

COVID-19 INFECTION – AN OVERVIEW

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Abstract

Coronavirus disease is an infectious disease which is caused by the SARS- CoV-2 virus. It is highly contagious diseases producing severe acute respiratory syndrome and had a catastrophic impact on the world. It resulted in millions of deaths worldwide. First case was reported in Wuhan, Hubei Province, China in 19th December, 2019, after that it rapidly spread out worldwide. Due to its worldwide spread, WHO declared it a global pandemic on 11th March, 2020. With the emergence of a novel coronavirus in Asia, public concerns have awakened regarding emerging viral threats and the potential for the next pandemic. By taking precautions, its spread can be reduced and taking proper care, severity of diseases may be decreased. In this article we will discuss about pathogenesis, diagnosis and, treatment for COVID-19 infection.

Keywords: COVID-19, WHO, respiratory syndrome, American Dental Association.

Introduction

Coronavirus disease is an infectious disease which is caused by the SARS- CoV-2 virus. It is highly contagious diseases producing severe acute respiratory syndrome and had a catastrophic impact on the world. It resulted in millions of deaths worldwide. First case was reported in Wuhan, Hubei Province, China in 19th December, 2019, after that it rapidly spread out worldwide. Due to its worldwide spread, WHO declared it a global pandemic on 11th March, 2020.¹

The COVID-19 comes under the family of single-stranded ribonucleic acid (RNA) viruses called Coronaviridae.² These viruses are believed to spread from animals to humans and it was reported that this novel coronavirus has a resemblance to coronavirus species found in bats, making it zoonotic in nature.³ This virus belongs to same family which was linked to severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) which were discovered in 2002 and 2012, respectively.⁴ The name severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was given by The International Committee on Taxonomy of Viruses.⁵ The other popular name that is COVID-19 was given due to the similarity of its published genome sequence with that of beta-corona viruses like SARS-CoV and MERS-CoV.³

SARS-CoV-2 virus adapted with genetic evolution and developing mutations similar to other RNA viruses results in various characteristics which are different than their ancestral strains. Several variants of SARS-CoV-2 have been reported during the course of this pandemic.

On the basis of epidemiological update by the WHO, following are the five variants of concern:

1. Alpha (B.1.1.7): First variant of concern, which was described in the United Kingdom (UK) in December 2020.⁶
2. Beta (B.1.351): First found in South Africa in December 2020.⁶
3. Gamma (P.1): Firstly reported in Brazil in early January 2021.⁶
4. Delta (B.1.617.2): First reported in India in December 2020.⁶
5. Omicron (B.1.1.529): First reported in South Africa in November 2021.⁷

In humans, the SARS-CoV-2 can be found in salivary and nasopharyngeal secretions and can spread via direct contact or respiratory droplets. Dentists are at higher risk of catching this infection as most of dental procedures involve production of aerosols.⁵ The common modes of transmission of infection in a dental clinic are⁵:

- Cross infection from aerosols
- Contact with blood and saliva.
- Injury from sharp instruments and needles
- Touching contaminated surfaces
- Inhalation of respiratory droplets
- Inappropriate use of personal protective equipment

However, the number of deaths reported in England and Wales between March and December 2020, was not significantly higher which led to the conclusion that there is low infection rate among dentists that might be due to the meticulous safety protocols followed in dental clinics.

ics. The American Dental Association (ADA), as well as most European dental organizations, recommended prescreening of patients before visiting the dental clinic, suggested only one patient at a time in the waiting room of dental clinic, measuring staff and patients' temperatures, hand washing and sanitizing, make sanitizer easily available to patients, disinfection of all surfaces, to use personal protection equipment for the medical team, disposable shoe covers for patients, use of UV lamps and other air purifiers and high-efficiency aspiration during treatment procedures in the dental clinic.⁸

Pathophysiology

COVID- 19 infection transmission occurs through respiratory droplets. Faecal-oral transmission is also possible. Vertical transmission of infection has also been observed. It is confirmed that virus is present in sputum, pharyngeal swabs and faeces. Most of patients develop symptoms within 11.5 to 15.5 days after exposure. So, it is advised to quarantine the person for 14 days if he/she has been exposed to infection. The average incubation period of COVID-19 is 5.2 days.^{9,10}

