COVID-19 Pandemic: Dental Considerations and Review of Literature

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Abstract

The pandemic of coronavirus disease 2019 (COVID-19) caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) presents an unprecedented challenge to the healthcare professionals and Mankind. The World Health Organization has declared COVID 19 as a Pandemic due to its widespread dissemination worldwide. As per the latest statistics, more than 8.12 million cases have been reported with 4,39 421 deaths in more than 200 countries. The total population affected in India is Approximately 3,43,091. The states of Maharashtra, Tamil Nadu, Delhi and Gujarat, account for majority of the positive cases reported in India. Due to high rate of human to human transmission, protocols to prevent the virus dissemination is the need of the hour. There is a high risk of cross infection between patients and dental practitioners due to the COVID-19 transmission via contact with droplets and aerosols generated during dental clinical procedures. Dental clinics in high risk areas should adhere to strict and effective infection control protocols. This article, provides potential information about COVID-19, its transmission during oral procedures and highlights on the suggested treatment policies for oral health practitioners. It also provides a brief outline of the currently available treatment strategies for COVID 19.

Keywords: COVID 19, Oral Health Practitioners, Dental Infection Control, Personal Protective Equipment.

1. INTRODUCTION

The novel Coronavirus disease 2019, also called COVID-19, is the newest infectious disease; rapidly spreading worldwide resulting in a worst Pandemic mankind has ever experienced. The etiologic agent of COVID-19 is the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).SARS-CoV-2 was first discovered in 2019 in Wuhan, China, unfortunately spreading globally, resulting in the 2019–2020 pandemic, as declared by the World Health Organization (WHO) and the Public Health Emergency of International Concern (PHEIC).[1] The International Committee on Taxonomy of Viruses (ICTV) announced "severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)" as the name of the new virus on 11 February 2020. This name was chosen because the virus is genetically related to the coronavirus responsible for the SARS outbreak of 2003. While related, the two viruses are different. The 2019 coronavirus is different from SARS-CoV, but it has the same host receptor: human angiotensin-converting enzyme 2 (ACE2).[2,3] WHO announced "COVID-19" as the name of this new disease on 11 February 2020, following guidelines previously developed with the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO).[1] As per the latest statistics, more than 8.12 million cases have been reported with 4,39 421 deaths in more than 200 countries. The total population affected in India is Approximately 3,43,091. The states of Maharashtra, Tamil Nadu, Delhi and Gujarat, account for majority of the positive cases reported in India. [4,5]

This pandemic and its severe outbreak worldwide, persuaded the Government of different countries to promote drastic impact measures to "flatten the curve" of the COVID-19 infection to decrease the mortality rate associated with this deadly disease[6]. The limitation of people circulating outside their home, social distancing, cessation of almost all working activities and the request to the population to use protective masks and gloves all have the aim of minimizing the likelihood that people who are not infected come

into contact with others who are already infected and probably still asymptomatic[7]. The healthcare professionals are involved as frontline workers, in the national emergency, working hard, often day and night: inadvertently, many of them have also become infected, and some have tragically died. We as Dental professionals are often the first to diagnose, as we work in close contact with patients. On 15 March 2020, the New York Times published an article entitled "The Workers Who Face the Greatest Coronavirus Risk", where an impressive schematic figure described that dentists are the workers most exposed to the risk of being affected by COVID-19, much more than nurses and general physicians.[8,1]

2. PHYSIOGNOMIES OF CORONA VIRUS

According to The Chinese Preventive Medicine Association 2020 recent research, similar to SARS-CoV and Middle East respiratory syndrome coronavirus (MERS-CoV), SARSCoV- 2 is zoonotic, with Chinese horseshoe bats (*Rhinolophus Sinicus*) being the most probable origin and pangolins as the most likely intermediate host.[1,9]

