European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 7, Issue 11, 2020

General and Specific Issues of Morbidity, Clinical Manifestations and Diagnosis of COVID-19 in Dental Practice

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Abstract: The article presents general information about etiology, epidemiology, pathogenesis and clinical manifestations infections COVID-19. The features and factors affecting the prevalence of COVID-19 in European countries and in the Russian Federation are given. Mechanisms consideredinvasions of SARS-CoV-2 and specific clinical manifestations of COVID-19 encountered in dental practice. Provides supporting facts about three different ways of spreading COVID-19 in dental practice, as well as data that allow making a conclusion and the possibility of infection through other routes. The features of the diagnosis of COVID-19 in dental practice, namely the factors that allow diagnostics in the early stages of the disease, are considered. Conclusions are drawn on the preventionand prospects of studying the spread of COVID-19 in dental practice.

Conflict of interest: The authors have declared no conflicts of interest.

Keywords: COVID-19, SARS-COV-2, Dental Practice, Clinical Manifestations, Diagnostics.

1. Introduction

SARS-CoV-2 coronavirus causes severe acute respiratory syndrome characterized by fever, respiratory and gastrointestinal symptoms, and other systemic manifestations[3].

For the first time, the coronavirus was isolated in 1965 from a patient with acute rhinitis, and in 1968 it was classified as a member of the Coronaviridae family, which at the beginning of 2020 included about 40 species. It got its name in connection with the specific configuration of the protein compound, which in shape resembles the solar corona during an eclipse. Various types of viruses infect humans, cats, birds, cattle and pigs [33].

Representatives of coronaviruses are divided into 4 genera: Alpha-, Beta-, Gamma- and Deltacoronavirus. Mammals are the natural hosts for most of the currently known Coronaviridae representatives [42].

In 2002 was for the first time highlighted SARS-CoV virus - the causative agent of atypical pneumonia -and heavy acute respiratory syndrome (TORSO)... This virus belongs to the genus Betacoronavirus. Bats serve as a natural reservoir for SARS-CoV, and camels and Himalayan civets are intermediate hosts. The SARS epidemic covered 37 countries, more than 8000 cases of the disease were registered, of which 774 were fatal. Since 2004, there have been no cases of SARS-CoV-induced SARS [21].

But at December 2019 yearand a new disease arose, which in its clinical signs was comparable to the previous one. Subsequently, the pathogen was identified, called SARS-CoV-2, and the disease caused by it - infection COVID-19.World Health Organization (WHO) announced infection COVID19 public health emergency on January 30, 2020. The number of confirmed SARS-CoV-2 and deaths from COVID-19 has grown exponentially [45].

The most common symptoms of COVID-19 include fever, dry cough, and fatigue. Rarer symptoms include joint and muscle pain, nasal congestion, headache, conjunctivitis, sore throat, diarrhea, loss of taste or smell, rashes, and discoloration of the skin on the fingers and toes. As a rule, these symptoms develop gradually and are mild. In some infected individuals, the disease is accompanied by very mild symptoms [63].
Today, there are still important questions related to the clinical approach to COVID-19, and there are still aspects to be explored. [44]
The incubation period ranges from 2 to 14 days; it can be lengthened (up to 21 days) upon infection from an animal [46].
Virus structure SARS-CoV-2is a spherical or pleomorphic enveloping particle with a single-stranded RNA that is bound to a nucleoprotein within a capsid composed of a matrix protein [23, 25]. New coronavirus SARS-CoV-2shares similarities with other types of coronavirus found in bats. Pangolins are thought to be intermediate hosts of the virusSARS-CoV-2[eighteen].
This is not surprising since the coronavirus family is zoonotic and can therefore be transmitted between animals and humans. Pathogenic for humans are pathogen severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV), the causative agent of SARS-CoV-2, as well as at least 6 seasonal coronaviruscirculating in the human population for a long time[11, 12].