The actual mechanisms which are responsible for long-term complications of COVID-19 infection are not clear. There is complex of multiple pathophysiological mechanisms for progression of COVID-19 infection. Possible pathophysiological mechanisms may include direct viral tissue damage; the entry receptor for SARS-CoV-2, angiotensin-converting enzyme 2 (ACE2), is expressed in a variety of locations in the body allowing the virus to enter target cells through activation of its spike protein by transmembrane serine protease². These receptors are expressed in various sites in body including epithelial cells, nasal goblet cells, gastrointestinal epithelial cells, pancreatic β cells, and renal podocytes suggesting that direct tissue damage may be a primary mechanism for complications resulted from SARS-CoV-2 infection. Studies early in the pandemic revealed that endothelial cells had high expression of ACE2 and that COVID-19 infection led to substantial alteration to the integrity of the vessel barrier and promotion of a procoagulative state. The long-term sequelae of these changes have been observed in follow-up studies of survivors of COVID-19, revealing pulmonary radiological abnormalities in 71% of patients and functional abnormalities in 25% of patients.

It was observed that there is complex of multiple pathophysiological mechanisms for progression of COVID-19 infection which are: direct cytopathic effects of SARS CoV 2, angiotensin converting enzyme 2 (ACE2) down regulation with subsequent renin-angiotensin-aldosterone system (RAAS) disbalance and

a dysregulated immune response featuring a 'cytokine storm' coagulopathy associated with exocytosis of procoagulatory factors, thrombotic microangiopathy – probably caused by virus induced endothelial injury, complement activation, and cytokine effects and uncontrolled localised and/or systemic 'immunothrombosis' and autoimmunity.^{11,12}

Symptoms

People who have COVID-19 infection can suffer from a variable symptoms and illness ranging from mild to severe intensity. Sometimes they may have no symptoms at all.

The most common symptoms occur in COVID-19 patients are:

- Fever or chills
- Sore throat, cough and shortness of breath.
- Fatigue, body aches and headache.
- Loss of taste or sense of smell.
- Congestion or runny nose.
- Gastrointestinal symptoms including nausea or vomiting and diarrhea.¹²

Children mostly have fever and cough after infection. However, children may have any of other symptoms similar to adults.¹³

Complication caused by COVID-19

Pulmonary complications

COVID-19 infection leads to various long-term pulmonary complications such as acute respiratory failure, pneumonia, chronic obstructive pulmonary disease (COPD), pulmonary embolism, dyspnea, ventilator dependence, pulmonary fibrosis, pulmonary hypertension, Cystic fibrosis, oxygen dependence, pulmonary function test (PFT) abnormalities, and fibrotic lung disease.¹⁴

In COVID -19 patients, the most common cause of death is acute respiratory failure, as in acute respiratory failure lungs are unable to pump sufficient oxygen into blood or also may not take enough carbon dioxide out. Severe pneumonia occurs in both lungs of infected person and it is serious illness and can be deadly. In pneumonia, air sacs in lungs become inflamed resulting in difficulty in breathing. In increased illness lungs get filled with fluid, pus and cell debris. These patients, are not able to transfer oxygen to the blood to keep their systems working properly.

Acute respiratory distress syndrome (ARDS) is most common complication of COVID-19. In patients with ARDS, the lungs are so severely damaged that fluid be-

gins to leak into them, due to that body has trouble in getting oxygen into the bloodstream. In such conditions patient may need mechanical help to breathe such as a ventilator till the recovery of lungs.¹⁵

Cardiovascular complications

COVID -19 infected patients hospitalized have suffered from heart problems. Xiong et al explained that myocyte injury resulted from increased metabolic demands induced by viral inflammation which become challenge for a weak heart. In pathological analysis it was reported that there is neither direct viral invasion of the virus to heart tissue nor lymphocytic infiltration. But autopsy analysis of patients reported myocyte necrosis suggesting invasion of SARS-CoV-2 into the pericytes and cause micro-circulation dysfunction.

Cardiomyopathy and cardiac arrhythmia also observed in COVID -19 patients. Higher sympathetic nervous system activity resulted from myocarditis and pro-inflammatory state, hypoxia, hypotension, ACE 2-receptors downregulation, drug toxicity/interaction, all these factors could lead to occurrence of cardiac arrhythmia or they aggravate arrhythmias.¹⁶

Diagnosis

RT PCR is a diagnostic test that uses nasal swab, tracheal aspirate or bronchoalveolar lavage (BAL) specimens. The primary, and preferred, method for diagnosis is the collection of upper respiratory samples via nasopharyngeal and oropharyngeal swabs. The use of bronchoscopy as a diagnostic method for COVID- 19 is not recommended as the aerosol that is generated, poses a substantial risk for both patients and healthcare staff. Bronchoscopy can be considered only for intubated patients when upper respiratory samples are negative and other diagnostic tools would significantly change the clinical management. However, bronchoscopy may be indicated when clinical and safety criteria are met and in the case of uncertain diagnosis.¹⁷ Alternatively, tracheal aspiration and nonbronchoscopic BAL can be used to collect respiratory specimens in intubated patients.¹⁸