Coronaviruses are single stranded RNA viruses of the family Coronaviridae, and order Nidovirales.[10,11] The four species of coronaviruses presently are,α- CoV, β-CoV, γ-CoV, and δ-CoV.[12,13] The α and β type target the respiratory, gastrointestinal, and central nervous system of humans and mammals, whereas γ and δ infect the birds.[13-15] The different species of CoV cause minor respiratory infection; but the SARS-CoV and the Middle East respiratory syndrome coronavirus (MERS-CoV) discovered in 2002–2003 and in 2012, respectively, caused serious respiratory infections.. Based on the phylogenetic analysis, the present 2019-nCoV and the SARS-CoV and MERS-CoV belong to the β-CoV [10,13]

The archetypal structure of 2019-nCoV includes the "spike protein" (S) in the membrane envelope,[16] and other polyproteins, nucleoproteins, and membrane proteins, such as RNA polymerase, 3-chymotrypsin-like protease, papain-like protease, helicase, glycoprotein, and accessory proteins The S protein attaches to host cell receptors and provides easy access of the virus entry on specific cells.[17,18]

3. ETIOPATHOGENESIS

SARS-CoV-2, a single-stranded RNA-enveloped virus, targets cells through the viral structural spike (S) protein that binds to the angiotensin-converting enzyme 2 (ACE2) receptor. Following receptor binding, the virus particle uses host cell receptors and endosomes to enter target cells. A host type 2 transmembrane serine protease, TMPRSS2, facilitates cell entry via the S protein[19].

Once inside the cell, viral polyproteins are synthesized that encode for the replicase-transcriptase complex. The virus then synthesizes RNA via its RNA-dependent RNA polymerase. Structural proteins are synthesized leading to completion of assembly and release of viral particles.[20]Due to the increased affinity of ACE2 with 2019-nCoV S protein, it is hypothesised that patients with higher expression of ACE2 may be prone to CoV infections. [9]

4. MODES OF TRANSMISSION

The results from the ongoing Community based research implicate, that the emergence of COVID-19 was initiated by animal-to-human transmission, and then resulted in widespread human-to-human dissemination.[1]

- Point of contact with Symptomatic COVID-19 is the prime aetiology
- Respiratory droplets and closed contact resulted in human -human transmission[9]
- The isolation of nCoV-2 in stool of patients from countries like China and USA lead to a possibility of Feaco oral transmission[22]
- The Vertical transmission from mothers to their new born infants is yet to be established[23]
- The high infection rate in Asymptomatic individuals results in further spread of this contagious infection. Approximately 79% of the spread could be due to of the asymptomatic carriers[24]

The modes of direct contact include coughing, sneezing and droplet spread. Contact dissemination can occur through Oral, nasal and

Ocular mucous membranes.[9,25,26]. The typical COVID infection does not include visual manifestations, but the isolation of 2019-nCoV samples from conjunctiva suggests the possibility of eye exposure as one of the routes of entry for the virus into the host cells.[27]

5. CLINICAL PRESENTATION

Stereotypically, most of the patients present with minor symptoms like fever and dry cough. Recently prodromal symptoms of loss of taste and smell have been reported by patients. Few patients can experience dyspnoea, tiredness, and other uncharacteristic presentations like myalgia, pharyngitis headache, diarrhoea, and vomiting.[28] Serious manifestations include acute respiratory distress syndrome, arrhythmia, and shock, and require admission to the intensive care unit.[29] Geriatric patients and individuals with existing comorbidities like diabetes, hypertension, and cardiovascular disease are associated with poor prognosis .[30] The fatality rate which depicts the (cumulative deaths divided by cumulative cases) of COVID-19 is 0.39% to 4.05%[31]

6. DIAGNOSIS

The patients with COVID-19 are identified on the basis of travel history to affected areas in the past 14 days, archetypal clinical symptoms, Radiological presentations on Computed tomography (CT) scans, and Gold standard diagnostic laboratory tests (reverse transcriptase polymerase chain reaction- qRT-PCR) conducted on respiratory tract specimens.[1]

