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Modern Concepts on the Etiology and Pathogenesis of Chronic Periodontitis

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Abstract: To date, among the problems of modern dentistry, one of the important places is occupied by periodontal disease. Numerous scientists and practicing doctors note the medical and social significance of the problem under consideration. Modern aspects of the etiology and pathogenesis of chronic periodontitis remains a little studied issue. The results of the analysis of literature data on chronic periodontitis are presented.

Keywords: chronic periodontitis, caries, dentistry, diagnostics.

Relevance. Chronic periodontitis is a disease in which tissues surrounding the root of the tooth undergo chronic inflammation. The disease is the outcome of caries, complicated by pulpitis. The second most common cause of periodontitis is improper dental treatment. Ignoring the symptoms of periodontitis can lead to serious complications, up to tooth loss, destruction of the jaw bone tissue with the formation of its fractures, and the development of osteomyelitis [Snitkovsky Arkady Aleksandrovich, 2022].

In the structure of dental morbidity, periodontitis ranks third after dental caries and pulpitis; in the age group of 25-47 years, the proportion of this form of complicated caries reaches 50% [3; 4]. The inflammatory process in the periodontium develops due to pulp necrosis and the entry of infected and toxic contents of the root canals of the teeth through the apical foramen, penetrating into the periodontal tissues, triggering reactions at the cellular, immune, microcirculatory levels, resulting in the destruction of periodontal tissues. Bacteria are the cause of the development of the inflammatory process in periodontal tissues. Microbial symbiosis in the content of carious cavities is a source of primary infection for the development of pulpitis and periodontitis [2; 5; 6; 9]. Currently, using various cultivation methods, more than 400 species of microorganisms have been isolated in endodontic tooth samples with various forms of pathology. Facultative anaerobic bacteria, organized into mixed communities, predominate in the primary infection of periapical foci [Kogina E.N., 2015].

To date, among the problems of modern dentistry, one of the important places is occupied by periodontal disease. Numerous scientists and practicing doctors note the medical and social significance of the problem under consideration [Kukushkin V.L., 2014; Kuratov I.A. et al., 2015; Blashkova S.L. et al., 2015; Lukina G.I. et al., 2016; Shashmurina V.R. et al., 2018]. Complications arising from chronic diseases of periodontal tissues, including chronic apical periodontitis, can lead to long-term disability of a person, worsening the quality of life of the patient [Gerasimova L.P. et al., 2014; Trigolos N.N. et al., 2015; Shaimbetova A.R., 2017; Shashmurina V.R. et al., 2018].

In the structure of dental diseases, chronic apical periodontitis is the most common complication of dental caries and reaches up to 50% of visits in the age group of 34-47 years, the inflammatory process in periodontium in people over 50 years of age is the cause of tooth extraction in more than 50% of cases [Kukushkin V .L., 2014; Kuratov I.A. et al., 2015; Lukina G.I. et al., 2016; Shashmurina V.R. et al., 2018; Gbadebo S.O. et al., 2014; Yang N.Y. et al., 2018]. An increase in the proportion of elderly and senile people contributes to an increase in the incidence of various forms of chronic periodontitis [Iordanishvili A.K., 2015].

According to numerous studies, in the general structure of seeking dental care, the prevalence of chronic apical periodontitis is high and does not tend to decrease [Yuanita T. et al., 2018]. At the same time, the presence of a focus of chronic infection in the periodontium, in addition to local problems associated with the loss of the functional value of the tooth, is also a source of focal diseases, such as infective endocarditis, sepsis, urinary tract infections, etc. [Lukina G.I. et al., 2016].

The greatest potential danger to the human body is represented by destructive forms of chronic apical periodontitis, since prolonged inflammation of periodontal tissues is the most common cause of tooth loss and the formation of foci of odontogenic infection, which can lead to inflammatory diseases of the maxillofacial region [Gerasimova L.P. et al., 2014; Trigolos N.N. et al., 2015; Shaimbetova A.R., 2017; Shashmurina V.R. et al., 2018]. The proportion of this form of the disease is 9-21% of the total number of patients with chronic apical periodontitis [Gbadebo S.O. et al., 2014; Yang N.-Y. et al., 2018].

