AJPMHS GLOBAL RESEARCH NETWORK

AMERICAN Journal of Pediatric Medicine and Health Sciences
Volume 01, Issue 10, 2023 ISSN (E): 2993-2149

Modern Aspects of Changes in the Oral Mucosa During Coronavirus Infection

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Summary. Dental problems and the risk of oral diseases when infected with coronavirus infection increases at least twice. In SARS-CoV-2, epithelial damage causes similar pathogenic signs in oral tissues, such as ulcers, erosions, blisters, vesicles, pustules, fissure or depapillated tongue, maculum, papule, plaque, pigmentation, halitosis, whitish areas, hemorrhagic crust, necrosis, petechiae, edema, erythema, angular cheilitis.

Key words: COVID-19, oral mucosa, stomatitis, cheilitis.

Relevance. COVID-19 is an extremely severe acute respiratory infection caused by the SARS-CoV-2 coronavirus. The SARS-CoV-2 virus is distinguished by its ability to infect various organs both through direct infection and through the body's immune response. This disease can occur in both mild and severe forms. One of the common complications is the development of viral pneumonia. Coronavirus can also infect the oral mucosa. The pathogenic agent enters the body thanks to angiotensin-converting enzyme 2, which is localized both on the surface of the alveoli and pulmonary structures, and on the epithelial cells of the oral cavity, where it begins to actively multiply [3,6]. Due to the spread of the new coronavirus infection, the number of diseases of the oral mucosa caused by COVID-19 is steadily increasing. The high probability of collision of the oral mucosa with viral particles is one of the first and the high content of the 2019-nCoV ACE2 receptor in the epithelial cells of the tongue and salivary glands creates conditions for a rapid increase in the viral load and thereby increases the risk of adverse manifestations of Covid-19 disease in the oral cavity . In 2021, doctors noted new consequences of the COVID-19 disease, with inflammation, painful rashes and ulcers in the mouth appearing in sick and recovering patients. Those patients who have dental diseases or diseases whose treatment has taken a long time, such as caries, are susceptible to oral problems. The most common manifestations of COVID-19 in the oral cavity in patients were plaque on the tongue (51.4%), leukoplakia (13.8%), and traumatic oral ulcers (9.2%). In one study of patients with COVID-19, oral lesions included aphthous ulcers (36.5%), erythema (25.7%), and lichen planus (16.2%) [6]. Oral ulcers (17.2%) and spots on the oral mucosa and lips (13.8%) have also been detected in patients with COVID-19 (Soares et al., 2020). Thus, many patients may have the same symptoms, undetected due to lack of oral examination by healthcare professionals (Martín Carreras-Presas et al., 2020). The process of development of ulcers in the oral cavity: painful inflammation of the papillae of the tongue (day), then the appearance of an erythematous spot (day), which turns into irregular and asymptomatic ulcers; Consequently, many patients may be unaware of an oral ulcer due to the lack of pain (Chaux-Bodard et al., 2020). Burning

sensation in the mouth (22.4%) could be caused by several reasons (e.g. candida infection, dry mouth, oral ulceration or drug effects). A viral infection can weaken the immune system, causing secondary infections such as oral thrush. Candidiasis is the most common opportunistic infection in HIV (Nokta, 2008) and has also been reported in COVID-19 (dos Santos et al., 2020; Vinayachandran & Saravanakarthikeyan, 2020). The appearance of oral lesions in patients with COVID-19 may be due to the direct or indirect effect of SARS-CoV-2 on the oral mucosa, hypersensitivity to medications taken during COVID-19 infection, the patient's susceptibility to the disease itself, or prolonged the risk of hospitalization. The SARS-CoV-2 virus infects human cells through angiotensin converting enzyme (ACE-2) receptors, as ACE-2 acts as the primary host cell receptor for this virus [7,12]. Patients with oral lesions who have recovered from coronavirus infection exhibit a wide range of clinical phenotypes, including severe and asymptomatic cases. According to the literature data, damage to the oral mucosa in multisystem inflammatory syndrome of the Kawasaki type, accompanied by fissures, cheilitis, and erosions, in most cases correlates with a more severe course of the disease and hospitalization of the patient [5]. The category of patients who are subject to hospitalization and treatment using mechanical ventilation without the use of oral hygiene protocols is especially vulnerable to the development of oral pathology. Most often, they develop changes such as dryness, erythema, bleeding, ulceration, and the development of opportunistic infections; in the long term – tooth loss, periodontal disease [6]. According to Dziedzic et al., oral lesions may be associated with a weakened immune system or taking multiple medications during coronavirus infection [7]. Researchers have published a number of reports of possible oral manifestations of SARS-CoV-2 infection, such as intraoral and labial aphthous ulcers indicating viral infection, petechiae and erythematous macules, blood blisters, depapillation on the dorsum of the tongue, decreased salivation leading to xerostomia and disorders sensitivity (eg, dysgeusia, hyposmia and anosmia) [8–10]. Dysgeusia and xerostomia are the main oral manifestations observed in patients with COVID-19 [11]. In the work of Ganesan A. et al. 2022, atypical erythematous lesions were observed in 7.2% of cases on the buccal mucosa adjacent to the molar area, in addition to isolated solitary ulcers (3% of cases), resembling small aphthae. Initially, these lesions were asymptomatic and began as inconspicuous isolated erythematous areas that then progressed to diffuse erythematous areas with irregular margins. Such patients reported a burning sensation localized in the erythematous area [12]. A recent systematic review demonstrated that ulcerative lesions, even vesiculobullous lesions, involve activation of co-infection and immune-mediated changes [13]. In most cases, patients with damage to the oral cavity complain of various rashes, defects, plaques, and cracks in the oral cavity, which can form during the height of the COVID-19 disease or appear after treatment.