Zou et al. found that the levels of SARS CoV-2 RNA were higher in samples collected from the upper respiratory tract in the first 3 days after symptom onset, and high levels of SARS CoV-2 RNA were also found in samples collected from upper respiratory tract samples from an asymptomatic patient.¹⁹

Laboratory test

The most common laboratory abnormalities reported

on admission amongst hospitalized patients with pneumonia included leucopenia (9–25%) or leukocytosis (24–30%), lymphopenia (63%) and elevated levels of alanine aminotransferase and aspartate aminotransferase (37%).^{20,21} Increased inflammation indices, usually including reduced procalcitonin and increased C-reactive protein (CRP) levels, are associated with clinical severity. Young et al. observed an average CRP level of 1.1 mg/dL in patients with normal percentage oxygen saturation (SatO₂) and of 6.6 mg/dL in hypoxemic patients.²¹ Moreover, Ruan et al.²² observed a correlation between CRP and mortality risk. Increased troponin was also reported in 7% of patients who subsequently died because of fulminant myocarditis.²³ Troponin appears to be a strong prognostic indicator of mortality. Finally, it was noticed that D-dimer and ferritin levels were usually high in hospitalized patients.

Radiological findings

Typical CT findings in individuals with COVID-19 were ground-glass opacities, particularly on the peripheral and lower lobes, and bilateral multiple lobular and sub segmental areas of consolidation, especially in ICU patients.²⁴ The number of lung segments involved was found to be related to disease severity. These opacities tended to flow together and thicken with progression of the disease. Non typical CT findings included pleural effusion (only about 5%), masses, cavitations and lymphadenopathies; therefore, these would suggest alternative diagnoses.²⁵

Treatment

Many people with COVID-19 may have mild illness and can be treated with supportive care. Supportive treatment is aimed at relieving symptoms, these are:

- Pain relievers, such as ibuprofen or acetaminophen.
- Cough syrup or medicine.
- Rest.
- Fluid intake.

The FDA has approved the antiviral medicine remdesivir to treat COVID-19 in adults and children who are age 12 and older in the hospital. Remdesivir may be given to patients who are hospitalized with COVID-19 and need supplemental oxygen or have a higher risk of serious illness. It's given to patients through a needle in the vein.

Paxlovid is another medicine approved to treat COVID-19 in adults. It includes nirmatrelvir, a drug that blocks the activity of a specific enzyme needed for the virus that causes COVID-19 to replicate and an an-

tiviral drug called ritonavir that helps to slow the breakdown of nirmatrelvir. Paxlovid continues to be available under emergency use authorization to treat mild to moderate COVID-19 in people age 12 and older who are at higher risk of serious illness. Paxlovid tablets are taken by mouth.

The FDA also has approved the rheumatoid arthritis drugs such as baricitinib and tocilizumab to treat COVID-19 in some cases. Baricitinib is a tablet which seems to work against COVID-19 by reducing inflammation and having antiviral activity. Tocilizumab is an injection which works against COVID-19 by reducing inflammation. Both medicines may be used for patients in the hospital with COVID-19 who are on mechanical ventilators or need supplemental oxygen.

The FDA has authorized another drug called molnupiravir to treat mild to moderate COVID-19 in adults who are at higher risk of serious illness and who aren't able to take other treatment options. The medicine is taken by mouth as a pill.

The U.S. National Institutes of Health has recommended the corticosteroid dexamethasone for people hospitalized with severe COVID-19 who are on supplemental oxygen or need mechanical ventilation. Other corticosteroids, such as prednisone, methylprednisolone (Medrol) or hydrocortisone, may be used if dexamethasone isn't available.²⁶

Precautions for prevention of COVID-19 infection

1. Washing hands frequently and carefully

Washing hands several times a day, especially after touching anything, including phone or laptop. It is recommended to use warm water and soap and rub hands for at least 20 seconds. Work the lather to wrists, between fingers, and under fingernails. Antibacterial and antiviral soap can be used. Use hand sanitizer when washing hands is not possible.

2. Avoid touching face

SARS-CoV-2 can live on some surfaces for up to 72 hours. So one can get the virus on his/her hands on touching a surface such as gas pump handle, cell phone, a doorknob etc. So avoid touching any part of face or head, including mouth, nose, and eyes after touching such things. Also avoid biting fingernails. This can give SARS-CoV-2 a chance to go from hands into body.

3. Stop shaking hands and hugging people

Similarly, avoid touching other people. Skin-to-skin contact can transmit SARS-CoV-2 from one person to

another.