Prevalence of COVID-19

DiseaseSARS-CoV-2all age groups are affected the adult population. However, the highest mortality rate is in elderly and senile persons [38].
A large number of European countries are among the leaders in the prevalence of morbidity and mortality from COVID-19. In some of them, tests are very limited due to the possibility of taking a smear only after hospitalization or in the presence of vivid clinical symptoms [28, 35].
It has been proven that the official incidence rate is higher in those countries where extensive laboratory examination of patients is carried out. This is especially true for countries with a higher life expectancy [36, 49].
The increase in the incidence among the elderly can be attributed to various reasons. For example, in Italy, Spain, Belgium, more people live in nursing homes, and in southern Europe (particularly Italy and Spain), people are more likely to live in extended families, which can increase the risk of infection for the elderly [30, 42].
Analysis of the dynamics of the spread of SARS-CoV-2 to RussiaFederations spring 2020 showsthat the greatest growth was recorded in the metropolitan area, as well as in transport hubsthrough which significantmasses of tourists returning from vacation. It has also been suggested thatthe number of cases is higher in regions with high incomes of the population, sincehigh-income populationtravels, as well as in such regions there are higher opportunities for the diagnosis of diseases [59].If the average per capita income of the population in the region is 1% higher, then the number of confirmed cases of the disease in it will be 1.2–1.4% higher. Demographic potential shows the number of residents in other regions of Russia, divided by the distance to them, that is, the proximity of large centers [60].
The closer a region is to a large agglomeration, the higher the number of cases in it, which is primarily due to the spread of the disease from Moscow to neighboring regions (Moscow region). A large number of temporary labor migrants left Moscow, what helped spread coronavirusand SARS-CoV-2 onEuropean part of the country [thirteen].
The larger the size of the regional center, in accordance with the model of the spatial distribution of innovations, the higher the proportion of tourists visiting foreign countries.

Also, the higher the density of interaction, the higher the level of infection. The first infected were more likely to live in large Russian cities near international airports [53].

A large proportion of older residents in the population is negatively associated with the number of cases. Mortality in old age from coronavirus is higher, but the officially recorded incidence is lower, which may be associated with a higher level of self-isolation of the elderly population, less social activity [8, 50, 61, 62].

We used Rospotrebnadzor data on the number of detected cases of a new coronavirus infection and the number of deaths from a new coronavirus infections in different constituent entities of the Russian Federation on 01/10/2020 [77]. We also used Rosstat data on the population size in different constituent entities of the Russian Federation as of January 1, 2020 to assess the level mortality from new coronavirus infection per 100,000 people in different constituent entities of the Russian Federation [80].

It is worth noting the weak correspondence of the incidence rate (per 100 thousand), number of tested per 100 thousand. It should be noted that the regions are strongly differ in morbidity - from 97 to 2399 per 100 thousand people, interquartile interval - from 399 to 709 people, in half of the regions the incidence rate is more than 560 per 100 thousand population [7nine]... In Moscow, the Moscow region and St. Petersburg the incidence is, respectively, 2055, 894 and 655 cases per 100 thousand people. A number of indicators differ significantly from region to region, for example, in terms of population coverage testing the maximum value (83,758 tests per 100 thousand in the Yamalo-Nenets Autonomous district) almost 8 times exceeds the minimum indicator (10916 tests per 100 thousand in the Bryansk region); the number of laboratory tests carried out per detected case ranges from 12 (in the Republic of Kalmykia) to 174 tests (in the Chukotka Autonomous District). Currently, there is an increase in the number of active cases in 42 regions - the largest increase is observed in St. Petersburg, Stavropol Territory, Sverdlovsk Region, Krasnoyarsk Territory and Arkhangelsk Region...In 7 regions, the level of testing increasedfor last 2 weeks - in the Altai and Trans-Baikal Territories, Kaluga and Leningrad regions, in the republics of Gorny Altai, Karelia, Mari El, Tatarstan, Khakassia, in the Saratov and Tula regions, the Udmurt Republic, the Ulyanovsk region and Khabarovsk Territory. In 25 regions, the level of testing did not decrease (in Jewish Autonomous District, Belgorod, Bryansk, Vladimir, Volgograd, Voronezh and Kostroma regions, Krasnodar region, Kursk, Magadan, Moscow, Novgorod, Omsk, Oryol, Penza and Pskov regions, in Dagestan, Kalmykia, the Komi Republic, Rostov and Samara regions, St. Petersburg, Stavropol Territory, Tambov and Yaroslavl regions). Death rates from COVID-19 also differ significantly between regions. St. Petersburg (43.52), Moscow (37.85), Arkhangelsk region (21.59), Tula region (20.33), Republic of Tyva (18.74), Murmansk are leading in the number of deaths per 100 thousand of the population. region (17.60), Republic of Kalmykia (17.35), Yamalo-Nenets Autonomous district (15.82), Republic of Ingushetia (15.69), Republic of Dagestan (15.66). The average number of deaths per 100 thousand is 8.08, the median is 5.88, the interquartile range is 3.49-11.01 per 100 thousand. [76,78].