The laboratory diagnostic tests should be performed using nasopharyngeal, oropharyngeal, and blood samples. Expectorated sputum and other specimens in severe respiratory disease should be considered as lower respiratory tract samples.[1] Saliva can also be used as a non-invasive alternative screening test or when other respiratory specimens cannot be obtained. [9]

7. PROBABLE COURSE OF SPREAD OF COVID-19 IN DENTAL CLINICS

The Oral health professionals and patients are exposed to infectious microbes, such as viruses and bacteria which manifest the oral cavity and respiratory tract.[9] Transmission can also occur through contacts and fomites. The virus was isolated by viral culture in the saliva of the COVID patients. [26] The 2019-nCov gains entry enters through the ACE2 cell receptor[2].The ACE2+ cells are present profoundly in the respiratory tract and epithelium of the salivary gland duct.[32]

There is a high risk of transmission of 2019-nCoV infection in the dental clinics and hospitals as the dental procedures requires closed contact with the patients, and repeated contact with saliva, blood, and other body fluids, and treatment with sharp instruments. The infectious microbiota diffuses in the dental settings through inhalation of infected suspended particles in the air[33], direct contact with patient fomites, saliva, blood,[34]secretions expelled by the patient while coughing, sneezing or without wearing a mask[35,36], and indirect contact with soiled instruments and/or environmental surfaces. These are the different routes wherein, infections could be transmitted in dental clinics and hospitals, during this pandemic[37]

7.1 Airborne

The dental settings are a store house of droplet and aerosol transmission of 2019-nCoV and is a matter of concern.[34] The dental procedures involve the use of high-speed dental handpiece. They operate on high-speed gas to rotate the turbine with water. This leads to generation of droplet and aerosol mixed with patient's saliva or blood. The particulates are of miniscule size and stay suspended in the air and later reside on environmental surfaces or enter the respiratory tract.[36]

7.2 Contaminated Surfaces Spread

The deadly corona viruses settle on surfaces like metal, glass, or plastic for a few days. The aerosols and droplets generated during the dental procedures contaminate the environmental surfaces. The CoV remains infectious from 2 h up to 9 days, and survives well in humid environment. It is imperative to maintain a clean and dry environment in the dental office.[9,35,38]

8. RECOMMENDATIONS FOR DENTAL PRACTICE[1,9]

The Oral health professionals should follow strict protocols to decrease aerosol production.

8.1 Patient Evaluation[39]

The following protocols should be observed:

1. Establishment of Precheck Triages- A specific area should be allotted as a triage area in dental clinics and staff should be trained to record the temperature of every patient with an Infrared thermometer. The patients should be provided with mask
2. In this triage area questions should be asked regarding medical co-morbidities, history of contact with COVID positive patients, and any history of travel. (WHO 2020a)
3. Patients with fever should referred to special COVID clinics
4. Patients with positive history of travel in endemic regions in previous 14 days, should be quarantined for fourteen days
5. Areas with high number of COVID-19 cases, should delay the routine dental procedures

Prior to dental examination the patients should be evaluated for the presence of COVID -19 infection with a specially designed proforma, consisting of the following questions.[9]

1. Presence of fever while reporting to the dental clinic or in the past 14 days?
2. Presence of dry cough or conscious breathing?
3. History of foreign visit or areas with high COVID-19 infection?
4. Close contact with COVID-19 positive patients in the past 14 days?
5. Participation in large assemblies, meetings or contact with unaccustomed people?

