Coronavirus COVID-19 outbreak & Dentistry; Routes of Transmission & Infection- Control Challenges and Responsibilities

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Abstract

The 2019 coronavirus disease (COVID-19) pandemic, originating in Wuhan, China, is becoming a major public health problem for not only China, but countries all over the world as well. The World Health Organization (WHO) has reported that outbreaks of the novel coronavirus have become a globally worried public health emergency. As of February 4, 2021, COVID-19 has been recognized in 235 countries, with more than 105.000.000 (one hundred and five millions) laboratory-confirmed cases and above 2.280.000 (million) deaths. To prevent the virus from further spreading and to help manage the disease situation, infection control measures are necessary. The risk of cross contamination can be high between patients and dental practitioners because of the characteristics of dental settings. Strict and efficient infection management protocols are urgently needed for dental practices and hospitals in areas which are (potentially) affected by COVID-19. This article, based on our experience and relevant guidelines and research, introduces essential knowledge about COVID-19 and nosocomial infection in dental settings and provides recommended management protocols for dental practitioners and students in (potentially) affected areas.

Keywords: *Corona Ncovid-2019, infection control, dental public health, dental education, transmission, dental practice management*

Introduction

A novel coronavirus was officially confirmed on January 8 , 2020 by the Chinese Center for Disease Control and Prevention (Li et al. 2020) as the causative pathogen of COVID-19. The 2019 coronavirus disease epidemics (COVID-19) started in Wuhan , China, in December 2019 and have become a major public health concern not only for China, but also for other countries around the world.[1]

On January 30, 2020, WHO announced that this outbreak had constituted a public health emergency of international concern.[2] The novel coronavirus was initially named 2019-nCoV and officially as severe acute respiratory syndrome coronavirus 2 (SARSCoV-2). As of October 2, COVID-19 [4]has been recognized in 235 countries, with above 34.000.000 laboratory-confirmed cases and more than 1.000.000 deaths (WHO 2020b).[3 6]

1. The routes of transmission

As stated in the 6th Edition of the COVID-19 Treatment Regimen (Trial Implementation) [5] released by the National Health Commission of the People's Republic of China (2020), the possible routes of 2019-nCoV transmission are primarily direct contact and droplet transmission. Aerosol transfer is also a possible transmission route when exposure to high aerosol concentrations occurs in a relatively closed environment. Routine dental procedures generate aerosols, posing potential risks to dental care staff and patients. Although there are no confirmed cases of coronavirus transmission in the dental community, given the high transmissibility of the disease, dental teams should be alert and ensure a healthy atmosphere for both employees and patients.[7]

Several possible transmission scenarios with COVID-19 have been identified. Talking, coughing, sneezing (related to human respiratory activity) and aerosols emitted during clinical procedures are expected, as is the case with other respiratory infections, to be transmitted through droplet contact. The nasopharyngeal or oropharyngeal can be the origin of the droplets, usually associated with saliva. On the other hand, larger droplets may lead to viral transmission to nearby subjects[8], and long-distance transmission is likely to result in viral transmission of smaller droplets polluted with air-suspended viral particles.[9,10.]

Diagnosis of COVID-19 is theoretically carried out using salivary diagnostic platforms[13,12]. For as long as 29 days after infection, some strains of viruses have been found in saliva.[14, 15], indicating that a non-invasive platform for the rapid differentiation of saliva biomarkers could boost the detection of diseases.[16]

Samples of saliva might be collected in patients who present with oropharyngeal secretions as a symptom.[9, 10] Given the need for close contact for the collection of nasopharyngeal or oropharyngeal samples between healthcare workers and infected patients, the likelihood of saliva self-collection would substantially reduce the risk of transmission of COVID-19. In addition, nasopharyngeal and oropharyngeal collection, especially in patients with thrombocytopenia who are infected, causes pain and can promote bleeding. In the lower respiratory tract, just 28 % of COVID-19 patients developed sputum, which suggests a strong limitation for diagnostic evaluation as specimens.[17] At least three different pathways are suggested for the presence of COVID-19 in saliva: first, COVID-19 in the lower and upper respiratory tracts. [18, 19] which reaches the oral cavity along with the liquid droplets often exchanged by these organs.