It should be noted that the minimum and maximum incidence rates per 100 thousand. between regions differs almost 30 times, the minimum and maximum number of tested individuals per 100 thousand people between regions differs in 21 time. All this indicates that for comparison of regions, one should not rely on absolute indicators without normalization to population size, testing coverage [75].

From the published data on morbidity and mortality from COVID-19, many different conclusions are drawn, which are rapidly spreading on the Internet through social media platforms. But, despite the availability and openness of the data that exists today, much less is known about the criteria on the basis of which these data are collected and what their

limitations are. The incidence of COVID-19 in dental practice was not an exception [26, 27, 43].

Infection Problem COVID-19 in Dental Practice

One of the little-known aspects is semiology at the level of the oral cavity. This may be due to the fact that dentists worldwide are separated from daily clinical activities due to the risks of potential transmission infectious agentsmainly due to the presence of saliva aerosols in some of them [5]. After the pandemic was declaredSARS-CoV-2many dental services have been suspended. Health authorities have recommended limiting them to dental emergencies only. On the other hand, people stopped visiting the dentist, either because of the fear that arose or because of the situation of restriction of freedom, recommended or mandatory, in which most of the world's population found itself. These reasons may explain the paucity of reports of oral mucosal lesions in patients with COVID-19 or other oral manifestations. Especially when you consider that in many situations, dentists are the most suitable professionals for the clinical assessment of human oral health.

Implementation virus SARS-CoV-2begins in the area of the nasopharynx and oropharynx. The name "coronavirus" comes from a highly glycosylated cell surface protein (S-protein). It is believed that this S-protein is responsible for the entry of the virus into cells. For invasion, the S protein must be cleaved into two different functional domains (S1 and S2) by proteases found in the cell in order for the virus to fuse with the cell. This cleavage is a critical step and is mediated by furin, a protein convertase [15].

Among symptoms oral cavity lesionsdescribed in patients with COVID-19, most often described ageusia, hypogeusia, dysgeusia. This is especially important because the angiotensin receptor-converting enzyme-2, to which SARS-CoV-2 binds, can enter the host cell, being highly expressed in epithelial cells, especially in the tongue, compared to other tissues of the oral cavity or gums. Somesymptoms oral lesions can be a clinical manifestation of SARS-CoV-2 infection, and on the other hand, patients should undergo a complete examinationin order to relate them to COVID-19 [31, 39].

It is also important to regularly assess signs and symptoms that may occur in the oral cavity in patients, having positive result test and RT-PCR[32].

The mucous membrane is affected in 75% of cases (dorsum of the tongue, hard palate, gingival mucosa), while 25% of manifestations were on the mucous membrane of the lips and cheeks. In some cases, erythematous lesions and ulcers were observed. [37].

There are also nonspecific oral symptoms such as xerostomia (dry mouth) and ageusia (loss of taste). Asymptomatic cases pose significant challenges to outbreak management as they can play a critical role in transmission. Decreased salivation and xerostomia are associated clinical symptoms of COVID-19. These symptoms can be explained by dysfunction of the tongue or salivary gland expressing ACE and furin[6].What's more, irregular ulcers on the dorsum of the tongue have been suggested as a potential first clinical manifestation of COVID-19. [4].Oral symptoms may be due to co-infection with SARS-CoV-2 and another bacterial infection that increases the severity of COVID19 [1].

The absence of symptoms in a patient in the case of COVID-19 does not exclude that the patient is highly contagious [14, 51].

How COVID-19 is Spread in Dental Practice

Dental transmission of SARSCoV-2 can occur in three main ways [72]. The first is direct exposure during a dental consultation to drops of saliva, blood, or other patient materials that could potentially contain the SARS-CoV-2 virus [47].The second- indirect contact with contaminated surfaces or tools [47]. Coronaviruses persist for several hours on dry inert

surfaces and up to 6 days in a humid environment [17].This duration is closely related to temperature, residual moisture, seed starting material, type of surface, and the presence of body fluids. The third- way- inhalation of suspended airborne viruses. The recent awareness of this situation is related to the potential dramatic effects of SARS-CoV-2 and airborne aerosol production during dental procedures. Some procedures are sensitive to aerosols (ultrasonic instruments, high-speed hand pieces, turbine and air polisher); it is important to eliminate the formation of drops and aerosols during visits to the dentist [nine].There are no data on the average titer of the virus in the emitted aerosol particles, as well as on the minimum infectious dose in susceptible people.