Separate areas in the clinic and dental hospital should be designated for treating dental patients9

1. Triage and waiting area – Triage staff should donn one-use surgical mask, cap, and medical apron. Temperature should be recorded and a screening questionnaire should be performed
2. Dental clinic: Personal Protective Equipment (PPE), including disposable N95 masks, gloves, gowns, cap, shoe cover, impervious shoe covers and goggles or face shield for the dentists. The area should be sanitized after each patient
3. Isolation clinic: A separate area should be allocated for patients suspicious with COVID-19, convalescing from COVID-19 and for treatments which involve production of droplets and aerosols

9. GENERAL PRECAUTIONS DURING DENTAL TREATMENT:

1. Hand hygiene: Presence of Feaco–oral transmission, emphasises the need of hand hygiene. Frequent washing of hands with solutions containing (60-90%) of alcohol prior to patient examination and dental procedures, after touching the patient, surrounding areas and equipment without disinfection, and after touching the oral mucosa, damaged skin or wound, blood, body fluid, secretion, and excreta is mandatory. Attentiveness should be adhered to prevent frequent contact with the facial areas like eyes, mouth, and nose.[1,9]
2. Personal protective measures for the Oral health professionals: Due to the risk of aerosol spread in dental clinics and hospitals, barrier-protection equipment, including protective eyewear, N 95 masks, gloves, caps, face shields, and protective outerwear, is mandatory for all health care workers in this Pandemic.[40] A policy has been proposed for protection of dental staff and is divided in three levels to prevent dissemination of COVID-19 infection.[9]

   - Primary protection (standard protection for staff in clinical settings). Wearing disposable working cap, disposable surgical mask, and medical apron using protective goggles or face shield, and disposable latex gloves or nitrile gloves if necessary
   - Secondary protection (advanced protection for dental professionals). Wearing disposable caps and surgical

masks, protective eyewear, face shield, and medical apron with disposable outer cloth wear and latex gloves

- Tertiary protection (Reinforced protection after contact with suspected or confirmed COVID-19)

In normal circumstances a COVID-19 patient is not anticipated to be treated in the dental clinic. But if emergency situation arises special protective clothing as mentioned above with impervious shoe cover should be worn.

3. Mouth rinse before dental procedures: Prior to dental treatment, rinsing with antimicrobial mouthwash will reduce the microbial load. The 2019-nCoV is susceptible to oxidation, pre-treatment mouth rinse comprising of oxidative agents like 1% hydrogen peroxide or 0.2% povidone is suggested, to decrease salivary load of oral microbes, including asymptomatic 2019-nCoV shedding
4. Rubber dam isolation: Drastic reduction of saliva and blood-contaminated aerosol while working with high-speed handpieces and dental ultrasonic devices by Rubber dam has been advocated. Rubber dam usage can decrease the airborne particles in ~3-foot diameter of the operational field by 70%. Along with regular suction, extra high-volume suction for aerosol and spatter should be employed [39, 41]
5. The 4- quadrant procedure is effective for controlling infection. Droplets and aerosol production can be decreased with saliva ejectors
6. Some cases where rubber dam cannot be used physical devices, for example Carisolv and hand scalers, are advised for caries debridement and periodontal scaling, to decrease aerosol generation
7. Anti-retraction handpiece: The high-speed dental handpiece without anti-retraction valves may aspirate and expel the debris and fluids during the dental procedures. More importantly, the microbes, including bacteria and virus, may further contaminate the air and water tubes within the dental unit, and thus can potentially cause cross-infection. Therefore, the use of dental handpieces without anti-retraction function should be prohibited during the epidemic period of COVID-19. Anti-retraction dental handpiece with specially designed anti-retractive valves or other anti-reflux designs are strongly recommended as an extra preventive measure for crossinfection.[42]