Modern science considers apical periodontitis as an inflammatory process in the periapical periodontal tissues of an infectious, traumatic and drug nature, which is under the influence of a complex of exogenous and endogenous factors [Trigolos N.N. et al., 2015; Blashkova S.L. et al., 2017]. The reason for the development of destructive forms of periodontitis in the vast majority of cases is the entry of infected and toxic contents of the root canals into periodontal tissues, which leads to the launch of reactions at the cellular, immune, microcirculatory levels, where the result is the destruction of periapical tissues [Blashkova S.L. et al., 2015; Lukina G.I. et al., 2016; Kuratov I.A. et al., 2017; Pavlovich O.A. et al., 2017; Metzger Z. et al., 2013; Sullivan M. et al., 2016].

The main source of infection in the development of pulpitis and periodontitis are pathogenic microorganisms and their metabolic products originating from the root canal system [Brain L.A. et al., 2013; Siqueira Jr. J.F. et al., 2009; Yuanita T. et al., 2018]. The decay products of the pulp and dentin from the root canal or periodontal pocket are also important [Gerasimova L.P. et al., 2014]. Most often, obligate anaerobes (including bacteroids), gram-positive rods, streptococci, enterococci, E. coli, micrococci, lactobacilli, fungi of the genus Candida, Neisseria and bacteria of the genus Vellionella are sown in this case [Gorbunova I.L. et al., 2015; Mallick R. et al., 2014].

It is known that favorable conditions are created in the endodontist for the vital activity of many types of pathogenic and opportunistic aerobic and anaerobic microorganisms [Brain L.A. et al., 2013; Siqueira J.F. et al., 2009; Yuanita T. et al., 2013]. These microorganisms are found in all parts of the root canal system, including lateral canals, anastomoses, and dentinal tubules at a depth of up to 300 microns from the side of the pulp [Karakov K.G. et al., 2015].

The pathogenesis of chronic apical periodontitis is based on the development of a localized inflammatory response, which is accompanied by cell infiltration and the release of inflammatory mediators [Sullivan M. et al., 2016; Yuanita T. et al., 2018]. The pulp chamber is a hard-to-reach place for the immune system, as a result of which it often becomes a reservoir of the infectious process. The inflammation observed in the root canal system and the periapical region is a protective reaction of the body, an attempt to prevent the spread of infection to more distant tissues [Trigolos N.N. et al., 2015; Shaimbetova A.R., 2017].

A number of authors have shown that during periodontitis there is a sensitization of the body, a change in immunological reactivity with the formation of secondary immunodeficiency, a violation of the state of local immunity, which has a significant impact on the course of the pathological process, the effectiveness of the therapy and the results of treatment, as well as the risk of complications and recurrence of the disease [Blashkova S.L. et al., 2015; Trigolos N.N. et al., 2015; Goldobin D.D. et al., 2017; Metzger Z. et al., 2013; Sullivan M. et al., 2016; Jakovljevic A. et al., 2015; Yang N.-Y. et al., 2018]. Conducted under the guidance of Professor Ovrutsky G.D. immunomorphological studies back in the 70s of the XX century found the dependence of the outcome of periodontal diseases on the state of non-specific mechanisms of body defense [Ovrutsky G.D. et al., 2021].

Despite numerous studies, the problem of treating chronic apical periodontitis remains relevant, due to the prevalence of the disease, a fairly high frequency of exacerbations, both in early and long-term follow-up [Gerasimova L.P. et al., 2014; Kurmanalina M.A. et al., 2017; Shaimbetova A.R., 2017].

Given that pathogenic microorganisms in the root canal system are inaccessible to the action of systemic antimicrobial drugs, immune defense mechanisms, the need for timely endodontic treatment is beyond doubt [Gerasimova L.P. et al., 2014].

The treatment of chronic apical periodontitis remains one of the most pressing problems in endodontics today. This is due to the complexity and laboriousness of medical manipulations, with a significant prevalence of the disease, in particular, the imperfection of the methods of antiseptic effects on the root canal system [Aletdinova S.M., 2013). New materials and techniques are regularly introduced into dental practice, aimed at improving the effectiveness of the treatment of complicated forms of caries [Vetkova K.V. et al., 2014; Oliveira L.D. et al., 2012].

