

COVID-19: WHAT SHOULD WE KNOW?

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The Coronavirus Disease 2019 (COVID-19) following its first outbreak in Wuhan, China has rapidly spread all over the globe as a pandemic with unprecedented morbidity and mortality. Majority of this explosive spread have occurred by human to human transmission through aerosol route with a minor element of transmission through contaminated surfaces. This brief review article describes in a simplified manner the basic understanding about the virus, the pathobiology of infection, modes of transmission and preventive measures to avoid the infection.

Keywords: SARS-CoV-2, COVID-19, ACE2, fomite

What is COVID-19?

An outbreak of new type of RNA virus infection causing severe acute respiratory syndrome was reported in the city of Wuhan, China in December 2019. This disease was described as Coronavirus Disease 2019 or COVID-19. In February 2020, the International Committee on Taxonomy of Viruses (ICTV) announced the name of the new virus as “severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2)” because of its predominant clinical presentation affecting respiratory system in humans.¹ This virus belongs to a large group of viruses which has a covering of spikes forming a crown like thorns (Fig. 1). The Latin word for crown is *corona* which is the source of the name of this virus.

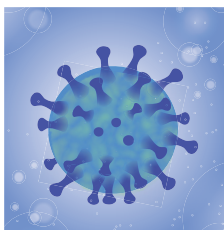


Fig. 1. Thorny crown-like appearance of Coronavirus

Why is it called “Novel” Coronavirus?

The RNA viruses with presence of corona (Coronavirus group) cause infections in mammals and birds mainly affecting respiratory tract; with symptoms ranging from mild self-limiting to severe lethal disease. The mild disease results in symptoms like “common cold” whereas severe disease results in “Severe Acute Respiratory Syndrome” (SARS). The COVID-19 or SARS-CoV-2 has several unique features in its transmission and pathobiology of the disease in humans which are not seen in earlier infections with other types of coronaviruses. That is why it is called as a “Novel Coronavirus” by many experts. These unique features of the virus are described in this article.

Where did COVID-19 come from?

The Coronavirus infection was first noted in the city of Wuhan, China. Several experts

felt that the virus infection was transmitted to human beings from bats as there was significant structural similarity between the bat coronavirus and the coronavirus causing COVID-19. It was believed that the large open-air wet market in the city of Wuhan which sells fish, meat and other products from large variety of domestic and wild animals kept in poor hygienic conditions, might have led to the animal to human transmission. However, selling of bat meat at Wuhan could not be documented during the outbreak of infection. Therefore, another theory was proposed which advocated its transmission from Pangolin which also harbors similar virus. However, unlike previous coronavirus infections in human in the form of SARS (2002) and MERS (2012) which are described below, a definite proof of animal origin of the virus or intermediate animal host is yet to be established. Nevertheless, whatever may be the exact source of the current novel virus, it is spreading rapidly through human-to-human contact.

What is the history of Coronavirus infection in humans?

Reviewing human infections reveals that till date there are seven coronaviruses which can infect humans.² In 1965, the first human coronavirus infection was identified causing common cold-like symptoms. A coronavirus infection causing SARS was then detected in south China in 2002 spreading to 28 countries causing death of 774 individuals. Similar outbreak of SARS was noted in the Middle East countries in 2012 killing 858 people which was called Middle East Respiratory Syndrome (MERS). The latest infection of human coronavirus is COVID-19 which has

spread in 220 countries across the world involving all continents infecting more than 57 million people with more than 1.3 million deaths. As on 16th January 2021, total number of cases in the world was 94,418,097 leading to the death of 2,020,165 patients. The number of infections per million population was highest in the United States of America (72,592) whereas it was significantly low (7,600) in India. However, considering the large population of about 138 crores India was the second country in the world in terms of total number of infections.³ The total number of infection on the above mentioned date was highest in USA (24,104,425) followed by India (10,543,659)³.

How does COVID-19 spread?

