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The state of mineralizing properties of the saliva in children with gastroesophageal reflux disease

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Abstract

Gastroesophageal reflux disease (GERD) is one of the most common, potentially dangerous gastrointestinal diseases, which, according to the World Health Organization (WHO), is considered to be a disease of the 21st century. In addition, there is a "rejuvenation" of this nosological form. The frequency of pathology of the digestive system among the pediatric population of Ukraine is the second only to the diseases of the respiratory system. The oral cavity is the beginning of the digestive tract, and its mucous membrane is an important integral component of the system of anatomical and physiological connections of the gastrointestinal tract, and the oral fluid is one of the most important elements that perform the mineralizing function.

The authors conducted the investigation to study the mineralizing properties of the saliva in children with GERD, which involved 92 children, of whom 45 children had manifestations of GERD; the remaining 47 were somatically healthy. The content of ionized calcium and inorganic phosphates together, Δ pH, as well as the state of bone metabolism were studied in order to detect a disturbance of the total mineralization of the bone tissue using an ultrasonic densitometer.

A decrease in the mineralizing properties of the mixed saliva was found in patients with GERD.

Key words: gastroesophageal reflux disease; children.

According to the Ministry of Health of Ukraine, diseases of the gastrointestinal tract occupy one of the first places in the structure of pediatric somatic pathology and tend to increase [1]. Among the chronic diseases of the gastrointestinal tract in children, the first place is occupied by injuries of the upper digestive tract, including GERD [2]. GERD is traditionally referred to as acid-dependent disease, where the main factor is a hydrochloric acid, but the basis of its development is a disorder of motility of the upper gastrointestinal tract. In the structure of clinical manifestations of GERD in children, as well as in adults, there are esophageal (heartburn, regurgitation, wet spot symptom, belching, odynophagia, dysphagia) and extraesophageal symptoms. Extraesophageal symptoms, the mechanism of which is the direct contact of the mucous membrane of the upper, lower respiratory tract and oral cavity with the gastric or gastrointestinal content, indicate the development of pathological processes in the ENT organs, bronchopulmonary system and oral cavity [3 - 5]. The hydrochloric acid is recognized as a factor of pathological changes in the oral cavity in the gastrointestinal diseases [6], which leads to a decrease in the saliva pH, resulting in focal demineralization of the teeth with the appearance of hard tissue erosions and caries [7, 8].

The oral cavity is the beginning of the digestive tract, and its mucous membrane is an important integral part of the system of anatomical and physiological connections of the gastrointestinal tract, and the oral fluid is one of the most important elements responsible for homeostasis of the oral cavity and gastrointestinal tract as well as is of importance in maintaining the homeostasis of the teeth hard tissues and provides physicochemical metabolic processes between the tooth enamel and oral cavity. The saliva mineralizing function is a significant physiological function that depends on the composition and physicochemical properties of this biological fluid, including its supersaturation with hydroxyapatite, the solubility of which depends on the active concentration of calcium and phosphorus ions, pH and ionic strength of the saliva. The mixed saliva performs a mineralizing function only under the condition of neutral or slightly alkaline pH, when it is supersaturated with calcium and phosphorus ions [9].

Materials and methods

The clinical study involved 92 children, of whom 45 children had manifestations of GERD; the remaining 47 were somatically healthy. The clinical study included taking medical history, subjective data and objective examination methods. The functional activity of the salivary glands was assessed by salivation rate and expressed in ml / min [10]. In children, the saliva pH was measured using a pH meter with a flat electrode "PHscan 20F" (Bante Instruments Limited, China), followed by the determination of ΔpH , as this index is a sign of instability of homeorhesis and inability to maintain acid-base balance in the oral cavity in case of significant fluctuations. To assess the value of ΔpH a child was taken 5 samples of the mixed saliva of 1 ml and pH was determined immediately after sampling [11]. Subsequently, the average pH value and the confidence interval of deviations were calculated taking into account the Student's ratio. In case when the value of ΔpH is in the range of 0.2 - 1.0, this indicates low caries resistance, high caries resistance corresponds to ΔpH , which is in the range of 0.01 - 0.1.