In endodontics, scientific and practical achievements include several areas: the study of the characteristics of the influence of such materials on micro- and macro-organisms, as well as on cells and periodontal tissues; improvement of methods of instrumental and drug treatment of the root canal; creation of new drugs for the treatment and obturation of root canals [Farahat A., Salah E.H., Al-Shraim M., 2014].

Treatment of chronic apical periodontitis is aimed at sanitation of root canals, removal of pathogenic microflora, activation of regeneration processes in the periapical region and high-quality obturation to prevent reinfection of the root canal system and periodontal tissues [Kurmanalina M.A. et al., 2017].

Important in the treatment of chronic apical periodontitis is the use of modern methods of X-ray imaging, which allow to determine the state of periapical tissues, the presence and severity of their damage, to conduct differential diagnosis, to assess the quality of endodontic treatment, the degree of root canal obturation, the dynamics and prognosis of the disease [Ternovoy S.K. et al., 2010; Baikov D.E. et al., 2006; Makedonova Yu.A. et al., 2015; Borden W.G. et al., 2013; Dorasani G. et al., 2013; Filho E.M.M. et al., 2018].

Despite the introduction of new technologies, complications after endodontic treatment are quite common, and if there are foci of destruction of periapical tissues on an x-ray, then instead of retreating a tooth, dentists offer the patient to remove it and replace the defect with an implant, considering this method of treatment to be the best in comparison with an attempt save your own tooth. Today, endodontics has extensive information about the structure of the root canal system, modern techniques, microscopes, instruments, etc. have appeared [Borisova E.G. and others, 2019; Dmitrieva L.A. et al., 2015; Friedman S., 2015]. One of the key factors in the development of the disease of the pulp and periapical tissues is considered to be bacterial infection of the root canal system. The main goal of treatment is to achieve their maximum sterility, given the fact that the existence of microorganisms in the root canal takes place in the form of a biofilm. For high-quality biomechanical instrumentation, there are currently a large number of endodontic

instruments. Complete removal of dentinal sawdust and microorganisms is not easy to achieve due to the formation of a smear layer on the walls of the root canal after instrumentation and their complex morphology, which has been proven by the results of numerous studies. The search for new treatment strategies is very relevant, since most drugs for intracanal use have a limited antibacterial spectrum of action and a low ability to diffuse into the dentinal tubules [Stabholz A., Sahar-Helft S., Moshonov J., 2018].

Chronic apical periodontitis, modern science considers as an inflammatory process of the periapical periodontal tissues of a traumatic, infectious and drug nature, which is under the influence of a complex of endo- and exogenous factors [Berezin K.A., 2015; Trigolos N.N. et al., 2015].

In most cases, the cause of the development of chronic apical periodontitis is the entry of toxic and infected contents of the root canals into periodontal tissues, which leads to the launch of reactions at the immune, cellular, microcirculatory levels, leading to the destruction of periapical tissues [Berezin K.A., 2015; Kuratov I.A. et al., 2017; Pavlovich O.A. et al., 2017; Metzger Z. et al., 2013; Sullivan M. et al., 2016].

In the treatment of chronic apical periodontitis, it is important to use modern methods of X-ray examination, which allow determining the state of periapical tissues, conducting differential diagnostics, assessing the quality of endodontic treatment, predicting and monitoring the dynamics [Ternovoy S.K. et al., 2010; Baikov D.E. et al., 2006; Makedonova Yu.A. et al., 2015; Borden W.G. et al., 2013; Dorasani G. Et al., 2013; Filho E.M.M. et al., 2018].

Modern dental practice is focused on the preservation and "rescue" of the most clinically difficult teeth. In the treatment of advanced forms of chronic apical periodontitis, the question of choosing drugs for intracanal use becomes acute [Ricucci D., Siqueira J., 2015].

The use of new technologies and equipment contributes to the successful implementation of complex treatment, reducing the time, improving the quality of prevention, diagnosis and treatment of complications. One of the most important is the treatment of chronic apical periodontitis, since the clinical course of the inflammatory process often occurs against the background of a reduced immune system of the body and somatic pathology in the patient [Mitronin A.V., 2004; Matsepuro K.A., Mitronin A.V., 2014]. The use of modern cone-beam computed tomography makes it possible to carry out diagnostics in detail and plan treatment [Dmitrieva L.A. et al., 2015].