Understanding the mode of transmission of coronavirus is very important to identify the preventive measures and stop the spread of infection. The virus is transmitted through one of the following modes as described in WHO scientific brief⁴:

- (a) Contact and droplet transmission – It can spread by direct, indirect and close contact with an infected person through their secretions like saliva and respiratory droplets. Shaking hands with an infected person can lead to the spread of infection to other persons by direct contact. The droplets, respiratory secretions in the size range of 5 to 10 μm diameter, are released from the body through nose and/or mouth via coughing, sneezing, spitting, singing and even talking. The respiratory droplets equal to 5 μm diameter and smaller are termed as droplet nuclei or aerosol. The respiratory droplets containing virus from the infected

person can infect other person through the mouth, nose, eyes or in close contact within a distance of 1 metre. The respiratory droplet can also stick to surfaces of nearby objects and can be transmitted to others which is described in detail below as fomite spread.

- (b) Airborne transmission – The air drop nuclei or aerosol (size less than 5 μm) because of their smaller size can remain suspended in the air for long time in a closed space and it can affect people staying at a distance more than 1 m. In crowded and closed places, there is a higher chance of aerosol and droplet-mediated transmission.
- (c) Fomite transmission – Secretions from infected person can contaminate surface of objects like furniture, cloth, utensil, etc. The virus can stay alive on the surface for different period ranging from a few hours to few days depending on the nature of the surface, humidity and temperature.
- (d) Faecal transmission – Few cases have reported presence of virus in the faeces of infected person highlighting a possibility of faecal transmission.

How does infection occur with development of symptoms?

Any person can inhale the respiratory droplet/aerosol discharged from an infected person. Once the SARS-CoV-2 virus enters the nasal cavity and throat of the individual, they come in contact with Angiotensin Converting Enzyme 2 (ACE2) receptors in the lining cells

and binds with them. The virus enters the cells through this receptor, hijacks the cell's machinery making large number of copies of itself and invades new cells. This is the reason for taking nasal and throat swab while diagnosing the infection. The virus multiplies in the infected cells and the person may shed it in large number in the secretions and respiratory droplets in the first few days when he/she may be asymptomatic but can infect another person.

After contracting infection, the person develops variable symptoms after 7 to 10 days. The usual symptoms are sore throat, fever, dry cough, loss of smell and taste, tiredness and breathing difficulties. In persons with weak immune system, especially in old age or with other systemic diseases like hypertension, diabetes, chronic respiratory diseases, malignancy, etc., there is a higher risk of infection. In severe cases, the virus affects the lower respiratory tract where the lining epithelium is rich in ACE2 receptor causing pneumonia and acute respiratory distress syndrome (ARDS). Other vital organs like brain, liver, heart, kidney, gastrointestinal tract can be affected by the virus less commonly with and without blood coagulation abnormality.⁵

What is the basic structure of SARS-CoV-2?

The SARS-CoV-2 virus has a lipid envelope with spike surface glycoprotein (S), small envelope protein (E), matrix protein (M), and nucleocapsid protein (N) containing RNA in the core with a size of 70 – 90 nm (Fig. 2). The spike protein enables the virus to infect cells through ACE2 receptor (Wadman, et al., 2020).

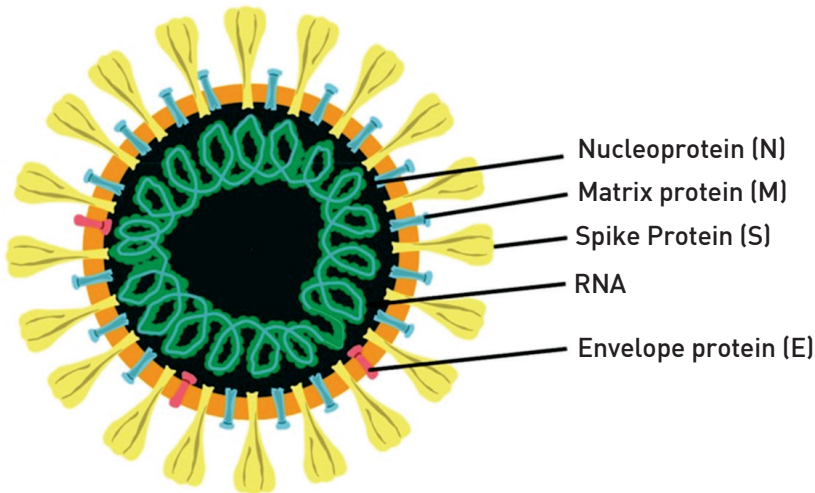


Fig. 2. Schematic diagram of the SARS-CoV-2 virus

What are the organs affected following SARS-CoV-2 infection?