Biochemical analysis has been performed in the thin part of the mixed saliva in a centrifuge tube for 10 minutes, which was collected in the morning on an empty stomach after pre-rinsing the mouth with distilled water. The saliva was stored in the freezer at -20°C until the analysis, it was defreezed at a room temperature and centrifuged at 3500 rpm for 15 min before using and subsequently biochemical studies were performed to determine a number of indices [12]. Concentrations of ionized calcium and inorganic phosphates were determined to assess the mineralizing properties of the saliva.

The principle of the method of determining the concentration of ionized calcium in the oral fluid is based on the fact that o-cresolphthaleincomplexone (CPK) in an alkaline environment with calcium ions is a violet complex. The intensity of the color is proportional to the concentration of calcium ions. 8-Oxyquinoline (OX) is added to the reaction mixture, which binds metals that interfere with the determination of calcium (particularly magnesium) and form a less stronger complex with calcium than CPK. The level of calcium in the saliva was expressed in mmol / l [13].

The level of inorganic phosphates in the oral cavity was determined by the reaction of phosphorus with molybdate in the acidic environment, resulting in the formation of a phosphomolybdate complex. The color intensity at a wavelength of 340 ± 10 nm is proportional to the concentration of inorganic phosphorus, which is expressed in mmol / l [13].

Densitometric assessment of bone metabolism was performed.

The study was performed using a densitometer Osteo Syst SONOST 2000 (Korea) [14].

There was determined:

- SOS - the velocity of the ultrasonic wave propagation through the calcaneus, measured in m / s and depends on the density and total mineralization of the bone;
- BUA - broadband ultrasonic wave attenuation, measured in dB / MHz, reflects the number, size and spatial orientation of the trabecular bone tissue, i.e. its architectonics;
- BQI, % - bone quality index, calculated by SOS and BUA.

Results and discussion

One of the important functions of the saliva is mineralizing, which provides caries resistance of the tooth tissues. The mineralizing function depends on the rate of salivation, the biochemical composition of the saliva and its pH.

At rest, the rate of salivation averages 0.3-0.5 ml / min [15]. In children with GERD, an average value of 0.7 ml / min was obtained, which was 40% above the upper limit of normal value. This fact is explained by the presence of hyperacidity in these children.

The main indices of biochemical profile and pH-metry were determined to study the mineralizing properties of the oral fluid, but the most informative is the determination of ΔpH , because this index, in case of significant fluctuations, is a sign of homeorhesis and inability to maintain acid-base balance in the oral cavity. Based on the pH-metry data obtained, ΔpH was calculated, which were:

- children without GERD - 0.14 ± 0.01 ;
- children with GERD - 0.33 ± 0.02 .

The mean ΔpH index in children with GERD was 0.33 ± 0.02 , which in turn is the result of periodic reflux of the gastric content into the esophagus and oral cavity. Continuing the discussion of the mineralizing properties of the mixed saliva, which is very important for maintaining dental health, it should be noted that the content of ionized calcium and inorganic phosphates together with ΔpH is of significance for its characteristics, because this index, in case of significant fluctuations, is a sign of homeorhesis instability and the body's inability to maintain acid-base balance in the mouth. The lack of acid-base balance in the oral cavity, i.e. its fluctuation to the acidic or alkaline side leads to a disturbance of the process of the tooth mineralization.

The ΔpH data obtained indicate low caries resistance in children with manifestations of GERD and correspond to the obtained indices of ionized calcium and inorganic saliva phosphates, which are shown in Table 1.

