group (+). For example, the highest rate of presence of β-D-galactose (+++) in ciliated cells was in the IAFMS group, where clinical signs of suppurative inflammation are stronger than in other groups.

The minimal (+) accumulation of β-D-galactose in the goblet cells of patients in the MixFIMS and MFIMS groups indicates a lower secretory activity of these cells, which may be due to local immunodepression, which is caused by the local and general effect of chemically active compounds. According to the presence of β-D-galactose (0), it can be assumed that the lesion of the basement membrane in the OMS (control) and IAFIMS was completely absent. Apparently, the early clinical manifestation of sinusitis in OVS and the timely treatment of complications that occur patients of the IAFIMS prevent the penetration of pathogens into the basal layer of Schneider's membrane. The relatively high saturation of β-D-galactose (++ / +) basal cells in patients with MFIMS can be caused by the duration of chronic inflammation (sometimes more than 10 years).

The concentration of sialic acids increases in body fluids during inflammatory processes. Sialic acids determine the elongated form of glycoproteins in the mucous membranes of the respiratory tract and, as a consequence, give a high viscosity of mucus. This protects the

mucous membranes from mechanical and chemical damage during inflammatory processes. All the above changes are used by researchers as an indicator of the activity of the inflammatory process [7]. The lowest indicator of the presence of sialic acid (Neu5Acα2-6Gal) in the ciliated cells was in the TFIMS and MFIMS (+) groups, which corresponds to clinical data. It is known that the presence of oroanthral fistula (TFYAVS) contributes to the outflow of exudate from the sinus and therefore clinically such sinusitis is easier. As for the group MFIMS, it should be noted that the absence of severe clinical symptoms in this group of patients is associated with the syndrome of immune dysfunction of those who take drugs and immunosuppression in those who chronically take hormonal drugs.

Minor sugars (mannose and fucose) have prebiotic and immunostimulating properties. They are involved in the synthesis of hormones and immunoglobulins [2]. According to the distribution of α-L-fucose (Fucα1-2Gaβ1-4Glc) can be assumed that in ciliated cells local immune response processes were intense (+++) in patients of the TFIMS group, in the MixFIMS group and in the control group. In the basement membrane - in control patients, TFIMS and IAFIMS (+ / ++). In the basal cells, in patients with TFIMS and MFIMS, in goblet cells in patients with MixFIMS (++).

Conclusion

1. We determined the dependence of the distribution of glucoconjugates in the structures of the Schneider membrane from the pathogenesis of maxillary sinusitis, which indicates differences in the functional activity of different structures of the Schneider membrane depending on the pathogenesis of maxillary sinusitis.

2. A high degree of bacterial damage to the Schneider membrane is determined in iatrogenic forms of maxillary sinusitis.

3. The activity of metabolic processes in the deeper layers of the Schneider membrane is less with odontogenic maxillary sinusitis and with iatrogenic sinusitis after the treatment of complications of dental caries (IAFIMS).

4. Low antibacterial activity is detected in iatrogenic sinusitis on the background of oroanthral fistula (TFIMS) and against the background of the chronic use of hormonal preparations and drugs (MFIMS).

5. Local immunostimulating activity is expressed in all groups.

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