As shown in Fig. 3, the major organs involved in the infection includes lungs, heart, blood vessels, liver, kidney, brain, eye, nasal track and intestine. The symptoms develop in patients according to the pathology of the organ involved.

What are the diagnostic tests for SARS-CoV-2?

The detection of specific viral nucleic acid by Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) is the primary mode of diagnosis. RT-PCR method includes the reverse transcription of SARS-CoV-2 RNA into complementary DNA (cDNA) strands, followed by amplification of specific regions of the cDNA (Udugama, et al., 2020). According to the recommendation of Indian Council of Medical Research, the other test useful for screening of the disease is Rapid Antigen test

which can be done quickly as a point of care diagnosis. The detection of specific antibody in the serum is also indicative of earlier infection.⁶

How can we prevent the spread of infection and protect ourselves?

At present there is no highly effective antiviral drug for treatment of COVID-19. Several vaccines are now available for immunization and protection against the infection. Considering the large population in India it will take several months to year to vaccinate the majority of individuals. So, till we can complete vaccination of the majority of our population or get an effective drug for fighting this devastating infection, we should know how we can protect ourselves and prevent spread of this infection. None of the vaccines currently available can protect 100% infection. During infection the virus can mutate and some of the mutants may partially evade the immune response. So even after

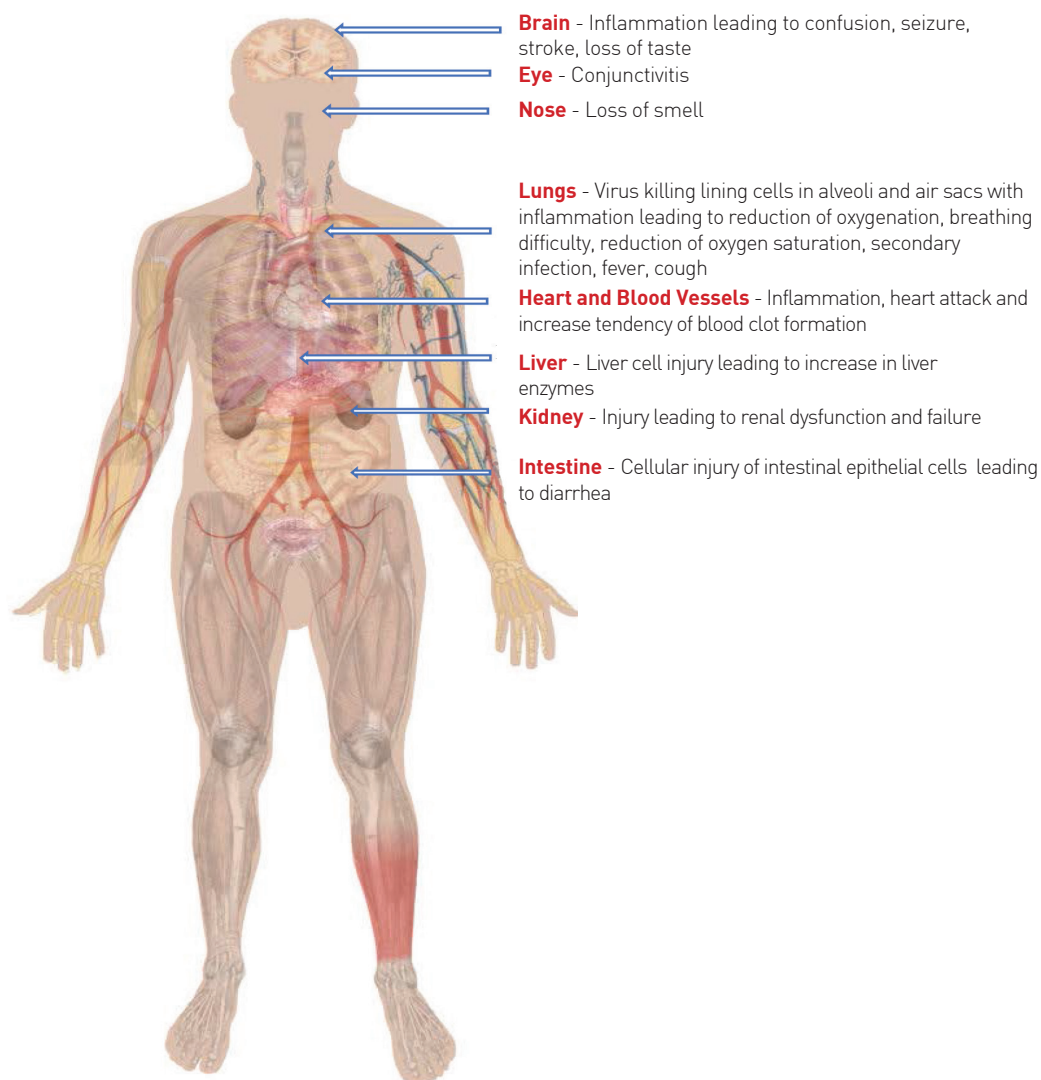


Fig. 3. The schematic diagram showing the involvement of different organs following SARS-CoV-2 infection

vaccination all of us have to continue to take appropriate measures to avoid spread of infection caused by mutant virus. At present, most of the students are studying from home through online classes. Understanding the

logistics and principles of protection will be very important when the rate of infection will reduce to prevent its next surge. The different preventive measures are discussed as follows:

- (a) *Mask*: Wearing a mask properly covering both mouth and nose is the most important mode of prevention. It prevents entry of respiratory droplet from the infected person. Also, it will prevent spread of droplet by the infected person who may be symptomatic or asymptomatic. The mask should be worn for all the time when a person is outside the home. Students should wear the mask in the class as well as during all other activities. In situations, when it has to be taken out, like during eating, the person should avoid sitting with other person in close distance. One should avoid touching exterior surface of the mask and soil it. The mask should be disposed properly in the designated container. The reusable mask should be washed in soap water and dried before next use.