4. Don't share personal items

Do not share personal items like phones, makeup and combs etc. It's also important not to share eating utensils and straws.

5. Cover mouth and nose during coughing and sneeze

SARS-CoV-2 is found in high amounts in the nose and mouth. This means it can be carried by air droplets to other people when someone cough, sneeze, or talk. It can also land on hard surfaces and stay there for up to 3 days. So one should use a tissue or sneeze into elbow to keep hands as clean as possible.

6. Clean and disinfect surfaces

Use alcohol-based disinfectants to clean hard surfaces in home such as countertops, door handles, furniture, and toys. Also, one should clean phone, laptop, and anything else which is used regularly several times a day. Disinfect areas after bringing groceries or packages into home.

7. Take physical (social) distancing seriously

Physical (social) distancing, also means staying home and working remotely when possible.

If one has to go out for necessities, should keep a distance of 6 feet (2 m) from other people as infected person can transmit the virus by speaking to someone.

8. Wash fresh groceries

Wash all products under running water before eating or preparing. Be sure to wash hands before and after handling these items.

11. Wear a (homemade) mask

The Centers for Disease Control and Prevention (CDC) recommends that almost everyone wears a cloth face mask in public settings where physical distancing may be difficult, such as grocery stores. When used correctly, these masks can help to prevent people who are asymptomatic or undiagnosed from transmitting SARS-CoV-2 when they breathe, talk, sneeze, or cough. This, in turn, slows the transmission of the virus.

Some pointers to keep in mind:

- Wearing a mask alone will not prevent from getting a SARS-CoV-2 infection. Careful handwashing and physical distancing must also be followed.
- Cloth masks aren't as effective as other types of masks, such as surgical masks or N95 respirators.

However, these other masks should be reserved for healthcare workers and first responders.

- Wash hands before put on the mask.
- Wash mask after each use.
- One can also transfer the virus from the mask to his/her hands. So wash hands after touching the front of the mask.
- A mask shouldn't be worn by a child under 2 years old, a person who has trouble breathing, or a person who can't remove the mask on their own.

9. Self-quarantine if sick

One should call doctor if having any symptoms. Stay home until recovery and that person should avoid sitting, sleeping, or eating with loved ones even living in the same home.

Why are these measures so important?

Following the guidelines diligently is important because SARS-CoV-2 is different than other coronaviruses, including the one it's most similar to, SARS-CoV.

Ongoing medical studies show exactly why we must protect ourselves and others from getting a SARS-CoV-2 infection.

Here's how SARS-CoV-2 may cause more problems than other viruses:

Someone may not have symptoms

Sometimes person can carry or have a SARS-CoV-2 infection without any symptoms at all. This means he/she may unknowingly transmit it to more vulnerable people who may become very ill.

It has a longer incubation time

SARS-CoV-2 may have a longer incubation time. This means that the time between getting the infection and developing any symptoms is longer than other coronaviruses. According to the CDC Trusted Source, SARS-CoV-2 has an incubation period of 2 to 14 days. This means that someone who's carrying the virus may come into contact with many people before symptoms begin.

Patient may get sicker, faster

SARS-CoV-2 may make patient more unwell much earlier. Viral loads were highest 10 days after symptoms began for SARS CoV-1. In comparison, doctors in China who tested 82 people with COVID-19 found that the viral load peaked 5 to 6 days after symptoms began. This means that the SARS-CoV-2 virus may multiply and spread in someone who has COVID-19 disease almost twice as fast as other coronavirus infections.

Virus can stay alive in the air

Lab tests showed that both SARS-CoV-2 and SARS-CoV can stay alive in the air for up to 3 hours. Other hard surfaces like countertops, plastics, and stainless steel can harbor both viruses. The virus may stay on plastic for 72 hours and 48 hours on stainless steel. SARS-CoV-2 can live for 24 hours on cardboard and 4 hours on copper — a longer time than other coronaviruses.

Patient may be very contagious

Even if patient do not have symptoms, can have the same viral load (number of viruses) in the body as a person who has severe symptoms.