High expression of the protein angiotensin-converting enzyme-2 (ACE2) has been identified in various cells respiratoryways(type II lung alveolar cells), salivaryglands, oral mucosa, epithelial cells of the esophagus, cholangiocytes and epithelial cells of the ileum and colon, urinary tract, and myocardial cells. [22, 52,54,56,57].

Features of COVID-19 Diagnostics in Dental Practice

Oral liquid-can be a diagnostic or monitoring tool SARS-CoV-2either alone or in combination with other tests in addition to clinical examination[34].Whole salivarefers to a hypotonic biological fluid, which includes saliva and non-salivary elements, such as secretions of noobronchial origin or fluids of the gingival sulcus, desquamated epithelial cells, serum, blood derivatives, microorganisms (viruses, bacteria, parasites and fungi), as well as exogenous substances [19, 20, 24]. Also carried out a study that collected and compared various human samples (oral swabs, blood samples) from positive patients. After treatment, half of the oral swabs (50%) were negative for SARS-CoV-2 RNA, six (40%) had a positive blood test, and serum was positive. The virus could be detected in patients' blood, while oral swabs were negative, suggesting that oral swabs are probably better indications of early infection.[29, 55].Using viral culture, it was also found that live viruses are present in the deep throat saliva of infected people. [41].

Particular attention should be paid to the viral load of saliva, which changes over time: it is high during the first week after the onset of symptoms and subsequently decreases over time. Low levels of SARS-CoV-2 RNA in saliva can still be quantified even after complete clinical recovery[40]. Saliva samples taken directly from the salivary gland duct are more likely to be detected late in the disease, and positive SARS-CoV-2 nucleic acid tests in saliva obtained from salivary glands may indicate the severity of COVID-19 [7].

Recommendations for Working with Patients in Dental Practice in the conditions of COVID-19

WHO does not recommend self-medication or self-administration of any medication as prevention or treatment for COVID-19. However, there are several clinical trials currently underway that are investigating both Western and traditional medicines. WHO is coordinating efforts to develop vaccines and drugs for the prevention and treatment of COVID-19 and will publish updated information as research results become available [70]. Medical masks should be used in conjunction with other basic preventive measures such as hand hygiene and social distancing. Medical masks and respirators, such as N95, FFP2 or their equivalents, are recommended for use by healthcare professionals in the process of caring for patients, and should be given priority to medical personnel. Close contact with people suspected of having COVID-19 or with confirmed infection, as well as with objects and surfaces around them, are the main factors in the transmission of infection, which puts medical personnel at the highest risk of infection [71]. The reason for the highest danger specifically for dentists is that, given the specifics of the work, the risk of infection of a doctor and an assistant while treating a patient with coronavirus when using conventional

PPE is 99.99%. According to the law of the Russian Federation, dentists are classified as medium occupational risk, along with other professions that do not work with aerosol suspensions from patients.

2. Conclusions

From scientific publications, the possible transmission routes of SARSCoV-2 in dentistry have been summarized, such as spread by airborne droplets, contact spread and spread through contaminated surfaces.The most significant foreign publications describe practical strategies for preventing transmission of the virus during dental diagnosis and treatment, including patient assessment, hand hygiene, personal protective measures for dental professionals, preparation for dental procedures, isolation with a rubber dam, disinfection of clinic premises and treatment of medical waste [73, 74].

Lack of unambiguous answers to questions about the degree of contagiousness, modes of transmission, mortality, methods and duration of treatment, became the basis problem in the health care system in general and in dental practice in particular. This influenced the tactics of organizing and operating dental clinics, which led to a significant decrease in the volume of services provided to the population.At the same time, the leading principle of performing dental work was understanding, what any patient should be considered a potential carrier of coronavirus infection... Only if all the requirements for the provision of medical care in the conditions of COVID-19 in dental practice are met will it be possible to avoid and reduce the incidence.

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