10. SPECIAL CONSIDERATIONS

1. Pre-treatment antimicrobial mouth wash to decrease the salivary microbial load [43]
2. Circumvent procedures which can induce coughing
3. Curtailing the use of 3-way syringes which causes aerosol-generation[39]
4. Intraoral radiographic procedures induce saliva secretion and coughing.44 Extraoral radiographs like panoramic radiography and cone beam CT, are preferred diagnostic modalities during this pandemic[1]
5. Severe dental pain arising from pulpal inflammation, Pericoronitis or third-molar pain, Surgical post-operative osteitis, Abscess, or localized bacterial infection resulting in localized pain and swelling should be treated depending on the immune status of the patient. Appropriate medications such as Oral Paracetamol 500 mg, with Oral Amoxycillin 500 mg (In case of swelling and pus discharge) can be provided. Patients with severe pain following deep caries leading to irreversible pulpitis, can be advised chemical caries removal under rubber dam isolation and a high-volume saliva ejector under local anesthesia followed by pulp devitalization[1]
6. The treatment planning of tooth fracture, luxation, or avulsion is dependent on the age, the traumatic severity of dental tissue, the development of the apex, and the duration of tooth avulsion.45 If the tooth needs to be extracted, absorbable suture is preferred[1]
7. Patients reporting with facial soft tissue bruises, debridement and suturing of the wound should be performed. The wound is irrigated with antimicrobials with the use of saliva ejector to avoid spatter. Emergency cases with comminuted Life-threatening

cases with oral and maxillofacial fractures should be hospitalized immediately. A chest CT is preferable to rule out COVID -19 infection, as the RT-PCR test is laborious and not feasible in such a situation[1]

11. AFTER DENTAL PROCEDURE

1. Clean [PPE] with soap and water, or if visibly soiled, clean and disinfect reusable facial protective equipment. e.g., clinician and patient protective eyewear or face shields) between patients
2. Non-disposable equipments (e.g., handpieces, dental x-ray equipment, dental chair and light) should be disinfected according to manufacturer's instructions. Handpieces should be cleaned to remove debris, followed by heat-sterilization after each patient
3. Surfaces such as door handles, chairs, desks, elevators, and bathrooms should be cleaned and disinfected frequently

12. PRECAUTIONS AFTER REACHING HOME

The health care provider should change from scrubs to personal clothing before returning home. Upon arriving home, DHCPs should take off shoes, remove and wash clothing [separately from other household residents], and immediately shower.

13. MANAGEMENT OF MEDICAL WASTE

The medical waste (including disposable protective equipment after use) should be disposed routinely in make shift areas. The nondisposable instrument and items should be immersed in solution and sterilised. The infectious medical waste from suspected or confirmed COVID-19 patients should be disposed in a double-layer yellow colour medical waste package bags and "gooseneck" ligation should be used. The bags should be encrypted with special markings and disposed according to the protocols of medical waste management.[9]

14. PHARMACOLOGIC MANAGEMENT OF COVID-19

A narrative review by Sanders et al[46] proposed that there is no evidence from randomized clinical trials (RCTs) that any potential therapy improves outcomes in patients with either suspected or confirmed COVID-19. There are no clinical trial data supporting any prophylactic therapy. More than 300 active clinical treatment trials are underway. Chloroquine and hydroxychloroquine appear to block viral entry into cells by inhibiting glycosylation of host receptors, proteolytic processing, and endosomal acidification. These agents also have immunomodulatory effects through attenuation of cytokine production and inhibition of autophagy and lysosomal activity in host cells.[47,48]

Chloroquine inhibits SARS-CoV-2 in vitro with a half-maximal effective concentration (EC_{50}) in the low micromolar range. Hydroxychloroquine has in vitro activity with a lower EC_{50} for SARS-CoV-2 compared with chloroquine after 24 hours of growth (hydroxychloroquine: $EC_{50} = 6.14$ μM and chloroquine: $EC_{50} = 23.90$ μM). Chloroquine and hydroxychloroquine are relatively well tolerated as demonstrated by extensive experience in patients with SLE and malaria. However, both agents can cause rare and serious adverse effects (<10%), including QTc prolongation, hypoglycemia, neuropsychiatric effects, and retinopathy.[49] No high-quality evidence exists for the efficacy of chloroquine/hydroxychloroquine treatment of SARS or MERS. Currently, there are several RCTs of both chloroquine and hydroxychloroquine examining their role in COVID-19 treatment. Studies of chloroquine prophylaxis in health care workers and hydroxychloroquine for postexposure prophylaxis after high-risk exposures are planned or enrolling.[50]