This means patient may be just as likely to be contagious as someone who has COVID-19. In comparison, other previous coronaviruses caused lower viral loads and only after symptoms were present.²⁷

References

1. Sharma A, Ahmad Farouk I, Lal SK. COVID-19: A Review on the Novel Coronavirus Disease Evolution, Transmission, Detection, Control and Prevention. *Viruses*. 2021;29;13(2).
2. Hamid H, Khurshid Z, Adanir N, Zafar MS, Zohaib S. COVID-19 pandemic and role of human saliva as a testing biofluid in point-of-care technology 2020. *Eur J Dent* 2020;14(suppl S1):S123–S129.
3. Ather A, Patel B, Ruparel N B, Diogenes A, Hargreaves K M. Coronavirus disease 19 (COVID-19): implications for clinical dental care. *J Endod*. 2020;46(05):584–595.
4. Wax R S, Christian M D. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. *Can J Anaesth*. 2020;67(05):568–576.
5. Ali S, Farooq I, Abdelsalam M, AlHumaid J. Current clinical dental practice guidelines and the financial impact of COVID-19 on dental care providers. *Eur J Dent*. 2020;14 (1):S140-S145.
6. Raman R, Patel KJ, Ranjan K. COVID-19: Unmasking Emerging SARS-CoV-2 Variants, Vaccines and Therapeutic Strategies. *Biomolecules*. 2021;06;11(7).
7. Chenchula S, Karunakaran P, Sharma S, Chavan M. Current evidence on efficacy of COVID-19 booster dose vaccination against the Omicron variant: A systematic review. *J Med Virol*. 2022 Jul;94(7):2969-2976.
8. Goriuc A, Sandu D, Tatarciuc M, Luchian L. The

- impact of the COVID-19 pandemic on dentistry and dental education: A narrative review. *Int J Environ Res Public Health*.2022;19(5):2537.
9. D'Amico F, Baumgart DC, Danese S, Peyrin-Biroulet L. Diarrhea during COVID-19 infection: pathogenesis, epidemiology, prevention and management. *Clin Gastroenterol Hepatol*. 2020.
10. Li M., Chen L, Zhang J, Xiong C, Li X. The SARS-CoV-2 receptor ACE2 expression of maternal–fetal interface and fetal organs by single-cell transcriptome study. *PLoS One*. 2020;15.
11. Binkhorst M, Offringa A, Hoeven J. COVID-19: comprehensive synopsis of suggested pathophysiological mechanisms and repurposed drugs. *Preprints* 2020; 10.20944/preprints202007.0108.v1.
12. Centers for Disease Control and Prevention. Coronavirus disease (COVID-19): symptoms. Available at- <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>
13. Centers for Disease Control and Prevention. Coronavirus disease (COVID-19): COVID-19 in children & teens. Available at-<https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/children/symptoms.html>
14. Desai AD et al. Long term complications of COVID-19. *Am J Physiol Cell Physiol*. 2022 ; 322(1): C1–C11
15. 'Smith MW. Complications Coronavirus can cause. *WebMD*.2021. Available at-<https://www.webmd.com/covid/coronavirus-complications>
16. Wang D, Hu B, Hu C. et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. *JAMA*.2020;323(11), 1061–1069.
17. WHO . Laboratory testing for 2019 novel coronavirus (2019-nCoV) in suspected human cases. Interim Guid. Geneva, Switzerland: World Health Organization site, 2020.
18. Wang W, Xu Y, Gao R et al. Detection of SARS CoV 2 in different types of clinical specimens. *JAMA* 2020..
19. Zou L, Ruan F, Huang M et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. *N Engl J Med* 2020; 382: 1177–9.
20. Zhang W, Du R-H, Li B et al. Molecular and serological investigation of 2019-nCoV infected patients: implication of multiple shedding routes. *Emerg Microb Infect* 2020; 9: 386–9.
21. Young BE, Ong SWX, Kalimuddin S et al. Epidemiologic features and clinical course of patients infected with SARS CoV-2 in Singapore. *JAMA* 2020; 323: 1488.
22. Ruan Q, Yang K, Wang W, Jiang L, Song J. Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. *Intensive Care Med* 2020. [Epub ahead of print]
23. Driggin E, Madhavan MV, Bikdeli B et al. Cardiovascular considerations for patients, health care workers, and health systems during the coronavirus disease 2019 (COVID-19) pandemic. *J Am Coll Cardiol* 2020; 75: 2352–71.
24. Adhikari SP, Meng S, Wu YJ et al. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: a scoping review. *Infect Dis Poverty* 2020; 9: 29.
25. Kanne JP, Little BP, Chung JH, Elicker BM, Ketani LH. Essentials for radiologists on COVID- 19: an update—radiology scientific expert panel. *Radiology* 2020; 200527.
26. Coronavirus disease 2019. Available at-Coronavirus disease 2019 (COVID-19) - Diagnosis and treatment - Mayo Clinic
27. Iftikhar N. Coronavirus (COVID -19) prevention: 12 tips and strategies. Available at- Coronavirus (COVID-19) Prevention: 12 Things to Do Now ([healthline.com](https://www.healthline.com))