


CONTENT OF PROTEIN AND GLYCOPROTEINS, THEIR COMPONENTS IN THE ORAL FLUID IN CHILDREN WITH CHRONIC GASTRITIS, DUODENITIS

E. Romanenko¹, Doctor of Medicine
 A. Shtompel², Ph.D. in Medicine, Assistant
 O. Sinkovskaya³, Ph.D. in Medicine
 A. Matveeva⁴, Student
 N. Mirotina⁵, Doctor
 Dnipropetrovsk Medical Academy, Ukraine^{1,2,3,4}
 Dnipropetrovsk city children's dental polyclinic No. 2, Ukraine⁵

In the oral fluid of children with chronic gastritis, duodenitis there is the increased protein content (up to 7.33±0.43 g/l) against the background of the decreasing level of glycoproteins (up to 0.03±0.01 mg/ml). Coefficient of ratio protein / glycoproteins in the oral fluid is increased by a factor of 9510, which has shown the intensive decay of protein-carbohydrate complexes and the increasing content of the protein fragments. In the composition of glycoproteins there is the reduced amount of hexosamines (up to 0.23±0.01 mmol/l), against the background of the increasing sialic acids (up to 0.16±0.01 mmol/l) and fucose (up to 0.87±0.02 mmol/l). Coefficient of ratio of terminal and corpus monosaccharides in the glycoproteins of the oral fluid in patients with chronic gastritis, duodenitis is increased by a factor of 2.41 and 3.34, as compared to the same values in the control group of children, which significantly modifies the functional properties of the protein-carbohydrate complexes.

Keywords: oral fluid, gastritis, duodenitis, glycoproteins, hexosamines, sialic acids, fucose.

Conference participants

 <http://dx.doi.org/10.18007/gisap:msp.v0i13.1654>

One of the most perspective approaches to non-invasive diagnostics, focused on the oral cavity and upper gastrointestinal tract diseases is to consider the examination of the oral fluid composition.

Oral fluid criteria should describe both the local and general reactions, i.e. covered mucous membranes of a digestive tract. Composition of the oral fluid should change in case of inflammatory and non-inflammatory lesions, detected in oral cavity and in upper gastrointestinal tract.

Non-specific antimicrobial components of the oral fluid are protein-carbohydrate complexes (glycoproteins). Protein and glycoproteins create the oral fluid viscosity and a layer that protects mucous membranes of the oral cavity from influence of factors of the physical and chemical nature, pathogenic microflora.

Purpose of the research

The purpose is to study the content of the protein and glycoproteins, their

components in the oral fluid in children with chronic gastritis or duodenitis.

Materials and methods

189 patients were examined. Among them there were 92 (48.7%) boys and 97 (51.3%) girls, aged from 12 to 17. The first group included 107 patients with chronic gastritis, duodenitis. The second group (control) included 82 children with healthy oral cavity, without the somatic pathology.

Patients in the first group (56 girls and 51 boys) were treated in the gastroenterological department of the regional children's clinical hospital. Period of the gastrointestinal disease in the examined patients, according to the anamnesis, varied from 1 to 6 years. Diagnosis of gastroduodenal pathology was confirmed after clinical, endoscopic and ultrasonic examinations.

The content of glycoproteins, hexosamines, fucose and sialic acids in the oral fluid was determined among children with chronic gastritis,

duodenitis, and among children of the control group, according to our original methods. Research of the protein was carried out by biuret method.

Results and discussion

Analysis of oral fluid revealed the increase of protein content among children with chronic gastritis, duodenitis (table 1). Chronic gastritis and duodenitis are acid-related diseases. Their basic pathogenic link should be increasing production of the hydrochloric acid by the stomach glands. Increase of protein content in the oral fluid of children is considered to be protective reaction of the organism against the rising gastric juice acidity and reflux of acid stomach contents into the esophagus with concomitant motor disorders in the gastrointestinal tract.

In our opinion, increase of the protein level in the oral fluid is the compensatory reaction, which has shown an intensive function of salivary glands at the inflammatory processes

Tab. 1.