Thus, based on the data of scientific and medical literature over the past 10 years, we can conclude that the prevalence of chronic periodontitis in different age groups of the population currently remains at a consistently high level and does not tend to decrease [Mitronin A.V., 2014].

It has been proven that it is instrumentally impossible to fully clean the root canal due to the presence of an intracanal biofilm and the complexity of the internal morphology of the tooth [Moshonov J., 2018]. The leading role in the development of pathology belongs to the microbial factor [Pavlovich O.A. et al., 2017]. Therefore, it is the impact on the microbiota of the root canal system that plays a leading role in the effectiveness of endodontic treatment [Yang N.Y. et al., 2018]. To this end, S. Cohen, R. Burns. (2000), N. S. Soukos et al. (2006), N. Chugal et al. (2017), as well as a number of other researchers, recommend using sodium hypochlorite solutions at a concentration of 0.5-5.5% and 0.05-2% solutions of chlorhexidine bigluconate. Sodium hypochlorite has a wide range of bactericidal action aimed at spore-forming bacteria and their vegetative forms, fungi, as well as protozoa and viruses, but is not effective enough against Enterococcus faecalis [Mitronin A.V., 2014]. At the same time, sodium hypochlorite in a small volume of the root canal is quickly inactivated, and its frequent renewal, ultrasonic or thermal activation is necessary. Chlorhexidine has an elimination effect against Streptococcus mutans and anaerobic microorganisms [Moshonov J., 2018]. However, according to I.M. Rabinovich, I.V. Kornetova (2013) this antiseptic is not able to dissolve organic tissues. At the same time,

I.A. Belenova, O.A. Krasichkova (2014) believe that in order to increase the effectiveness of antibacterial treatment of the root canal in chronic apical periodontitis, the chlorhexidine solution must also be activated by ultrasound.

For irrigation of root canals, the standard technique of positive pressure is most often used [Pavlovich O.A. et al., 2017]. But, as noted by A.I. Kui et al. (2018) and Y.M. Moon et al. (2010), this technique does not provide satisfactory treatment of the apical part of the canal and causes the risk of complications associated with the removal of the irrigation solution beyond the apex [Blashkova S.L. et al., 2015]. The use of ultrasound to activate the irrigation solution significantly increases the efficiency of irrigation [Yang N.Y. et al., 2018]. However, according to G.T. Saleeva, S.V. Grigorieva (2013) when working with ultrasonic tips, it is necessary to take into account the possibility of the formation of steps, perforation and breakage of the instrument in the root canal. In addition, according to L.M. Lukinykh (2014), during ultrasonic irrigation, the effectiveness of irrigant activation decreases when the instrument contacts the root canal wall, as the amplitude of movement of the ultrasonic tip decreases. TG Khokhrina (2007, 2008) for the first time substantiated the expediency of using vacuum in the treatment of destructive forms of chronic periodontitis.

Odontogenic foci of chronic infection in periodontitis and periodontal pathology determine the development of acute inflammatory processes in the maxillofacial region with the participation of non-spore-forming anaerobes [Pavlovich O.A. et al., 2017]. Microbial associations in root canals produce enzymes and endotoxins that negatively affect chemotaxis and phagocytosis in periapical tissues, inhibiting the action of antibacterial drugs that are used in the process of endodontic treatment [Blashkova S.L. et al., 2015]. When a bacterial cell is damaged, endotoxin is released, which, getting into the periodontal space, leads to the initiation of an inflammatory reaction - the release of biologically active substances and prostaglandins, which are mediators of inflammation [Yang N.Y. et al., 2018]. Inflammatory mediators trigger an inflammatory reaction, accompanied by an increase in vascular permeability, a change in the rheological properties of the blood, the processes of exudation of leukocytes, which provokes the action of a damaging factor leading to the destruction of periodontal bone tissue [Blashkova S.L. et al., 2015]. At the same time, endotoxins act as antigens, sensitizing not only periodontal tissues, but also the macroorganism as a whole, which, with insufficient immunological reactivity, leads to the development of focal diseases in humans caused by the presence of a chronic odontogenic focus of infection [Kuratov I.A., 2020].

Thus, our study was due to the use of literature data on chronic apical periodontitis, which allow us to increase the level of diagnosis of the disease, develop criteria for the norm and pathology, and also substantiate an individual approach to the tactics of managing patients with this disease.

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