Secondly, COVID-19 present in the blood may reach the mouth through crevicular fluid, an oral cavity-specific exudate that contains local proteins derived from extracellular matrix and serum-derived proteins.[20] Finally, inflammation of major and minor salivary glands, with the subsequent release of saliva particles through the salivary ducts, is another way for COVID-19 to occur in the oral cavity. It is important to point out that shortly after infection in rhesus macaques, SARS-CoV may infect salivary gland epithelial cells, suggesting that salivary gland cells may be a key source of this virus in saliva.[21] Furthermore, the synthesis of SARS-CoV-specific secretory immunoglobulin A (sIgA) in the saliva of intra-nasally immunized animal models has previously been demonstrated.[22] Considering the similarity of both strains, we speculate that it is possible to conduct salivary diagnosis of COVID-19 could also be performed using specific antibodies to this virus.[23]

2. Aerosol transmission and its implication in dentistry

Large droplets or aerosols are formed (> 5 μm diameter) and tiny (~ 5 μm diameter) if a person coughs, sneezes, breathes, smiles, or talks deeply. Larger droplets easily fall to the ground due to gravity; thus, droplet transmission requires near physical contact between an infected person and a susceptible person. On the other side, for small droplets or tiny particle traces of evaporated droplets, there is a low settling velocity, meaning they can linger in the air for a longer period of time and migrate farther until they can reach the respiratory tract or contaminate surfaces (WHO, 2014). Aerosols from highly virulent pathogens such as severe acute respiratory syndrome coronavirus (SARSCoV) can travel more than six feet, results from a previous study showed.[24]

A number of nosocomial pathogens have been found to be transmitted via contaminated surfaces. 25 While human coronaviruses have limited capacity to live on a dry surface, like SARS-CoV and Middle East Respiratory Syndrome Coronavirus (MERS-CoV), several studies have indicated that they can persist on the surface for a few days, particularly when suspended and under human secretion.[25, 26] Hand contact with contaminated surfaces may lead to pathogen acquisition and transmission to the eyes, nose, or mouth, resulting in a new case of infection.[25]

Droplets and aerosols in dental setting

When performing dental procedures with a high speed handpiece, friction between the tooth and the rapidly moving bur will produce unnecessary heat. Without a coolant, the heat can cause damage to hard

dental tissue and lead to pathological changes to the dental pulp. It is also a general consensus to use a water coolant when performing dental procedures, including tooth preparation, oral prophylaxis, and oral surgery, in order to minimize heat gain,[29] as shown in Fig. 3.

Aerosols might be produced by the water coolant, though. These bio-aerosols are typically infected with bacteria, fungi, and viruses and have the ability to float in the air for a prolonged amount of time and to be inhaled by dentists or other patients when mixed with body fluids in the oral cavity, such as blood and saliva.[26, 27]. fig.1.

A study conducted by Zemouri, et al, (2017) [30] found that in the dental clinic, 38 types of microorganisms, like Legionella pneumophila, the causative agent of severe pneumonia, could be present in the air. After being treated in a dental clinic, patients contracting pneumonia have been confirmed.[31] Another community in the UK reported a tuberculosis epidemic among dental patients who contracted the infection at their local dentist.[32]

As far as coronavirus is concerned, Wang, et al, (2004) [33] investigated the oral cavity of SARS patients and found a large amount of SARS-CoV RNA in their saliva ((7.08-103) to (6.38-108) copies / mL), suggesting the likelihood of transmission of coronavirus through oral droplets. Previous research has shown that most cases of SARS-CoV and MERS-CoV have been related to hospital nosocomial transmission, partly due to aerosol-generating procedures in patients with respiratory dystrophy.[34] Based on current epidemiological data, 2019-nCoV has greater transmissibility than SARS-CoV and MERS-CoV (Chen, 2020).[35] During this outbreak, therefore, it is essential to modify the standard precautionary and infection control regimen aimed at 2019-nCoV.

