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Research Article

MORPHOLOGICAL AND FUNCTIONAL FACTORS OF PARODONTAL AND HARD TISSUES DISEASES

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ABSTRACT

In the structure of diseases of the endocrine system, one of the main places is occupied by the pathology of the thyroid gland (TG), the growth of which in recent years has acquired an expanded geographical distribution. The current situation cannot be explained only by the increased interest in the study of thyroid diseases, as well as the improvement of methods for their diagnosis. The development of modern therapeutic and surgical methods for the treatment of this pathology slightly improves the problem [7, 1]. This trend applies to all age groups: from children to older people. The situation is aggravated by the fact that in violation of the functions of the thyroid gland, lesions of other organs and tissues, including the cardiovascular, as well as the nervous system with the development of secondary pathological circles that form dysregulatory pathology [3,4].

KEYWORDS

Hypothyroidism, diseases of hard tissues of teeth and periodontal disease, periodontal disease, taste analyzer, chronic generalized periodontitis.

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INTRODUCTION

Information on the relationship between thyroid pathology and the dental status of patients available in the medical literature on this topic is scattered [2, 3]. According to the available data, the issues of the development and course of the carious process in thyroid pathology have not been sufficiently studied. Despite the active prevention and treatment of dental caries, this problem remains relevant. In Russia, according to Kuzmina E.M. (2013), the prevalence of caries is 22% in 6-year-olds and increases to 99% in 65-year-old patients examined [4, 2].

Various factors influence the development of the carious process. Local, such as pellicle, supragingival and subgingival dental deposits; nutritional imbalance; the amount of refined carbohydrates consumed; eating hard food anatomy and morphology of the tooth surface.

Violations of mineral metabolism in enamel lead to the formation of dental caries. Other factors include: environmental conditions (fluorine content in water); external influences - ionizing radiation; general diseases that affect the microflora of the oral cavity, local defense mechanisms of the body; past concomitant diseases, especially during the period of tooth development and during their lowest maturity [13, 6].

Inflammatory periodontal diseases are widespread. In the age group of 35-44 years, periodontal disease is 86.2%. In persons older than 65 years, periodontitis occurs in almost 100% of cases [3].

As a result, further research is required on the diagnosis and development of the carious process, its pathogenesis and progression, considering structural changes, using modern morphological research methods.

Gingival recession, atrophy of the alveolar process, and impaired bone formation are detected in hypothyroidism [14, 8]. A decrease in the level of thyroid hormones in hypothyroidism affects the metabolism of bone tissue and, in particular, the dentoalveolar system. Some authors note a delay in teething in hypothyroidism [5, 11]. In severe hypothyroidism, macroglossia and lip enlargement are detected [6, 3]; transitional occlusion in adult patients [10].

Having hyperthyroidism increases the risk of caries. Frequent symptoms in the oral cavity are burning of the mucous membrane, a decrease in taste sensitivity, desquamative glossitis, and a folded tongue. Hyperthyroidism can cause resorption and degeneration of the alveolar bone, accelerated dentition and osteoporosis of the jaws.

Treatment of dental diseases is often ineffective, due to the presence of general somatic pathology in the patient, in particular from the endocrine system. Initiated treatment periodically leads to chronic processes and the development of complications. All these data determine the relevance of an extended study of changes in the dentoalveolar complex with an assessment of the data of clinical, morphological, microelemental analysis in patients with primary hypothyroidism, which determined the purpose and objectives of our study.

The purpose of this study is to identify the dependence of clinical and morphological changes in the oral cavity in patients with hypothyroidism of the thyroid gland.

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Hypothyroidism is a clinical syndrome in which there is a persistent decrease in thyroid hormones. There are primary, secondary and tertiary hypothyroidism. In the primary form, the process that leads to the development of hypothyroidism is located directly in the thyroid gland and is caused by destruction by radioactive iodine (post-radiation) or by a tumor (hypothyroidism against the background of neoplasms of the thyroid gland), a congenital defect in the development of the thyroid gland (aplasia; hypoplasia), a decrease in the volume of its functioning tissue (postoperative; autoimmune thyroiditis; hypothyroidism due to viral infection of the thyroid gland). Hypothyroidism develops in 76% of patients within 1 year after surgical treatment of diffuse toxic goiter [5].