Remdesivir, formally known as GS-5734, is a monophosphate prodrug that undergoes metabolism to an active C-adenosine nucleoside triphosphate analogue. Research and development of the agent showed promise during the height of the Ebola virus outbreak due to its

low EC_{50} and host polymerase selectivity against the Ebola virus Currently, remdesivir is a promising potential therapy for COVID-19 due to its broad-spectrum, potent in vitro activity against several nCoVs, including SARS-CoV-2 with EC_{50} and EC_{90} values of 0.77 μM and 1.76 μM, respectively.[46] The first clinical use of remdesivir was for the treatment of Ebola[51]; however, successful case reports describing the use of remdesivir for COVID-19 have been reported.[52,53] Clinical trials are ongoing to evaluate the safety and antiviral activity of remdesivir in patients with mild to moderate or severe COVID-19 [54]

15. IMMUNOGLOBULIN THERAPY

Another potential adjunctive therapy for COVID-19 is the use of convalescent plasma or hyperimmune immunoglobulins. The rationale for this treatment is that antibodies from recovered patients may help with both free virus and infected cell immune clearance. [46]

The most effective long-term strategy for prevention of future outbreaks of this virus would be the development of a vaccine providing protective immunity. However, a minimum of 12 to 18 months would be required before widespread vaccine deployment. the first reported uncontrolled case series of 5 critically ill patients with COVID-19 treated with convalescent plasma in China was recently published.[55] Additionally, a case series of 3 patients with COVID-19 in Wuhan, China, treated with intravenous immunoglobulin at a dose of 0.3 to 0.5 g/kg/d for 5 days was recently published.[56] On March 24, 2020, the FDA released guidance for requesting an emergency investigational new drug application and screening donors for COVID-19 convalescent plasma. The current Centers for Disease Control and Prevention guidance for clinical care of patients with COVID-19 (as of March 7, 2020) highlights that no specific treatment for COVID-19 is available, and emphasizes that management should include "prompt implementation of recommended infection prevention and control measures and supportive management of complications." The guidance from the Centers for Disease Control and Prevention specifically mentions that corticosteroids should be avoided unless indicated for other reasons. Investigational therapeutics, specifically remdesivir, are mentioned as options through either compassionate use or ongoing clinical trials.[57]

Similarly, the current World Health Organization (WHO) clinical management guidance document (as of March 13, 2020) states "there is no current evidence to recommend any specific anti-COVID-19 treatment for patients with confirmed COVID-19."[58] The guidance emphasizes the role of supportive care based on severity of illness, ranging from symptomatic treatment for mild disease to evidence-based ventilatory management for ARDS and early recognition and treatment of bacterial infections and sepsis in critically ill patients. They recommend to "not routinely give systemic corticosteroids for treatment of viral pneumonia outside clinical trials" and state "investigational anti-COVID-19 therapeutics should be used only in approved, randomized, controlled trials." In this regard, the WHO recently announced plans to launch a global "megatrial" called SOLIDARITY with a pragmatic trial design that will randomize confirmed cases into either standard care or 1 of 4 active treatment arms (remdesivir, chloroquine or hydroxychloroquine, lopinavir/ritonavir, or lopinavir/ritonavir plus interferon-β) based on local drug availability.[59]

16. CONCLUSION

The COVID-19 pandemic represents the greatest global public health crisis of this generation and, potentially, since the pandemic influenza outbreak of 1918.Due to high risk of transmission in dental settings; recommended protocols and guidelines should be adopted to prevent spread of infection. The dental health care professionals should update themselves about the latest developments in managing this Pandemic. Psychologic counselling should be provided to affected individuals due to the fear of the disease. No treatment has proven to be effective till date. Future studies should focus on the use of Saliva as a non-invasive diagnostic tool for detection of virus. High quality clinical trials to contain the infection and development of vaccine is the need of the hour.

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