Content of protein and glycoproteins, their components in the oral fluid at the children in the research groups (M±m)

Groups	Indicators				
	Total protein, g/l	Common glycoproteins, mg/ml	Sialic acids, mmol/l	Fucose, mmol/l	Hexosamines, mmol/l
1 (n=107)	7.33±0.43 p<0.01	0.03±0.01 p<0.01	0.16±0.01 p<0.01	0.87±0.02 p<0.01	0.23±0.01 p<0.01
2 (n=82)	2.57±0.06	0.10±0.01	0.14±0.01	0.61±0.01	0.49±0.02

Note. p – significance of differences compare with indicators in the control group.

of gastroduodenal area. Examination of the protein level using the biuret method allows us to identify its fragments, firstly. Secondly, we could reveal a link between the increasing total protein level and the fast disintegration in the structures of an upper digestive tract.

At the same time, content of glycoproteins was significantly decreased in children with chronic gastritis, duodenitis, as the result of their rapid destruction in the oral cavity, and deterioration synthesis of the protein-carbohydrate complexes in the salivary glands.

In the course of the research the composition of glycoproteins, taken from saliva in the control group of children, revealed that average level of monosaccharides is decreasing in the following order: fucose (0.61 ± 0.01 mmol/l), hexosamines (0.49 ± 0.02 mmol/l), sialic acids (0.14 ± 0.01 mmol/l) (table 1). Typical feature of biochemical disorders in the structure of glycoproteins taken from oral fluid of children with chronic gastritis, duodenitis is the decreasing amount of hexosamines, which should demonstrate a number and length of carbohydrate chains in the glycoproteins. Decreasing level of hexosamines has shown the violation of the glycoprotein synthesis, occurring in the salivary and mucous glands.

The given trend was typical for structural changes in the epithelial cells of oral cavity, which should provoke violation of the protective properties of oral fluid. In this case takes place the growth of concentration of the sialic acids, i.e. fucose, which should be crucially important for creation of additional links between carbohydrate connections in some parts of the glycoprotein molecule.

Tab. 2.
Indicators total amount of monosaccharides in the oral fluid glycoproteins at the children groups (M±m)

Groups	Total amount of monosaccharides, mmol/l
1 (n=107)	1.23 ± 0.02 p=0.08
2 (n=82)	1.24 ± 0.02

Note. p – significance of differences compare with indicators in the control group.

Finally, decrease of hexosamines demonstrates the chronic pathology in the upper digestive tract. Sialic acids and fucose in the protein-carbohydrate complexes were located terminally. Thus, the sialic acids are responsible for hydrophilic properties of the glycoproteins; fucose should support the hydrophobic sites in a molecule, thereby, ensuring their adhesion to the hydrophobic areas in the membrane epithelial cells. The demonstrated situation contributes to enhanced colonization of epithelial cells by pathogenic microorganisms. Increasing level of sialic acids in the glycoproteins should lead to the increase of the oral fluid viscosity. In the physiologic conditions it protects the epithelium from adhesion with pathogens.

Increasing of the oral fluid hydrophobicity was associated with high content of fucose. It contributes to its thickening at the inflammation in the mouth and reduces its protective properties. Increasing content of the sialic acids in patients of the first group, as compared to the control group, demonstrates the development of the compensatory reactions in response to tissue inflammation in the upper digestive tract. However, taking into account the irregularities in the structure of glycoproteins as the result of the decreasing content of hexosamines the fucose is increasing. We believe in this

case, that changes of protective properties of the oral fluid are a part of pathogenesis of the oral cavity diseases.

At the same time, despite the significant differences in amounts of separate monosaccharides, the general quantity of monosaccharides in the 1st group of the studied children had no significant difference from the same indicator shown by children of the control group (table 2). This fact is explained by significant increasing of the terminal glycoprotein monosaccharides (sialic acids and fucose) against the background of reduction of content of the corpus monosaccharides (hexosamine). Although, the total amount of monosaccharides in a glycoprotein should not change, some changes occurred in the functional properties of protein-carbohydrate complexes.

Particular attention should be paid to examination of relationships in the content of protein and the protein-carbohydrate complexes, corpus and terminal monosaccharides in glycoproteins as the criteria, which reflected the imbalance between damaging and protective factors in the oral fluid

In order to determine the quality indicators of the oral fluid we have calculated the coefficient of ratios of protein and the glycoproteins, the corpus and terminal monosaccharides (table 3).