Table 1

The content of ionized calcium and inorganic phosphates in children with and without manifestations of GERD

Indices	Children without GERD (n=47)	Children with GERD (n=45)
The content of ionized calcium, mmol/l	1.22±0.06	0.94±0.05 *p
The content of inorganic phosphates, mmol/l	2.26±0.08	2.03±0.09 *p

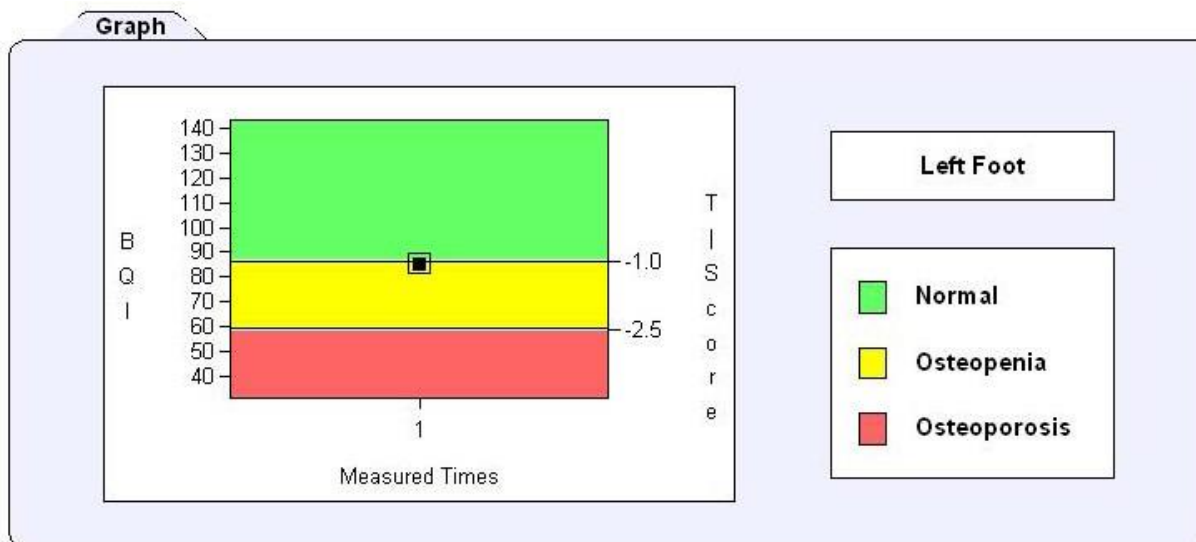
Note: * p - reliability of differences in children with GERD and children without GERD.

When comparing the data on the content of ionized calcium and inorganic phosphates in children with manifestations of GERD and children without gastrointestinal pathology, shown in Table 1, it was found that these indices of both groups of children are at the lower limit of normal value. However, both the calcium and phosphate content are lower in children with GERD than in children without GERD, which indicates a reduced mineralizing property of the mixed saliva against the background of GERD.

Taking into account the reduced mineralizing properties of the mixed saliva in children with GERD, it was decided to conduct a study of bone metabolism to identify disorders of total bone mineralization using an ultrasonic densitometer. Figure 1 shows an example of one of the results of densitometry.

Table 2 presents the average values obtained during densitometry in the children under study.

Table 2 shows that the average values of all densitometry indices do not have statistically significant differences in both groups and are within physiological limits [16].



	Measured Date	SOS	BUA	BQI	T-Score	Z-Score
Selected	2005-12-13	1550.5	41.7	85.2	-1.1	-1.1
Recent	2005-12-13	1550.5	41.7	85.2	-1.1	-1.1

Fig 1. The result of densitometry in a girl of 16 years old, diagnosed with: "Gastroduodenitis. GERD".

Table 2

The main indices of densitometry in somatically healthy children and children with GERD

Group	Indices		
	SOS, m/s	BUA, dB/MHz	BQI, conv.unit
Children without GERD (n=47)	1553±9.12	51.4±2.21	87.6±2.91
Children with GERD (n=45)	1568±10.21	49.2±2.13	85.5±2.82

Conclusions

1. The average value of ΔpH in children with GERD was 0.33 ± 0.02 , which indicated the instability of homeorhesis and the inability of the body to maintain acid-base balance in the oral cavity.

2. The average values of ionized calcium and inorganic phosphates in children with GERD are at the lower limit of normal value.

3. While analyzing the data of average values of ΔpH , ionized calcium and inorganic phosphates in children with GERD, it is obvious that the mineralizing property of the mixed saliva in patients with GERD is reduced.

4. The average values of densitometry in children of both groups had no statistically significant differences and were within physiological limits.

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