- (b) *Social Distancing*: Maintaining social distancing more than 1 metre significantly reduces the chance of inhaling a respiratory droplet from another person. This distance should be maintained in the class as well as during all other activities outside home. Any sport or other recreational activities which need close contact must be avoided. Going to crowded places should also be avoided.
- (c) *Hand washing and sanitization*: Frequent hand washing with soap is one of the best measures to avoid spread of infection from the contaminated objects or fomites which has been described earlier. The soap wash should be done for a duration for 20 seconds or more to deactivate the virus. In case, hand washing is not possible, hand sanitizers with 70% ethyl alcohol should be used. The students should realize that even mobile phones used by multiple persons can carry the infection.
- (d) *Surface sanitization of furniture and other objects*: The surface sanitization should be done for furniture, floor and other objects by antimicrobial agents which are easily available in the market. For indoor surface sanitization, mopping is a good method whereas for outdoors, spraying can be done for treating large surfaces.
- (e) *Ensuring circulation of outside air*: The windows should be kept open for circulation of outside air which can reduce accumulation of aerosol and droplets in the closed environment.
- (f) *Improving self-immunity*: Good immunity is the most important weapon to fight this infection at present. Nutritious food with adequate protein, vitamins and minerals, regular exercise and good sleep are essential requirement for good immunity. Fresh vegetables, fruits, spices like *haldi* (turmeric), *jeera* (cumin), *dhaniya* (coriander) and *lahsun* (garlic) are helpful to boost immunity. Indoor exercise is encouraged. For outdoor exercises, all precautions must be taken as mentioned above.

Conclusion

The COVID-19 infection has disrupted our normal life. Though, the online classes and social media-based technology have

helped to support our learning activities, they cannot replace direct interaction between students and teachers in the schools. Also, the interaction between friends in the schools, in and outside classrooms, and in the playground cannot be replaced by social media. Reopening of school with normalisation of activities can be done

gradually in a stage-wise manner provided we can prevent spread of the infection and significantly reduce the infection rate. Even after vaccination, reinfection can occur in few individuals with a mild course of illness. So, all of us have to follow the preventive norms sincerely and honestly to win the fight against COVID-19.

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