Tab. 3.
Ratio of protein and protein-carbohydrate complexes, corpus and terminal monosaccharides in the oral fluid (M±m)

Groups	Coefficient of ratios		
	Protein / glycoproteins	Sialic acids/ hexosamines	Fucose / hexosamines
1 (n=107)	$244.33 \times 10^3 \pm 26.02$ p<0.01	0.70 ± 0.12 p<0.01	4.14 ± 0.45 p<0.01
2 (n=82)	$25.70 \times 10^3 \pm 3.26$	0.29 ± 0.05	1.24 ± 0.10

Note. p – significance of differences compare with indicators in the control group.

It has been found out, that in the oral fluid of children from the control group the ratio of protein to glycoproteins was 25.70×10^3 , sialic acids to hexosamines – 0.29, fucose to hexosamines – 1.24. In the children of the 1st group, ratio of protein / glycoproteins in the oral fluid increased by 9510 times ($p < 0.01$), which indicates fast disintegration of glycoproteins in the oral cavity and the increasing content of protein fragments due to exposure of the microbial enzymes. Coefficient of ratio terminal and corpus monosaccharides in the glycoproteins of oral fluid among the patients with chronic gastritis, duodenitis is increasing, as compared to the same indices in the control group of children, by 2.41 and 3.34 times ($p < 0.01$).

Given changes could indicate the serious violation of biosynthesis and degradation of all components of the glycoproteins in the oral fluid in the course of the upper gastrointestinal tract diseases.

Taking into account, that immune defence of the oral cavity (immunoglobulins, complement, interferon) is represented by the protein-carbohydrate complexes, we believe, that in order to assess the barrier properties of oral fluid the research should be conducted, which should be focused on the level of hexosamines, because it allows us to make a qualitative assessment of maturity of glycoproteins.

Conclusions

Basic feature of biochemical indices should be focused on the oral fluid of children with chronic gastritis, duodenitis, having the increased protein content (up to 7.33 ± 0.43 g/l) against the background of the decreasing level of glycoproteins (up to 0.03 ± 0.01 mg/ml). Coefficient of ratio protein/glycoproteins in the oral fluid has increased by 9510 times, as compared to the same indicator in the control group of children. This indicates the fast disintegration of glycoproteins in the oral cavity. Qualitative composition of glycoproteins has changed due to the decreasing level of hexosamines (to 0.23 ± 0.01 mmol/l), increasing concentrations of the sialic acids (to 0.16 ± 0.01 mmol/l) and fucose (to 0.87 ± 0.02 mmol/l). Coefficient of ratio for the terminal and corpus monosaccharides in the glycoproteins of oral fluid in patients with chronic gastritis, duodenitis has increased, as compared to the same indices in the control group of children, by 2.41 and 3.34 times, and this significantly modifies the functional properties of the protein-carbohydrate complexes.

References:

1. Methods of determination glycoproteins and their components (hexosamines, fucose, sialic acids) with diagnostic purpose in the mixed saliva at the children with gastroduodenal

pathology: methodical recommendations, Yu.M. Stepanov, O.H. Romanenko, V.O. Kondratiev, et al. – Kyiv., 2015. – 20 p.

2. Tailford L.E. Mucin glycan foraging in the human gut microbiote., E.L. Tailford, E.H. Crost, D. Kavanaugh, N. Juge., *Frontal Genetics.* - 2015. - Vol. 19, No. 6. pp. 81-86. <https://doi.org/10.3389/fgene.2015.00081>

3. Spielmann N. Saliva: diagnostics and therapeutic perspectives., N. Spielmann, D.T. Wong., *Clinical Therapy.* - 2015., Vol. 37, No. 3., pp. 529 - 539. <https://doi.org/10.1111/j.1601-0825.2010.01773.x>

Information about authors:

1. Elena Romanenko – Doctor of Medicine, Dnipropetrovsk Medical Academy, address: Ukraine, Dnipro city; e-mail: helenromanenko@mail.ru

2. Anna Shtompel – PhD in Medicine, Assistant, Dnipropetrovsk State Medical Academy, address: Ukraine, Dnipro city; e-mail: helenromanenko@mail.ru

3. Olga Sinkovskaya – PhD in Medicine, Dnipropetrovsk State Medical Academy, address: Ukraine, Dnipro city; e-mail: helenromanenko@mail.ru

4. Anna Matveeva – Student, Dnipropetrovsk State Medical Academy, address: Ukraine, Dnipro city; e-mail: helenromanenko@mail.ru

5. Natalya Mirotina – Doctor, Dnipropetrovsk city children's dental polyclinic No. 2, address: Ukraine, Dnipro city; e-mail: helenromanenko@mail.ru