MATERIAL AND RESEARCH METHODS

To study the clinical and morphological factors in the development of periodontal diseases and hard tissues of the teeth, an in-depth dental examination of individuals was carried out with diseases of the periodontium and hard tissues of the teeth, having hypothyroidism in the regional dental clinic in the amount of 35 people - the main group, as well as 25 people with a healthy thyroid gland. These patients were taken as a comparison group.

RESULTS AND DISCUSSION

The development of thyroid pathology is influenced by various factors that have a complex effect on it. None of the types of endocrine diseases is not associated with the environment as thyroid disease. The structure and function of this organ depends on the intake of iodine and other macro- and microelements from outside. The existence of a direct relationship between the prevalence of thyroid pathology and the amount of iodine in the air, soil, water and food has been established.

It is known that its main role is the formation of thyroid hormones that affect the physiological functions and metabolic processes in the body. In primary hypothyroidism, the lack or absence of iodine disrupts the synthesis of thyroid hormones. As a result, all types of metabolism, oxygen utilization by tissues are inhibited, oxidative reactions are inhibited, gas exchange and basal metabolism are reduced. Slowing down the synthesis of protein catabolism and protein fractions, the process of their excretion from the body increases the amount of protein breakdown products in the extravascular spaces of organs, in skeletal and smooth muscles. Glycosaminoglycans are excessively deposited in the heart, lungs, and kidneys.

Recent data show that 70% of the country's densely populated area is deficient in iodine in air, soil, water and locally sourced food. In this regard, the number of diseases of the thyroid gland is progressing. The main intake of this element in the body occurs due to food (plant - 50%, animal - 40%). In particular, in many areas, an acid reaction of soils as a result of depletion in humus is characteristic, leading to a decrease in the content of iodine in it. The ubiquitous chalk deposits contribute to a decrease in the content of trace elements in water. The recommended dose of iodine per day is 150 micrograms according to WHO. Practically throughout the country, its real consumption is no more than 40-80 mcg per day, which corresponds to a moderate or moderate degree of iodine deficiency [6]. Whereas the actual consumption of iodine in Europe is up to 300 μg, in the USA it is up to 500 μg, in Japan and Iceland it is up to 1500 μg [11].

In a significant number of residents (especially children), after the accident, iodine deficiency caused an increased accumulation of radioactive iodine in the

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thyroid gland, with a further temporary risk of developing cancer [4]. The prevalence of endemic goiter is 20 - 30%. In nuclear reactor accidents, iodine-131 is the cause of radioactive contamination. Its effect on the thyroid gland formed loads in a short period of time (2.5 - 3 months) after the accident (the result of the decay of radioactive iodine). It is known that for radioisotopes of iodine the thyroid gland is a critical target organ [1,56,73,45,67]. Exposure of thyroid cells to radioactive iodine can also be observed at a later date (up to 50 years or more), leading to the development of hypothyroidism against the background of thyroid neoplasms, autoimmune thyroiditis.

Speaking about the content of trace elements in different regions, we note the study by Vanderpas J. (2016) in Central Africa, where selenium deficiency is pronounced, which, together with an increase in the content of thiocyanates and thiooxyzolidones, contributes to the development of endemic goiter with hypothyroidism and impaired mental development [12].

Substances thiocyanates and thiooxyzolidones that enter the body with food, contained in certain types of plants, mainly of the cruciferous family, have a goitrogenic effect. The group of strumogens includes products containing cynogenic glycosides (precursors of thiocyanates). Goitrin prevents the organization of iodine and the formation of active thyroid hormones of the thyroid gland. Flavonoids inhibit the peripheral metabolism of thyroid hormones, contributing to the occurrence of goiter and hypothyroidism as a result of eating food containing goitrogenic substances.