Infection-control challenges in dental field

The outbreak of COVID-19 has clearly put health professionals at risk. 2019-In health care workers (HCWs), nCoV infection has been discovered, and the number of such cases is gradually increasing.[36] Based on information obtained from China's Infectious Disease Information System, a total of 1716 HCWs have been infected with 2019-nCoV, with five confirmed deaths (The Novel Coronavirus Pneumonia Emergency Response Epidemiology Unit, 2020). As an infected HCW might also constitute a cross-transmission vector, it is necessary to ensure the health and personal safety of HCWs.

Luckily, there are no confirmed cases of COVID-19 transmission in the dental area. However, with the evidence given that the incubation period lasts up to 14 d. [37], it is not always possible to detect asymptotic carriers at an early stage or without examination. In addition, from asymptomatic contact, there has been a report of infection transmission, implying that during the incubation period, COVID-19 is contagious.[38]

Interestingly, a group of Chinese scientists have confirmed that the 2019-nCoV infection cell receptor for angiotensin-converting enzyme II (ACE2) is highly expressed in the oral cavity mucosa. Notably, this receptor is present in significant quantities in the epithelium of tongue cells.[39] These findings indicate that the oral cavity is a potentially high-risk carrier of 2019-nCoV infection and can be used in future prevention measures in the dental / clinical community.fig.2.[40]

Recommended Measures during the COVID-19 Outbreak

Recommendations for Management

The National Health Commission of China added COVID-19 in January 2020 to the category of Group B infectious diseases, which includes SARS and highly pathogenic avian influenza. However, it also recommended that all health care workers, a category reserved for highly infectious pathogens such as cholera and plague, use protective measures similar to those indicated for infections in group A. Since then, in most cities in mainland China, only dental emergency cases have been handled when strict implementation of infection prevention and control measures is recommended.[41]

Current Status of Our School and Hospital

The faculty and Hospital of dentistry, Assiut university provided dental care (including oral and maxillofacial surgery) to around 20,000 patients last

year and is home to 120 staff and 800 students. Our hospital does not have a fever clinic or belong to a designated one for patients with COVID-19. Any staff member who has fever, cough, sneezing, or COVID-19–related symptoms or has a close family member who is confirmed with the infection is advised to undergo a medical examination in a designated hospital and cease working. Since the starting emergence of positive case, the dental hospital stopped the routine dental treatment and act only for emergencies dental management only According to the instructions from the Ministry of high Education of Egypt, all students, including those in our faculty, have been required to not return to faculty until further notification. Students are recommended to learn online until further notifications.[42]

Dental emergencies can occur and intensify within a limited period of time and thus require immediate treatment. Rubber dams and high-volume saliva ejectors can help remove aerosols or spatters in dental procedures. Furthermore, for high or low-speed water spray drilling, face shields and goggles are essential.[43] During the epidemic, according to our clinical knowledge, if a carious tooth is diagnosed with symptomatic permanent pulpitis, pulp exposure should be made with the removal of chemo-mechanical caries under rubber dam isolation and after local anaesthesia with a high-volume saliva ejector; then pulp devitalization may be done to minimize pain[44,46].

Special precautions in dental emergency during COVID-19 outbreak

Because of the special characteristics of dentistry and the high transmissibility of COVID-19, dental hospitals and clinics across China are temporarily closed to avoid the potential risk of infection. However, there are dental emergencies that require urgent treatment and supervision, some of which are amended by ADA by 31-3-2020.[42] Therefore, special precautions should be followed when treating dental emergencies.

Patient screening: Dentists should take from each patient a full medical history, as is the routine, and at each recall visit confirm the health status. During this outbreak, targeted screening questions for COVID-19 must be asked. Such questions should include personal, travel, and epidemiological history. It is important to closely track the temperature and symptoms of the lower respiratory tract. Remember that symptoms of fever and fatigue may be caused by acute dental infection, so the aetiology should be verified.

Emergency care should be performed using the normal dental emergency regimen for patients whose infections are of dental origin.

For reported / verified cases of COVID-19 that are medically stable, laboratory testing and multidisciplinary team consultations should be conducted. After the outbreak, the patient should be reprogrammed if necessary to ensure the safety of patients and HCWs.