First of all, coronavirus affects the gums and their microcirculation. A lot of patients complained about the manifestation of stomatitis, which had not been observed before. And the treatment of these post-Covid stomatitis lasts longer. In addition, after surgical interventions, their gums do not heal for a very long time. For example, after tooth extraction in ordinary patients, five to six days are enough for healing, but for those who have suffered from Covid, healing lasts for eight to twelve days. Post-Covid patients are advised to postpone surgical interventions, because there is a risk that the seams may come apart. And often after suffering from coronavirus, dry mouth is often observed, i.e. xerostomia occurs. Angiotensin-converting enzyme is localized on the epithelial cells of the oral cavity, through which the coronavirus penetrates and multiplies in the tissues of the oral cavity [7]. With coronavirus,

the senses of taste and smell are very often impaired, but for many they are restored after recovery [3]. The body's immunity is a complex mechanism that helps the body resist viruses and bacteria, i.e. immunity is a counterweight to mutating cells [2, 4]. In this regard, everyone's own immune system becomes of great importance; those who have a strong immune system are less affected by viral infections, and they tolerate diseases more easily. When a person is concerned about dental diseases, he does not connect this with the state of his immunity, although the health of the oral cavity and teeth are directly related. Problems that arise in the oral cavity, gums, teeth, as well as the development of caries or exacerbation of existing problems in the oral cavity can be a consequence of a decrease in natural immunity in the oral cavity. Local immunity is necessary to protect the mucous membranes of the body from pathogenic bacteria, since in the human body about 70-80% of immunocompetent cells are located in the mucous membranes. Mucous membranes are a barrier to parasites, viruses and microbes, since the body mostly comes into contact with the external environment through mucous membranes. And naturally, if the immune system of the body's mucous membranes is strong, then the protection of the gums and teeth from the effects of bacteria contained in plaque will be higher. The oral immune system is a protective mechanism that is responsible for most of the processes occurring in the oral cavity - the preservation of mucosal tissue; restored gum disease after dental surgery, etc. Timely treatment of existing diseases (gingivitis, periodontitis), which, if not treated in time, can become chronic, as well as preventive measures taken for diseases of the oral cavity are also of great importance. Oral diseases affect the health of the body as a whole, since the oral cavity is located at the beginning of the gastrointestinal tract. There are general and local immunity. The general immune system in the human body with the participation of various mechanisms - lymph nodes, immune cells of various organs, etc. protects the body from foreign substances. Local immunity protects the body from pathogenic bacteria and is a barrier that protects the mucous membrane from damage, preventing the penetration of viruses and bacteria that develop existing diseases. In addition, due to local immunity, the mucous membranes are provided with epithelial cells and the lymphoid apparatus of the subepithelial spaces. In the oral cavity there are secretory immunoglobulins of types A, G and M, which are secreted by lymphoid cells. Coronavirus can infect the salivary glands, which blocks the production of immunoglobulin A, the main immunoglobulin that can fight pathogenic microbes in the oral cavity, which leads to numerous inflammatory processes. In the body, the virus first encounters the mucous membrane. And if the content of immunoglobulin A is reduced, then the mucous membrane will be vulnerable. For various reasons, local immunity weakens. This can be caused by diseases of the tissues of the oral cavity and teeth, as well as poor nutrition, which leads to the formation of plaque, which provides a bacterial load in the oral cavity; smoking and alcohol in the soft tissues of the oral cavity impair blood circulation; taking medications leads to gum inflammation; pregnancy leads to a lack of vitamins and nutrients, etc. For this reason, treatment of dental diseases: stomatitis, gingivitis, periodontitis, etc. Timing is essential for oral health. For strong immunity in the oral cavity, especially if it is weakened by gum disease or due to a high bacterial load, it is necessary to brush your teeth properly, give up destructive factors such as smoking, drinking alcohol, you can sometimes use dental floss, clean off plaque very carefully, especially in hard-to-reach areas of the teeth. It is imperative to visit a dentist for preventive purposes to obtain the necessary advice or treatment [5]. The issue of developing immunity to coronavirus has not yet been studied enough. For example, immunoglobulins

of class M (IgM) cause a rapid immune response, 4-5 days after infection, and immunoglobulins of class G (IgG) only about 3 months after infection. Also, the question of their existence in the body is controversial, whether 1 – 3 years or 5 years. The immune system, in the course of evolution, has learned to protect the human body from emerging threats, and currently we have a powerful defense system that turns on as soon as any pathogen enters the body. For example, if the temperature rises, this means that the immune system, together with the neuroendocrine system, has begun to work. When the temperature rises to 380C, the body produces interferon, which begins to fight the virus. As is known, the virus acts differently in each person's body; there are people whose temperature does not rise at all [6].

The results of the examination of patients with COVID-19 substantiate the need and advisability of including a dental examination in this category of patients after their clinical recovery. The task of a dentist is to timely diagnose dental manifestations in patients who have suffered coronavirus infection and select the most adapted algorithm for their treatment depending on the clinical manifestations in the oral cavity. The question of carrying out and prescribing therapeutic and preventive measures in order to prevent the development of pathology and its complications also remains open at the moment. Even asymptomatic COVID-19 can leave long-term adverse effects in the form of weakened immunity or a tendency to autoimmune processes, including in the oral cavity.

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