A similar effect on the thyroid gland is exerted by infectious diseases (in particular chronic ones) diagnosed in the human body. Some bacteria contain a special substance - progoitrin, under the influence of enzymes (myrosinase, etc.), which is converted into goitrin - a protein that actively inhibits the organization of iodine in the thyroid gland. There are bacteria (for example, Clostridium perfringens) that synthesize proteins and have thyroid-stimulating activity. In the process of vital activity, E. coli produces unknown proteins that reduce the ability of the thyroid gland to capture iodine. Drugs, as well as smoking, play a certain role in the development of the pathology of this organ. Drugs – phenylbutazone, PAS (para-aminosalicylic acid), antithyroid drugs , resorcinol, thiocyanates, and some others, can contribute to a diffuse increase in the thyroid gland (sporadic goiter with hypothyroidism; drug-induced hypothyroidism).

In a study by Völzke H. et al. (2015) the role of smoking and other possible predisposing factors were studied in Pomerania. The authors considered socio-demographic characteristics, bad habits (smoking and alcohol consumption), marital status, level of education, urine thiocyanate concentration as candidates for risk factors. It found that only older age and smoking were associated with an increased risk of goiter in both sexes.

A family history of thyroid disease and increasing age increase the likelihood of developing thyroid disease in women seven times more than in men. There is information about the significance of genetic factors in the formation of endemic goiter. Statistically significant differences in the incidence of endemic goiter in individuals with varying degrees of consanguinity to the proband were established, which corresponds to theoretical calculations for dominant inheritance with a penetrance of 0.7–0.8. This result indicates the importance of external factors in which hereditary predisposition dominates. Currently, the main known genetic determinants of autoimmune thyroiditis are the HLA, CTLA4 and TSH genes. In the

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development of congenital hypothyroidism, dyshormonogenesis of the human thyroperoxidase gene plays a role.

The combined effect of these factors is often so significant that a compensatory, sometimes even pronounced, increase in the size of the thyroid gland is not able to normalize its function.

The results of the study of the microstructure show that the topography of the surface of intact and carious teeth differ significantly. . When studying the hard tissues of teeth damaged by the carious process, we observe pathological changes.

The macroscopic appearance of dentine caries is a cavity formed by softened dark-colored tissue. In microscopic analysis, there is a loss of the dense structure of dentin, the tubules are deformed: they change the diameter and shape, merge with each other, and collapse. During caries, microorganisms spread through the dentinal tubules. The formation of areas with increased density (mineralization) at the border of the dentin with the tooth cavity is characteristic. On the rest of the dentin, the pattern is worn out due to demineralization. Places of remineralized dentin, lying on the border between normal dentin and carious focus, are distinguished by a lighter stripe. If the area of junction of dentin and enamel in the intact tissues of the tooth is dense, without violating the integrity of the boundaries, then with caries, separation of enamel and dentin is visible.

In patients with primary hypothyroidism, there is a strong junction border of dentin enamel, which looks like a lighter line between two zones that have different brightness. In the area of cracks, the line may be broken. Visualization of the dentin-enamel border is facilitated by the presence of heterogeneities in the tooth enamel.

In the enamel zone, we observe Gunter-Schreger stripes formed by the alternation of longitudinal and transverse sections of enamel prism beams, which explains the appearance of dark and light stripes that cross the enamel in the radial direction. The Gunther-Schreger stripes start at the enamel-dentin border and go outward, ending before reaching the outer surface of the enamel.

The dentine zone is visualized as a more homogeneous structure. When assessing the state of dentin in patients with primary hypothyroidism, it was noted that open dentinal tubules are most often found in the cervical region (enamel-cement border). In the presence of gingival recession, there is a loss of epithelial attachment, respectively, the surface with exposed dentinal tubules increases. The dentinal tubules are dilated, change their normal round shape to an oval, elongated one, sometimes merge with each other. The average diameter of tubules in the control group was 2.01 ± 0.26 μm. In the group of patients with primary hypothyroidism the average tubule diameter increases to 3.02 ± 0.23 μm, in some cases reaching 5.9 μm. With a carious process, a visible decrease in the diameter of the dentinal tubules can sometimes be observed, which can be associated with partial sclerosis. When studying the peripulpal dentin, no pathological changes were revealed in comparison with the control group.