For reported / verified cases of COVID-19 that require urgent dental treatment, the highest level of personal protection should be implemented. To encourage natural ventilation, WHO (2020a) [47] suggests using a negative pressure room with a minimum of 12 air changes per hour or at least 160 L / s per patient. Mechanical ventilation should start sooner before treating the next patient.

Special precautions in urgent cases practice

Waiting area

Post an instruction at the entrance of the waiting room on cough etiquette. Ensure that all patients cover their nose and mouth with a tissue or their elbow while coughing or sneezing; instruct them to dispose of used tissues in a waste bin immediately after use and ensure hand hygiene. Patients should be placed in a well-ventilated waiting room. For rooms with natural ventilation, 60 L / s per patient is considered sufficient ventilation.[48 49.]

Hand hygiene

There is a growing awareness of the importance of hand washing in preventing acute respiratory infections. Several epidemiological studies showed that during the outburst of SARS, hand washing with soap and 70 %-90 % alcohol-based hand rubs (ABHRs) were effective in curbing SARS transmission.[50, 51]

The WHO (2020c) [52] Noted that either hand washing with an ABHR or soap and water is required for hand hygiene; both techniques are equally efficient[54]. ABHRs are recommended when the hands are not clearly soiled[55]; water and soap should be used when the hands are obviously soiled[56], as indicated by WHO (2009)[53], before touching a patient, before any washing or aseptic surgery is performed, after exposure to body fluid, after touching a patient, and after touching a patient's area[43] [57].

Rubber dam isolation

During dental procedures that contain aerosols[58] [59], the rubber dam provides barrier protection from the primary source and will effectively eliminate any contaminants resulting from respiratory secretion. If the rubber dam is correctly located, the tooth undergoing treatment would be the only source of contamination.[60] Rubber dam application showed a significant decrease of 90% in the spread of microorganisms during cavity preparation.[61] Rubber Dam is used in all aerosol-generating activities. One drawback to the use of the rubber dam is that it is not feasible in processes requiring subgingival instrumentation, such as subgingival restoration and subgingival crown margin planning.[62]

Removal/filter of contaminated air

There are many ways to eliminate / filter contaminated air in treatment areas; the two most commonly used devices include the inexpensive high-volume evacuator (HVE) and the expensive high-efficiency particulate arrestor (HEPA) filters.

HVE filter: It is a suction device which helps remove air at a rate of up to 2.83 m^3 per minute. It is the best way to remove dental aerosols as they are formed and will effectively reduce emissions generated by the operating site by 90 %.[63] [62] One drawback of the HVE is that clinicians can encounter trouble operating it with one hand without a dental assistant. There are updated HVEs that tackle this issue in the market[64] In addition, it is difficult to clean and costly to repair soiled HEPA filters[65] [66].

Recommendations for Dental Education

For medical and dental schools, as well as their associated hospitals, challenges related to education are important. In order to improve mutual trust and facilitate appropriate cooperation, open contact was reported between students, clinical teachers, and administrative staff.[67] [68]Second, by making good use of online resources and learning about emerging academic trends, students should be encouraged to engage in self-learning. Third, during this period, it is easy for students to be affected by disease-associated fear and pressure, and dental schools should be able to offer psychological services to those who need them.[33]

What are we doing to improve the latest infection prevention and control methods after the outbreak? How will we respond in the future to similar infectious diseases? These are open questions in need of further discussion and research. We must be constantly aware of infectious threats that can threaten the current infection control regime, particularly in dental practices and dental medicine schools.

Conclusions

Dentists, by nature, are at high risk of exposure to infectious diseases. The emergence of COVID-19 has brought new challenges and responsibilities to dental professionals. A better understanding of aerosol transmission and its implication in dentistry can help us identify and rectify negligence in daily dental practice. In addition to the standard precautions, implementation of special precautions could prevent disease transmission from asymptomatic carriers. These special precautions would not only help control the spread of COVID-19 but also serve as a guide for managing other respiratory diseases.

Compliance with ethics guidelines

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I am paying the publishing costs for the research . I pledge to do so myself

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