When studying the surface of the cement covering the dentin of the root of an intact tooth of a patient without thyroid pathology, using scanning electron microscopy, round holes with a somewhat uneven contour were revealed, with a diameter of 5.15-6.24 microns. We assume that these holes are the exit points of collagen fibers and serve to carry out metabolic processes.

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The most consistent feature found in the hard tissues of the teeth of patients with primary hypothyroidism is thinning and loss of the cementum layer in the upper third of the root, leading to dentine exposure. The cement layer may undergo degenerative changes. This may explain hypersensitivity and the development of cervical caries.

In patients with primary hypothyroidism, enamel microcracks, enlarged enamel prisms, and dentinal tubules that change shape were revealed. Thus, the fact is noted that with primary hypothyroidism, reparative processes are weakly occurring in all structures of the dentoalveolar complex.

The hard tissues of the tooth consist of a large number of macro- and micro-elements, the main of which are calcium, phosphorus, oxygen, nitrogen, potassium, sodium, magnesium and fluorine. We found that qualitatively and quantitatively the microelement composition of hard tissues of the tooth did not differ significantly in age groups in the study region, depending on on the nosological form of primary hypothyroidism and the age of the patients. This allowed comparisons to be made between the mean scores of the main and control groups.

The highest percentage of calcium and phosphorus, these elements have a greater effect on the condition of tooth enamel. The enamel contains an extremely low amount of organic matter, while the degree of its mineralization is the highest, which ensures the performance of protective functions in relation to the dentin and pulp from mechanical damage and external influences.

Using scanning microscopy, the mineral components of the hard tissues of the tooth were studied, where several types of minerals of the apatite group were isolated, mainly hydroxyapatite $Ca_{10}(PO_4)_6OH_2$, and in a smaller amount carbonate apatite $Ca_{10}(PO_4)_6CO_3$, chloride apatite $Ca_{10}(PO_4)_6Cl_2$, fluorapatite $Ca_{10}(PO_4)_6F_2$. The presence of nitrogen, as one of the main elements of the organic component of the hard tissues of the tooth, with the exception of cement, was not determined.

The morphological structure and mineral composition of enamel are not constant, they can change under the influence of various factors: age, characteristics of the mineral metabolism of the body, composition and properties of saliva.

Indicators of macro- and microelement composition of enamel and dentin of intact and caries-affected teeth in patients without thyroid pathology are shown in the table (Table 5). The study revealed that in the enamel of the control group the content of calcium (Ca) is slightly higher (42.21±1.57%) than in the enamel of teeth with a carious process in the area of visually unchanged enamel (40.53±0.96%) . Differences in the calcium content in the enamel of intact and caries-damaged teeth are within the limits of the error of the method and depend on external factors, such as regular or irregular brushing of teeth, diet. The worse oral hygiene is, the more food residues are retained after eating, and the more actively cariogenic microorganisms multiply, respectively, they release more organic acids.

Against the background of increased excretion of the latter, the process of calcium leaching from the enamel and the destruction of hard tissues of the tooth occurs faster and on a larger scale.

CONCLUSIONS

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The density of the enamel structure depends on the high content of minerals and determines the resistance to pathological processes.

Magnesium and silicon enhance the mineralization process and affect the enamel density indicators [2]. An important role of magnesium was revealed: a sharp increase in the amount in the area prone to carious process in patients without thyroid pathology in the enamel by 17 times with a decrease in calcium by 4 times. In the enamel of intact teeth of patients with primary hypothyroidism, the magnesium content increases by 3.3 times with a decrease in calcium by 1.1 times. Violations of mineralization of enamel and dentin, characteristic of the teeth of patients with primary hypothyroidism, predetermine susceptibility to caries.

Thus, our study showed that the study of the microstructure and mineral metabolism of hard tissues of the tooth is of great interest, since the unique properties of enamel and dentin should be taken into account in the prevention and treatment of pathological changes in them.

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